



# **OPERATION AND SERVICE**

## **for**

**68AC353-102**  
**MICROMAX**

**T-348**

REV. 07/2012



TABLE OF CONTENTS

**SAFETY SUMMARY** ..... Safety-1

**DESCRIPTION** ..... 1-1

1.1 INTRODUCTION ..... 1-1

1.2 CONFIGURATION IDENTIFICATION ..... 1-1

1.3 OPTION DESCRIPTION ..... 1-1

    1.3.1 Condenser Cover (Skins) ..... 1-1

    1.3.2 Condenser Electrical Kit ..... 1-1

    1.3.3 Condenser Fan Kit ..... 1-1

    1.3.4 Condenser Refrigeration Kit ..... 1-1

    1.3.5 Evaporator Skins Kit ..... 1-1

    1.3.6 Evaporator Blower Kit ..... 1-1

    1.3.7 Evaporator Connection Kit S/D ..... 1-1

    1.3.8 Evaporator Connection Kit - Indash ..... 1-1

    1.3.9 Evaporator Connection Kit (Heating) ..... 1-1

    1.3.10 Air Exchange Kit ..... 1-2

    1.3.11 Controller Kit ..... 1-2

1.4 GENERAL DESCRIPTION ..... 1-4

    1.4.1 Compressor Assembly ..... 1-4

    1.4.2 Discharge Check Valve ..... 1-4

    1.4.3 Rooftop Unit ..... 1-5

    1.4.4 Condensing Section ..... 1-6

    1.4.5 Evaporator Section ..... 1-7

    1.4.6 Fresh Air System ..... 1-7

    1.4.7 System Operating Controls And Components ..... 1-8

1.5 REFRIGERATION SYSTEM COMPONENT SPECIFICATIONS ..... 1-8

1.6 ELECTRICAL SPECIFICATIONS - MOTORS ..... 1-8

1.7 ELECTRICAL SPECIFICATIONS - SENSORS AND TRANSDUCERS ..... 1-9

1.8 SAFETY DEVICES ..... 1-9

1.9 AIR FLOW ..... 1-10

1.10 AIR CONDITIONING REFRIGERATION CYCLE ..... 1-11

1.11 HEATING CYCLE ..... 1-13

1.12 CONTROL PANEL WITH GR60 RELAY BOARD ..... 1-14

1.13 CONTROL PANEL ..... 1-15

1.14 LOGIC BOARD ..... 1-16

1.15 RELAY BOARD - GR60, 24VDC ..... 1-17

1.15 RELAY BOARD - GR60, 24VDC (Continued) ..... 1-18

1.16 RELAY BOARD, 24VDC ..... 1-19

1.17 LOGIC BOARD, DATA COMMUNICATIONS ..... 1-20

1.18 CONTROL PANEL (Diagnostic Module) ..... 1-21

**OPERATION** ..... **2-1**

2.1 STARTING, STOPPING AND OPERATING INSTRUCTIONS ..... 2-1



TABLE OF CONTENTS - Continued

- 2.1.1 Power to Logic Board . . . . . 2-1
- 2.1.2 Starting . . . . . 2-1
- 2.1.3 Self-Test and Diagnostics (Check for Errors and/or Alarms) . . . . . 2-1
- 2.1.4 Stopping . . . . . 2-1
- 2.2 PRE-TRIP INSPECTION . . . . . 2-2
- 2.3 MODES OF OPERATION . . . . . 2-2
  - 2.3.1 Temperature Control . . . . . 2-3
  - 2.3.2 Cooling Mode . . . . . 2-3
  - 2.3.3 Heating Mode . . . . . 2-3
  - 2.3.4 Boost Pump . . . . . 2-3
  - 2.3.5 Vent Mode . . . . . 2-3
  - 2.3.6 Compressor Unloader Control . . . . . 2-3
  - 2.3.7 Evaporator Fan Speed Selection . . . . . 2-4
  - 2.3.8 Condenser Fan Control . . . . . 2-4
  - 2.3.9 Compressor Clutch Control . . . . . 2-4
  - 2.3.10 Liquid Line Solenoid Control . . . . . 2-4
  - 2.3.11 Alarm Description . . . . . 2-4
  - 2.3.12 Hour Meters . . . . . 2-4
- 2.4 MICROPROCESSOR DIAGNOSTICS . . . . . 2-4
  - 2.4.1 Control . . . . . 2-5
  - 2.4.2 Diagnostic Mode . . . . . 2-5
  - 2.4.3 System Parameters . . . . . 2-5
  - 2.4.4 Test Mode . . . . . 2-6
- TROUBLESHOOTING . . . . . 3-1**
  - 3.1 SELF DIAGNOSTICS . . . . . 3-1
  - 3.2 SYSTEM ALARMS . . . . . 3-1
    - 3.2.1 Alarm Codes . . . . . 3-1
    - 3.2.2 Activation . . . . . 3-1
    - 3.2.3 Alarm Queue . . . . . 3-1
    - 3.2.4 Alarm Clear . . . . . 3-1
    - 3.2.5 Exit Alarm Queue . . . . . 3-2
  - 3.3 TROUBLESHOOTING . . . . . 3-2
    - 3.3.1 Troubleshooting No CAN Communication . . . . . 3-2
    - 3.3.2 System Will Not Cool . . . . . 3-5
    - 3.3.3 System Runs But Has Insufficient Cooling . . . . . 3-5
    - 3.3.4 Abnormal Pressures . . . . . 3-5
    - 3.3.5 Abnormal Noise Or Vibrations . . . . . 3-5
    - 3.3.6 Control System Malfunction . . . . . 3-6
    - 3.3.7 No Evaporator Air Flow Or Restricted Air Flow . . . . . 3-6
    - 3.3.8 Expansion Valve Malfunction . . . . . 3-6
    - 3.3.9 Heating Malfunction . . . . . 3-6
- SERVICE . . . . . 4-1**
  - 4.1 MAINTENANCE SCHEDULE . . . . . 4-1



TABLE OF CONTENTS - Continued

4.2 OPENING TOP COVER (EVAPORATOR) 4-2
4.3 REMOVING TOP COVER (CONDENSER) 4-2
4.4 SUCTION AND DISCHARGE SERVICE VALVES 4-3
4.4.1 Installing R-134a Manifold Guage Set 4-3
4.5 PUMPING THE SYSTEM DOWN OR REMOVING THE REFRIGERANT CHARGE 4-4
4.5.1 System Pump Down For Low Side Repair 4-4
4.5.2 Refrigerant Removal From An Inoperative Compressor. 4-5
4.5.3 Pump Down An Operable Compressor For Repair 4-7
4.5.4. Removing Entire System Charge 4-7
4.6 REFRIGERANT LEAK CHECK 4-7
4.7 EVACUATION AND DEHYDRATION 4-8
4.7.1 General 4-8
4.7.2 Preparation 4-8
4.7.3 Procedure for Evacuation and Dehydrating System (One Time Evacuation) 4-8
4.7.4 Procedure for Evacuation and Dehydrating System (Triple Evacuation) 4-8
4.8 ADDING REFRIGERANT TO SYSTEM 4-8
4.8.1 Checking Refrigerant Charge 4-8
4.8.2 Adding Full Charge 4-9
4.8.3 Adding Partial Charge 4-9
4.9 CHECKING FOR NONCONDENSIBLES 4-9
4.10 CHECKING AND REPLACING HIGH OR LOW PRESSURE SWITCH 4-9
4.11 FILTER-DRIER 4-10
4.11.1 To Check Filter-Drier 4-10
4.11.2 To Replace Filter-Drier 4-10
4.12 SERVICING THE LIQUID LINE SOLENOID VALVE 4-11
4.12.1 Coil Replacement 4-11
4.12.2 Internal Part Replacement 4-11
4.12.3 Replace Entire Valve 4-11
4.13 THERMOSTATIC EXPANSION VALVE 4-12
4.13.1 Valve Replacement 4-12
4.13.2 Superheat Measurement 4-12
4.14 REPLACING EVAPORATOR RETURN AIR FILTERS 4-13
4.15 COMPRESSOR MAINTENANCE 4-13
4.15.1 Removing the Compressor 4-13
4.15.2 Transferring Compressor Clutch 4-14
4.15.2 Transferring Compressor Clutch (Continued) 4-15
4.15.3 Shim-less Compressor Clutch 4-15
4.15.4 Compressor Oil Level 4-16
4.15.5 Checking Unloader Operation 4-16
4.16 TEMPERATURE SENSOR CHECKOUT 4-17
4.17 PRESSURE TRANSDUCER CHECKOUT 4-17



TABLE OF CONTENTS - Continued

4.18 REPLACING SENSORS AND TRANSDUCERS 4-18
4.19 LOGIC BOARD REPLACEMENT 4-19
ELECTRICAL 5-1
5-1 INTRODUCTION 5-1

LIST OF FIGURES

Figure 1-1 System Component Identification 1-4
Figure 1-2 Rooftop Unit Components 1-5
Figure 1-3 Condensing Section Components 1-6
Figure 1-4 Evaporator Section Components 1-7
Figure 1-5 System Air Flow 1-10
Figure 1-6 Refrigerant Flow Diagram 1-12
Figure 1-7 Heat Flow Diagram 1-13
Figure 1-8 Control Panel 1-14
Figure 1-9 Control Panel 1-15
Figure 1-10 Logic Board 1-16
Figure 1-11. Relay Board - GR60 1-17
Figure 1-11. Relay Board - GR60 (Continued) 1-18
Figure 1-12. Relay Board 1-19
Figure 1-13 Logic Board, Data Communications 1-20
Figure 1-14 Micromate Control Panel 1-21
Figure 2-1 Capacity Control Diagram 2-2
Figure 4-1 Opening Top Cover (Evaporator) 4-2
Figure 4-2 Condenser Cover Removal 4-2
Figure 4-3 Suction or Discharge Service Valve 4-3
Figure 4-4 Manifold Gauge Set (R-134a) 4-4
Figure 4-5 Compressor Service Connections 4-5
Figure 4-6 Service Connections 4-6
Figure 4-7 Checking High Pressure Switch 4-10
Figure 4-8 Filter-Drier Removal 4-10
Figure 4-9 Liquid Line Solenoid Valve 4-11
Figure 4-10 Thermostatic Expansion Valve 4-12
Figure 4-11 Thermostatic Expansion Valve Bulb and Thermocouple 4-12
Figure 4-12 Compressor 4-14
Figure 4-13 Removing Bypass Piston Plug 4-14
Figure 4-14 Compressor Clutch 4-14
Figure 4-15 Transducer Terminal Location 4-17
Figure 5-1. Wiring Schematic - Legend (PM Motors) - 68AC353-102, 102-4, 102-5 5-2
Figure 5-2. Wiring Schematic - Control Circuit (PM Motors) - 68AC353-102, 102-4, 102-5 5-3



Figure 5-3. Wiring Schematic - Power Circuit (PM Motors) - 68AC353-102, 102-4, 102-5 . . . . . 5-4

Figure 5-4. Wiring Schematic - Legend (Brushless Motors) (CAN) - 68AC353-102-1, 102-3, 102-6 . . . . . 5-5

Figure 5-5. Wiring Schematic - Control Circuit (Brushless Motors) (CAN) - 68AC353-102-1, 102-3, 102-6 . . . . . 5-6

Figure 5-6. Wiring Schematic - Power Circuit (Brushless Motors) (CAN) - 68AC353-102-1, 102-3, 102-6 . . . . . 5-7

Figure 5-7. Wiring Schematic - Condenser Circuit (Brushless Motors) (CAN) - 68AC353-102-1, 102-3, 102-6 . . . . . 5-8

Figure 5-8. Wiring Schematic - Evaporator Circuit (Brushless Motors) (CAN) - 68AC353-102-1, 102-3, 102-6 . . . . . 5-9

Figure 5-9. Wiring Schematic - Legend (Brushless Motors) - 68AC353-102-2 & 102-7 . . . . . 5-10

Figure 5-10. Wiring Schematic - Control Circuit (Brushless Motors) - 68AC353-102-2 & 102-7 . . . . . 5-11

Figure 5-11. Wiring Schematic - Control Board Power Circuit (Brushless Motors) - 68AC353-102-2 & 102-7 . . . . . 5-12

Figure 5-12. Wiring Schematic - Condenser Motor Power Circuit (Brushless Motors) - 68AC353-102-2 & 102-7 . . . . . 5-13

Figure 5-13. Wiring Schematic - Evaporator Motor Power Circuit (Brushless Motors) - 68AC353-102-2 & 102-7 . . . . . 5-14

**LIST OF TABLES**

Table 1-1 Option Legend . . . . . 1-3

Table 1-2 Option Table . . . . . 1-3

Table 1-3 Additional Support Manuals . . . . . 1-4

Table 2-1. Unloader UV1 Relay . . . . . 2-4

Table 2-2. Unloader UV2 Relay . . . . . 2-4

Table 2-3 Evaporator Fan Speed Relay Operation . . . . . 2-4

Table 2-4. Controller Test List . . . . . 2-6

Table 2-5. Parameter Codes . . . . . 2-7

Table 3-1 Error Codes . . . . . 3-1

Table 3-2 Alarm Codes . . . . . 3-3

Table 3-3. General System Troubleshooting Procedures . . . . . 3-5

Table 4-1 Temperature Sensor Resistance . . . . . 4-17

Table 4-2 Pressure Transducer Voltage . . . . . 4-18

Table 4-3 Logic Board Configuration . . . . . 4-19

Table 4-4 R-134a Temperature - Pressure Chart . . . . . 4-20



## **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 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 CO<sub>2</sub> (never use water).

### **UNIT HAZARD LABEL IDENTIFICATION**

To help identify the hazard labels on the unit and explain the level of awareness each one carries, explanations with appropriate consequences are provided below:



Indicates an immediate hazard which WILL result in severe personal injury or death.



Indicates hazards or unsafe conditions which COULD result in severe personal injury or death.



Indicates potential hazards or unsafe practices which COULD result in minor personal injury, product or property damage.



## SPECIFIC WARNING AND CAUTION STATEMENTS

*The statements listed below are applicable to the refrigeration unit and appear elsewhere in this manual. These recommended precautions must be understood and applied during operation and maintenance of the equipment covered herein.*

### SPECIFIC WARNINGS AND CAUTIONS



#### **WARNING**

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



#### **WARNING**

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



#### **WARNING**

Do not use a nitrogen cylinder without a pressure regulator



#### **WARNING**

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



#### **WARNING**

The filter-drier may contain liquid refrigerant. Slowly loosen the ORS hex 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 68AC353 Air Conditioning and Heating equipment furnished by Mobile Climate Control as shown in Table 1-1 and Table 1-2. Additional support manuals are referenced in Table 1-3.

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

Model 68AC353 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 paragraphs provide 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 and Table 1-2.

#### **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 two different cover assemblies dependent upon the

curvature of the bus roof. The assemblies available are identified as the 10 M radius cover and the 6.5 M radius cover.

##### **1.3.2 Condenser Electrical Kit**

The 68AC353 condenser kits are wired for either 24 Volt permanent magnet motors or 24 Volt brushless motors.

##### **1.3.3 Condenser Fan Kit**

The 68AC353 condenser kits are available with either 4 or 6 fans, with either permanent magnet or brushless motors.

##### **1.3.4 Condenser Refrigeration Kit**

The 68AC353 condensers are all fitted with a condenser coil, a receiver with sight glasses and fusible plug, a charge isolation valve and interconnecting tubing.

##### **1.3.5 Evaporator Skins Kit**

The evaporator section may be fitted with one of two different cover assemblies dependent upon the curvature of the bus roof. The assemblies available are identified as the 10 M radius cover and the 6.5 M radius cover.

##### **1.3.6 Evaporator Blower Kit**

The 68AC353 evaporator kits are available with either 4 or 6 blowers, with either permanent magnet or brushless motors.

##### **1.3.7 Evaporator Connection Kit S/D**

The evaporator units are assembled to allow orientation of the connections for different mounting arrangements and may be supplied with various refrigerant piping layouts for specific applications.

##### **1.3.8 Evaporator Connection Kit - Indash**

The evaporator units are assembled to allow connections for various refrigerant piping layouts for remote evaporators.

##### **1.3.9 Evaporator Connection Kit (Heating)**

The evaporator units are assembled to allow orientation of the connections for different mounting arrangements and may be supplied with various engine coolant piping layouts for specific heating applications.



### 1.3.10 Air Exchange Kit

The unit will be fitted with a fresh air exchange assembly or an air exchange blank off plate. Fresh air exchange assemblies may be of the 25% or 50 % opening.

### 1.3.11 Controller Kit

The Micromax Controller operates the system through one of two relay boards and may be interrogated through the optional CAN +/- Data Communication Link.



**Table 1-1 Option Legend**

OPTION	DESCRIPTION
<b>Condenser Skins Kit</b>	
1	Standard Cover (R10M)
2	Cover (R6.5M)
<b>Condenser Electrical Kit</b>	
1	Condenser Electrical Kit
2	Condenser Electrical Kit / Brushless
<b>Condenser Fan Kit</b>	
1	24 Volt With 4 Brushless Motors
2	24 Volt With 4 PM Motors
3	24 Volt With 6 Brushless Motors
4	24 Volt With 6 PM Motors
<b>Evaporator Skins Kit</b>	
1	Standard Cover (R10M)
2	Cover (R6.5M)
<b>Evaporator Blower Kit</b>	
1	24 Volt With 6 Brushless Motors
2	24 Volt With 4 Brushless Motors
3	24 Volt With 6 PM Motors
<b>Evaporator Refrigeration Kit</b>	
1	4 Row Coil Refrigeration Kit
2	5 Row Coil Refrigeration Kit
3	3 Row Coil Refrigeration Kit

OPTION	DESCRIPTION
<b>Evaporator Connection Kit S/D</b>	
1	Left - ORS
2	Right - ORS
3	Left - ORS With Out Front Box Connection
<b>Evaporator Connection Kit - Indash</b>	
1	Right
2	Left
<b>Air Exchange Kit</b>	
1	0 to 50%
2	None
3	0 to 25%
<b>Controller Kit</b>	
1	Micromax With GR60 Relay Board (right)
2	Micromax Relay Board With CAN DATA (right)
3	Micromax Relay Board
4	Micromax Relay Board With CAN DATA (left)
5	Micromax With GR60 Relay Board (left)

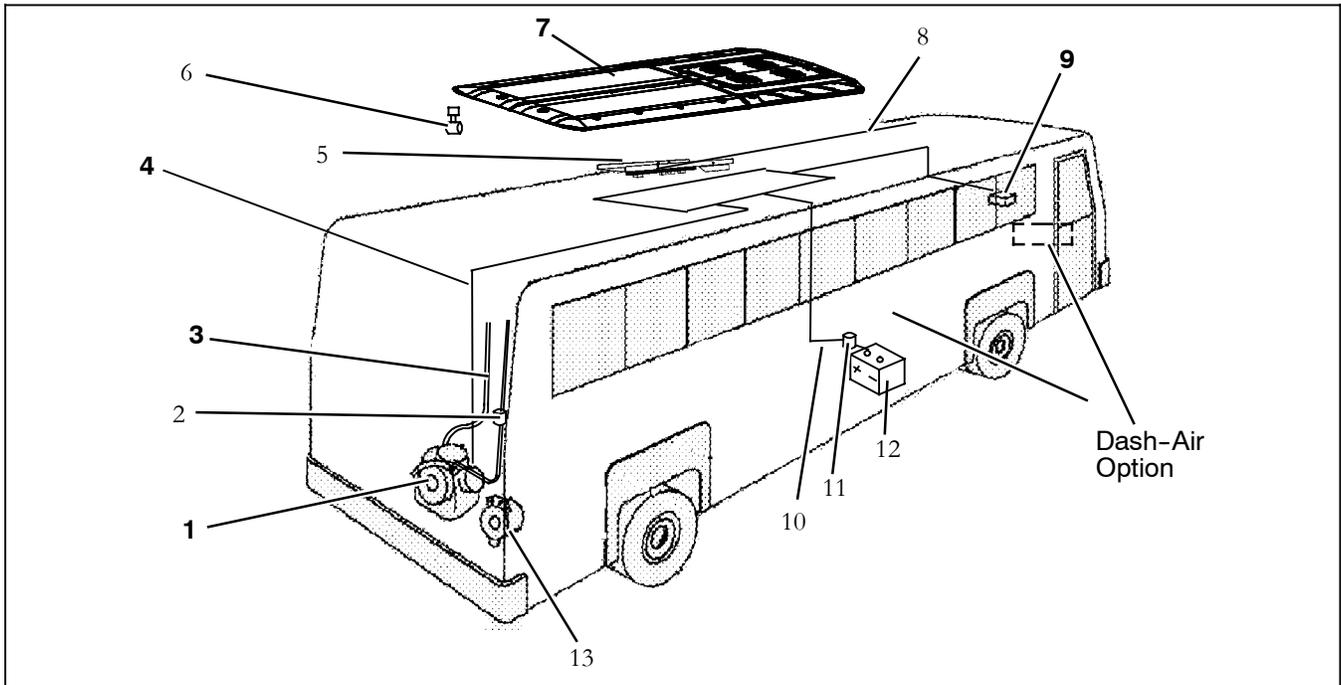
**Table 1-2 Option Table**

MODEL	PID Condenser AC353C	PID Evaporator AC353E	Condenser Skins Kit	Condenser Electrical Kit	Condenser Fan Kit	Evaporator Skins Kit	Evaporator Blower Kit	Evaporator Connection Kit S/D	Evaporator Connection Kit In Dash	Evaporator Refrigeration Kit	Air Exchange Kit	Controller Kit
-102	00001	00001	1	1	2	1	3	1	1	1	3	1
-102-1	00002	00002	1	2	1	1	1	1	1	1	3	2
-102-2	00003	00003	1	2	3	1	1	2	2	1	3	3
-102-3	00004	00004	1	2	3	1	1	2	2	1	3	4
-102-4	00005	00005	1	1	2	1	3	2	2	1	3	5
-102-5	00006	00006	1	1	4	1	3	2	2	1	3	5
-102-6	00007	00007	1	2	1	1	1	2	2	1	3	4
-102-7	00008	00008	1	2	1	1	1	2	2	1	3	3



Table 1-3 Additional Support Manuals

MANUAL/FORM NUMBER	EQUIPMENT COVERED	TYPE OF MANUAL
T-348PL	68AC353	Parts List
62-10699	Micromate	Diagnostic Tool (Card)



- |                                     |                          |
|-------------------------------------|--------------------------|
| 1. Compressor                       | 8. Main Harness          |
| 2. Discharge Check Valve            | 9. Driver Control        |
| 3. Refrigerant Lines                | 10. Power Harness        |
| 4. Compressor Harness               | 11. Main Circuit Breaker |
| 5. Electronics Boards - Power Relay | 12. Battery              |
| 6. Liquid Line Solenoid             | 13. Alternator           |
| 7. AC353 (Rooftop) See Figure 1-2   |                          |

Figure 1-1 System Component Identification

## 1.4 GENERAL DESCRIPTION

### 1.4.1 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.

### 1.4.2 Discharge Check Valve

A check valve is located in the discharge line close to the compressor. (see Figure 1-1) 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,

