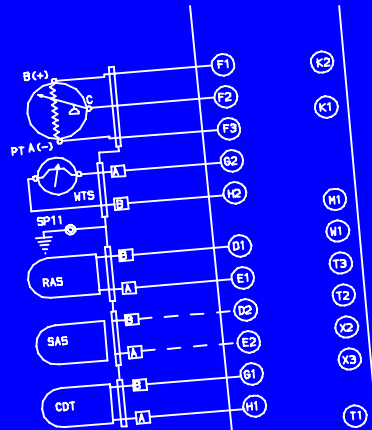




# Transport Air Conditioning



## OPERATION AND SERVICE

for

# AvantAC<sup>t</sup> Hybrid

Roof Top Air Conditioning Components



**TRANSICOLD**

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# **OPERATION AND SERVICE MANUAL**

**BUS  
AIR CONDITIONING  
EQUIPMENT**

**AvantAC<sup>t</sup>  
Hybrid**

**Roof Top Air Conditioning Components**

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## SAFETY SUMMARY

### SAFETY PRECAUTIONS

Your Carrier Transicold air-conditioning unit has been designed with the safety of the operator in mind. During normal operation, all moving parts are fully enclosed to help prevent injury. During all inspections and problem troubleshooting, you may be exposed to moving parts; please stay clear of all moving parts when the unit is in operation and when the 24VDC on/off switch is in the ON position and the main disconnect switch is in the RUN position.



**Be aware of HIGH VOLTAGE supplied to this equipment from the vehicle high voltage system and/or shore power source and that the equipment may start automatically. Do not attempt to service this equipment without proper training. Electrical power within this equipment is sufficiently high enough to cause serious injury or death.**

**Before servicing this equipment:**

- 1. If the vehicle is equipped with shore power, ensure the shore power supply is OFF and then disconnect the plug. When reconnecting, ensure the power plug is clean and dry before connecting to the electrical outlet/receptacle. Ensure power supply is correct for this application.**
- 2. Ensure the main disconnect from the vehicle high voltage power source is OFF, vehicle engine is off and ignition system is locked out.**
- 3. Both AC and DC power is used in this equipment. Test for both AC and DC voltage to confirm there is no power before working on any circuit or electrical component.**

### GENERAL SAFETY NOTICES

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

#### FIRST AID

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

#### OPERATING PRECAUTIONS

Always wear safety glasses.

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

No work should be performed on the unit until all circuit breakers, the 24VDC on/off switch and the main disconnect switch are off.

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

The unit is automatically controlled by the environmental temperature, which may allow the system to start at any time. The compressor, evaporator and condenser motors are all powered by nominal 480VAC 3 phase. No work should be performed on the unit until the 24VDC on/off switch is in the off position, the main disconnect switch is turned off and the vehicle engine is turned off.

The unit can be equipped with heating coils; they will be connected to the vehicle's engine pressurized cooling system. Under normal operating conditions, the engine coolant is under very high pressure and can be very hot. Contact with hot coolant can cause severe burns.

The refrigerant contained in the refrigerant system of your unit can cause frostbite, severe burns, or blindness when in direct contact with skin or eyes. For this reason, and because of legislation regarding the handling of refrigerants during system service, we recommend that, whenever your unit requires service of the refrigerant system, you contact your nearest Carrier Transicold authorized repair facility for service.

Beware of unannounced starting of the evaporator and condenser fans. Do not open the condenser fan grille or evaporator access panels before turning the 24VDC on/off switch to the OFF position and the main disconnect switch to the OFF position.



Be sure power is turned off before working on motors, controllers, solenoid valves and electrical control switches. 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.

In case of electrical fire, turn the 24VDC on/off switch and the main disconnect switch to the OFF position and extinguish with CO<sub>2</sub> (never use water).

## **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 aware of **HIGH VOLTAGE** supplied to this equipment from the vehicle high voltage system and/or shore power source and that the equipment may start automatically. Do not attempt to service this equipment without proper training. Electrical power within this equipment is sufficiently high enough to cause serious injury or death.

Before servicing this equipment:

1. If the vehicle is equipped with shore power, ensure the shore power supply is OFF and then disconnect the plug. When reconnecting, ensure the power plug is clean and dry before connecting to the electrical outlet/receptacle. Ensure power supply is correct for this application.
2. Ensure the main disconnect from the vehicle high voltage power source is OFF, vehicle engine is off and ignition system is locked out.
3. Both AC and DC power is used in this equipment. Test for both AC and DC voltage to confirm there is no power before working on any circuit or electrical component.

#### **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**

Oil vapor in piping stubs can ignite from torch flame and cause serious injury. Exercise extreme care when brazing, and keep brazing cloth and fire extinguisher handy for emergency use.



## CAUTION

Do not under any circumstances attempt to service the Inverter. Should a problem develop with these components, replace them.



## CAUTION

Under no circumstances should a technician electrically probe the inverter at any point, other than the connector terminals where the harness attaches. Improper use of of voltmeters, jumper wires, continuity tester, etc. can permanently damage the processor.



## 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 Systems Modules. Damage to the wiring harness can occur.

## SECTION 1

### DESCRIPTION

#### 1.1 INTRODUCTION

This manual contains operating instructions, service instructions and electrical data for the AvantAC<sup>†</sup> Electric Roof-Top Air Conditioning and Heating System components furnished by Carrier Transicold. Additional support manuals are referenced in Table 1-1.

The Carrier Transicold AvantAC series modules are of lightweight frame construction, designed to be installed on the vehicle roof.

AvantAC systems (see Figure 1-1.) consists of one or more roof top modules and a driver's display. To complete the system, the air conditioning and heating equipment interfaces with electrical cabling, engine coolant piping (for heating), duct work and other components installed in the vehicle.

Electric power required for operating the components is provided by the vehicle manufacturer.

The control circuit utilizes the vehicles 24VDC as its power source. Control of the system is achieved by a network of microprocessors which maintains the vehicle's interior temperature at the desired set point.

#### 1.2 CONFIGURATION IDENTIFICATION

Equipment identification information is provided on a decal located inside the module. See Figure 1-2, Figure 1-3 and Figure 1-4.

The decal provides the Serial Number and PID (Parts Identification Number). The PID number provides information on differences in detail parts.

#### 1.3 OPTION DESCRIPTION

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

##### 1.3.1 Module

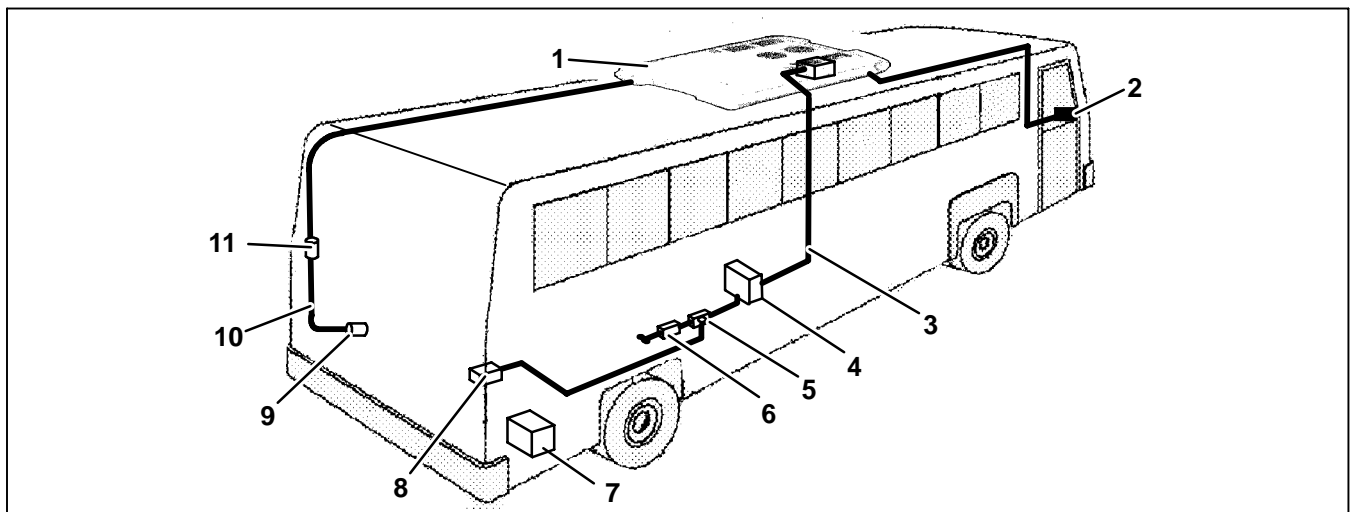
The rooftop module may be a standard (single), extended (dual) or water cooler module. The single and water cooler modules consists of one complete refrigeration system, electrical system and control system. The dual module consists of two independent refrigeration systems with single, extended electrical and control systems.

##### 1.3.2 Heating

The unit may be equipped with engine coolant heat. The heating loop may be fitted with a heat solenoid or motor driven valve and a separate dedicated coolant boost pump.

**Table 1-1 Additional Support Manuals**

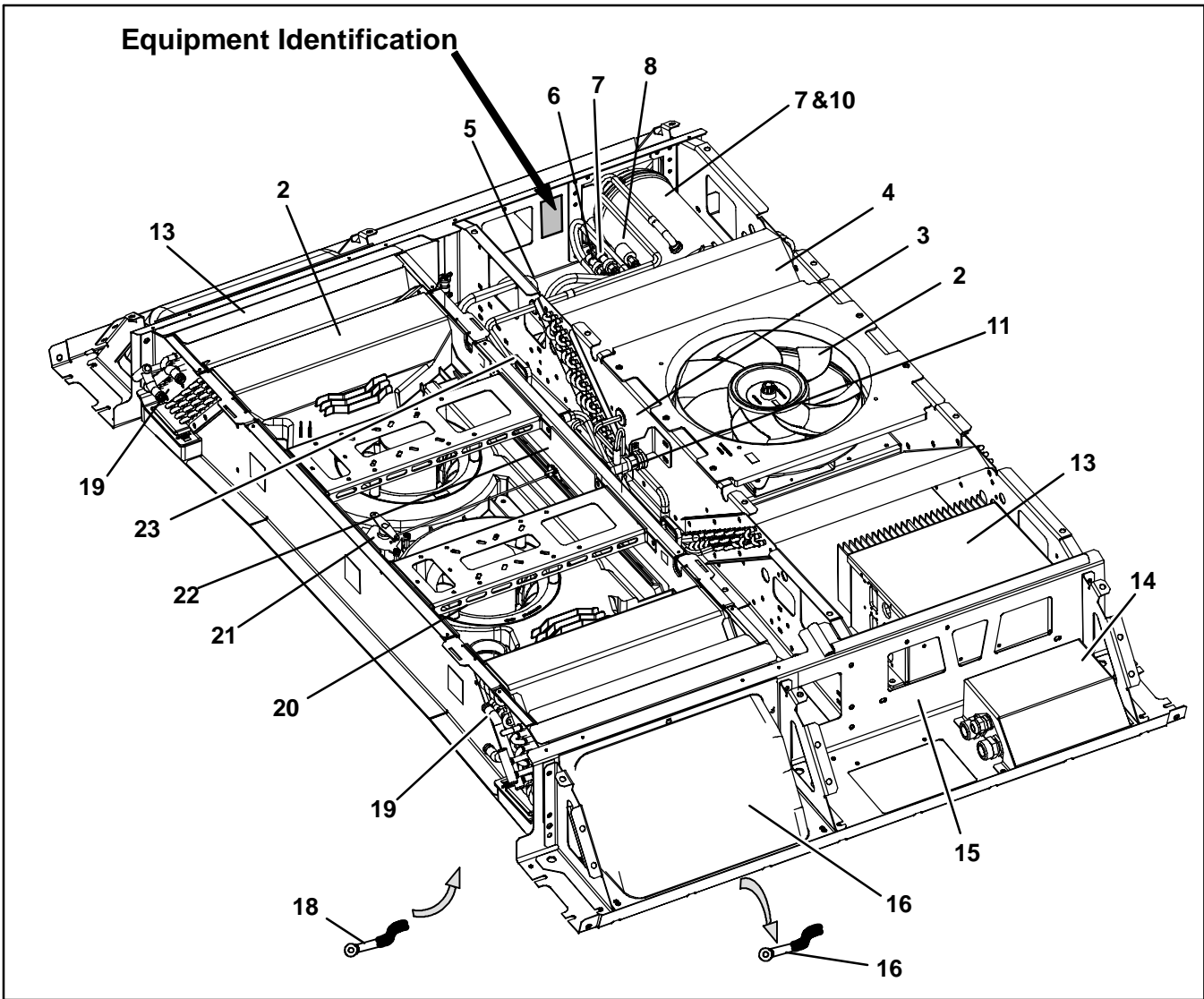
MANUAL/FORM NUMBER	EQUIPMENT COVERED	TYPE OF MANUAL
T-314PL	AvantAC Electric	Parts List
T-337	AvantAC Electric	Operator's Manual



**Figure 1-1 Component Identification**

- |  |                          |
|--|--------------------------|
| 1. Rooftop Module                            | 7. Battery               |
| 2. Driver's Display                          | 8. Power (Battery Pack)  |
| 3. Module Power Harness                      | 9. Coolant Pump          |
| 4. Fuse Box Assembly                         | 10. Coolant Water Piping |
| 5. Power Source Selection Switch (if fitted) | 11. Coolant Heat Valve   |
| 6. Shore Power Access (if fitted)            |                          |

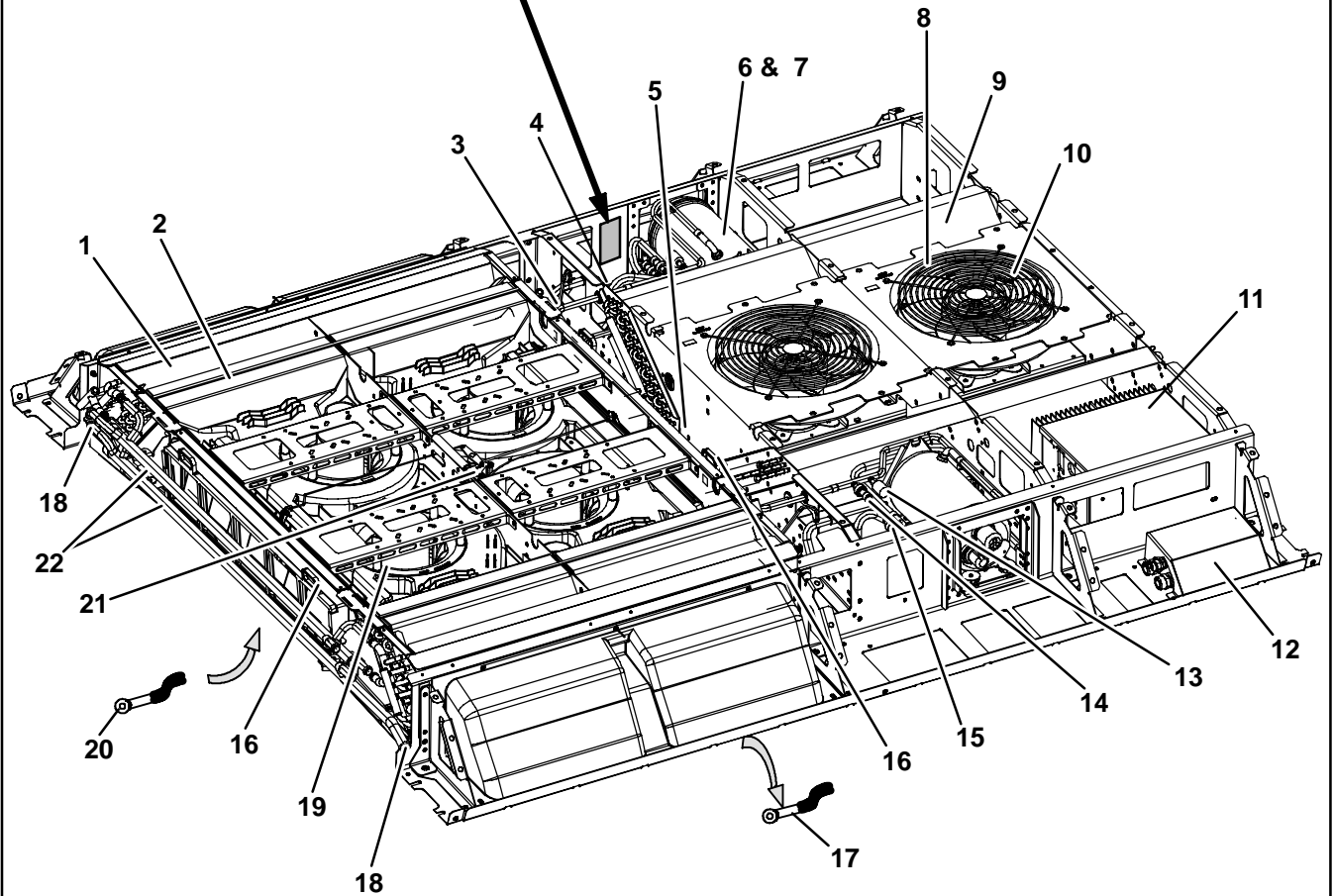
## Equipment Identification



- |                                  |  |
|----------------------------------|--|
| 1. Heater Coil (2)               | 14. Control Box  |
| 2. Evaporator Coil (2)           | 15. Ambient Temperature Sensor (Location)                      |
| 3. Accumulator                   | 16. Supply Air Duct (2)  |
| 4. Suction Pressure Transducer   | 17. Supply Air Temperature Sensor (Mounted In Supply Air Duct) |
| 5. Discharge Pressure Transducer | 18. Return Air Temperature Sensor (Mounted In Return Air Duct) |
| 6. Discharge Pressure Switch     | 19. Coolant Connections  |
| 7. Compressor Temperature Switch | 20. Evaporator Fan (2)   |
| 8. Compressor                    | 21. Damper Operator  |
| 9. Condenser Coil (2)            | 22. Damper   |
| 10. Fusible Plug (Location)      | 23. Air Filter   |
| 11. Condenser Fan                |  |
| 12. Thermal Expansion Valve      |  |
| 13. Inverter/Microprocessor      |  |

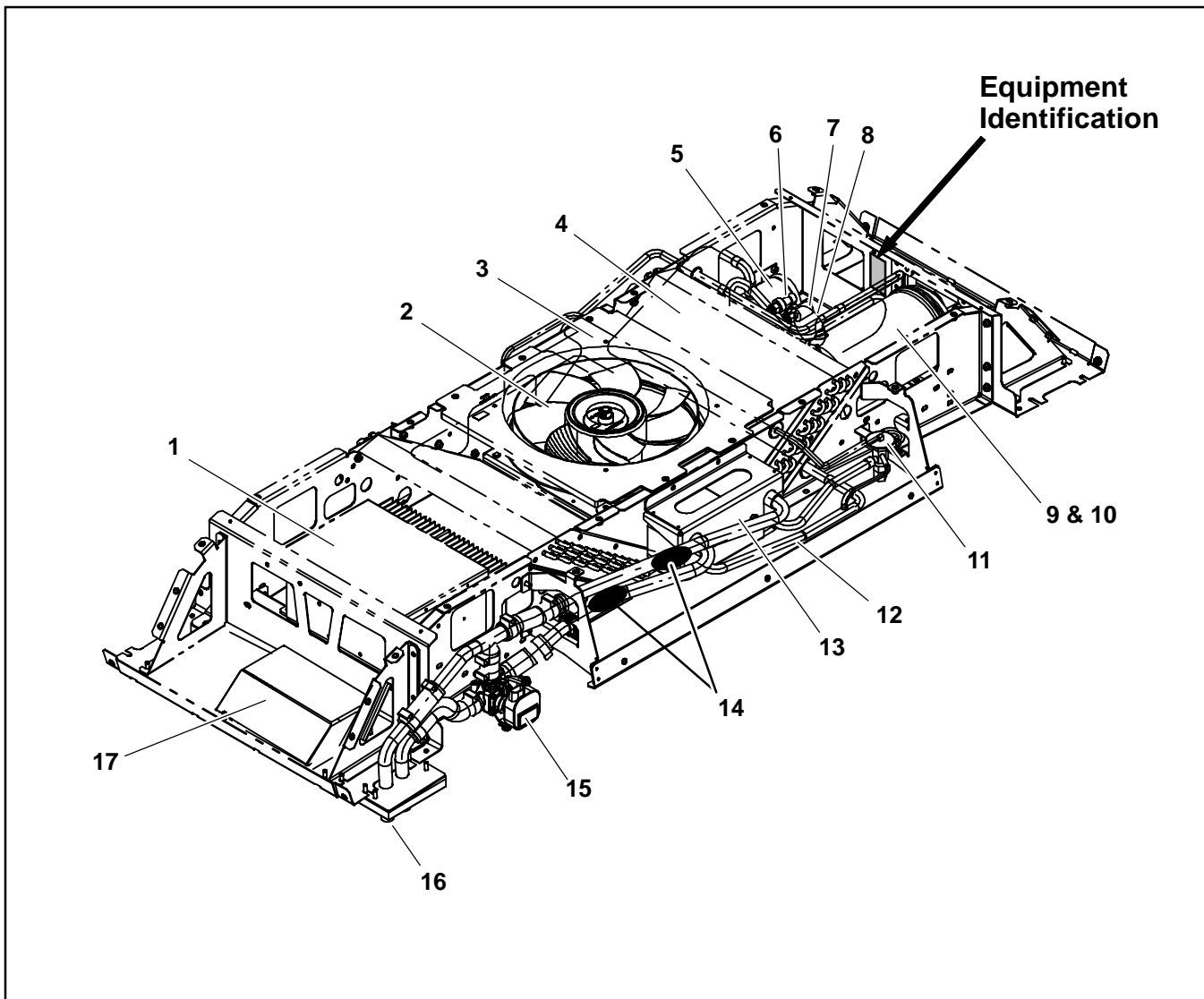
**Figure 1-2 Standard Module Components**

