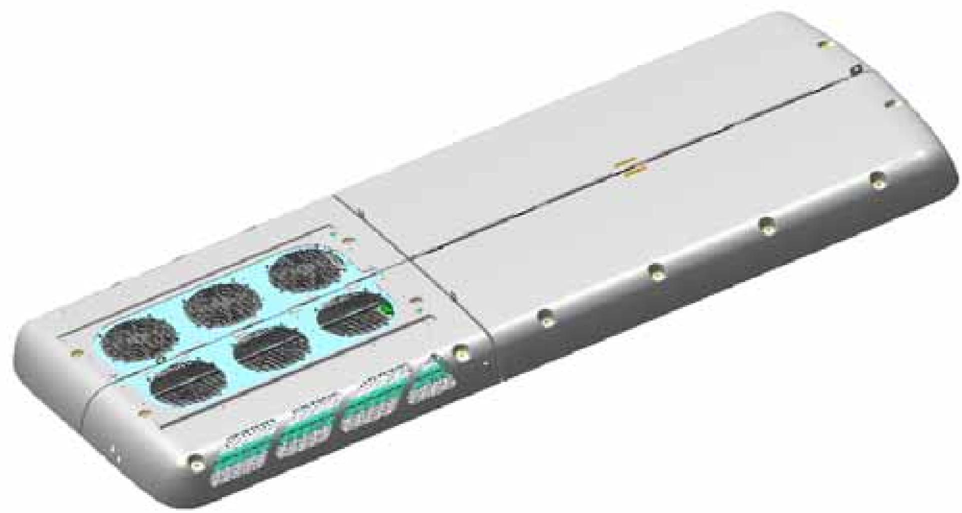
Mobile Climate Control

T-360 Manual



OPERATION AND SERVICE
for
Eco353N

T-360

REV. 09/2015

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SAFETY SUMMARY

GENERAL SAFETY NOTICES

The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered herein. A listing of the specific warnings and cautions appearing elsewhere in the manual follows the general safety notices.

FIRST AID

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

OPERATING PRECAUTIONS

Always wear safety glasses.

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

No work should be performed on the unit until all 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_2 (never use water).

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 vehicle 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 Connecting Nuts And Avoid Contact With Exposed Skin Or Eyes.

CAUTION

The AC430 Rooftop Systems has R134a service port couplings installed on the compressor and on the unit piping.

CAUTION

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

SECTION 1

DESCRIPTION

1.1 INTRODUCTION

This manual contains Operating Instructions, Service Instructions and Electrical Data for the Model Eco353N Air Conditioning and Heating equipment furnished by Mobile Climate Control as shown in Table 1-1 and Table 1-2.

Model Eco353N systems consists of a Rooftop unit containing the condensing section, the evaporator section and engine compartment mounted compressor(s). To complete the system, the air conditioning and heating equipment interfaces with an optional drivers evaporator (dash-air), electrical cabling, refrigerant piping, engine coolant piping (for heating), duct work and other components furnished by Mobile Climate Control and/or the bus manufacturer.

Additional support manuals are shown in Table 1-3.

Operation of the unit is controlled automatically by an electronic thermostat. The controls maintain the vehicle's interior temperature at the desired set point.

Table 1-1 Eco353N Models (Single Loop)

Model	Voltage	Controller	With Heat	Motor Type	Roof Radius
Y50-35301-02	24 VDC	EnviroMATE	No	Permanent Magnet	10M
Y50-35301-03	24 VDC	EnviroMATE	No	Permanent Magnet	6.5M
Y50-35301-04	24 VDC	EnviroMATE	No	Permanent Magnet	3.4M
Y50-35301-05	24 VDC	EnviroMATE	Yes	Permanent Magnet	10M
Y50-35301-06	12 VDC	EnviroMATE	No	Permanent Magnet	3.4M
Y50-35301-07	24 VDC	EnviroMATE	No	Permanent Magnet	3.4M
Y50-35301-08	24 VDC	EnviroMATE	No	Permanent Magnet	10M
Y50-35301-09	24 VDC	EnviroMATE	No	Permanent Magnet	10M
Y50-35301-10	24 VDC	EnviroMATE	Yes	Permanent Magnet	3.4M
Y50-35301-11	24 VDC	EnviroMATE	Yes	Permanent Magnet	3.4M
Y50-35301-12	12 VDC	EnviroMATE	No	Brushless	3.4M
Y50-35301-13	12 VDC	EnviroMATE	No	Permanent Magnet	10M
Y50-35301-14	24 VDC	EnviroMATE	No	Permanent Magnet	3.4M

Table 1-2 Eco353N Models (Dual Loop)

Model	Voltage	Controller	With Heat	Motor Type	Roof Radius
Y50-35302-00	12 VDC	EnviroMATE	No	Permanent Magnet	10M
Y50-35302-01	12 VDC	EnviroMATE	Yes	Permanent Magnet	6.5M
Y50-35302-02	12 VDC	EnviroMATE	No	Permanent Magnet	10M

Table 1-3 Additional Support Manuals

MANUAL NUMBER	EQUIPMENT COVERED	TYPE OF MANUAL
T-360PL	Eco 353N	Service Parts List

1.2 GENERAL DESCRIPTION

1.2.1 Rooftop Unit

The rooftop unit includes the condenser section and the evaporator section (See Figure 1-1). Rooftop units can accommodate various roof radius applications.

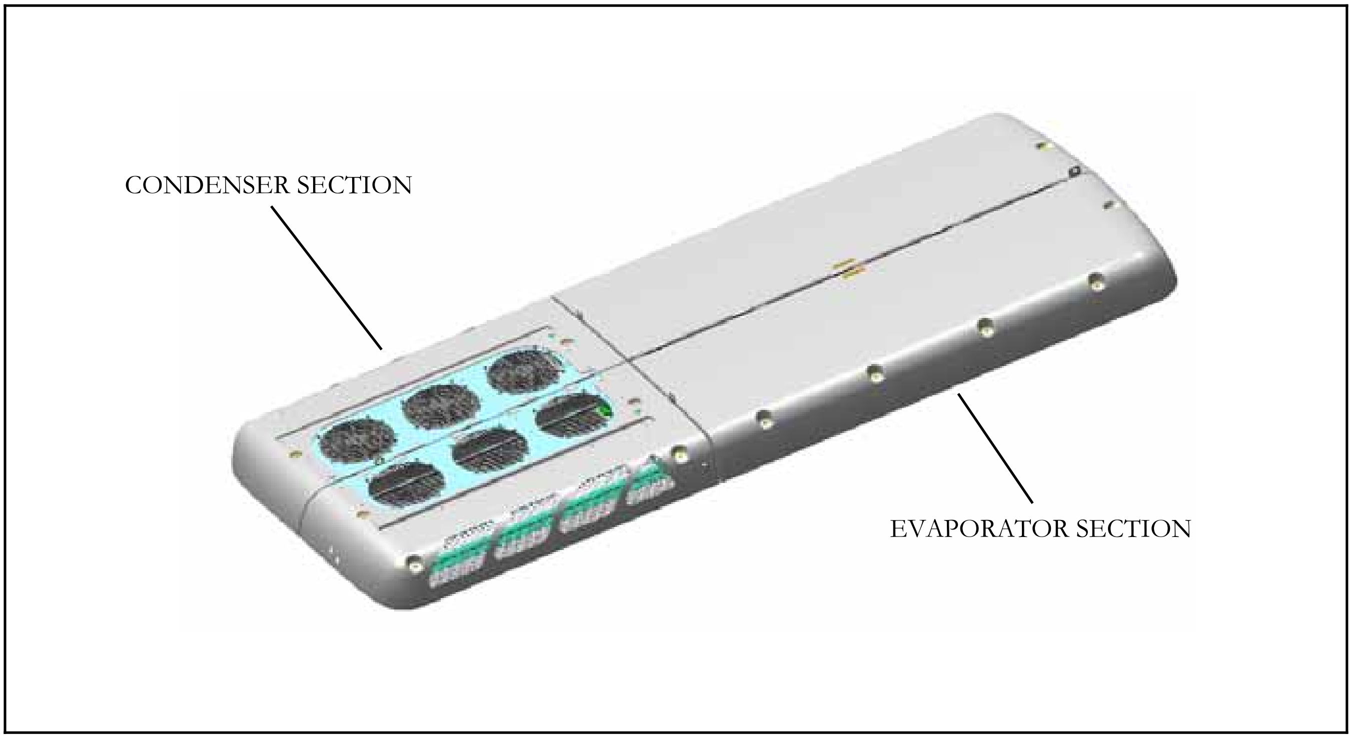
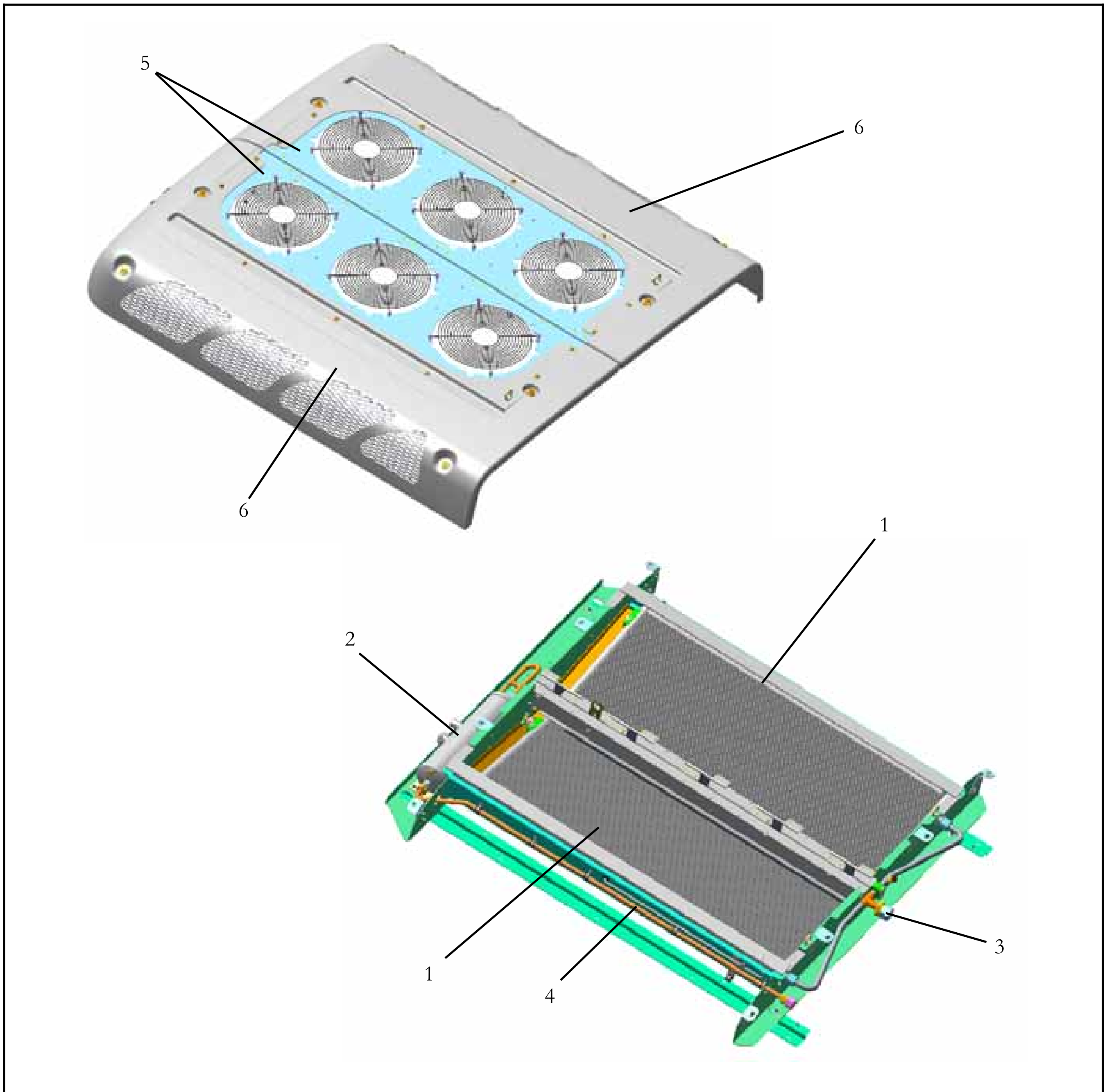


Figure 1-1 Eco353N Rooftop Unit

1.2.2 Condensing Section

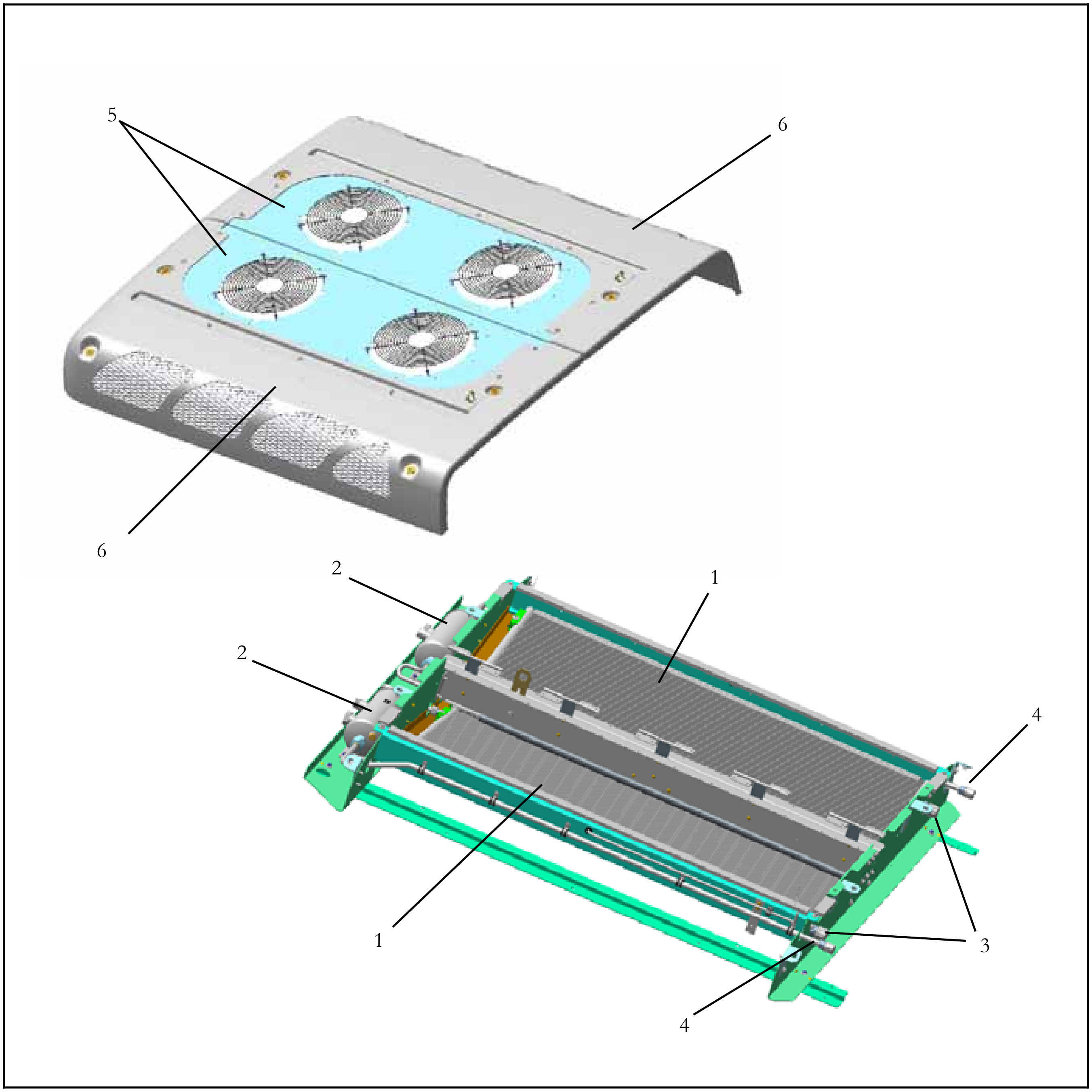
The condensing section includes the condenser coils, four (4) or six (6) fan and motor assemblies, and receiver assembly(s).

The condenser coils provide heat transfer surface for condensing refrigerant gas at a high temperature and pressure into a liquid at high temperature and pressure. The condenser fans circulate ambient air across the outside of the condenser tubes at a temperature lower than refrigerant circulating inside the tubes; this results in condensation of the refrigerant into a liquid. The receiver collects and stores liquid refrigerant. The receiver is also fitted with a pressure relief valve which protects the system from unsafe high pressure conditions, and sightglass/moisture indicators for checking refrigerant.