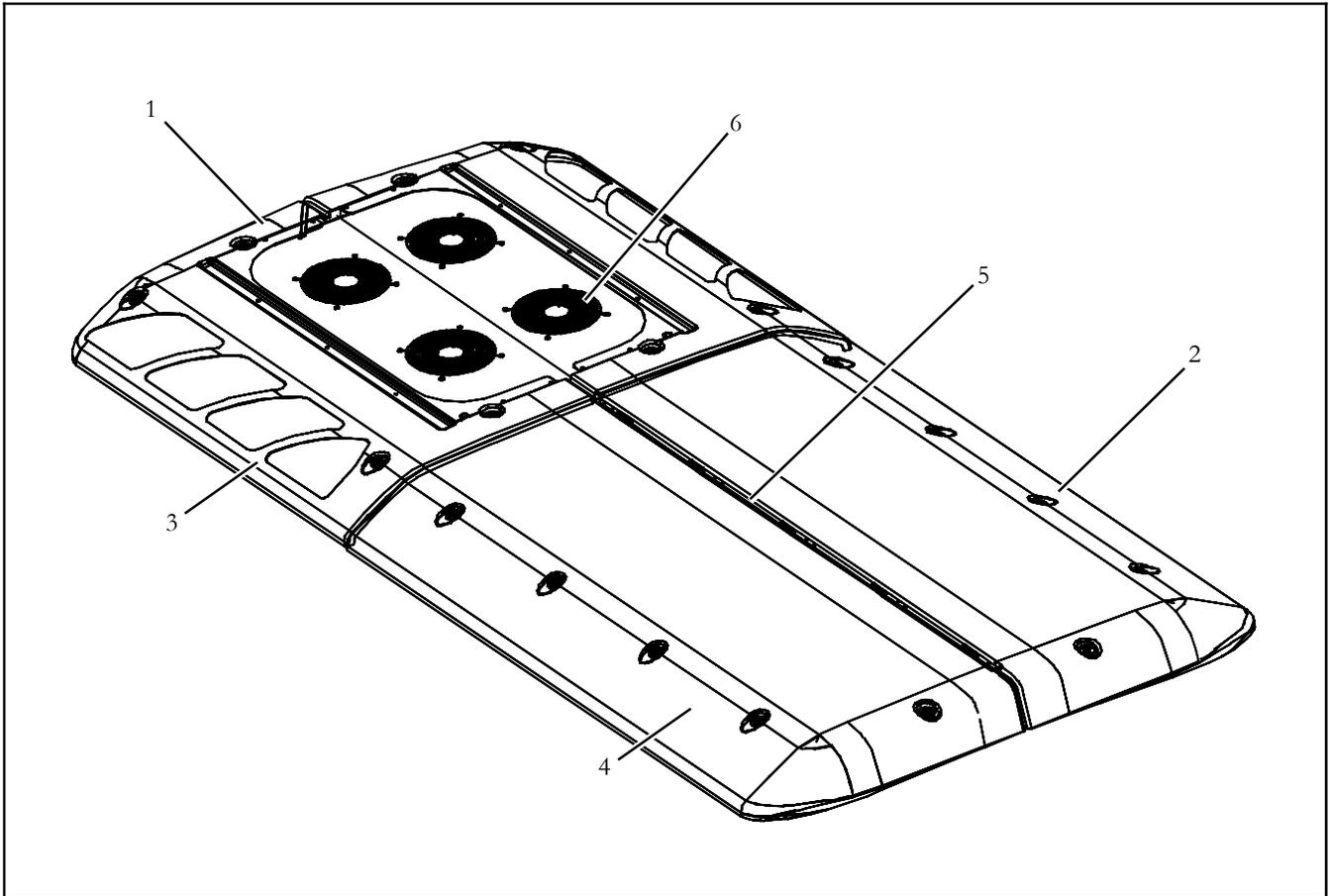


preventing the flow of high pressure liquid from the condenser back into the compressor.

### 1.4.3 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**



### 1.4.4 Condensing Section

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

High pressure high temperature refrigerant gas from the compressor passes thru the shipping shut-off valves to the condenser coils.

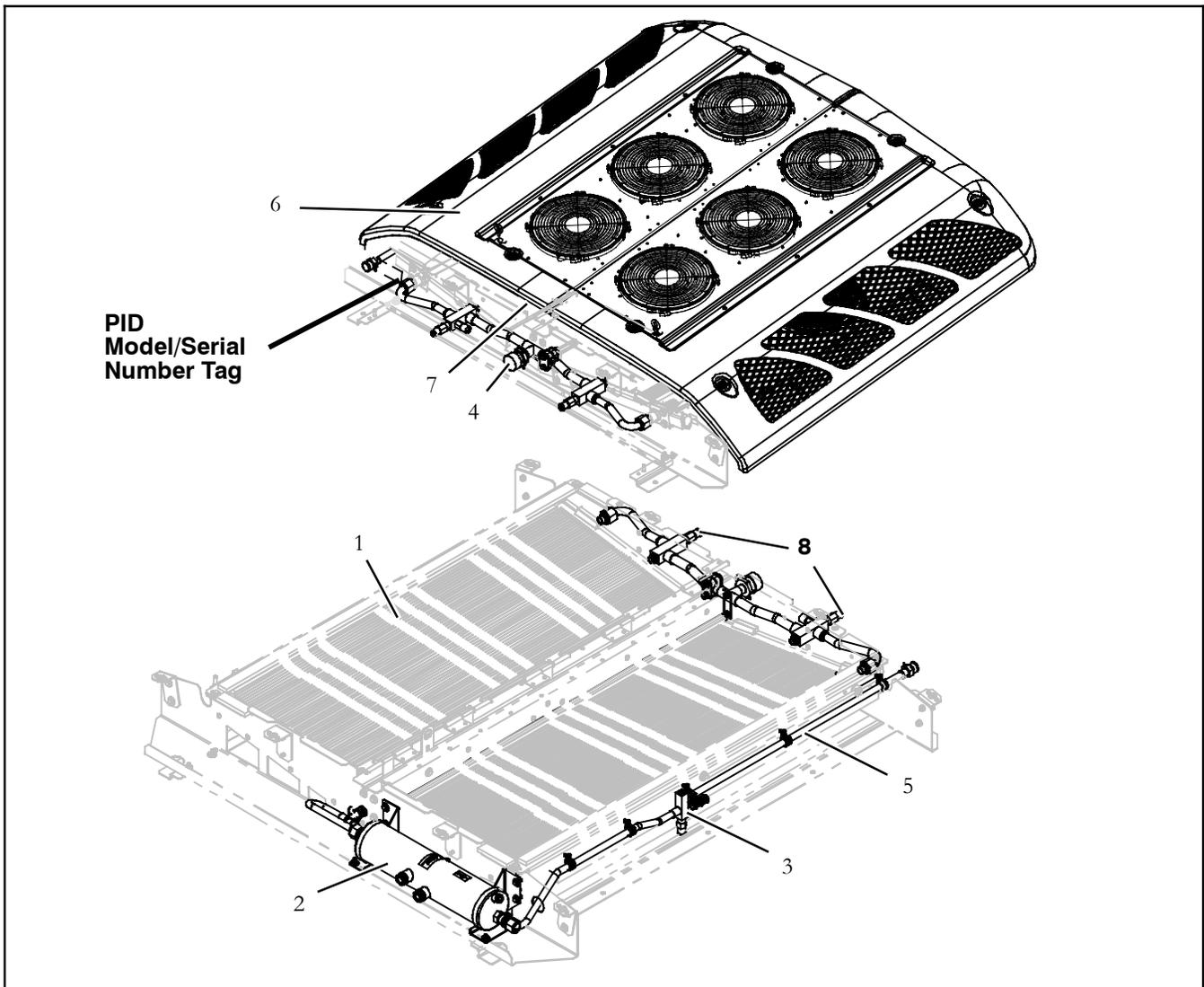
The condenser coils provide heat transfer surface for condensing refrigerant gas at a high temperature and pressure. The condenser fans circulate ambient air across the outside of the condenser tubes at a temperature lower than refrigerant circulating inside

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 and liquid level sight glasses to determine proper refrigerant liquid level.

The liquid refrigerant then passes thru the liquid line charge isolation valve to the evaporator.

An ambient temperature sensor measures ambient temperature and sends an electrical signal to the controller.



- |                           |                                     |
|---------------------------|-------------------------------------|
| 1. Coil Assembly          | 5. Liquid Line                      |
| 2. Receiver               | 6. Condenser Fan and Motor Assembly |
| 3. Charge Isolation Valve | 7. Ambient Temperature Sensor       |
| 4. Discharge Line.        | 8. Shipping Shut-off Valves         |

**Figure 1-3 Condensing Section Components**



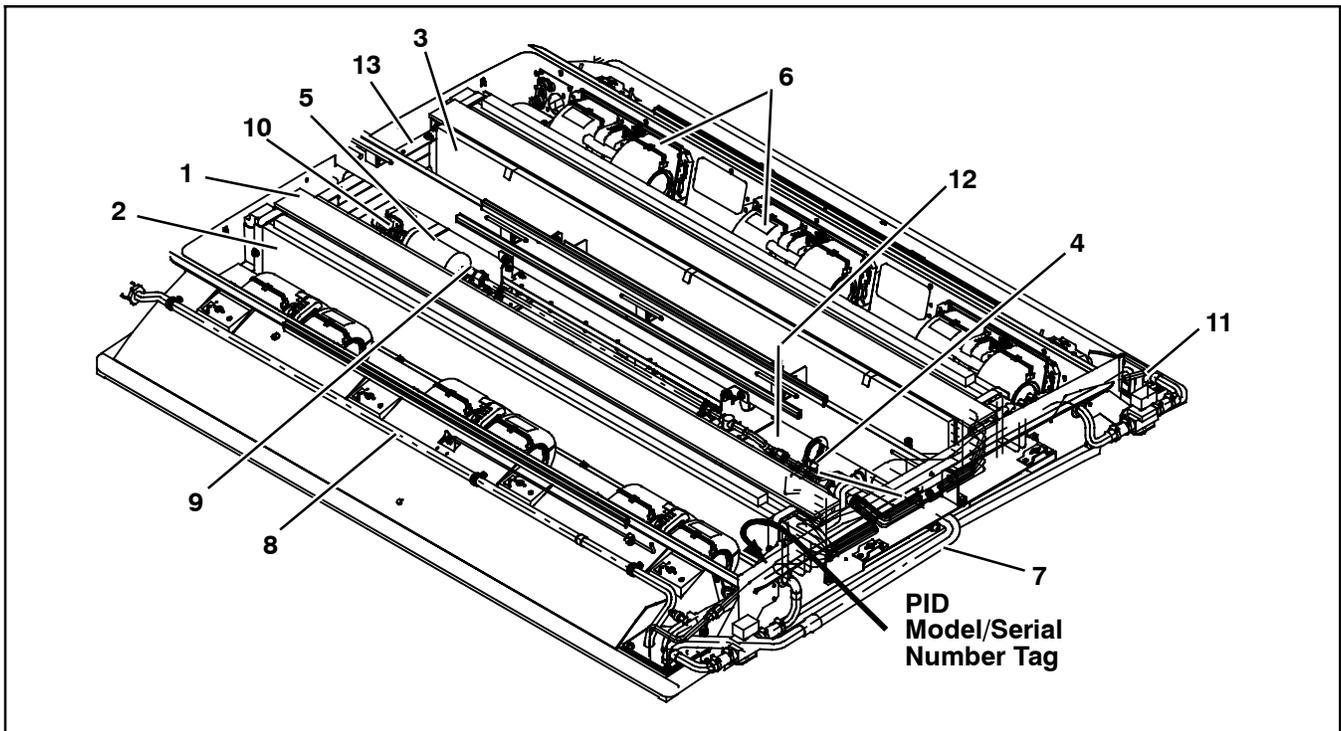
### 1.4.5 Evaporator Section

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     | 8. Discharge Line        |
| 2. Heat Coil                    | 9. Service Valve         |
| 3. Evaporator Return Air Filter | 10. Liquid Line Solenoid |
| 4. Expansion Valve              | 11. Heat Line Connection |
| 5. Filter Drier                 | 12. Control Panel        |
| 6. Blower & Motor Assembly      | 13. Fresh Air Damper     |
| 7. Suction Line                 |                          |

Figure 1-4 Evaporator Section Components

### 1.4.6 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.

1.4.7 System Operating Controls And Components

The system is operated by a Mobile Climate Control Micromax microprocessor controller which consist of a relay board (Figure 1-11), logic board (Figure 1-10), 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 1-14). 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 15.8 Lb (7.17 kg)

b. Compressor

Table with 2 columns: UNIT MODEL, AC353. Rows include 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 ± 2°F (6.7 ± 1°C)

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

Table with 3 columns: Evaporator Motor, Brushless, Permanent Magnet. Rows include Horsepower (kW), Full Load Amps (FLA), Operating Speed (RPM), Bearing Lubrication.

b. Condenser Fan Motor

Table with 3 columns: Condenser Motor, Brushless, Permanent Magnet. Rows include Horsepower (kW), Full Load Amps (FLA), Operating Speed (RPM), Bearing Lubrication.



## 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)

### 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 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 125 amp fuse or circuit breaker. Independent fuses or circuit breakers protect each evaporator blower motor and condenser motor assembly. 5 amp fuses protect each relay board output, 10 amp fuses protect ignition circuit output.

### c. Ambient Lockout

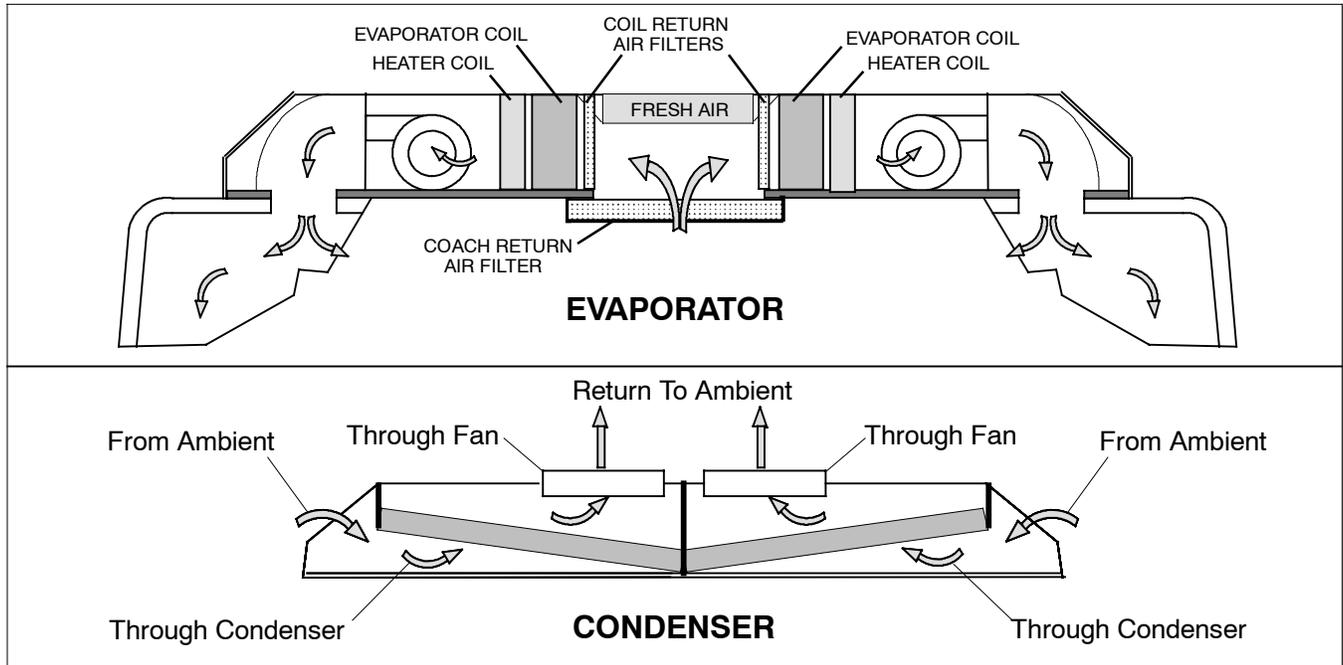
The ambient temperature sensor located in the condenser section measures the condenser inlet air temperature. When the temperature has fallen below the cut out set point the compressor is locked out until the temperature rises above the cut in setting. The set points will be programmed to cut out at 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. Water Temperature Switch (WTS)

When the the engine coolant temperature has fallen below the cut out set point, the evaporator fans are locked out until the temperature rises above the cut in set point. 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.



**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 receiver is equipped with two sight glasses to observe refrigerant charge level.

The refrigerant leaves the receiver and passes through the charge isolation valve to the liquid line solenoid valve. From the liquid line solenoid valve

the refrigerant enters the filter-drier where an absorbent keeps the refrigerant clean and dry.

From the filter-drier, the liquid refrigerant then flows through the liquid line service valve to the thermostatic expansion valve. The liquid line is equipped with a sight glass to observe the refrigerant for restricted flow. The thermostatic 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.

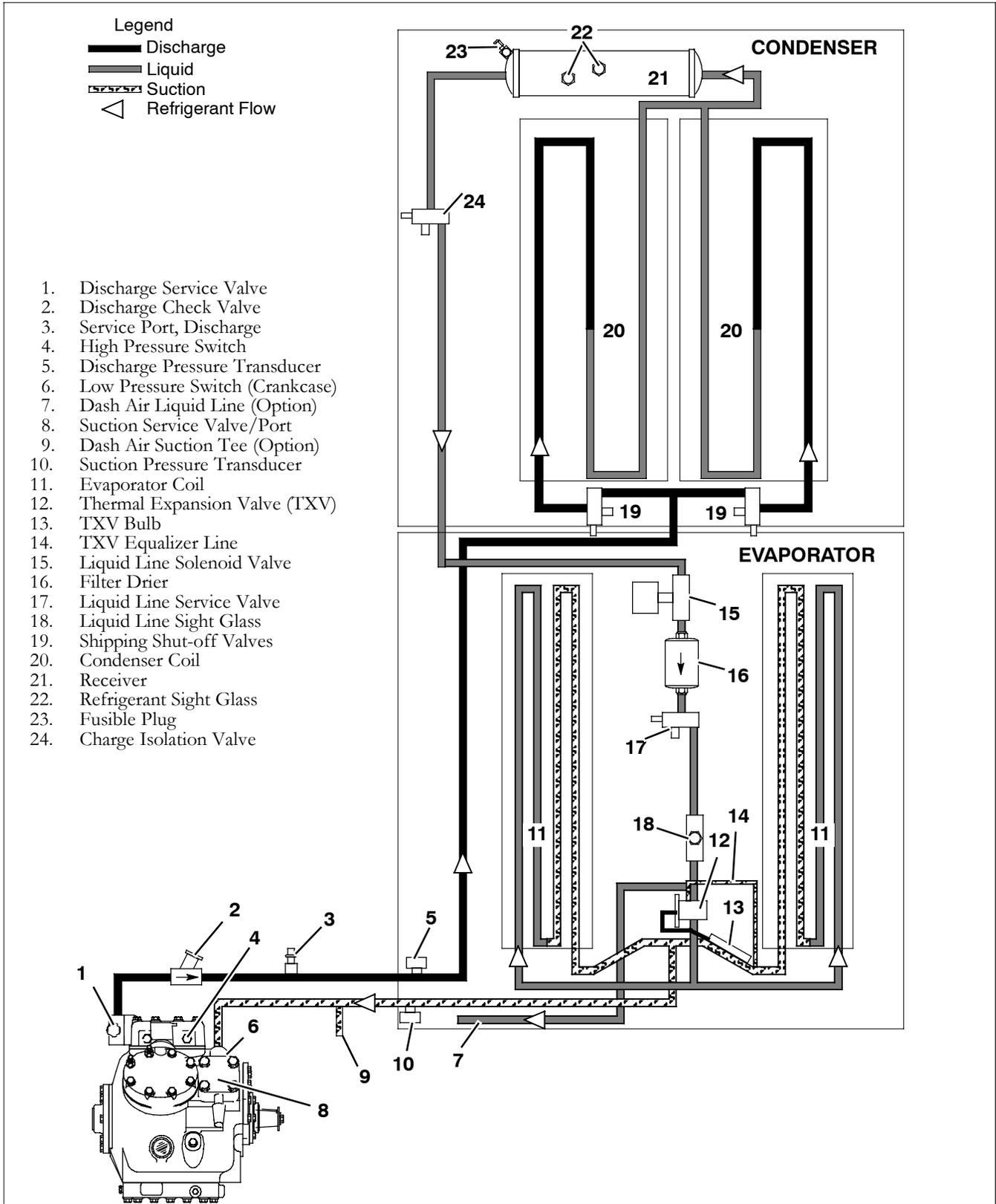


Figure 1-6 Refrigerant Flow Diagram

### 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

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.

