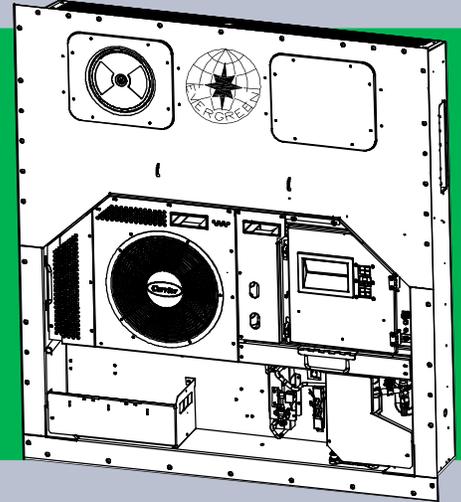
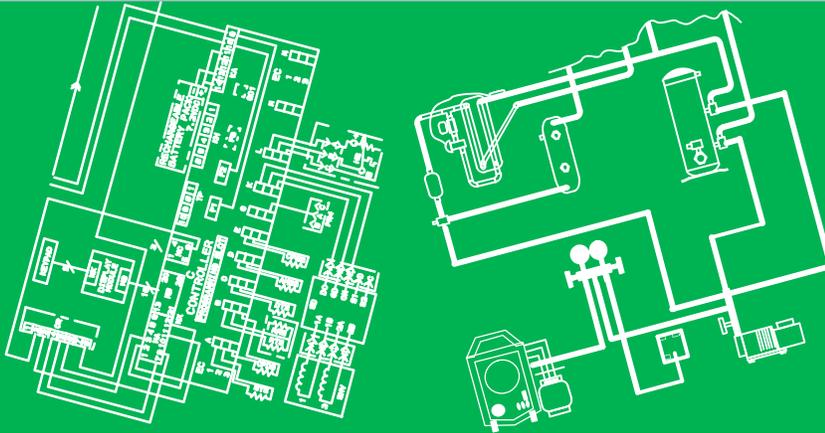




# Container Refrigeration



# OPERATION & SERVICE MANUAL

For

## 69NT40-561-201

### Evergreen Container Refrigeration Units





**TRANSICOLD**

# **OPERATION AND SERVICE MANUAL CONTAINER REFRIGERATION UNIT**

Model  
69NT40-561-201

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## SAFETY SUMMARY

### GENERAL SAFETY NOTICES

The following general safety notices supplement 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 and start-stop switches are turned off, and power supply is disconnected.

In case of severe vibration or unusual noise, stop the unit and investigate.

### MAINTENANCE PRECAUTIONS

Beware of unannounced starting of the evaporator and condenser fans. Do not open the condenser fan grille or evaporator access panels before turning power off, disconnecting and securing the power plug.

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.

When performing any arc welding on the unit or container, disconnect all wire harness connectors from the modules in control boxes. Do not remove wire harness from the modules unless you are grounded to the unit frame with a static safe wrist strap.

In case of electrical fire, open circuit switch and extinguish with CO<sub>2</sub> (never use water).

### SPECIFIC WARNING AND CAUTION STATEMENTS

To help identify the label hazards on the unit and explain the level of awareness each one carries, an explanation is given with the appropriate consequences:

**DANGER** - means an immediate hazard that **WILL** result in severe personal injury or death.

**WARNING** - means to warn against hazards or unsafe conditions that **COULD** result in severe personal injury or death.

**CAUTION** - means to warn against potential hazard or unsafe practice that could result in personal injury, product or property damage.

*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.*

#### **WARNING**

**EXPLOSION HAZARD: Failure to follow this WARNING can result in death, serious personal injury and / or property damage.**

**Never use air or gas mixtures containing oxygen (O<sub>2</sub>) for leak testing or operating the product.**

**Charge Only With R-134a: Refrigerant must conform to AHRI Standard 700 specification.**

#### **WARNING**

**Beware of unannounced starting of the evaporator and condenser fans. The unit may cycle the fans and compressor unexpectedly as control requirements dictate.**

#### **WARNING**

**Do not attempt to remove power plug(s) before turning OFF start-stop switch (ST), unit circuit breaker(s) and external power source.**

#### **WARNING**

**Make sure the power plugs are clean and dry before connecting to power receptacle.**

#### **WARNING**

**Make sure that the unit circuit breaker (CB-1) and the START-STOP switch (ST) are in the "O" (OFF) position before connecting to any electrical power source.**

 **WARNING**

Make sure power to the unit is OFF and power plug disconnected before replacing the compressor.

 **WARNING**

Before disassembly of the compressor, be sure to relieve the internal pressure very carefully by slightly loosening the couplings to break the seal.

 **WARNING**

Do not use a nitrogen cylinder without a pressure regulator.

 **WARNING**

Do not remove the condenser fan grille before turning power OFF and disconnecting power plug.

 **WARNING**

Always turn OFF the unit circuit breaker (CB-1) and disconnect main power supply before removing electrical parts.

 **WARNING**

Always turn OFF the unit circuit breaker (CB-1) and disconnect main power supply before working on moving parts.

 **WARNING**

Installation requires wiring to the main unit circuit breaker, CB1. Make sure the power to the unit is off and power plug disconnected before beginning installation.

 **CAUTION**

Charge receiver according to nameplate specifications to ensure optimal unit performance.

 **CAUTION**

Do not remove wire harnesses from controller modules unless you are grounded to the unit frame with a static safe wrist strap.

 **CAUTION**

Unplug all controller module wire harness connectors before performing arc welding on any part of the container.

 **CAUTION**

Do not attempt to use an ML2i PC card in an ML3 equipped unit. The PC cards are physically different and will result in damage to the controller.

 **CAUTION**

Pre-trip inspection should not be performed with critical temperature cargoes in the container.

 **CAUTION**

When Pre-Trip key is pressed, economy and dehumidification will be deactivated. At the completion of Pre-Trip activity, economy and dehumidification must be reactivated.

 **CAUTION**

When a failure occurs during automatic testing, the unit will suspend operation awaiting operator intervention.

 **CAUTION**

When Pre-Trip test Auto 2 runs to completion without being interrupted, the unit will terminate pre-trip and display "Auto 2" "end." The unit will suspend operation until the user depresses the ENTER key!

 **CAUTION**

Allowing the scroll compressor to operate in reverse for more than two minutes will result in internal compressor damage. Turn the start-stop switch OFF immediately.

 **CAUTION**

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

 **CAUTION**

The scroll compressor achieves low suction pressure very quickly. Do not use the compressor to evacuate the system below 0 psig. Never operate the compressor with the suction or discharge service valves closed (frontseated). Internal damage will result from operating the compressor in a deep vacuum.

 **CAUTION**

Take necessary steps (place plywood over coil or use sling on motor) to prevent motor from falling into condenser coil.

 **CAUTION**

The unit must be OFF whenever a programming card is inserted or removed from the controller programming port.

 **CAUTION**

Use care when cutting wire ties to avoid nicking or cutting wires.

 **CAUTION**

Do not allow moisture to enter wire splice area as this may affect sensor resistance.



## SECTION 1

### INTRODUCTION

#### 1.1 INTRODUCTION

The Carrier Transicold model 69NT40–561–201 series units are of lightweight aluminum frame construction, designed to fit in the front of a container and serve as the container's front wall.

They are one piece, self-contained, all electric units, which include cooling and heating systems to provide precise temperature control.

The units are supplied with a complete charge of refrigerant R-134a and compressor lubricating oil, and are ready for operation upon installation. Forklift pockets are provided for unit installation and removal.

The base unit operates on nominal 380/460 volt, 3-phase, 50/60 hertz (Hz) power. Control system power is provided by a transformer which steps the supply power down to 18 and 24 volts, single phase.

The controller is a Carrier Transicold Micro-Link 3 microprocessor. The controller operates automatically to select cooling, holding or heating as required to maintain the desired set point temperature within very close limits. The unit may also be equipped with an electronic temperature recorder.

The controller has a keypad and display for viewing or changing operating parameters. The display is also equipped with lights to indicate various modes of operation.

#### 1.2 CONFIGURATION IDENTIFICATION

Unit identification information is provided on a plate located on the back wall of the condenser section. The plate provides the unit model number, the unit serial number and the unit parts identification number (PID). The model number identifies the overall unit configuration, while the PID number provides information on specific optional equipment, factory provisioned to allow for field installation of optional equipment and differences in detailed parts.

#### 1.3 FEATURE DESCRIPTIONS

##### 1.3.1 Control Box

Units are equipped with an aluminum control box.

##### 1.3.2 Temperature Readout

The unit is fitted with suction and discharge refrigerant temperature sensors. The sensor readings may be viewed on the controller display.

##### 1.3.3 Pressure Readout

The unit is fitted with evaporator, suction, and discharge pressure transducers. The transducer readings may be viewed on the controller display.

##### 1.3.4 Compressor

The unit is fitted with a scroll compressor equipped with suction and discharge service connections.

##### 1.3.5 Condenser Coil

The unit is fitted with a four-row square formed condenser coil using 7mm tubing.

##### 1.3.6 Evaporator

The evaporator section is equipped with an electronic expansion valve (EEV).

##### 1.3.7 Evaporator Fan Operation

Units are equipped with three-phase evaporator fan motors. Opening of an evaporator fan internal protector will shut down the unit.

##### 1.3.8 Plate Set

Each unit is equipped with a tethered set of wiring schematics and wiring diagram plates. The plate sets are ordered using a seven-digit base part number and a two-digit dash number.

##### 1.3.9 Battery

The refrigeration controller has a rechargeable battery pack that has been fitted to the ML3 controller.

##### 1.3.10 Dehumidification

The unit is fitted with a humidity sensor. This sensor allows setting of a humidity set point in the controller. In dehumidification mode, the controller will operate to reduce internal container moisture level.

##### 1.3.11 USDA

The unit is supplied with fittings for additional temperature probes which allow recording of USDA Cold Treatment data by the integral DataCORDER function of the Micro-Link refrigeration controller.

##### 1.3.12 Interrogator

Units have the DataCORDER function and are fitted with interrogator receptacles for connection of equipment to download the recorded data. Two receptacles are fitted; one is accessible from the front of the container and the other is mounted inside the container (with the USDA receptacles).

##### 1.3.13 Remote Monitoring

The unit is fitted with a remote monitoring receptacle. This item allows connection of remote indicators for COOL, DEFROST and IN RANGE. The receptacle is mounted at the control box location.

### **1.3.14 Communications Interface Module**

The unit is fitted with a communications interface module. The communications interface module is a slave module, which allows communication with a master central monitoring station. The module will respond to communication and return information over the main power line. Refer to the ship master system technical manual for further information.

### **1.3.15 Gutters**

Rain gutters are fitted over the control box and recorder section to divert rain away from the controls.

### **1.3.16 Handles**

The unit is equipped with handles to facilitate access to stacked containers. These fixed handles are located on either side of the unit.

### **1.3.17 Back Panels**

Aluminum back panels are bolted.

### **1.3.18 460 Volt Cable**

A 460 volt power cable and plug designs are installed for the main 460 volt supply.

### **1.3.19 Cable Restraint**

A bungee cord style cable restraint is available for storage of the power cables.

### **1.3.20 Upper Air (Fresh Air Make Up)**

The unit is fitted with an upper fresh air makeup assembly. The fresh air makeup assembly is equipped with a vent positioning sensor (VPS).

### **1.3.21 Labels**

Safety Instruction and Function Code listing labels are supplied in English and Traditional Chinese.

### **1.3.22 Controller**

Two replacement controllers are available:

1. Re-manufactured – Controller is the equivalent of a new OEM controller and is supplied with a 12-month warranty.
2. Repaired – Controller has had previous faults repaired and upgraded with the latest software.

Note: Repaired controllers are NOT to be used for warranty repairs; only full OEM Remanufactured controllers are to be used.

Replacement controllers will be factory-equipped with the latest version of operational software, but will NOT be configured for a specific model number and will need to be configured at the time of installation or sale.

### **1.3.23 Condenser Grille**

The unit is equipped with direct bolted grilles.

## SECTION 2

### DESCRIPTION

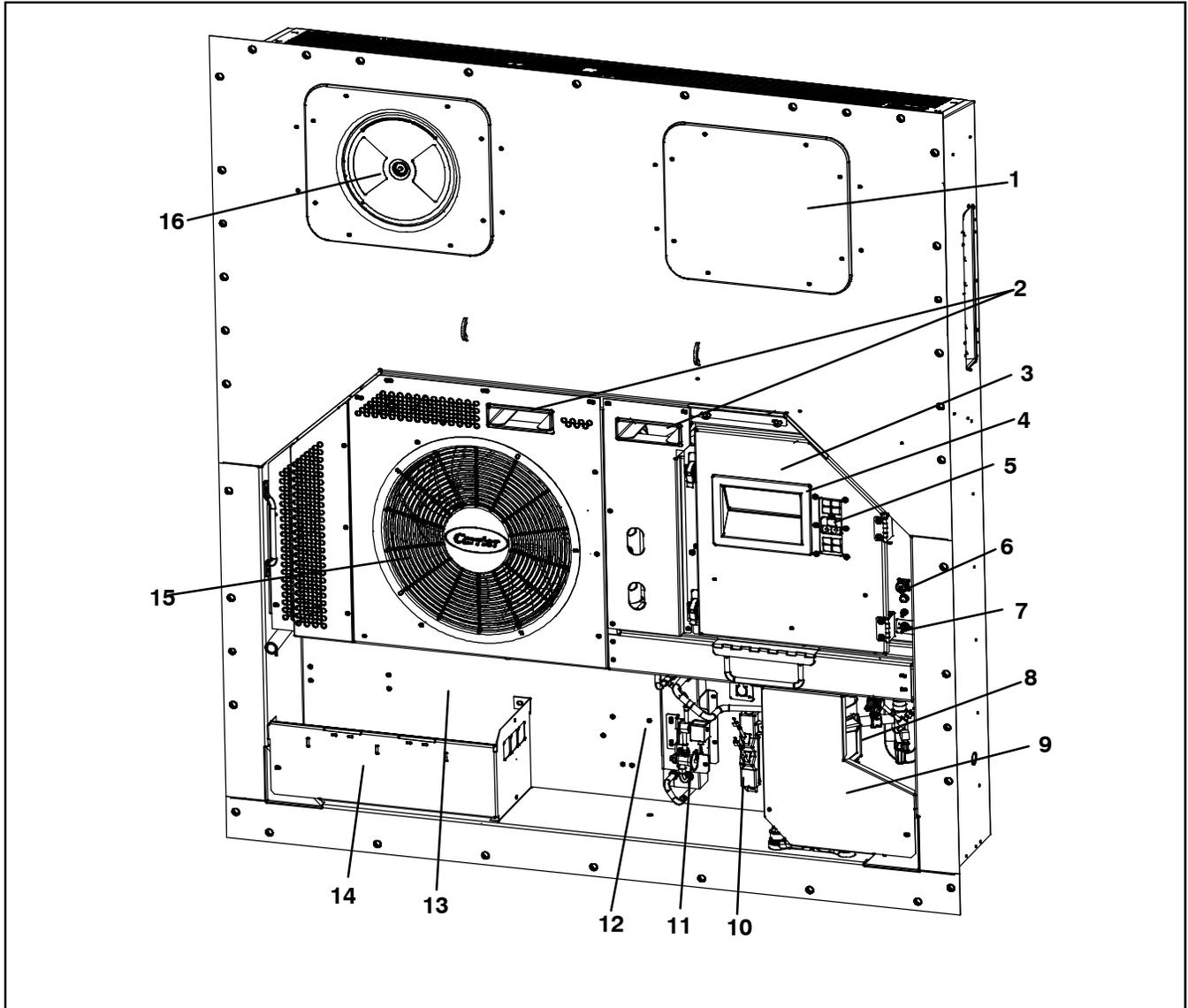
#### 2.1 GENERAL DESCRIPTION

##### 2.1.1 Refrigeration Unit – Front Section

The unit is designed so that the majority of the components are accessible from the front (see Figure 2-1). The unit model number, serial number and parts identification number can be found on the serial plate on the back wall of the condenser section.