## Equipment Identification



- |   |  |
|---|--|
| 1. Heater Coil (2)                        | 13. Discharge Pressure Transducer (2)                          |
| 2. Evaporator Coil (2)                    | 14. Discharge Pressure Switch (2)                              |
| 3. Thermal Expansion Valve (Location) (2) | 15. Suction Pressure Transducer (2)                            |
| 4. Accumulator (Location) (2)             | 16. Air Filter (2)   |
| 5. Damper (2)                             | 17. Supply Air Temperature Sensor (Mounted In Supply Air Duct) |
| 6. Compressor (2)                         | 18. Coolant Connection (2)                                     |
| 7. Compressor Temperature Switch (2)      | 19. Evaporator Fan (4)   |
| 8. Fusible Plug (Location) (2)            | 20. Return Air Temperature Sensor (Mounted In Return Air Duct) |
| 9. Condenser Coil (2)                     | 21. Damper Operator  |
| 10. Condenser Fan (2)                     | 22. Coolant Crossover Pipes                                    |
| 11. Inverter/Microprocessor               |  |
| 12. Control Box                           |  |

**Figure 1-3 Extended Module Components**



- |                                  |                                     |
|----------------------------------|-------------------------------------|
| 1. Inverter/Microprocessor       | 10. Compressor                      |
| 2. Condenser Fan                 | 11. Thermal Expansion Valve (TXV)   |
| 3. Fusible Plug (Location)       | 12. TXV Bulb                        |
| 4. Condenser Coil (2)            | 13. Heat Exchanger                  |
| 5. Accumulator                   | 14. Coolant Temperature Sensors (2) |
| 6. Suction Pressure Transducer   | 15. 3-Way Valve                     |
| 7. Discharge Pressure Transducer | 16. Cooler Connections              |
| 8. Discharge Pressure Switch     | 17. Control Box                     |
| 9. Compressor Temperature Switch |                                     |

**Figure 1-4 Water Cooler Module Components**

## **1.4 GENERAL DESCRIPTION**

### **1.4.1 Main Disconnect Switch**

The main disconnect switch is mounted near the power supply. Actual location is determined by the coach builder. It is used to connect and disconnect 650VDC power from the rest of the system.

### **1.4.2 24VDC On/Off Switch**

A 24VDC on/off switch is mounted on the vehicle dashboard or other location, depending on the application. It is used to control the 24VDC power supply to the inverter, displays, heat valves, roof top modules and heat pump relay.

### **1.4.3 Driver's Display**

If a Driver's Display is utilized, it may be mounted on the vehicle dashboard. It is used to accept the driver's input and communicate with the inverter (See Figure 2-1).

### **1.4.4 Rooftop Module**

The rooftop module (see Figure 1-2) is comprised of the refrigeration system, inverter/microprocessor, heating system and fresh air system. All components are accessible by removing the covers. Descriptions of the systems are provided in the following sub paragraphs.

### **1.4.5 Rooftop Module - Extended**

The extended rooftop module (see Figure 1-3) has the same components as a rooftop module except that it has two refrigeration systems and a larger heating system. All components are accessible by removing the covers. Descriptions of the systems are provided in the following sub paragraphs.

### **1.4.6 Rooftop Module - Water Cooler**

The water cooler rooftop module (see Figure 1-4) is comprised of the refrigeration system and inverter/microprocessor. A refrigerant to coolant heat exchanger and 3-way valve replaces the evaporator coil and fan found in the other modules. All components are accessible by removing the covers. Descriptions of the systems are provided in the following sub paragraphs.

### **1.4.7 Cooling System - Rooftop Module**

The refrigeration system includes the evaporator coils, accumulator, suction pressure transducer, compressor, compressor temperature switch, high pressure switch and discharge pressure transducer, condenser coils, thermal expansion valve (TXV), fusible plug, condenser fan and motor assembly, evaporator fan and motor assemblies, a return air temperature sensor and a supply air temperature sensor.

The compressor raises the pressure and the temperature of the refrigerant and forces it thru the discharge lines into the condenser tubes. The condenser fan(s) 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 TXV.

The TXV meters the flow of liquid refrigerant entering the evaporator coils.

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

The accumulator collects any liquid refrigerant returning in the suction line and prevents liquid return to the compressor. The system is also fitted with a fusible plug which protects the system from unsafe high pressure conditions. A return air sensor measures temperature of the air entering the coils and sends an electrical signal to the microprocessor.

### **1.4.8 Cooling System - Water Cooler**

The refrigeration system includes the coolant heat exchanger, accumulator, suction pressure transducer, compressor, compressor temperature switch, high pressure switch and discharge pressure transducer, condenser coils, thermal expansion valve (TXV), fusible plug, condenser fan and motor assembly and a 3-way valve.

The compressor raises the pressure and the temperature of the refrigerant and forces it thru the discharge lines into the condenser tubes. The condenser fan circulates surrounding air (which is at a temperature lower than the refrigerant) over the outside of the condenser tubes. Heat transfer is established from the refrigerant (inside the tubes) to the condenser air (flowing over the tubes). The condenser tubes have fins designed to improve the transfer of heat from the refrigerant gas to the air; this removal of heat causes the refrigerant to liquefy, thus liquid refrigerant leaves the condenser and flows to the TXV.

The TXV meters the flow of liquid refrigerant entering the the coolant heat exchanger.

The liquid refrigerant that flows into the coolant heat exchanger is colder than the coolant that is circulated thru the heat exchanger. Heat transfer is established from coolant to the refrigerant. Coolant flow is controlled by the 3-way valve.

The accumulator collects any liquid refrigerant returning in the suction line and prevents liquid return to the compressor. The system is also fitted with a fusible plug which protects the system from unsafe high pressure conditions.

### **1.4.9 Heating System**

The heating system includes the heating coils, coolant crossover pipes, heat valve and (if fitted) a coolant boost pump.

The heating coils provide heat transfer surface for transferring heat from engine coolant water circulating inside the tubes to air circulating over the outside of the tubes, thus providing heating. The evaporator fans circulate the air over the coils.

A heat valve controls the flow of engine coolant water to the heating coils upon receipt of a signal from the microprocessor.

If fitted, a coolant boost pump is used to increase the flow of engine coolant to the heating coils from the vehicle.

#### 1.4.10 Fresh Air System

The fresh air system (if fitted) includes the damper operator and damper. In the automatic mode, as return air temperature approaches set point, a signal is provided by the microprocessor to open the damper. Fresh air enters the return air stream allowing delivery of fresh, conditioned air to the vehicle interior. In the vent mode, the evaporator fans are operated and the damper is opened to the pre-set position. The vent mode can utilize the outside ambient air to act as a temperature compensating medium without operating the cooling or heating system.

#### 1.4.11 Power & Distribution System

The power distribution system consists of the power box, a power source selection switch and shore power box (if equipped), then the module contactor box and the inverter/microprocessor in each module. Power flows through the power box or external source to the Control Box. The Control Box contains the individual set of fuses for power to each module. At each module, power flows through the module contactor box to the inverter. The inverter provides power to the evaporator fan motors, condenser fan motor(s) and compressor(s).

Low voltage power to the module contactor coil flows from the inverter through the evaporator fan motor internal protectors, condenser fan motor internal protector, compressor temperature switch and high pressure switch. If any of these normally closed switches opens due to an out of tolerance condition, the module contactor opens, de-energizing the module.

#### 1.4.12 Inverter/Microprocessor

The Inverter receives constant voltage direct current, then inverts it to a variable frequency variable voltage power. The power is then delivered to the compressor(s), condenser fan motor(s) and evaporator fan motors as called for by the microprocessor.

The microprocessor receives signals from the various devices and calculates required system operation parameters to bring vehicle interior temperature to the required set point.

#### 1.4.13 System Operation

The manual operating controls may consist of a single OEM supplied ON/OFF switch, a Carrier Transicold supplied driver's display, an OEM supplied driver's display or via communication with an EVCU. Modes of operation include cooling, heat, reheat and vent.

In the vent mode the evaporator fans and damper 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. 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, evaporator fans and condenser fan(s) are operated to provide refrigeration as required. Once interior temperature reaches the desired set point, the system may operate in the vent or reheat mode. A controller programmed for vent mode will de-energize the compressor 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.

### 1.5 REFRIGERATION SYSTEM COMPONENT SPECIFICATIONS

#### a. Refrigerant Charge

R-134a 2.8 Lb (1.2 kg) – Per Compressor

#### b. Thermostatic Expansion Valve:

Superheat Setting: 5°F (2.8°C)

MOP Setting: 50 ± 5 psig (3.4 ± 0.34 bar)

#### c. High Pressure Switch (HPS):

Opens at: 350 ± 10 psig (23.8 ± 0.7 bar)

Closes at: 240 ± 10 psig (16.3 ± 0.7 bar)

### 1.6 ELECTRICAL SPECIFICATIONS - MOTORS

#### a. Evaporator Fan Motor

Evaporator Motor	440 VAC (Rated) 3 Phase
Horsepower (kW)	0.19 (0.14)
Full Load Amps (FLA)	0.5
Operating Speed (RPM)	2600 (Nominal)
Bearing Lubrication	Factory Lubricated (additional grease not required)

#### b. Condenser Fan Motor

Condenser Motor	440 VAC (Rated) 3 Phase
Horsepower (kW)	0.34 (0.25)
Full Load Amps (FLA)	0.6
Operating Speed (RPM)	2600 (Nominal)
Bearing Lubrication	Factory Lubricated (additional grease not required)



## 1.7 ELECTRICAL SPECIFICATIONS - SENSORS AND TRANSDUCERS

### a. Pressure Transducer

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

### b. Temperature Sensors

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

## 1.8 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions with safety devices. Safety devices with Carrier Transicold 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, module operation will automatically stop if the HPS switch contacts open due to an unsafe operating condition.

### b. Fuses and Circuit Breakers

The system is protected against high current by fuses.

### c. Thermal Switch

The compressor motor is protected with a thermal protection switch.

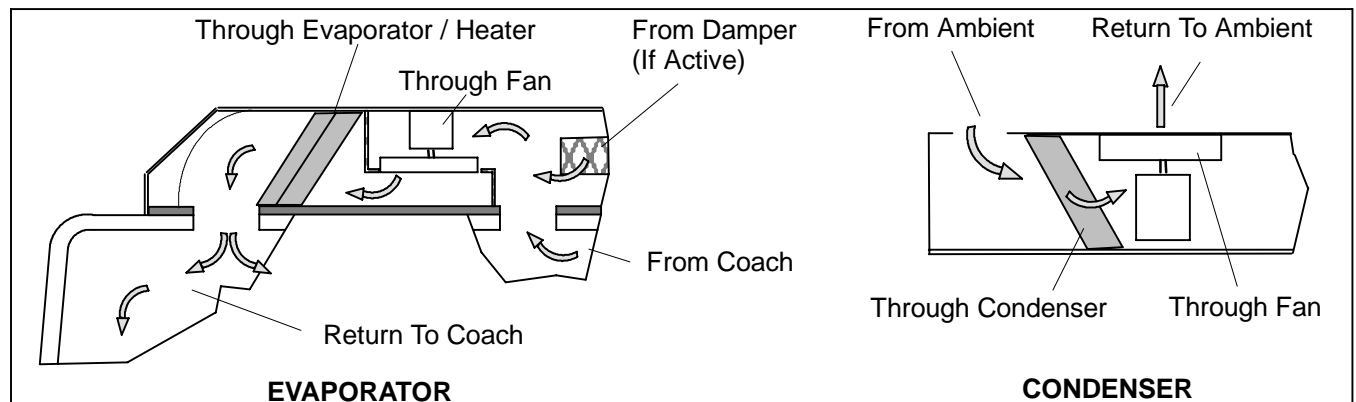


Figure 1-5 Air Flow Paths

### d. 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 default set points are programmed to cut out at 50°F (10°C)[32°F (0°C) watercooler] and cut in at 53.6°F (12°C) however, these settings may be changed for specific applications. This setting protects the compressor from damage caused by operation at low pressures.

## 1.9 AIR FLOW

The paths for ambient air through the condenser and coach air through the evaporator are illustrated in Figure 1-5.

## 1.10 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 compressor, air-cooled condenser coils, thermostatic expansion valve, evaporator coils and the suction line accumulator.

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 thermal expansion valve.

The thermal expansion valve reduces pressure and temperature of the liquid and meters the flow of liquid refrigerant to the evaporators 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 vehicle.

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 vehicle.

The transfer of heat from the air to the low temperature liquid refrigerant in the evaporator causes the liquid to

vaporize. This low temperature, low pressure vapor passes through the suction line to the accumulator and returns to the compressor where the cycle repeats. The accumulator prevents the return of liquid refrigerant to the compressor.

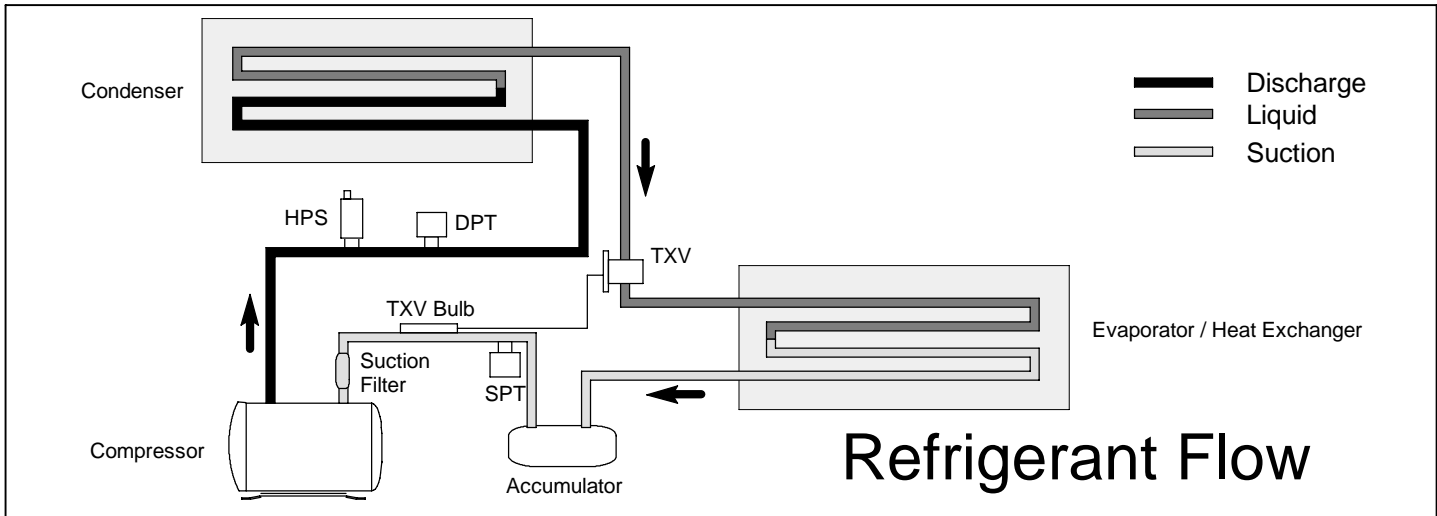


Figure 1-6 Refrigerant Flow Diagram

**1.11 HEATING CYCLE**

Heating circuit (See Figure 1-7) components furnished by Carrier Transicold include the heater coils and a heat valve. Components furnished by the bus manufacturer may include auxiliary heater and coolant boost pump. The controller automatically controls the heat valve during the heating and reheat modes to maintain

required temperatures inside the vehicle. Engine coolant (glycol solution) is circulated through the heating circuit. 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.

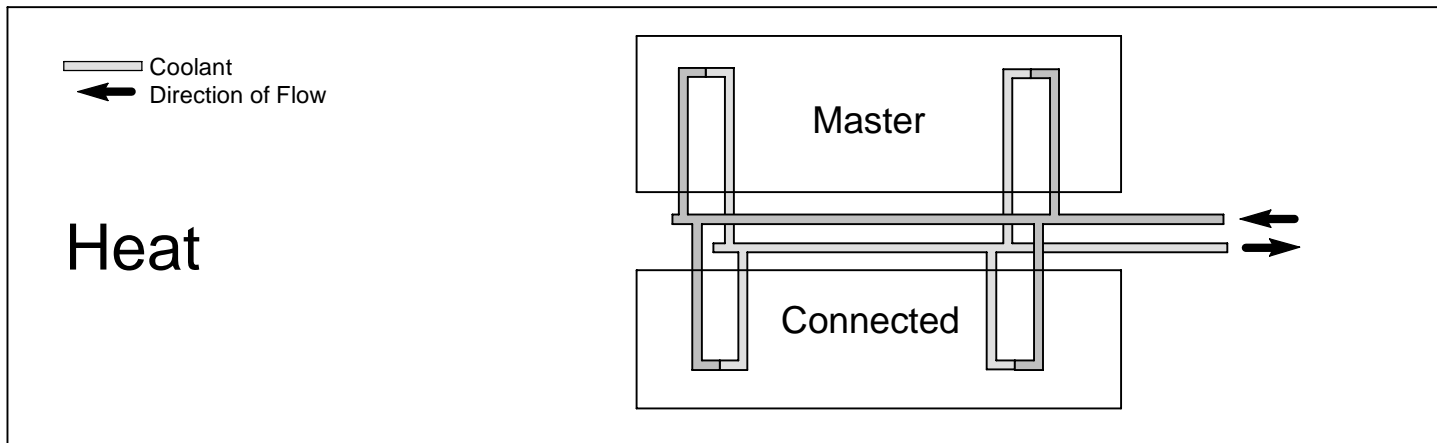
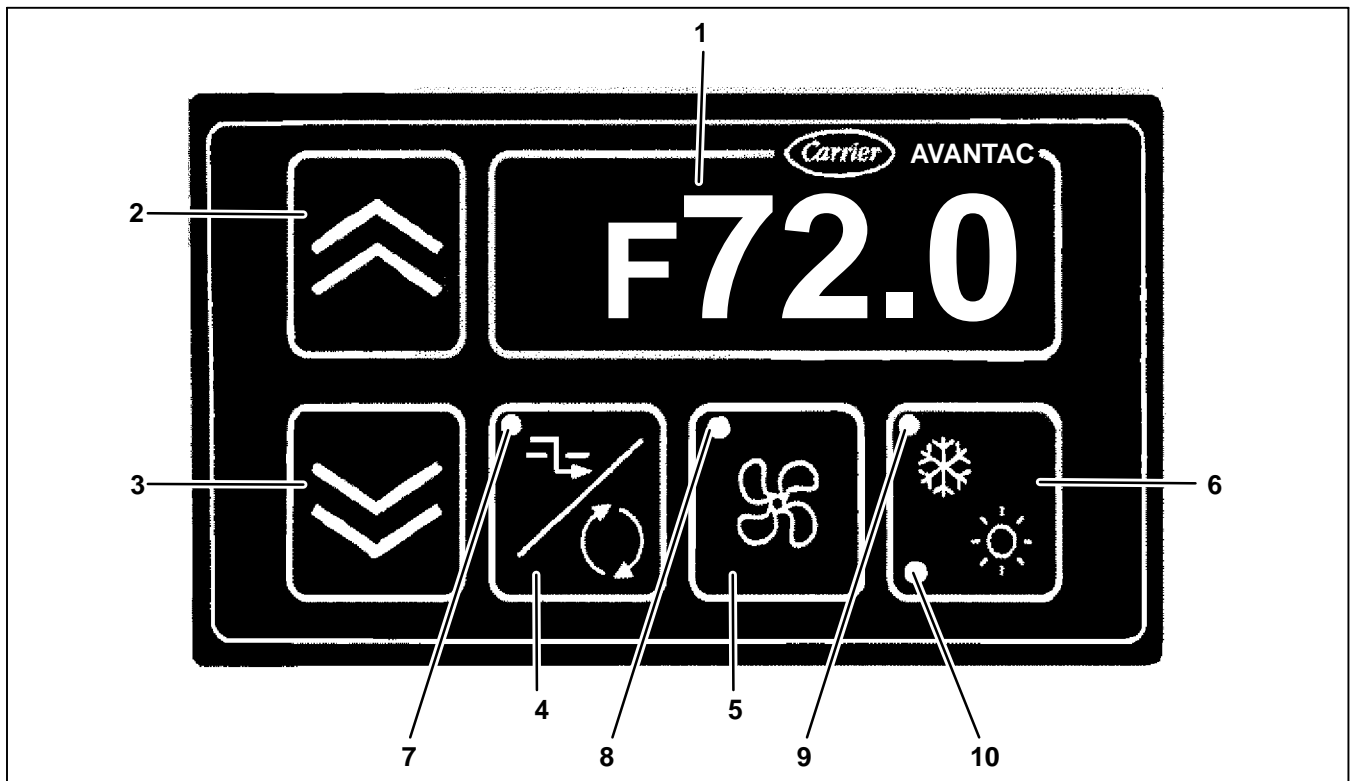


Figure 1-7 Coolant Flow Diagram

## SECTION 2 OPERATION


### 2.1 STARTING, STOPPING AND OPERATING INSTRUCTIONS










- | KEYS                               | LEDS                               |
|------------------------------------|------------------------------------|
| 1. Display                         | 7. Fresh Air Open (Green)          |
| 2. Plus Key                        | 8. Manual Blower 'ON' (Green)      |
| 3. Minus Key                       | 9. Cooling/Heating (Green)         |
| 4. Recirculate/Fresh Air (Flap)    | 10. Malfunction Cooling Unit (Red) |
| 5. Blower Control Key              |                                    |
| 6. Automatic Climate Control (A/C) |                                    |





**Figure 2-1 Driver's Display**

#### 2.1.1 Starting





- a. Before starting the vehicle engine, make sure the main disconnect switch is in RUN (1) position and power source selection switch (if fitted) is put to generator power side.
- b. Start the vehicle engine and wait for the air pressure to build up to the required level. If the Low Voltage ON/OFF switch is not in the ON position, put it in the ON position.
- c. When the 24VDC power is applied, the driver display will show return air set point. Press the A/C  key on the display to trigger the start up sequence. The start up sequence will start from the generator to the evaporator, condenser and compressor. There will be some time delay between each module and each component due to module sequencing. The green LED light on the A/C key (See Figure 2-1, item 9) will confirm the system is running.