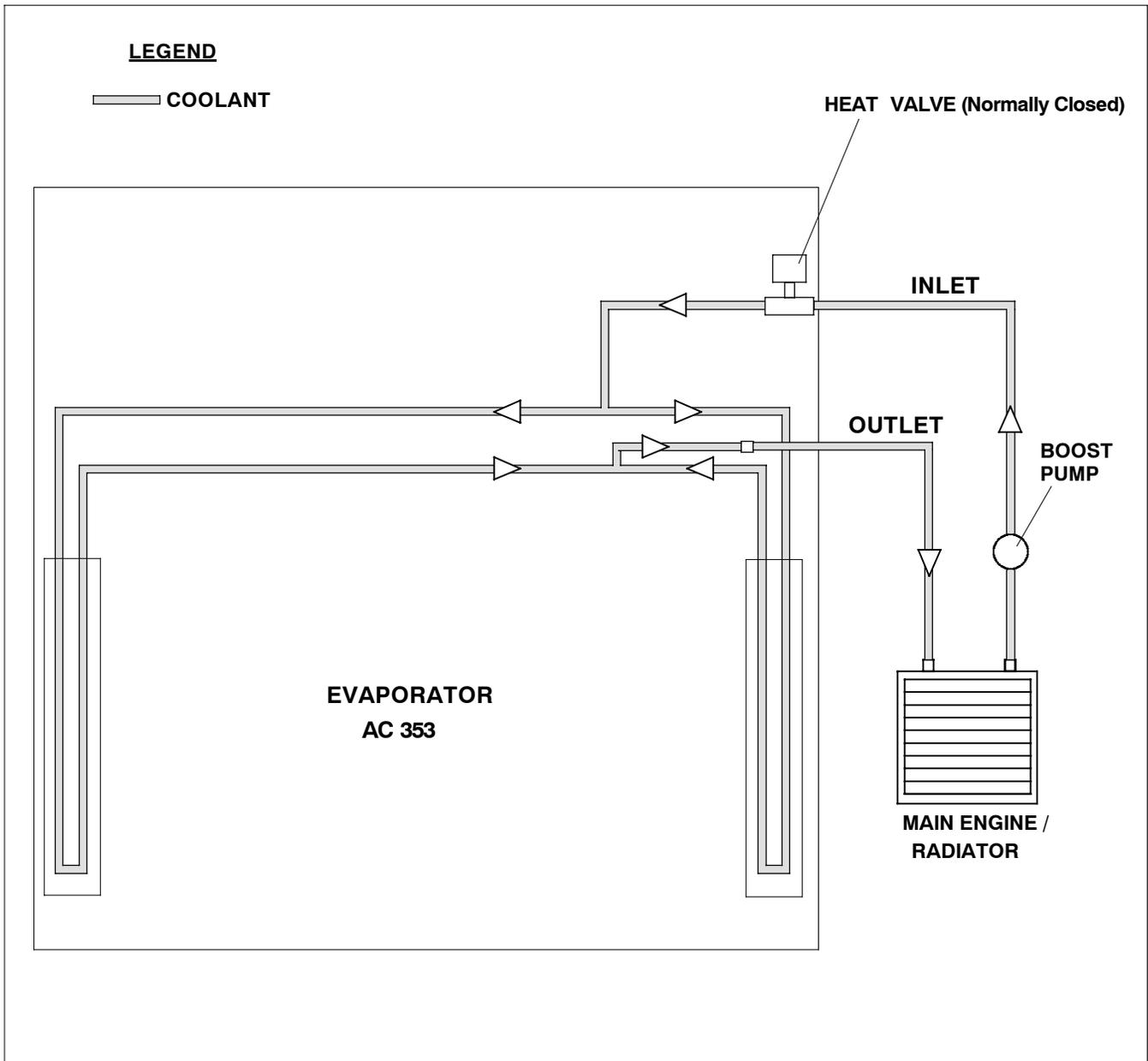
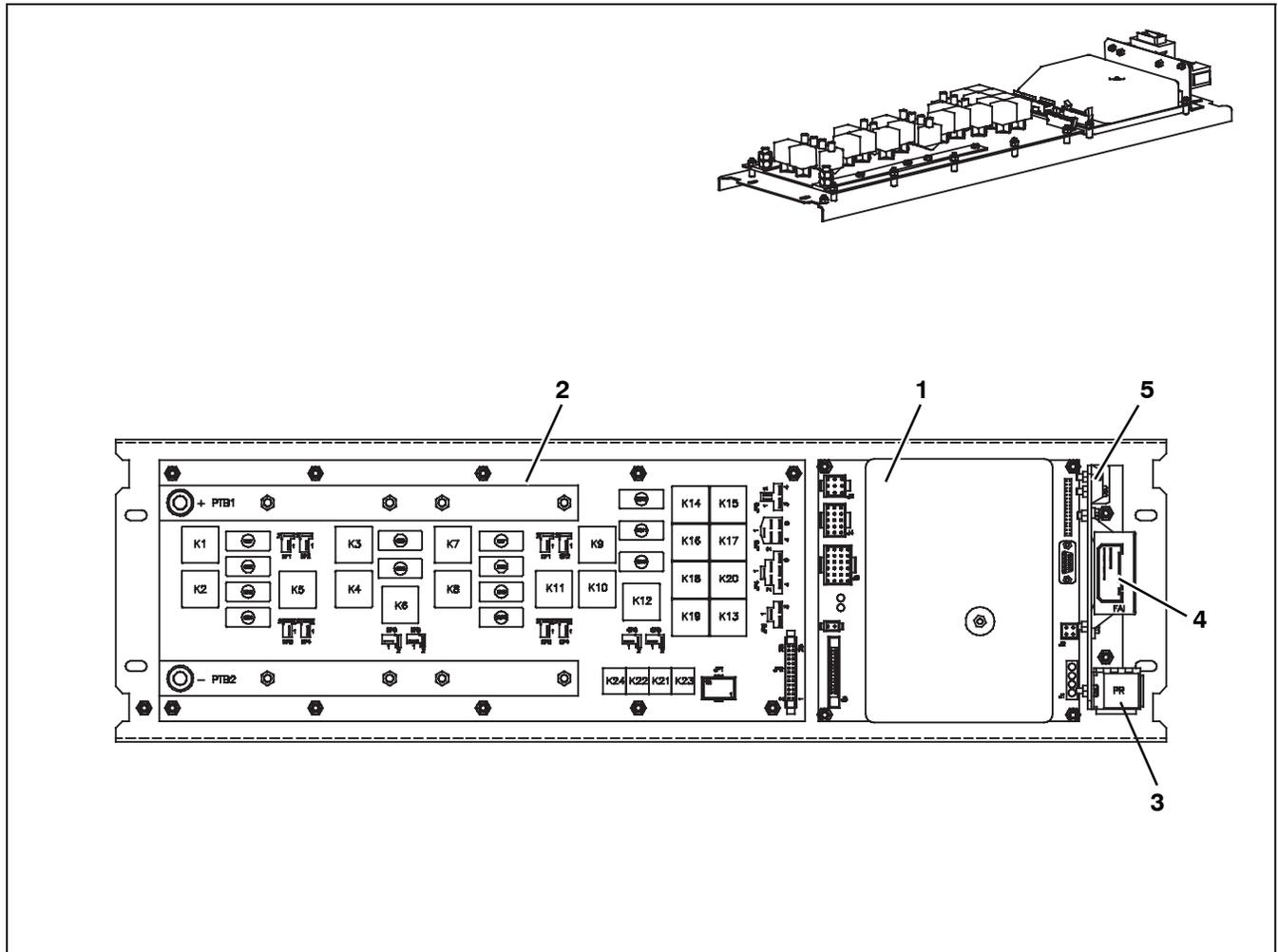


Figure 1-7 Heat Flow Diagram

**1.12 CONTROL PANEL WITH GR60 RELAY BOARD**

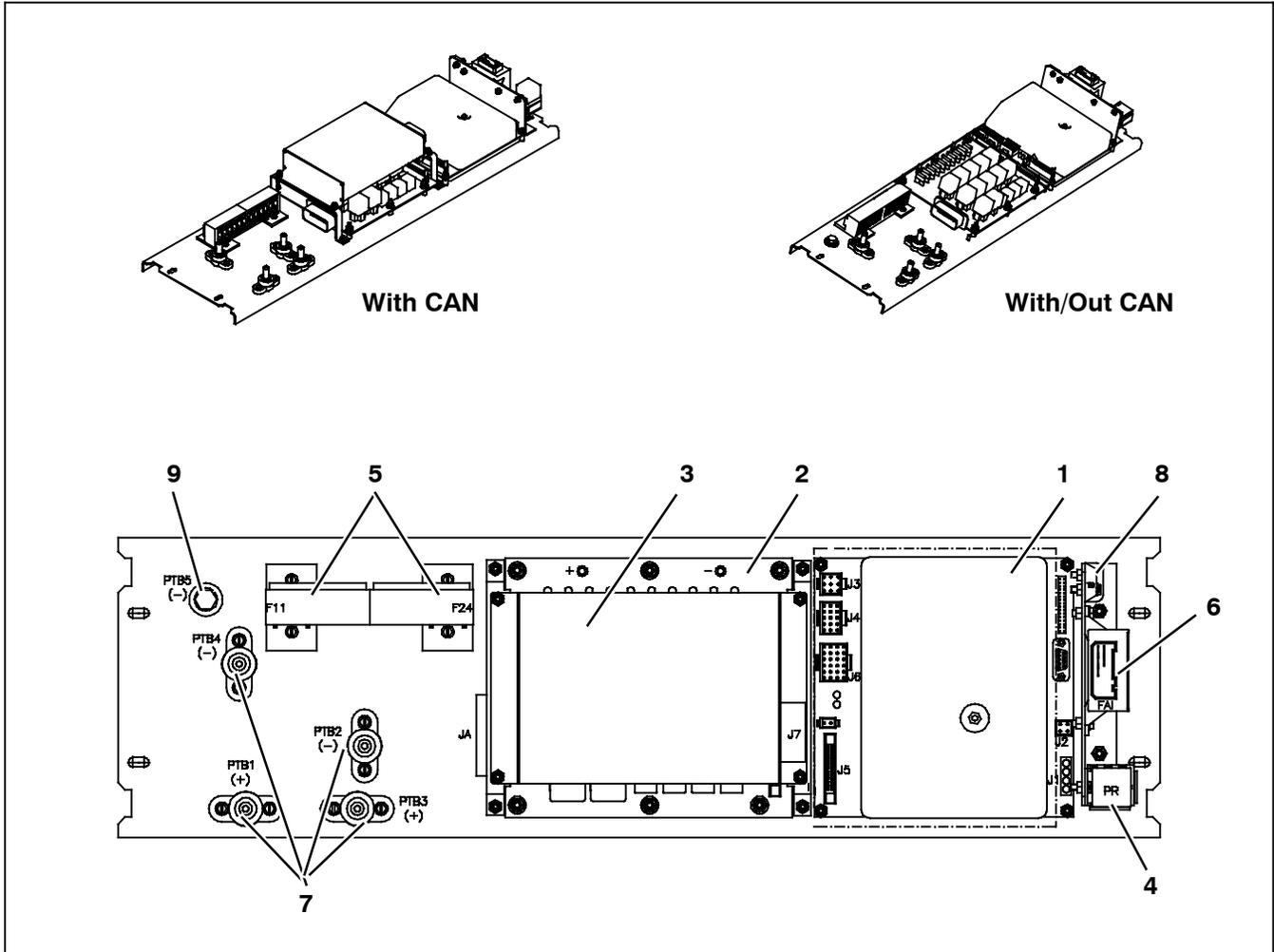


- |   |                        |
|---|------------------------|
| 1. Logic Board (See Figure 1-10)        | 4. Fresh Air           |
| 2. Relay Board - GR60 (See Figure 1-11) | 5. Terminal Block (TB) |
| 3. Power Relay (ON)                     |                        |

**Figure 1-8 Control Panel**



### 1.13 CONTROL PANEL

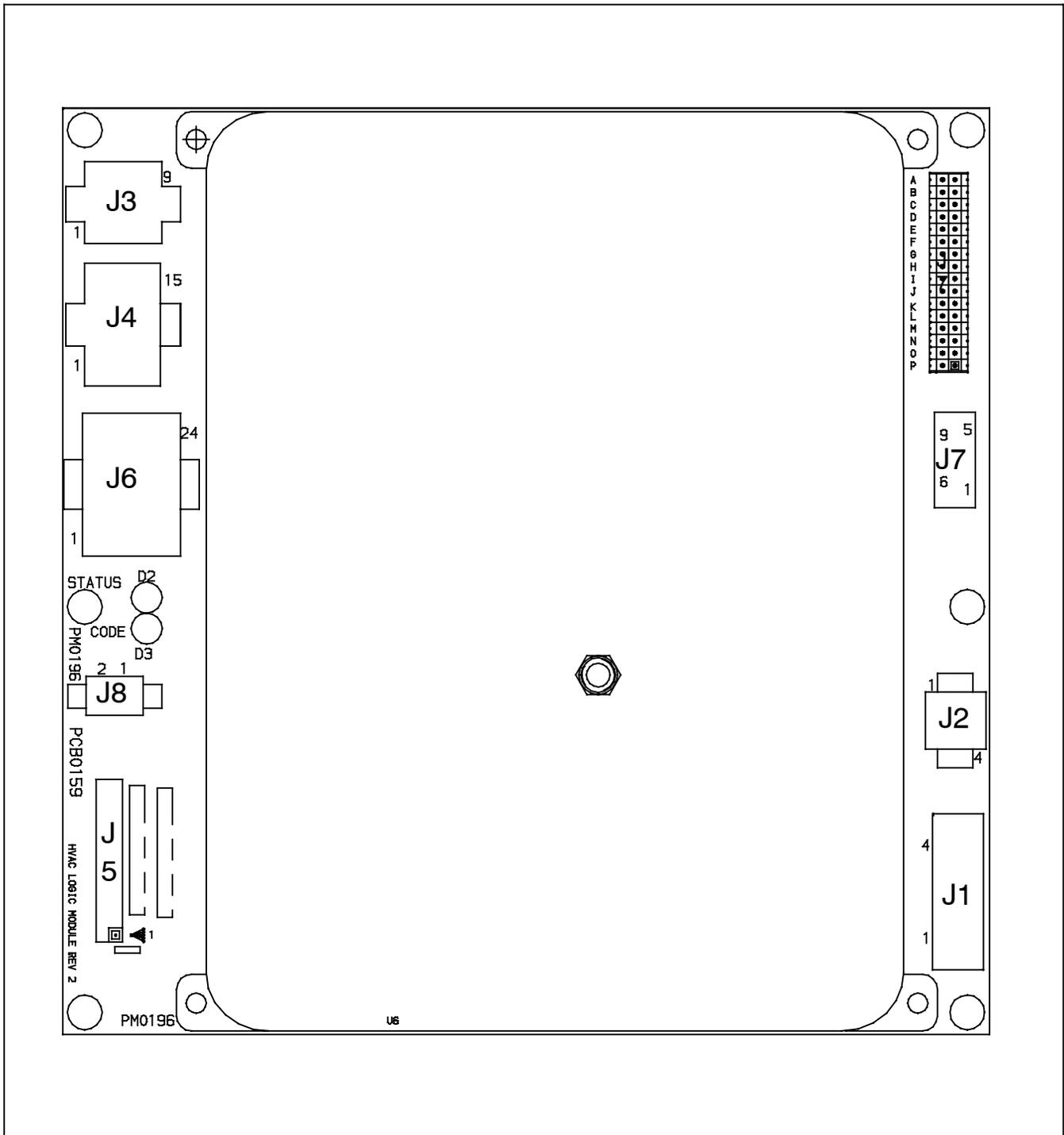


- |  |                               |
|--|-------------------------------|
| 1. Logic Board (See Figure 1-10)                         | 5. Fuses                      |
| 2. Relay Board (See Figure 1-12)                         | 6. Fresh Air                  |
| 3. Logic Board, Data Communications<br>(See Figure 1-13) | 7. Power Terminal Block (PTB) |
| 4. Power Relay (ON)                                      | 8. Terminal Block (TB)        |
|  | 9. Ground                     |

**Figure 1-9 Control Panel**



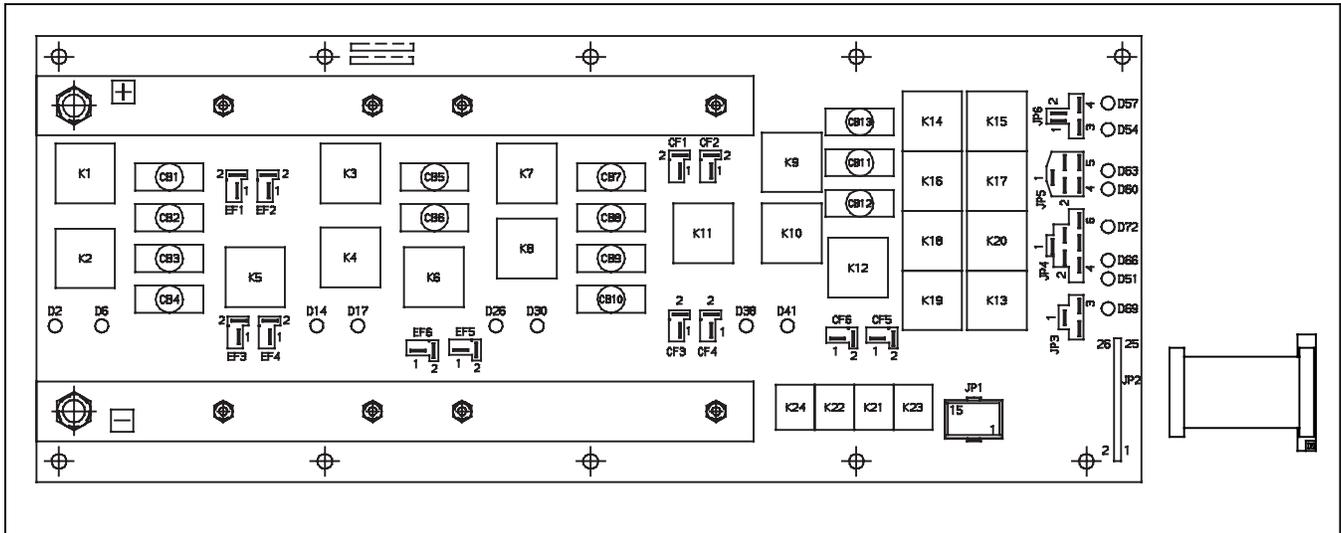
### 1.14 LOGIC BOARD



- J1 Logic board power in.
- J2 Micromate Display interface.
- J3 Manual control inputs.
- J4 Interlock Inputs  
(WTS, low side pressure switch etc.)
- J5 Relay board interface.
- J6 Sensor inputs (Thermistors, etc.).
- J7 Diagnostics interface (RS232, DB9).
- J8 Not used
- D2 Blinks once per second in normal operation.  
On steady to indicate alarms detected.
- D3 Off In normal operation, blinks out alarm  
codes (2 digits each) when alarms detected.
- A-P Configuration Jumpers

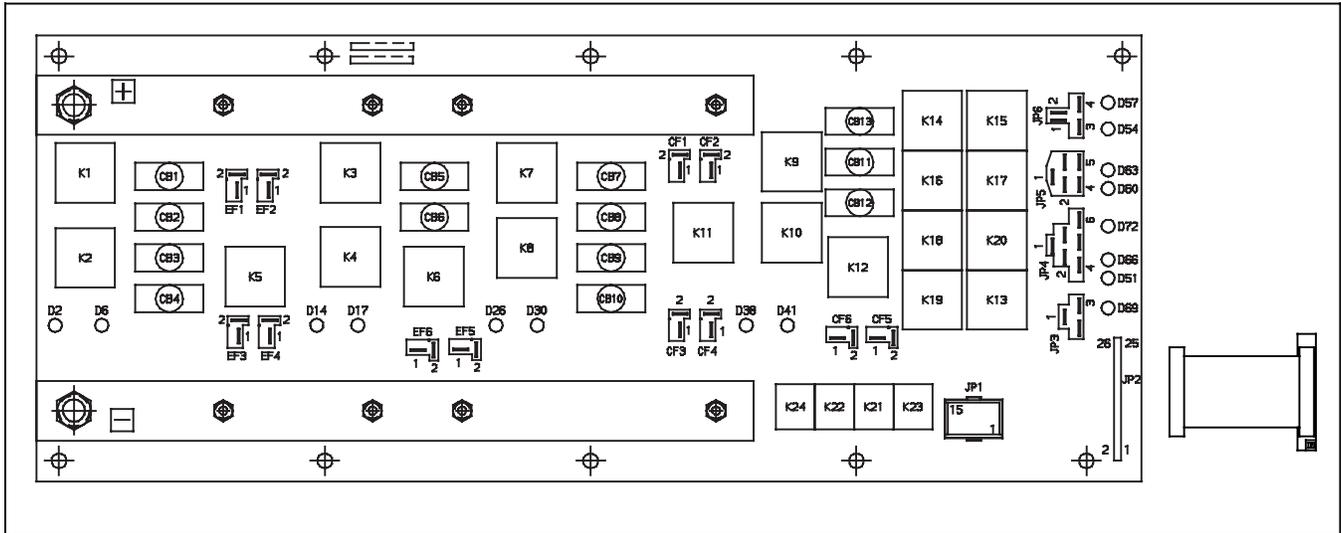
**Figure 1-10 Logic Board**

## 1.15 RELAY BOARD - GR60, 24VDC



**Figure 1-11. Relay Board - GR60**

- |   |  |
|---|--|
| <p>K1 Energizes evaporator fans 1 &amp; 2 in high speed or evaporator fans 1,2,3 &amp; 4 in low speed.</p> <p>K2 Energizes evaporator fans 3 &amp; 4 in high speed (not energized in low speed).</p> <p>K3 Energizes evaporator fan 5 in high speed or evaporator fans 5 &amp; 6 in low speed.</p> <p>K4 Energizes evaporator fan 6 in high speed (not energized in low speed).</p> <p>K5 Connects the negative side of evaporator fans 1 &amp; 2 to ground in high speed. Connects the negative side of evaporator fans 1 &amp; 2 to positive side of evaporator fans 3 &amp; 4 in low speed</p> <p>K6 Connects the negative side of evaporator fan 5 to ground in high speed. Connects the negative side of evaporator fan 5 to positive side of evaporator fan 6 in low speed</p> <p>K7 Energizes condenser fans 1 &amp; 2 in high speed or condenser fans 1,2,3 &amp; 4 in low speed</p> <p>K8 Energizes condenser fans 3 &amp; 4 in high speed (not energized in low speed).</p> <p>K9 Energizes condenser fan 5 in high speed or condenser fans 5 &amp; 6 in low speed.</p> <p>K10 Energizes condenser fan 6 in high speed (not energized in low speed).</p> <p>K11 Connects the negative side of condenser fans 1 &amp; 2 to ground in high speed. Connects the negative side of condenser fans 1 &amp; 2 to the positive side of condenser fans 3 &amp; 4 in low speed.</p> | <p>K12 Connects the negative side of condenser fan 5 to ground in high speed. Connects the negative side of condenser fan 5 to the positive side of condenser fan 6 in low speed.</p> <p>K13 Energizes the A/C clutch &amp; liquid solenoid valve (LSV).</p> <p>K14 Energizes unloader 1.</p> <p>K15 Energizes unloader 2.</p> <p>K16 Energizes the fresh air damper.</p> <p>K17 Energizes the heat solenoid valve (HSV).</p> <p>K18 Energizes the A/C fault light output.</p> <p>K19 Energizes the boost pump.</p> <p>K20 Energizes the floor blower output.</p> <p>K21 Is energized by the logic board to turn the evaporator fans on high. The contacts of this relay energize the coils of relays K1, K2, K3 &amp; K4.</p> <p>K22 Is energized by the logic board to turn the evaporator fans on low. The contacts of this relay energize the coils of relays K1, K3, K5 &amp; K6.</p> <p>K23 Is energized by the logic board to turn the condenser fans on high. The contacts of this relay energize the coils of relays K7, K8, K9 &amp; K10.</p> <p>K24 Is energized by the logic board to turn the condenser fans on low. The contacts of this relay energize the coils of relays K7, K9, K11 &amp; K12.</p> |
|---|--|

**Figure 1-11. Relay Board - GR60 (Continued)**


### 1.15 RELAY BOARD - GR60, 24VDC (Continued)

#### e. Thermal Circuit Breakers

CB 1	Evaporator Fan #1.	15 Amp.
CB 2	Evaporator Fan #2.	15 Amp.
CB 3	Evaporator Fan #3.	15 Amp.
CB 4	Evaporator Fan #4.	15 Amp.
CB 5	Evaporator Fan #5.	15 Amp.
CB 6	Evaporator Fan #6.	15 Amp.
CB 7	Condenser Fan #1.	15 Amp.
CB 8	Condenser Fan #2.	15 Amp.
CB 9	Condenser Fan #3.	15 Amp.
CB10	Condenser Fan #4.	15 Amp.
CB11	Condenser Fan #5.	15 Amp.
CB12	Condenser Fan #6.	15 Amp.
CB13	A/C clutch, Unloaders 1&2, Fresh air damper, Heat valve, Fault output and Spare output.	15 Amp

#### f. Connectors

EF1-EF6	Evaporator fans.
CF1-CF4	Condenser fans.
JP1	External evaporator & condenser fan thermal overload connections.
JP2	Logic board connector.
JP3	Boost pump.
JP4	A/C clutch, fault output, compressor high pressure switch.
JP5	Spare output, fresh air output, heat valve.
JP6	Unloaders 1 & 2.