##### 2.1.2 Fresh Air Makeup Vent

The function of the upper makeup air vent is to provide ventilation for commodities that require fresh air circulation. A manually operated venting system is located in the upper left access panel.



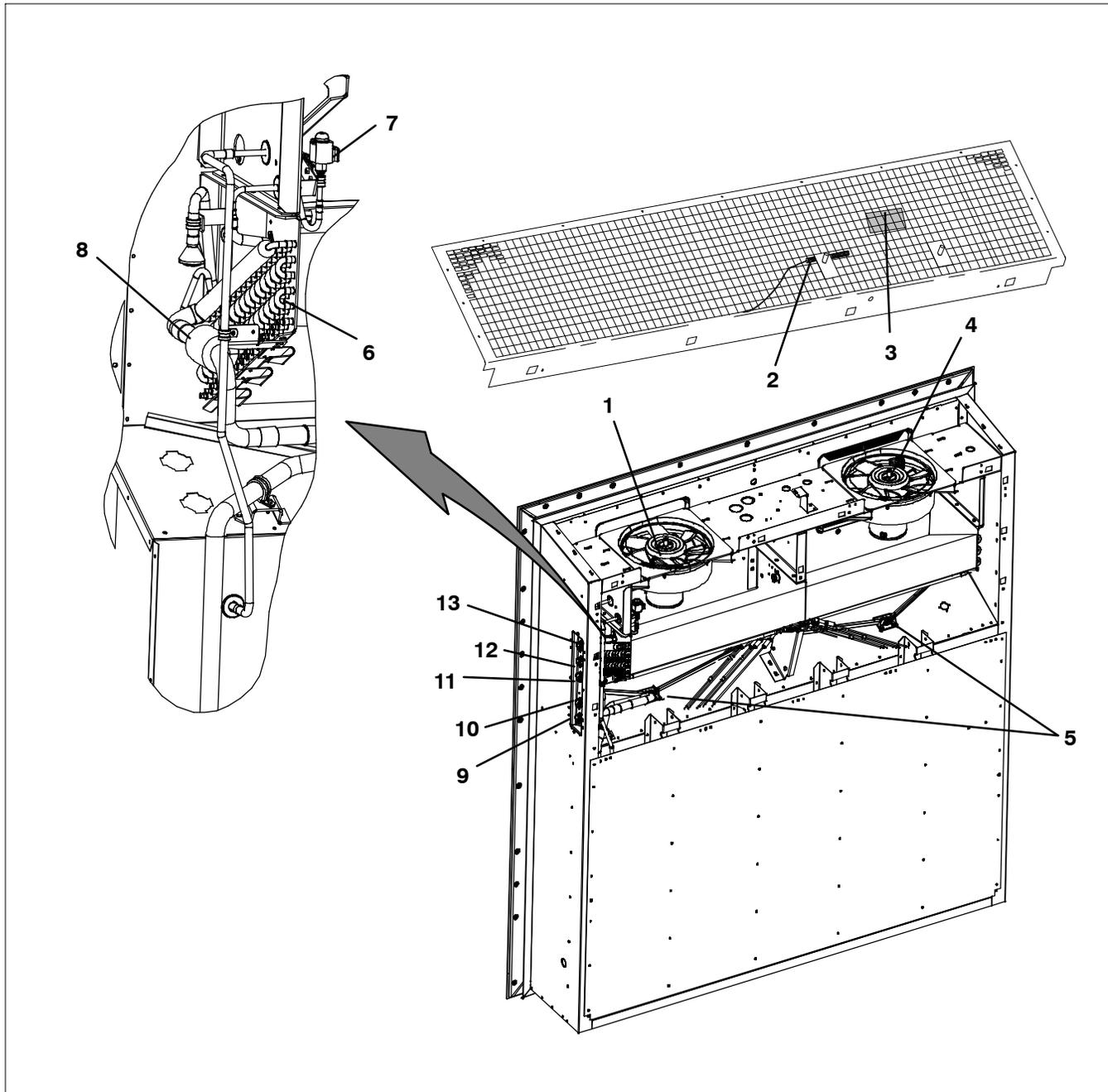
1. Access Panel (Evap. Fan #1)
2. Fork Lift Pockets
3. Control Box
4. Unit Display
5. Control Panel
6. Remote Monitoring Receptacle
7. Start-Stop Switch, ST
8. Compressor
9. Compressor Cover
10. Supply Temperature Supply/Recorder Sensor Assembly (STS/SRS)
11. Economizer
12. Ambient Temperature Sensor (AMBS)
13. Serial Plate
14. Power Cables and Plug (Location)
15. Condenser Grille
16. Upper Fresh Air Makeup Vent Panel (Evap. Fan #2)

Figure 2-1 Refrigeration Unit – Front Section

### 2.1.3 Evaporator Section

The evaporator section is shown below. The evaporator fans circulate air through the container by pulling it in the top of the unit, directing it through the evaporator coil, where it is heated or cooled, and discharging it at the bottom.

Most evaporator components are accessible by removing the upper rear panel (as shown in the illustration) or by removing the evaporator fan access panels (see Figure 2-1).



- |  |  |
|--|--|
| 1. Evaporator Fan Motor #1 (EM1)                       | 8. Evaporator Temperature Sensors (Location) (ETS1 & ETS2) |
| 2. Return Recorder Sensor/Temperature Sensor (RRS/RTS) | 9. Interrogator Connector (Rear) (ICR)                     |
| 3. Humidity Sensor (HS)                                | 10. USDA Probe Receptacle PR2                              |
| 4. Evaporator Fan Motor #2 (EM2)                       | 11. USDA Probe Receptacle PR1                              |
| 5. Evaporator Coil Heaters (Underside of Coil)         | 12. USDA Probe Receptacle PR3                              |
| 6. Evaporator Coil                                     | 13. Cargo Probe Receptacle PR4                             |
| 7. Electronic Expansion Valve (EEV)                    |  |

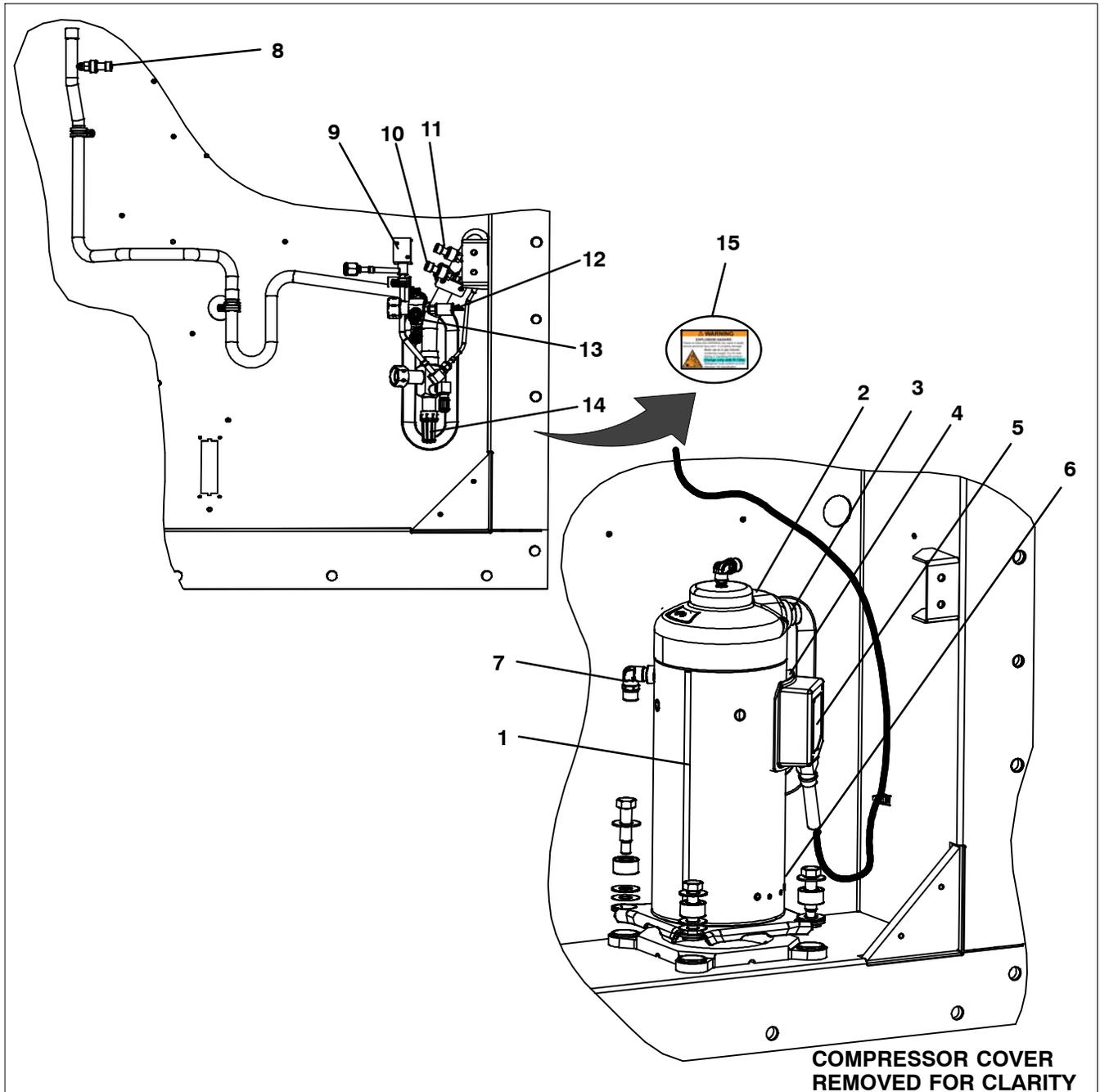
**Figure 2-2 Evaporator Section**

### 2.1.4 Compressor Section

The compressor section includes the compressor, digital unloader valve (DUV), high pressure switch, discharge pressure transducer (DPT), evaporator

pressure transducer (EPT) and the suction pressure transducer (SPT).

The supply temperature sensor, supply recorder sensor and ambient sensor are located to the left of the compressor.



1. Compressor
2. Compressor Discharge Temperature Sensor (CPDS) (Location)
3. Discharge Connection
4. Suction Connection (Location)
5. Compressor Terminal Box
6. Oil Drain (Location)
7. Economizer Connection

8. Discharge Pressure Transducer (DPT)
9. Digital Unloader Valve (DUV)
10. Suction Pressure Transducer (SPT)
11. Evaporator Pressure Transducer (EPT)
12. High Pressure Switch (HPS)
13. Discharge Service Valve
14. Suction Service Valve
15. Warning Label

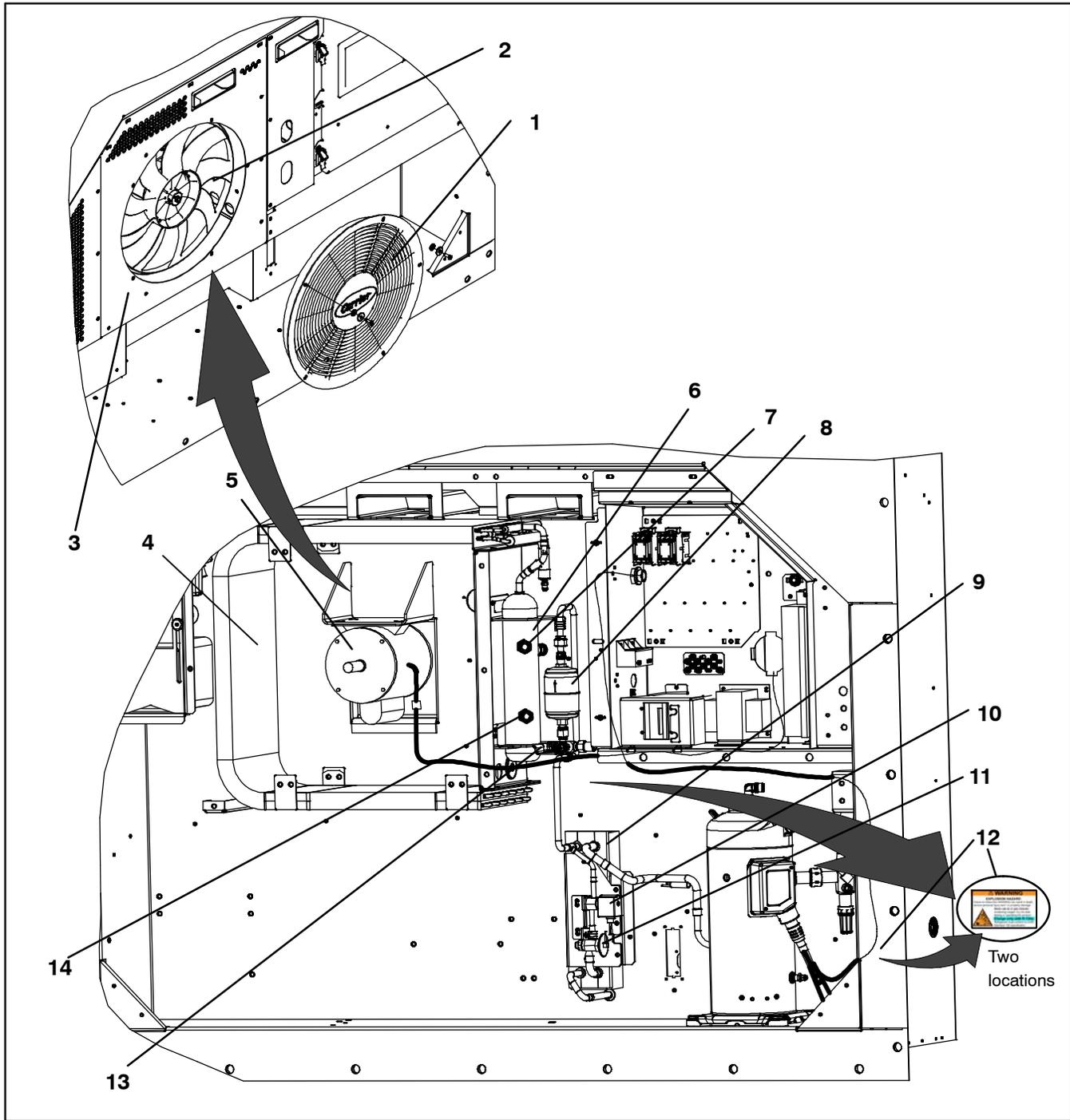
**Figure 2-3 Compressor Section**

### 2.1.5 Air-Cooled Condenser Section

The air-cooled condenser section consists of the condenser fan, condenser coil, receiver, liquid line service valve, filter drier, fusible plug, economizer,

economizer expansion valve, economizer solenoid valve (ESV), and sight glass/moisture indicator.

The condenser fan pulls air from around the coil and discharges it horizontally through the condenser fan grille.