1 Coil Assembly
2. Receiver
3. Discharge Lines
4. Liquid Line
5. Condenser Fan Deck and Motor Assembly
6. Cover Assembly

Figure 1-2 Condensing Section Components (Single Loop)



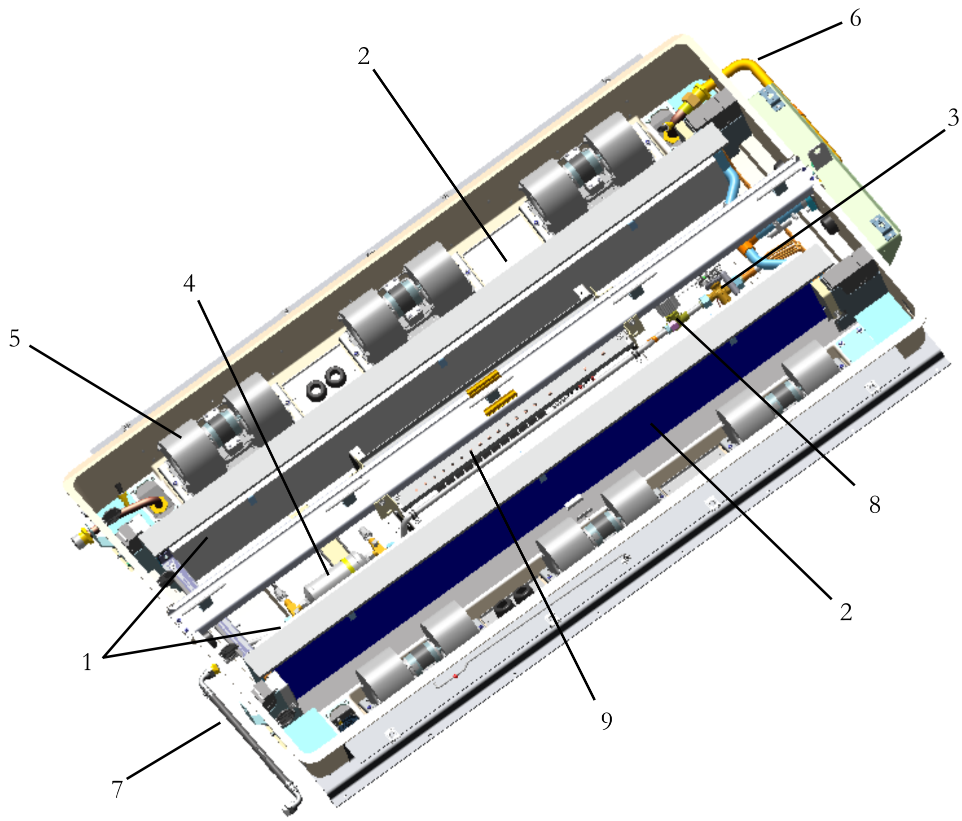
1 Coil Assembly
2. Receiver
3. Discharge Lines
4. Liquid Lines
5. Condenser Fan Deck and Motor Assembly
6. Cover Assembly

Figure 1-3 Condensing Section Components (Dual Loop)

1.2.3 Evaporator Section

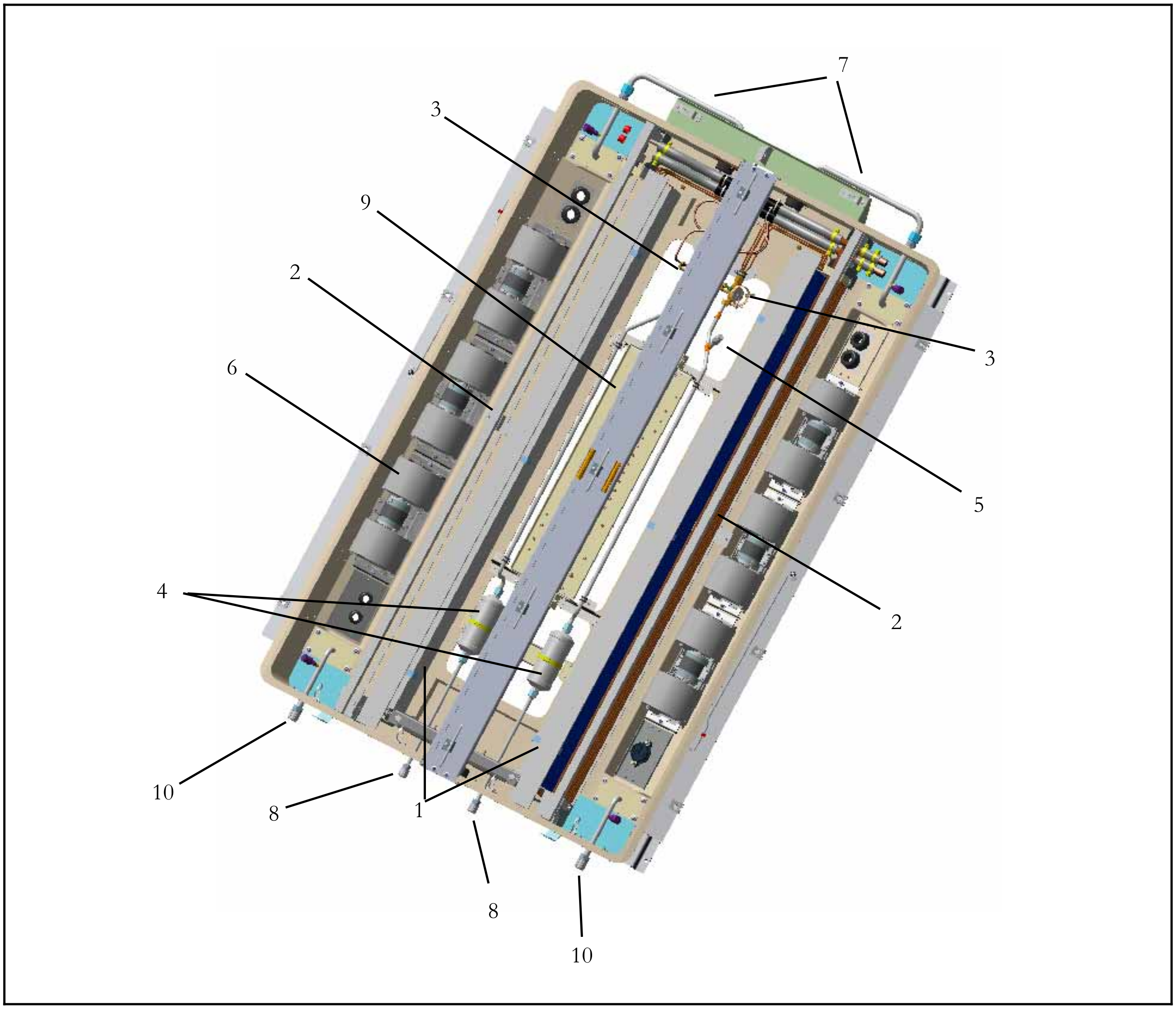
The evaporator section includes the evaporator coils, four (4) or six (6) fan and motor assemblies, two (optional) heater coil assemblies, a thermostatic expansion valve, filter drier, service valves (if equipped) and condensate drain connections.

The evaporator coils provide heat transfer surface for transferring heat from air circulating over the outside of the coil to refrigerant circulating inside the tubes; thus providing cooling. The heating coils (if equipped) provide a heat transfer surface for transferring heat from engine coolant 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(s) removes moisture and debris from the liquid refrigerant before it enters the thermostatic expansion valve in the evaporator assembly. The service valves (if equipped) enable isolation of the filter-drier for service. The thermostatic expansion valve meters the flow of refrigerant entering the evaporator coils. The heat valve controls the flow of engine coolant 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 Assemblies
2. Heat Coils (if equipped)
3. Expansion Valve
4. Filter Drier
5. Blower & Motor Assemblies
6. Suction Line
7. Liquid Line
8. Liquid Line Solenoid
9. Control Panel

Figure 1-4 Evaporator Section Components (Single Loop)



1. Evaporator Coil Assemblies
2. Heat Coils (If Equipped)
3. Expansion Valves
4. Filter Driers
5. Drivers Unit Interface (Optional)
6. Blower & Motor Assembly
7. Suction Lines
8. Liquid Lines
9. Control Panel
10. Discharge Lines to Condenser

Figure 1-5 Evaporator Section Components (Dual Loop)

1.2.4 Enviromate Microprocessor

This Enviromate controller has two (2) modes, Auto and Vent.

In the auto mode the compressor is energized while the evaporator and condenser fans are operated to provide refrigeration as required. The compressor (s) capacity is matched to the bus requirements. Once interior temperature reaches the desired set point, the compressor(s) is de-energized.

In the auto mode the heat valves are opened to allow a flow of engine coolant through the heat coils located in the evaporator section if the interior temperature drops below setpoint. The evaporator fans operate to circulate air over the heat coils in the same manner as the cooling mode.

In the vent mode, the evaporator fans operate to circulate interior air only.

1.2.5 Compressor Assembly

The compressor assembly for the Single Loop system is mounted in the engine compartment and includes the refrigerant compressor, clutch assembly, suction and discharge service valves, suction and discharge servicing (charging) ports and electric solenoid unloaders.

The compressor assemblies for the Dual Loop system are mounted in the engine compartment and includes the refrigerant compressors and clutch assemblies. High pressure switch and low pressure switches are supplied in the unit assembly. Charge ports can be provided at compressor assemblies, or spliced into hose assemblies between the compressor and rooftop unit.

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.

1.2.6 Discharge Check Valve

A check valve is located in the discharge line close to the compressor (Single Loop only). 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.

1.3 REFRIGERATION SYSTEM COMPONENT SPECIFICATIONS

a. Refrigerant Charge R-134a (Approximate)

NOTE

Refrigerant charge will depend on hose lengths and diameters; or if there is an In-Dash unit (front evaporator). The following should only be used as a base guideline.

Eco 353N Single Loop - Transit Compressor
13 Pounds (5.9 kg)

Eco 353N Dual Loop - TM21 Compressors
8 lbs. 10 oz. (3.9 kg) (**Per Loop**)

b. Compressors (R-134a)

Compressor	**05G**
Weight, (Dry W/Clutch)	145 Lbs. (65.77 kg)
Oil Charge	5.5 Pints (2.6 liters) POE
Compressor	**Bitzer 4NFCY**
Weight, (W/O Clutch)	73 Lbs. (33 kg)
Oil Charge	5.5 Pints (2.6 liters) POE
Compressor	**Bock FK40**
Weight, (W/O Clutch)	73 Lbs. (33 kg)
Oil Charge	4.2 Pints (2 liters) POE
Compressor	**TM21**
Weight, (Dry W/Clutch)	~19 Lbs. (8.6 kg)
Oil Charge	6-7 Oz. (180-200 cc) PAG

NOTE

Additional oil charge of 2 ounces per pound of refrigerant will be required in each circuit on the dual loop units (in addition to the compressor oil charge).

c. Thermostatic Expansion Valves:

Single Loop
TGEN 12 (37 kW)
Superheat Factory Set at 9°F (5°C)
MOP 70 psig (4.8 bar)

Dual Loop
TGEN 4.5 (24 kW)
Superheat Factory Set at 9°F (5°C)
MOP 70 psig (4.8 bar)

d. High Pressure Switch (HPS) *Normally Closed*

Opens at: 300 ± 10 psig (20.68 ± 0.68bar)
Closes at: 200 ± 10 psig (13.79 ± 0.68bar)

e. Low Pressure Switch (LPS) *Normally Open*

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

1.4 ELECTRICAL SPECIFICATIONS - MOTORS

a. Evaporator Blower/Motor

Evaporator Motor	**Permanent Magnet**
	12 VDC
Full Load Amps (FLA) @ 13.5 VDC	29.3
Airflow CFM (m^3/h) *	680 (1180)
Evaporator Motor	**Permanent Magnet**
	24 VDC
Full Load Amps (FLA) @ 13.5 VDC	15.3
Airflow CFM (m^3/h) *	660 (1140)
Evaporator Motor	**Brushless**
	24 VDC
Full Load Amps (FLA) @ 26VDC	21.2
Airflow CFM (m^3/h) *	630 (1070)

* Ratings at 0" static pressure

b. Condenser Fan Motors

Condenser Motor	**Permanent Magnet**
	12 VDC
Full Load Amps (FLA) @ 13.0 VDC	17.9
Airflow CFM (m^3/h) *	1628 (2760)
Condenser Motor	**Permanent Magnet**
	24 VDC
Full Load Amps (FLA) @ 27.0 VDC	7.2
Airflow CFM (m^3/h) *	1603 (2724)
Condenser Motor	**Brushless**
	12 VDC
Full Load Amps (FLA) @ 26 VDC	7.0
Airflow CFM (m^3/h) *	1610 (2735)

* Ratings at 0" static pressure

c. Return Air Sensor

Output: 10K ohms ± 2% at 77° F (25°C)

d. Ambient Sensor

Output: 10K ohms ± 2% at 77° F (25°C)

1.5 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 air conditioning cycle, compressor clutch 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 evaporator section of the unit.

Low Pressure Switch (LPS)

The low pressure switch is installed in the evaporator section and opens on a pressure drop to shut down the system when a low pressure condition occurs.

b. Fuses and Circuit Breakers

The Relay Board is protected against high current by an OEM supplied circuit breaker or fuse (200 Amp for 12 VDC systems). Independent 20 Amp, 12 VDC fuses protect each condenser motor. Independent 25 Amp, 12 VDC fuses protect each evaporator motor. Output circuits are protected by additional 2,3,5 and 10 Amp fuses according to circuit loads. During a high current condition, the fuse may open.

1.6 AIR FLOW

The paths for ambient air through the condenser and coach air through the evaporator are illustrated in Figure 1-6.

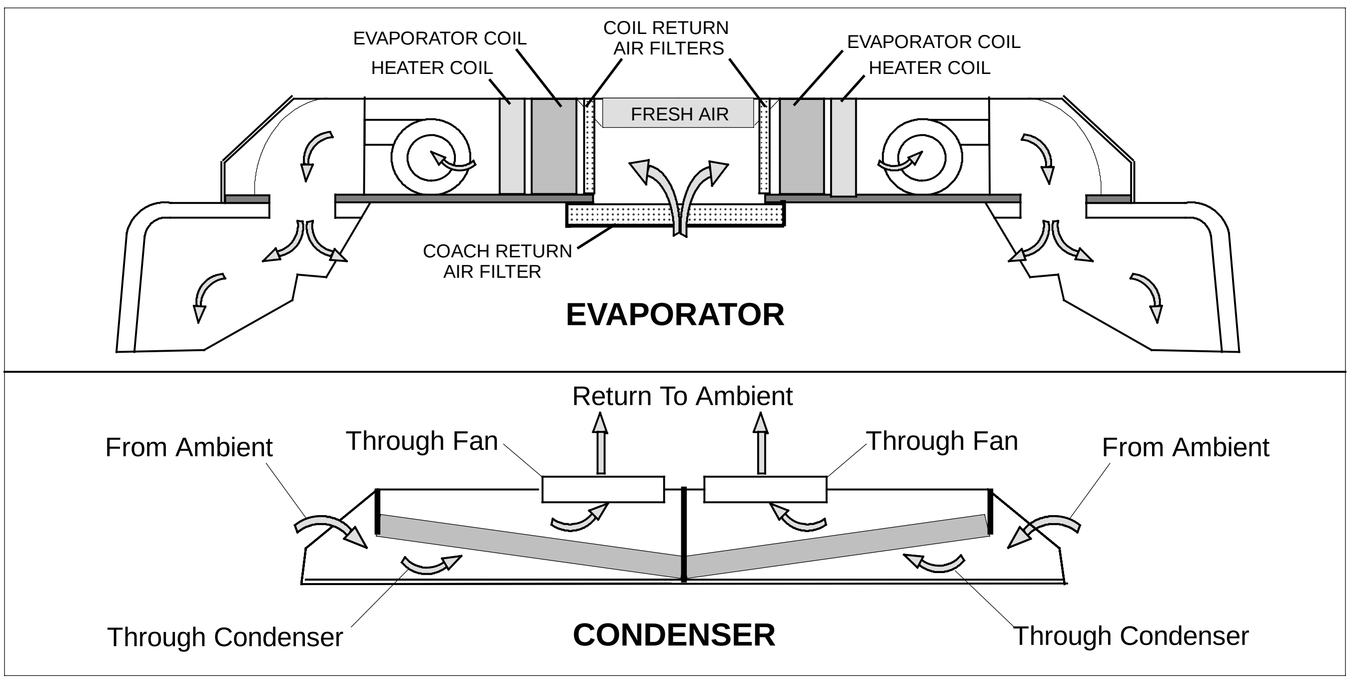


Figure 1-6 System Air Flow

1.7 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 a refrigerant (See Figure 1-7 or Figure 1-8 refrigerant flow diagram). The main components of the system are the A/C compressor, air-cooled condenser coils, receiver, filter-drier, thermostatic expansion valve, liquid line solenoid valve (if equipped), 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 refrigerant leaves the receiver and passes through the receiver outlet/service valve, through a filter-drier where a desiccant keeps the refrigerant clean and dry.

From the filter-drier, the liquid refrigerant then flows through the liquid line to the sight-glass and then to the thermostatic expansion valve. The thermal expansion valve reduces pressure and temperature of the liquid and meters the flow of liquid refrigerant to the evaporator to obtain maximum use of the evaporator heat transfer surface.

The low pressure, low temperature liquid that flows into the evaporator tubes is colder than the air that is circulated over the evaporator tubes by the evaporator fans (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.

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.