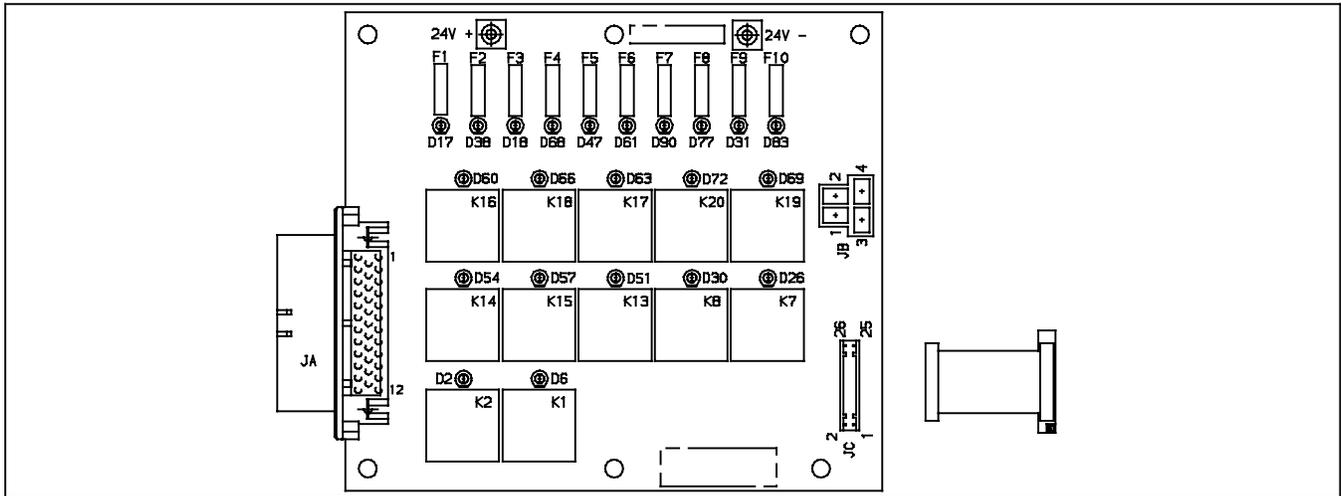
#### g. LEDs

D 2	Relay K1 output active (evaporator fans 1,2,3 & 4 energized)
D 6	Will be brightly lit if evaporator fans 1, 2, 3 & 4 are on high. Will be at half intensity if they are on low.
D14	Relay K3 output active (evaporator fans 5 & 6 energized).
D17	.Will be brightly lit if evaporator fans 5 & 6 are on high. Will be at half intensity if they are on low.
D26	Relay K7 output active (condenser fans 1, 2, 3 & 4 energized).
D30	Will be brightly lit if condenser fans 1, 2, 3 & 4 are on high. Will be at half intensity if they are on low.
D38	Relay K9 output active (condenser fans 5 & 6 energized).
D41	Will be brightly lit if condenser fans 5 & 6 are on high. Will be at half intensity if they are on low.
D51	A/C clutch, liquid solenoid valve output active.
D54	Unloader 1 output active.
D57	Unloader 2 output active.
D60	Fresh air output active.
D63	Heat solenoid valve output active.
D66	A/C fault output active.
D69	Boost pump output active.
D72	Floor blower output active.



**1.16 RELAY BOARD, 24VDC**

**Figure 1-12. Relay Board**



**a. Relays**

- K1 Energizes evaporator fans in low speed
- K2 Energizes evaporator fans in high speed (not energized in low speed).
- K7 Energizes condenser fans in low speed
- K8 Energizes condenser in high speed (not energized in low speed).
- K13 Energizes the A/C clutch and liquid line solenoid valve.
- K14 Energizes unloader 1.
- K15 Energizes unloader 2.
- K16 Energizes fresh air damper.
- K17 Energizes reheat coolant valve.
- K18 Energizes the fault light output.
- K19 Energizes the boost pump.
- K20 Energizes the driver's liquid line solenoid valve.

**b. Connectors**

- JA Relay board connector (communication to system).
- JB Boost pump.
- JC Ribbon Cable (Logic Module to Relay Board)

**c. Fuses**

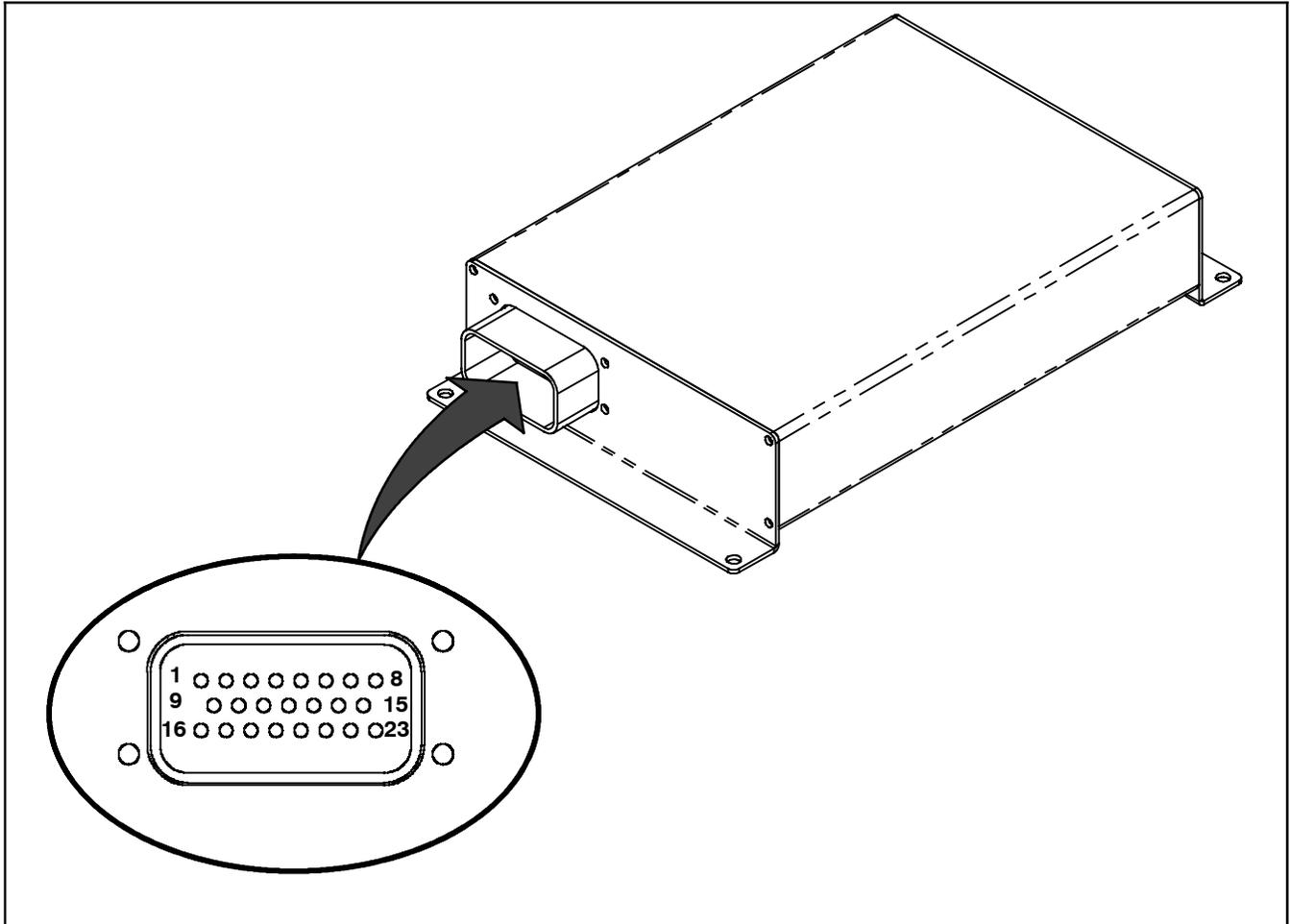
- F1 Fresh air relay.
- F2 Unloader 1 relay.
- F3 Evaporator fan motor relay.
- F4 Fault light out relay.
- F5 Unloader 2 relay.
- F6 Heater relay.
- F7 Clutch relay.
- F8 Spare.
- F9 Condenser motor fan relay.
- F10 Boost pump relay.

**d. LEDs**

- D2 Evaporator fans output active – high speed
- D6 Evaporator fans output active.
- D26 Condenser fans output active.
- D30 Condenser fans on high speed
- D51 A/C clutch and liquid line solenoid valve output active.
- D54 Unloader 1 output active.
- D57 Unloader 2 output active.
- D63 Heat output active (RCV).
- D66 Fault output active.
- D69 Boost pump output active.
- D72 Driver's liquid line solenoid valve active.
- D17 Fresh air relay fuse out.
- D38 Unloader 1 relay fuse out.
- D18 Evaporator fan motor relay fuse out.
- D68 Fault light out relay fuse out.
- D47 Unloader 2 relay fuse out.
- D61 Heater relay fuse out.
- D90 Clutch relay fuse out.
- D77 Unloader 1 fuse out.
- D31 Condenser motor fan relay fuse out.
- D83 Boost pump relay fuse out.



### 1.17 LOGIC BOARD, DATA COMMUNICATIONS

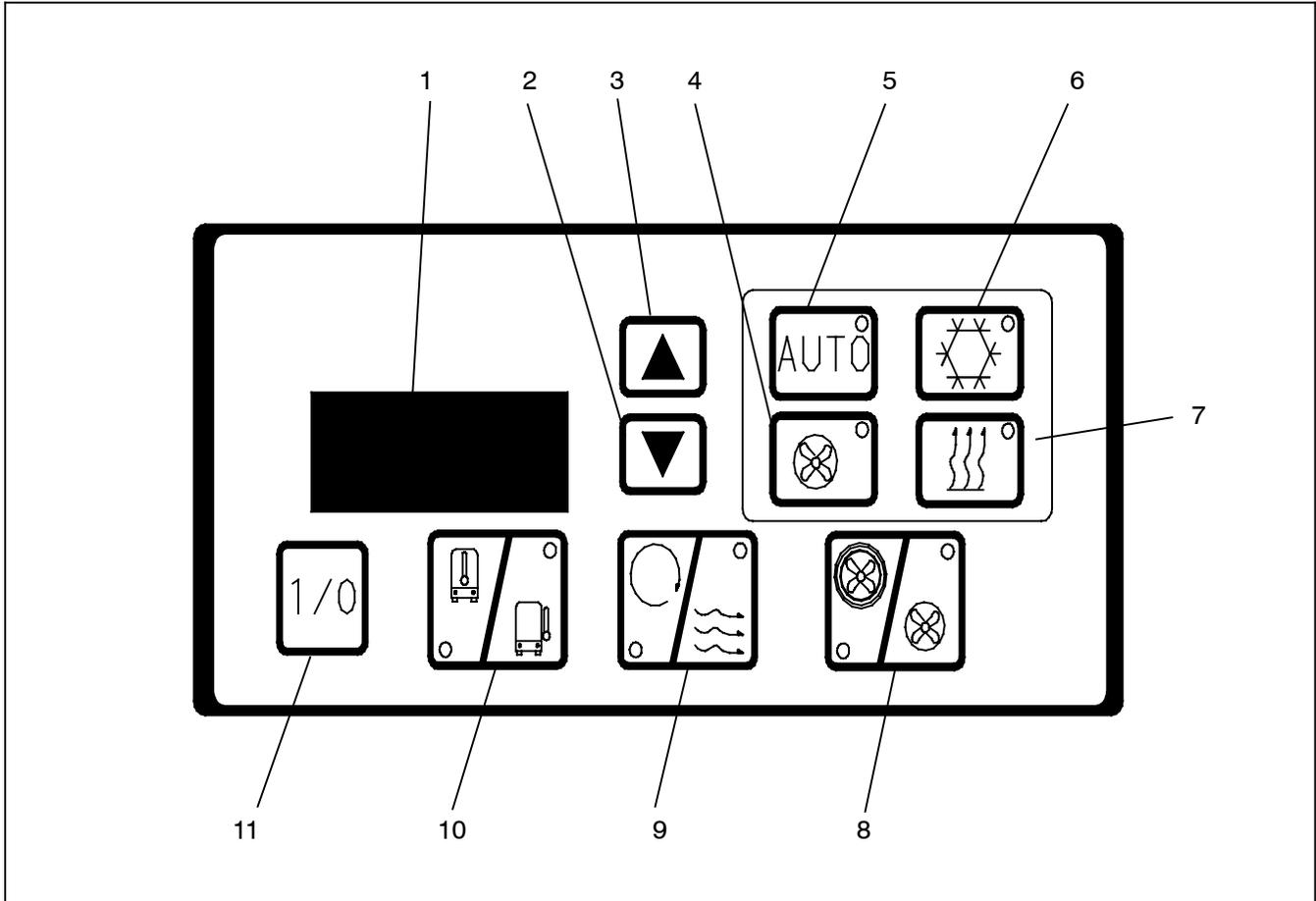


Pin	Function	Remarks	Pin	Function	Remarks
1	+24VDC In	Power In	13	RS-232 TXD	HVAC Data Port
2	24VDC Return	Ground	14	RS-232 RXD	HVAC Data Port
3	Alt, CAN_H	CAN Port #2 (Optional)	15	LED Out	Status Indicator (Optional)
4	Alt, CAN_L	CAN Port #2 (Optional)	16	N/C	
5	N/C		17	N/C	
6	N/C		18	RS-232 Gnd	HVAC Data Port
7	N/C		19	N/C	
8	LED Gnd	Status Indicator (Optional)	20	N/C	
9	CAN_H	J1939 Port	21	N/C	
10	CAN_L	J1939 Port	22	N/C	
11	N/C		23	N/C	
12	N/C				

Figure 1-13 Logic Board, Data Communications



### 1.18 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 1-14 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 interface.
- b. 24 vdc, 125 amp, power from a circuit breaker 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, placing the switch in the ON position will start the system.
- c. MICROMATE CONTROL PANEL  
It is suggested the system be started in the automatic mode.

1. The Micromate Control Panel Display (see Figure 1-14) 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, then the controller is programmed to display return air temperature. If the controller does not automatically cycle back to the return air indicator, then 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 completed, 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 1-14) 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 (if supplied), 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 additional Micromate operating data 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 by removing power to the Logic Board. Note: If OEM switches at the dash are supplied, they will override control unless the J3 plug on the logic board is disconnected.



### 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 section 4.15.4)
- c. Check refrigerant charge. (Refer to section 4.8.1)
- d. Ensure that self-test has been successfully performed and that there are no errors or alarms indicated. (Refer to section 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 1-10), relay board (Figure 1.15 or Figure 1.16), 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.

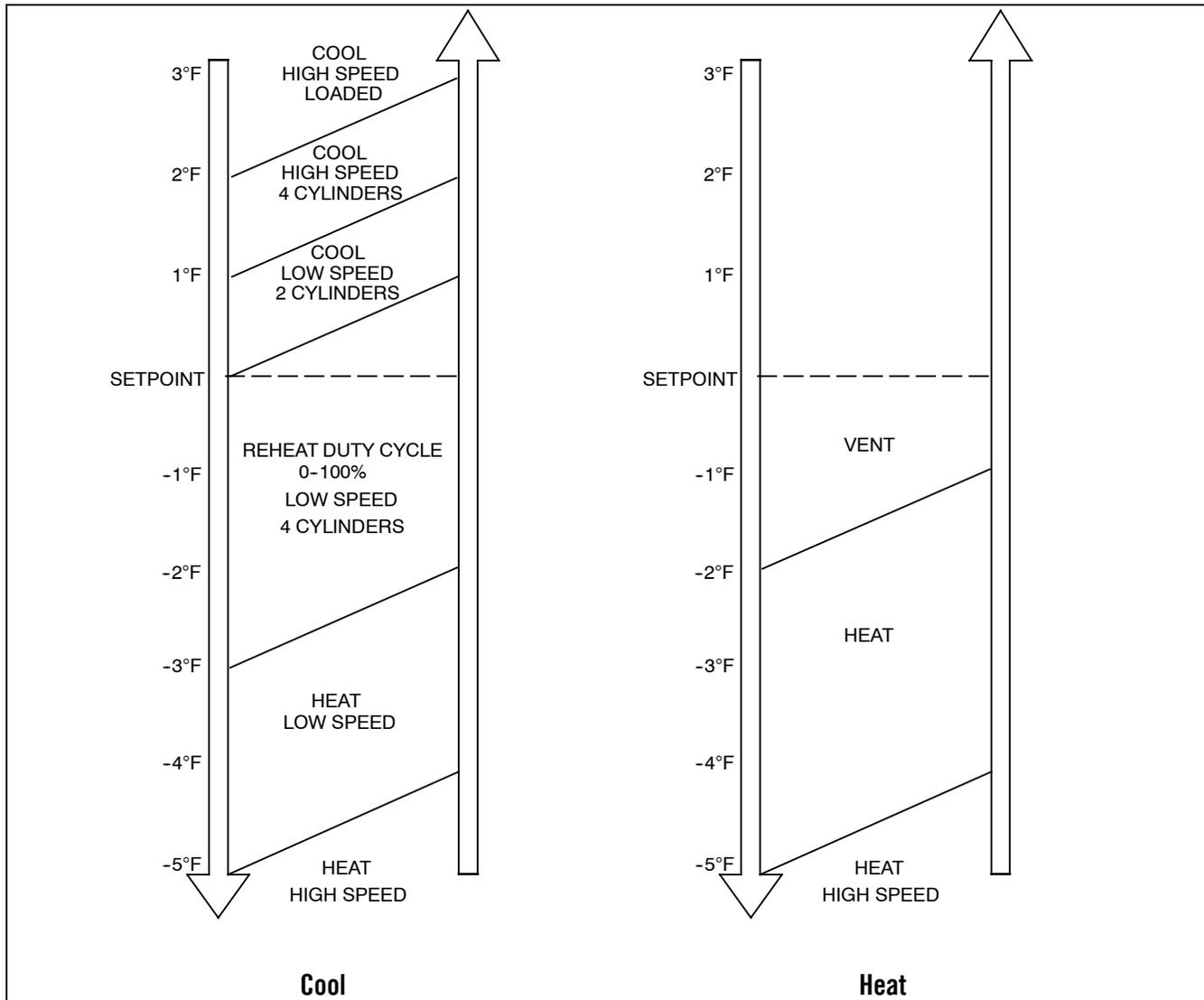


Figure 2-1 Capacity Control Diagram



## 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 section of the evaporator coil. 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

When the unit is in the heat mode, and if 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 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 05G compressor has three banks of two cylinders each. Energizing a valve de-activates a bank of cylinders. The outboard cylinder banks of the 05G are equipped with unloader valves (UV1 and UV2), each controlling two cylinders; this allows the 05G to be operated with two, four or six cylinders.

Whenever the compressor is started, the unloaders are energized for a preset delay time to reduce starting torque. After the delay, unloaders may be de-energized. Any subsequent changes between energizing and de-energizing the unloaders for temperature control is also staged for a preset delay time. Once an unloader is energized for pressure control, it remains energized for two minutes 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 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, unloader UV1 is energized unloading a cylinder bank (two cylinders); this output will remain energized until the pressure increases to above 34 psig.



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

**c. Discharge Pressure**

Discharge pressure is also controlled by the unloaders:

1 Compressor Unloader UV1 Relay. When the discharge pressure increases above set point A (see chart below), unloader UV1 is energized; this unloader will remain energized until the pressure decreases below set point B (see chart below).

**Table 2-1. Unloader UV1 Relay**

HPS Switch (PSIG)	Set Point A (PSIG)	Set Point B (PSIG)
300	275	220

2 Compressor Unloader UV2 Relay. On R-134a systems when the discharge pressure increases above set point A (see chart below), unloader UV2 is energized; this unloader will remain energized until the pressure decreases below set point B (see chart below).

**Table 2-2. Unloader UV2 Relay**

HPS Switch (PSIG)	Set Point A (PSIG)	Set Point B (PSIG)
300	285	225

**2.3.7 Evaporator Fan Speed Selection**

Temperature control is the primary method of determining the fan speed selection. Table 2-3 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 2-3 Evaporator Fan Speed Relay Operation**

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

**2.3.8 Condenser Fan Control**

The condenser fans start in low speed when the compressor clutch output is energized. The fans will switch to high speed when the discharge pressure reaches 190 psig (R-134a) and will remain energized in high speed for a minimum period of 5 minutes. The fans will switch to low speed when discharge

pressure decreases below 135 PSIG. High speed will also remain activated if a high pressure alarm has been activated and operation has not been locked out (refer to Table 3-2).

**2.3.9 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 or during high and low pressure conditions.

The clutch coil will be de-energized if the discharge pressure rises to the cutout setting of the compressor mounted high pressure switch. An alarm will be triggered if this condition exists for more than a 0.5 second. The clutch coil will energize when the discharge pressure falls to the reset point of the high pressure switch.

The clutch coil will be de-energized whenever the suction pressure decreases below 10 PSIG, an alarm will be triggered if this condition exists for more than 10 seconds. The clutch coil will energize when the suction pressure rises to the reset point. If the alarm is triggered 3 times in a 30 minute time period the system will be locked out (See 3.2.1 Alarm Codes).

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

**2.3.10 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.

**2.3.11 Alarm Description**

Alarm descriptions and troubleshooting procedures are provided in section 3.

**2.3.12 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 are 999,999. Refer to paragraph 2.4.2 for instructions on reading parameter codes.

**2.4 MICROPROCESSOR DIAGNOSTICS**

The Micromate control panel 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 Control

### NOTE

1. This procedure should be performed by an HVAC technician who has been trained on Mobile Climate Control system design. The control configuration is preset by the manufacturer and resetting of the parameters should not be required. It is recommended that MCC Service or Engineering is contacted before any control configuration is changed. MCC can not 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 (refer to Figure 1-10) to the original board. Refer to paragraph 4.19.
  - a. Turn the A/C main power switch (located in the driver's area) to OFF.
  - b. Connect the Micromate control panel to the service port (J2) located in the return air section. (refer to Figure 1-10)
  - 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 I/O key on the Micromate panel.

### NOTE

Be sure to reconnect J3 when testing is completed or the system will fail to operate when the Micromate is disconnected.

### NOTE

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

## 2.4.2 Diagnostic Mode

The diagnostic mode can be entered by pressing the UP and DOWN arrow keys simultaneously for 3 seconds. The Micromate control panel display screen will go blank for one second and then enter the alarm screen. The diagnostic mode allows alarms and system parameters to be viewed. If there are any alarms stored, the most recent alarm will be shown. To exit the diagnostic mode, press the ON/OFF key once, or do not touch any keys for 30 seconds. To view additional alarm information, refer to section 3.

## 2.4.3 System Parameters

To view system parameters, first enter the Diagnostic Mode. Refer to paragraph 2.4.2. The parameters are shown in Table 2-5. While in the diagnostic mode, press an UP or DOWN arrow key to switch the display to the Parameter Display. With the first Parameter displayed, press the DOWN arrow key to scroll through the list from the first to the last parameter or press the UP arrow to scroll from the last to the first parameter. 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 3 seconds.
- b. Enter the test mode immediately by pressing the COOL button five times.
- c. If an alarm is present, press the UP arrow key until “---” is displayed.
- d. In the test mode, the display will read “T##” where “##” indicated the test number that is currently running.
- e. The initial indication will be “T00”. This indicates the controller is in the test mode and all relays are de-energized. Press the DOWN arrow key to bring the Micromate to the next test screen and energize the corresponding component(s). Press the UP arrow key move backwards through the list. A listing of tests is provided in Table 2-4.
- f. To terminate testing, press the I/O key.