- d. To change temperature set point, press the Plus  or Minus  arrow key. each key press will change set point by 1°F (0.5°C).
- e. To control the evaporator speed manually, press the BLOWER CONTROL  key. The display will show the current fan speed. Press the Plus  or Minus  key to change the evaporator fan speed.
- f. If the evaporator fan is in manual control and you want to change it back to automatic control, press the BLOWER CONTROL  key. The green LED (See Figure 2-1, item 8) on the BLOWER CONTROL key will turn off to indicate the fan is under automatic control.


g. To close the fresh air damper (flap), press the FLAP  key. When the green LED (See Figure 2-1, item 7) is off, the flap is closed. When the green LED is on, the flap is under automatic control.

h. To see return air temperature, press the Minus  and FLAP  keys together. To see ambient temperature, press the Minus  and FLAP  keys together again. When the display is showing return air or ambient temperature, if no key is pressed for 10

seconds, the display will return to the default return air set point.

i. To see alarm codes and other parameters, press the Plus  and Minus  keys together. To exit the list display, press the Plus  and Minus  keys together again.

### 2.1.2 Shut Down

a. To shut down the system, press the A/C  key. When the green LED on this key (See Figure 2-1, item 9) is off, the system is off.

### 2.1.3 DRIVERS DISPLAY (Key Operation)

KEY	OPERATION
Plus Key	When the display shows return air temperature, press the Plus key will go to show return air set point. When the display shows return air set point, press Plus key will increase set point by 1°F (0.5°C). When the display shows manual fan speed, press Plus key will increase evaporator fan speed by 10Hz. When the display shows information list, press Plus key will move to next display item in the information list.
Minus Key	When the display shows return air temperature, press the Minus key will go to show return air set point. When the display shows return air set point, press Minus key will decrease set point by 1°F (0.5°C). When the display shows manual fan speed, press Minus key will decrease evaporator fan speed by 10Hz. When the display shows information list, press Minus key will move to previous display item in the information list.
Plus and Minus Key	When the display shows return air temperature set point, return air temperature or ambient temperature, press Plus and Minus together will go to show information list. When the display shows manual fan speed, press Plus and Minus together will show return air set point.
Recirculate/Fresh Air Key	Toggles fresh air flap automatic control or close. When the LED is on, the flap is under automatic control. When the LED is off, the flap is closed.
Blower Control Key	System OFF: Pressing this key activates the generator, evaporator motors and fresh air flap. The evaporator fan speed is controlled by pressing the Plus or Minus key. System ON: Pressing the key changes the evaporator fan speed to manual control, so that the operator can control evaporator fan speed with the Plus or Minus keys. Pressing again returns evaporator fan speed control to automatic. When the LED is on, the evaporator fan is running and the speed is fixed to the manual setting.
Automatic Climate Control	Toggles rooftop module on or off. When the upper left corner LED is on, the rooftop module is on. The bottom left corner LED is an alarm indicator. When there is an alarm, the LED will flash on and off.
Minus key and Recirculate/Fresh Air key	Press Minus and Flap keys together to show return air temperature. When the display shows return air temperature, press the Minus and Flap key together again to show ambient temperature
Recirculate/Fresh Air key and Automatic Climate Control key	Activate reheat mode for 20 minutes. When reheat mode is activated, the green LED (See Figure 2-1, Item 9) will be flashing.
Recirculate/Fresh Air key and Blower Control key	Switch off all control functions. Turn off display.

## 2.1.4 DRIVERS DISPLAY (Information List)

DISPLAY	EXAMPLE	DESCRIPTION
Alarm List	A112	Module 1 Alarm 12
	A241	Module 2 Alarm 41
Module List	No1	Module 1
	d620	DC bus 620Vdc
	EP60	Evaporator 60Hz
	0215	Evaporator Hour 215
	Cd90	Condenser 90Hz
	CP70	Compressor 70Hz
	0196	Compressor 1 Hour 196
	0000	Compressor 2 Hour 0

## 2.2 SYSTEM CONTROL

### 2.2.1 Power Up

When the 24VDC power is applied to the inverter, the climate controller will go through power up sequence.

In the power up sequence, the controller will initialize the peripherals and memory. The controller will retrieve saved parameters and establish communication link with the EVCU, driver display and other controllers. After that, the controller will start the main control loop.

### 2.2.2 Start Up

The controller will first check DC voltage and the power ready signal from the Electric Vehicle Control Unit (EVCU). If the voltage is confirmed in the normal range and the power ready signal is received, the controller will start the evaporator. When the evaporator is confirmed in the ON state, flap control and temperature control will be turned on.

After starting the evaporator, the controller will monitor the evaporator state. If the evaporator state goes to OFF or TRIP, the controller will retry to start the evaporator. The maximum retry attempt is 1. If retry fails, the shutdown sequence will be initiated.

After turning on temperature control, the controller will monitor the temperature control state. If the temperature control state goes to TRIP, the shutdown sequence will be initiated.

### 2.2.3 Return Air Temperature

If module configuration selects using averaged temperature, averaged return air temperature will be used. If module configuration doesn't select using averaged temperature but selects using zone control, return air temperature of the module whose module number equals to the zone number will be used. If that module return air sensor is bad, averaged return air temperature will be used.

If module configuration doesn't select using averaged temperature and also doesn't select using zone control, the controller's own return air temperature will be used. If the controller's own return air sensor is bad, averaged return air temperature will be used. If all modules return air sensors are bad, temperature control will stop.

### 2.2.4 Ambient Air Temperature

If module configuration selects using averaged temperature, averaged ambient temperature will be used. If module configuration doesn't select using averaged temperature but selects using zone control, ambient temperature of the module whose module number equals to the zone number will be used. If that module ambient sensor is bad, averaged ambient temperature will be used.

If module configuration doesn't select using averaged temperature and also doesn't select using zone control, controller's own ambient temperature will be used. If controller's own ambient sensor is bad, averaged ambient temperature will be used. If all modules ambient sensors are bad, temperature control will stop.

### 2.2.5 Return Air Set Point

If module configuration selects using auto return air set point, controller's return air set point will be determined by the ambient temperature. If ambient temperature is less than or equal to 59°F (15°C), the return air set point will be 64°F (18°C). If ambient temperature is greater than or equal to 95°F (35°C), the return air set point will be 79°F (26°C). If ambient temperature is between 59°F (15°C) and 95°F (35°C), the return air set point will be a linear interception from 64°F (18°C) to 79°F (26°C). For example, if ambient temperature is 77°F (25°C), the return air set point will be 72°F (22°C). The default span of the return air set point variation is +/- 5°F (3°C) and it is a configurable parameter.

If module configuration doesn't select using auto return air set point, the return air set point will be default to 72°F (22°C) and can be changed through driver display or CAN communication.

### 2.2.6 Condenser Discharge Set Point

If module configuration selects using auto condenser discharge pressure set point, controller's discharge pressure set point will be determined by the ambient temperature. The set point will be R-134a saturated pressure at (ambient + offset). The default offset is 54°F (12°C) and it is a configurable parameter.

If module configuration doesn't select using auto condenser discharge pressure set point, the discharge pressure set point will be default to 185 PSIG (12.6 bar) and it is a configurable parameter.

### 2.2.7 EVCU Power Set Point

The EVCU will determine and set power limits to the A/C system.

### 2.2.8 Pressure Difference

The compressor will be enabled to run if the pressure difference between discharge and suction is less than a certain value. The pressure difference value will consider R-134a saturated vapor pressure under return air temperature and ambient temperature conditions. For example, if return air temperature is 70°F (21°C) and ambient temperature is 104°F (40°C), pressure difference will be  $(135 - 71) = 64$  psi. The compressor will be enabled to run when pressure difference is less than 64 psi.

### 2.2.9 Temperature Control Band

The controller will try to maintain return air temperature in a band centered at the return air set point. The default band is from set point - 1.5°F (1°C) to set point + 1.5°F (1°C) and it is a configurable parameter.

### 2.2.10 Temperature Control Mode Change Band

Temperature control mode change band is a band wider than the temperature control band. It allows return air temperature over shoot or under shoot for a short while without triggering control mode change. If return air temperature goes out side of the change band, the control mode will be changed.

### 2.2.11 Mode Change Time Delay

A timer will be started when temperature control leaves the cooling or heating mode. The temperature control will re-enter the cooling or heating mode after the timer expires.

### 2.2.12 Control Period (PI)

The control period (PI) is 2-seconds. Every 2-seconds the sensor inputs will be updated and the averaged temperature will be calculated. Minimum fresh air will be calculated. The fresh air flap will be positioned and the motor heat valve (if fitted) will be adjusted.

If temperature control is in COOL mode the following PI will be calculated:

- Compressor current
- Compressor EVCU power
- Compressor discharge pressure
- Condenser discharge pressure
- Compressor suction pressure
- Evaporator suction pressure
- Compressor return air temperature
- Evaporator cool return air temperature

If temperature control is in HEAT mode, the following PI will be calculated:

- Heater return air temperature
- Heater supply air temperature
- Evaporator heat return air temperature
- Evaporator heat supply air temperature

If the temperature control is in REHEAT mode, the following PI will be calculated:

- Compressor current
- Compressor generator power
- Compressor discharge pressure
- Condenser discharge pressure
- Compressor suction pressure
- Evaporator suction pressure

- Heater return air temperature
- Heater supply air temperature
- Evaporator heat return air temperature
- Evaporator heat supply air temperature

If the ambient temperature is higher than the return air set point, fresh air will be used as heating source and fresh air control PI will be calculated. If ambient temperature is lower than the return air set point, fresh air will be used as cooling source and fresh air control PI will be calculated.

### 2.2.13 Supply Air Temperature

Supply air temperature is used for heating. When the engine coolant temperature is low, evaporator fan speed is kept to the minimum. When the engine coolant temperature is too high, the heating is limited.

### 2.2.14 Supply Air Temperature Offset for Evaporator Fan

*Supply air temperature offset for evaporator fan* is a parameter for evaporator fan control in heating. When the the supply air temperature is lower than the setting, the evaporator fans will run at minimum speed.

### 2.2.15 Supply Air Temperature Offset for Heater

*Supply air temperature offset for heater* is a parameter for heating control. When the the supply air temperature is higher than the setting, the heating will be reduced to minimum.

### 2.2.16 Floor Heater

If the controller is configured for floor heater control and connected to harness connector J13-E: The floor heater will be turned on when return air temperature is lower than the set point minus 11°F (6°C). The floor heater will be turned off when the return air temperature is higher than the set point minus 7°F (4°C).

The floor heater can also be connected to inverter connector J3-6. With this option the heater is controlled by a floor temperature sensor.

### 2.2.17 Floor Temperature Sensor

As an option for floor heater control, an additional temperature sensor can be connected to inverter connector J3-29 and is placed to better sense floor temperature.

### 2.2.18 Floor Heater Cut In and Cut Out Temperature Setting

The default floor heater cut in temperature is lower than the return air set point minus 11°F (6°C). The default cut out temperature is higher than the return air set point minus 7°F (4°C).

### 2.2.19 Door Open Signal

As an option, an open/close contact can be connected to inverter connector J3-28 for an open door signal. A closed circuit would indicate that the door is open, an open circuit would indicate that the door is closed.

### 2.2.20 Door Open Evaporator Speed

When the door open contact is connected to inverter connector J3-28: if the door opens, the evaporator will run at a fixed speed as set by the parameter door open evaporator speed.

### 2.2.21 Door Open Time Delay

When the door open contact is connected: if the door closes, the evaporator will continue to run at a fixed speed for 10 seconds before changing to a higher speed.

### 2.2.22 Reheat Delay

If the Reheat mode is activated from the driver display by pressing the Fresh Air and A/C keys together, the reheat mode will run for 20 minutes, then terminate.

### 2.2.23 Fresh Air Delay

If the fresh air flap is closed from the driver display by pressing the Fresh Air key, the fresh air flap will stay closed for 5 minutes before reopening.

## 2.3 MODES OF OPERATION

### 2.3.1 Temperature Control Modes

The temperature control modes are described as the VENT, COOL, HEAT and REHEAT modes.

#### 2.3.1.a Vent Mode

In the VENT mode, the fresh air flap is used to maintain return air temperature. Evaporator fans are used to circulate the air.

The VENT mode starts with turning off the compressor. When the compressor is confirmed in the OFF state, the condenser will be turned off. When the condenser is confirmed in the OFF state, the heater will be turned off. When the heater is confirmed in the OFF state, VENT mode is activated.

In the VENT mode, if:

- the averaged return air sensor is bad or averaged ambient air sensor is bad, temperature control will stop.
- the evaporator state changes to OFF or TRIP, if the evaporator trip flag is not set, evaporator motors will be restarted. If evaporator trip flag is set, temperature control will stop.
- the mode change time delay passed, if return air temperature is higher than the control band and if com-

pressor start up condition is satisfied, COOL mode will start.

- the mode change time delay passed, if return air temperature is lower than the control band and ambient temperature is lower than the heat lockout, HEAT mode will start.

The system can enter VENT mode from the driver display by pressing the BLOWER key. The key will initiate the start-up procedure to turn on the generator, evaporator and flap. It will not turn on the temperature control. The evaporator speed will be manually controlled after start-up.

#### 2.3.1.b Cool Mode

In the COOL mode, evaporator fans, compressor speed and flap position are used to maintain return air temperature. Condenser fans are used to maintain discharge pressure.

The COOL mode starts from turning off the heater. When the heater is confirmed in the OFF state, the condenser fans will be turned on. When the condenser fans are confirmed in the ON state, the compressor will be turned on. When the compressor is confirmed in the ON state, the COOL mode is A/Ctive.

In the COOL mode, if:

- REHEAT is enabled, if return air temperature is lower than the change band, REHEAT mode will start.
- REHEAT is disabled, if return air temperature is lower than the change band, VENT mode will start.
- compressor state changes from ON to OFF or TRIP, VENT mode will start.
- low suction pressure flag is set, VENT mode will start.
- condenser state changes from ON to OFF or TRIP, VENT mode will start.
- evaporator state changes from ON to OFF or TRIP, VENT mode will start.
- ambient temperature is lower than compressor lockout temperature, VENT mode will start.
- averaged return air sensor is bad or averaged ambient air sensor is bad, temperature control will stop.

In the COOL mode, the compressor speed will be the lowest output of the following PI:

- Compressor generator power PI
- Compressor discharge pressure PI
- Compressor suction pressure PI
- Compressor return air temperature PI

The maximum compressor frequency is limited to 60Hz in the first 90 seconds of compressor start-up. After 90 seconds, the compressor can run at a higher frequency if the temperature control calls for it.

In the COOL mode, the condenser speed will be set to the output of the condenser discharge pressure PI. During start-up, the condenser will run at 60 Hz first, then change to another frequency depending on condenser pressure. If the inverter high temperature warning flag is set, the condenser will be forced to run maximum speed which is 90Hz by default

In COOL mode, the evaporator speed will be set to the lower of the output of the evaporator suction pressure PI and the output of the evaporator cool return air temperature PI. During start-up, the evaporator will run at 60Hz, then change frequency as the controller dictates.

In COOL mode, the flap will be set to the higher output of the minimum fresh air lookup table and the output of the fresh air return air temperature PI.

### 2.3.1.c Heat Mode

HEAT mode starts from turning off the compressor. When the compressor is confirmed in OFF state, condenser will be turned off. When the condenser is confirmed in OFF state, heater will be turned on. When the heater is confirmed in ON state, HEAT mode is on.

In the HEAT mode, if:

- a. the heater state changes to OFF or TRIP, if so then the VENT mode will start.
- b. the evaporator state changes to OFF or TRIP, if so then the VENT mode will start.
- c. the averaged return air sensor is bad or averaged ambient air sensor is bad, if so then temperature control will stop.
- d. ambient temperature is higher than the heat lockout, if so then the VENT mode will start.
- e. REHEAT is enabled and the return air temperature is higher than the reheat cut in, REHEAT mode will start.
- f. REHEAT is disabled and the return air is higher than the mode change band, VENT mode will start.

In the HEAT mode, heat control will be set to the minimum of the output of the heat return air temperature PI and heat supply temperature PI.

In HEAT mode, evaporator speed will be set to the minimum of the output of the evaporator heat return air temperature PI and evaporator heat supply air temperature PI.

In HEAT mode, flap will be set to the higher of the minimum fresh air lookup table and the output of the fresh air return air temperature PI.

### 2.3.1.d Reheat Mode

REHEAT mode starts from turning on the condenser. When the condenser is confirmed in the ON state, the compressor will be turned on. When the compressor is confirmed in the ON state, the heater will be turned on. When the heater is confirmed in the ON state, REHEAT mode is on.

In the REHEAT mode, if :

- a. the heater state changes to OFF or TRIP, the COOL mode will start.
- b. the compressor state changes to OFF or TRIP, the HEAT mode will start.
- c. the condenser state changes to OFF or TRIP, the HEAT mode will start.
- d. the evaporator state changes to OFF or TRIP, the VENT mode will start.

- e. averaged return air sensor is bad or averaged ambient air sensor is bad, temperature control will stop.
- f. ambient temperature is higher than heat lockout, or return air temperature is outside of the mode change band, the COOL mode will start.
- g. ambient temperature is lower than cool lockout or return air temperature is less than reheat cut out, the HEAT mode will start.

In REHEAT mode, the compressor speed will be the lowest of the following PI:

- a. Compressor current PI
- b. Compressor generator power PI
- c. Compressor discharge pressure PI
- d. Compressor suction pressure PI

In the REHEAT mode, the condenser speed will be set to the output of the condenser discharge pressure. If inverter high temperature warning flag is set, the condenser will be forced to run maximum speed which is 90Hz by default.

In the REHEAT mode, the evaporator speed will be set to the lowest of the output of the evaporator suction pressure PI, the output of the evaporator heat return air temperature PI and the output of the evaporator heat supply air temperature PI.

In the REHEAT mode, the flap will be set to the higher output of the minimum fresh air lookup table and the output of the fresh air return air temperature PI.

### 2.3.2 Temperature Control Stop

The temperature control stop sequence begins with turning off the compressor. When compressor is confirmed OFF, the condenser will be turned off. When the condenser is confirmed OFF, the heater will be turned off. When the heater is confirmed OFF, the temperature control is in OFF.