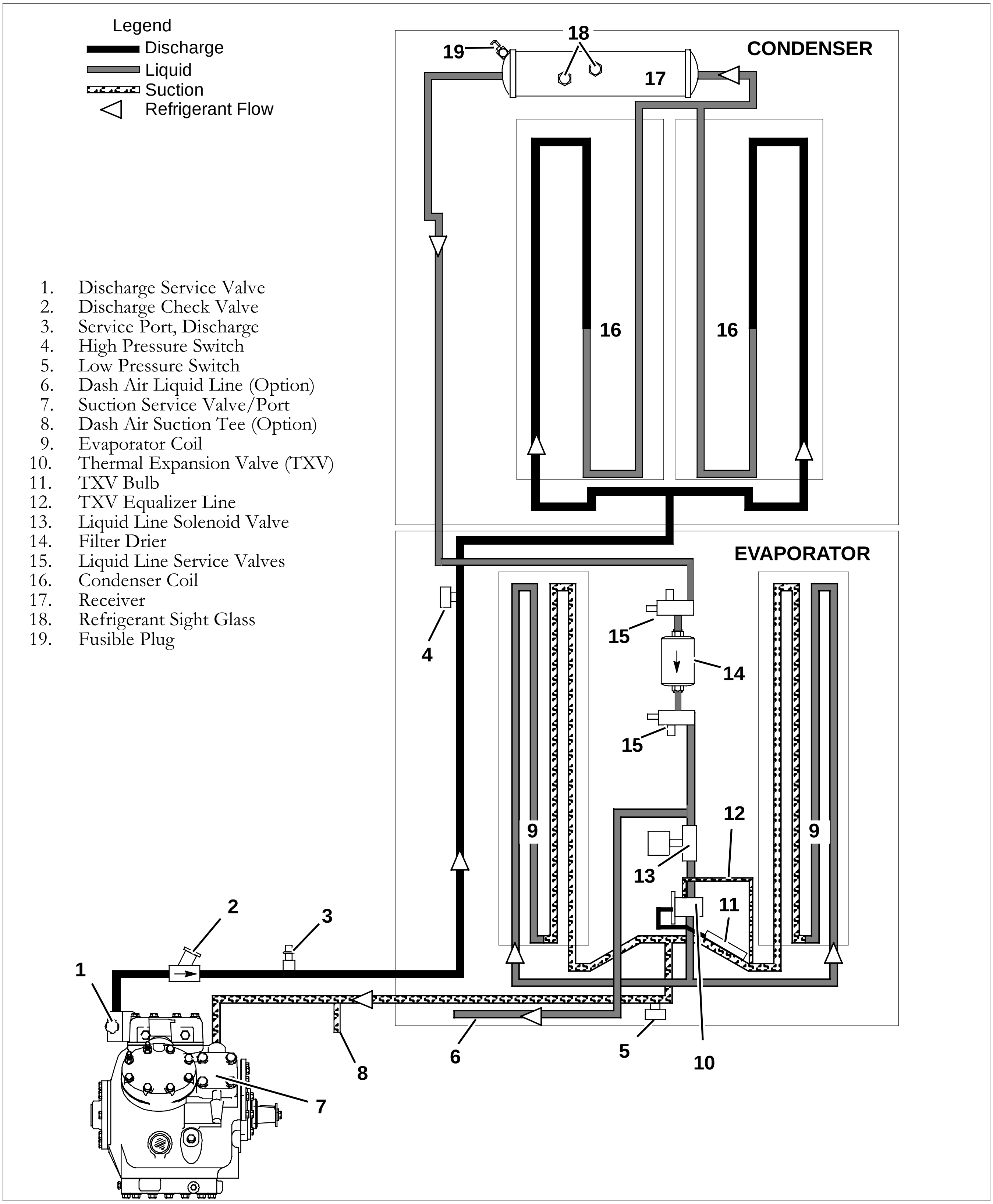
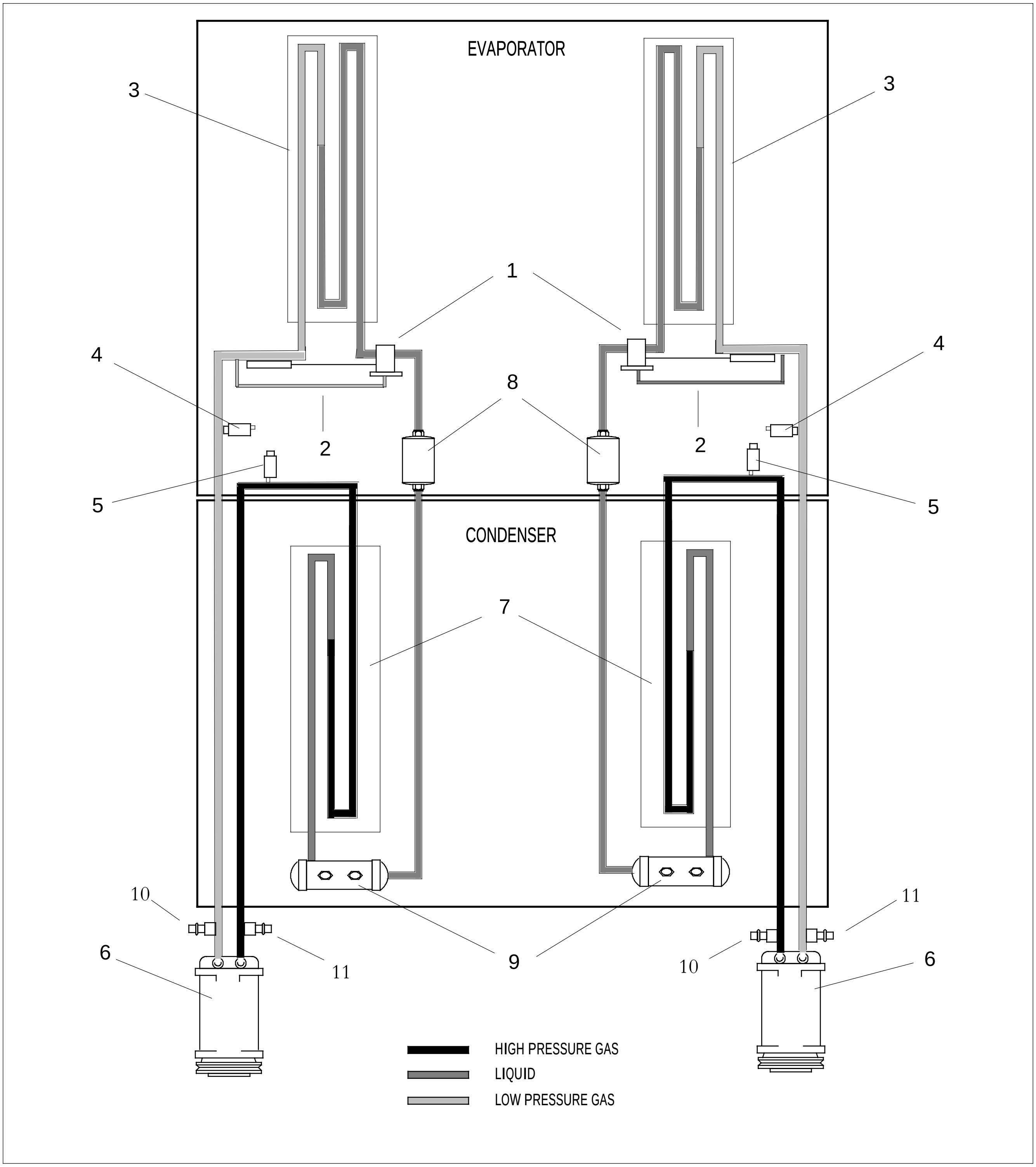


Figure 1-7 Refrigerant Flow Diagram (Single Loop)



1	Thermal Expansion Valve	7	Condenser Coil
2	Equalizer Line	8	Filter-Drier
3	Evaporator Coil	9	Receiver
4	Low Pressure Switch	10	Suction Service Port
5	High Pressure Switch	11	Discharge Service Port
6	Compressor (TM-21)		

Figure 1-8 Refrigerant Flow Diagram (Dual Loop)

1.8 HEATING CYCLE

Heating circuit (See Figure 1-9) 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.

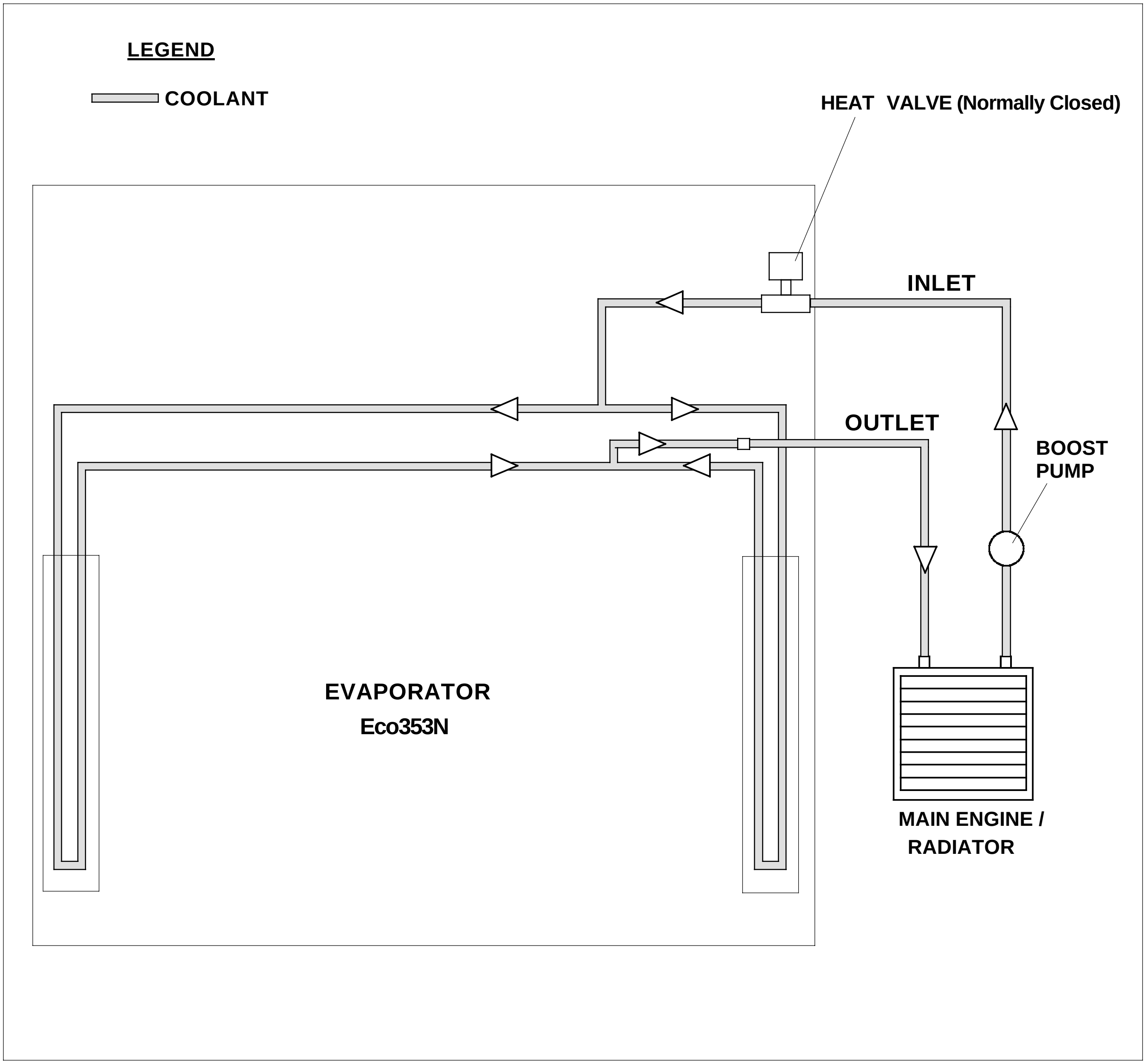
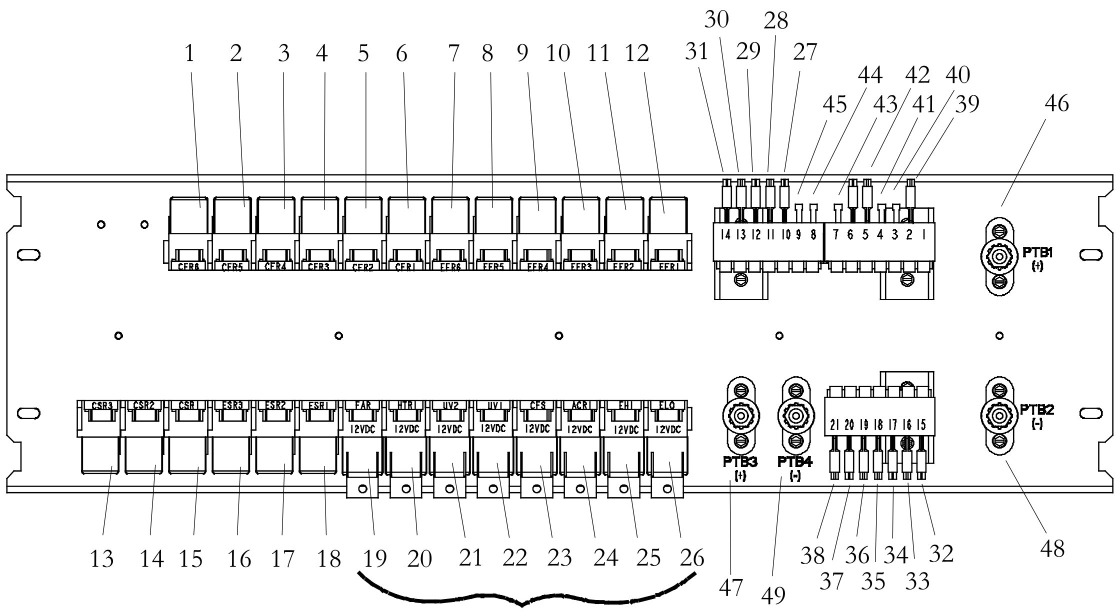


Figure 1-9 Heat Flow Diagram



Note: Relays 19 thru 26
are 12 VDC (Coil Voltage)

REF: Y25- 00030- 00 Rev 6

Figure 1-10 Eco353 With EnviroMATE Control Board (Single Circuit 24VDC)

1. CFR6, Condenser Fan Relay 6
2. CFR5, Condenser Fan Relay 5
3. CFR4, Condenser Fan Relay 4
4. CFR3, Condenser Fan Relay 3
5. CFR2, Condenser Fan Relay 2
6. CFR1, Condenser Fan Relay 1
7. EFR6, Evaporator Fan Relay 6
8. EFR5, Evaporator Fan Relay 5
9. EFR4, Evaporator Fan Relay 4
10. EFR3, Evaporator Fan Relay 3
11. EFR2, Evaporator Fan Relay 2
12. EFR1, Evaporator Fan Relay 1
13. CSR3, Condenser Speed Relay 3
14. CSR2, Condenser Speed Relay 2
15. CSR1, Condenser Speed Relay 1
16. ESR3, Evaporator Speed Relay 3
17. ESR2, Evaporator Speed Relay 2
18. ESR1, Evaporator Speed Relay 1
19. FAR, Fresh Air Relay
20. Heat, Heat Valve Relay
21. UV2, Unloader Valve 2
22. UV1, Unloader Valve 1
23. CFS, Condenser Fan Speed Relay
24. ACR1, Air Conditioning Relay 1
25. EHI, Evaporator High
26. ELO, Evaporator Low
27. F10, Fuse 20 Amp, Evaporator Fan 1
28. F11, Fuse 20 Amp, Evaporator Fan 2
29. F12, Fuse 20 Amp, Evaporator Fan 3
30. F13, Fuse 20 Amp, Evaporator Fan 4
31. F14, Fuse 20 Amp, Evaporator Fan 5
32. F15, Fuse 20 Amp, Evaporator Fan 6
33. F16, Fuse 20 Amp, Condenser Fan 3
34. F17, Fuse 20 Amp, Condenser Fan 6
35. F18, Fuse 20 Amp, Condenser Fan 2
36. F19, Fuse 20 Amp, Condenser Fan 5
37. F20, Fuse 20 Amp, Condenser Fan 1
38. F21, Fuse 20 Amp, Condenser Fan 4
39. F2, Fuse 10 Amp, ACR1 Relay
40. F3, Fuse 5 Amp, Unloader Valve 1
41. F4, Fuse 5 Amp, Unloader Valve 2
42. F5, Fuse 20 Amp, Floor Heat Valve or Boost Pump
43. F7, Fuse 5 Amp, Evaporator Low Relay
44. F8, Fuse 5 Amp, Evaporator High Relay
45. F9, Fuse 5 Amp, Condenser Speed Relay
46. PTB1, Main Power Supply, Positive (+)
47. PTB3, Main Power Supply, Positive (+)
48. PTB2, Main Power Supply, Negative (-)
49. PTB4, Main Power Supply, Negative (-)

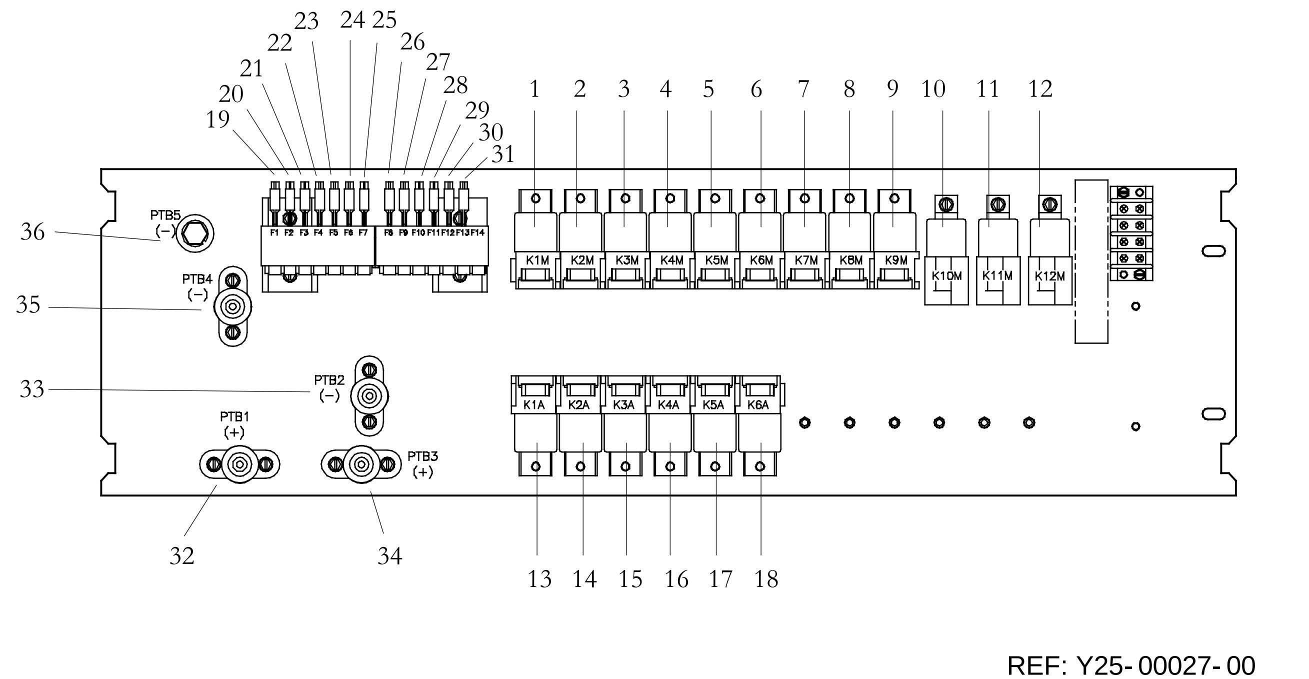


Figure 1-11 Eco353 With EnviroMATE Control Board (Dual/Single Circuit 12VDC)