Table 2-4. Controller Test List

TEST	OUTPUT	STATE
T00	All Relays	Off
T01	Evaporator Fans High	On
T02	Evaporator Fans Low	On
T03	Condenser Fans High	On
T04	Condenser Fans Low	On
T05	Compressor & Liquid Line Solenoid	On
T06	Unloader Valve 1	On
T07	Unloader Valve 2	On
T08	Not Applicable	On
T09	Reheat Coolant Valve	On
T10	Fault	On
T11	Boost	On
T12	Spare/Motor Input/	On
	Floor Blower	



**Table 2-5. 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	Not used.
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 <i>CL</i> and if it is open circuited it will display <i>OP</i> .
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 reheat coolantvalve 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	Reheat Valve Delay	This is the minimum time (in seconds) that the reheat 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 60°F and 80°F.
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 60°F and 80°F.



**Table 2-5. 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 32°F. This value can be modified between 20°F and 40°F 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 value the 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.
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.



Table 2-5. Parameter Codes - Continued

Code	Code Name	Description
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	When the value is OFF, the fresh air damper will operate 5°F above or below the control set point. When the value is ON, the fresh air damper will operate 2°F above or below the control set point.
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



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 1-10) flash simultaneously. The Micromate control panel display will indicate errors with the code ER-#, where "ER" is the error prefix and # is the error number.

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.

#### 3.2 SYSTEM ALARMS

##### 3.2.1 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 1-10) 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 control panel 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 alarm 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 3 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.

##### 3.2.2 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.

##### 3.2.3 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.

##### 3.2.4 Alarm Clear

The user may clear inactive alarms using the Micromate control panel keypad. Refer to paragraph 3.2.1.



**3.2.5 Exit Alarm Queue**

To exit the alarm queue press the ON/OFF key once, or if no key is pressed for 30 seconds it will reset to normal mode.

**3.3 TROUBLESHOOTING**

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

**3.3.1 Troubleshooting No CAN Communication**

Follow these steps:

1. Connect the Micromate display unit.
2. Check that the parameters are displayed by the Micromate display unit.
3. If no parameters are displayed, STOP. The Micromate logic unit is bad.
4. Use an RS232 USB cable to connect a laptop USB port to the Micromate Logic unit.
5. Launch HyperTerminal software by clicking on “start\ All Programs\accessories\communications\HyperTerminal”.
6. With the Caps Lock set, press the “S” and “5” keys in unison, then press “Enter”.
7. With the Caps Lock set, press “O” and press “Enter”.
8. A stream of five 2 digit numbers starting with “3D” should be shown.

```

3D 00 E6 DD 5C
3D 00 FF C4 41
3D 00 EB D8 35

```

9. If no digits are streamed, STOP. The Micromate Logic unit or the interface connection is defective.
10. Connect the RS232 USB cable to the Gateway RS232 connector.
11. The following 3 repeating streams should be shown.

```

T18FFDD19800000000000000000
T18FFDE19800000000000000000
T18FFDD19800FF00000000FFFF
T18FFDD19800000000000000000
T18FFDE19800000000000000000
T18FFDD19800FF00000000FFFF

```

12. If no 3 repeating streams are shown, STOP. The Gateway unit is bad.



**Table 3-2 Alarm Codes**

<b>ALARM NO.</b>	<b>TITLE</b>	<b>CAUSE</b>	<b>REMEDY</b>	<b>CONTROLLER RESPONSE</b>
A11	Coil Freeze	Coil temperature is less than 32°F and the compressor is operating.	Check causes of coil freezing. (Refer to section 3.3.7)	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 4.16. 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. Condenser fans will run on high speed.
A17	Low Pressure Shutdown	Low suction pressure switch open or wiring defective.	Check cause of low suction pressure. (Refer to section 3.3.4)	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 (except for the evaporator fans and heat) and the system is locked out until the power is cycled or the alarm is reset.
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 3.3.4)	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 (except for the evaporator fans and heat) 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
A22	Breaker Trip/Blown Fuse Alarm	A breaker/fuse on the relay board has tripped or a fan relay has failed.	Check breakers/fuse for tripped device. Repair short and reset/replace breaker/fuse.	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	Not used			
A26	Not used			
A31	Maintenance Alarm 1	The compressor hour meter is greater than the value in Maintenance Hour Meter 1.	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.	Reset the maintenance hour meter.	Alarm will be generated.
A33	Low Pressure Warning	Suction pressure low enough to energize UV2.	Check cause of low suction pressure. (Refer to section 3.3.4)	Alarm will be generated.
A34	High Pressure Warning	Discharge pressure high enough to energize UV2.	Check cause of high discharge pressure. (Refer to section 3.3.4)	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
<b>3.3.2 System Will Not Cool</b>		
Compressor will not run	Active system alarm V-Belt loose or defective Clutch coil defective Clutch malfunction Compressor malfunction	3.2 Check Check/Replace Check/Replace See Table 1-3
Electrical malfunction	Coach power source defective Circuit Breaker/safety device open	Check/Repair Check/Reset
<b>3.3.3 System Runs But Has Insufficient Cooling</b>		
Compressor	V-Belt loose or defective Compressor valves defective	Check See Table 1-3
Refrigeration system	Abnormal pressures No or restricted evaporator air flow Expansion valve malfunction Restricted refrigerant flow Low refrigerant charge Service valves partially closed Safety device open Liquid solenoid valve stuck closed	3.3.4 3.3.7 3.3.8 4.11 4.8 Open 1.8 Check
Restricted air flow	No evaporator air flow or restriction	3.3.7
Heating system	Reheat coolant valve stuck open	3.3.9
<b>3.3.4 Abnormal Pressures</b>		
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	4.18 See Table 1-3 4.8
High suction pressure	Compressor valve(s) worn or broken	See Table 1-3
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 3.3.8 3.3.7 Replace
Suction and discharge pressures tend to equalize when system is operating	Compressor valve defective	See Table 1-3
<b>3.3.5 Abnormal Noise Or Vibrations</b>		
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 1-3 See Table 1-3 3.3.8 4.15.4 Check Check/Adjust Clean



**Table 3-3 General System Troubleshooting Procedures - Continued**

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
<b>3.3.5 Abnormal Noise Or Vibrations - Continued</b>		
Condenser or evaporator fans	Loose mounting hardware Defective bearings Blade interference Blade missing or broken	Check/Tighten Replace Check Check/Replace
<b>3.3.6 Control System Malfunction</b>		
Will not control	Sensor or transducer defective Relay(s) defective Microprocessor controller malfunction Logic Board J3 connector unplugged	4.16 or 4.17 Check Check
<b>3.3.7 No Evaporator Air Flow Or Restricted Air Flow</b>		
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
<b>3.3.8 Expansion Valve Malfunction</b>		
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 4.6 Replace Replace 4.13
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 4.13
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
<b>3.3.9 Heating Malfunction</b>		
Insufficient heating	Dirty or plugged heater core Reheat 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	Reheat coolant solenoid valve(s) malfunctioning or plugged Controller malfunction Pump(s) malfunctioning Safety device open	Check/Replace Replace Repair/Replace 1.8
Continuous Heating	Reheat 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 3.2.1

**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		
<b>a. Daily Maintenance</b>			
X	X	Pre-trip Inspection - after starting Check tension and condition of V-belt	2.2 None
<b>b. Weekly Inspection</b>			
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
<b>c. Monthly Inspection and Maintenance</b>			
	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 5 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.

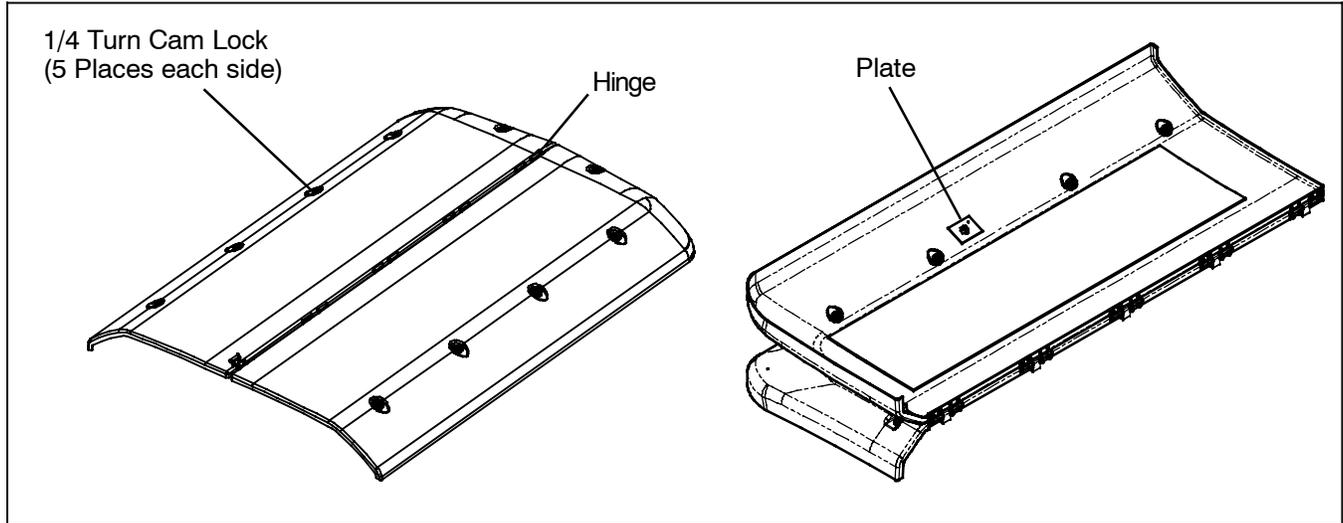


Figure 4-1 Opening Top Cover (Evaporator)

### 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: (See Figure 4-2.)

- a. Twist all (4) of the 1/4 Turn cam locks counter-clockwise.
- b. Grasp the condenser cover section under the bottom edge and lift up evenly.

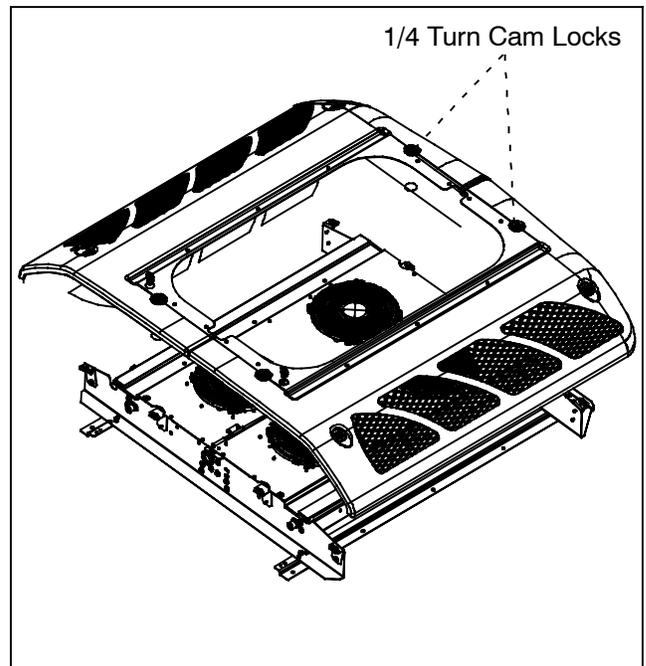


Figure 4-2 Condenser Cover Removal



### 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.

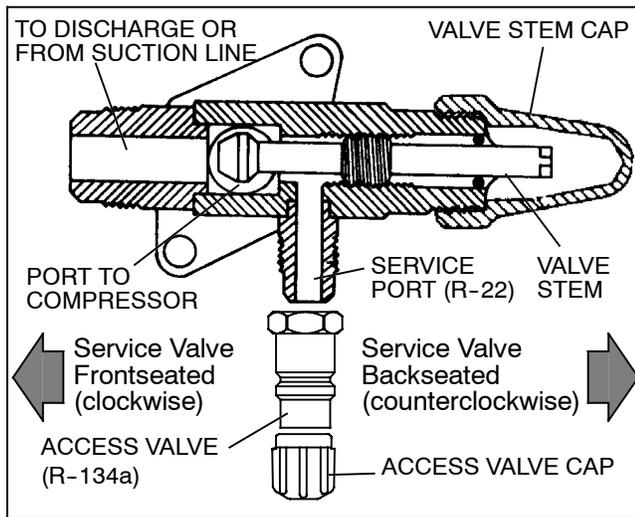


Figure 4-3 Suction or Discharge Service Valve

#### 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 Transicold. (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.

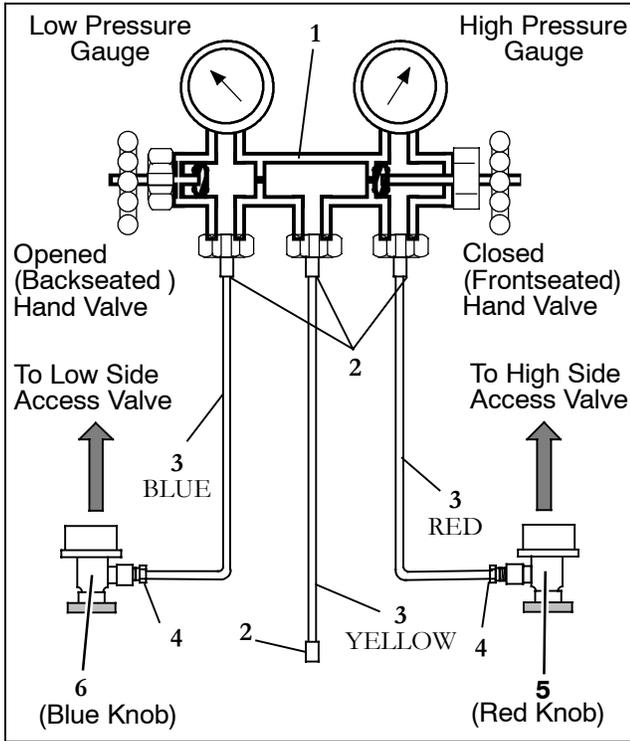
##### c. Removing the Manifold Gauge Set

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 discharge & suction service ports (items 2 & 6). Refer to Figure 4-6.
- b. Frontseat the charge isolation valve (11) by turning clockwise. Disconnect suction pressure transducer (7), install a jumper on the compressor mounted low pressure switch (8).

- 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 (6) to trap refrigerant in the high side of the system between the compressor suction service valve and the charge isolation valve. Wait 5 minutes to verify that system pressure 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 (15). Refer to paragraph 4.11.
- g. Energize the Liquid Line Solenoid Valve (LSV) (13) using an external power source (24 VDC).
- h. Move the suction service hose (blue) from the compressor suction service valve to the filter drier outlet valve (16). Mid-seat the Filter Drier Outlet Valve and evacuate the low side of the system to 500 microns. Close off the pump valve (23) and vacuum gauge valve (22) and shut the vacuum pump off. Wait 5 minutes to verify that vacuum holds.
- i. Back-seat the filter drier outlet valve. Re-attach the suction service hose (blue) to the compressor suction service valve. Open the suction service valve (6) and charge isolation valve (11).
- j. Disconnect external 24 VDC to liquid solenoid valve (13).
- k. Run and check refrigerant level. Refer to paragraph 4.8.1.



### 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 discharge and suction service valves (items 1 & 6).
- 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 vacuum pump isolation valve (15) and vacuum gauge isolation valve (14), 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.

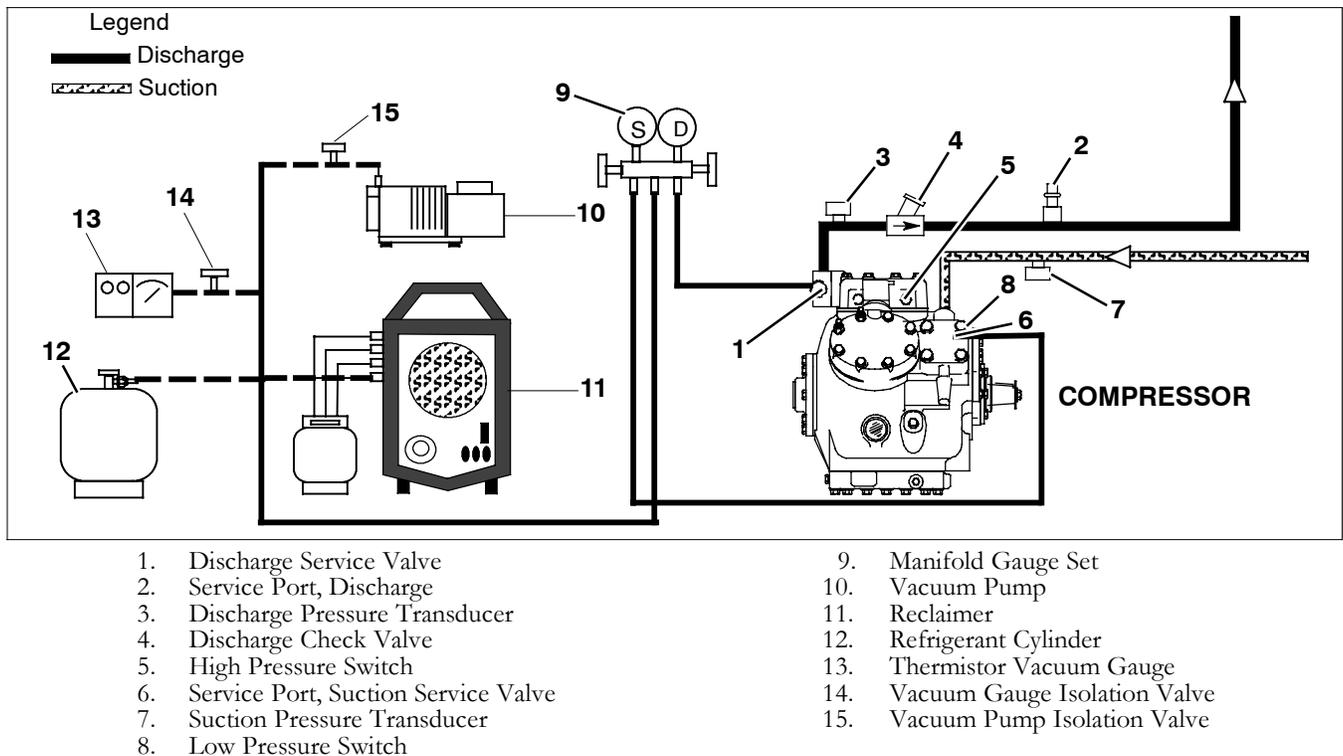
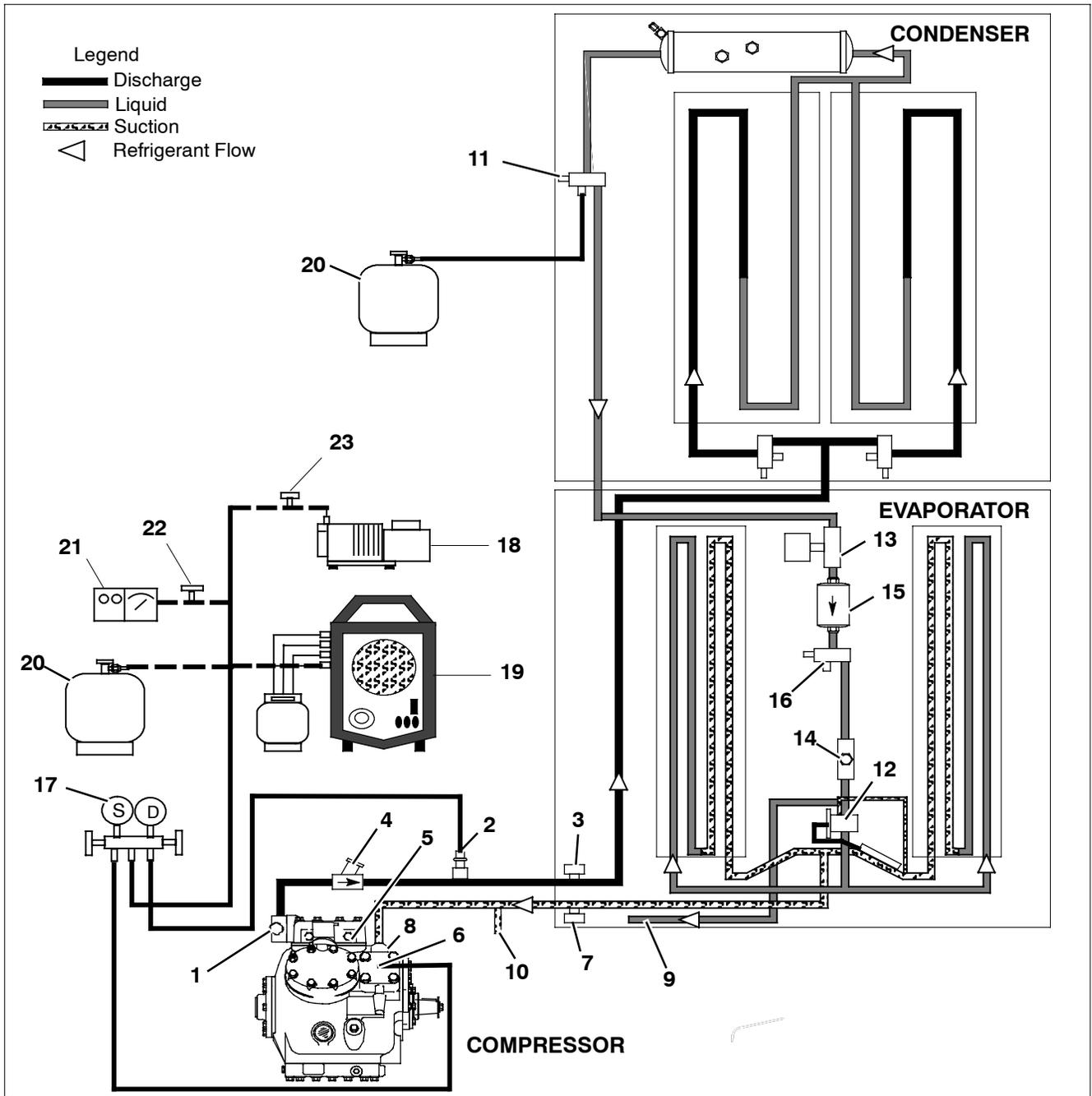


Figure 4-5 Compressor Service Connections



- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Discharge Service Valve</li> <li>2. Service Port, Discharge</li> <li>3. Discharge Pressure Transducer</li> <li>4. Discharge Check Valve</li> <li>5. High Pressure Switch</li> <li>6. Service Port, Suction Service Valve</li> <li>7. Suction Pressure Transducer</li> <li>8. Low Pressure Switch (to crankcase)</li> <li>9. Dash Air Liquid Tee (Optional)</li> <li>10. Dash Air Suction Tee (Optional)</li> <li>11. Charge Isolation Valve</li> <li>12. Thermal Expansion Valve</li> </ol> | <ol style="list-style-type: none"> <li>13. Liquid Line Solenoid Valve</li> <li>14. Liquid Line Sightglass</li> <li>15. Filter Drier</li> <li>16. Filter Drier Outlet Service (King) Valve</li> <li>17. Manifold Gauge Set</li> <li>18. Vacuum Pump</li> <li>19. Reclaimer</li> <li>20. Refrigerant Cylinder</li> <li>21. Thermistor Vacuum Gauge</li> <li>22. Vacuum Gauge Isolation Valve</li> <li>23. Vacuum Pump Isolation Valve</li> </ol> |
|---|--|

Figure 4-6 Service Connections



### 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 4-6.
- b. Frontseat the compressor suction service valve (6) 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 (1) 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 (23), isolate vacuum gauge valve (22) 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 4-6.

- b. Connect a reclaimer to the center manifold gauge set connection.
- c. Energize the Liquid Line Solenoid Valve (LSV) (13) 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 solenoid 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.