- 1. Grille and Venturi Assembly
- 2. Condenser Fan
- 3. Condenser Coil Cover
- 4. Condenser Coil
- 5. Condenser Fan Motor
- 6. Receiver
- 7. Sight Glass

- 8. Filter Drier
- 9. Economizer
- 10. Economizer Solenoid Valve (ESV)
- 11. Economizer Expansion Valve
- 12. Warning Label (location)
- 13. Service Access Valve
- 14. Liquid Level/Moisture Indicator

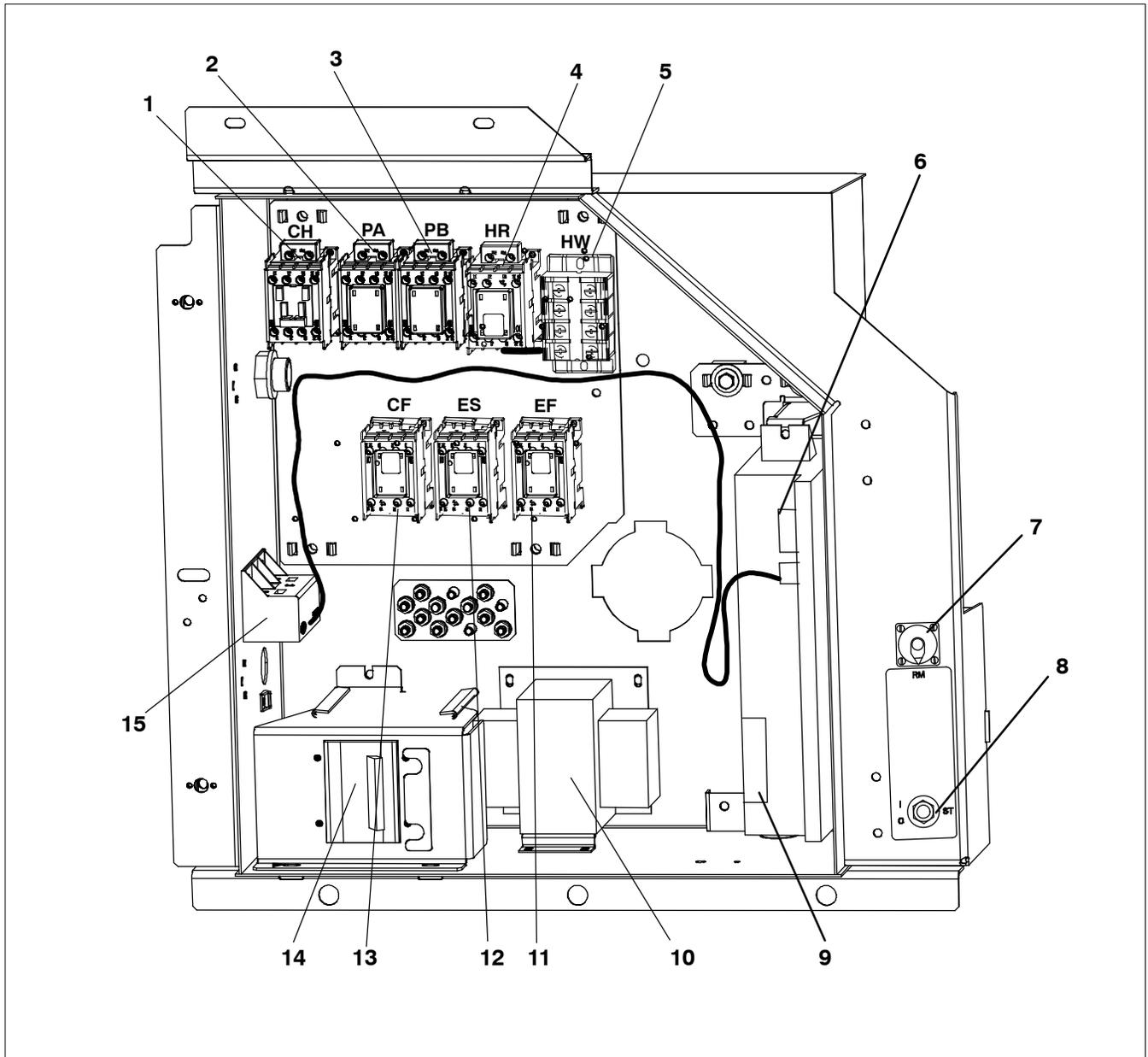
Figure 2-4 Air-Cooled Condenser Section

### 2.1.6 Control Box Section

The control box (Figure 2-5) includes: the manual operation switches, circuit breaker (CB-1), compressor, fan and heater contactors, control power transformer, fuses, key pad, display module, current sensor module, controller module and the communications interface module.

### 2.1.7 Communications Interface Module

The communications interface module is a slave module which allows communication between the refrigeration unit and a ship system master central monitoring station. The module will respond to communication, and return information over the ships main power line. Refer to the master system technical manual for further information.



- |  |  |
|--|--|
| 1. Compressor Contactor – CH                 | 9. Controller Battery Pack (Standard Location) |
| 2. Compressor Phase A Contactor – PA         | 10. Control Transformer                        |
| 3. Compressor Phase B Contactor – PB         | 11. High Speed Evaporator Fan Contactor – EF   |
| 4. Heater Contactor – HR                     | 12. Low Speed Evaporator Fan Contactor – ES    |
| 5. Terminal Block – HW                       | 13. Condenser Fan Contactor – CF               |
| 6. Controller/DataCORDER Module (Controller) | 14. Circuit Breaker – 460V                     |
| 7. Remote Monitoring Receptacle              | 15. Current Sensor Module                      |
| 8. Start-Stop Switch, ST                     |  |

Figure 2-5 Control Box Section

## 2.2 REFRIGERATION SYSTEM DATA

<b>a. Compressor/Motor Assembly</b>	Model Number	ZMD26KVE-TFD-272
	Weight (With Oil)	42.9 kg (95 lb)
	Approved Oil	Uniqema Emkarate RL-32-3MAF
	Oil Charge	1774 ml (60 ounces)
<b>b. Electronic Expansion Valve Superheat (Evaporator)</b>	Verify at -18°C (0F) container box temperature	4.4 to 6.7°C (8 to 12°F)
<b>c. Economizer Expansion Valve Superheat</b>	Verify at -18°C (0F) container box temperature	4.4 to 11.1°C (8 to 20°F)
<b>d. Heater Termination Thermostat</b>	Opens	54° (+/- 3) C = 130° (+/- 5) F
	Closes	38° (+/- 4) C = 100° (+/- 7) F
<b>e. High Pressure Switch</b>	Cut-Out	25 (+/- 1.0) kg/cm <sup>2</sup> = 356 (+/- 10) psig
	Cut-In	18 (+/- 0.7) kg/cm <sup>2</sup> = 256 (+/- 10) psig
 <b>WARNING</b>		
<p><b>EXPLOSION HAZARD:</b> Failure to follow this WARNING can result in death, serious personal injury and / or property damage.</p> <p><b>Never use air or gas mixtures containing oxygen (O<sub>2</sub>) for leak testing or operating the product.</b></p> <p><b>Charge Only With R-134a:</b> Refrigerant must conform to AHRI Standard 700 specification.</p>		
<b>f. Refrigerant</b>	R-134a	Conforming to AHRI standard 700 specifications
 <b>CAUTION</b>		
<p>Charge receiver according to nameplate specifications to ensure optimal unit performance.</p>		
<b>g. Refrigerant Charge</b>	Receiver	4.54 kg (10 lbs)
<b>h. Fusible Plug</b>	Melting point	99°C = (210°F)
	Torque	6.2 to 6.9 mkg (45 to 50 ft-lbs)
<b>i. Unit Weight</b>	Refer to unit model number plate	

### 2.3 ELECTRICAL DATA

<b>a. Circuit Breaker</b>	CB-1 (25 amp)	Trips at 29 amps		
<b>b. Compressor Motor</b>	Full Load Amps (FLA)	13 amps @ 460 VAC		
<b>c. Condenser Motor</b>	<b>Fan</b>	Nominal Supply	<b>380 VAC, Three Phase, 50 Hz</b>	<b>460 VAC, Three Phase, 60 Hz</b>
		Full Load Amps	.71 amps	.72 amps
		Horsepower	0.21 hp	0.36 hp
		Rotations Per Minute	1450 rpm	1750 rpm
		Voltage and Frequency	360 – 460 VAC +/- 2.5 Hz	400 – 506 VAC +/- 2.5 Hz
		Bearing Lubrication	Factory lubricated, additional grease not required	
	Rotation	Counter-clockwise when viewed from shaft end		
<b>d. Evaporator Heaters</b>	<b>Coil</b>	Number of Heaters	6	
		Rating	750 watts +5/-10% each @ 230 VAC	
		Resistance (cold)	66.8 to 77.2 ohms @ 20°C (68°F)	
		Type	Sheath	
<b>e. Evaporator Motor(s)</b>	<b>Fan</b>	Nominal Supply	<b>380 VAC/3 PH/50 Hz</b>	<b>460 VAC/3 PH/60 Hz</b>
		Full Load Amps High Speed	1.07	.9
		Full Load Amps Low Speed	0.47	0.47
		Nominal Horsepower High Speed	0.36	0.63
		Nominal Horsepower Low Speed	0.05	0.8
		Rotations Per Minute High Speed	2850 rpm	3450 rpm
		Rotations Per Minute Low Speed	1425 rpm	1725 rpm
		Voltage and Frequency Tolerance	360 – 460 VAC +/- 1.25 Hz	400 – 500 VAC +/- 1.5 Hz
		Bearing Lubrication	Factory lubricated, additional grease not required	
		Rotation	CW when viewed from shaft end	
<b>f. Fuses</b>	Control Circuit	7.5 amps (F3A,F3B)		
	Controller/DataCORDER	5 amps (F1 & F2)		
	Emergency Bypass	10 amps (FEB)		
<b>g. Vent Positioning Sensor</b>	Electrical Output	0.5 VDC to 4.5 VDC over 90 degree range		
	Supply Voltage	5 VDC +/- 10%		
	Supply Current	5 mA (typical)		
<b>h. Solenoid Coils (ESV) 24 VDC</b>	<b>Valve</b>	Nominal Resistance @ 77°F (25°C)	7.7 ohms +/- 5%	
		Maximum Current Draw	0.7 amps	
<b>i. DUV Coils 12 VDC</b>		Nominal Resistance @ 77°F (20°C)	14.8 ohms +/- 5%	
		Maximum Current Draw	929 mA	
<b>j. EEV Nominal Resistance</b>		Coil Feed to Ground (Gray Wire)	47 ohms	
		Coil Feed to Coil Feed	95 ohms	

**Section 2.3 – ELECTRICAL DATA–CONTINUED**

<b>k. Humidity Sensor</b>	Orange wire	Power
	Red wire	Output
	Brown wire	Ground
	Input voltage	5 VDC
	Output voltage	0 to 3.3 VDC
	<b>Output voltage readings verses relative humidity (RH) percentage:</b>	
	30%	0.99 V
	50%	1.65 V
	70%	2.31 V
	90%	2.97 V

**2.4 SAFETY AND PROTECTIVE DEVICES**

Unit components are protected from damage by safety and protective devices listed in Table 2–1. These devices monitor the unit operating conditions and open a set of electrical contacts when an unsafe condition occurs.

Open safety switch contacts on either or both of devices IP–CP or HPS will shut down the compressor.

Open safety switch contacts on device IP–CM will shut down the condenser fan motor.

The entire refrigeration unit will shut down if one of the following safety devices open: (a) circuit breaker(s); (b) fuse (F3A/F3B, 7.5A); or (c) evaporator fan motor internal protector(s) – (IP).

**Table 2–1 Safety and Protective Devices**

<b>UNSAFE CONDITION</b>	<b>DEVICE</b>	<b>DEVICE SETTING</b>
	Circuit Breaker (CB–1, 25 amp) – Manual Reset	Trips at 29 amps (460 VAC)
Excessive current draw in the control circuit	Fuse (F3A & F3B)	7.5 amp rating
Excessive current draw by the controller	Fuse (F1 & F2)	5 amp rating
Excessive current draw by the Emergency Bypass module	Fuse (FEB)	10 amp rating
Excessive condenser fan motor winding temperature	Internal Protector (IP–CM) – Automatic Reset	N/A
Excessive compressor motor winding temperature	Internal Protector (IP–CP) – Automatic Reset	N/A
Excessive evaporator fan motor(s) winding temperature	Internal Protector(s) (IP–EM) – Automatic Reset	N/A
Abnormal pressures/temperatures in the high refrigerant side	Fusible Plug – Used on the Receiver	99°C = (210°F)
Abnormally high discharge pressure	High Pressure Switch (HPS)	Opens at 25 kg/cm <sup>2</sup> (356 psig)

## 2.5 REFRIGERATION CIRCUIT

### 2.5.1 Standard Operation

Starting at the compressor, (see Figure 2–6), upper schematic) the suction gas is compressed to a higher pressure and temperature.

The refrigerant gas flows through the discharge line and continues into the air-cooled condenser. Air flowing across the coil fins and tubes cools the gas to saturation temperature. By removing latent heat, the gas condenses to a high pressure/high temperature liquid and flows to the receiver, which stores the additional charge necessary for low temperature operation.

The liquid refrigerant continues through the liquid line, the filter drier (which keeps refrigerant clean and dry) and the economizer (not active during standard operation) to the electronic expansion valve (EEV).

As the liquid refrigerant passes through the variable orifice of the EEV, the pressure drops to suction pressure. In this process some of the liquid vaporizes to a gas (flash gas), removing heat from the remaining liquid. The liquid exits as a low pressure, low temperature, saturated mix. Heat is then absorbed from the return air by the balance of the liquid, causing it to vaporize in the evaporator coil. The vapor then flows through the suction tube back to the compressor.

During the standard mode of operation, the normally closed digital unloader valve (DUV) controls the system refrigerant flow and capacity by loading and unloading the compressor in frequent discrete time intervals. If the system capacity has been decreased to the lowest allowable capacity with the DUV, the unit will enter a trim heat mode of operation, during which the controller will pulse the evaporator heaters in sequence with the compressor digital signal in order to absorb the excess capacity.

### 2.5.2 Economized Operation

In the economized mode, (see Figure 2–7) the frozen and pull down capacity of the unit is increased by sub-cooling the liquid refrigerant entering the electronic expansion valve. Overall efficiency is increased because the gas leaving the economizer enters the compressor at a higher pressure, therefore requiring less energy to compress it to the required condensing conditions.

Liquid refrigerant for use in the economizer circuit is taken from the main liquid line as it leaves the filter drier. The flow is activated when the controller energizes the economizer solenoid valve (ESV).

The liquid refrigerant flows through the ESV to the expansion valve internal passages, absorbing heat from the liquid refrigerant flowing to the electronic expansion valve. The resultant “medium” temperature/pressure gas enters the compressor at the economizer port fitting.

When the control air temperature falls to 2.0°C (3.6°F) above set point, the DUV unloads the compressor's scroll and begins to reduce the capacity of the unit. Percentage of the unit capacity is accessed through code select 01 (Cd01). For example, if Cd01 displays 70, it indicates that the compressor is operating unloaded with the DUV engaged 30% of the time.

### 2.5.3 Electronic Expansion Valve

The microprocessor controls the superheat leaving the evaporator via the electronic expansion valve (EEV), based on inputs from the evaporator pressure transducer (EPT). The microprocessor transmits electronic pulses to the EEV stepper motor, which opens or closes the valve orifice to maintain the superheat set point.