1. K1M, Evaporator Motor 1 Relay
2. K2M, Evaporator Motor 2 Relay
3. K3M, Evaporator Motors 1 & 2 Speed Relay
4. K4M, Evaporator Motor 3 Relay
5. K5M, Evaporator Motor 4 Relay
6. K6M, Evaporator Motors 3 & 4 Speed Relay
7. K7M, Evaporator Motor 5 Relay
8. K8M, Evaporator Motor 6 Relay
9. K9M, Evaporator Motors 5 & 6 Speed Relay
10. K10M, Condenser Motors 1 & 2 Relay
11. K11M, Condenser Motors 3 & 4 Relay
12. K12M, Condenser Motors 5 & 6 Relay
13. K1A, Evaporator Low Speed Relay
14. K2A, Evaporator High Speed Relay
15. K3A, Compressor Clutches 1 & 2 and Condenser/LSV Control Signal
16. K4A, Heat Valve Relay
17. K5A, Fresh Air Relay (Optional)
18. K6A, Condenser On Signal and Liquid Line Solenoid Valve Signal
19. F1, Fuse 30 Amp, Evaporator Fan 1
20. F2, Fuse 30 Amp, Evaporator Fan 2
21. F3, Fuse 30 Amp, Evaporator Fan 3
22. F4, Fuse 30 Amp, Evaporator Fan 4
23. F5, Fuse 30 Amp, Evaporator Fan 5
24. F6, Fuse 30 Amp, Evaporator Fan 6
25. F7, Fuse 20 Amp, Condenser Fan 1
26. F8, Fuse 20 Amp, Condenser Fan 2
27. F9, Fuse 20 Amp, Condenser Fan 3
28. F10, Fuse 20 Amp, Condenser Fan 4
29. F11, Fuse 20 Amp, Condenser Fan 5
30. F12, Fuse 20 Amp, Condenser Fan 6
31. F13, Fuse 15 Amp, KA Relay Control Power
32. PTB1, Main Power Supply, Positive (+)
33. PTB3, Main Power Supply, Positive (+)
34. PTB2, Main Power Supply, Negative (-)
35. PTB4, Main Power Supply, Negative (-)
36. PTB5, Main Power Supply, Negative (-)

SECTION 2

OPERATION ENVIROMATE CONTROLLER

2.1 EnviroMATE Controller (Single Zone)

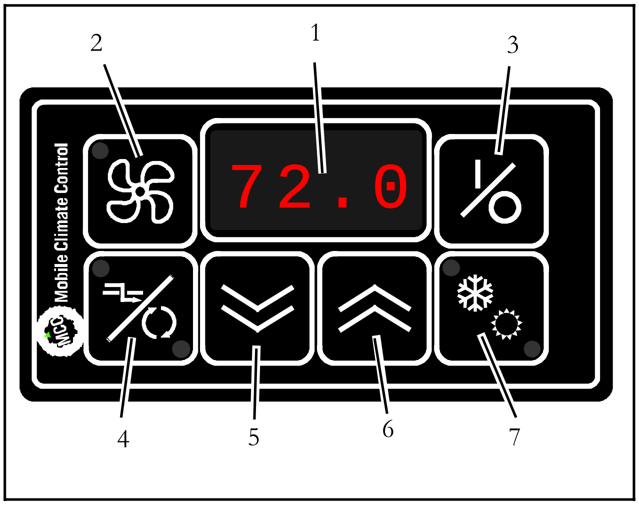


Figure 2-1 EnviroMATE Control Panel

1 Display
2 Vent Key
3 On/Off Key
4 Fresh Air Damper Key
5 Decrease Selection Key
6 Increase Selection Key
7 Cool/Heat Key

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

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

2.1.1 Controller Operation

Once the EnviroMATE controller is powered with 12VDC, supplied by the Bus OEM, the system can be turn On or Off using the On/Off key (Item 3 in Figure 2-1). When the display is powered On, the controller will go through self test mode, and then the current set point will be displayed. To adjust the temperature set point up or down, use the Increase/Decrease selection keys (Items 5 and 6 in Figure 2-1). Temperature set point can be set from 64°F to 82°F (17.8°C to 27.8°C)

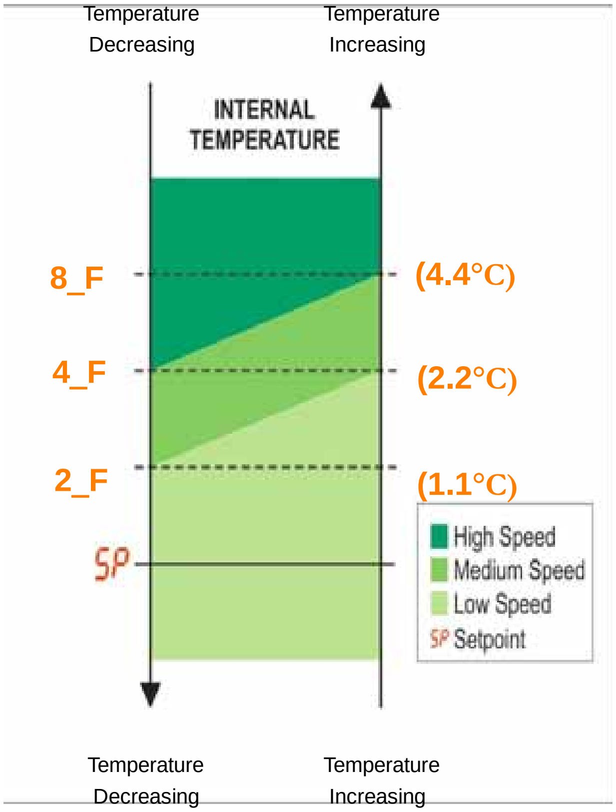
NOTE

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

The controller is equipped with two temperature sensors to monitor the evaporator return air temperature, and the outside air temperature. To view the return air temperature, press and hold the Increase Selection Key for 3 seconds (Item 6 in Figure 2-1) . To view the outside air temperature, press and hold the Decrease Selection Key (Item 5 in Figure 2-1).

2.1.2 Evaporator Fan Operation

Evaporator fan speeds are controlled automatically according to the chart shown below. There are 3 fan speeds controlled by relays mounted to an auxiliary electrical panel.



Fan speeds can be controlled manually by pressing the Vent Key (Item 2 in Figure 2-1), an LED light will activate in the corner of the Vent Key . After pressing the Vent Key, use the Increase/Decrease Keys (Item 5 and 6 in Figure 2-1) to set the desired fan speed. The display will show the following symbols, indicating selected speed:

u1 = Low speed (Controller Output **Pin 4**)

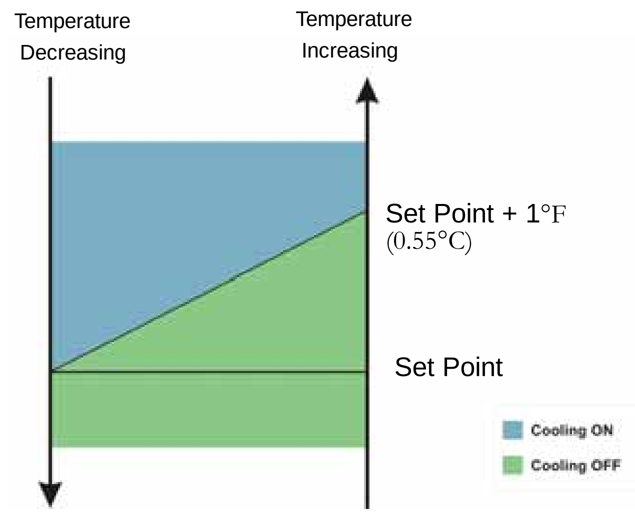
u2 = Medium speed (Controller Output **Pin 18**)

u3 = High speed (Controller Output **Pin 19**)

2.1.3 Cooling Mode

When Cooling Mode is selected, the controller will check the Outside Air temperature. If the Outside Air temperature is below 24°F (-4.4°C), the compressor function will be disabled. If Outside Air temperature is above 24°F (-4.4°C), and the Return Air temperature is above the set point, the compressor will be energized by providing an output voltage from **Pin 6** of controller to enable cooling .

The chart below shows the temperature control of the compressor operation.



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

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

2.1.4 Heating Mode (If equipped)

The EnviroMATE Controller has the ability to control output to a heat control valve and boost pump (OEM supplied), to supply heat provided by the engine coolant system. If heat is selected by pressing the Cool/Heat Key (Item 7 in Figure 2-1), and the interior temperature is more than 1°F below set point, the controller will open a coolant heat valve to allow engine coolant flow to the heater coil until temperature rises to set point.

2.1.5 Sensors

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

2.1.6 Voltage

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

2.1.7 Schematics

Typical system schematic for an EnviroMATE single loop system can be found in Section 5.

2.2 EnviroMATE Controller (Dual Zone)

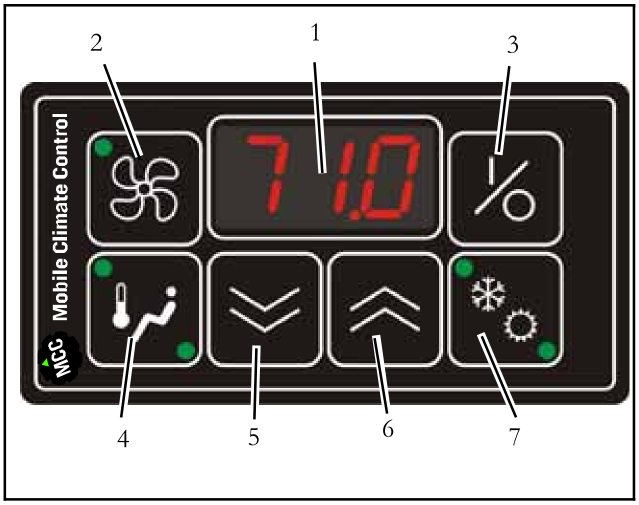


Figure 2-2 EnviroMATE Control Panel

1 Display
2 Vent Key
3 On/Off Key
4 Temperature Zone Key
5 Decrease Selection Key
6 Increase Selection Key
7 Cool/Heat Key

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

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

NOTE

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

2.2.1 Controller Operation

Once the EnviroMATE controller is powered with 12 VDC, supplied by the Bus OEM, the system can be turn On or Off using the On/Off key (Item 3 in Figure 2-1). When the display is powered On, the controller will go through self test mode, and then the current set point will be displayed. To adjust the temperature set point up or down, use the Increase/Decrease selection keys (Items 5 and 6 in Figure 2-1). Temperature set point can be set from 64°F to 82°F (17.8°C to 27.8°C).

The controller is equipped with two return air temperature sensors, one in each zone to monitor the evaporator return air temperature. To view the return air temperature for Zone 1, press the Temperature Zone Key once (Item 4 in Figure 2-2). The green LED light in upper left corner of Key will light, indicating Zone 1 return air temperature. Return air temperature will be shown on display.

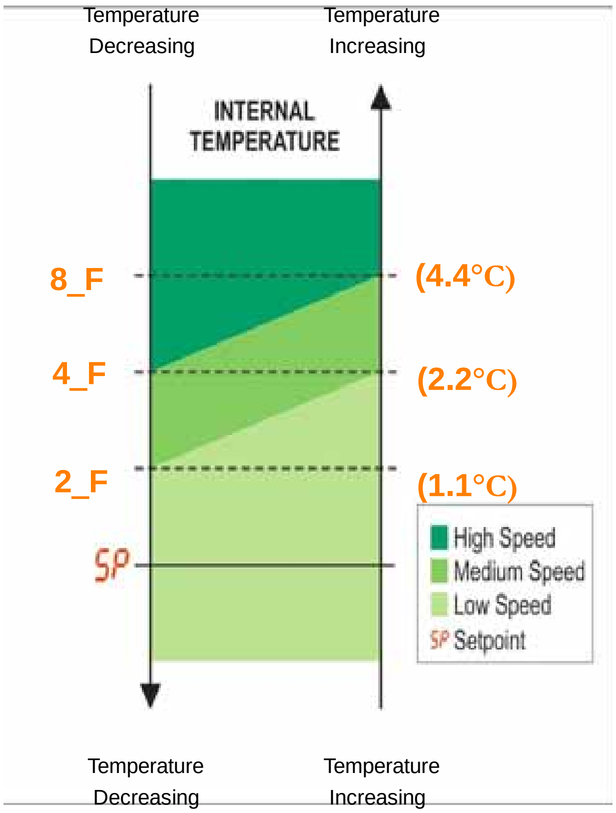
To view the return air temperature for Zone 2, press the Temperature Zone Key again (Item 4 in Figure 2-2). The green LED light in bottom right corner of Key will light, indicating Zone 2 return air temperature. Return air temperature will be shown on display.

Led 	Temperature shown
	Zone 1
	Zone 2

After a few seconds, the display will return to the set point temperature.

2.2.2 Evaporator Fan Operation (Automatic)

Evaporator fan speeds are controlled automatically according to the chart shown below. There are 3 fan speeds controlled by relays mounted to an auxiliary electrical panel. Each zone will control the evaporator fan speeds in that zone, according to the return air temperature sensor controlling that particular zone.



2.2.3 Evaporator Fan Operation (Manual)

Fan speeds can be controlled manually by pressing the Vent Key (Item 2 in Figure 2-2), an LED light will activate in the corner of the Vent Key . After pressing the Vent Key, use the Increase/Decrease Keys (Item 5 and 6 in Figure 2-2) to set the desired fan speed. The display will show the following symbols, indicating selected speed:

u1 = Low speed

(Controller Output **Pin 4 for Zone 1, Pin 12 for Zone 2**)

u2 = Medium speed

(Controller Output **Pin 18 for Zone 1, Pin 24 for Zone 2**)

u3 = High speed

(Controller Output **Pin 19 for Zone 1, Pin 23 for Zone 2**)

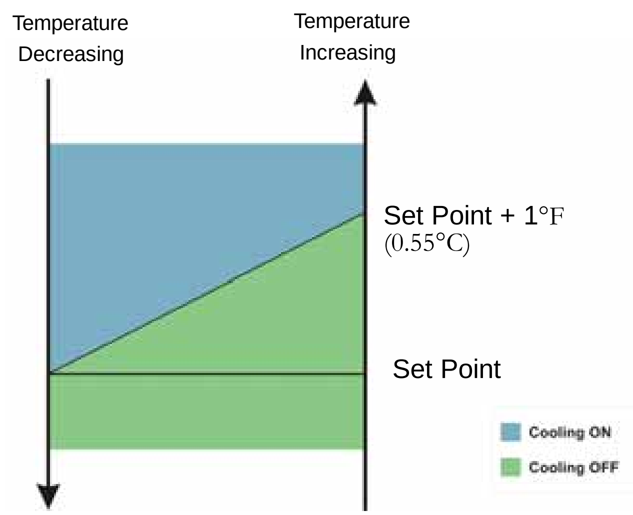
2.2.4 Cooling Mode

When Cooling Mode is selected (Item 7 in Figure 2-2), The green LED light will display in upper left corner of Key by the "Snowflake" symbol. The controller will then compare the return air temperature value for each Zone, with the selected set point temperature. If the value of the return air temperature for Zone 1 is more than 1°F (0.55°C) above system set point, the controller will output a signal on **Pin 6** of controller to energize the condenser and compressor for cooling.

If the value of the return air temperature for Zone 2 is more than 1°F (0.55°C) above system set point, the controller will output a signal on **Pin 10** of controller to energize the condenser and compressor for cooling.

Each zone will control the system components for cooling independently according to need.

The chart below shows the temperature control of the compressor operation.



The controller will constantly monitor the low pressure switch and freeze up thermostat to protect system components by monitoring voltage on **Pin 14** (Zone 1), and **Pin 16** (Zone 2) of controller. If the freeze up thermostat, or low pressure switch circuit opens, the controller will de-energize the compressor clutch relay, and the condenser fan relay for a minimum time of 1 minute, or until the open circuit closes.

The controller will constantly monitor the high pressure switch to protect system components by monitoring voltage on **Pin 13** (Zone 1), and **Pin 5** (Zone 2) of controller. If the high pressure switch circuit opens, the controller will de-energize the compressor clutch relay, and the condenser fan relay will remain energized to lower system pressure. The compressor relay will remain open for a minimum time of 1 minute, or until high pressure switch circuit closes.