- a. Evacuate and dehydrate only after pressure leak test. Refer to paragraph 4.6.
- b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump with a minimum of 6 cfm (10.2 m<sup>3</sup>/hr) volume displacement, (MCC P/N 07-00176-11), and a good vacuum indicator (MCC P/N 07-00414-00).
- c. Keep the ambient temperature above 60°F (15.6°C) to speed evaporation of moisture. If ambient temperature is lower than 60°F (15.6°C), ice may form before moisture removal is complete.

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

- a. Remove refrigerant using a refrigerant recovery system. Refer to paragraph 4.5.4.
- b. The recommended method is connecting lines (refrigerant hoses designed for vacuum service) as shown in Figure 4-6.
- c. Energize the Liquid Line Solenoid Valve (LSV) (13) using an external power source (24 VDC).
- d. Start vacuum pump. Slowly open valves halfway and then open vacuum gauge valve (items 22 & 23).
- e. Evacuate unit until vacuum gauge indicates 500 microns Hg vacuum.
- f. Close off pump valve (23), and stop pump. Wait five minutes to see if vacuum holds.

- g. Remove external 24 VDC from Liquid Line Solenoid.

- h. Charge system. Refer to paragraph 4.8.2.

### 4.7.4 Procedure for Evacuation and Dehydrating System (Triple Evacuation)

- a. Remove refrigerant using a refrigerant recovery system. Refer to paragraph 4.5.4.
- b. The recommended method is connecting lines (refrigerant hoses designed for vacuum service) as shown in Figure 4-6.
- c. Energize the Liquid Line Solenoid Valve (LSV) (13) using an external power source (24 VDC).
- d. Start vacuum pump. Slowly open valves halfway and then open vacuum gauge valve.
- e. Evacuate unit until vacuum gauge indicates 2000 microns Hg vacuum. Close gauge valve, vacuum pump valve, and stop vacuum pump.
- f. Break the vacuum with nitrogen. Raise system pressure to approximately 2 psig.
- g. Purge the nitrogen from the system.
- h. Repeat steps d. thru g. one time.
- i. Start vacuum pump and open all valves. Dehydrate unit to 500 microns Hg vacuum.
- j. Close off pump valve (23), and stop pump. Wait five minutes to see if vacuum holds.
- k. Remove external 24 VDC from Liquid Line Solenoid.
- l. 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.

- a. Coach engine operating at high idle.
- b. Unit operating fully loaded (six cylinder) in cool mode for 15 minutes.
- c. Compressor discharge (head) pressure to 150 PSIG (R-134a). It may be necessary to block condenser air flow to raise discharge pressure.
- d. Under the above conditions, the system is properly charged when the white balls are floating and a liquid level is detected in the receiver sight glasses. Adjust the charge (add or remove) to meet this condition.



## 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 should only be done at the charge isolation valve on the bus roof (See Figure 4-6, Item 11) or the discharge line service port (See Figure 4-6, Item 2).

- c. Place appropriate refrigerant cylinder on scales. Prepare to charge liquid refrigerant into the system by connecting the charging hose from refrigerant cylinder (20) to the charge isolation valve(11).
- d. Energize the Liquid Line Solenoid Valve (LLSV) (13) using an external power source (24 VDC).
- e. Note weight of refrigerant and cylinder.
- f. Open cylinder valve (20) and purge hose at charge isolation valve (11).
- g. Midseat filter drier inlet valve to allow liquid refrigerant to flow into the low 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 charge isolation 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. See Figure 4-6.
- b. Place appropriate refrigerant cylinder on scale. Prepare to charge vapor refrigerant by connecting charging hose from container to center connection on gauge manifold. Purge air from hoses.
- c. Run the unit in the cool mode as described in section 4.8.1. With the suction service valve mid-seated, open the refrigerant cylinder valve and add

vapor charge until the white balls are floating and a liquid level is detected in the receiver sight glasses.

- 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

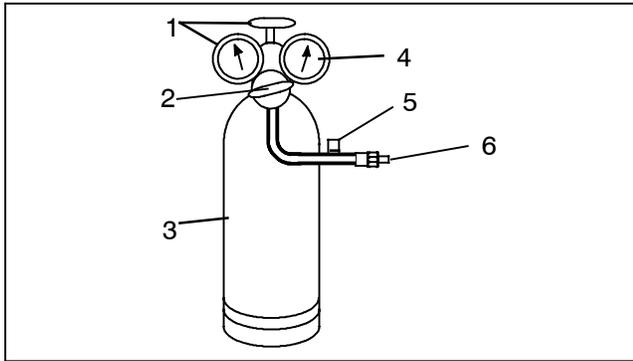
**Do not use a nitrogen cylinder without a pressure regulator**



### 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

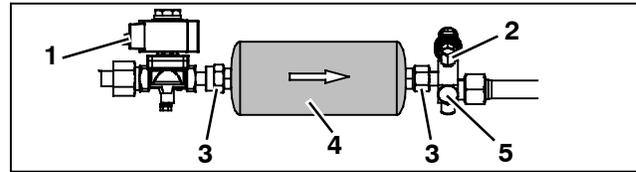
**Figure 4-7 Checking High Pressure Switch**

- 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 and reconnect 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 Solenoid Valve
2. Valve Service Port
3. Hex Nut (ORS)
4. Filter-Drier
5. Filter-Drier Outlet Service Valve

**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 the filter-drier clamp.



## WARNING

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

- e. Using two open end wrenches, slowly crack open the ORS hex 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 O-Rings and seat in the grooves of the filter-drier.
- 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), and that the O-Rings have remained in place. Finger tighten ORS hex nuts.
- h. Tighten the filter-drier ORS hex nuts using two open end wrenches.
- i. Evacuate the filter-drier and lines by connecting a vacuum pump as shown in Figure 4-6. Evacuate to 500 microns.
- j. Backseat (fully close) the service valve port and replace valve cap.
- 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 locking nut and O-Ring, then the threaded collar.
- e. Lift coil from enclosing tube and replace.
- f. With the coil installed replace the threaded collar, then the O-Ring and locking nut.
- g. Connect wire leads and test operation

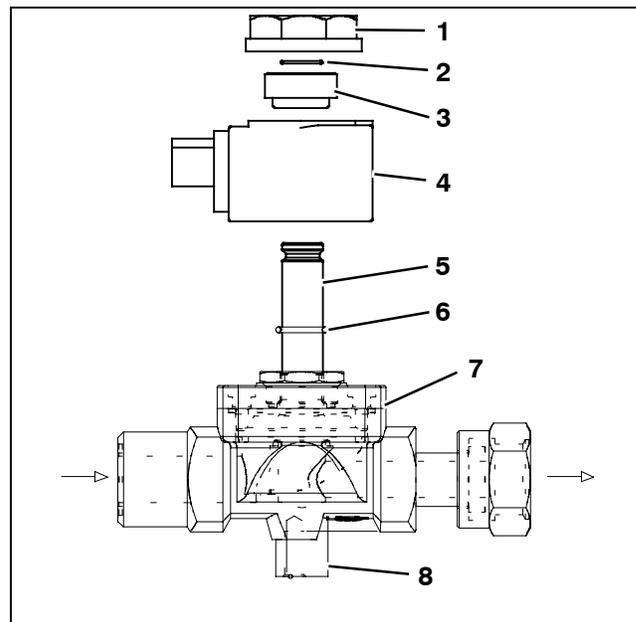
#### 4.12.2 Internal Part Replacement

- 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.
- b. Remove coil assembly. Refer to paragraph 4.12.1.
- c. Disconnect valve from liquid line and filter-drier.
- d. Unbolt valve body from frame and remove from unit. See Figure 4-9, item 8.
- e. Install new valve onto frame.
- f. Apply a light coat of oil to the O-Rings and connect the liquid line and the filter-drier.
- g. Leak check connections.
- h. Evacuate low side and re-open charge isolation valve.
- i. Replace coil assembly and test operation.

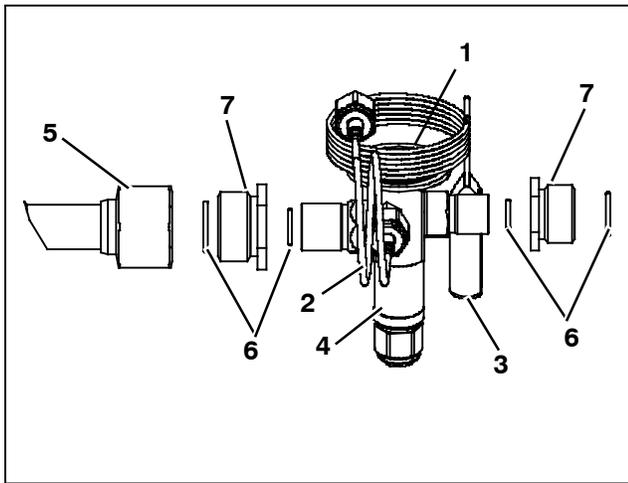


- |                    |                     |
|--------------------|---------------------|
| 1. Locking Nut     | 5. Plunger Assembly |
| 2. O-Ring          | 6. O-Ring           |
| 3. Threaded Collar | 7. Body             |
| 4. Coil            | 8. Mount            |

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. Body                |
| 2. Equalizer Connection | 5. ORS Fitting         |
| 3. Bulb                 | 6. O-Ring              |
|                         | 7. ORS Adapter Fitting |

**Figure 4-10 Thermostatic Expansion Valve**

**4.13.1 Valve Replacement**

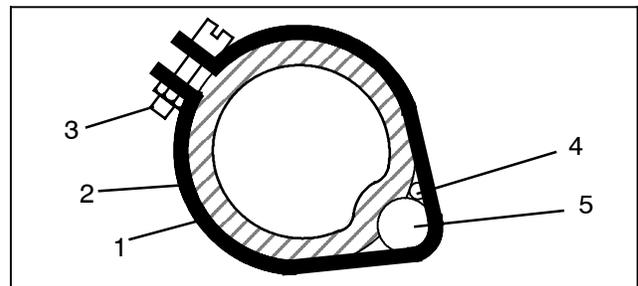
- Pump down low side of the unit. Refer to paragraph 4.5.1.
- Remove insulation from expansion valve and bulb. See Figure 4-10 and Figure 4-11.
- Loosen retaining straps holding bulb to suction line and detach bulb from the suction line.
- Loosen flare nuts on equalizer line and disconnect equalizer line from the expansion valve.
- Using two open end wrenches, slowly crack open the ORS hex nuts on each side of the valve assembly. Remove the valve assembly from the unit.
- Remove the adapter fittings from the valve and install the fittings on the new valve using care to oil and install new O-Rings.

- Reinstall the valve assembly into the unit, again taking care to oil and install new O-Rings.
- 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       | 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.



- d. Connect an accurate low pressure gauge to the low pressure port (Figure 1-6).
- e. Start bus and run on fast idle until unit has stabilized, about 20 to 30 minutes.

### NOTE

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

The evaporator return air filters are located in the evaporator section next to the evaporator coils. Access to the filters is accomplished by removing the evaporator covers.

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. Open the evaporator top cover. Refer to paragraph 4.2.
- c. Grasp and lift the filter elements out using care not to damage the evaporator coil.

- d. Reverse procedure to install new filters and close the covers.

## 4.15 COMPRESSOR MAINTENANCE

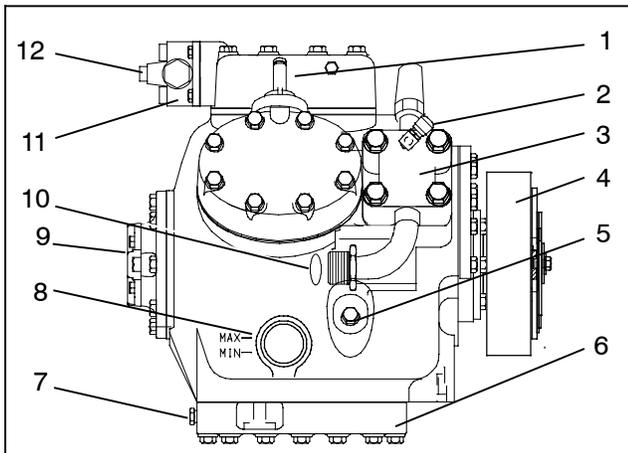
### 4.15.1 Removing the Compressor

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.

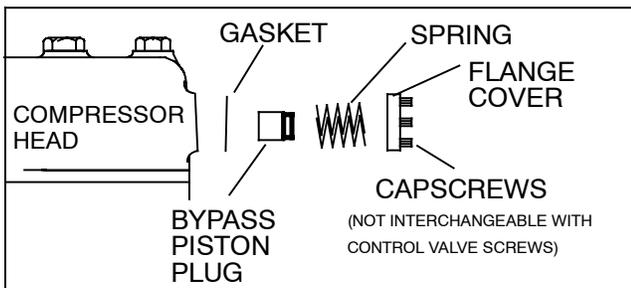


Figure 4-13 Removing Bypass Piston Plug

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:

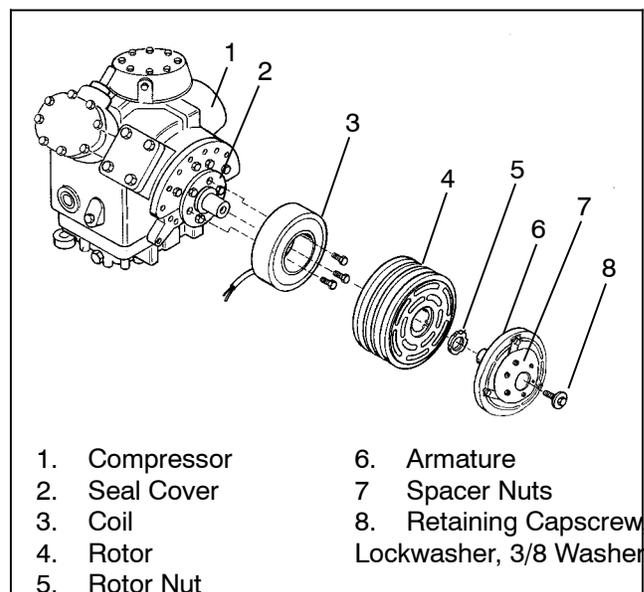


Figure 4-14 Compressor Clutch



### 4.15.2 Transferring Compressor Clutch (Continued)

- 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 Shim-less 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. 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.



**WARNING**

**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 50 psig in the compressor due to the crankshaft movement when charged. If there is not 50 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.



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 (See Figure 4-15) and J6-23 (suction) (Logic Board) or C (See Figure 4-15) and J6-20 (discharge) (Logic Board). See Figure 5-2 for Logic Board locations.
- 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.

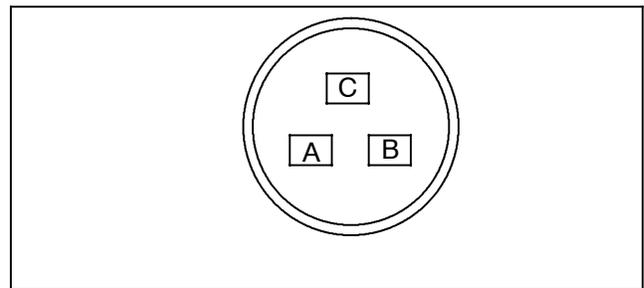


Figure 4-15 Transducer Terminal Location



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.
- er. Sensor/transducer connections are fitted with Schrader valves to facilitate replacement.

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
<b>Psig</b>	<b>Voltage</b>	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 1-10) 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 <sub>2</sub> 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 <sup>2</sup>	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 <sup>2</sup>	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 <sup>2</sup>	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. For applications with OEM supplied operating switches, the switches are wired to the Logic Board connector J3 as shown. For units with a Micromate control panel as the operators control, there is no wiring to the Logic Board J3 connector, instead the Micromate control panel is hard wired to the Logic Board connector J2. When the micromate control panel is used for service or diagnostic purposes, it is wired in the same manner as shown for drivers panel use, thru the optional Service Port. Contact your Mobile Climate Control service representative or call the technical hot line at 800-450-2211 for questions related to the schematic for your specific model.



LEGEND

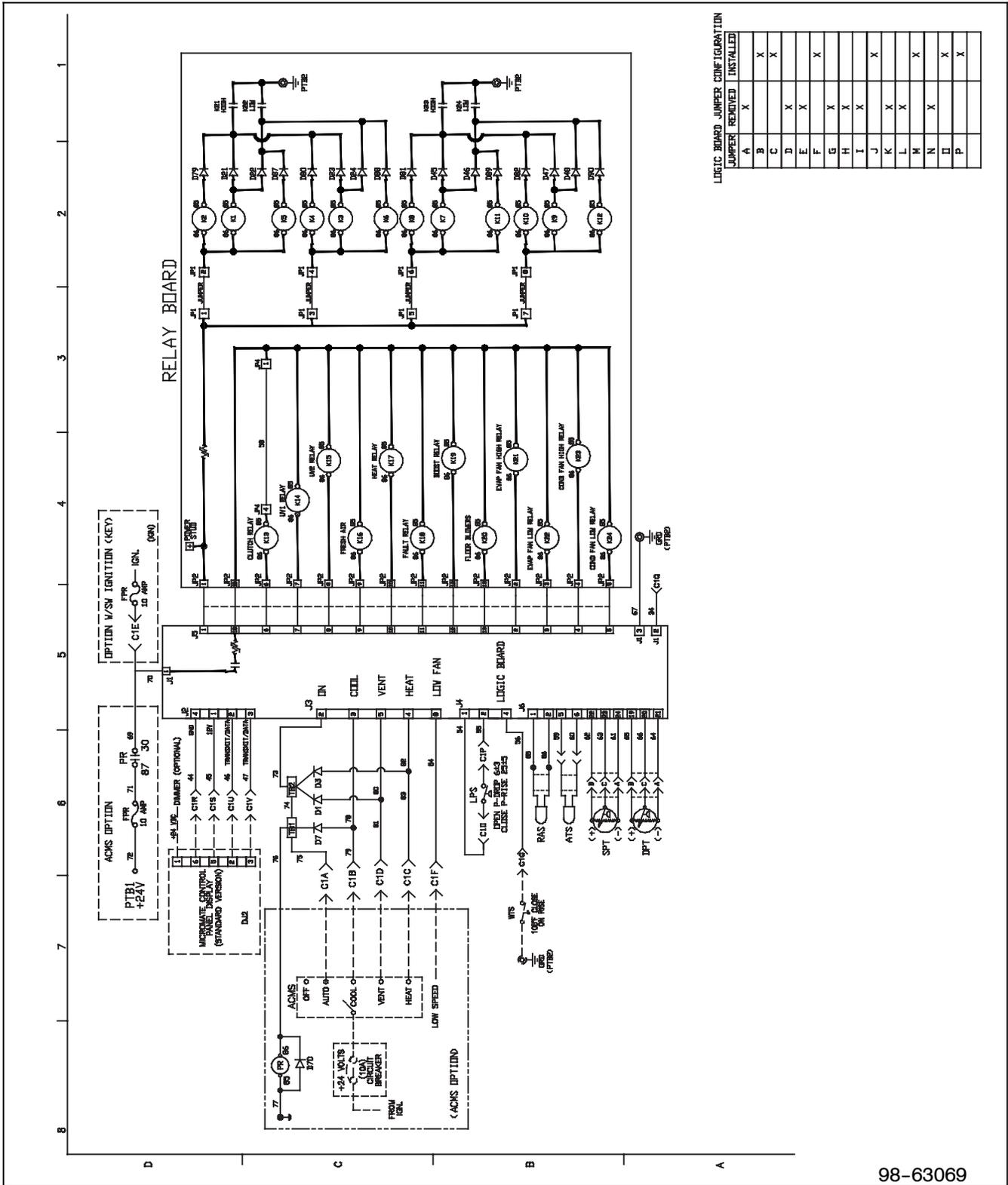
SYMBOL	DESCRIPTION
ATS	AMBIENT TEMPERATURE SENSOR
BPS	BOOST PUMP SIGNAL
CB	CIRCUIT BREAKER
CB1	CIRCUIT BREAKER, EF1
CB2	CIRCUIT BREAKER, EF2
CB3	CIRCUIT BREAKER, EF3
CB4	CIRCUIT BREAKER, EF4
CB5	CIRCUIT BREAKER, EF5
CB6	CIRCUIT BREAKER, EF6
CB7	CIRCUIT BREAKER, CF1
CB8	CIRCUIT BREAKER, CF2
CB9	CIRCUIT BREAKER, CF3
CB10	CIRCUIT BREAKER, CF4
CB11	CIRCUIT BREAKER, CF5
CB12	CIRCUIT BREAKER, CF6
CB13	CIRCUIT BREAKER, MISC
CF1	COND MOTOR 1
CF2	COND MOTOR 2
CF3	COND MOTOR 3
CF4	COND MOTOR 4
CF5	COND MOTOR 5
CF6	COND MOTOR 6
CL	COMPRESSOR CLUTCH
D2	EF1/2 LED ASSEMBLY
D6	EF3/4 LED ASSEMBLY
D14	EF5 LED ASSEMBLY
D17	EF6 LED ASSEMBLY
D26	CF1/2 LED ASSEMBLY
D30	CF3/4 LED ASSEMBLY
D38	CF5 LED ASSEMBLY
D41	CF6 LED ASSEMBLY
D51	CLUTCH LED ASSEMBLY
D54	UV1 LED OUTPUT ACTIVE
D57	UV2 LED OUTPUT ACTIVE
D60	FRESH AIR VALVE LED OUTPUT ACTIVE
D63	HSV LED OUTPUT ACTIVE
D66	ALARM LED OUTPUT ACTIVE
D69	BOOST PUMP OUTPUT ACTIVE
D72	FLOOR BLOWER OUTPUT ACTIVE
DPT	DISCHARGE PRESSURE TRANSDUCER
EM1	EVAP MOTOR 1
EM2	EVAP MOTOR 2
EM3	EVAP MOTOR 3
EM4	EVAP MOTOR 4
EM5	EVAP MOTOR 5
EM6	EVAP MOTOR 6
F22	FUSE 22 POWER IN - LOGIC BOARD
FAI	FRESH AIR INVERTOR
FAM	FRESH AIR MOTOR
FTS	FREEZE TEMPERATURE SENSOR (NOT USED)
HPS	HIGH PRESSURE SWITCH
HSV	HEAT SOLENOID VALVE
K1	EF1/2 RELAY
K2	EF3/4 RELAY
K3	EF5 RELAY
K4	EF6 RELAY
K5	EF HIGH RELAY
K6	EF 5/6 HIGH RELAY
K7	CF1/2 RELAY
K8	CF3/4 RELAY
K9	CF5 RELAY
K10	CF6 RELAY
K11	CF 1/2, 3/4 RELAY LOW SPEED
K12	CF 5/6 RELAY LOW SPEED
K13	CLUTCH RELAY
K14	UV1 RALAY
K15	UV2 RELAY
K16	FRESH AIR RELAY
K17	HEAT RELAY
K18	FAULT RELAY
K19	BOOST RELAY
K20	SPARE RELAY
K21	EVAP. FAN HIGH RELAY
K22	EVAP. FAN LOW RELAY
K23	COND. FAN HIGH RELAY
K24	COND. FAN LOW RELAY
LPS	LOW PRESSURE SWITCH
LSV	LIQUID SOLENOID VALVE
PTB1	POWER TERMINAL BLOCK 1 (POS)
PTB2	POWER TERMINAL BLOCK 2 (NEG)
RAS	RETURN AIR SENSOR
SPT	SUCTION PRESSURE TRANSDUCER
UV1	UNLOADER SOLENOID VALVE #1
UV2	UNLOADER SOLENOID VALVE #2
WTS	WATER TEMPERATURE SWITCH