# STANDARD OPERATION

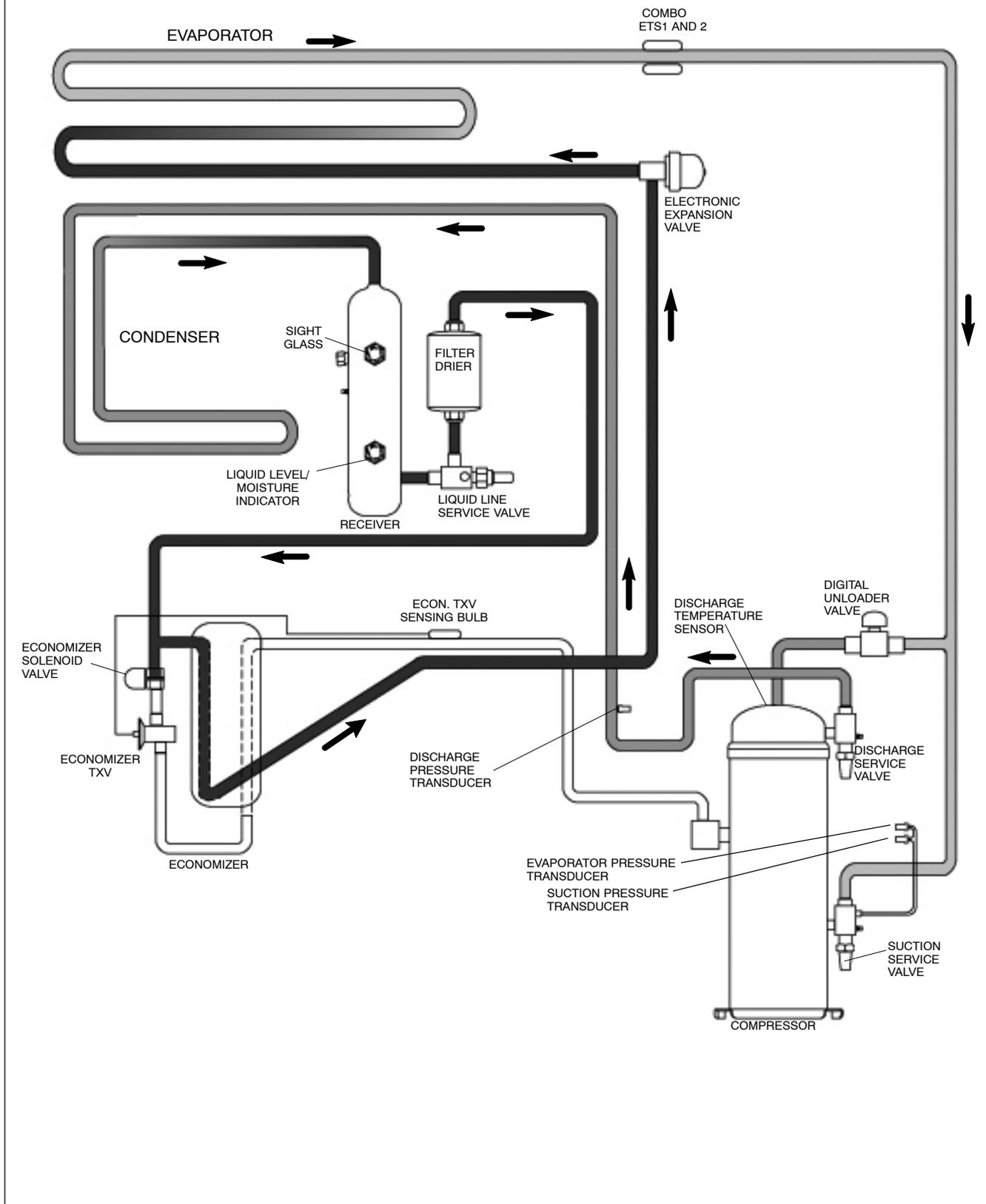


Figure 2-6 Refrigeration Circuit Schematic – Standard Operation

# ECONOMIZED OPERATION

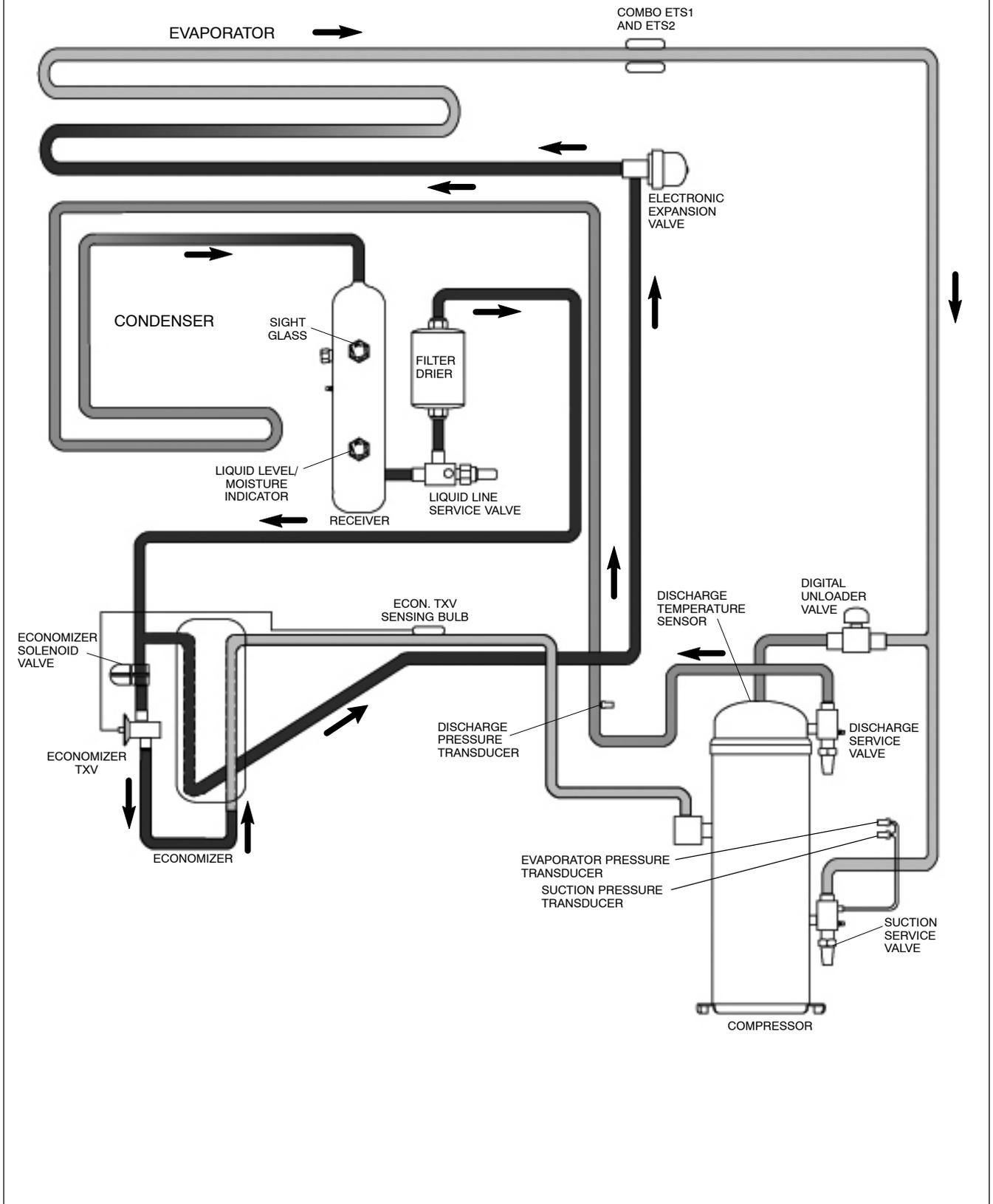


Figure 2-7 Refrigeration Circuit Schematic – Economized Operation



## SECTION 3 MICROPROCESSOR

### 3.1 TEMPERATURE CONTROL MICROPROCESSOR SYSTEM

The temperature control Micro-Link 3 microprocessor system (see Figure 3-1) consists of a keypad, display module, the control module (controller) and interconnecting wiring. The controller houses the temperature control software and the DataCORDER software. The temperature control software functions to operate the unit components as required to provide the desired cargo temperature and humidity.

The DataCORDER software functions to record unit operating parameters and cargo temperature parameters for future retrieval. Coverage of the temperature control software begins with paragraph 3.2. Coverage of the DataCORDER software is provided in paragraph 3.7.

The keypad and display module serve to provide user access and readouts for both of the controller functions, temperature control and DataCORDER. The functions are accessed by keypad selections and viewed on the display module. The components are designed to permit ease of installation and removal.

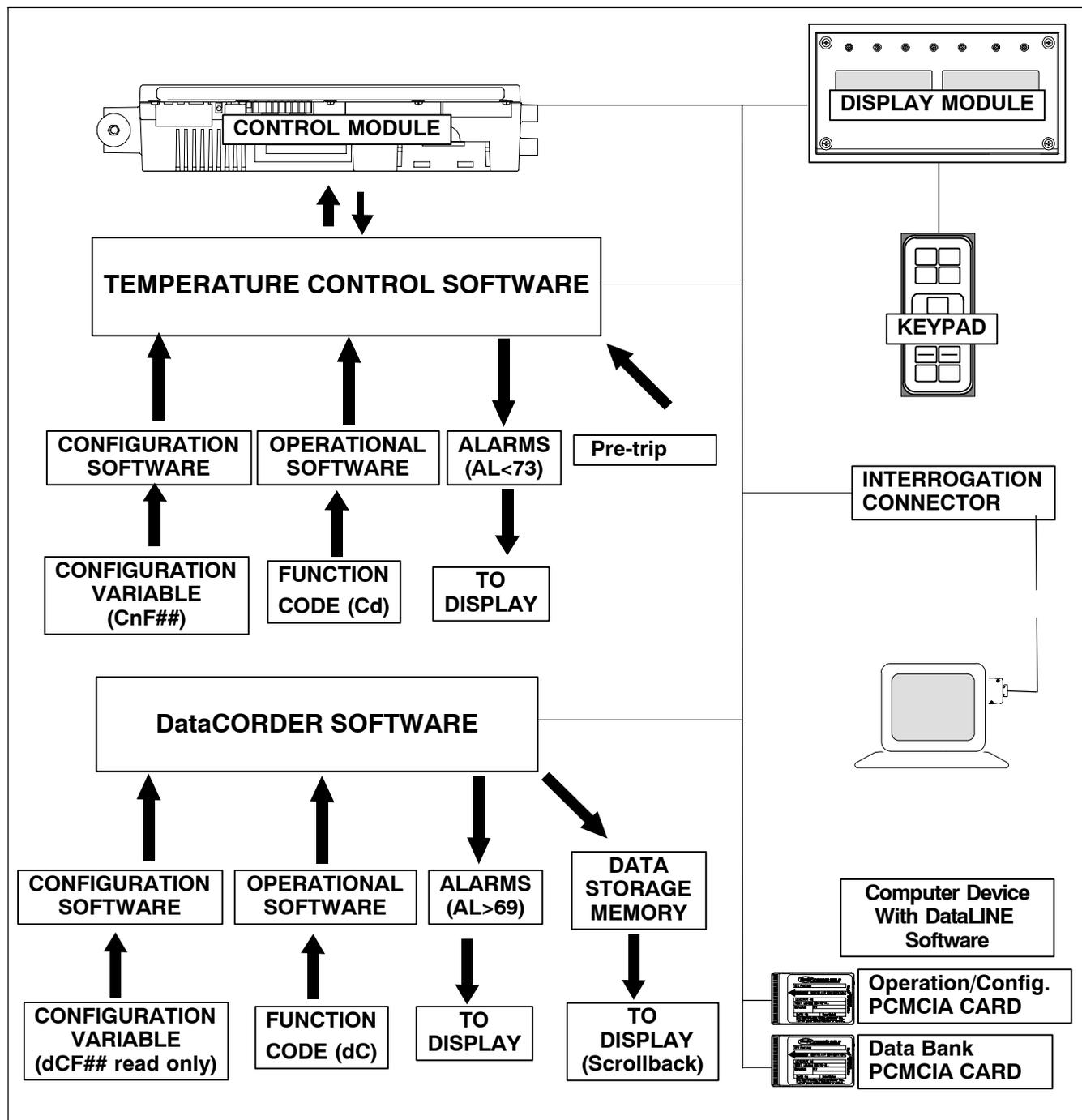
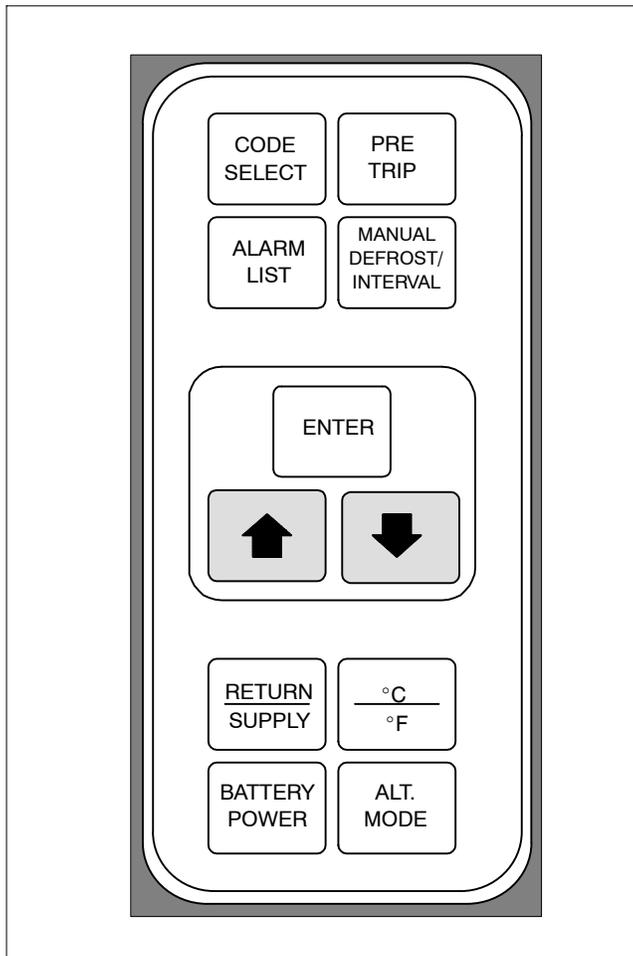


Figure 3-1 Temperature Control System

### 3.1.1 Keypad

The keypad (Figure 3–2) is mounted on control box door. The keypad consists of eleven push button switches that act as the user’s interface with the controller. Descriptions of the switch functions are provided in Table 3–1.



**Figure 3–2 Keypad**

### 3.1.2 Display Module

The display module (Figure 3–3) consists of two 5-digit displays and seven indicator lights. The indicator lights include:

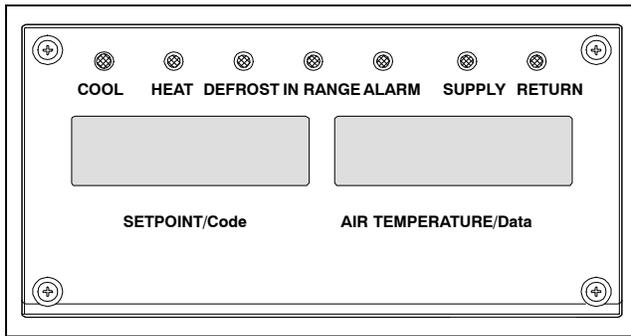
1. COOL - Blue LED: Energized when the refrigerant compressor is energized.
2. HEAT - Orange LED: Energized to indicate heater operation in heat mode, defrost mode, or dehumidification.
3. DEFROST - Orange LED: Energized when the unit is in defrost mode.
4. IN RANGE - Green LED: Energized when the controlled temperature probe is within the specified tolerance of set point.