### 2.3.3 Temperature Control Failure

The temperature control fails if any of the following conditions happen:

- a. Evaporator trip flag is set.
- b. Temperature control turns off the compressor but the compressor is still in the ON state.
- c. Temperature control turns off the condenser but the condenser is still in the ON state.
- d. Temperature control turns off the heater but the heater is still in the ON state.

### 2.3.4 Shut Down

Shutdown sequence starts from turning off the temperature control. When the temperature control is in OFF state, evaporator and flap will be turned off. When evaporator and flap are confirmed in OFF state, control box contactor will open and then the system is off.



## SECTION 3

### TROUBLESHOOTING

#### WARNING

Be aware of **HIGH VOLTAGE** supplied to this equipment from the vehicle high voltage system and/or shore power source and that the equipment may start automatically. Do not attempt to service this equipment without proper training. Electrical power within this equipment is sufficiently high enough to cause serious injury or death.

Before servicing this equipment:

1. If the vehicle is equipped with shore power, ensure the shore power supply is **OFF** and then disconnect the plug. When reconnecting, ensure the power plug is clean and dry before connecting to the electrical outlet/receptacle. Ensure power supply is correct for this application.
2. Ensure the main disconnect from the vehicle high voltage power source is **OFF**, vehicle engine is off and ignition system is locked out.
3. Both AC and DC power is used in this equipment. Test for both AC and DC voltage to confirm there is no power before working on any circuit or electrical component.

#### CAUTION

Do not under any circumstances attempt to service the Inverter. Should a problem develop with these components, replace them.

#### CAUTION

Under no circumstances should a technician electrically probe the inverter at any point, other than the connector terminals where the harness attaches. Improper use of of voltmeters, jumper wires, continuity tester, etc. will permanently damage the processor.

### 3.1 SYSTEM ALARMS

#### 3.1.1 Discrete Output LED

When the inverter is powered up, the Discrete Output LED will be energized. The heart beat and alarm code will start 4 seconds later. The Discrete Output LED is located behind the return air grill of each module.

#### 3.1.2 Heart Beat

When there are no faults (shutdown, trip or sensor alarm), the Discrete Output LED will flash 2 seconds on, 2 seconds off.

#### 3.1.3 Alarm Codes

The power controller 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 3-1. The alarm codes can be read by counting the number of times that the Discrete Output LED 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 AvantAC Electric Driver Display will indicate there is an alarm when the small LED in the bottom corner of the A/C button is illuminated (See Figure 2-1, Item 10). The alarm code will be displayed by A### where "A" is an active alarm prefix. The first of the three digits is the

module number that generates the alarm, the next two digits is the alarm code. If no alarms are present, the display will show A000. To access the alarm codes, press the Plus and Minus keys at the same time. If multiple alarms are present, the display will scroll through each alarm automatically. When showing the alarm code, pressing the Plus and Minus keys at the same time will exit the alarm code display mode. A listing of alarm codes is provided in Table 3-1.

#### 3.1.4 Activation

When alarms are detected, they are placed in an alarm queue in the order at which they initiated. Each alarm recorded will also capture some critical parameters like DC bus voltage and ambient temperature. It will also capture the evaporator run time corresponding to the activation time. To view the complete information about an alarm, use PC HyperTerminal Interface (See Section 4).

#### 3.1.5 Alarm Queue

The alarm queue consist of 31 alarm locations. When the alarm queue is full the controller will erase the oldest alarm and save the newest alarm.

### 3.2 GENERAL TROUBLESHOOTING PROCEDURES

General procedures for system troubleshooting are provided in Table 3-2.

**Table 3-1 Driver Display Panel Alarm Message Definition**

<b>ALARM NO.</b>	<b>TITLE</b>	<b>CAUSE</b>	<b>REMEDY</b>	<b>CONTROLLER RESPONSE</b>
11	DC bus over voltage	Inverter DC bus voltage higher than 800VDC.	Check fuses. Check power cable wiring. Check ground fault.	System shutdown.
12	DC bus under voltage	Inverter DC bus voltage lower than 200VDC.	Check fuses. Check power cable wiring. Check ground fault. Check generator belt.	System shutdown.
13	DC bus fault	Power control input voltage is high.	Check fuses. Check power cable wiring.	System shutdown.
14	Temperature fault	Power controller temperature is high.	Check causes of high discharge pressure. Check condenser airflow. Check inverter cooling.	Rooftop module shutdown.
21	High IGBT temperature	Compressor 1 Power controller output module over temperature	Check causes of high discharge pressure. Check condenser airflow. Check inverter cooling.	Compressor 1 shutdown.
23	High compressor current	Compressor 1 output overload	Check causes of high discharge pressure. Check for single phasing.	Compressor 1 shutdown.
24	Low suction pressure	Compressor 1 suction pressure is low or wiring is defective.	Check suction pressure transducer and wiring. Check causes of low suction pressure. Check for refrigerant leak.	Compressor 1 shutdown.
25	High discharge pressure	Compressor 1 discharge pressure is high or wiring is defective.	Check discharge pressure transducer and wiring. Check causes of high discharge pressure. Check for over refrigerant charging.	Compressor 1 shutdown.
26	Compressor Reverse	Compressor 1 no pressure difference, or wiring defective.	Compressor is not running. Pressure transducer malfunction	Compressor 1 shutdown.
27	Compressor Trip	Compressor 1 high discharge pressure or high temperature or defective wiring.	Check high pressure switch, shell temperature and wiring. Check causes of high discharge pressure.	Compressor 1, compressor 2 shutdown.
31	High IGBT temperature	Compressor 2 Power controller output module over temperature	Check causes of high discharge pressure. Check condenser airflow. Check inverter cooling.	Compressor 2 shutdown.
33	High compressor current	Compressor 2 output overload	Check causes of high discharge pressure. Check for single phasing.	Compressor 2 shutdown.

34	Low suction pressure	Compressor 2 suction pressure low or wiring defective.	Check suction pressure transducer and wiring. Check causes of low suction pressure. Check for refrigerant leak.	Compressor 2 shutdown.
35	High discharge pressure	Compressor 2 discharge pressure high or wiring defective.	Check discharge pressure transducer and wiring. Check causes of high discharge pressure. Check for over refrigerant charging.	Compressor 2 shutdown.
36	Compressor reverse	Compressor 2 no pressure difference or wiring defective	Check compressor wiring, check pressure transducer and wiring.	Compressor 2 shutdown.
42	Evaporator trip	Evaporator fan motor overload or wiring defective	Check evaporator motor, winding resistance, insulation and wiring.	Rooftop module shutdown.
43	Condenser trip	Condenser fan motor overload or wiring defective	Check condenser motor, winding resistance, insulation and wiring.	Rooftop module cooling disabled.
44	Heater trip	The heater control does not move or wiring defective	Check heat control connector and wiring.	Rooftop module heating disabled.
45	Flap trip	The fresh air flap does not move or wiring defective	Check flap motor and connector and wiring.	Flap closed.
46	CAN0 trip	Wiring defective	Check connector and wiring. Check terminal resistor. Check polarity of the CAN bus.	Rooftop module shutdown.
47	CAN4 trip	Internal communications breaks down.	Replace power controller.	Rooftop module shutdown.
51	Discharge pressure transducer 1 failure	Bad sensor or wiring.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	Compressor 1 shutdown.
53	Suction pressure transducer 1 failure	Bad sensor or wiring.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	Compressor 1 shutdown.
55	Ambient temperature failure	Bad sensor or wiring.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	Use averaged ambient temperature.
56	Averaged ambient temperature failure	Bad sensor or wiring.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	Cooling, heating and reheat disabled.

57	Return air temperature failure	Bad sensor or wiring.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	Use averaged return air temperature.
58	Averaged return air temperature failure	Bad sensor or wiring.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	Cooling, heating and reheat disabled.
61	Discharge pressure transducer 2 failure	Bad sensor or wiring.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	Compressor 2 shutdown.
63	Suction pressure transducer 2 failure	Bad sensor or wiring.	Ensure all connectors are plugged in. Check sensor voltage or wiring. Replace sensor or repair wiring.	Compressor 2 shutdown.

**Table 3-2 General System Troubleshooting Procedures**

INDICATION/TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
<b>3.2.1 System Will Not Start</b>		
No voltage from EVCU.	Main disconnect switch turn off Power distribution wiring defective Communications network breaks down or short circuit 24VDC power supply from battery disconnect or fuse blown or wiring defective	1.4.1 Check/Repair Check/Repair Repair/Replace
Driver display not working	Communication wire and connector between display and controller broken or short circuit Controller is not configured for connecting to driver display	Check/Repair 4.6.1
<b>3.2.2 Rooftop Module Not Working</b>		
LED not flashing	Lost 24VDC power to the rooftop module Controller not loaded with application software Boot load connector is connected which puts the controller in boot load mode	2.1 4 4.6
<b>3.2.3 Rooftop Module Will Not Cool</b>		
Compressor will not run	Protection circuit wiring defective High discharge/suction pressure differential Compressor minimum run time Ambient temperature lockout Compressor malfunction	2.2.8 2.2.4 5.11
Electrical malfunction	Fuse blown Insulation breakdown	Replace Repair/Replace
<b>3.2.4 Module Runs But Has Insufficient Cooling</b>		
Compressor	Compressor running minimum speed due to pressure transducer malfunction	5.19
Restricted air flow	No evaporator air flow or restriction	5.13
Heating system	Reheat coolant valve stuck open	Repair/Replace

**Table 3-2 General System Troubleshooting Procedures - Continued**

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
<b>3.2.5 Abnormal Pressure</b>		
High discharge pressure	Discharge pressure transducer failure Refrigerant overcharge Non-condensable in system Condenser motor failure	5.19 5.8 5.8 5.14
<b>3.2.6 Abnormal Noise Or Vibration</b>		
Condenser or evaporator fans	Loose mounting hardware Defective bearings Blade interference Blade missing or broken	Check/Tighten Replace Check Check/Replace
<b>3.2.7 Control System Malfunction</b>		
Will not control	Sensor or transducer defective Heat valve malfunction Wrong heat valve configuration Airflow blockage Wrong zone configuration	5.18 or 5.19 Check/Replace Check Check Check
<b>3.2.8 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 Evaporator fan loose or defective Fan damaged Return air filter dirty Icing of coil Safety device open Fan rotation incorrect	Repair/Replace Repair/Replace Repair/Replace Clean/Replace Clean/Defrost 1.8 Check
<b>3.2.9 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	5.8 Check 4.6 Replace Replace 5.10
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	5.10 5.10
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 5.10 Replace Replace 5.10
<b>3.2.10 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 Sensor failure	Check/Replace  Replace Repair/Replace 1.8
Continuous Heating	Reheat coolant solenoid valve stuck open	Replace

# SECTION 4

## TECHNICIAN INTERFACE

### 4.1 INTRODUCTION (LAPTOP)

The following instructions are intended for field service technician's information for the connection of a laptop computer to the Carrier AvantAC Electric Bus Rooftop A/C Systems. This will allow access for system configuration and diagnosis using HyperTerminal software via the PC.

#### 4.1.1 Laptop Connection

To connect the PC to the system, an RS232 9-pin male to female connecting lead is required (purchase locally).

Once the computer is up and running, it will need to be connected via the above lead from the male 9-pin RS232 plug on the back of the PC to one of the spare male RS232 ports in the return air of one of the modules (preferably not the one connected to the drivers display).

#### NOTE

If the PC that is to be connected is not equipped with an RS232 port, a USB to RS232 Adapter will be required (purchase locally).

Ensure that the PC is started before connecting to the module. If the connection is made before starting the PC, the Windows operating system may lock out COM1. If unable to read data using these procedures, shut down the computer, disconnect the lead and restart the computer.

### 4.2 HYPERTERMINAL SETUP

From Windows start button, go to Accessories, Communications and HyperTerminal.

In the 'HyperTerminal' window, double click on Hypertrm.exe.

1. "New Connection - HyperTerminal" window and "Connection Description" Dialog will be shown on the screen.

In the "Connection Description" the "Name" field will be displayed. Enter a name (ex. AvantAC AE Monitor). Click OK button. "Connect To" dialog will be shown.



Figure 4-1 Connection Description

2. In the "Connect to" dialog, see the last input field "Connect using:". Pull down the list to allow selection of "COM1". This assumes the system is connected to the PC via COM1. If not, select appropriately (if the system is connected to COM2 on the PC). After selecting the correct serial port connection, click the OK button. "COM1 Properties" dialog will be shown on the screen.



Figure 4-2 Connect To

3. The operator is now in the “**COM1 Properties - Port Settings**” dialog. Here select bits per second as “**9600**” and select Flow control as “**Xon/Xoff**”. Click the OK button. Now the “**AvantAC AE Monitor - HyperTerminal**” window should be displayed and ready to monitor the Avant AC AE system,



**Figure 4-3 COM1 Properties**

If there is a need to go over the above set up again, in the “**AvantAC AE Monitor - HyperTerminal**” window, click the “**Disconnect**” button, or from the menu select “**Call**” then “**Disconnect**”. After disconnecting, go to “**File**” and “**Properties**”. The “**AvantAC AE Monitor Properties**” dialog will be shown. In the dialog the serial port can be changed by selecting a different port from the “**Connect using**” list. Clicking the “**Configure...**” button will allow selection of “**Bit per second**” and “**Flow Control**” method parameters.

**NOTE**

If data is displayed on the screen but is not formatted properly, select “**Call** and “**Disconnect**”. Go to “**File** and “**Properties**”. Click on the “**Settings**”, then under the Emulation” list, select “**ANSI**” terminal. Click OK.

If there are still problems displaying the data in a readable format, exit HyperTerminal and come back in again.

**4.3 TERMINAL DISPLAY**

To start monitoring the System, it must first be supplied with at least the 24VDC supply. If the Heartbeat LED lights are flashing (which can be viewed from inside the return air of all of the modules) then data should be visible on the connected PC.

**4.3.1 Main Menu**

Once 24VDC is switched on, the following should be displayed in the HyperTerminal Window:

Controller Diagnostic Interface

1. Connect to Driver Display
2. Connect to Data Logger
3. Connect to Terminal Display
4. Help

Here selection of “3” is required to display the data. The display then switches to level 0 information display mode. In level 0, users can change temperature set point and turn on and off the system. The Information pages 1 through page 4 can be displayed and alternated between on the screen.

If required, press “**Enter**” on the PC to bring up the above table again, and then enter “**955**”. The display then switches to level1 information display mode. In level 1, users can do all of level 0 options as well as additional manual control operation and system configuration. Pages 1 through 7 can now be displayed on the screen and alternated between by pressing the “**Space Bar**” on the PC.

**4.3.2 Information Display**

Entering “3” or “955” from the main menu will switch to the information display mode.

To navigate between pages and within the page, you will need to follow and utilize the following keys:

Key	Operation
Arrow key	Moves cursor
Space bar	Change to next page
+	Increase the parameter at cursor by one unit
-	Decrease the parameter at the cursor by one unit
Enter	Back to main menu (Do not use unless needing to go back to main menu.)

**NOTE**

Only use these keys while in the the Hyper Terminal Program. All numbers and other keys will be disabled. If “Enter” is accidentally pressed it will return to the start. The desired access code will again need to be utilized to gain access back into the system.

To move to another program, minimize the HyperTerminal window. This will reinstate keyboard functions. Return to HyperTerminal to continue navigation.

Ensure that HyperTerminal is active again to be able to switch between pages.

## 4.4 PAGE DISPLAYS

### 4.4.1 Page 1 - System Overview and Automatic Control

1 EVCU	AC On	AC PWR	UpLim	LoLim	Conn1	Conn2
	0	0	0	0	0	0
AVANTAC	TotalA	TotalP	Conn1	Conn2	Stat1	Stat2
	0	0	0	0	0	0
INV	INV0	INV1	INV2	INV3	INV4	COOLER
RUN	0	0	0	0	0	0
RET SP	22.0	22.0	22.0	22.0	22.0	22.0
DC BUS	15	15	15	15	15	15
CMP1 A	0.0	0.0	0.0	0.0	0.0	0.0
CMP2 A	0.0	0.0	0.0	0.0	0.0	0.0
TOTA A	0.0	0.0	0.0	0.0	0.0	0.0
STATUS	200	0	0	0	0	0
EVAP Hz	0	0	0	0	0	0
COND Hz	0	0	0	0	0	0
COMP Hz	0	0	0	0	0	0
HEAT %	0	0	0	0	0	0
FLAP%	0	0	0	0	0	0
AMB T	-40.00	-40.00	-40.00	-40.00	-40.00	-40.00
RET T	-40.00	-40.00	-40.00	-40.00	-40.00	-40.00
SUC1 P	7.0	-1.0	-1.0	-1.0	-1.0	-1.0
DIS1 P	8.4	-1.0	-1.0	-1.0	-1.0	-1.0
SUC2 P	7.0	-1.0	-1.0	-1.0	-1.0	-1.0
DIS2 P	8.3	-1.0	-1.0	-1.0	-1.0	-1.0

#### Note:

Line 1:	<p><b>AC On:</b> Command from EVCU to turn on A/C system 0: Off, 1: On.  <b>AC PWR:</b> Power ready signal from EVCU 0: Power is not ready, 1: Power is ready, 2: Power supply error.  <b>UpLim:</b> Upper power limit. Example: 30 for 30 kW  <b>LoLim:</b> Lower power limit. Example: 15 for 15 kW, for future use.  <b>Conn1:</b> EVCU connection indication 1, for future use.  <b>Conn2:</b> EVCU connection indication 2, for future use.</p>
Line 2:	<p><b>TotalA:</b> Total current draw of the A/C system. Example, 45 for 45 Amps  <b>TotalP:</b> Total power draw of the A/C system. Example, 32 for 32 kW  <b>Conn1</b> Module connection status 1, for module 0, 1, 2, 3. 0 for not connected, 1 for connected  <b>Conn2:</b> Module connection status 2, for module 4, 5. 0 for not connected, 1 for connected  <b>Stat1:</b> Module status 1, for module 0, 1, 2, 3. 0 for off, 1 for on, 2 for error  <b>Stat2:</b> Module status 2, for module 4, 5. 0 for off, 1 for on, 2 for error                      Example: 1011 means; Module 3, 1 and 0 are On. Module 2 are off.</p>
Line 3	Inverter Title Text
RUN	Command to turn on and off of the module, 0->1 for ON, 1->0 for OFF.
RET SP	Return air set point, "+" to increase, "-" to decrease.
DC BUS	Inverter DC bus voltage, 600 for 600VDC.
CMP1 A	Compressor 1 current, 6.5 for 6.5A.
CMP2 A	Compressor 2 current, 6.5 for 6.5A.
TOTA A	Total DC bus current, 12.5 for 12.5A.
STATUS	<p><b>Inverter status:</b> ---x: Evaporator statue, 0: Off, 1: On, 2: Trip.                      --x-: Condenser status, 0: Off, 1: On, 2: Trip.                      -x--: Compressor 1 status, 0: Off, 1: On, 2: Trip.                      x---: Compressor 2 status, 0: Off, 1: On, 2: Trip.</p>
EVAP Hz	Evaporator frequency, 60 for 60Hz.
COND Hz	Condenser frequency, 60 for 60Hz.
COMP Hz	Compressor frequency, 60 for 60Hz.
HEAT %	Heat level, 50 for 50%
FLAP%	Flap level, 50 for 50%
AMB T	Ambient temperature
RET T	Return air temperature
SUC1 P	Suction pressure 1
DIS1 P	Discharge pressure 1
SUC2 P	Suction pressure 2
DIS2 P	Discharge pressure 2



#### 4.4.2 Page 2 - Temperature Control Information

<b>2 COUNT</b>	199	0	0	0	0	0
<b>EVAP Hz</b>	60	60	60	60	60	60
<b>COND Hz</b>	60	60	60	60	60	60
<b>COMP Hz</b>	60	60	60	60	60	60
<b>HEAT %</b>	25	25	25	25	25	25
<b>FLAP %</b>	0	0	0	0	0	0
<b>AMB T</b>	-40.00	-40.00	-40.00	-40.00	-40.00	-40.00
<b>RET T</b>	-40.00	-40.00	-40.00	-40.00	-40.00	-40.00
<b>ZONE AMB</b>	-40.00	-40.00	-40.00	-40.00	-40.00	-40.00
<b>ZONE RET</b>	-40.00	-40.00	-40.00	-40.00	-40.00	-40.00
<b>RET SP</b>	22	-40.00	-40.00	-40.00	-40.00	-40.00
<b>DISP SP</b>	12.6	-1.0	-1.0	-1.0	-1.0	-1.0
<b>SUP T1</b>	-40.00	-40.00	-40.00	-40.00	-40.00	-40.00
<b>SUP T2</b>	-40.00	-40.00	-40.00	-40.00	-40.00	-40.00
<b>SPARE T1</b>	-40.00	-40.00	-40.00	-40.00	-40.00	-40.00
<b>SPARE T2</b>	-40.00	-40.00	-40.00	-40.00	-40.00	-40.00
<b>Board T</b>	36	0	0	0	0	0
<b>IGBT T1</b>	29	0	0	0	0	0
<b>IGBT T2</b>	0	0	0	0	0	0
<b>IGBT T3</b>	29	0	0	0	0	0
<b>COND A</b>	0.12	0.00	0.00	0.00	0.00	0.00
<b>EVAP A</b>	0.04	0.00	0.00	0.00	0.00	0.00