SYMBOLS

	INDICATES CONNECTOR TERMINAL
	INDICATES GROUND
	INDICATES A WIRE
	INDICATES AN OEM SUPPLIED WIRE OR OPTION
	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 PRESSURE SWITCH NO
	INDICATES TEMPERATURE SENSOR
	INDICATES MANUAL RESET BREAKER
	INDICATES RELAY COIL
	INDICATES SWITCH N/O
	INDICATES TEMPERATURE SWITCH NO
	INDICATES POLY SWITCH
	INDICATES LAMP
	INDICATES RIBBON CABLE

98-63069

Figure 5-1. Wiring Schematic - Legend (PM Motors) - 68AC353-102, 102-4, 102-5



98-63069

Figure 5-2. Wiring Schematic - Control Circuit (PM Motors) - 68AC353-102, 102-4, 102-5

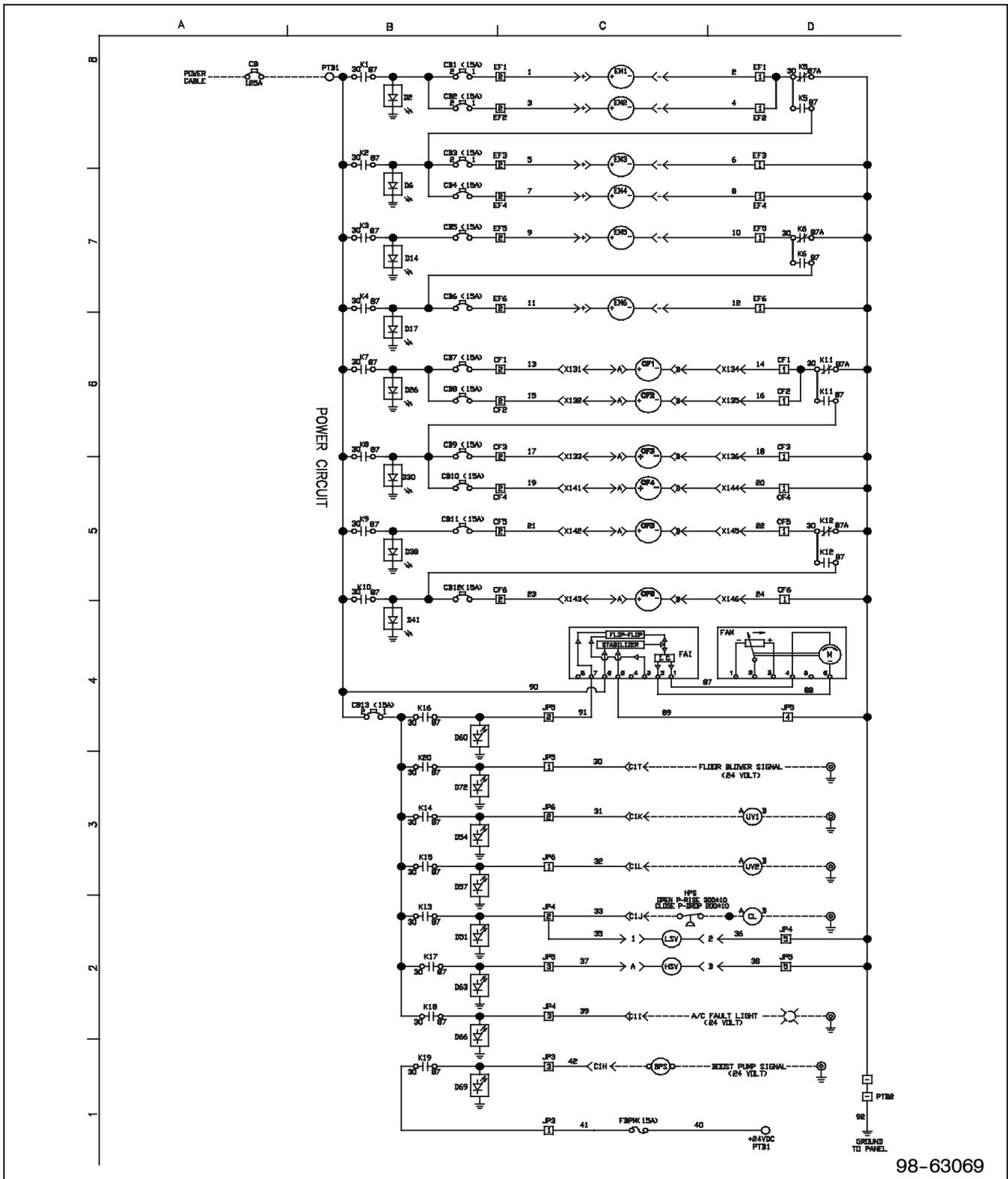


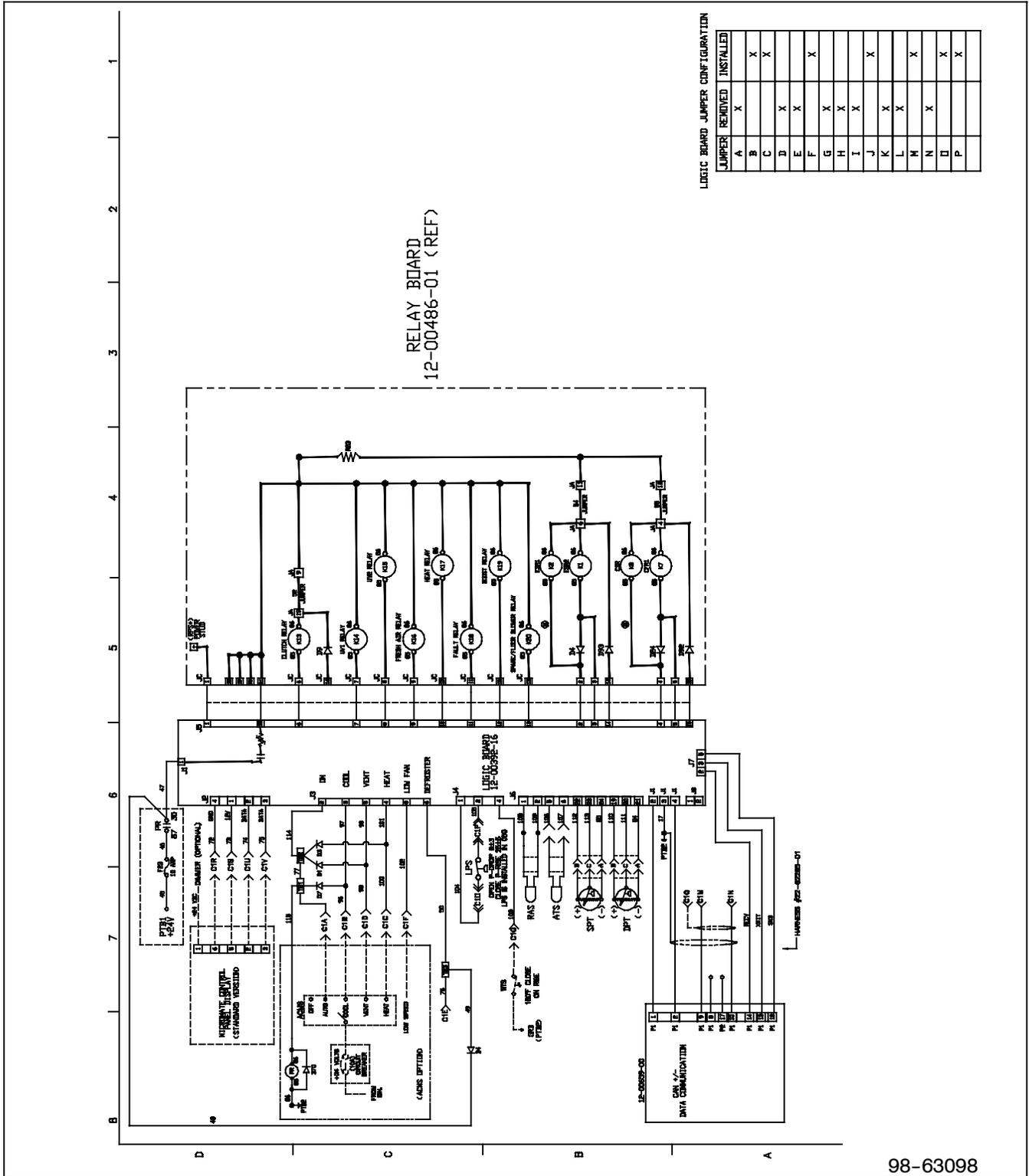
Figure 5-3. Wiring Schematic - Power Circuit (PM Motors) - 68AC353-102, 102-4, 102-5



LEGEND		SYMBOLS	
SYMBOL	DESCRIPTION		
ACMS	AIR CONDITIONING MANUAL SWITCH		INDICATES CONNECTOR TERMINAL
ATS	AMBIENT TEMPERATURE SENSOR		INDICATES GROUND
BPS	BOOST PUMP SIGNAL		INDICATES A WIRE
CFR1	CONDENSER FAN RELAY 1		INDICATES A WIRE (DEM SUPPLIED)
CL	COMPRESSOR CLUTCH		INDICATES GROUND STUD CONNECTION
CM1	COND MOTOR 1		INDICATES POWER STUD
CM2	COND MOTOR 2		INDICATES A CONNECTOR
CM3	COND MOTOR 3		INDICATES A NORMALLY OPEN CONTACT
CM4	COND MOTOR 4		INDICATES A CONNECTOR WITH PIN LOCATION
CM5	COND MOTOR 5		INDICATES DIODE
CM6	COND MOTOR 6		INDICATES FUSE
CSR	COND SPEED RELAY ON (HIGH SPEED)		INDICATES PRESSURE SENSOR
D2	RELAY K2 OUTPUT ACTIVE		INDICATES LED ASSEMBLY
D6	RELAY K1 OUTPUT ACTIVE		INDICATES PRESSURE SWITCH NC
D17	FUSE 1 OPEN (FRESH AIR DAMPER)		INDICATES TEMPERATURE SENSOR
D18	FUSE 3 OPEN (EVAPORATOR FAN)		INDICATES MANUAL RESET BREAKER
D26	RELAY K7 OUTPUT ACTIVE		INDICATES RELAY COIL
D30	RELAY K8 OUTPUT ACTIVE		INDICATES SWITCH N/O
D31	FUSE 9 OPEN (CONDENSER FAN)		INDICATES TEMPERATURE SWITCH NO
D38	FUSE 2 OPEN (UNLOADER #1)		INDICATES LAMP
D47	FUSE 5 OPEN (UNLOADER #2)		INDICATES POLY SWITCH
D51	A/C CLUTCH & LSV OUTPUT ACTIVE		INDICATES RIBBON CABLE
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)		
DFT	DISCHARGE PRESSURE TRANSDUCER		
EM1	EVAP MOTOR 1		
EM2	EVAP MOTOR 2		
EM3	EVAP MOTOR 3		
EM4	EVAP MOTOR 4		
EM5	EVAP MOTOR 5		
EM6	EVAP MOTOR 6		
FAM	FRESH AIR MOTOR		
FAI	FRESH AIR INVERTOR		
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, CM6		
F23	FUSE 23, 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	LDM PRESSURE SWITCH		
PR	POWER RELAY (CND)		
PTB1	POWER TERMINAL BLOCK 1 (POS)		
PTB2	POWER TERMINAL BLOCK 2 (NEG)		
PTB3	POWER TERMINAL BLOCK 3 (POS)		
PTB4	POWER TERMINAL BLOCK 4 (NEG)		
RPS+	RELAY POWER STUD (POS)		
RPS-	RELAY POWER STUD (NEG)		
RAS	RETURN AIR SENSOR		
SPT	SUCTION PRESSURE TRANSDUCER		
TB1	TERMINAL BLOCK (TERMINAL 1)		
TB2	TERMINAL BLOCK (TERMINAL 2)		
TB3	TERMINAL BLOCK (TERMINAL 3)		
TB4	TERMINAL BLOCK (TERMINAL 4) NO USED		
UV1	UNLOADER VALVE 1		
UV2	UNLOADER VALVE 2		
WTS	WATER TEMPERATURE SWITCH		

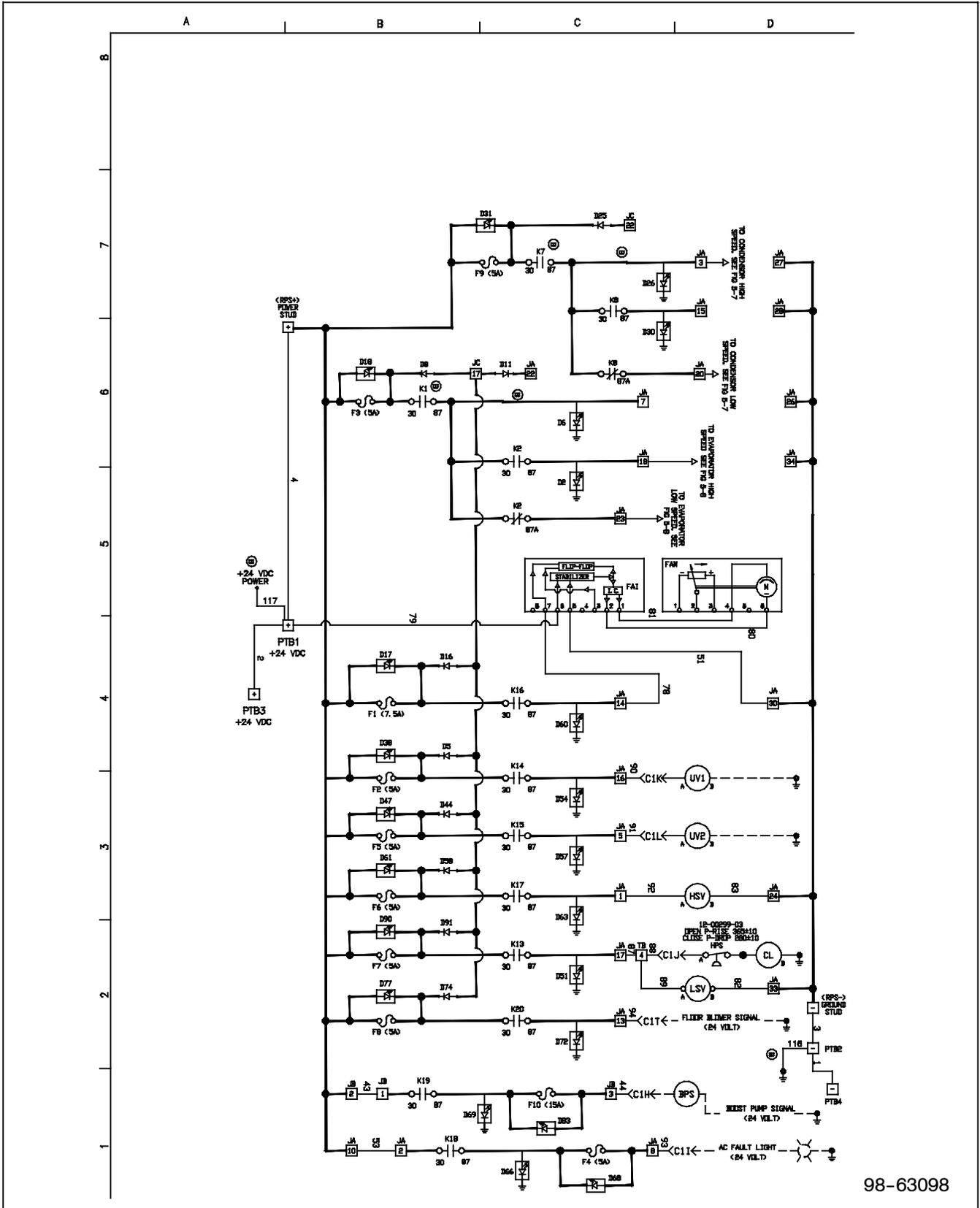
98-63098

Figure 5-4. Wiring Schematic - Legend (Brushless Motors) (CAN) - 68AC353-102-1, 102-3, 102-6



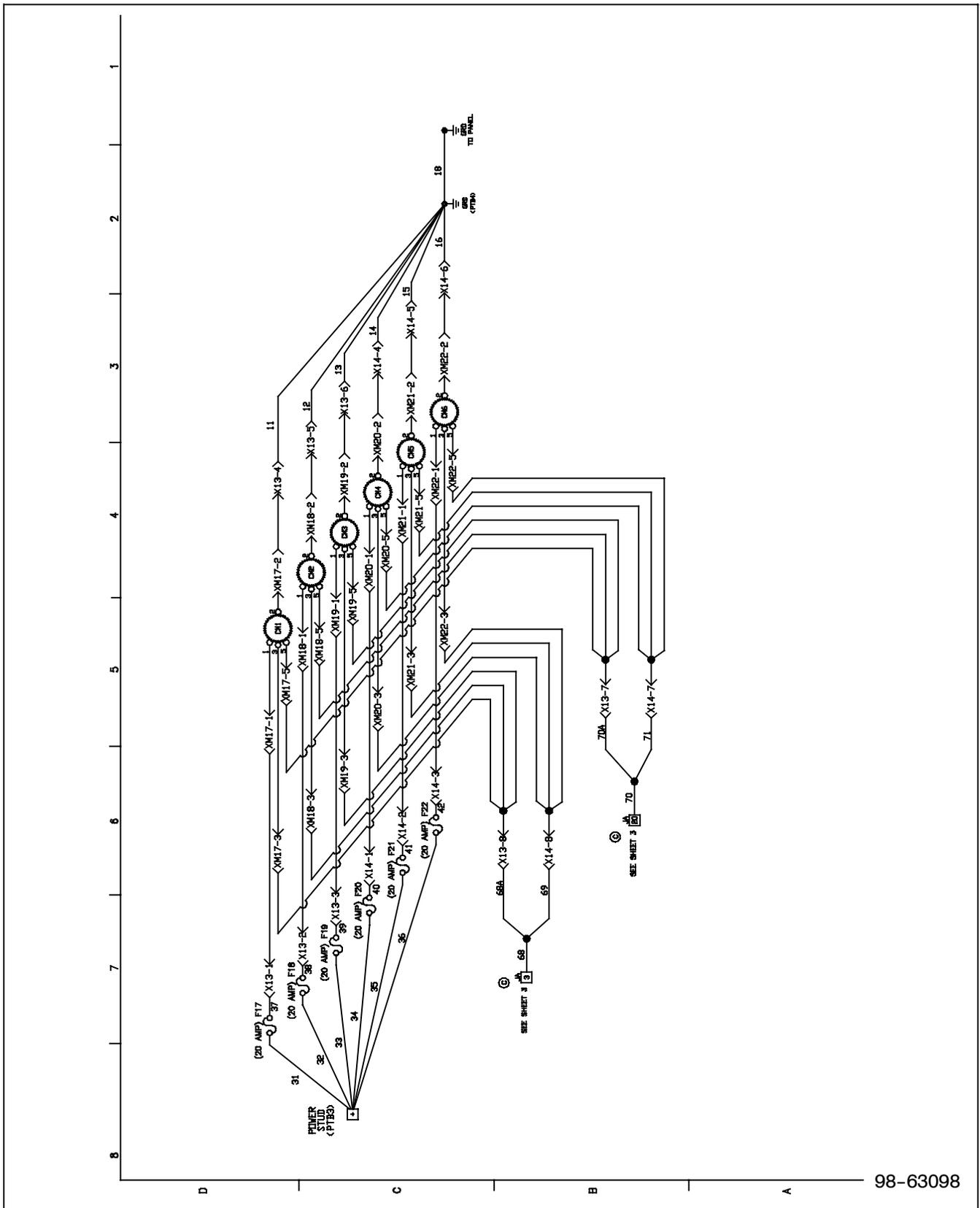
98-63098

Figure 5-5. Wiring Schematic - Control Circuit (Brushless Motors) (CAN) - 68AC353-102-1, 102-3, 102-6



98-63098

Figure 5-6. Wiring Schematic - Power Circuit (Brushless Motors) (CAN) - 68AC353-102-1, 102-3, 102-6