**Table 3–1 Keypad Function**

KEY	FUNCTION
CODE SELECT	Accesses function codes.
PRE TRIP	Displays Pre-trip selection menu. Discontinues Pre-trip in progress.
ALARM LIST	Displays alarm list and clears the alarm queue.
MANUAL DEFROST / INTERVAL	Displays selected defrost mode. Depress and hold the MANUAL DEFROST / INTERVAL key for five (5) seconds to initiate defrost using the same logic as if the optional manual defrost switch was toggled on.
ENTER	Confirms a selection or saves a selection to the controller.
Arrow Up	Change or scroll a selection up. Pre-trip advance or test interrupt.
Arrow Down	Change or scroll selection downward. Pre-trip repeat backward.
RETURN / SUPPLY	Display non-controlling probe temperature (momentary display).
Celsius / Fahrenheit	Display alternate English/Metric scale (momentary display). When set to F, pressure is displayed in psig and vacuum in “/hg.” “P” appears after the value to indicate psig and “i” appears for inches of mercury. When set to C, pressure readings are in bars. “b” appears after the value to indicate bars.
BATTERY POWER	Initiate battery backup mode to allow set point & function code selection if AC power is not connected.
ALT MODE	This key is pressed to switch the functions from temperature software to the DataCORDER software. The remaining keys function the same as described above except the readings or changes are made to the DataCORDER programming.

**NOTE**

- The controlling probe in perishable range is the SUPPLY air probe and the controlling probe in frozen range is the RETURN air probe.
5. SUPPLY - Yellow LED: Energized when the supply air probe is used for control. When this LED is illuminated, the temperature displayed in the AIR TEMPERATURE display is the reading at the supply air probe. This LED will flash if dehumidification or humidification is enabled.
  6. RETURN - Yellow LED: Energized when the return air probe is used for control. When this LED is illuminated, the temperature displayed in the AIR TEMPERATURE display is the reading at the return air probe.
  7. ALARM - Red LED: Energized when an active or an inactive shutdown alarm in the alarm queue.



**Figure 3-3 Display Module**

### 3.1.3 Controller



**Do not remove wire harnesses from controller modules unless you are grounded to the unit frame with a static safe wrist strap.**



**Unplug all controller module wire harness connectors before performing arc welding on any part of the container.**



**Do not attempt to use an ML2i PC card in an ML3 equipped unit. The PC cards are physically different and will result in damage to the controller.**

#### NOTE

Do not attempt to service the controller modules. Breaking the seal will void the warranty.

The Micro-Link 3 controller is shown in Figure 3-4. It is fitted with test points, harness connectors and a software card programming port.

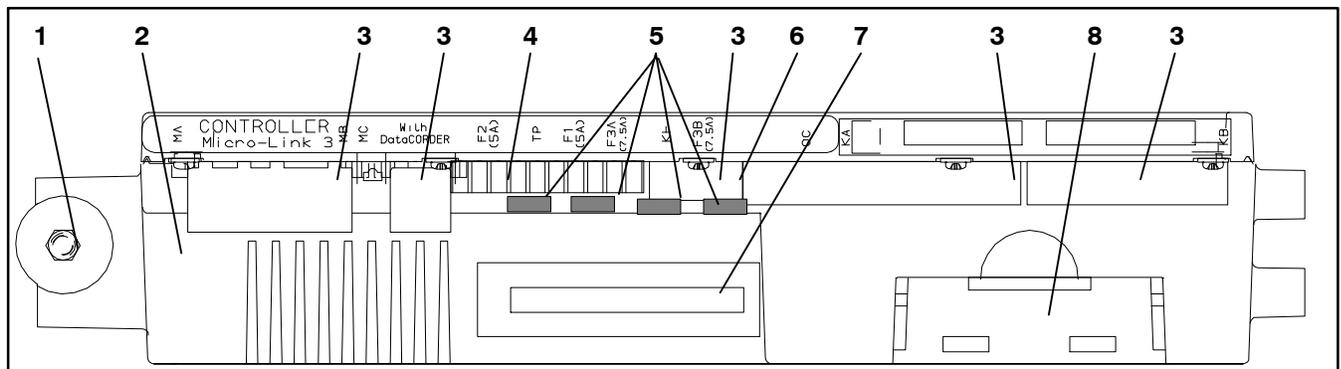
## 3.2 CONTROLLER SOFTWARE

The controller software is a custom designed program that is subdivided into configuration software and operational software. The controller software performs the following functions:

- Control supply or return air temperature to required limits, provide modulated refrigeration operation, economized operation, unloaded operation, electric heat control, and defrost. Defrost is performed to clear buildup of frost and ice to ensure proper air flow across the evaporator coil.
- Provide default independent readouts of set point and supply or return air temperatures.
- Provide ability to read and (if applicable) modify the configuration software variables, operating software Function Codes and Alarm Code indications.
- Provide a Pre-trip step-by-step checkout of refrigeration unit performance including: proper component operation, electronic and refrigeration control operation, heater operation, probe calibration, pressure limiting and current limiting settings.
- Provide battery-powered ability to access or change selected codes and set point without AC power connected.
- Provide the ability to reprogram the software through the use of a memory card.

### 3.2.1 Configuration Software (CnF Variables)

Configuration software is a variable listing of the components available for use by the operational software. This software is factory installed in accordance with the equipment fitted and options listed on the original purchase order. Changes to the configuration software are required only when a new controller has been installed or a physical change has been made to the unit such as the addition or removal of an option. A configuration variable list is provided in Table 3-4. Change to the factory-installed configuration software is achieved via a configuration card or by communications.



- |   |                                     |
|---|-------------------------------------|
| 1. Mounting Screw                         | 5. Fuses                            |
| 2. Micro-Link 3 Control/DataCORDER Module | 6. Control Circuit Power Connection |
| 3. Connectors                             | 7. Software Programming Port        |
| 4. Test Points                            | 8. Battery Pack (Standard Location) |

**Figure 3-4 Control Module**

### 3.2.2 Operational Software (Cd Function Codes)

The operational software is the actual operation programming of the controller which activates or deactivates components in accordance with current unit operating conditions and selected modes of operation.

The programming is divided into function codes. Some of the codes are read only, while the remaining codes may be user configured. The value of the user configurable codes can be assigned in accordance with user desired mode of operation. A list of the function codes is provided in Table 3-5.

To access the function codes:

- a. Press CODE SELECT, then press an arrow key until the left window displays the desired function code.
- b. The right window will display the selected function code value for five seconds before returning to normal display mode.
- c. If additional time is required, pressing the ENTER key will extend the display time to 30 seconds.

### 3.3 MODES OF OPERATION

General operation sequences for cooling, heating and defrost are provided in the following sub-paragraphs. Schematic representation of controller operation is provided in Figure 3-5 & Figure 3-8.

Operational software responds to various inputs. These inputs come from the temperature sensors, pressure transducers, the temperature set point, the settings of the configuration variables and the function code assignments. The actions taken by the operational software changes as the input values change. Overall interaction of the inputs is described as a "mode" of operation. The modes of operation include perishable (chill) mode and frozen mode. Descriptions of the controller interaction and modes of operation are provided in the following sub paragraphs.

#### 3.3.1 Start up - Compressor Phase Sequence

At start up, the controller logic checks for proper phase sequencing and compressor rotation. If incorrect sequencing is causing the compressor and three-phase evaporator fan motors to rotate in the wrong direction, the controller will energize or de-energize relay TCP as required (see Figure 7-2). Relay TCP will switch its contacts, energizing or de-energizing relays PA and PB. Relay PA is wired to energize the circuits on L1, L2 and L3. Relay PB is wired to energize the circuits on L3, L2, and L1, thus providing reverse rotation.

#### 3.3.2 Start up - Compressor Bump Start

At start up, the controller logic will initiate a compressor bump start procedure to clear liquid refrigerant from the compressor. If suction and discharge pressures have equalized, the compressor will perform three compressor bump starts. A compressor bump start may also occur after a defrost cycle has been completed.

During Bump Start, the EEV will close. Relays TS, TQ, TN, TE, and TV will be de-energized (opened). The result of this action will close the ESV and shut all fans off. The compressor will start for 1 second, then pause for five seconds. This sequence will be repeated two more times. After the final bump start the unit will pre-position the EEV to the correct starting position, pause and start up.

#### 3.3.3 Perishable Mode Temperature Control

In Perishable Mode, the controller maintains the supply air temperature at set point, the SUPPLY indicator light is illuminated and the default reading on the display window is the supply temperature sensor reading.

When the supply air temperature enters the in-range temperature tolerance (Cd30), the green IN-RANGE light will energize.

With set points above  $-10^{\circ}\text{C}$  ( $14^{\circ}\text{F}$ ), perishable mode is active.

#### 3.3.4 Perishable Pulldown

When the system is in Perishable Pulldown Mode, the highest priority is given to bringing the container down to set point. When cooling from a temperature that is more than  $2.5^{\circ}\text{C}$  ( $4.5^{\circ}\text{F}$ ) above set point, the system will be in perishable pulldown mode in economized operation.

However, pressure and current limit functions may restrict the valve if either exceeds the preset value.

#### 3.3.5 Perishable Steady State

Perishable Steady State is used to maintain the control temperature near a setpoint that is above the heat lock-out temperature.

Once set point is reached, the unit will transition to perishable steady state mode. This results in unloaded operation by cycling the DUV to limit capacity and maintain steady temperature control.

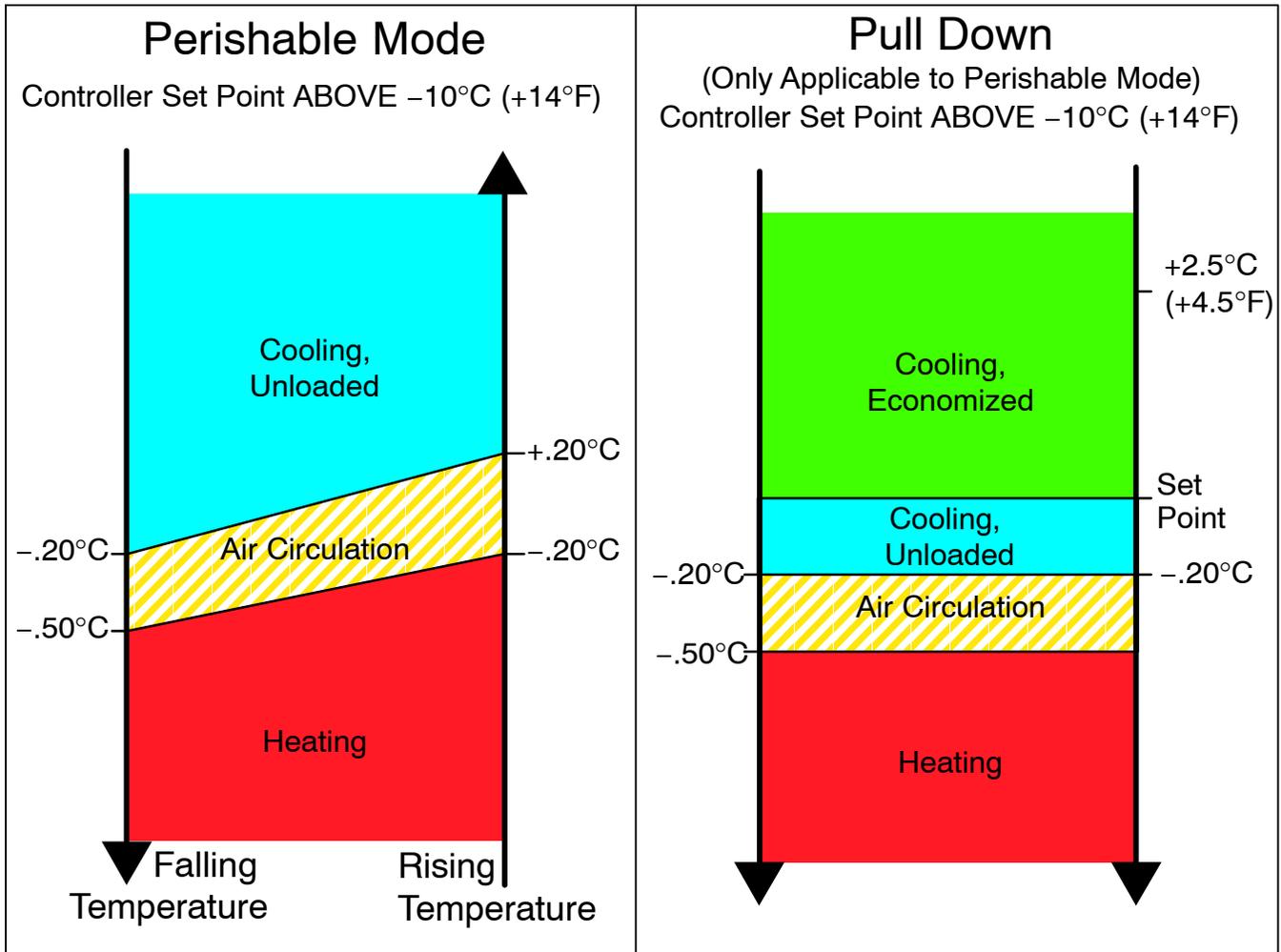
The unit is capable of maintaining supply air temperature to within  $\pm 0.2^{\circ}\text{C}$  ( $\pm 0.36^{\circ}\text{F}$ ) of set point. Supply air temperature is controlled by positioning of the electronic expansion valve (EEV), cycling of the digital unloader valve (DUV), cycling of the compressor, and cycling of the heaters.

#### 3.3.6 Perishable Idle, Air Circulation

Perishable Idle Mode is used when it is unnecessary to run the compressor to maintain control temperature. If the controller has determined that cooling is not required or the controller logic determines suction pressure is at the low pressure limit, the unit will transition to Perishable Idle Mode. During Perishable Idle Mode, the compressor is turned off, but the evaporator fans continue to run to circulate air throughout the container. If temperature rises  $+0.2^{\circ}\text{C}$  ( $+0.4^{\circ}\text{F}$ ) above set point, the unit will transition back to perishable steady state.

#### 3.3.7 Perishable Heating

When it is necessary to raise the control temperature, the system will enter Perishable Heating Mode. If the temperature drops to  $0.5^{\circ}\text{C}$  ( $0.9^{\circ}\text{F}$ ) below set point, the unit will transition to Perishable Heating Mode, and the heaters will be energized. The unit will transition back to Perishable Idle Mode when the temperature rises to  $0.2^{\circ}\text{C}$  ( $0.4^{\circ}\text{F}$ ) below the set point, and the heaters will de-energize.



**Figure 3-5 Controller Operation - Perishable Mode**

### 3.3.8 Perishable Dehumidification

Dehumidification is provided to reduce the humidity levels inside the container. Dehumidification is activated when a humidity value is set at Cd33. The yellow SUPPLY LED will flash ON and OFF every second to indicate that dehumidification is active. Once dehumidification is active and the following conditions are satisfied, the controller will activate the heat relay to begin dehumidification.

1. The humidity sensor reading is above the humidity set point (Cd33).
2. The unit is in perishable steady state and supply air temperature is less than  $0.25^{\circ}\text{C}$  ( $0.45^{\circ}\text{F}$ ) above set point.
3. The heater debounce timer (three minutes) has timed out.
4. Heater termination thermostat (HTT) is closed.

If the above conditions are true for at least one hour the evaporator fans will switch from high speed to low speed. Evaporator fan speed will then switch every hour, as long as the 4 conditions are met.

If any condition except item (1) becomes false OR if the relative humidity sensed is 2% below the dehumidification set point, the high speed evaporator fans will be energized.