If a low or high pressure condition occurs, an alarm will be generated and shown on the display. The alarms related to low and high pressure are listed below:

L1- Low pressure failure (Zone 1)

L2- Low pressure failure (Zone 2)

H1- High pressure failure (Zone 1)

H2- High pressure failure (Zone 2)

If any condition occurs 3 times within 30 minutes, the cooling circuit will be disabled for the associated Zone until controller power is cycled. An alarm will be generated to indicate this occurrence and shown on the display. Evaporator fans will remain energized to provide ventilation. Lock out of cooling system alarms will show as:

t1- Lock out of Zone 1 cooling system

t2- Lock out of Zone 2 cooling system

2.2.5 Alarm Descriptions

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

Figure 2-3 EnviroMATE Alarms (Single Zone)

Mobile Climate Control

SECTION 3

TROUBLESHOOTING

Table 3-1 General System Troubleshooting Procedures

INDICATION - TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1 System Will Not Cool		
Compressor will not run	Drive-Belt loose or defective Clutch coil defective Clutch malfunction Compressor malfunction	Check Check/Replace Check/Replace See Table 1-3
Electrical malfunction	Coach power source defective Circuit Breaker/safety device open	Check/Repair Check/Reset
3.2 System Runs But Has Insufficient Cooling		
Compressor	Drive-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	3.3 3.5 3.6 4.11 4.7 Open 1.5
Restricted air flow	No evaporator air flow or restriction	3.5
Heating system	Heat valve stuck open	3.7
3.3 Abnormal Pressures		
High discharge pressure	Refrigerant overcharge Noncondensable in system Condenser motor failure Condenser coil dirty	4.7.1 Check Check Clean
Low discharge pressure	Compressor valve(s) worn or broken Low refrigerant charge	See Table 1-3 4.7
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	Open Check/Open 4.11 4.7 3.6 3.5
Suction and discharge pressures tend to equalize when system is operating	Compressor valve defective	See Table 1-3
3.4 Abnormal Noise Or Vibrations		
Compressor	Loose mounting hardware Worn bearings Worn or broken valves Liquid slugging Insufficient oil Clutch loose, rubbing or is defective Drive-Belt cracked, worn or loose Dirt or debris on fan blades	Check/Tighten See Table 1-3 SeeTable 1-3 3.6 1.3 Repair/Replace Adjust/Replace Clean

Table 3-1 General System Troubleshooting Procedures - Continued

INDICATION - TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.4 Abnormal Noise Or Vibrations - Continued		
Condenser or evaporator fans	Loose mounting hardware Defective bearings Blade interference Blade missing or broken	Check/Tighten Replace Check Check/Replace
3.5 No Evaporator Air Flow Or Restricted Air Flow		
Air flow through coil blocked	Coil frosted over Dirty coil Dirty filter	Defrost coil Clean Clean/Replace
No or partial evaporator air flow	Motor(s) defective Motor brushes defective Evaporator fan loose or defective Fan damaged Return air filter dirty Icing of coil Fan relay(s) defective Safety device open Fan rotation incorrect	Repair/Replace Replace Repair/Replace Repair/Replace Clean/Replace Clean/Defrost Check/Replace 1.5 Check
3.6 Expansion Valve Malfunction		
Low suction pressure with high super-heat	Low refrigerant charge Wax, oil or dirt plugging valve orifice Ice formation at valve seat Power assembly failure Loss of bulb charge Broken capillary tube	4.7 Check 4.6 Replace Replace 4.14
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	4.14 4.14
Side to side temperature difference (Warm Coil)	Wax, oil or dirt plugging valve orifice Ice formation at valve seat Power assembly failure Loss of bulb charge Broken capillary	Check 4.6 Replace Replace 4.14
3.7 Heating Malfunction		
Insufficient heating	Dirty or plugged heater core Coolant solenoid valve(s) malfunctioning or plugged Low coolant level Strainer(s) plugged Hand valve(s) closed Water pumps defective Auxiliary Heater malfunctioning.	Clean Check/Replace Check Clean Open Repair/Replace Repair/Replace
No Heating	Coolant solenoid valve(s) malfunctioning or plugged Controller malfunction Pump(s) malfunctioning Safety device open	Check/Replace Replace Repair/Replace 1.5
Continuous Heating	Coolant solenoid valve stuck open	4.12

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

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

4.1 MAINTENANCE SCHEDULE

SYSTEM		SYSTEM	REFERENCE SECTION
ON	**OFF**		
a. Daily Maintenance			
X		Pre-trip Inspection - after starting	4.2
	X	Check tension and condition of drive belts.	None
b. Weekly Inspection			
	X	Perform daily inspection	See above
	X	Check condenser, evaporator coils and air filters for cleanliness	None
	X	Check refrigerant hoses, fittings and component connections for leaks	4.5
X		Feel filter-drier for excessive temperature drop across drier	4.11
c. Monthly Inspection and Maintenance			
	X	Perform weekly inspection and maintenance	See above
	X	Clean evaporator drain pans and hoses	None
	X	Check all wire harnesses/electrical panels for corrosion/chafing and loose terminals	Replace/Tighten None
	X	Check fan/blower motor bearings	None
	X	Check compressor mounting bolts for tightness	

4.2 Pre-trip Inspection

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

1. Listen for abnormal noises in compressor or fan motors.
2. Check compressor oil level if applicable.
   Single circuit models utilize a compressor with oil sump and sight glass.
   Dual circuit models utilizing automotive style compressors do not utilize a compressor sump for checking oil level.
3. Check refrigerant charge. (Refer to section 4.7).
4. Ensure that self test of controller has successfully been performed and there are no alarms or error codes indicated. (Refer to section 2).

4.1 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.

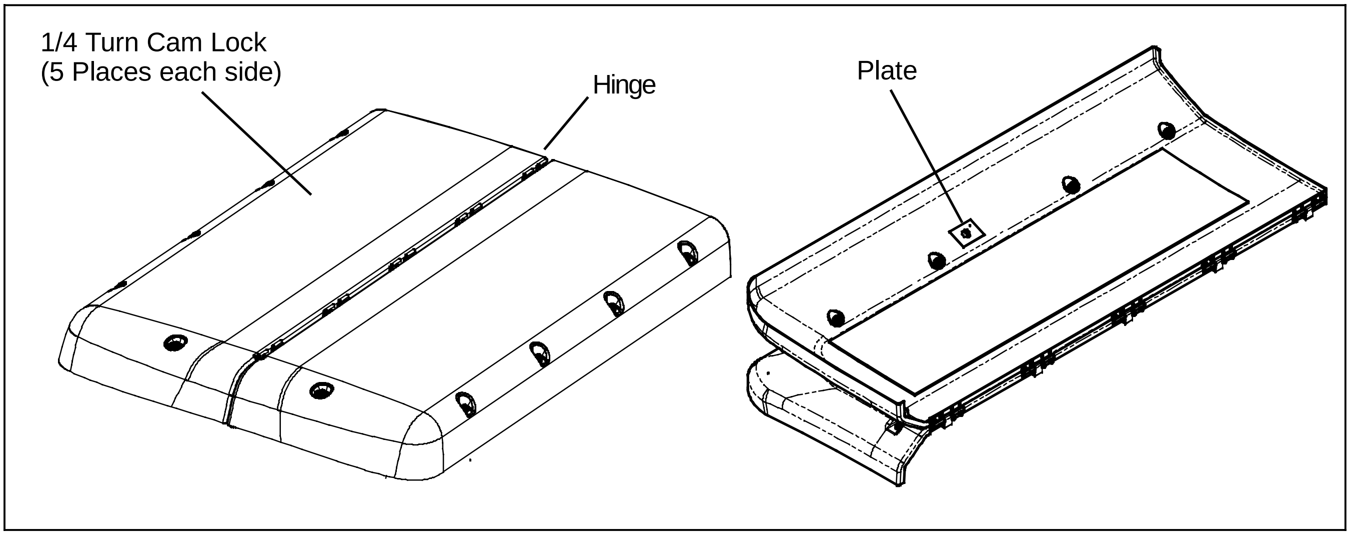


Figure 4-1 Opening Top Cover (Evaporator)

4.2 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.

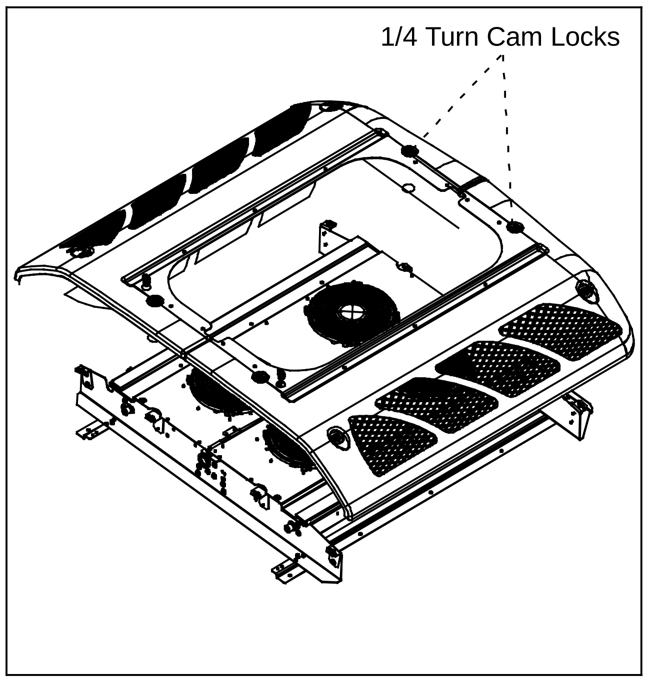


Figure 4-2 Condenser Cover Removal

4.3 SUCTION AND DISCHARGE SERVICE VALVES (Single Loop Only)

NOTE

To avoid damage to the valve stem packing and avoid potential refrigerant leaks, the following procedure should be followed when operating service valves, and should be included as part of standard maintenance practice.

1) Before opening or closing the service valve, loosen the packing gland nut by ¼ turn to minimize wear of valve packing material (See Figure 4-3).

2) After operation of valve is complete, tighten the packing gland nut securely, without over tightening.

The suction and discharge service valves (Figure 4-3) are provided with a double seat and a gauge port. These valves allow of servicing of both the compressor and other refrigerant line access points.

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.

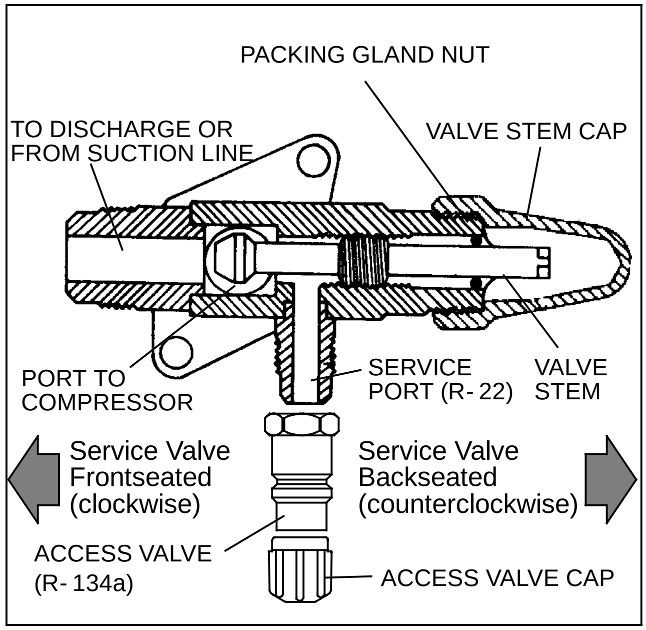


Figure 4-3 Suction or Discharge Service Valve

4.3 MANIFOLD GAUGE SET

A manifold gauge set can be used to determine system operating pressures, add charge, equalize or evacuate system.

When the suction pressure hand valve is front seated (turned all the way clockwise), the suction (low) pressure can be read. When the discharge pressure hand valve is front seated (turned all the way clockwise), discharge (high) pressure can be read.

4.3.1 Installing R-134a Manifold Gauge/Hose Set

An R-134a manifold gauge/hose set with self-sealing hoses is pictured in 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 mid-seat 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 R134a to 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 the 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. Connect the field service couplers (see Figure 4-4) to the suction and discharge service ports.

NOTE

If utilizing the compressor service ports or king valve ports to connect gauge/hose set, it will be necessary to mid-seat the service valves to open the access ports to system pressures.

2. Turn the field service coupling knobs clockwise, which will open the system to the gauge set.

3. Read the system pressures.

CAUTION

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

c. Removing the Manifold Gauge Set.

1. While the compressor is still ON, backseat (counterclockwise) the high side field service coupler on the manifold gauge set. Mid-seat 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.

2. Back-seat the low side field service coupler and front-seat both manifold set hand valves. Back-seat the service valves (if applicable). Remove the couplers from the access valves.

3. Install access valve caps.

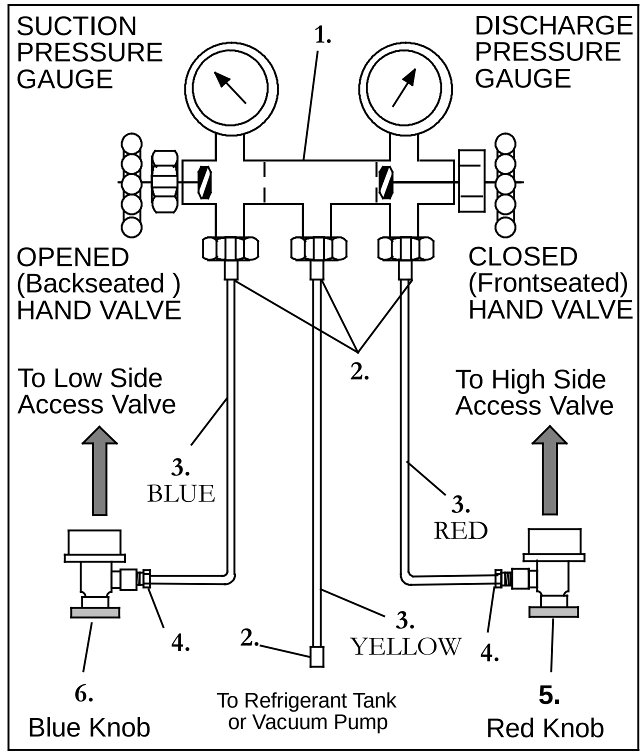


Figure 4-4 Manifold Gauge Set (R-134a)

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

4.4 REMOVING THE REFRIGERANT CHARGE

NOTE

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

4.4.1 Removing Entire System Charge

To remove the entire refrigerant charge, do the following:

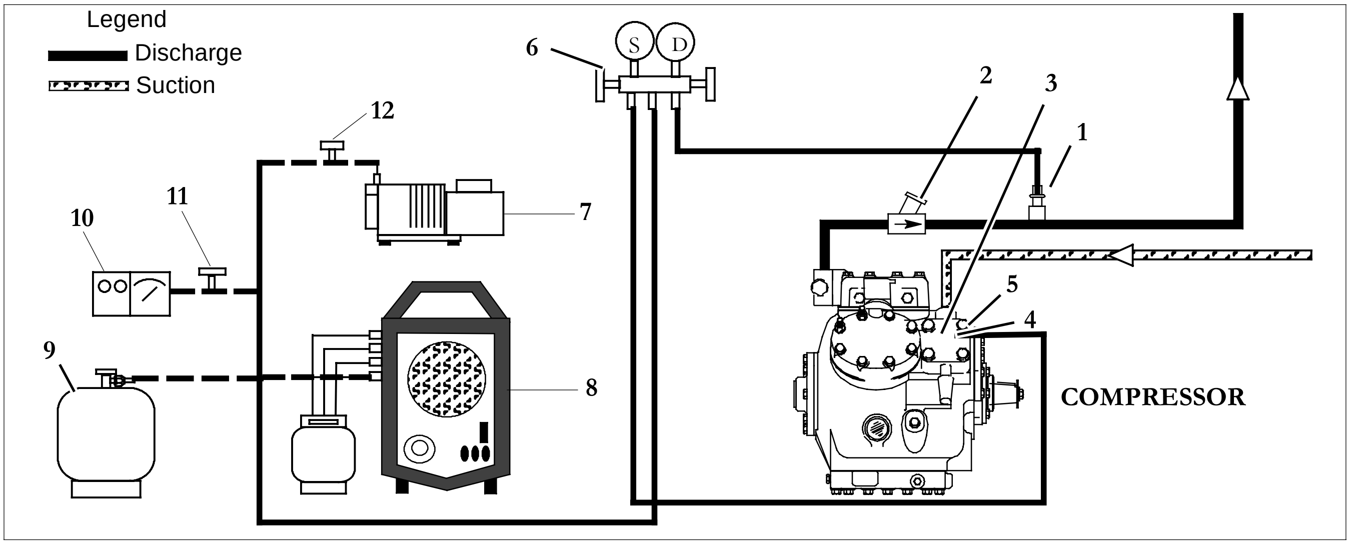
a. Connect a manifold gauge set to the system as shown in Figure 4-5 or Figure 4-6 depending on system application.

NOTE

If system is equipped with a discharge check valve and liquid line solenoid (LLS), it may be necessary to energize the LLS to remove system charge.

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

c. Recover refrigerant in accordance with reclaimer manufacturers instructions.