98-63098

**Figure 5-7. Wiring Schematic - Condenser Circuit (Brushless Motors) (CAN) - 68AC353-102-1, 102-3, 102-6**

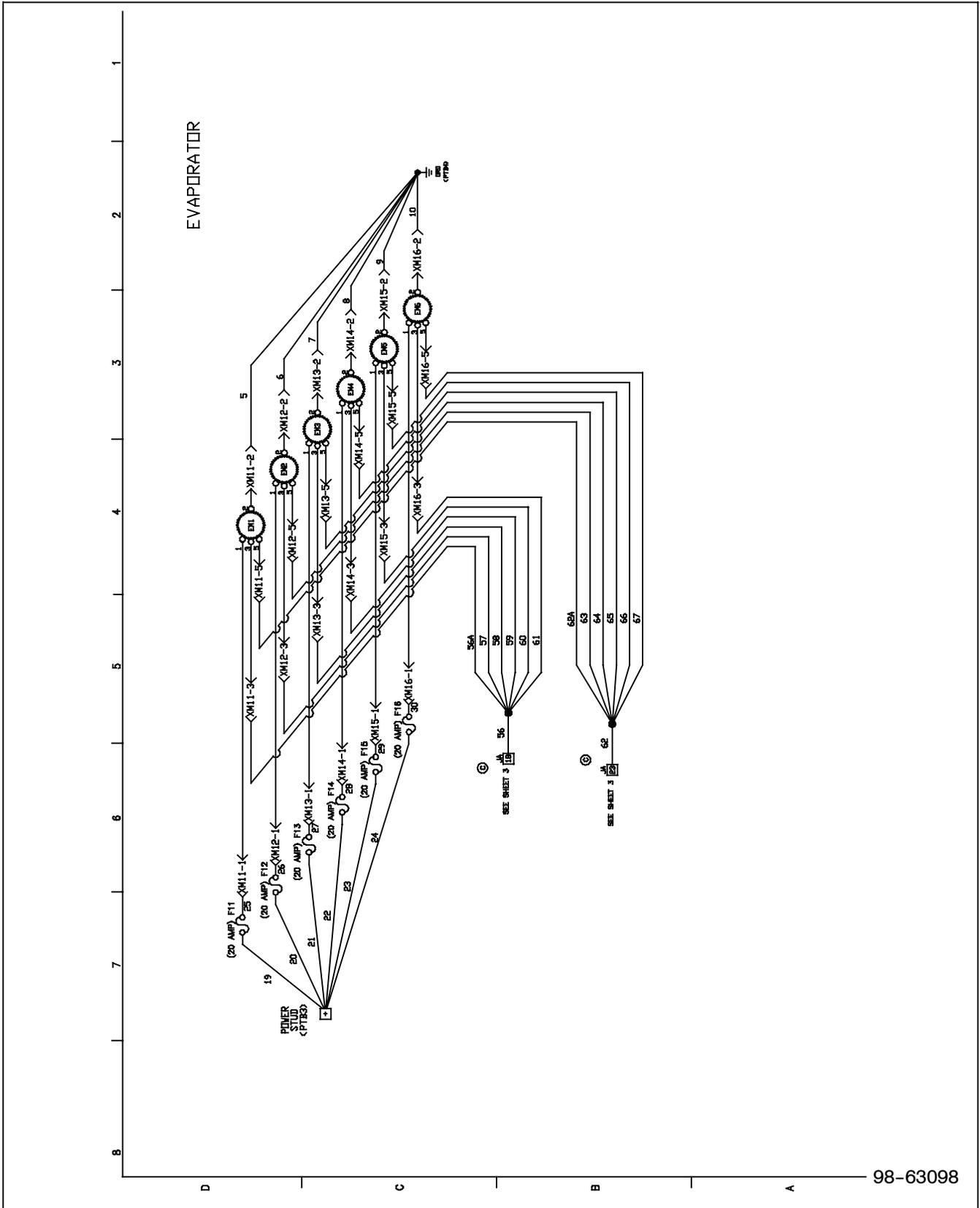


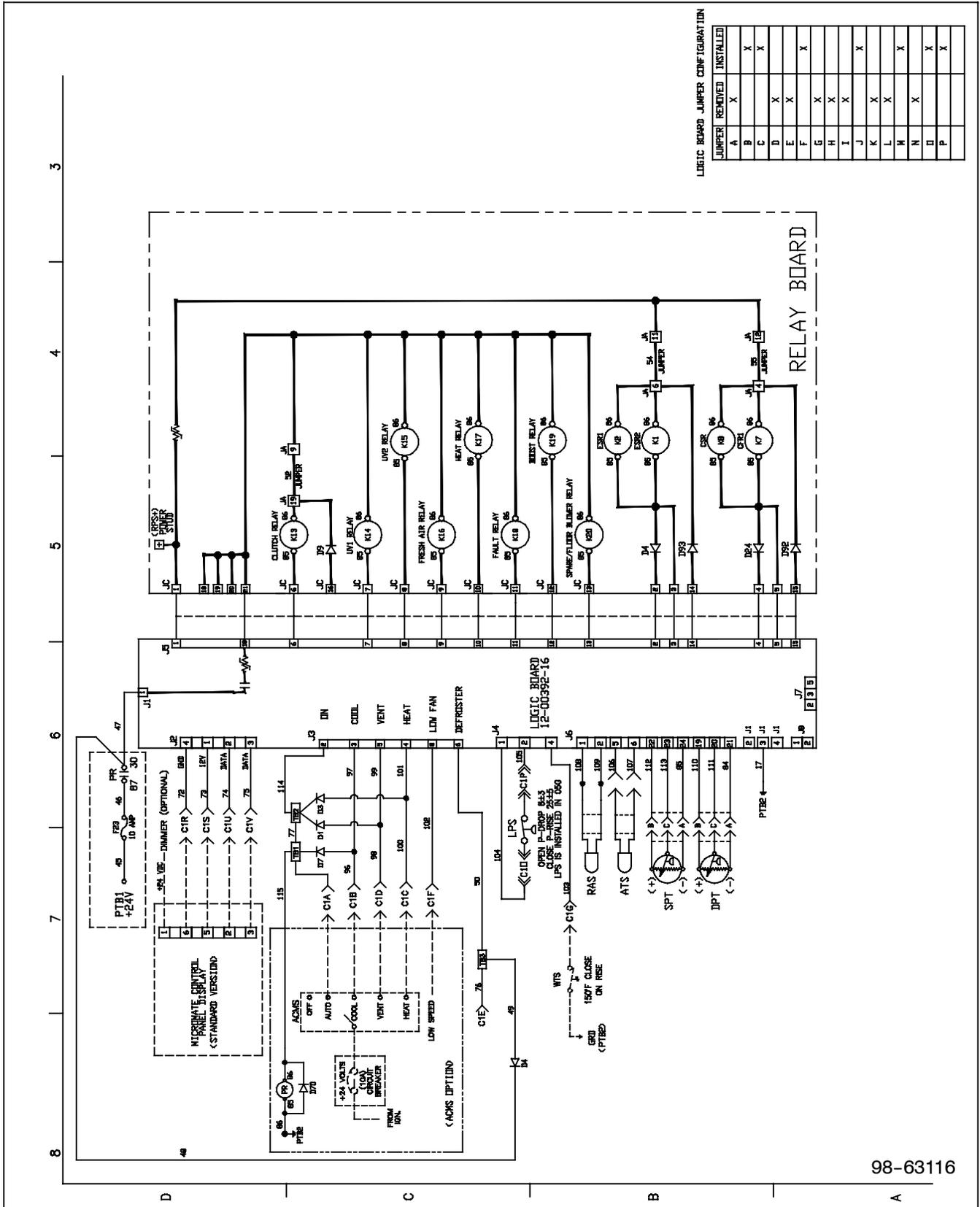
Figure 5-8. Wiring Schematic - Evaporator Circuit (Brushless Motors) (CAN) - 68AC353-102-1, 102-3, 102-6



LEGEND		SYMBOLS	
SYMBOL	DESCRIPTION		
ACMS	AIR CONDITIONING MANUAL SWITCH		INDICATES CONNECTOR TERMINAL
ATS	AMBIENT TEMPERATURE SENSOR		INDICATES GROUND
BPS	BOOST PUMP SIGNAL		INDICATES A WIRE
CFR1	CONDENSER FAN RELAY 1		INDICATES A WIRE (OEM SUPPLIED)
CL	COMPRESSOR CLUTCH		INDICATES GROUND STUD CONNECTION
CM1	COND MOTOR 1		INDICATES POWER STUD
CM2	COND MOTOR 2		INDICATES A CONNECTOR
CM3	COND MOTOR 3		INDICATES A NORMALLY OPEN CONTACT
CM4	COND MOTOR 4		INDICATES A CONNECTOR WITH PIN LOCATION
CM5	COND MOTOR 5		INDICATES DIODE
CM6	COND MOTOR 6		INDICATES FUSE
CSR	COND SPEED RELAY ON (HIGH SPEED)		INDICATES PRESSURE SENSOR
D2	RELAY K2 OUTPUT ACTIVE		INDICATES LED ASSEMBLY
D6	RELAY K1 OUTPUT ACTIVE		INDICATES PRESSURE SWITCH NC
D17	FUSE 1 OPEN (FRESH AIR DAMPER)		INDICATES TEMPERATURE SENSOR
D18	FUSE 3 OPEN (EVAPORATOR FAN)		INDICATES MANUAL RESET BREAKER
D26	RELAY K7 OUTPUT ACTIVE		INDICATES RELAY COIL
D30	RELAY K8 OUTPUT ACTIVE		INDICATES SWITCH N/O
D31	FUSE 9 OPEN (CONDENSER FAN)		INDICATES TEMPERATURE SWITCH NO
D38	FUSE 2 OPEN (UNLOADER #1)		INDICATES LAMP
D47	FUSE 5 OPEN (UNLOADER #2)		INDICATES POLY SWITCH
D51	A/C CLUTCH & LSV OUTPUT ACTIVE		INDICATES RIBBON CABLE
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		
EM1	EVAP MOTOR 1		
EM2	EVAP MOTOR 2		
EM3	EVAP MOTOR 3		
EM4	EVAP MOTOR 4		
EM5	EVAP MOTOR 5		
EM6	EVAP MOTOR 6		
FAM	FRESH AIR MOTOR		
FAI	FRESH AIR INVERTOR		
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, CM6		
F23	FUSE 23, 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)		
PTB3	POWER TERMINAL BLOCK 3 (POS)		
PTB4	POWER TERMINAL BLOCK 4 (NEG)		
RPS+	RELAY POWER STUD (POS)		
RPS-	RELAY POWER STUD (NEG)		
RAS	RETURN AIR SENSOR		
SPT	SUCTION PRESSURE TRANSDUCER		
TB1	TERMINAL BLOCK (TERMINAL 1)		
TB2	TERMINAL BLOCK (TERMINAL 2)		
TB3	TERMINAL BLOCK (TERMINAL 3)		
TB4	TERMINAL BLOCK (TERMINAL 4) NOT USED		
UV1	UNLOADER VALVE 1		
UV2	UNLOADER VALVE 2		
VTS	WATER TEMPERATURE SWITCH		

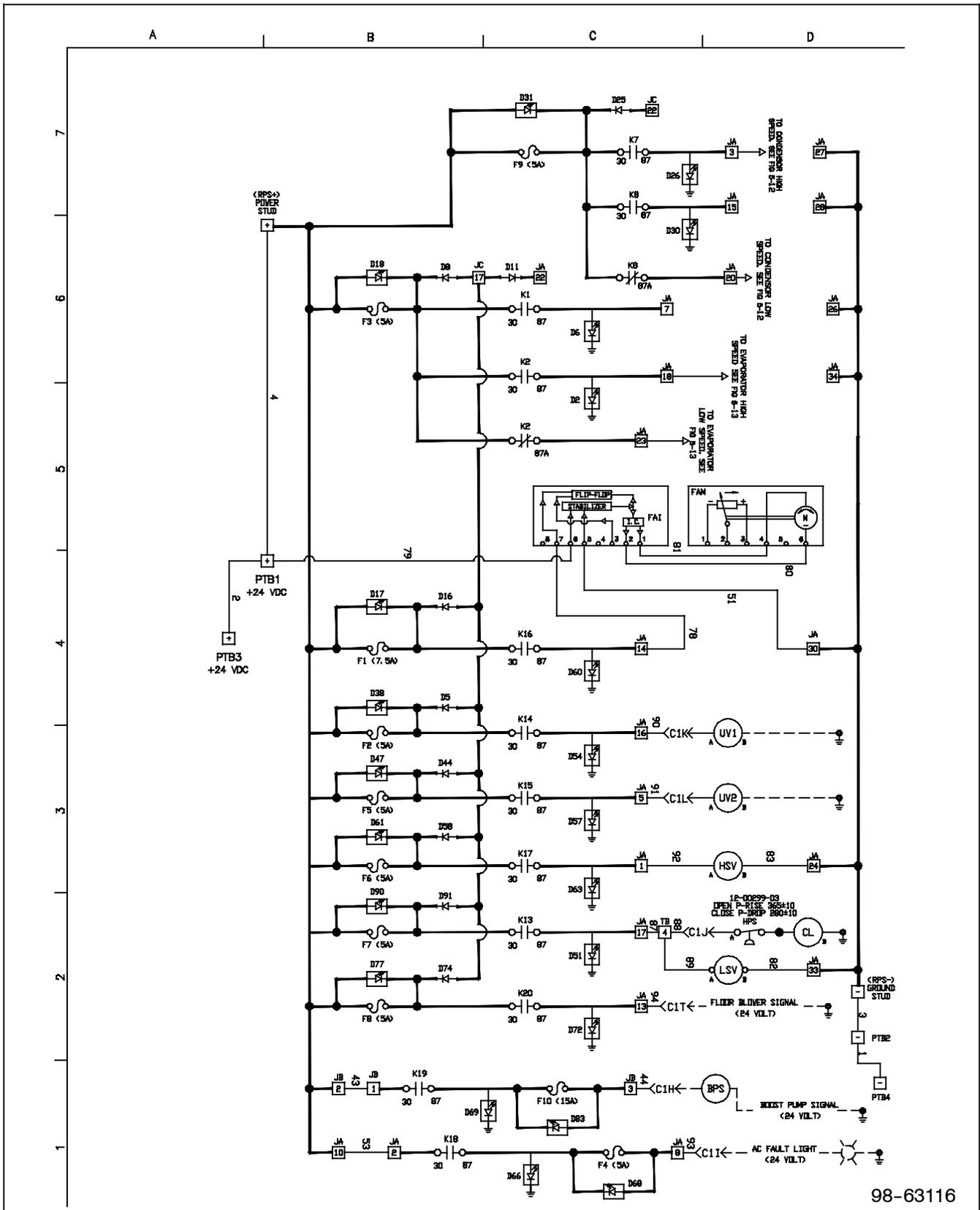
98-63116

Figure 5-9. Wiring Schematic - Legend (Brushless Motors) - 68AC353-102-2 & 102-7

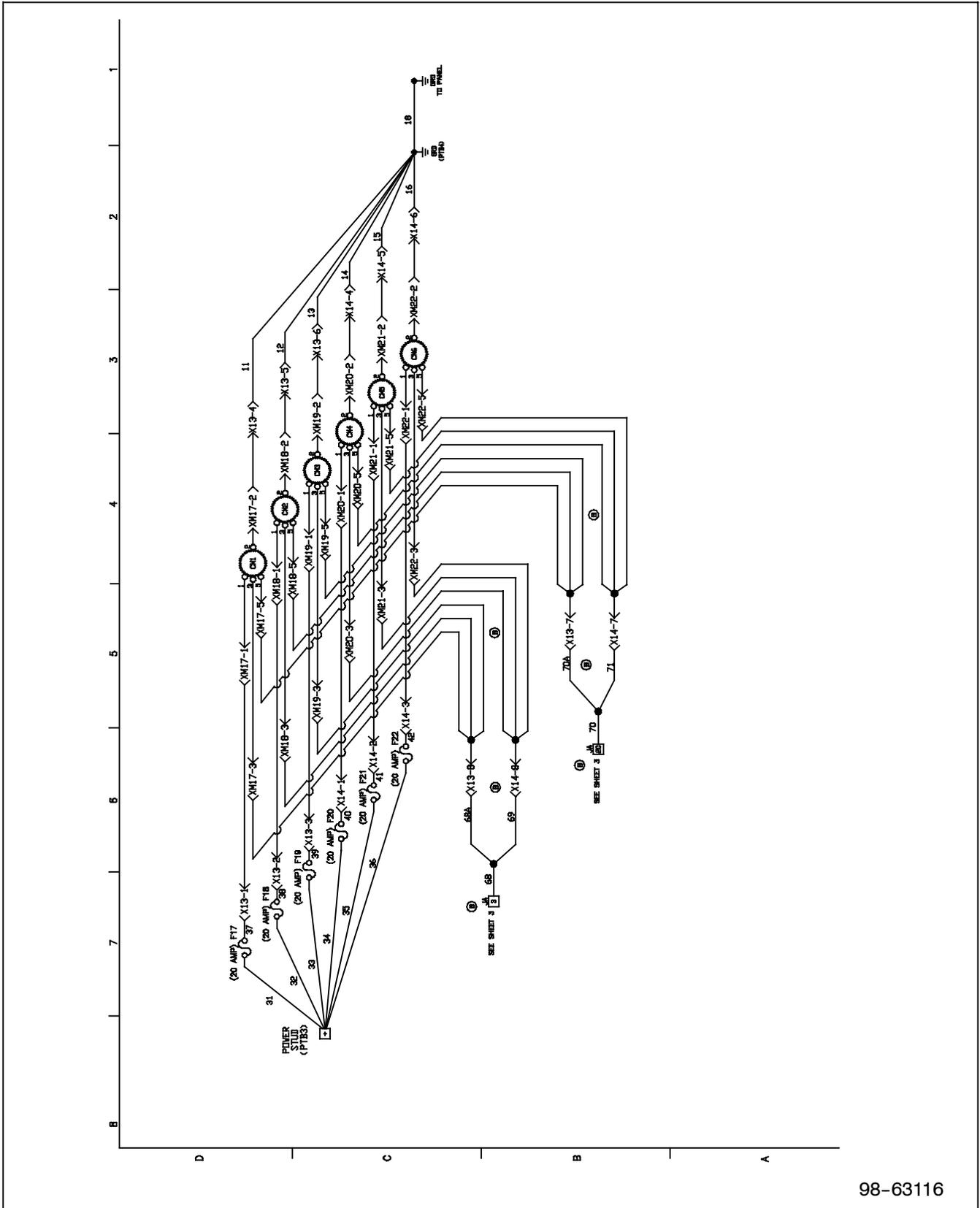


98-63116

Figure 5-10. Wiring Schematic - Control Circuit (Brushless Motors) - 68AC353-102-2 & 102-7

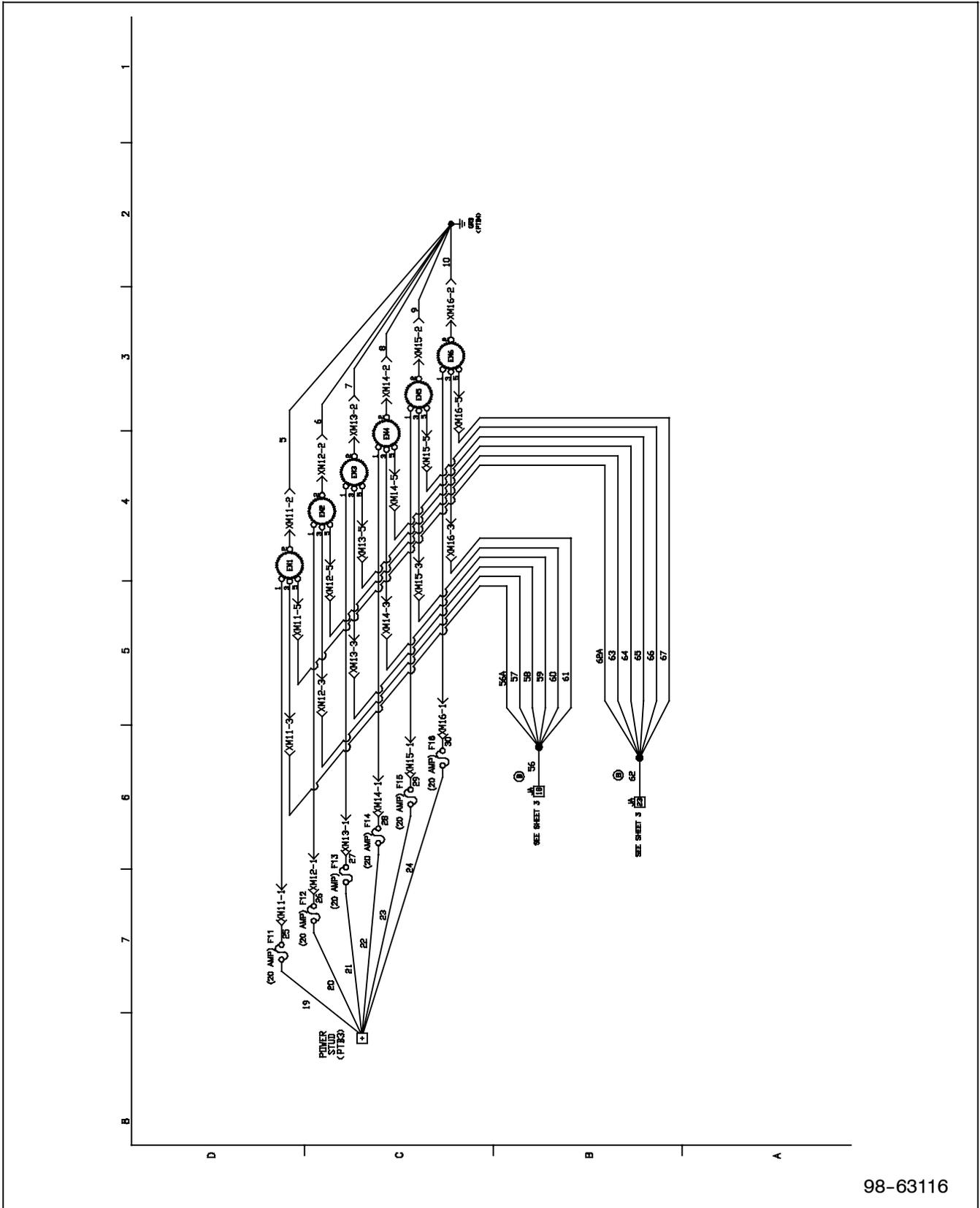


**Figure 5-11. Wiring Schematic - Control Board Power Circuit (Brushless Motors) - 68AC353-102-2 & 102-7**



98-63116

Figure 5-12. Wiring Schematic - Condenser Motor Power Circuit (Brushless Motors) - 68AC353-102-2 & 102-7



98-63116

Figure 5-13. Wiring Schematic - Evaporator Motor Power Circuit (Brushless Motors) - 68AC353-102-2 & 102-7



## **A**

Air Filter, 4-13  
AIR FLOW, 1-10  
Alarm, 2-4, 3-1  
Alarm Clear, 3-1  
Alarm Codes, 3-1  
Alarm Queue, 3-1  
Ambient Lockout, 1-9

## **B**

Boost Pump, 2-3

## **C**

Circuit Breaker, 1-9, 1-18  
Clutch, 2-4, 4-14, 4-15  
Compressor, 1-4, 1-8, 4-13  
Condenser Fan, 1-8, 2-4  
Condensing Section, 1-6  
CONFIGURATION IDENTIFICATION, 1-1  
Control Panel, 1-21  
Cooling Mode, 2-3

## **D**

DESCRIPTION, 1-1  
Diagnostics, 2-1, 2-4, 2-5  
Discharge Check Valve, 1-4  
Discharge Pressure, 2-4

## **E**

Evacuation, 4-8  
Evacuation, One Time, 4-8  
Evacuation, Triple, 4-8  
Evaporator Fan, 1-8, 2-4

Evaporator Section, 1-7  
Exit Alarm Queue, 3-2

## **F**

Filter-Drier, 4-10  
Fresh Air System, 1-7  
Fuse, 1-9

## **H**

Heating Cycle, 1-13  
Heating Mode, 2-3  
High Pressure Switch, 1-8, 1-9, 4-9  
Hour Meter, 2-4

## **I**

INTRODUCTION , 1-1

## **L**

LEAK CHECK, 4-7  
Liquid Line Solenoid, 2-4, 4-11  
Logic Board, 1-16, 2-1, 3-1, 4-19  
Low Pressure Switch, 1-8, 1-9, 4-9

## **M**

Maintenance Schedule, 4-1  
Micromate Control Panel, 2-1, 3-1  
Modes Of Operation, 2-2

## **N**

Noncondensibles, Check For, 4-9

## **O**

Oil Level, 4-16  
Operating Controls, 1-8



Operating Instructions, 2-1  
OPTION DESCRIPTION, 1-1

## P

Pre-Trip Inspection, 2-2  
Pressure Transducer, 1-9, 4-17, 4-18  
Pump Down, 4-4, 4-7

## R

Refrigerant Charge, 1-8, 4-4, 4-8, 4-9  
Refrigerant Removal, 4-5, 4-7  
Refrigeration Cycle, 1-11  
Relay Board, 1-17, 1-18, 1-19  
Relay Board - GR60, 1-17, 1-18  
Rooftop Unit, 1-5

## S

SAFETY DEVICES, 1-9  
Self Diagnostics, 3-1  
SERVICE, 4-1  
Service Valves, 4-3  
Suction Pressure, 2-3  
Superheat, 4-12

System Parameters, 2-5  
System Shutdown, 2-1  
System Start-up, 2-1

## T

Temperature Control, 2-3  
Temperature Pressure Chart, 4-20  
Temperature Sensor, 1-9, 4-17, 4-18  
Thermostatic Expansion Valve, 1-8, 4-12  
Top Cover, 4-2  
Troubleshooting, 3-1  
Troubleshooting No CAN Communication, 3-2

## U

Unloader Control, 2-3

## V

Vent Mode, 2-3

## W

Water Temperature Switch, 1-8, 1-9  
Wiring Schematics, 5-1

# Every driver deserves the best possible vehicle climate with MCC products

MCC provides exceptional performance in mobile climate comfort.



[www.mcc-hvac.com](http://www.mcc-hvac.com)

Member of MCC Group • Certified ISO 9001 and ISO 14001.  
Specifications subject to change without notice. MCC is a registered trademark.