**Note:**

<b>Count</b>	Counter increases by 1 for every 2-second.
<b>EVAP Hz</b>	Evaporator speed, 60 for 60Hz.
<b>COND Hz</b>	Condenser speed, 60 for 60Hz.
<b>COMP Hz</b>	Compressor speed, 60 for 60Hz.
<b>HEAT %</b>	Heat control level, 50 for 50%.
<b>FLAP %</b>	Flap opening level, 25 for 25%.
<b>AMB T</b>	Ambient temperature
<b>RET T</b>	Return air temperature
<b>ZONE AMB</b>	Zone ambient temperature
<b>ZONE RET</b>	Zone return air temperature
<b>RET SP</b>	Return air set point
<b>DISP SP</b>	Discharge pressure set point
<b>SUP T1</b>	Supply air temperature 1
<b>SUP T2</b>	Supply air temperature 2
<b>IGBT T1</b>	IGBT module 1 temperature
<b>IGBT T2</b>	IGBT module 2 temperature
<b>COND A</b>	Condenser current, 1.2 for 1.2A
<b>EVAP A</b>	Evaporator current, 0.9 for 0.9A

#### 4.4.3 Page 3 - Hour meters and alarm queues

3 SELECT	0	0	0	0	0	0
MSG ID	0	0	0	0	0	0
EVAP HR	0	0	0	0	0	0
CMP1 HR	0	0	0	0	0	0
CMP2 HR	0	0	0	0	0	0
KW HR	0	0	0	0	0	0
REVISION	0	0	0	0	0	0
BAT VOLT	0	0	0	0	0	0
SUC VREF	0	0	0	0	0	0
DP1 VREF	0	0	0	0	0	0
DP2 VREF	0	0	0	0	0	0
ALM CODE	0	0	0	0	0	0
ALM VAL1	0	0	0	0	0	0
ALM VAL2	0	0	0	0	0	0
ALM DC	0	0	0	0	0	0
ALM AMB	0	0	0	0	0	0
ALM HOUR	0	0	0	0	0	0
ALM MIN	0	0	0	0	0	0

**Note:**

<b>SELECT</b>	<b>Select message ID</b> 1: Hour meter and kilowatt hour meter. 2: Inverter software revision and voltage reference. 3 - 33 alarm code and value
<b>MSG ID</b>	Message ID, feed back of Select message ID
<b>EVAP HR</b>	Evaporator run time, 1 for 1 hour.
<b>CMP1 HR</b>	Compressor 1 run time, 1 for 1 hour.
<b>CMP2 HR</b>	Compressor 2 run time, 1 for 1 hour.
<b>KW HR</b>	System total energy consumption meter, 1 for 1 kilowatt hour.
<b>REVISION</b>	Inverter software revision number
<b>BAT VOLT</b>	Battery voltage, 245 for 24.5VDC
<b>SUC VREF</b>	Suction pressure transducer voltage reference, 50 for 5.0VDC.
<b>DP1 VREF</b>	Discharge pressure transducer voltage reference, 50 for 5.0VDC.
<b>DP2 VREF</b>	Discharge pressure transducer voltage reference, 50 for 5.0VDC.
<b>ALM CODE</b>	Alarm code
<b>ALM VAL1</b>	Alarm value 1
<b>ALM VAL2</b>	Alarm value 2
<b>ALM DC</b>	DC bus voltage when the alarm happens.
<b>ALM AMB</b>	Ambient temperature when the alarm happens.
<b>ALM HOUR</b>	Evaporator hour meter when the alarm happens.
<b>ALM MIN</b>	Minute after start up when the alarm happens. The maximum value is 255 minutes. If alarm happens 255 minutes after the system start up, it will stay in 255.

#### 4.4.4 Alarm Code Definitions –

ALARM CODE	Definition	ALM VAL1	ALM VAL2
11	DC bus over voltage	Generator line voltage	Generator excitation command
12	DC bus under voltage	Generator line voltage	Generator excitation command
13	DC bus fault	Generator line voltage	Generator excitation command
14	Inverter temperature fault	IGBT1 temperature	IGBT2 temperature
21	IGBT1 over temperature	IGBT1 temperature	Compressor 1 current
23	Compressor 1 over current	Compressor 1 current	Compressor speed
24	Compressor 1 low suction pressure	Compressor 1 suct pres	Compressor speed
25	Compressor 1 high discharge pressure	Compressor 1 disch pres	Compressor speed
26	Compressor 1 reverse rotation	Compressor 1 suct pres	Compressor 1 disch pres
27	Compressor 1 trip	alarm value(0)	Compressor speed
31	IGBT2 over temperature	IGBT2 temperature	Compressor 2 current
33	Compressor 2 over current	Compressor 2 current	Compressor speed
34	Compressor 2 low suction pressure	Compressor 2 suct pres	Compressor speed
35	Compressor 2 high discharge pressure	Compressor 2 disch pres	Compressor speed
36	Compressor 2 reverse rotation	Compressor 2 suct pres	Compressor 2 disch pres
37	Compressor 2 trip	alarm value(3)	Compressor speed
41	Generator trip	Fault1	Fault2
42	Evaporator trip	alarm value(2)	Evaporator speed
43	Condenser trip	alarm value(1)	Condenser speed
44	Heater trip	position	Battery voltage
45	Flap trip	position	Battery voltage
46	CAN port 0 failure	CAN0RFLG	Battery voltage
47	CAN port 4 failure	CAN4RFLG	Battery voltage
51	Compressor 1 discharge pressure failure	Compressor 1 disch pres	Comp 1 disch pres volt reference
52	Compressor 1 discharge temperature failure	Compressor 1 disch temp	0
53	Compressor 1 suction pressure failure	Compressor 1 suct pres	Suct pressure voltage reference
54	Compressor 1 suction temperature failure	Compressor 1 suct temp	0
55	Ambient temperature failure	0	0
56	Averaged ambient temperature failure	Averaged ambient temp	0
57	Return air temperature failure	Return air temperature	0
58	Averaged return air temperature failure	Averaged return air temp	0
61	Compressor 2 discharge pressure failure	Compressor 2 disch pres	Comp 2 disch pres volt reference
62	Compressor 2 discharge temperature failure	Compressor 2 disch temp	0
63	Compressor 2 suction pressure failure	Compressor 2 suct pres	Suct pressure voltage reference
64	Compressor 2 suction temperature failure	Compressor 2 suct temp	0
65	Supply air temperature inverter side failure	Inverter side S/A temp	0
66	Supply air temperature comp side failure	Comp side S/A temp	0

#### Note:

- Details of generator line voltage, excitation command, fault code 1, fault code 2, see Page 1 - System overview and automatic control.
- The unit of IGBT temperature is degree C.
- The unit of compressor current is 0.1A, 35 for 3.5A.
- The unit of compressor, evaporator and condenser speed is 1Hz.
- The unit of suction and discharge pressure is 0.1bar. It is in absolute pressure.
- Averaged ambient, return air, averaged return air, suction and supply air temperature are in 8 bit format. Use the following calculation to convert them to degree C.
 

0 - 40	t -40
40 - 200	(t -40) x 0.25
200 - 245	(t -200) + 40
- The unit of discharge temperature is degree C.
- The unit for voltage reference is 0.1V.
- The unit for battery voltage is 0.2V.
- The alarm value for compressor 1, compressor 2, evaporator and condenser:
  - 1: Alarm
  - 2: Fault
  - 4: Internal fault 1
  - 8: Internal fault 2
  - 16: DC bus fault
  - 32: Communication fault
  - 64: Temperature fault
  - 128: DC link fault

#### 4.4.5 Page 4 – Alarms

4 OVER V	0	0	0	0	0	0
UNDR VLT	0	0	0	0	0	0
DC FAULT	0	0	0	0	0	0
OVER TMP	0	0	0	0	0	0
CP1 HI T	0	0	0	0	0	0
CP1 HI A	0	0	0	0	0	0
CP1 LO P	0	0	0	0	0	0
CP1 HI P	0	0	0	0	0	0
CP1 REV	0	0	0	0	0	0
CP1 TRIP	0	0	0	0	0	0
CP2 HI T	0	0	0	0	0	0
CP2 HI A	0	0	0	0	0	0
CP2 LO P	0	0	0	0	0	0
CP2 HI P	0	0	0	0	0	0
CP2 REV	0	0	0	0	0	0
CP2 TRIP	0	0	0	0	0	0
GEN ALM	0	0	0	0	0	0
EVAP ALM	0	0	0	0	0	0
COND ALM	0	0	0	0	0	0
HTR ALM	0	0	0	0	0	0
FLAP ALM	0	0	0	0	0	0
CAN0 ALM	0	0	0	0	0	0
CAN4 ALM	0	0	0	0	0	0

**Note:**

OVER V	Alarm 11, Inverter DC bus over voltage alarm.
UNDR VLT	Alarm 12, Inverter DC bus under voltage alarm.
DC FAULT	Alarm 13, Inverter DC bus faulty alarm.
OVER TMP	Alarm 14, Inverter over temperature alarm.
CP1 HI T	Alarm 21, Inverter compressor 1 output over temperature.
CP1 HI A	Alarm 23, Compressor 1 over current.
CP1 LO P	Alarm 24, Compressor 1 low suction pressure
CP1 HI P	Alarm 25, Compressor 1 high discharge pressure
CP1 REV	Alarm 26, Compressor 1 reverse rotation
CP1 TRIP	Alarm 27, Inverter compressor 1 output trips.
CP2 HI T	Alarm 31, Inverter compressor 2 output over temperature
CP2 HI A	Alarm 33, Compressor 2 over current
CP2 LO P	Alarm 34, Compressor 2 low suction pressure
CP2 HI P	Alarm 35, Compressor 2 high discharge pressure
CP2 REV	Alarm 36, Compressor 2 reverse rotation
CP2 TRIP	Alarm 37, Inverter compressor 2 trip
GEN ALM	Alarm 41, Generator alarm
EVAP ALM	Alarm 42, Evaporator alarm
COND ALM	Alarm 43, Condenser alarm
HTR ALM	Alarm 44, Heater alarm
FLAP ALM	Alarm 45, Flap alarm
CAN0 ALM	Alarm 46, CAN port 0 alarm
CAN4 ALM	Alarm 47, CAN port 4 alarm

#### 4.4.6 Page 5 - Manual Control

5 TEST	0	0	0	0	0	0
CLR AL	0	0	0	0	0	0
RST KW	0	0	0	0	0	0
MANUAL	0	0	0	0	0	0
FLAP	0	0	0	0	0	0
GEN	0	0	0	0	0	0
EVAP	0	0	0	0	0	0
COND	0	0	0	0	0	0
COMP	0	0	0	0	0	0
HEATER	0	0	0	0	0	0
EVAP MAN	60	60	60	60	60	60
COND MAN	60	60	60	60	60	60
COMP MAN	60	60	60	60	60	60
HEAT SP	10	10	10	10	10	10
FLAP SP	50	50	50	50	50	50
DC BUS	0	610	620	615	600	0
STATUS	0	111	111	111	111	0
EVAP Hz	0	60	60	60	60	0
COND Hz	0	90	90	90	90	0
COMP Hz	0	60	60	60	60	0
HEAT %	0	0	0	0	0	0
FLAP %	0	10	11	12	11	0
TIMER	0	0	0	0	0	0

**Note:**

TEST	Set up test mode
CLR AL	0->1 Clear alarm queue
RST KW	0->1 Reset kilowatt hour meter to 0
MANUAL	Set up manual control, 0: Auto, 1: Manual
FLAP	0->1 Turn on, 1->0 Turn off
GEN	0->1 Turn on, 1->0 Turn off
EVAP	0->1 Turn on, 1->0 Turn off
COND	0->1 Turn on, 1->0 Turn off
COMP	0->1 Turn on, 1->0 Turn off
HEAT	0->1 Turn on, 1->0 Turn off
EVAP MAN	Evaporator speed manual setting, + increase, - decrease.
COND MAN	Condenser speed manual setting, + increase, - decrease.
COMP MAN	Compressor speed manual setting, + increase, - decrease.
HEAT SP	Heater set point manual setting, + increase, - decrease.
FLAP SP	Flap set point manual setting, + increase, - decrease.
DC BUS	DC bus voltage
STATUS	Status, same as STATUS in information page 1.
EVAP Hz	Evaporator speed
COND Hz	Condenser speed
COMP Hz	Compressor speed
HEAT %	Heat control level
FLAP %	Flap control level
TIMER	Compressor minimum off timer. Count down from 60 when compressor is turned off.

#### 4.4.7 Page 6 - System Configuration 1

6 RS232	PC	DISP	PC	PC	DLOG	PC
PRESSURE	bar	bar	bar	bar	bar	bar
DEG C/F	0	0	0	0	0	0
RE-HEAT	0	0	0	0	0	0
AUTO SPT	0	0	0	0	0	0
AUTO DIS	0	0	0	0	0	0
AVG TEMP	0	0	0	0	0	0
ZONE CTL	0	0	0	0	0	0
EXTENDED	0	0	0	0	0	0
FIXED SP	0	0	0	0	0	0
HEAT CTL	NO	NO	NO	NO	NO	NO
ZONE NO.	0	0	0	0	0	0
SP SPAN	0	4	4	4	4	0
DIST DIF	0	12	12	12	12	0
FULL PWR	0	90	90	90	90	0
OVER DRV	0	0	0	0	0	0
COMP AMP	0	6.5	6.5	6.5	6.5	0
MIN COMP	0	40	40	40	40	0
MAX COMP	0	90	90	90	90	0
MIN EVAP	0	40	40	40	40	0
MAX EVAP	0	90	90	90	90	0
MAX HEAT	0	100	100	100	100	0
MAX FLAP	0	95	95	95	95	0

**Note:**

<b>RS232</b>	RS232 port selection: PC: for connecting to PC running HyperTerminal DSP2: for connecting to individual driver display <b>Default is PC for HyperTerminal connection.</b>	DSP1: for connecting to driver display DLOG: for connecting to a ML3 or PC based logger.
<b>PRES-SURE</b>	Pressure unit selection Bar: use bar for pressure unit <b>Default is 0, bar.</b> This setting affects the HyperTerminal display page 1 and 2. For the configuration data, the pressure unit is bar.	PSIG: use psig for pressure unit.
<b>DEG C/F</b>	Temperature unit selection 0: Degree C <b>Default is 0, degree C</b> This setting affects driver display and HyperTerminal display page 1 and 2. For the configuration data, the temp unit is C.	1: Degree F
<b>RE-HEAT</b>	Reheat selection 0: Reheat disabled <b>Default is 0, reheat disabled</b>	1: Reheat enabled
<b>AUTO SP</b>	Automatic set point selection 0: disable automatic set point <b>Default is 0, disable automatic set point</b>	1: enable automatic set point
<b>AUTO DIS</b>	Automatic discharge pressure set point selection 0: disable automatic discharge pressure set point <b>Default is 0, disable automatic discharge pressure set point</b>	1: enable automatic discharge pressure set point
<b>AVG TEMP</b>	Averaged temperature control selection 0: disable average temperature <b>Default is 0, disable averaged temperature</b>	1: enable average temperature
<b>ZONE CTL</b>	Zone temperature control selection 0: disable zone temperature control <b>Default is 0, disable zone control</b>	1: enable zone temperature control
<b>EX-TENDED</b>	Extended inverter 0: standard inverter drivers one compressor <b>Default is 0 for standard inverter.</b>	1: extended inverter drivers two compressor
<b>FIXED SP</b>	Fixed set point 0: disable fixed s/p, driver can change set point <b>Default is 0 for driver display can change the set point.</b>	1: enable fixed s/p, driver can't change set point

#### 4.4.7 Page 6 - Note: (Continued)

<b>HEAT CTL</b>	<p>Heater control</p> <p>NO: No heating</p> <p>NCV: Normally closed solenoid valve</p> <p>MOTOR: Motor valve</p> <p><b>Default is NO for no heating.</b></p>	<p>SLAVE: Slave heat, the heat is controlled by other modules</p> <p>NOV: Normally opened solenoid valve</p> <p>FLR: If Floor Heater Are connected to control through unit</p>
<b>ZONE NO.</b>	<p>Zone number selection</p> <p>It is the module ID the inverter will use as zone number.</p> <p><b>Default is 0.</b></p>	
<b>SP SPAN</b>	<p>Set point span for automatic set point, + increase, - decrease.</p> <p>When "AUTO SP" is enabled, the return air set point will be 22C when ambient temperature is 25C. The set point will be increased to 22 + span when ambient is above 35C. The set point will be decreased to 22 - span when the ambient temperature is below 15C.</p> <p><b>Default is 4C, 18C set point for ambient below 15C, 26C set point for ambient above 35C.</b></p>	
<b>DIST DIF</b>	<p>Discharge temperature difference for automatic discharge pressure set point, + increase, - decrease.</p> <p>When "AUTO DIS" is enabled, the discharge pressure set point will be determined by ambient temperature.</p> <p><b>Default is 12 for 12C.</b></p>	
<b>FULL PWR</b>	<p>Generator full power frequency. At this frequency the generator will deliver full power. Below this frequency, the generator will reduce power output to maintain constant torque until 60Hz. Below 60Hz; the generator power will be further reduced to reduce torque. At 30Hz, the power will be 25% of power output at 60Hz.</p> <p><b>Default is 100% for full power at 90Hz, 66% power at 60Hz and 50% power at 50Hz.</b></p> <p>+ to increase, - to decrease, range is from 50Hz to 120Hz</p>	
<b>OVER DRV</b>	<p>Get more than full load power from the generator when generator frequency is higher than 90Hz. For example, OVER DRV is 10, the maximum power from the generator will be 110% of its rated power at <math>90 + 3 \times 10 = 120\text{Hz}</math>.</p>	
<b>COMP AMP</b>	<p>Compressor current set point, + increase, - decrease.</p> <p><b>Default is 6.5 for 6.5A; range is from 35 to 65 for 3.5A to 6.5A.</b></p>	
<b>MIN COMP</b>	<p>Minimum compressor speed, + increase, - decrease.</p> <p><b>Default is 40 for 40Hz, range is from 30Hz to 50Hz</b></p>	
<b>MAX COMP</b>	<p>Maximum compressor speed, + increase, - decrease.</p> <p><b>Default is 90 for 90Hz, range is from 50Hz to 90Hz</b></p>	
<b>MIN EVAP</b>	<p>Minimum evaporator speed, + increase, - decrease.</p> <p><b>Default is 40 for 40Hz, range is from 30Hz to 50Hz</b></p>	
<b>MAX EVAP</b>	<p>Maximum evaporator speed, + increase, - decrease.</p> <p><b>Default is 90 for 90Hz, range is from 50Hz to 90Hz.</b></p>	
<b>MAX HEAT</b>	<p>Maximum heat opening, + increase, - decrease.</p> <p><b>Default is 100 for 100%, range from 20 to 100 for 20% to 100%.</b></p>	
<b>MAX FLAP</b>	<p>Maximum flap, + increase, - decrease.</p> <p><b>Default is 50 for 50%, range from 10 to 100 for 10% to 100%.</b></p>	

#### 4.4.8 Page 7 - System Configuration 2

7 DIS SP	12.6	12.6	12.6	12.6	12.6	12.6
H SUP EV	0	0	0	0	0	0
H SUP HT	8	8	8	8	8	8
FLOOR IN	6	6	6	6	6	6
FLOOR HY	2	2	2	2	2	2
RHT IN	3	3	3	3	3	3
RHT HY	1	1	1	1	1	1
RHT COMP	50	50	50	50	50	50
RHT CURR	3.5	3.5	3.5	3.5	3.5	3.5
RHT T(M)	20	20	20	20	20	20
DEACC DC	400	400	400	400	400	400
DEACC PW	70	70	70	70	70	70
DEACC FR	100	100	100	100	100	100
DEACC RT	5	5	5	5	5	5
DR EVAP	60	60	60	60	60	60
DR T(S)	10	10	10	10	10	10
FLP T(M)	5	5	5	5	5	5
SHORE PW	4.5	4.5	4.5	4.5	4.5	4.5