1. Discharge Service Port
2. Discharge Check Valve
3. High Pressure Switch
4. Service Port, Suction Service Valve
5. Low Pressure Switch
6. Manifold Gauge Set
7. Vacuum Pump
8. Reclaimer
9. Refrigerant Cylinder
10. Thermistor Vacuum Gauge
11. Vacuum Gauge Isolation Valve
12. Vacuum Pump Isolation Valve

Figure 4-5 Compressor Service Connections (Single Loop)

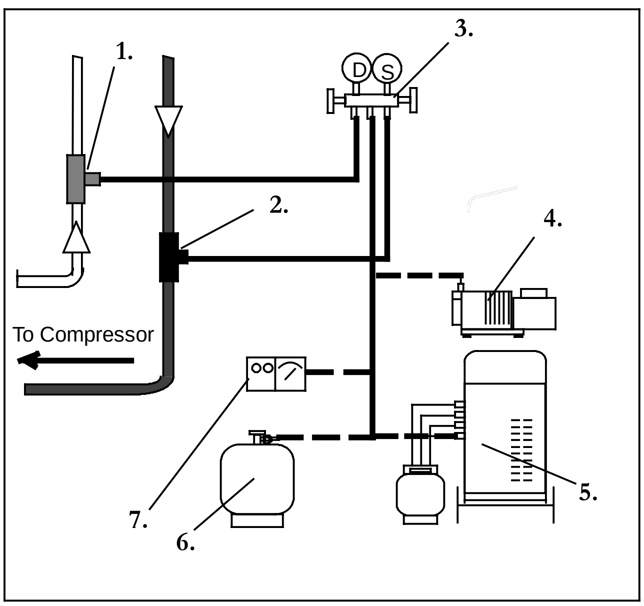


Figure 4-6 In-Line Service Connections (Dual Loop)

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

4.5 REFRIGERANT LEAK CHECK

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

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

NOTE

It must be 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 clean up.

a. Ensure filter drier service and solenoid valves (if equipped) are open.

1. Filter drier service valves should be back seated.

b. If system is without refrigerant, charge system with refrigerant vapor to build up pressure between 20 to 30 psig (1.36 to 2.04 bar).

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 soapsuds is satisfactory only for locating large leaks.

e. Remove test gas and replace filter-drier.

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

g. Charge the unit. (Refer to paragraph 4.7.)

4.6 EVACUATION AND DEHYDRATION

4.6.1 General

The presence of moisture in a refrigeration system can have many undesirable effects. The most common are copper plating, acid sludge formation, "freezing-up" of metering devices by free water, and formation of acids, resulting in metal corrosion. An evacuation should take place after a system repair (replacement of filter drier. expansion valve, solenoid valve, etc).

4.6.2 Preparation

NOTE

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

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

b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump with a minimum of 5 cfm *(8.5 m^3/hr)* volume displacement, and a good micron gauge (MCC P/N 07-00414-00).

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

4.6.3 Procedure for Evacuation and Dehydrating System

a. Remove refrigerant using a refrigerant recovery system. Refer to paragraph 4.4.1

b. The recommended method is connecting 3/8" OD refrigerant hoses designed for vacuum service as shown in Figure 4-5 or Figure 4-6, depending on system design.

c. Make sure vacuum pump valve is open.

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

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

f. Wait five minutes to see if vacuum holds.

g. Charge system. Refer to paragraph 4.7.2

4.7 ADDING REFRIGERANT TO SYSTEM

4.7.1 Checking Refrigerant Charge

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

a. Bus engine operating at high idle.

b. Unit operating in cool mode for 15 minutes.

c. Compressor discharge pressure at least 150 psig (10.21 bar). (It may be necessary to heat coach interior to raise discharge pressure.)

d. Under the above conditions, the system is properly charged when the float ball in the lower receiver tank sight glass is showing ½ to ¾ level. No refrigerant visible in upper sight glass.

4.7.2 Adding Full Charge

a. Connect a manifold gauge set to the system as shown in Figure 4-5 or Figure 4-6 depending on system application.

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

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

CAUTION

On single loop with transit style compressor, liquid refrigerant should not be added directly at discharge service valve port. Refrigerant should be added up stream of the discharge check valve, or at filter-drier king valves.

d. Note weight of refrigerant and cylinder.

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

f. When correct charge has been added (refer to paragraph 1.3, refrigerant specifications), close cylinder valve and front seat manifold discharge valve.

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

h. If necessary, prepare the cylinder as required to allow vapor charging. Start the unit and run in cooling mode.

i. Backseat the manifold suction valve and charge vapor until the correct charge has been added. Close cylinder valve and front seat suction manifold valve.

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

4.8 CHECKING FOR NONCONDENSIBLES

To check for non-condensibles, 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 discharge (in-line) service port.

d. Check saturation pressure as it corresponds to the condenser/receiver temperature. See temperature-Pressure chart Table Table 4-3 for R134a.

e. If gauge reading is 3 psig or more than the calculated P/T pressure in step d., non-condensables are present.

f. Remove refrigerant using a refrigerant recovery system.

g. Evacuate and dehydrate the system. (Refer to paragraph 4.6.)

h. Charge the unit with clean refrigerant. (Refer to paragraph 4.7.2.)

4.9 CHECKING AND REPLACING HIGH OR LOWPRESSURE CUTOUT SWITCH

4.9.1 Replacing High Or Low Pressure Switches

a. The high and low pressure switches are equipped with Schreader valves to allow removal and installation without recovering the refrigerant charge.

b. Disconnect wiring from defective switch.

c. Install new cutout switch after verifying switch settings.

4.9.2 Checking High Pressure Switches

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 system.

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

c. Connect switch to a cylinder of dry nitrogen. (SeeFigure 4-7).

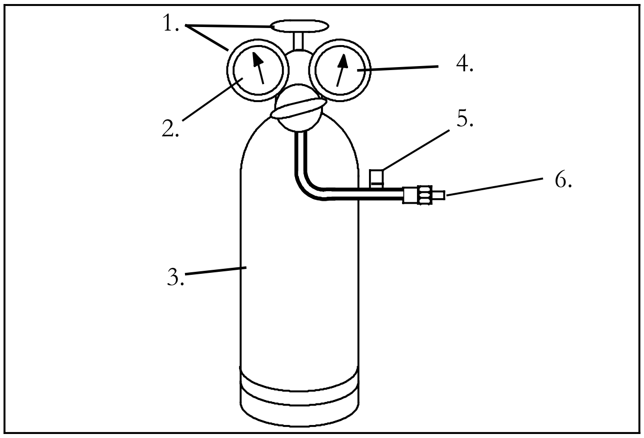


Figure 4-7 Checking High Pressure Switch

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

d. Set nitrogen pressure regulator higher than switch cutout setting. (refer to paragraph 1.3.)

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

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

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

4.9.3 Checking Low Pressure Switches

a. Disconnect wiring and remove switch from system.

b. Connect an ohmmeter across switch terminals. If the switch is good, the ohmmeter will indicate an infinite reading on an ohmmeter (no continuity).

c. Connect switch to a cylinder of dry nitrogen. (SeeFigure 4-7).

d. Set nitrogen pressure regulator higher than switch cutout setting. (refer to paragraph 1.3.)

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

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

4.10 SERVICE VALVES (Single Loop Only)

The filter/drier (High Side) service valves (Figure 4-8) are provided with a double seat and a gauge port, which allows servicing of the filter drier assembly.

Turning the valve stem counterclockwise (all the way out) will *backseat* the valve to open the line to the system 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 service port cap.

Turning the valve stem clockwise (all the way forward) will *frontseat* the valve to isolate the system and open the service port.

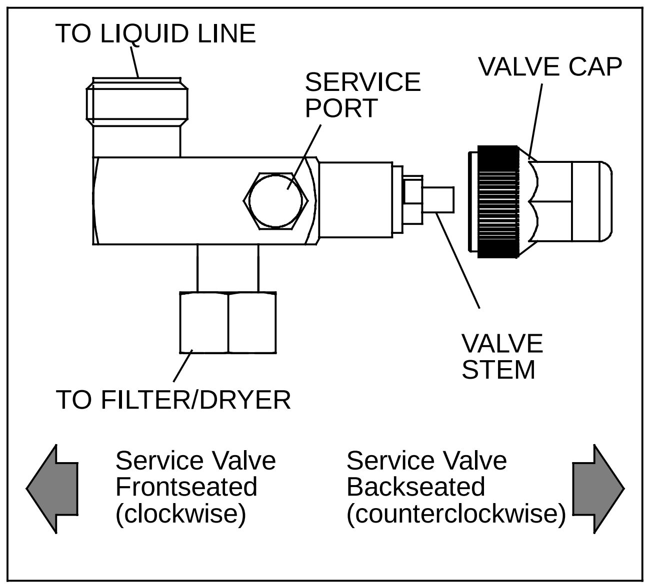


Figure 4-8 Service Valve R134a (High Side)

4.11 FILTER-DRIER

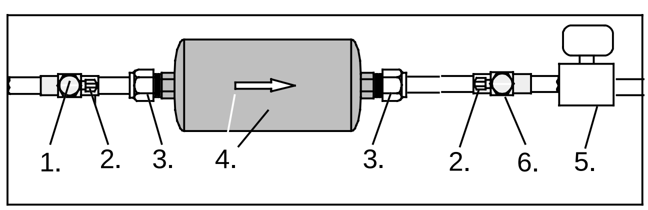


Figure 4-9 Filter-Drier Removal

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

4.11.1 To Check Filter-Drier

The filter-drier (See Figure 4-9) must be changed if the system has been opened (for any reason), or the filter drier is partially restricted. Restriction can be identified by either the outlet frosting or a temperature difference between the inlet and outlet.

4.11.2 To Replace Filter-Drier Assembly (Single Loop Only)

Filter Drier replacement can be accomplished by performing the following procedure.

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

b. Front seat the filter-drier service valves on both sides of the filter drier.

c. Connect manifold gauge set and reclaimer to the filter drier service valve access ports and reclaim any refrigerant contained in the filter drier.

d. Place a new filter-drier near the unit for immediate installation.

WARNING

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

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

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

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

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

i. Connect vacuum pump to manifold gauge set and evacuate filter to 500 microns. Close gauge valve, vacuum pump valve, and stop vacuum pump.

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

k. Remove Gauges.

4.12 SERVICING THE HEAT VALVE (If Equipped)

The heat valve (Figure 4-10) 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 coolant system, or improper voltage to the coil.

NOTE

The OEM supplied heating (hot water) Solenoid Valve is normally located outside of the AC353N rooftop air conditioning system.

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 magnetic circuit due to the omission of the coil housing or plunger.

4. Mechanical interference 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. Torn diaphragm.

4. 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.

3. Torn diaphragm.

4.12.1 Coil Replacement

a. It is not necessary to drain the coolant from the system.

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

c. Disconnect wire leads to coil.

d. Remove coil retaining screw and nameplate.

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

f. Connect wire leads and test operation.

4.12.2 Internal Part Replacement

a. Disconnect system from bus battery.

b. Open the vent fitting at the top of the outlet header of the heater coil.

c. Drain coil by opening the drain-cock on the inlet tube.

d. Disassemble valve and replace defective parts.

e. Assemble valve, refill and bleed coolant lines.

4.12.3 Replace Entire Valve

a. Disconnect system from bus battery.

b. Drain coolant from lines as previously described and disconnect hoses to valve .

c. Disconnect wire leads to coil.

d. Remove valve assembly from bracket.

e. Install new valve and re-connect hoses. It is not necessary to disassemble the valve when installing.

f. Refill and bleed coolant lines.

g. Connect wire leads and test operation.

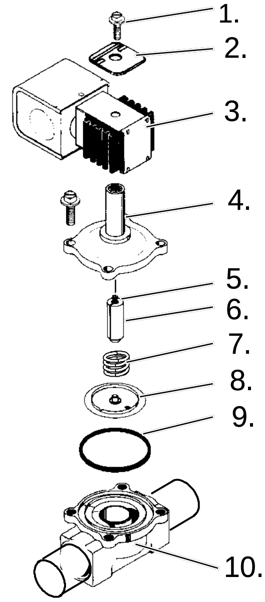


Figure 4-10 Heat Valve

1. Coil Retaining Screw
2. Nameplate
3. Coil Housing Assembly
4. Enclosing Tube & Bonnet Assembly
5. Kick- Off Spring
6. Plunger
7. Closing Spring
8. Diaphragm
9. O- Ring
10. Valve Body

4.13 REPLACING RETURN AIR FILTERS

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

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

a. Insure air conditioning system is in the off position.

b. Open the return air grille with the filter-diffuser assembly.

c. Remove and replace the filter element.

d. Close and secure the return air grill.

4.14 THERMOSTATIC EXPANSION VALVE

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

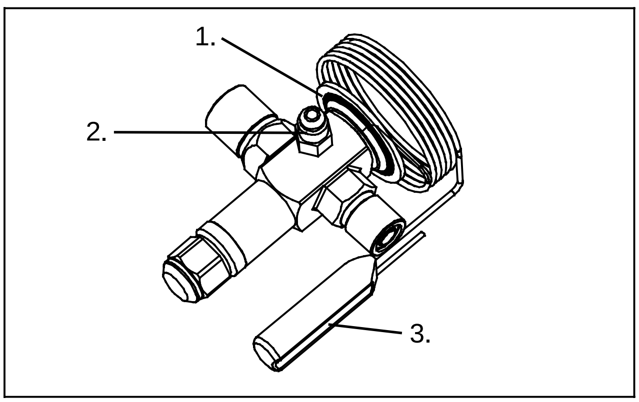


Figure 4-11 Thermostatic Expansion Valve

1.. Power Head Assembly
2.. Equalizer Connection
3.. Bulb

4.14.1 Valve Replacement

a. Recover and recycle refrigerant from the system.(refer to 4.4.1)

b. Remove insulation from expansion valve bulb. (See Figure 4-11 and Figure 4-12.)

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

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

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

NOTE

R-134a valves are adjustable. Valves are preset at the factory.

f. 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.

g. Fasten equalizer line to the expansion valve.

h. Leak check the new valve (Refer to paragraph 4.5)

i. Evacuate and recharge the system. (Refer to paragraph 4.6.)

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

k.Check refrigerant charge. (Refer to 4.7.1)

4.14.2 Superheat Measurement

NOTE

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

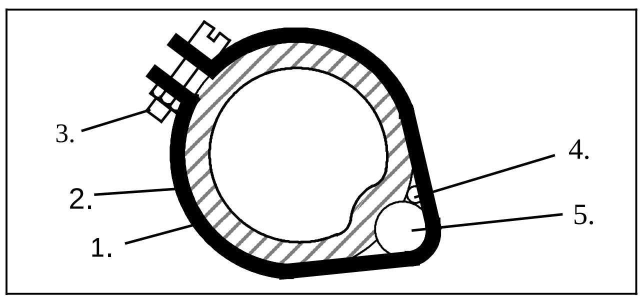


Figure 4-12 Thermostatic Expansion Valve Bulb and Thermocouple

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

a. Open top cover.

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

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

d. 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 4-12). Reinstall insulation around the bulb.

e. Connect an accurate low pressure gauge to the low pressure port.

f. Close top cover being careful to route thermocouple sensing wire and gauge hose outside the unit.

g. 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 1.3 for MOP.

h. From the temperature/pressure chart, determine the saturation temperature corresponding to the evaporator outlet pressure.

i. 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.

j. 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 superheat. Add the readings and divide by the number of readings taken to determine average superheat. See Section 1.3 for Specifications.

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

4.15 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

4.16 PRESSURE TRANSDUCER CHECKOUT

NOTE

System must be operating to check transducers.

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

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

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

CAUTION

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

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

e. Use a digital volt-ohmmeter to measure voltage across the transducer connector corresponding to terminals A & B. See Figure 4-13. The reading should be 5.0 VDC.

f. Use a digital volt-ohmmeter to measure voltage across the transducer at terminals A & C. See Figure 4-13. Compare to values in Table 4-2. A reading within two percent of the values in the table would be considered good.

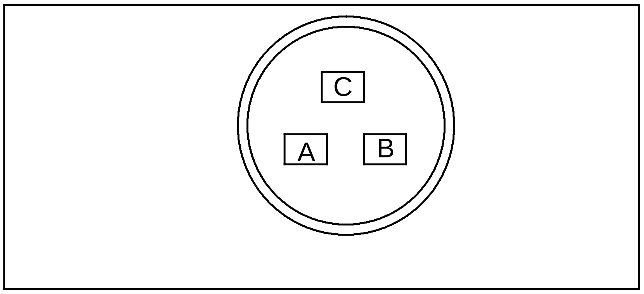


Figure 4-13 Transducer Terminal Location

4.17 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. Sensor/transducer connections are fitted with Schreader valves to facilitate replacement.

d. Connect wiring to replacement sensor or transducer.

e. Checkout replacement sensor or transducer. Refer to section 4.15 or 4.16 as applicable.