During dehumidification power is applied to the defrost heaters. This added heat load causes the controller to open the EEV to match the increased heat load while still holding the supply air temperature very close to the set point.

Opening the EEV reduces the temperature of the evaporator coil surface, which increases the rate at which water is condensed and removes water from the passing air. Removing water from the air reduces the relative humidity. When the relative humidity sensed is 2% below set point, the controller de-energizes the heat relay. The controller will continue to cycle heating to maintain relative humidity below the selected set point. If dehumidification is terminated by a condition other than the humidity sensor, e.g., an out-of-range or compressor shutdown condition, the heat relay is de-energized immediately.

Two timers are activated during dehumidification to prevent rapid cycling and consequent contactor wear:

1. Heater debounce timer (three minutes) - The heater debounce timer is started whenever the heater contactor status is changed. The heat contactor remains energized (or de-energized) for at least three minutes even if the set point criteria are satisfied.
2. Out-of-range timer (five minutes) - The out-of-range timer is started to maintain heater operation during a temporary out-of-range condition. If supply air temperature remains outside of the user selected in-range setting for more than five minutes, the heaters will be de-energized to allow the system to recover. The out-of-range timer starts as soon as temperature exceeds in-range tolerance value set by Cd30.

### 3.3.9 Perishable Mode Cooling - Sequence of Operation

#### NOTE

In Standard Perishable Mode, the evaporator motors run in high speed. In Economy Fan Mode, the fan speed is varied.

- a. When supply air temperature is above set point and decreasing, the unit will cool with the condenser fan motor (CF), compressor motor (CH), and evaporator fan motors (EF) energized, and the blue COOL light illuminated. (See Figure 3-6). Also, if current or pressure limiting is not active, the controller will close contacts TS to open the economizer solenoid valve (ESV) and place the unit in economized operation.

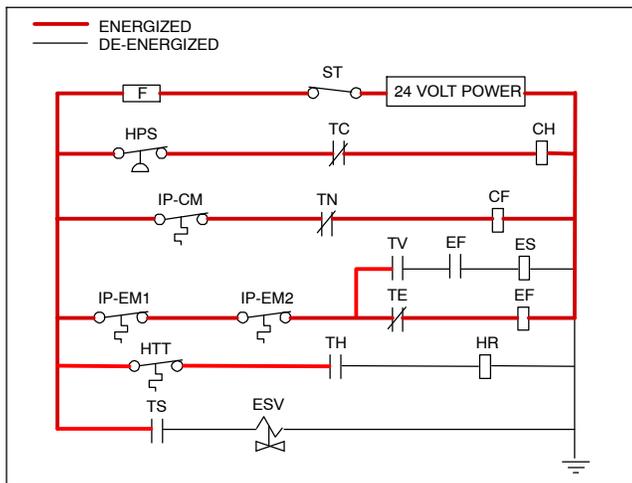
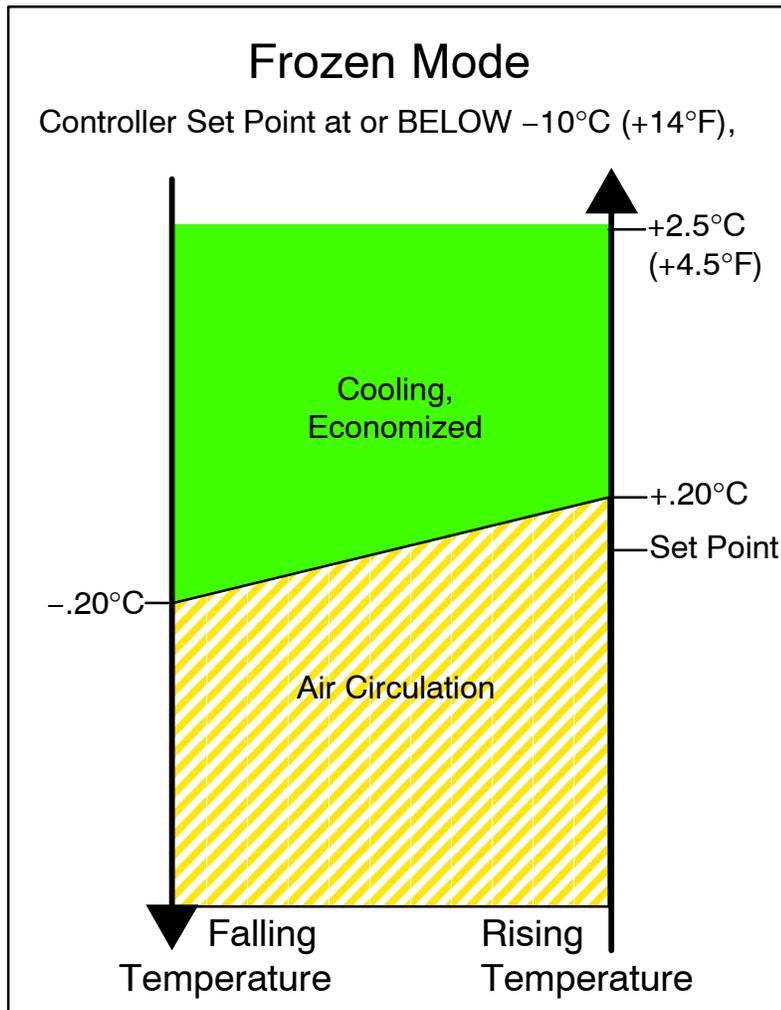


Figure 3-6 Perishable Mode Cooling

- b. When supply air temperature decreases to a predetermined tolerance above set point (Cd30), the green IN RANGE light is illuminated.
- c. As air temperature continues to fall, unloaded cooling starts (DUV pulses opens) as the supply air temperature approaches set point. (See Figure 3-5).
- d. When unloaded cooling starts, EEV control will transition from a full cool superheat set point to a lower modulated cool superheat set point. Once unloading starts, the EEV controls evaporator superheat based on the system duty cycle where instantaneous superheat will vary.
- e. When the supply air temperature has fallen to within 1.9°C (3.4°F) of set point temperature **and** the average capacity of the system has fallen below 70%, the unit will open contacts TS to close the ESV and take the unit out of economized operation.
- f. The controller continuously monitors supply air temperature. Once the supply air temperature falls below set point, the controller periodically records supply air temperature, set point and time. A calculation is then performed to determine temperature drift from set point over time. If the calculation determines that cooling is no longer required, contacts TC and TN are opened to de-energize the compressor motor and the condenser fan motor. In addition the controller will close the EEV.
- g. The evaporator fan motors continue to run to circulate air throughout the container. The green IN RANGE light remains illuminated as long as the supply air temperature is within tolerance of the set point.
- h. If the supply air temperature increases to 1.0°C (1.8°F) above set point and three minutes have elapsed, contacts TC and TN close to restart the compressor and condenser fan motors in standard mode (non-economized) operation. The white COOL light is also illuminated.
- i. If the average system capacity has risen to 100% during unloaded cooling and three minutes off time has elapsed, relay TS will energize to open the ESV, placing the unit in economized mode.
- j. If the supply air increases more than 2.5°C (4.5°F) above set point temperature, the microprocessor will transition the evaporator superheat control from modulation back to full cool control.





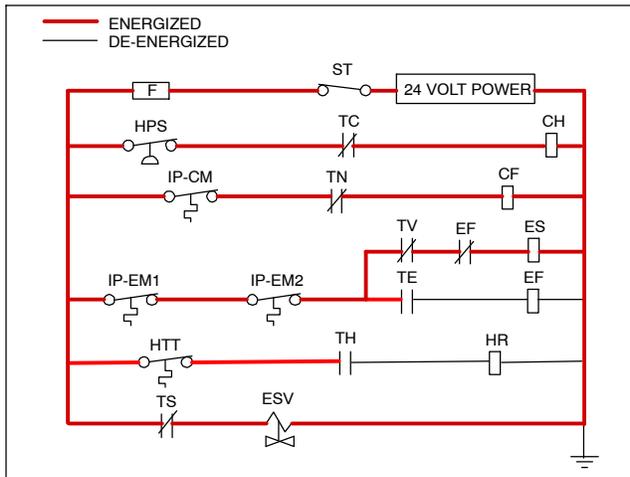
**Figure 3-8 Controller Operation - Frozen Mode**

### 3.3.15 Frozen “Heat” Mode

If the temperature drops  $10^{\circ}\text{C}$  ( $18^{\circ}\text{F}$ ) below set point, the unit will transition to the frozen “heat” mode. The evaporator fans are brought to high speed, and the heat from the fans is circulated through the container. The unit will transition back to frozen steady state when the temperature rises back to the transition point.

### 3.3.16 Frozen Mode Cooling - Sequence of Operation

- a. When the return air temperature is above set point and decreasing, the unit will transition to economized cooling with the condenser fan motor (CF), compressor motor (CH), economizer solenoid valve (ESV), low speed evaporator fan motors (ES) energized and the blue COOL light illuminated. (See Figure 3-9).
- b. When the return air temperature decreases to a pre-determined tolerance above set point, the green IN-RANGE light is illuminated.
- c. When the return air temperature decreases to  $0.2^{\circ}\text{C}$  ( $0.4^{\circ}\text{F}$ ) below set point, contacts TC, TS and TN are opened to de-energize the compressor, economizer solenoid valve and condenser fan motor. The blue COOL light is also de-energized. The EEV will close.
- d. The evaporator fan motors continue to run in low speed to circulate air throughout the container. The green IN-RANGE light remains illuminated as long as the return air is within tolerance of set point.
- e. If return air temperature drops to  $10^{\circ}\text{C}$  ( $18^{\circ}\text{F}$ ) or more below set point, the evaporator fans increase to high speed.
- f. When the return air temperature increases to  $0.2^{\circ}\text{C}$  ( $0.4^{\circ}\text{F}$ ) above set point and three minutes have elapsed, the EEV opens and contacts TC, TS and TN close to restart the compressor, open the ESV and restart the condenser fan motor. The blue COOL is illuminated.



**Figure 3-9 Frozen Mode**

**NOTE**

The EEV and DUV are independently operated by the microprocessor. Complete schematics and legends are located in Section 7.

**3.3.17 Defrost**

Defrost is initiated to remove ice buildup from the evaporator coil which can obstruct air flow and reduce the cooling capacity of the unit. The defrost cycle may consist of up to three distinct operations. The first is de-icing of the coil, the second is a probe check cycle and the third is snap freeze.

De-icing of the coil consists of removing power to the cooling components (compressor, evaporator fans, condenser fan), closing the EEV, and turning on the heaters, which are located below the evaporator coil. During normal operation, de-icing will continue until temperatures indicate that the ice on the coil has been removed, proper air flow has been restored, and the unit is ready to control temperature efficiently.

After de-icing, and depending on unit configuration, a Defrost/Probe Check and/or Snap Freeze may occur:

During Defrost / Probe Check, the evaporator fans are allowed to run for a period of time after de-icing in order to validate the accuracy of the temperature sensors, and confirm that defrost was executed properly. Refer to Section 4.8, Probe Diagnostics for additional information.

Defrost / Snap Freeze allows the system to cool for a period of time after de-icing, with the evaporator fans turned off. This allows for the removal of latent de-icing heat from the evaporator coils, and freezes any remaining moisture that might otherwise be blown into the container.

**3.3.18 Automatic Defrost**

In perishable mode, perishable-pull down mode, or frozen mode, automatic defrost starts with an initial defrost set to three hours and then adjusts the interval to the next defrost based on the accumulation of ice on the evaporator coil. In this way, defrosts are scheduled to occur only when necessary.

In frozen mode, once the frozen set point has been reached, automatic defrost will set the time interval to 12 hours for the first two defrosts, and then adjust to 24 hours thereafter.

All defrost interval times reflect the number of compressor run time hours since the last defrost cycle. The minimum defrost interval in the automatic setting is three hours while the maximum is 24, refer to Section 3.3.19, Defrost Intervals for more information.

In frozen mode the amount of actual time necessary to accumulate defrost interval time will exceed the defrost interval time by a factor of two to three depending on the compressor duty-cycle. Defrost interval time is only accumulated when the compressor is running, and the Defrost Termination Sensor (DTS) reads less than 10°C (50°F), at which point the Defrost Termination Thermostat (DTT) is considered closed.

If defrost does not terminate correctly and temperature reaches the set point of the Heat Termination Thermostat (HTT), the HTT will open to de-energize the heaters (AL59 & AL60). If the HTT does not open and termination does not occur within two hours, the controller will terminate defrost. AL60 will be activated to inform of a possible DTS failure.

**3.3.19 Defrost Initiation**

Initiation of defrost is dependent on the state of the Defrost Temperature Thermostat (DTT). The functionality of the DTT is controlled by the system software, based on the temperature reading of the Defrost Termination Sensor (DTS). In the case of a failed DTS, the RTS may be used to determine the state of the DTT.

Defrost cannot be initiated when the DTT is considered OPEN, because an open DTT indicates that the temperature is too high for ice to build up. Defrost can only occur when the temperature sensed by the DTS is low enough to CLOSE the DTT.

If the DTT is closed and the unit is in Perishable or Frozen Mode, then defrost can be initiated when any one of the following additional conditions become true:

1. Manual defrost is initiated by the operator. Request for defrost is ignored during Pretrip, and the DTT must be considered CLOSED for MDS activation to work.

Manual defrost is initiated by pressing the MANUAL DEFROST/INTERVAL key for greater than 5 seconds, or pressing the PRE TRIP key and the ALT MODE key for greater than 5 seconds. If the two key method is used the display may show "P" or "Dc" while waiting for defrost to initiate.

2. The Defrost Interval Timer reaches or exceeds the Defrost Interval.
3. During Pretrip, defrost may occur during tests P-8, and P-10. Defrost is forced during Pretrip test P-9.
4. Temperature Probe Diagnostics logic determines that a Probe Check is necessary based on temperature values currently reported by the supply and return probes.
5. An Initiate Defrost command is sent via communications.
6. The microprocessor can determine if defrost is required by calculating the difference between return air temperature and supply air temperature (Delta T). If the temperature difference between return air and supply air is too great, it indicates reduced air flow over the evaporator coil, and a defrost cycle may be required:
  - a. In Perishable Pull Down - Defrost will be initiated if Delta T increases to greater than 12°C (53.6°F), DTT is closed, and 90 minutes of compressor run time have been recorded.
  - b. In Frozen Mode - Defrost will be initiated if Delta T increases to greater than 16°C (60.8°F), DTT is closed, and 90 minutes of compressor run time have been recorded.
  - c. In Perishable Steady State – A baseline Delta T is used to determine when defrost should be activated. The baseline is recorded after completion of an initial defrost cycle. In order to record a baseline Delta T, the unit must be cooling, and the evaporator fans and heaters must remain in a stable state for a period of five minutes. Defrost will then be initiated if Delta T increases to greater than 4°C (7.2°F) above the baseline, the DTT is closed, and 90 minutes of compressor run time have been recorded.

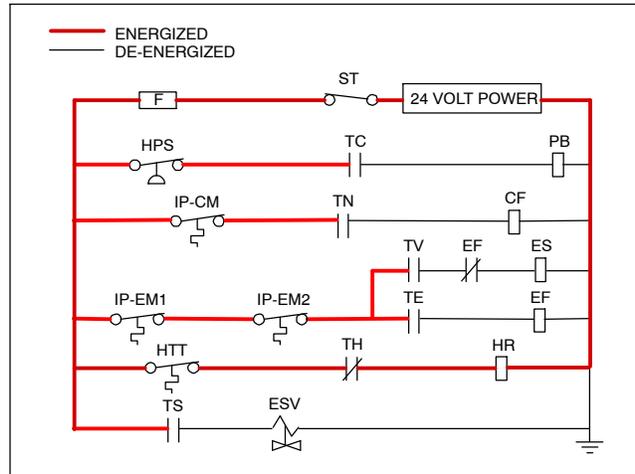
**NOTE**

During defrost, the Defrost Relay is energized, the orange DEFROST light is illuminated, and the orange HEAT light is illuminated.