**Note:**

DIS SP	Discharge pressure set point. <b>Default is 12.6 bar or 185 psig. Range from 8.0bar to 15.0bar or 116 psig to 217 psig.</b>
H SUP EV	Heat mode supply air temperature offset for evaporator speed control. When supply air temperature is lower than (return air set point + H SUP EV), evaporator speed will be reduced. <b>Default is 0.</b> If return air set point is 22C, the evaporator speed will be reduced if supply air temperature is lower than 22C. This is to prevent cold air blow.
H SUP HT	Heat mode supply air temperature offset for heater control. When supply air temperature is higher than (return air temperature + H SUP HT), heater output will be reduced. <b>Default is 8.</b> If return air set point is 22C, the heater output will be reduced if supply air temperature is higher than $22 + 8 = 30C$ . This is to prevent hot air blow and also reduce heat control overshoot.
FLOOR IH	Floor heater cut in temperature. When the heater is configured as floor heater, if return air temperature is lower than (return air set point – FLOOR IN), heater output will be turned on. When floor temperature sensor is installed and floor temperature is lower than (return air set point – FLOOR IN), floor heater output will be turned on. <b>Default is 6.</b> If return air set point is 22C, the heater or floor heater will be turned on when return air or floor temperature is lower than $22 - 6 = 16C$ .
FLOOR HY	Floor heater hysteresis. <b>Default is 2.</b> If return air set point is 22, FLOOR IN is 6. The floor heater will be turned off when return air temperature is higher than $16 + 2 = 18C$ .
RHT IN	Reheat cut in temperature. When reheat is selected, if return air temperature is higher than (return air set point – RHT IN), reheat will be enabled. <b>Default is 3.</b> If return air set point is 22C, reheat is enabled if return air temperature is higher than $22 - 3 = 19C$ .
RHT HY	Reheat hysteresis. <b>Default is 1.</b> If return air set point is 22C, RHT IN is 3, reheat will be disabled when return air temperature is lower than $19 - 1 = 18C$ .
RHT COMP	Reheat mode compressor speed. <b>Default is 50.</b> When in reheat mode, the compressor will run 50Hz.
RHT CURR	Reheat mode compressor current set point. <b>Default is 3.5A.</b> When in reheat mode, the compressor current will be limited to 3.5A.
RHT T(M)	Reheat time duration in minute. <b>Default is 20.</b> If reheat is activated by driver display, it will run for 20 minutes.
DEACC DC	Fast de-acceleration DC bus voltage level. <b>Default is 400V.</b> If DC bus voltage is lower than 400V, the compressor and condenser will be shut down.
DEACC PW	Fast de-acceleration generator power setting. <b>Default is 70.</b> Detect fast de-acceleration when generator power is higher than 70%.
DEACC FR	Fast de-acceleration generator frequency setting. <b>Default is 100.</b> Detect fast de-acceleration when generator frequency is lower than 100Hz.
DEACC - RT	Fast de-acceleration generator frequency change setting. <b>Default is 5.</b> Consider fast de-acceleration if generator frequency reduces more than 5Hz per measurement.
DR EVAP	Door open evaporator speed. <b>Default is 60Hz.</b> When door open signal is connected and door open is detected, evaporator will run 60Hz.
DR T(S)	Door open time delay. <b>Default is 10 seconds.</b> When door open signal disappears, the evaporator speed will back to normal after 10 seconds delay.
FLP T(M)	Fresh air close time duration. <b>Default is 5 minutes.</b> When fresh air is closed by driver display, it will be reopened after 5 minutes.
SHORE PW	Shore power compressor current setting. <b>Default is 4.5A.</b> When the system is powered by shore power, the maximum compressor current is limited to 4.5A.



## 4.5 BOOT LOADER PROCEDURE

The Boot loader configuration is used to reprogram the microprocessor's on-chip flash memory. It receives program codes from a PC running HyperTerminal. The Boot loader will be activated at power-up when the inverter Boot loader Jumpers are connected together.

### 4.5.1 Activating Boot Loader

With all power OFF, connect the two Jumper Wires together (pink insulated spade connector pair) which are located in the return air of the module that has been connected to the PC.

Switch on the 24VDC power supply to the module only. When activated, the Boot loader program will show the following menu on the PC HyperTerminal screen:

#### DP256 Boot loader

- a) Erase Flash
- b) Program Flash
- c) Change Baud Rate
- d) Erase EPROM
- ?

Selecting "a" will erase all existing program memory.

Selecting "d" will erase all existing parameters saved in the EPROM.

Selecting "b", the microprocessor will wait for the PC to send the program code in Motorola S19 format.

After selecting "b", the inverter is waiting for the PC to send the new program. On the HyperTerminal window main menu, select "Transfer" and "Send Text File". The "Send Text File" dialog will be shown. In the "Send Text File" dialog, select the folder where new program code has been saved. Since the program code has extension .S19, in the "Files of type:" list, select "All files (\*.\*)" This will then display the relevant .S19 files in the saved folder to be viewed and allow selection.

Review the file list and click on the desired file name. The selected file will then be sent to the inverter for programming.

The HyperTerminal screen, will display running "\*\*\*\*\*" which indicates that the new program is being uploaded. When the programming is finished, the Boot loader menu will be show again.

After successfully programming the inverter, disconnect the Boot loader Jumpers and cycle the 24VDC power.

#### NOTE

NOTE: Only 24VDC power is needed to run Boot loader. Before downloading software to any inverter, make sure the main disconnect switch is in OFF (0) position and that the bus engine is shut down.

This procedure will need to be followed for every inverter within the system unless instructed otherwise.

After loading the software to the inverter, the boot load jumper must be disconnected.

## 4.6 OTHER RS232 CONNECTIONS

Based on system configuration, the RS232 port can be connected to the following devices:

- Boot loader
- Terminal Display
- Driver Display
- Data Logger

As previously mentioned, with the Boot Loader jumpers disconnected and the 24VDC powered to the A/C system the following main menu will be displayed on the HyperTerminal screen:

### Controller Diagnostic Interface

- 1) Connect to Driver Display
- 2) Connect to Data logger
- 3) Connect to Terminal Display
- 4) Help

#### 4.6.1 Drivers Display

Entering "1" will re-configure the communication port to use a Driver Display data format. The Standard fitment is the Carrier AvantAC Digital Display. If using the RS232 port for connecting to the AvantAC drivers display or another display which accepts the same format, enter "1". Once selected, the HyperTerminal screen will disappear and a series of running lines will cross the HyperTerminal display.

Note \* When there is a need to connect to an RS-232 port that was previously connected to a drivers display running lines will be displayed in the HyperTerminal screen. To display the Main Menu again on the HyperTerminal screen, press the "Space Bar" once [1] and then the "ESC" button three [3] times. If this is not successful try again.

#### 4.6.2 Data Logger

This option is used if the LabView or similar Programs are to be utilized for viewing or logging data. Before using LabView, go into HyperTerminal main menu and select "2". This will display running cryptic symbols in the HyperTerminal screen. Once this is displayed, shut down the HyperTerminal program and leave the session.

Once these procedures have been carried out, open LabView or equivalent and follow its required instructions.

If access is required into the HyperTerminal program again, start the program and follow the above procedures indicated in the foot note for the 'drivers display.

#### 4.6.3 Terminal Display

Refer to Section 2.1 Starting, Stopping and Operating instructions in this manual.

#### 4.6.4 Help

Selecting this option brings up the help menu which will provide some insight into any problem that may arise when using the HyperTerminal connection to the AvantAC Electric A/C System.

#### 4.7 HYPERTERMINAL FILE CONVERSION TO EXCEL

##### NOTE

To convert the saved HyperTerminal File to an Excel based format, a program called scantxt is required to be installed on the converting PC.

When using the HyperTerminal to capture the text, use simple directory and file name. The directory and file name should be no more than 8 characters long and use no space character.

Save files to the same directory as the scantxt program, currently under 'C' drive Temp/hypt.

After ending the HyperTerminal section, go to START -> RUN and enter "command" to open command window.

In command window, go to the directory where you save the text file.

```
CD [space] \
```

```
CD [space] temp\hypt
```

Type DIR to see files in that folder

Then type - scantxt [11-21-05].txt > [11-21-05].dat. [change 11-21-05 to what ever the file has been saved as.]

This will save the output to a file named 11-21-05.dat. After that, run EXCEL and open the file 11-21-05.dat. When EXCEL asks how to separate the field, choose Delimited, click Next button and select space as Delimiter.

In EXCEL, some editing work will need to be done to convert the titles over the top of the inputs in 6 row lots.

## SECTION 5

### SERVICE

**WARNING**

Be aware of **HIGH VOLTAGE** supplied to this equipment from the vehicle high voltage system and/or shore power source and that the equipment may start automatically. Do not attempt to service this equipment without proper training. Electrical power within this equipment is sufficiently high enough to cause serious injury or death.

Before servicing this equipment:

1. If the vehicle is equipped with shore power, ensure the shore power supply is OFF and then disconnect the plug. When reconnecting, ensure the power plug is clean and dry before connecting to the electrical outlet/receptacle. Ensure power supply is correct for this application.
2. Ensure the main disconnect from the vehicle high voltage power source is OFF, vehicle engine is off and ignition system is locked out.
3. Both AC and DC power is used in this equipment. Test for both AC and DC voltage to confirm there is no power before working on any circuit or electrical component.

**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 the vehicle 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.

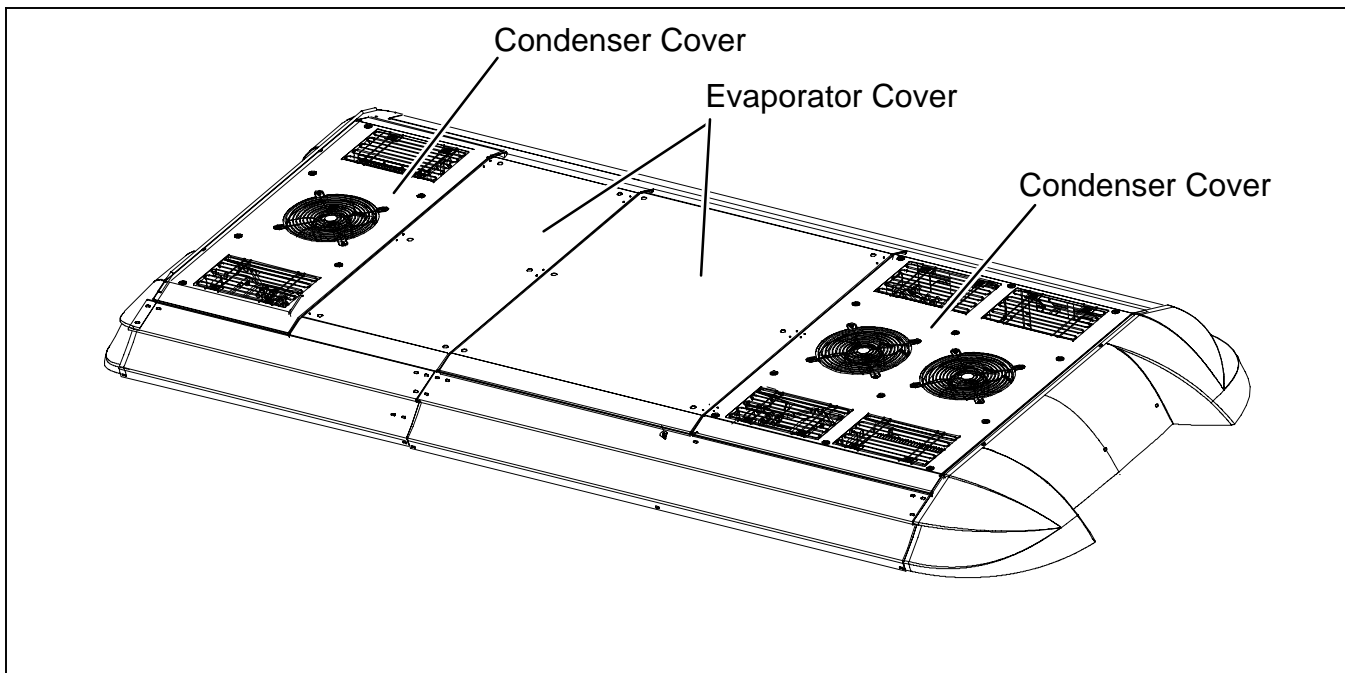
### 5.1 MAINTENANCE SCHEDULE

SYSTEM		SYSTEM
ON	OFF	
<b>a. Daily Maintenance</b>		
X		Pre-trip Inspection - after starting
<b>b. Weekly Inspection</b>		
	X	Perform daily inspection
	X	Check condenser, evaporator coils and for cleanliness
	X	Clean return air filters
<b>c. Monthly Inspection and Maintenance</b>		
	X	Perform weekly inspection and maintenance
	X	Clean evaporator drain pans and hoses
	X	Check wire harnesses for chafing and loose terminals
	X	Check fan motor bearings
	X	Clean fresh air filters

### 5.2 OPENING TOP COVER (EVAPORATOR)

To open either side of the evaporator assembly cover do the following: (See Figure 5-1.)

- a. Twist all of the 1/4 Turn cam locks counterclockwise.
- b. Grasp the cover section under the bottom edge and lift up.
- c. Fold back and lay on top of the condenser section.



**Figure 5-1 System Cover Removal**

### 5.3 REMOVING TOP COVER (CONDENSER)

The condenser cover assembly incorporates the condenser air inlet grills and the condenser fan grills (See Figure 5-1.). To remove the cover from the condenser assembly do the following:

- Remove all mounting bolts holding the condenser section that will be removed.
- Remove the condenser fan grills.
- Loosen the screws securing the front or rear spoiler
- Twist all of the 1/4 Turn cam locks counterclockwise that secure the evaporator cover.
- Fold the evaporator lid back onto the condenser cover.
- Using two people, grasp both sections together under the bottom edge and lift up evenly from both sides carefully maneuvering the seal from under the spoiler.

### 5.4 INSTALLING 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 Carrier Transicold. (Carrier Transicold P/N 07-00294-00, which includes items 1 through 6, Figure 5-2). To perform service using the manifold gauge/hose set, do the following:

#### 5.4.1 Preparing Manifold Gauge/Hose Set For Use

- 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:
- Back seat (turn counterclockwise ) both field service couplers (see Figure 5-2) and midseat both hand valves.
- Connect the yellow hose to a vacuum pump and an R-134a cylinder.

- Evacuate to 10 inches of vacuum and then charge with R-134a to a slightly positive pressure of 1.0 psig.
- Front seat both manifold gauge set hand valves and disconnect from cylinder. The gauge set is now ready for use.

#### 5.4.2 Connecting Manifold Gauge/Hose Set

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

- Ensure the 24VDC on/off switch is in the off position and the main disconnect switch is in the off position.
- Remove the suction and discharge pressure transducers from their corresponding access ports.

#### NOTE

Take care to ensure that the suction and discharge transducers are returned to their respective ports, and not swapped.

- Connect R-134a adapter (Carrier Part Number 40-00529-00) to the low side (suction) service port and R-134a adapter (Carrier Part Number 40-60042-01) to the high side (discharge) service port.
- Connect the field service coupler (see Figure 5-2) to the access valve adapter.
- Turn the field service coupling knob clockwise, which will open the system to the gauge set.
- Read system pressures.
- Repeat the procedure to connect the other side of the gauge set.

#### 5.4.3 Removing the Manifold Gauge Set

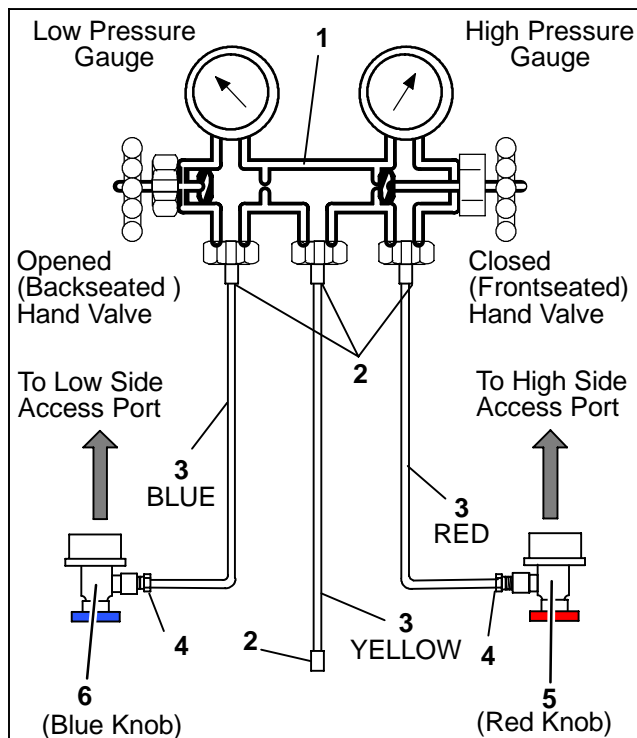
- Midseat both hand valves on the manifold gauge set and allow the pressure in the manifold gauge set to be drawn down to low side pressure. This returns any liquid that may be in the high side hose to the system.



## CAUTION

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

- Backseat both field service couplers and frontseat both manifold set hand valves. Remove the couplers from the access valves.
- Remove both R-134a adapters from the suction and discharge access ports.
- Re-install the suction and discharge pressure transducers on to their respective ports.



- Manifold Gauge Set
- Hose Fitting (0.5-16 Acme)
- Refrigeration and/or Evacuation Hose (SAE J2196/R-134a)
- Hose Fitting w/O-ring (M14 x 1.5)
- High Side Field Service Coupler
- Low Side Field Service Coupler

Figure 5-2 Manifold Gauge Set (R-134a)

## 5.5 REMOVING THE REFRIGERANT CHARGE

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

## 5.6 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.

- If system is without refrigerant, charge system with refrigerant vapor to build up pressure to approximately 30 PSIG (2.04 bar).
- Add sufficient nitrogen to raise system pressure to 150 to 200 psig (10.21 to 13.61 bar).
- 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.
- Remove test gas.
- Evacuate and dehydrate the system. Refer to paragraph 5.7.
- Charge the unit. Refer to paragraph 5.8.

## 5.7 EVACUATION AND DEHYDRATION

### 5.7.1 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 5.7.3) should be performed after a major system repair (compressor, evaporator, or condenser replacement). A one time evacuation (Refer to paragraph 5.7.4) should take place after a minor system repair (replacement of a TXV or a suction filter).

### 5.7.2 Preparation

## NOTE

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

- Evacuate and dehydrate only after pressure leak test. Refer to paragraph 5.6.
- 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, (CTD P/N 07-00176-11), and a good vacuum indicator (CTD P/N 07-00414-00).
- Keep the ambient temperature above 60°F (15.6°C) to speed evaporation of moisture. If ambient temperature is lower than 60°F (15.6°C), ice may form before moisture removal is complete.

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

- a. Remove refrigerant using a refrigerant recovery system.
- b. The recommended method is connecting lines (refrigerant hoses designed for vacuum service) as described in 5.4.
- c. Make sure vacuum pump valve is open.
- d. Start vacuum pump. Slowly open valves halfway and then open vacuum gauge valve.
- e. Evacuate unit until vacuum gauge indicates 2000 microns Hg vacuum. Close gauge valve, vacuum pump valve, and stop vacuum pump.
- f. Break the vacuum with nitrogen. Raise system pressure to approximately 2 psig.
- g. Purge the nitrogen from the system.
- h. Repeat steps d. thru g. one time.
- i. Start vacuum pump and open all valves. Dehydrate unit to 500 microns Hg vacuum.
- j. Close off pump valve, and stop pump. Wait five minutes to see if vacuum holds.
- k. Charge system. Refer to paragraph 5.8.

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

- a. Remove refrigerant using a refrigerant recovery system.
- b. The recommended method is connecting lines (refrigerant hoses designed for vacuum service) as described in 5.4.
- c. Make sure vacuum pump valve is open.
- d. Start vacuum pump. Slowly open valves halfway and then open vacuum gauge valve.
- e. Evacuate unit until vacuum gauge indicates 500 microns Hg vacuum.
- f. Close off pump valve, and stop pump. Wait five minutes to see if vacuum holds.
- g. Charge system. Refer to paragraph 5.8.

## 5.8 ADDING REFRIGERANT TO SYSTEM

- a. Install manifold gauge set.
- b. Evacuate and dehydrate system. Refer to paragraph 5.7.
- c. Place refrigerant cylinder on scales. Prepare to charge liquid refrigerant by connecting charging hose from refrigerant cylinder to center connection on gauge manifold. Purge air from hoses.
- d. Note weight of refrigerant and cylinder.
- e. Open cylinder valve, backseat discharge valve on gauge manifold and allow liquid refrigerant to flow into the high side of the system
- f. When correct charge has been added (refer to paragraph 1.5), close cylinder valve and frontseat manifold discharge valve.