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

Table 4-2 Pressure Transducer Voltage

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

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

Temperature		Vacuum			
°F	°C	"/hg	cm/hg	kg/cm@	bar
-40	-40	14.6	49.4	37.08	0.49
.35	.37	12.3	41.6	31.25	0.42
-30	-34	9.7	32.8	24.64	0.33
-25	-32	6.7	22.7	17.00	0.23
-20	-29	3.5	11.9	8.89	0.12
-18	-28	2.1	7.1	5.33	0.07
-16	-27	0.6	2.0	1.52	0.02

Temperature		Pressure			
°F	°C	psig	kPa	kg/cm@	bar
-14	-26	0.4	1.1	0.03	0.03
-12	-24	1.2	8.3	0.08	0.08
-10	-23	2.0	13.8	0.14	0.14
-8	-22	2.9	20.0	0.20	0.20
-6	-21	3.7	25.5	0.26	0.26
-4	-20	4.6	31.7	0.32	0.32
-2	-19	5.6	36.6	0.39	0.39
0	-18	6.5	44.8	0.46	0.45
2	-17	7.6	52.4	0.53	0.52
4	-16	8.6	59.3	0.60	0.59
6	-14	9.7	66.9	0.68	0.67
8	-13	10.8	74.5	0.76	0.74
10	-12	12.0	82.7	0.84	0.83
12	-11	13.2	91.0	0.93	0.91
14	-10	14.5	100.0	1.02	1.00
16	-9	15.8	108.9	1.11	1.09
18	-8	17.1	117.9	1.20	1.18
20	-7	18.5	127.6	1.30	1.28
22	-6	19.9	137.2	1.40	1.37
24	-4	21.4	147.6	1.50	1.48
26	-3	22.9	157.9	1.61	1.58

Temperature		Pressure			
°F	°C	psig	kPa	kg/cm@	bar
28	-2	24.5	168.9	1.72	1.69
30	-1	26.1	180.0	1.84	1.80
32	0	27.8	191.7	1.95	1.92
34	1	29.6	204.1	2.08	2.04
36	2	31.3	215.8	2.20	2.16
38	3	33.2	228.9	2.33	2.29
40	4	35.1	242.0	2.47	2.42
45	7	40.1	276.5	2.82	2.76
50	10	45.5	313.7	3.20	3.14
55	13	51.2	353.0	3.60	3.53
60	16	57.4	395.8	4.04	3.96
65	18	64.1	441.0	4.51	4.42
70	21	71.1	490.2	5.00	4.90
75	24	78.7	542.6	5.53	5.43
80	27	86.7	597.8	6.10	5.98
85	29	95.3	657.1	6.70	6.57
90	32	104.3	719.1	7.33	7.19
95	35	114.0	786.0	8.01	7.86
100	38	124.2	856.4	8.73	8.56
105	41	135.0	930.8	9.49	9.31
110	43	146.4	1009	10.29	10.09
115	46	158.4	1092	11.14	10.92
120	49	171.2	1180	12.04	11.80
125	52	184.6	1273	12.98	12.73
130	54	198.7	1370	13.97	13.70
135	57	213.6	1473	15.02	14.73
140	60	229.2	1580	16.11	15.80
145	63	245.6	1693	17.27	16.93
150	66	262.9	1813	18.48	18.13
155	68	281.1	1938	19.76	19.37

SECTION 5

ELECTRICAL

5.1 INTRODUCTION

This section includes electrical wiring schematics. The schematics shown in this section provides information for the Eco353N model rooftop air conditioning units which are fitted with four (4) or six (6) double-shafted evaporator blower/motor assemblies and four (4) or six (6) condenser fan motors. Figure 5-1 thru Figure 5-6 shows the EnviroMATE controller used with the Eco353N system.

UNIT	CONTROLLER	FIGURE NUMBERS
Eco353N Single Loop (12/24 VDC)	EnviroMATE	Figure 5-2 Thru Figure 5-4
Eco353N Dual Loop (12 VDC- PM Motors)	EnviroMATE	Figure 5-5 Thru Figure 5-6
Eco353N Dual Loop (12 VDC- Brushless Motors)	EnviroMATE	Figure 5-7 Thru Figure 5-9

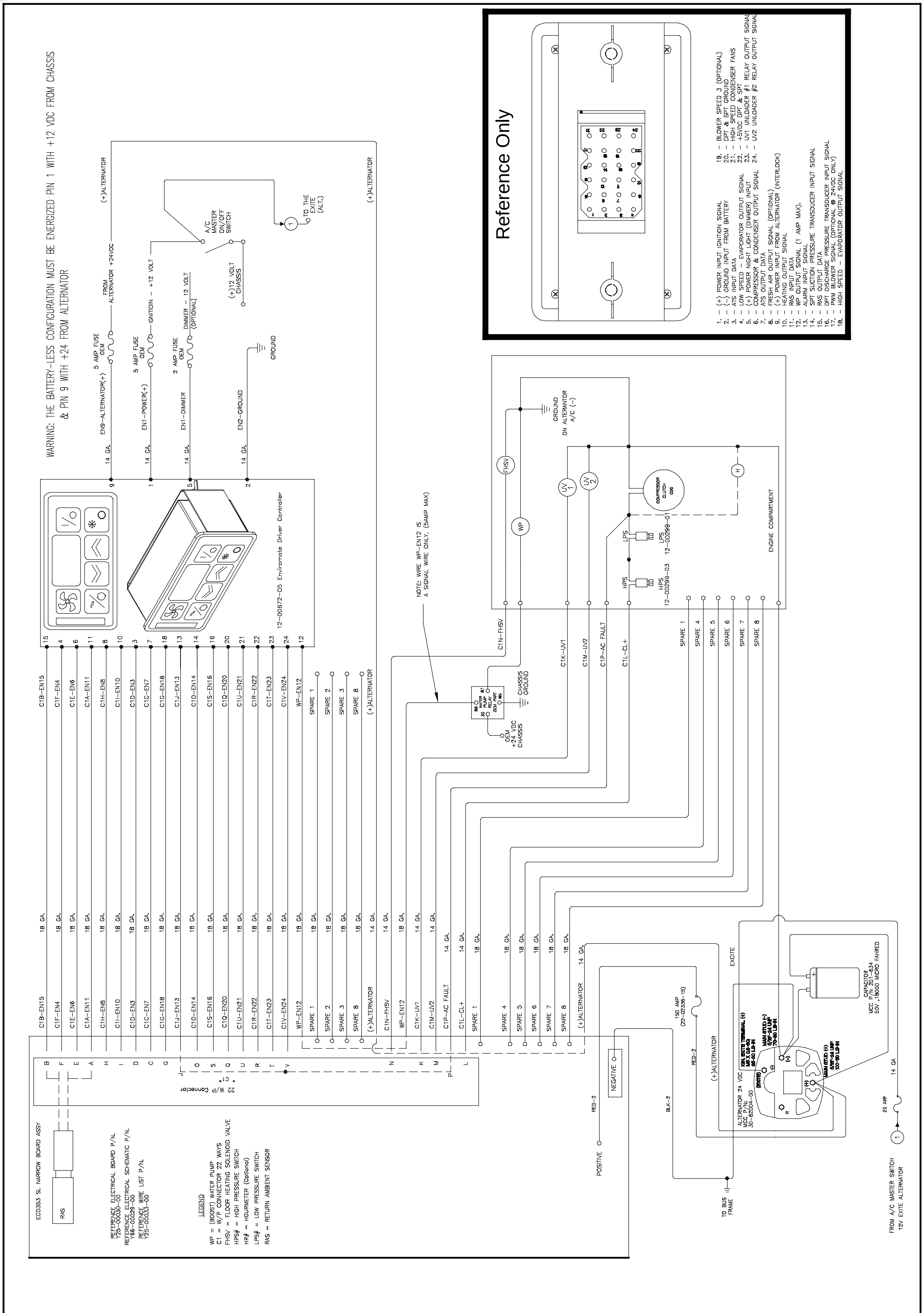
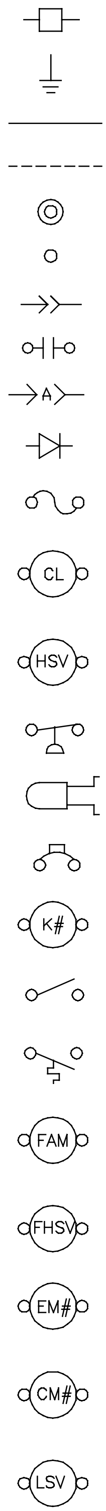


Figure 5-1 Installation Schematic (Single Loop - Enviromate 12/24 VDC)

SYMBOLS



INDICATES CONNECTOR TERMINAL

INDICATES GROUND

INDICATES A WIRE

INDICATES A WIRE (OEM SUPPLIED OR INTERNAL HVAC)

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 CLUTCH COIL

INDICATES HEATING SOLENOID COIL

INDICATES PRESSURE SWITCH NC

INDICATES TEMPERATURE SENSOR

INDICATES MANUAL RESET BREAKER

INDICATES RELAY COIL

INDICATES SWITCH N/O

INDICATES TEMPERATURE SWITCH NO

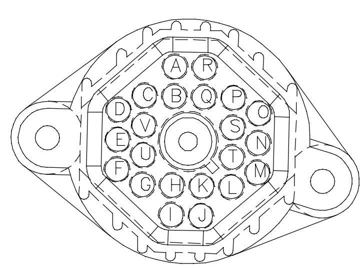
INDICATES FLOOR AIR MOTOR

INDICATES FLOOR SOLENOID COIL

INDICATES EVAPORATOR MOTOR

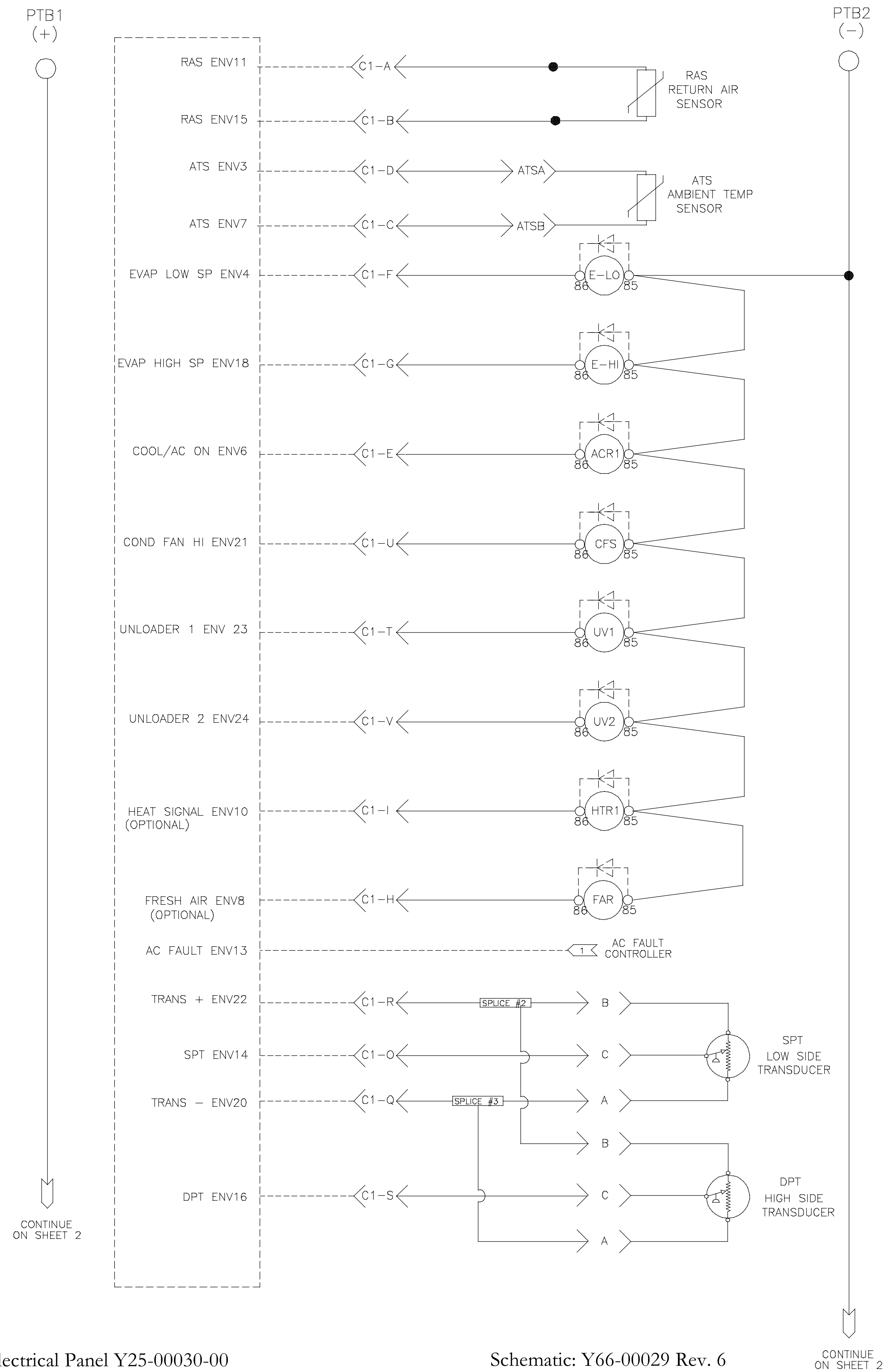
INDICATES CONDENSER MOTOR

INDICATES LIQUID SOLENOID COIL



22-01565-00
CONNECTOR (REAR VIEW-WIRE SIDE)
(REFERENCE ONLY)

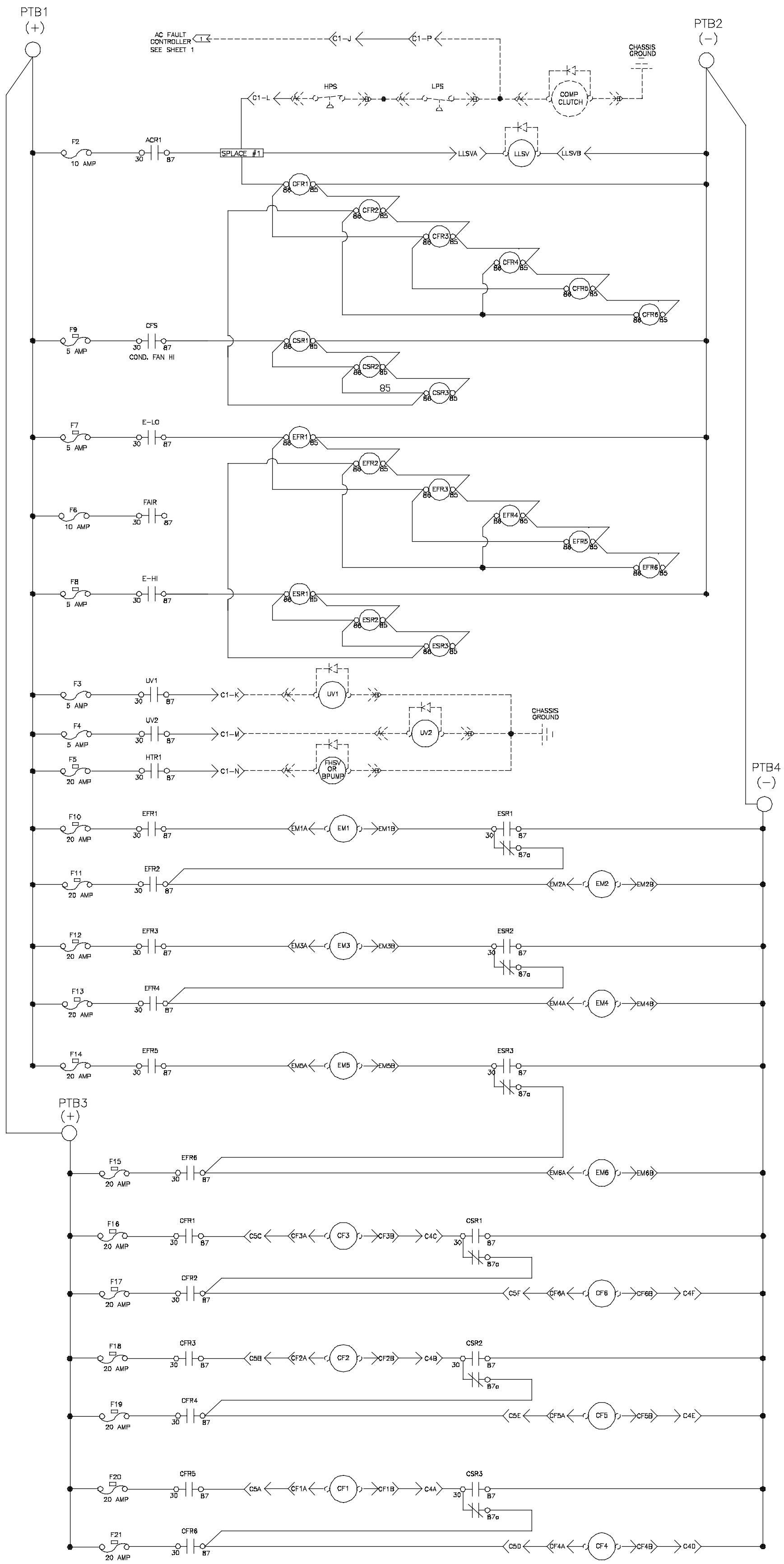
Figure 5-2 Symbols/Diagrams



Electrical Panel Y25-00030-00

Schematic: Y66-00029 Rev. 6

Figure 5-3 Single Loop Logic Circuit (Single Loop - Enviromate 12/24 VDC)