Defrost may be initiated any time the DTS reading falls below the set point. Defrost will terminate when the DTS reading rises above the DTT set point. The DTT is not a physical component. It is a controller setting that acts as a thermostat, “closing” (allowing defrost) when the DTS reading is below the set point and “opening” (terminating or preventing defrost) when the DTS temperature reading is above set point.

The DTT set point is set to 25.6°C (78°F). When a request for defrost is made through the manual defrost switch, communications or probe check the unit will enter defrost if the DTS reading is at or below the DTT set point. Defrost will terminate when the DTS reading rises above the DTT set point. When a request for defrost is made with the defrost interval timer or by demand defrost, the DTS must be below 10°C (50°F).

When defrost is initiated, the controller closes the EEV, opens contacts TC, TN and TE (or TV) to de-energize the compressor, condenser fan and evaporator fans. The blue COOL light is also de-energized. The controller then closes contacts TH to supply power to the heaters, and the orange DEFROST light is illuminated. When the DTS reading rises to the DTT setting, the de-icing operation is terminated.



**Figure 3-10 Defrost**

**NOTE**

The EEV and DUV are independently operated by the microprocessor. Complete schematics and legends are located in Section 7.

**3.3.20 Defrost Interval**

There are two modes for defrost initiation, user-selected timed intervals and automatic control.

The user-selected values are 3, 6, 9, 12, 24 hours, AUTO, or PuLS; factory default is 3 hours.

Automatic defrost starts with an initial defrost at three hours and then adjusts the interval to the next defrost based on the accumulation of ice on the evaporator coil. Following a start-up or after termination of defrost, the time will not begin counting down until the DTS reading falls below set point (DTT closed). If the reading of DTS rises above set point (DTT open) any time during the timer count down, the interval is reset and the count-down starts over.

### 3.3.21 Defrost Related Settings

The probe check is a test that compares temperature sensor readings to determine if any sensors have failed.

If probe check fails, the system will run for eight minutes to validate. At the end of eight minutes, probe alarms will be set or cleared based on the current conditions.

When the return air temperature falls to 7°C (45°F), the controller ensures that the defrost temperature sensor (DTS) reading has dropped to 10°C (50°F) or below. If it has not it indicates a failed DTS, a DTS failure alarm is triggered and the defrost mode is operated by the return temperature sensor (RTS).

The value of the defrost interval timer will be saved at power down and restored at power up. This option prevents short power interruptions from resetting an almost expired defrost interval, and possibly delaying a needed defrost cycle.

After a new Defrost Interval is selected, the previously selected Interval is used until the next defrost termination, the next time the DTT contacts are OPEN, or the next time power to the control is interrupted.

If any Auto Pretrip sequence is initiated, Cd27 will be set to 'AUTO'.

## 3.4 PROTECTION MODES OF OPERATION

### 3.4.1 Evaporator Fan Operation

Opening of an evaporator fan internal protector will shut down the unit.

### 3.4.2 Failure Action

Function code Cd29 may be operator set to select the action the controller will take upon a system failure. The factory default is full system shutdown. Refer to Table 3-5.

### 3.4.3 Generator Protection

Function codes Cd31 (Stagger Start, Offset Time) and Cd32 (Current Limit) may be operator set to control the start up sequence of multiple units and operating current draw. The factory default allows on demand starting (no delay) of units and normal current draw. Refer to Table 3-5.

### 3.4.4 Compressor High Temperature Protection

The controller continuously monitors compressor discharge pressure and temperature, and suction pressure. If discharge pressure or temperature rises above the allowed limit or suction pressure falls below the allowed limit, the compressor will be cycled off and on every 3 minutes. Condenser and evaporator fans will continue to operate during the compressor off cycle.

If high compressor dome temperature occurs, as measured by the compressor discharge temperature sensor (CPDS), the controller will allow additional refrigerant to be released into the system in order to provide cooling to the evaporator coil and compressor dome. The controller is alerted to high compressor dome temperatures via the CPDS when ambient temperature is greater than 43.3°C (110°F), return air temperature is less than -17.5°C (.5°F) and the compressor discharge temperature is greater than 117.7°C (244°F).

Dome temperature control logic will disengage when return air temperature and ambient temperature return to allowed limits or when the compressor turns off.

### 3.4.5 Compressor Low Pressure Protection

If the suction pressure low limit is triggered, the DUV will energize to raise the suction pressure.

### 3.4.6 Perishable Mode - System Pressure Regulation

In perishable mode, system pressures may need to be regulated at ambient temperatures of 20°C (68°F) and below. Once below this ambient temperature, the condenser fan may cycle on and off based on limits imposed for discharge pressure. For extremely cold ambient temperatures, -18°C (0°F), heater cycling may occur within normal system operation based on discharge pressure limits.

## 3.5 CONTROLLER ALARMS

Alarm display is an independent controller software function. If an operating parameter is outside of expected range or a component does not return the correct signals back to the controller, an alarm is generated. A listing of the alarms is provided in Table 3-6.

The alarm philosophy balances the protection of the refrigeration unit and that of the refrigerated cargo. The action taken when an error is detected always considers the survival of the cargo. Rechecks are made to confirm that an error actually exists.

Some alarms requiring compressor shutdown have time delays before and after to try to keep the compressor on line. An example is alarm code "LO," (low main voltage), when a voltage drop of over 25% occurs, an indication is given on the display, but the unit will continue to run.

### When an Alarm Occurs:

- The red alarm light will illuminate for alarm code numbers 15, 17, 20, 21, 22, 23, 24, 25, 26, and 27.
- If a detectable problem exists, its alarm code will be alternately displayed with the set point on the left display.
- The user should scroll through the alarm list to determine what alarms exist or have existed. Alarms must be diagnosed and corrected before the Alarm List can be cleared.

### To Display Alarm Codes:

- While in the Default Display mode, press the ALARM LIST key. This accesses the Alarm List Display Mode, which displays any alarms archived in the alarm queue.
- The alarm queue stores up to 16 alarms in the sequence in which they occurred. The user may scroll through the list by depressing an ARROW key.
- The left display will show "AL##," where ## is the alarm number sequentially in the queue.
- The right display will show the actual alarm code. "AA##" will display for an active alarm, where "##" is the alarm code. Or "IA##" will display for an inactive alarm, see Table 3-6.
- "END" is displayed to indicate the end of the alarm list if any alarms are active.

f. "CLEAR" is displayed if all alarms are inactive. The alarm queue may then be cleared by pressing ENTER. The alarm list will clear and "----" will be displayed.

#### NOTE

AL26 is active when none of the sensors are responding. Check the connector at the back of the controller; if it is loose or unplugged, reconnect it, then run a Pre-trip test (P5) to clear AL26.

### 3.6 PRE-TRIP DIAGNOSTICS

Pre-trip Diagnostics is an independent controller function that suspends normal refrigeration controller activities and provides pre-programmed test routines. The test routine can be run in Auto Mode, which automatically performs a pre-programmed sequence of tests, or Manual Mode, which allows the operator to select and run any of the individual tests.



#### CAUTION

**Pre-trip inspection should not be performed with critical temperature cargoes in the container.**



#### CAUTION

**When the Pre-trip key is pressed economy and dehumidification will be deactivated. At the completion of the Pre-trip test, economy and dehumidification must be reactivated.**

A Pre-trip test may be initiated by use of the keypad or via communication, but when initiated by communication the controller will execute the entire battery of tests (Auto Mode).

At the end of a Pre-trip test, the message "P," "rSLts" (pretest results) will be displayed. Pressing ENTER will allow the user to see the results for each of the sub-tests. The results will be displayed as "PASS" or "FAIL" for each test run to completion.

A detailed description of the Pre-trip tests and test codes is provided in Table 3-7. Detailed operating instructions are provided in Paragraph 4.7.

### 3.7 DataCORDER

#### 3.7.1 Description

Carrier Transicold "DataCORDER" software is integrated into the controller and serves to eliminate the temperature recorder and paper chart. DataCORDER functions may be accessed by keypad selections and viewed on the display module. The unit is also fitted with interrogation connections (see Figure 3-1) which may be used with the Carrier Transicold DataReader to download data. A personal computer with Carrier Transicold DataLINE software installed may also be used to download data and configure settings.

The DataCORDER consists of:

- Configuration Software
- Operational Software

- Data Storage Memory
- Real Time Clock (with internal battery backup)
- Six Thermistor Inputs
- Interrogation Connections
- Power Supply (battery pack)

The DataCORDER performs the following functions:

- a. Logs data at 15, 30, 60 or 120 minute intervals and stores two years of data (based on one hour interval).
- b. Records and displays alarms on the display module.
- c. Records results of Pre-trip testing.
- d. Records DataCORDER and temperature control software generated data and events as follows:

- Container ID Change
- Software Upgrades
- Alarm Activity
- Battery Low (battery pack)
- Data Retrieval
- Defrost Start and End
- Dehumidification Start and End
- Power Loss (with and without battery pack)
- Power Up (with and without battery pack)
- Remote Probe Temperatures in the Container (USDA Cold treatment and Cargo probe recording)
- Return Air Temperature
- Set Point Change
- Supply Air Temperature
- Real Time Clock Battery (Internal) Replacement
- Real Time Clock Modification
- Trip Start
- ISO Trip Header (When entered via Interrogation program)
- Economy Mode Start and End
- "Auto 1/Auto 2/Auto 3" Pre-trip Start and End
- USDA Trip Comment
- USDA Probe Calibration
- Fresh Air Vent Position

#### 3.7.2 DataCORDER Software

The DataCORDER Software is subdivided into Operational Software, Configuration Software, and the Data Memory.

##### a. Operational Software

The Operational Software reads and interprets inputs for use by the Configuration Software. The inputs are labeled Function Codes. Controller functions (see Table 3-8, page 3-40) which the operator may access to examine the current input data or stored data. To access these codes, do the following:

1. Press the ALT. MODE and CODE SELECT keys.

2. Press an arrow key until the left window displays the desired code number. The right window will display the value of this item for five seconds before returning to the normal display mode.
3. If a longer display time is desired, press the ENTER key to extend the display time to 30 seconds.

**b. Configuration Software**

The configuration software controls the recording and alarm functions of the DataCORDER. Reprogramming to the factory-installed configuration is achieved via a configuration card. Changes to the unit DataCORDER configuration may be made using the DataLINE interrogation software.

A list of the configuration variables is provided in Table 3–2. Descriptions of DataCORDER operation for each variable setting are provided in the following paragraphs.

**3.7.3 Sensor Configuration (dCF02)**

Two modes of operation may be configured, the Standard Mode and the Generic Mode.

**a. Standard Mode**

In the standard mode, the user may configure the DataCORDER to record data using one of seven standard configurations. The seven standard configuration variables, with their descriptions, are listed in Table 3–3.

The inputs of the six thermistors (supply, return, USDA #1, #2, #3 and cargo probe) and the humidity sensor input will be generated by the DataCORDER. See Figure 3–11.

**NOTE**

The DataCORDER software uses the supply and return recorder sensors (SRS, RRS). The temperature control software uses the supply and return temperature sensors (STS, RTS).

**b. Generic Mode**

The generic recording mode allows user selection of the network data points to be recorded. The user may select up to a total of eight data points for recording. A list of the data points available for recording follows. Changing the configuration to generic and selecting which data points to record may be done using the Carrier Transicold Data Retrieval Program.

1. Control mode

2. Control temperature
3. Frequency
4. Humidity
5. Phase A current
6. Phase B current
7. Phase C current
8. Main voltage
9. Evaporator expansion valve percentage
10. Discrete outputs (Bit mapped - require special handling if used)
11. Discrete inputs (Bit mapped - require special handling if used)
12. Ambient sensor
13. Evaporator temperature sensor
14. Compressor discharge sensor
15. Return temperature sensor (RTS)
16. Supply temperature sensor (STS)
17. Defrost temperature sensor
18. Discharge pressure transducer
19. Suction pressure transducer
20. Evaporator pressure transducer
21. Vent position sensor (VPS)

**3.7.4 Logging Interval (dCF03)**

The user may select four different time intervals between data recordings. Data is logged at exact intervals in accordance with the real time clock. The clock is factory set at Greenwich Mean Time (GMT).

**3.7.5 Thermistor Format (dCF04)**

The user may configure the format in which the thermistor readings are recorded. The short resolution is a 1 byte format and the long resolution is a 2 byte format. The short requires less memory and records temperature with variable resolutions depending on temperature range. The long records temperature in 0.01°C (0.02°F) steps for the entire range.

**Table 3–2 DataCORDER Configuration Variables**

CONFIGURATION NO.	TITLE	DEFAULT	OPTION
dCF02	Sensor Configuration	2	2,5,6,9,54,64,94
dCF03	Logging Interval (Minutes)	60	15,30,60,120
dCF04	Thermistor Format	Short	Long
dCF05	Thermistor Sampling Type	A	A,b,C
dCF06	Controlled Atmosphere/Humidity Sampling Type	A	A,b
dCF07	Alarm Configuration USDA Sensor 1	A	Auto, On, Off
dCF08	Alarm Configuration USDA Sensor 2	A	Auto, On, Off
dCF09	Alarm Configuration USDA Sensor 3	A	Auto, On, Off
dCF10	Alarm Configuration Cargo Sensor	A	Auto, On, Off



**Table 3–3 DataCORDER Standard Configurations**

<b>Standard Config.</b>	<b>Description</b>
2 sensors (dCF02=2)	2 thermistor inputs (supply & return)
5 sensors (dCF02=5)	2 thermistor inputs (supply & return) 3 USDA thermistor inputs
6 sensors (dCF02=6)	2 thermistor inputs (supply & return) 3 USDA thermistor inputs 1 humidity input
9 sensors (dCF02=9)	Not Applicable
6 sensors (dCF02=54)	2 thermistor inputs (supply & return) 3 USDA thermistor inputs 1 cargo probe (thermistor input)
7 sensors (dCF02=64)	2 thermistor inputs (supply & return) 3 USDA thermistor inputs 1 humidity input 1 cargo probe (thermistor input)
10 sensors (dCF02=94)	2 thermistor inputs (supply & return) 3 USDA thermistor inputs 1 humidity input 1 cargo probe (thermistor input)

**3.7.6 Sampling Type (dCF05 & dCF06)**

Three types of data sampling are available: average, snapshot and USDA. When configured to average, the average of readings taken every minute over the recording period is recorded. When configured to snapshot, the sensor reading at the log interval time is recorded. When USDA is configured, supply and return temperature readings are averaged and the three USDA probe readings are snapshot.

**3.7.7 Alarm Configuration (dCF07 - dCF10)**

USDA and cargo probe alarms are configured to AUTO. The probes act as a group. This function is designed to assist users who keep the DataCORDER configured for USDA recording, but do not install the probes for every trip. If all the probes are disconnected, no alarms are activated. As soon as one of the probes is installed, all of the alarms are enabled and the remaining probes that are not installed will give active alarm indications.

**3.7.8 DataCORDER Power Up**

The DataCORDER may be powered up in any one of four ways:

1. *Normal AC power:* The DataCORDER is powered up when the unit is turned on via the Stop-Start switch.