## 5.9 CHECKING AND REPLACING HIGH OR LOW PRESSURE SWITCH



**WARNING**

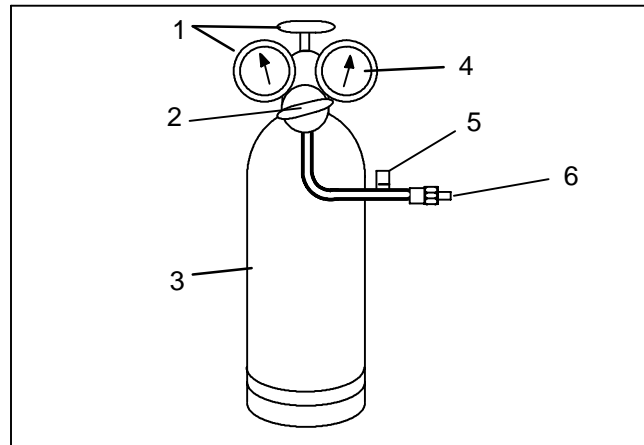
**Do not use a nitrogen cylinder without a pressure regulator**



**WARNING**

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

- a. Disconnect wiring and remove switch from unit. All units are equipped with a schrader valve at the pressure switch connections.
- b. Connect switch to a cylinder of dry nitrogen. See Figure 5-3.

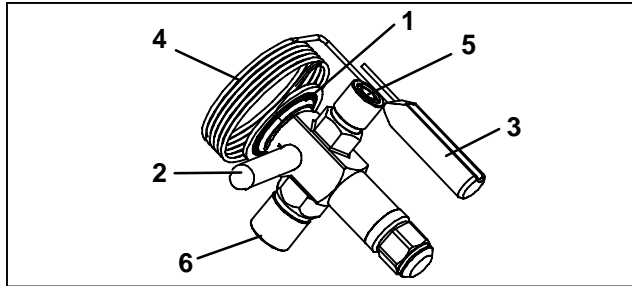


**Figure 5-3 Checking High Pressure Switch**

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

## 5.10 THERMOSTATIC EXPANSION VALVE

The thermostatic expansion valve (See Figure 5-4) 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 5-4 Thermostatic Expansion Valve**

1. Power Head Assembly
2. Equalizer Connection
3. Bulb
4. Capillary Tube
5. Liquid Connection From Filter Dryer
6. Refrigerant Connection to Evaporator

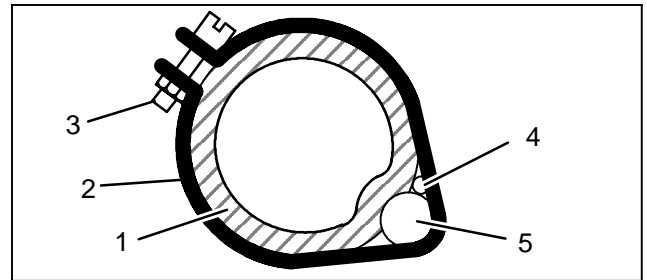
### 5.10.1 Valve Replacement

- a. Remove refrigerant using a refrigerant recovery system.
- b. Remove insulation from expansion valve and bulb. See Figure 5-4 and Figure 5-5.
- c. Loosen retaining straps holding bulb to suction line and detach bulb from the suction line.
- d. Unbrazed equalizer line from the expansion valve.
- e. Remove capscrews and clamps securing refrigerant lines to frame.
- f. Unbrazed the inlet connection, then the outlet connections to the TXV. Be careful to protect any insulation or wires that are in the area.
- g. Install the new valve. Brazed the outlet connection, then the inlet connections to the TXV. Be careful to protect any insulation or wires that are in the area.
- h. Brazed the equalizer line to the expansion valve.
- i. Leak check the new valve and evacuate and dehydrate the refrigeration system. Refer to paragraph 5.7.
- j. The thermal bulb is installed below the center of the suction line (four or eight o'clock position). This area must be clean to ensure positive bulb contact. Strap thermal bulb to suction line. Ensure that retaining straps are tight and replace insulation.
- k. Check superheat. Refer to paragraph 5.10.2.

### 5.10.2 Superheat Measurement

#### NOTE

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



**Figure 5-5 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'o'clock position)

- a. Remove Presstite insulation from expansion valve bulb and suction line.
- b. Loosen one TXV bulb clamp and make sure area under clamp is clean.
- c. Place temperature thermocouple in contact with the suction tube and parallel to the TXV bulb, and then secure loosened clamp making sure both bulb and thermocouple are firmly secured to suction line. See Figure 5-5. Reinstall insulation around the bulb.
- d. Obtain pressure port (Figure 1-6).
- e. Start system and run 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.

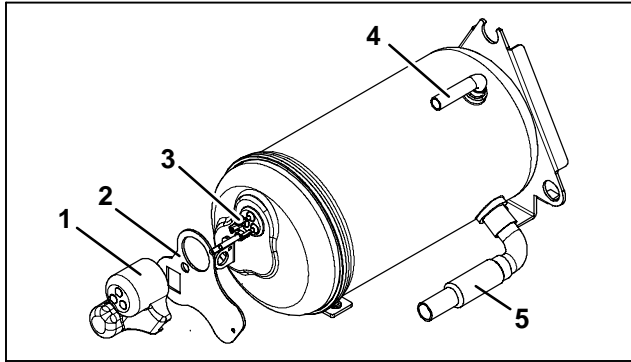
- f. From the temperature/pressure chart (Table 5-3), determine the saturation temperature corresponding to the evaporator outlet pressure.
- g. Note the temperature of the suction gas at the expansion valve bulb. Subtract the saturation temperature from this temperature. The difference is the superheat of the suction gas.
- h. The superheat may cycle from a low to high reading. Monitor the superheat taking readings every 3-5 minutes for a total of 5-6 readings. Calculate the superheats, add the readings and divide by the number of readings taken to determine average superheat. Refer to paragraph 1.5 for superheat setting.
- i. If superheat is not within tolerance, replace the valve.

## 5.11 COMPRESSOR MAINTENANCE

### 5.11.1 Removing the Compressor

- a. Install a manifold gauge set (Refer to paragraph 5.4).
- b. Disconnect wiring to the compressor terminals.

- c. Remove refrigerant using a refrigerant recovery system (Refer to paragraph 5.7.3).
- d. Remove the high pressure switch.
- e. Cut the suction and discharge tube as close to the compressor as possible.
- f. Remove the four bolts holding the compressor/base assembly to the condenser frame and remove from the unit.
- g. Remove four bolts holding the compressor to the base.



**Figure 5-6 Compressor**

- 1. Terminal Cover
- 2. Terminal Gasket
- 3. Terminals
- 4. Discharge Line
- 5. Suction Line

### 5.11.2 Replacing the Compressor

#### NOTES

Check oil level in service replacement compressor.

- a. Bolt the new compressor to the base.
- a. Bolt the new compressor/base in to the condenser frame.
- b. Connect a nitrogen supply to the high pressure switch port.
- c. Remove the Schrader valve from the suction pressure transducer port.
- d. Add nitrogen to the unit (5-psig maximum flow), leaving the other connector open to the atmosphere.



#### WARNING

**Oil vapor in piping stubs can ignite from torch flame and cause serious injury. Exercise extreme care when brazing, and keep brazing cloth and fire extinguisher handy for emergency use.**

- e. Using field-supplied copper slip couplings, braze the discharge and suction lines into place.

- f. Replace the Schrader valve to the suction pressure transducer port.
- g. Replace the high pressure switch onto the port that has no Schrader valve.
- h. Leak check the brazed connections and evacuate and dehydrate the refrigeration system. Refer to paragraph 5.7.
- i. Recharge system. Refer to paragraph 5.8.
- j. Reconnect wiring to the compressor terminals.
- k. Replace the high and low pressure transducers onto their respective ports.

### 5.12 REPLACING RETURN AIR FILTERS

The return air filters are located behind the return air grille, 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. Ensure the 24VDC on/off switch is in the off position and the main disconnect switch is in the off position.
- b. Remove the return air grille.
- c. Loosen filter retaining hardware and remove the filter from the grille.
- d. Reverse procedure to install new filters.

### 5.13 REPLACING THE EVAPORATOR MOTOR

- a. Ensure the 24VDC on/off switch is in the off position and the main disconnect switch is in the off position.
- b. Disconnect wiring from the defective fan motor and the speed controller.
- c. Remove 4 screws securing the evaporator bracket/orifice/motor and fan assembly to the evaporator assembly.
- d. Lift the evaporator bracket/orifice/motor and fan assembly from the evaporator assembly.
- e. Remove 4 screws securing the fan motor to the evaporator bracket.
- f. Loosen the set screw on the fan wheel and separate it from the evaporator motor.
- g. Attach the new motor to the evaporator bracket, leaving the screws loose.
- h. Place the fan wheel on to the motor shaft.
- i. Adjust the fan wheel to the orifice ring so that no contact is made when the wheel is rotated.
- j. Tighten the 4 screws securing the fan motor to the evaporator bracket and the set screw securing the fan wheel to the fan motor.
- k. Reconnect wiring for the fan motor and the speed controller.
- l. Replace the 4 screws securing the evaporator bracket to the evaporator assembly and tighten.
- m. Check the fan for rotation, adjust as necessary.



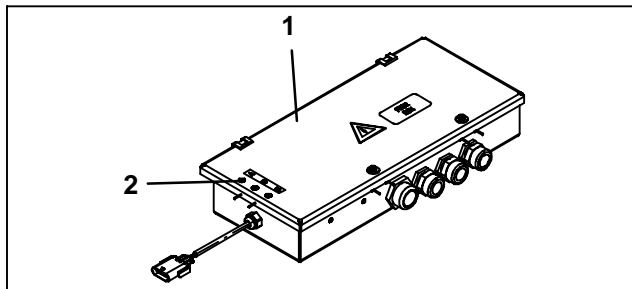
#### 5.14 REPLACING THE CONDENSER MOTOR

- a. Ensure the 24VDC on/off switch is in the off position and the main disconnect switch is in the off position.
- b. Remove the 4 screws securing the condenser fan grill to the top cover and remove the fan grill.
- c. Loosen the set screw on the fan blade and remove the fan blade from the motor.
- d. Remove the 4 screws securing the condenser fan motor to the fan motor support. and remove the fan motor.
- e. Unplug the fan motor wiring harness and remove the fan motor.
- f. Reverse steps e. thru b. to install the condenser motor.

#### 5.15 REPLACING THE DAMPER DOOR MOTOR

- a. Ensure the 24VDC on/off switch is in the off position and the main disconnect switch is in the off position.
- b. Remove the top cover. Refer to paragraph 5.2.
- c. Locate the motor.
- d. Unsnap the linkage rods from the door(s).
- e. Remove the 3 screws securing the motor to the housing.
- f. Unplug the motor from the wiring harness and remove it from the evaporator assembly.
- g. Loosen the set screw on the lever assembly and remove it from the motor.
- h. Reverse steps g. thru b. to install the damper door motor.

#### 5.16 FUSE BOX HYBRID SYSTEM



**Figure 5-7 Control Box - Hybrid**

1. Control Box
2. Module Indicator Lights

- a. Ensure the 24VDC on/off switch is in the off position and the main disconnect switch is in the off position.
- b. Using a phillips screwdriver, remove the two screws securing the cover to the control box and open the cover.
- c. Using a Volt/Ohm/Meter check for power in the box and then remove the fuses.

#### 5.17 TEMPERATURE SENSOR CHECKOUT

- a. An accurate ohmmeter must be used to check resistance values shown in Table 5-1.
- 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 5-1.
- 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 5-1 Thermistor Resistance**

Temperature		Resistance In Ohms
°C	°F	
-30	-22	177,400
0	32	32,700
25	77	10,000
50	122	3600

## 5.18 PRESSURE TRANSDUCER CHECKOUT

### NOTE

System must be operating to check transducers.

- With the system running use the driver display and manifold gauges to check suction and/or discharge pressure(s) simultaneously.
- 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.
- 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 Systems Modules. Damage to the wiring harness can occur.

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

- Use a digital volt-ohmmeter to measure voltage across the transducer connector corresponding to terminals A & B. See Figure 5-8. The reading should be 5.0 VDC.
- Use a digital volt-ohmmeter to measure wire continuity between the connector positions corresponding to C and E-46 (Suction) or C and G-46 (discharge). See Figure 7-1.
- Use a digital volt-ohmmeter to measure voltage across the transducer at terminals A & C. See Figure 5-8. Compare to values in Table 5-1. A reading within two percent of the values in the table would be considered good.

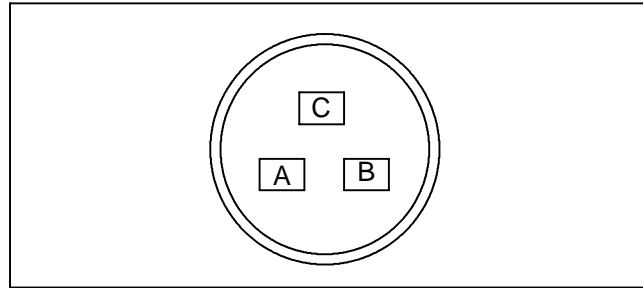


Figure 5-8 Transducer Terminal Location

Table 5-2 Pressure Transducer Voltage

"/hg	Voltage	Psig (Bar)	Voltage	Psig (Bar)	Voltage	Psig (Bar)	Voltage
20"	0.369	70 (4.42)	1.152	155 (10.55)	1.985	240 (16.33)	2.818
10"	0.417	75 (5.10)	1.204	160 (10.89)	2.034	245 (16.67)	2.867
Psig (Bar)	Voltage	80 (5.44)	1.250	165 (11.23)	2.083	250 (17.01)	2.916
0 (0)	0.466	85 (5.78)	1.299	170 (11.57)	2.132	255 (17.35)	2.965
5 (0.34)	0.515	90 (6.12)	1.348	175 (11.91)	2.181	260 (17.69)	3.014
10 (0.68)	0.564	95 (6.46)	1.397	180 (12.25)	2.230	265 (18.03)	3.063
15 (1.02)	0.614	100 (6.80)	1.446	185 (12.59)	2.279	270 (18.37)	3.112
20 (1.36)	0.663	105 (7.14)	1.495	190 (12.93)	2.328	275 (18.71)	3.161
25 (1.70)	0.712	110 (7.48)	1.544	195 (13.27)	2.377	280 (19.05)	3.210
30 (2.04)	0.761	115 (7.82)	1.593	200 (13.61)	2.426	285 (19.39)	3.259
35 (2.38)	0.810	120 (8.16)	1.642	205 (13.95)	2.475	290 (19.73)	3.308
40 (2.72)	0.858	125 (8.51)	1.691	210 (14.29)	2.524	295 (20.07)	3.357
45 (3.06)	0.907	130 (8.85)	1.740	215 (14.63)	2.573	300 (20.41)	2.406
50 (3.40)	0.956	135 (9.19)	1.789	220 (14.97)	2.622	305 (20.75)	3.455
55 (3.74)	1.007	140 (9.53)	1.838	225 (15.31)	2.671	310 (21.09)	3.504
60 (4.08)	1.054	145 (9.87)	1.887	230 (15.65)	2.720		
65 (4.42)	1.103	150 (10.21)	1.936	235 (15.99)	2.769		

## 5.19 REPLACING SENSORS AND TRANSDUCERS

- Ensure the 24VDC on/off switch is in the off position and the main disconnect switch is in the off position.
- Tag and disconnect wiring from defective sensor or transducer.
- Remove and replace defective sensor or transducer.

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

- Connect wiring to replacement sensor or transducer.
- Checkout replacement sensor or transducer. Refer to section 5.17 or 5.18 as applicable.
- Repair or replace any defective component(s), as required.

**Table 5-3 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 6

### SHORE POWER CONTROL BOX

#### **WARNING**

Be aware of **HIGH VOLTAGE** supplied to this equipment from the vehicle high voltage system and/or shore power source and that the equipment may start automatically. Do not attempt to service this equipment without proper training. Electrical power within this equipment is sufficiently high enough to cause serious injury or death.

Before servicing this equipment:

1. If the vehicle is equipped with shore power, ensure the shore power supply is **OFF** and then disconnect the plug. When reconnecting, ensure the power plug is clean and dry before connecting to the electrical outlet/receptacle. Ensure power supply is correct for this application.
2. Ensure the main disconnect from the vehicle high voltage power source is **OFF**, vehicle engine is off and ignition system is locked out.
3. Both AC and DC power is used in this equipment. Test for both AC and DC voltage to confirm there is no power before working on any circuit or electrical component.

#### **WARNING**

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

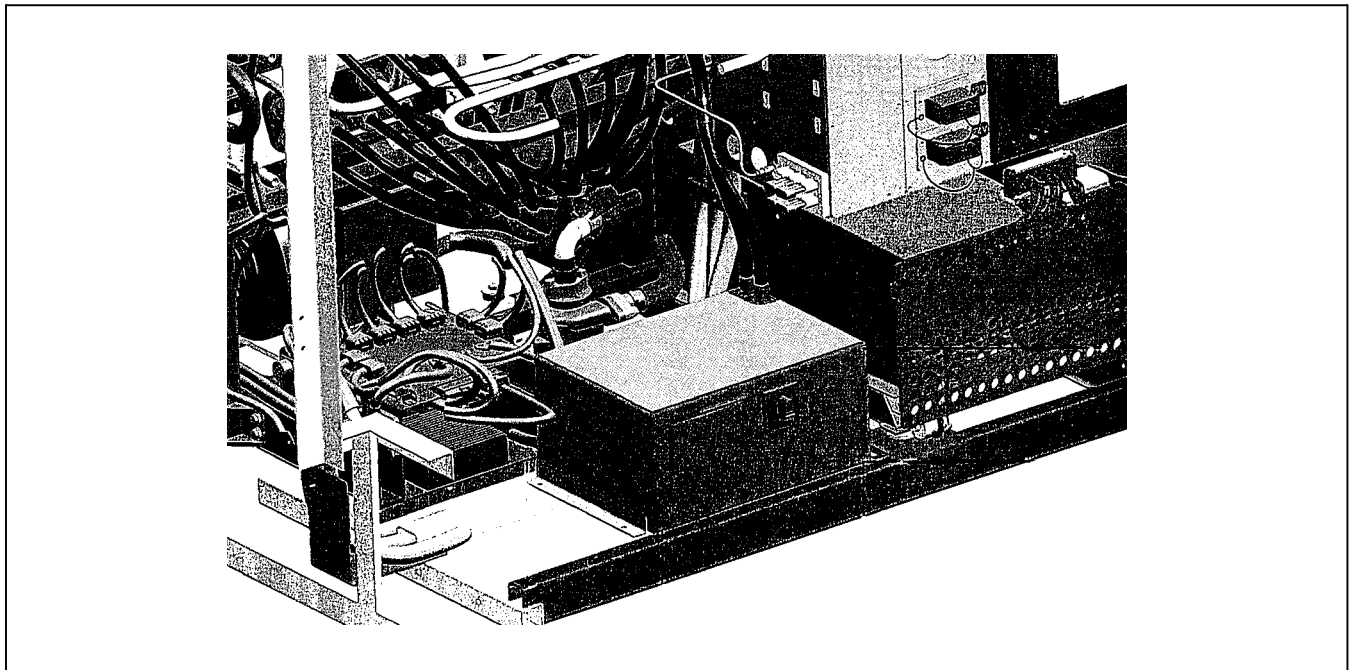


Figure 6-1 Shore Power Control Box

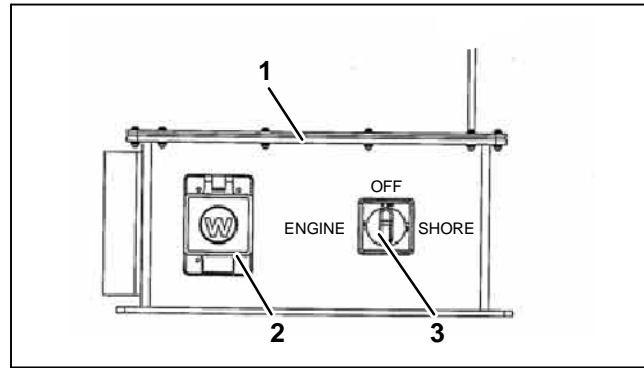
#### 6.1 SHORE POWER REQUIREMENT

The shore power control box satisfies a requirement to operate the hybrid system from other than the vehicle's on board generating system.

## 6.2 SHORE POWER OPERATION

In the event that shore power is desired, the shore power control box converts 460VAC nominal power to 650VDC power that is supplied to the air conditioning safety box.