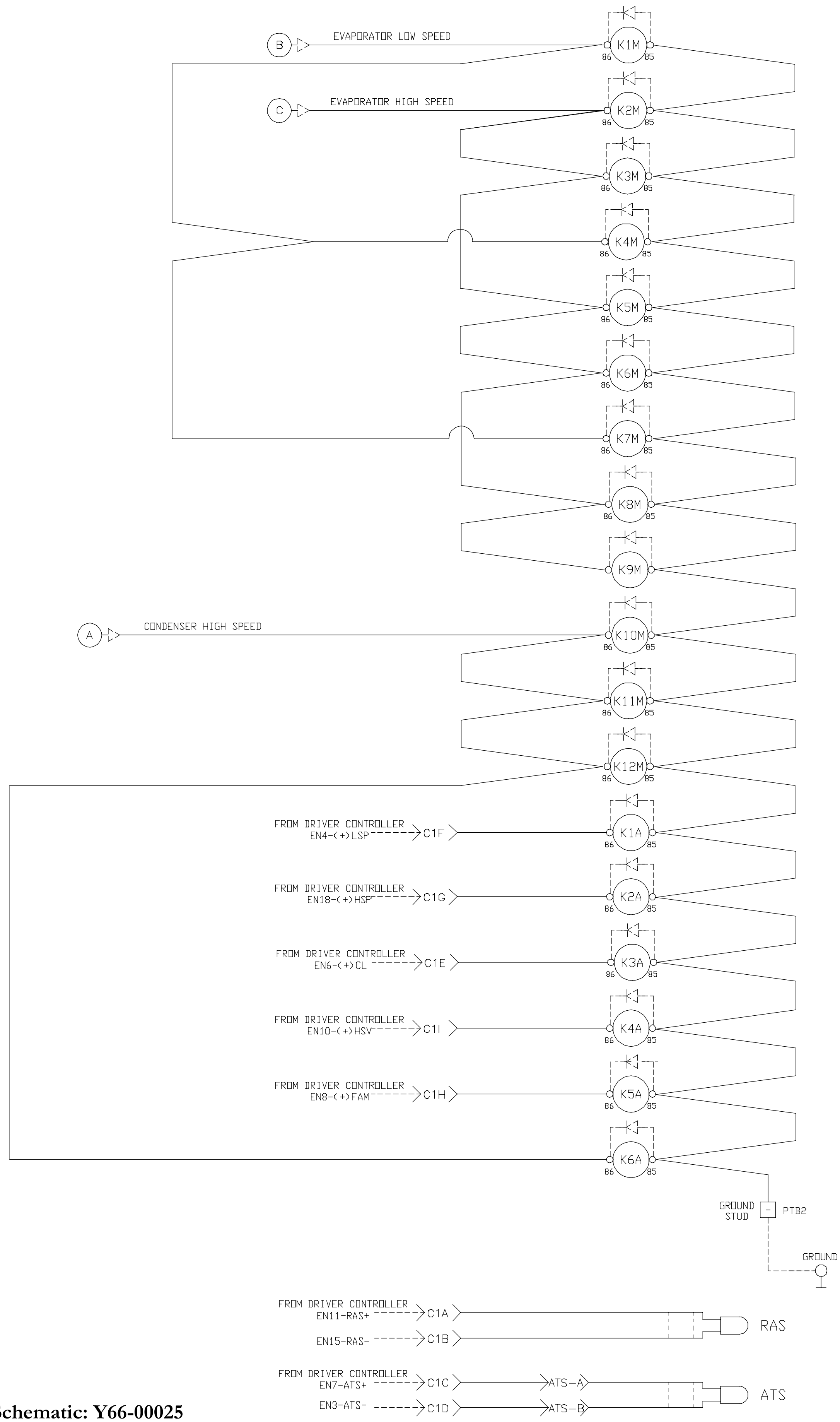


Electrical Panel Y25-00030-00

Schematic: Y66-00029 Rev. 6

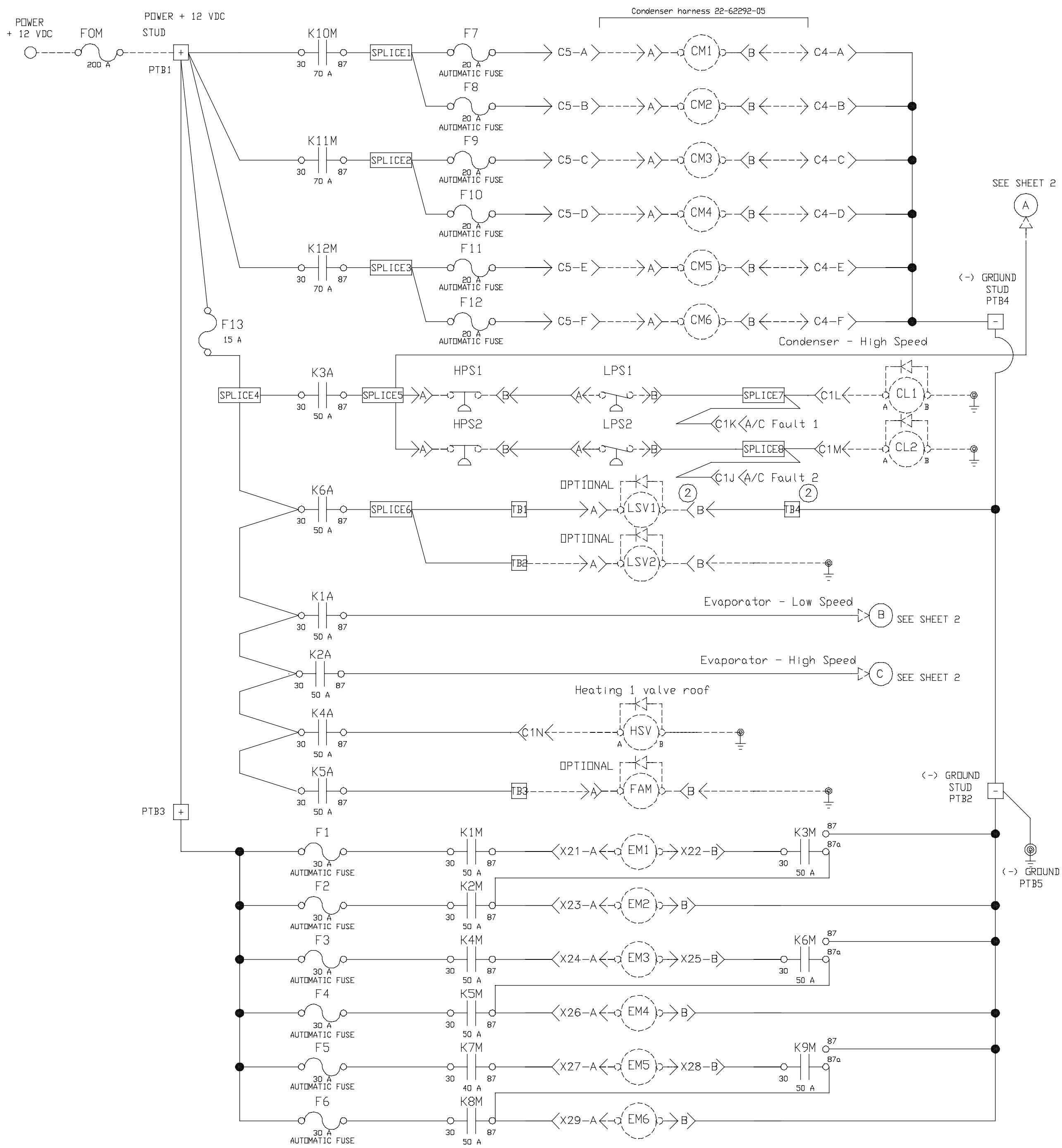
Figure 5-4 Single Loop Power Circuit (Single Loop - Enviromate 12/24 VDC)

Mobile Climate Control



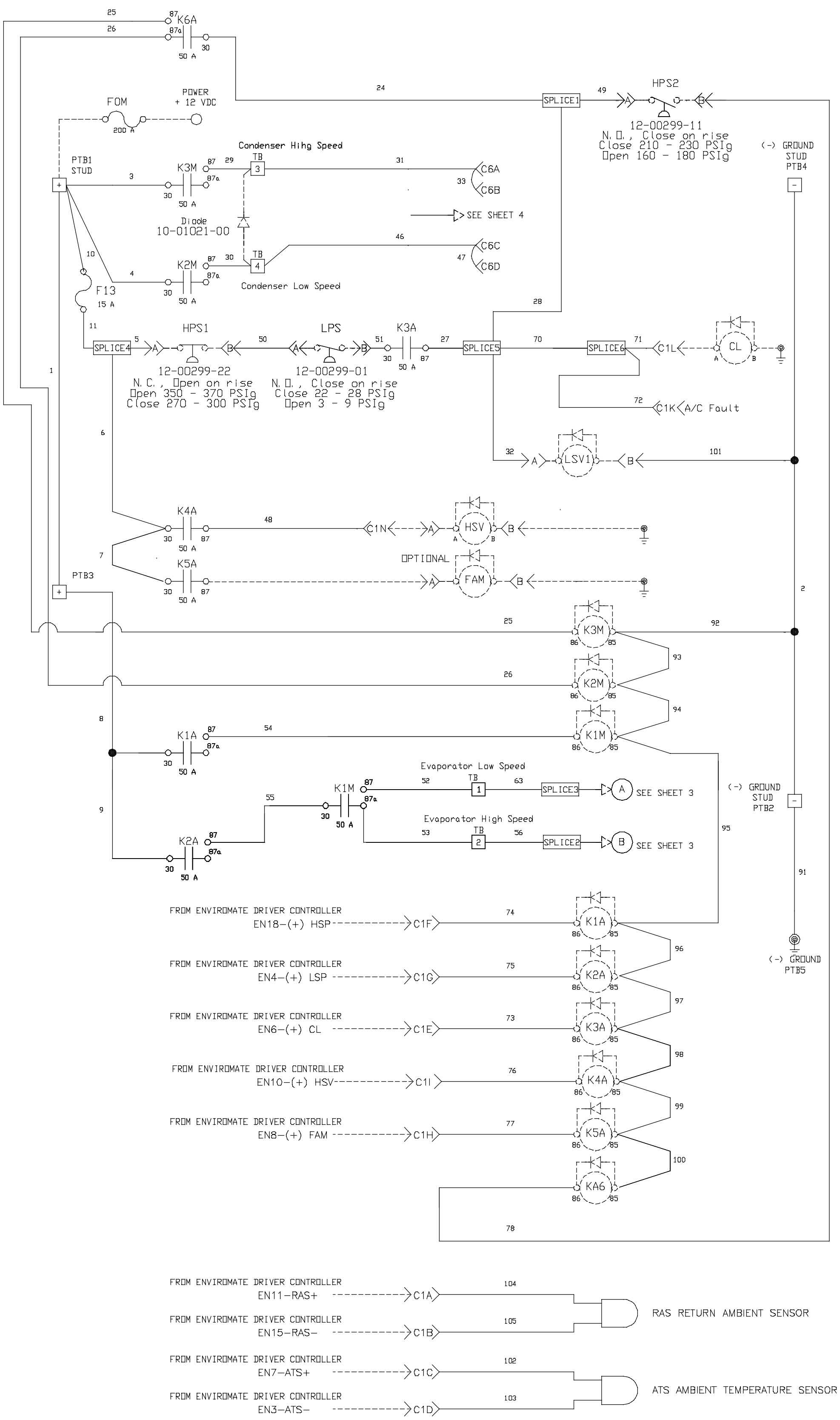
Schematic: Y66-00025

Figure 5-5 Dual Loop Logic Circuit



Schematic: Y66-00025

Figure 5-6 Dual Loop Power Circuit



Schematic: Y66-00051-00

Figure 5-7 Single Loop Control Circuit (12VDC Brushless)

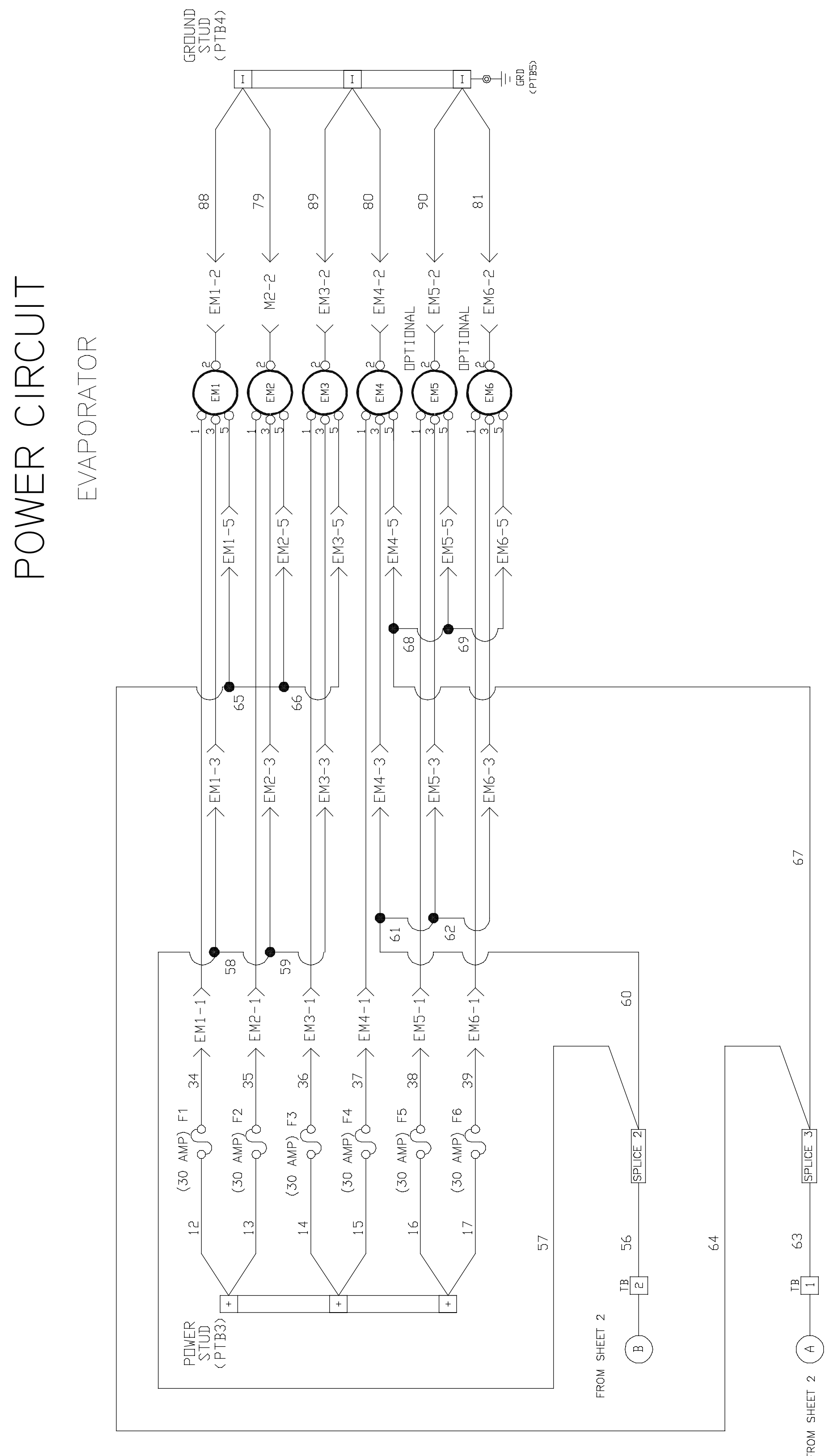
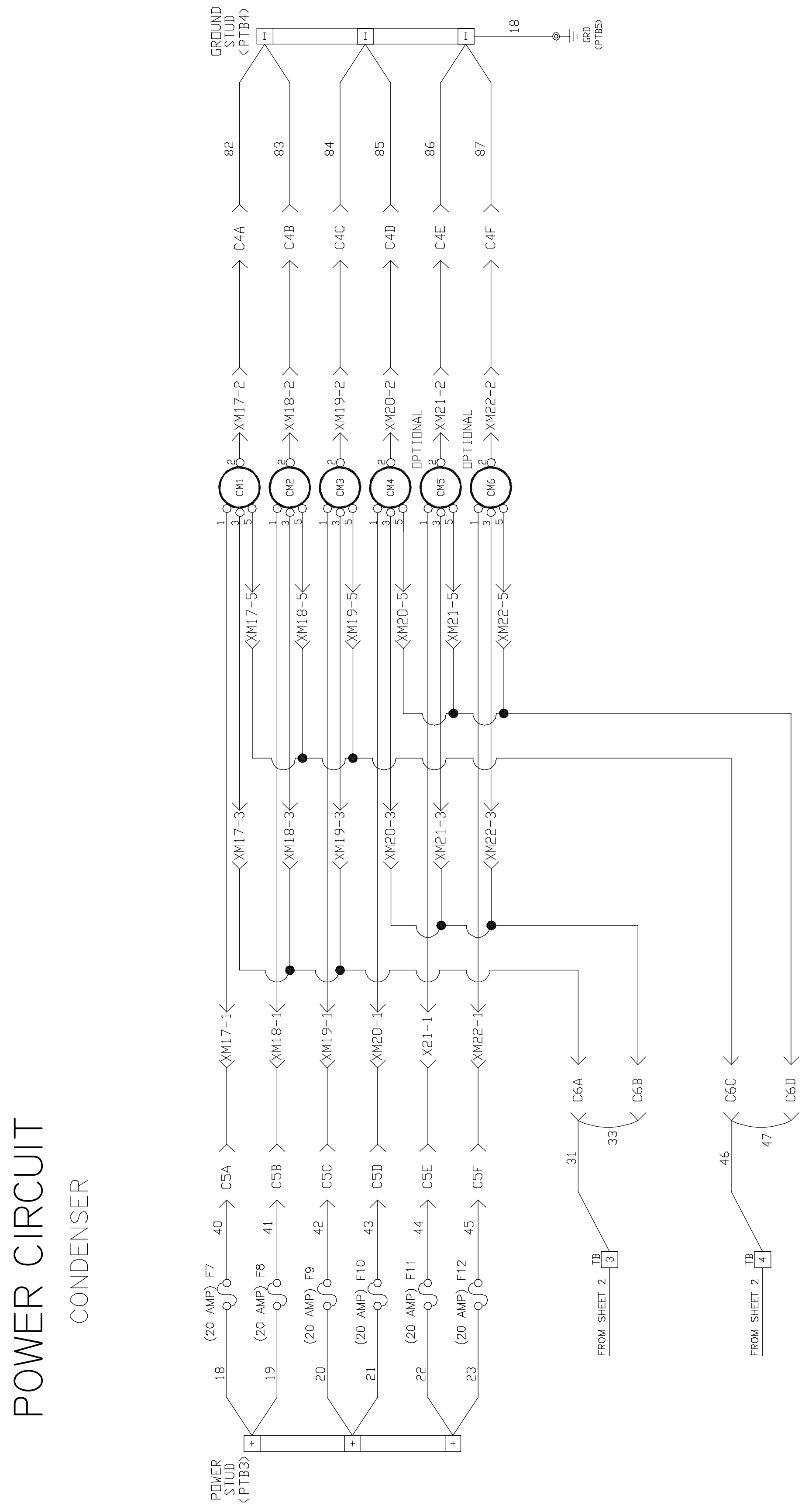


Figure 5-8 Single Loop Power Circuit Evaporator (12VDC Brushless)

Schematic: Y66-00051-00



Schematic: Y66-00051-00

Figure 5-9 Single Loop Power Circuit Condenser (12VDC Brushless)

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