- a. The vehicle engine should be OFF.
- b. An interlock is built into the system to prevent shore power from powering the system should the engine be operational.
- c. The vehicle main electrical disconnect should be ON.
- d. The 460VAC plug (see Figure 6-2, item 2) is inserted into the power receptacle.
- e. Turn the selector switch (see Figure 6-2, item 3) from "ENGINE" to "SHORE".
- f. Operate the system.



**Figure 6-2 Warning Labels**

1. Shore Power Control Box
2. 460VAC Power Receptacle
3. Selector Switch

## SECTION 7

### ELECTRICAL



Be aware of **HIGH VOLTAGE** supplied to this equipment from the vehicle high voltage system and/or shore power source and that the equipment may start automatically. Do not attempt to service this equipment without proper training. Electrical power within this equipment is sufficiently high enough to cause serious injury or death.

Before servicing this equipment:

1. If the vehicle is equipped with shore power, ensure the shore power supply is **OFF** and then disconnect the plug. When reconnecting, ensure the power plug is clean and dry before connecting to the electrical outlet/receptacle. Ensure power supply is correct for this application.
2. Ensure the main disconnect from the vehicle high voltage power source is **OFF**, vehicle engine is off and ignition system is locked out.
3. Both **AC** and **DC** power is used in this equipment. Test for both **AC** and **DC** voltage to confirm there is no power before working on any circuit or electrical component.

#### 7-1 INTRODUCTION

This section includes the wiring schematics and legend for the AvantAC Electric Roof Top Air Conditioning System. The diagrams are presented as follows:

Table 7-1 - Legend for use with the presented schematic diagrams.

Figure 7-1 - 8-KW roof top module wiring diagram.

Figure 7-2 - 16-KW roof top module wiring diagram.

Figure 7-3 - 5-KW water cooler wiring diagram.

Figure 7-4 - 24VDC power connection and module number assignment.

**Table 7-1 Wiring Schematic - Legend**

<b>ZONE</b>	<b>ACRONYM</b>	<b>DESCRIPTION</b>	<b>ZONE</b>	<b>ACRONYM</b>	<b>DESCRIPTION</b>
E47	AMBS	Ambient Air Temperature Sensor	D11	IMCC	Insulation Monitor Connector Control
XX	BL	Bootloader Jumper	E12	IMCP	Insulation Monitor Connector Power
A13	BTY+	Battery Positive	H12	IMD	Insulation Monitor Device
A12	BTY-	Battery Negative	H43	INV	Inverter
I40	CB	Contactora Box	H41	J1	Inverter Power Input Connector
I17	FB1	Control Box Fuse Block 1	H29	JP1	Input Power Connector
G17	FB2	Control Box Fuse Block 2	I44	J2	Inverter Climate Controller 23-Pin Connector
I17	FB3	Control Box Fuse Block 3	B44	J3	Inverter Climate Controller 35-Pin Connector
J17	FB4	Control Box Fuse Block 4	B41	J4	Inverter Power Output Connector
K17	FB5	Control Box Fuse Block 5	H46	J6	Module Power & CAN Connector
I40	CBPE	Control Box Primary Earth	J46	J7	Module Heat Valve Connector
G30	CD	Condenser Connector	J46	J8	Module Address Connector
G2,B11	CGND	Chassis Ground	L46	J9	Module RS232 Connector
E48	CNTR	CAN Network Terminal Resistor	B39	J10	Safety Box Output Connector
D33	COMP	Compressor Motor	J35,H59,85	J11	Safety Box Contactora Connector
E33	COND	Condenser Motor	L46	LED	Light Emitting Diode
C42,K42	CP1,CP2	Compressor Connector	A14	LVF	Low Voltage Fuse
F46	DPT1,DPT2	Discharge Pressure Transducer	A15	LVSW	Low Voltage Switch
F34	EV1	Evaporator 1 Connector	C47	M	Motor
G34	EV2	Evaporator 2 Connector	H10	PE	Primary Earth
F33	EVAP1	Evaporator Motor 1	XXX	PWRCON1	Power Connector
G33	EVAP2	Evaporator Motor 2	G47	RTS	Return Temperature Sensor
F31	EVIP1	Evaporator 1 IP Connector	L13	SB	Safety Box
E31	EVIP2	Evaporator 2 IP Connector	J37,I60,86	SBC	Safety Box Connector
M44	FGND	Frame Ground	E47	SPT	Suction Pressure Transducer
C47	FLAP	Flap Motor Assembly & Connector	G7	ST	Main Disconnect Switch
D2	GEN	Generator	H47	STS	Supply Temperature Sensor
D3	GHV	Generator High Voltage Connector	H11	TR	Test Resistor
B4	GLV	Generator Low Voltage Connector	J11	TS	Test Switch
B31	HPS	High Pressure Switch	B31	TSW	Temperature Switch
J12	IMBG	Insulation Monitor Box Ground	G40	TVS	Transient Voltage Suppressor
			XXX	PWRCON1	Power Connector

 Wire Ground

 Chassis Ground

 Splice Point

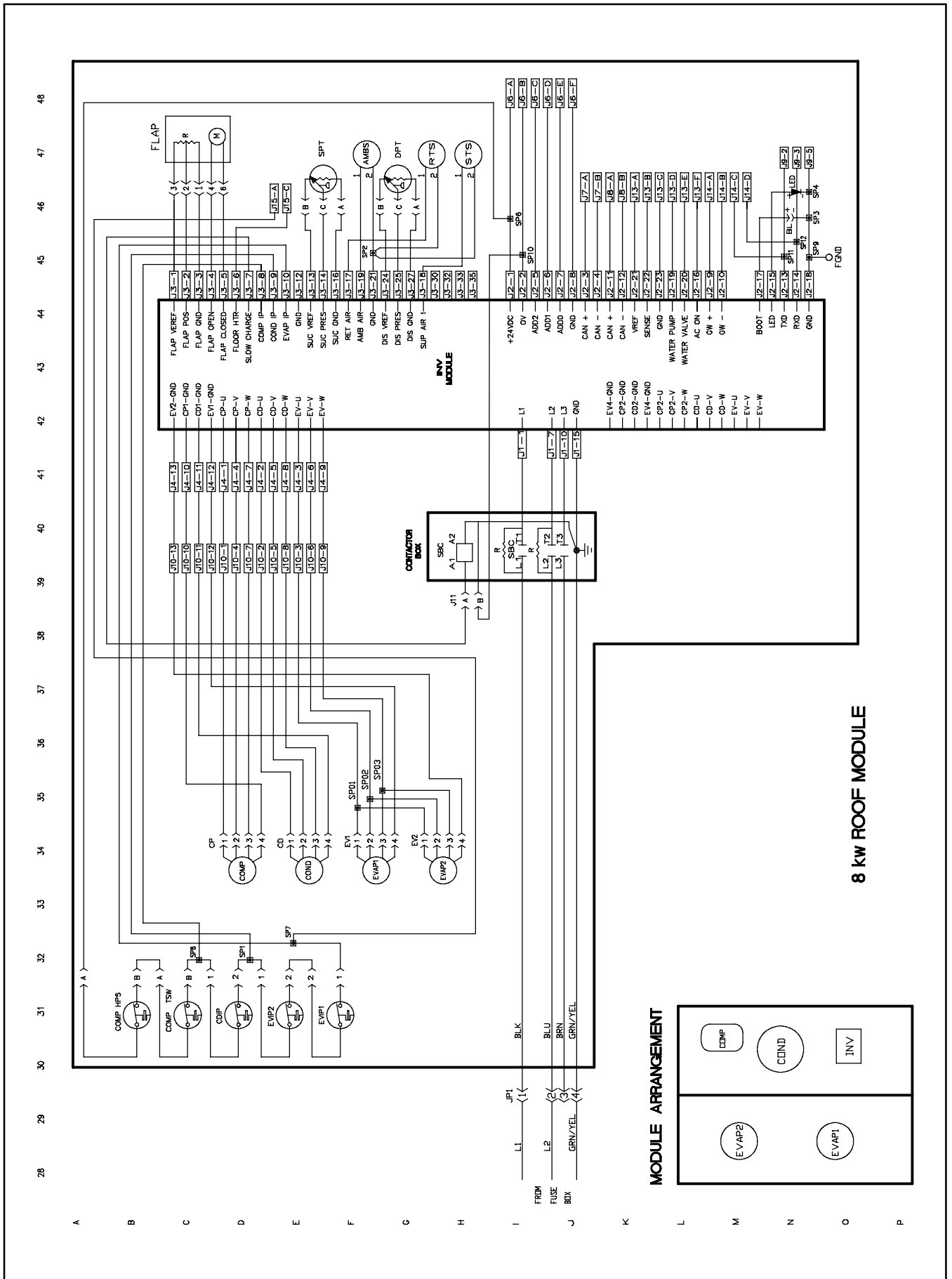
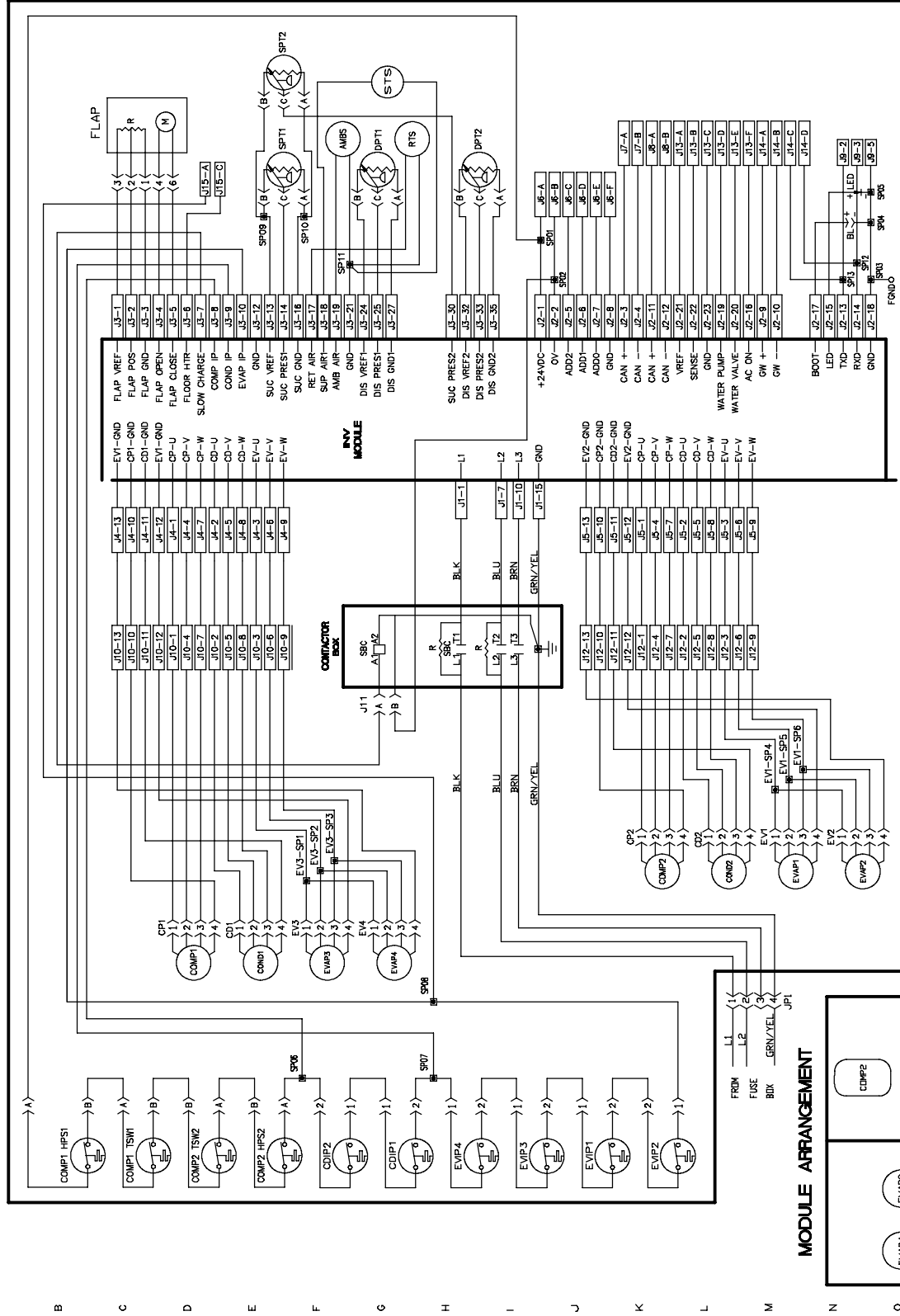


Figure 7-1 8-KW Roof Top Wiring Diagram



29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49



16 kW ROOF MODULE

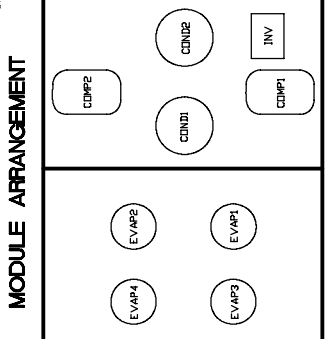


Figure 7-2 16-KW Roof Top Wiring Diagram

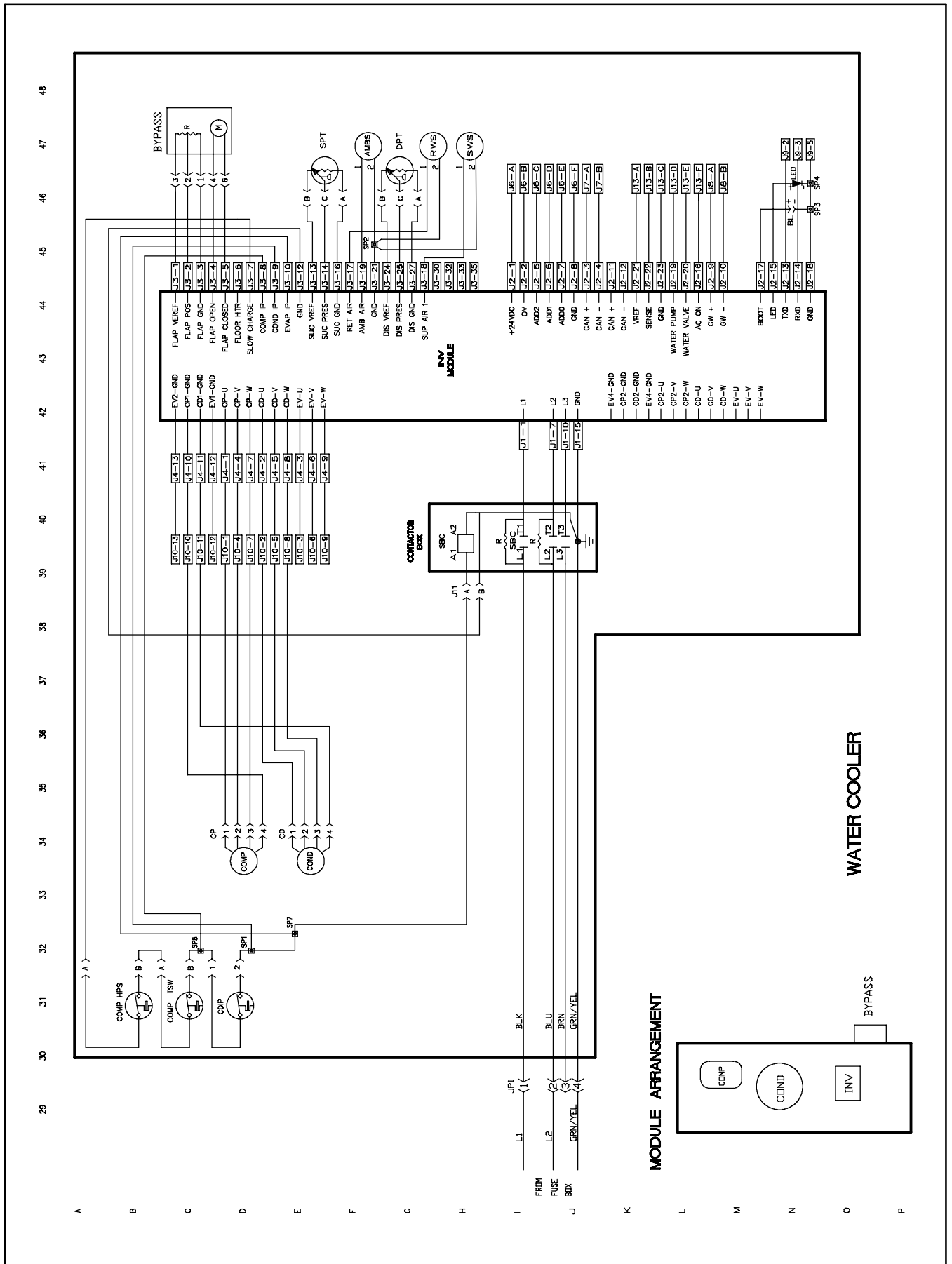


Figure 7-3 5-KW Water Cooler Wiring Diagram

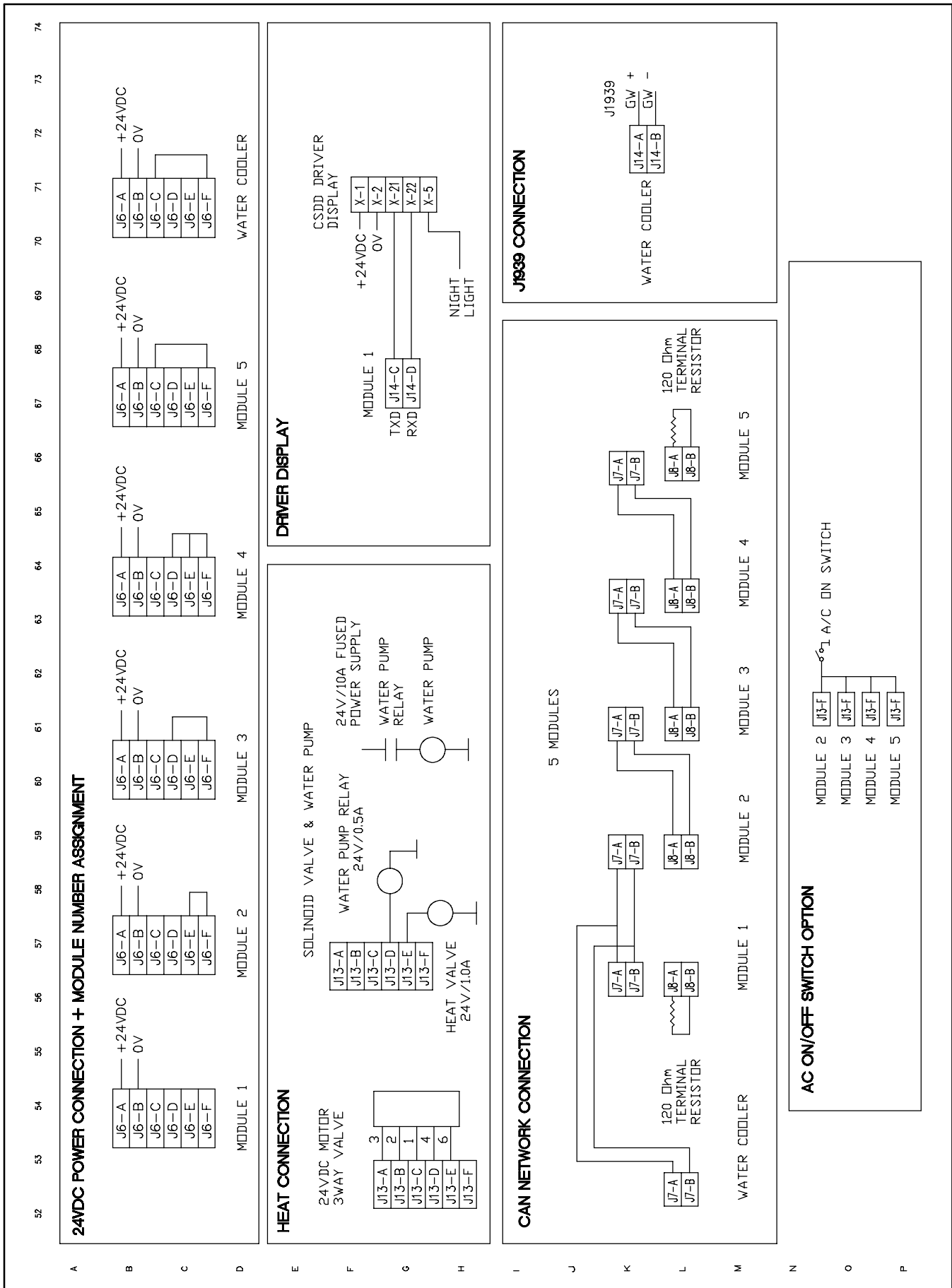


Figure 7-4 24-VDC Power Connection and Module Number Assignment

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