2. *Controller DC battery pack power:* If a battery pack is installed, the DataCORDER will power up for communication when an interrogation cable is plugged into an interrogation receptacle.
3. *External DC battery pack power:* A 12 volt battery pack may also be plugged into the back of the interrogation cable, which is then plugged into an interrogation port. No controller battery pack is required with this method.
4. *Real Time Clock demand:* The DataCORDER is equipped with a charged battery pack and when AC power is not present, the DataCORDER will power up when the real time clock indicates that a data recording should take place. When the DataCORDER is finished recording, it will power down.

During DataCORDER power-up, while using battery-pack power, the controller will perform a hardware voltage check on the battery. If the hardware check passes, the controller will energize and perform a software battery voltage check before DataCORDER logging. If either test fails, the real time clock battery power-up will be disabled until the next AC power cycle. Further DataCORDER temperature logging will be prohibited until that time.

An alarm will be generated when the battery voltage transitions from good to bad indicating that the battery pack needs recharging. If the alarm condition persists for more than 24 hours on continuous AC power, it indicates that the battery pack needs replacement.

**3.7.9 Pre-trip Data Recording**

The DataCORDER will record the initiation of a Pre-trip test (refer to paragraph 3.6) and the results of each test included in Pre-trip. The data is time-stamped and may be extracted via the Data Retrieval program. Refer to Table 3–9 for a description of the data stored in the DataCORDER for each corresponding Pre-trip test.

**3.7.10 DataCORDER Communications**

Data retrieval from the DataCORDER can be accomplished by using the DataLINE, DataBANK Card, or a communications interface module.

**NOTE**

A DataLINE or a communications interface module display of Communication Failed is caused by faulty data transfer between the DataCORDER and the data retrieval device. Common causes include:

1. Bad cable or connection between DataCORDER and data retrieval device.
2. PC communication port(s) unavailable or misassigned.

### a. DataLINE

The DataLINE software for a personal computer is supplied on CD. This software allows interrogation, configuration variable assignment, screen view of the data, hard copy report generation, cold treatment probe calibration and file management. Refer to Data Retrieval manual 62-10629 for a more detailed explanation of the DataLINE interrogation software. The DataLINE manual may be found on the internet at [www.container.carrier.com](http://www.container.carrier.com).

### b. DataBANK™ Card

The DataBANK™ card is a PCMCIA card that interfaces with the controller through the programming slot and can download data at a fast rate. Files downloaded to DataBANK card files are accessible through an Omni PC Card Drive. The files can then be viewed using the DataLINE software.

### c. Communications Interface Module

The communications interface module is a slave module, which allows communication with a master central monitoring station. The module will respond to communication and return information over the main power line.

With a communications interface module installed, all functions and selectable features that are accessible at the unit may be performed at the master station. Retrieval of all DataCORDER reports may also be performed. Refer to the master system technical manual for further information.

### 3.7.11 USDA Cold Treatment

Sustained cold temperature has been employed as an effective postharvest method for the control of Mediterranean and certain other tropical fruit flies. Exposing infested fruit to temperatures of 2.2°C (36°F) or below for specific periods results in the mortality of the various stages of this group of insects.

In response to the demand to replace fumigation with this environmentally sound process, Carrier has integrated Cold Treatment capability into its microprocessor system. These units have the ability to maintain supply air temperature within one quarter degree Celsius of set point and record minute changes in product temperature within the DataCORDER memory, thus meeting USDA criteria. Information on USDA is provided in the following sub-paragraphs.

#### a. USDA Recording

A special type of recording is used for USDA cold treatment purposes. Cold treatment recording requires three remote temperature probes be placed at prescribed locations in the cargo. Provision is made to connect these probes to the DataCORDER via receptacles located at the rear left-hand side of the unit. Four or five receptacles are provided. The four 3-pin receptacles are for the probes. The 5-pin receptacle is the rear connection for the Interrogator. The probe receptacles are sized to accept plugs with tritam coupling locking devices. A label on the back panel of the unit shows which receptacle is used for each probe.

The standard DataCORDER report displays the supply and return air temperatures. The cold treatment report displays USDA #1, #2, #3 and the supply and return air temperatures. Cold treatment recording is backed up by a battery so recording can continue if AC power is lost.

#### b. USDA/ Message Trip Comment

A special feature in DataLINE allows the user to enter a USDA (or other) message in the header of a data report. The maximum message length is 78 characters. Only one message will be recorded per day.

### 3.7.12 USDA Cold Treatment Procedure

The following is a summary of the steps required to initiate a USDA Cold Treatment:

- a. Calibrate the three USDA probes by ice bathing the probes and performing the calibration function with the DataLINE. This calibration procedure determines the probe offsets and stores them in the controller for use in generating the cold treatment report. Refer to the Data Retrieval manual 62-10629 for more details.
- b. Pre-cool the container to the treatment temperature or below.
- c. Install the DataCORDER module battery pack (if not already installed).
- d. Place the three probes. The probes are placed into the pulp of the product (at the locations defined in the following table) as the product is loaded.

Sensor 1	Place in pulp of the product located next to the return air intake.
Sensor 2	Place in pulp of the product five feet from the end of the load for 40 foot containers, or three feet from the end of the load for 20 foot containers. This probe should be placed in a center carton at one-half the height of the load.
Sensor 3	Place in pulp of product five feet from the end of the load for 40 foot containers or three feet from the end of the load for 20 foot containers. This probe should be placed in a carton at a side wall at one-half the height of the load.

- e. To initiate USDA recording, connect the personal computer and perform the configuration as follows, using the DataLINE software:
  1. Enter ISO header information.
  2. Enter a trip comment if desired.
  3. Configure the DataCORDER for five probes (s, r, P1, P2, P3) (dcf02=5).
  4. Configure the logging interval for one hour.
  5. Set the sensor configuration to "USDA."
  6. Configure for two byte memory storage format (dcf04=LONG).
  7. Perform a "trip start."

### 3.7.13 DataCORDER Alarms

The alarm display is an independent DataCORDER function. If an operating parameter is outside of the expected range or a component does not return the correct values to the DataCORDER, an alarm is generated. The DataCORDER contains a buffer of up to eight alarms. A listing of the DataCORDER alarms is provided in Table 3-10, page 3-42. Refer to paragraph 3.7.7 for configuration information.

To display alarm codes:

- a. While in the Default Display mode, press the ALT. MODE & ALARM LIST keys. This accesses the DataCORDER Alarm List Display Mode, which displays any alarms stored in the alarm queue.
- b. To scroll to the end of the alarm list, press the UP ARROW. Depressing the DOWN ARROW key will scroll the list backward.
- c. The left display will show "AL#" where # is the alarms number in the queue. The right display will show "AA##," if the alarm is active, where ## is the alarm number. "IA##," will show if the alarm is inactive
- d. "END" is displayed to indicate the end of the alarm list if any alarms are active. "CLEAR" is displayed if all the alarms in the list are inactive.
- e. If no alarms are active, the alarm queue may be cleared. The exception to this rule is the DataCORDER alarm queue Full alarm (AL91), which does not have to be inactive in order to clear the alarm list. To clear the alarm list:
  1. Press the ALT. MODE & ALARM LIST keys.
  2. Press the UP/DOWN ARROW key until "CLEAR" is displayed.
  3. Press the ENTER key. The alarm list will clear and "-----" will be displayed.

4. Press the ALARM LIST key. "AL" will show on the left display and "-----" on the right display when there are no alarms in the list.

5. Upon clearing of the alarm queue, the alarm light will be turned off.

### 3.7.14 ISO Trip Header

DataLINE provides the user with an interface to view/modify current settings of the ISO trip header through the ISO Trip Header screen.

The ISO Trip Header screen is displayed when the user clicks on the "ISO Trip Header" button in the "Trip Functions" Group Box on the System Tools screen.

F9 function - Provides the user with a shortcut for manually triggering the refresh operation. Before sending modified parameter values, the user must ensure that a successful connection is established with the controller.

If the connection is established with the DataCORDER, the current contents of the ISO Trip Header from the DataCORDER will be displayed in each field. If the connection is not established with the DataCORDER, all fields on the screen will be displayed as "Xs." If at any time during the display of the ISO Trip Header screen the connection is not established or is lost, the user is alerted to the status of the connection.

After modifying the values and ensuring a successful connection has been made with the DataCORDER, click on the "Send" button to send the modified parameter values.

The maximum allowed length of the ISO Trip Header is 128 characters. If the user tries to refresh the screen or close the utility without sending the changes made on the screen to the DataCORDER, the user is alerted with a message.

### 3.8 CONTROLLER CONFIGURATION VARIABLES

**Table 3–4 Controller Configuration Variables**

CONFIGURATION NUMBER	TITLE	SETTING
CnF02	Evaporator Fan Speed	dS (Dual)
CnF03	Control Temperature Sensors	FOUr
CnF04	Enable Dehumidification	On
CnF08	Evaporator Motor Type	3Ph
CnF09	Refrigerant Type	r134a
CnF11	Defrost “Off” Selection	noOFF
CnF15	Enable Discharge Temperature Sensor	Out
CnF16	Enable DataCORDEr	On (Yes)
CnF17	Enable Discharge Pressure Transducer	In (Yes)
CnF18	Heater Type	nEW (High Watt)
CnF20	Enable Suction Pressure Transduce	In (Yes)
CnF23	Enable Defrost Interval Save	SAv
CnF24	Enable Long Pre-trip Test Series	Auto
CnF25	Enable Pre-trip Data Recording	rSLtS
CnF26	Heat Lockout Temperature	-10C
CnF27	Enable Suction Temperature Sensor	In
CnF28	Enable Bulb Mode	NOr
CnF31	Probe Check	Std
CnF32	Enable Single Evaporator Fan Option	(Not Allowed)
CnF33	Enable Snap Freeze	OFF
CnF34	Temperature Unit Display	bOth
CnF41	Enable Low DTT Setting	Out
CnF44	Autoslide Enable	Out
CnF45	Low Humidity Enabled	Out
CnF46	Quench/Liquid Injection Valve Type	nC=1=nc
CnF47	Vent Position	UP
CnF49	OEM Reset Option	OFF
CnF51	Timed Defrost Disable	0-out
CnF55	TXV Boost Relay	0-out
CnF56	TXV Boost Circuit	0-out
CnF57	PWM Compressor Control	0-out
CnF59	Electronic Evaporator Expansion Valve	2-KE
CnF61	ACT ASC Control Enable	0-out
CnF62	Extended Temperature Control Enable	0-out
CnF63	CCPC Pre-trip/Tripstart Default State	1-off
CnF66	High Speed Evaporator Fan Option	0-off
CnF67	Air Heaters	0-out

**Note:** Configuration numbers not listed are not used in this application. These items may appear when loading configuration software to the controller but changes will not be recognized by the controller programming.

### 3.9 CONTROLLER FUNCTION CODES

Table 3-5 Controller Function Codes (Sheet 1 of 6)

Code No.	TITLE	DESCRIPTION
<b>Note: If the function is not applicable, the display will read “-----”</b>		
<b>Display Only Functions</b> – Cd01 through Cd26 are display only functions.		
<b>Display Only Functions</b>		
Cd01	Digital Unloader Valve Closed (%)	Displays the DUV percent closed. The right display reads 100% when the valve is fully closed. The valve will usually be at 10% on start up of the unit except in very high ambient temperatures.
Cd03	Compressor Motor Current	The current sensor measures current draw in lines L1 & L2 by all of the high voltage components. It also measures current draw in compressor motor leg T3. The compressor leg T3 current is displayed.
Cd04	Line Current, Phase A	The current sensor measures current on two legs. The third unmeasured leg is calculated based on a current algorithm. The current measured is used for control and diagnostic purposes. For control processing, the highest of the Phase A and B current values is used for current limiting purposes. For diagnostic processing, the current draws are used to monitor component energization. Whenever a heater or a motor is turned ON or OFF, the current draw increase/reduction for that activity is measured. The current draw is then tested to determine if it falls within the expected range of values for the component. Failure of this test will result in a Pre-trip failure or a control alarm indication.
Cd05	Line Current, Phase B	
Cd06	Line Current, Phase C	
Cd07	Main Power Voltage	The main supply voltage is displayed.
Cd08	Main Power Frequency	The value of the main power frequency is displayed in Hertz. The frequency displayed will be halved if either fuse F1 or F2 is bad (alarm code AL21).
Cd09	Ambient Temperature	The ambient sensor reading is displayed.
Cd10	Evaporator Temperature Sensor	Evaporator temperature sensor reading is shown on the right display.
Cd11	Compressor Discharge Temperature	Compressor discharge temperature sensor reading, using compressor dome temperature, is displayed.
Cd12	Compressor Suction Pressure	Reading for evaporator pressure transducer (EPT) is shown on the left display; Press ENTER at Cd12 to show reading for compressor suction port pressure on right display.
Cd14	Compressor Discharge Pressure	Compressor discharges pressure transducer reading is displayed.
Cd15	Digital Unloader Valve	The status of the valve is displayed (Open - Closed).
Cd16	Compressor Motor Hour Meter/Unit Run Time Hour Meter	This code displays the compressor motor hours. User can view unit run time by pressing the ENTER key while in Cd16. Total hours are recorded in increments of 10 hours (i.e., 3000 hours is displayed as 300). The Compressor Motor Hour Meter display can be reset to 0 by pressing and holding the ENTER key for 5 seconds. The Unit Run Time Hour Meter cannot be reset.
Cd17	Relative Humidity %	Humidity sensor reading is displayed. This code displays the relative humidity, as a percent value.
Cd18	Software Revision #	The software revision number is displayed.
Cd19	Battery Check	This code checks the Controller/DataCORDER battery pack. While the test is running, “btest” will flash on the right display, followed by the result. “PASS” will be displayed for battery voltages greater than 7.0 volts. “FAIL” will be displayed for battery voltages between 4.5 and 7.0 volts, and “-----” will be displayed for battery voltages less than 4.5 volts. After the result is displayed for four seconds, “btest” will again be displayed, and the user may continue to scroll through the various codes.
Cd20	Config/Model #	This code indicates the dash number of the model for which the Controller is configured (i.e., if the unit is a 69NT40-561-201, the display will show “61201”). To display controller configuration database information, press ENTER. Values in “CFYYMMDD” format are displayed if the controller was configured with a configuration card or with a valid OEM serial port configuration update; YYMMDD represents the publication date of the model configuration database.

**Table 3-5 Controller Function Codes (Sheet 2 of 6)**

Cd21	Capacity Mode	The mode of operation is displayed (Unloaded - Standard - Economized).
Cd22	Compressor State	The status of the compressor is displayed (OFF, On).
Cd23	Evaporator Fan	Displays the current evaporator fan state (OFF, LOW, HIGH).
Cd25	Compressor Run Time Remaining Until Defrost	This code displays the time remaining until the unit goes into defrost (in tenths of an hour). This value is based on the actual accumulated compressor running time.
Cd26	Defrost Temperature Sensor Reading	Defrost temperature sensor reading is displayed.
<b>Configurable Functions</b> – Cd27 through Cd37 are user-selectable functions. The operator can change the value of these functions to meet the operational needs of the container.		
Cd27	Defrost Interval (Hours or Automatic)	<p>This is the desired period of time between defrost cycles. Factory default is 3 hours. Refer to Section 3.3.20 for information on Defrost Interval.</p> <p>CnF11 determines whether the operator will be allowed to chose “OFF” as a defrost interval option.</p> <p>CnF64 determines whether the operator will be allowed to choose “PuLS” as a defrost interval option. For units operating with “PuLS” selected, defrost interval is determined by the unit temperature setpoint and the Evaporator Fan Pulsing Temperature Setting (Cd60). When the unit temperature setpoint is equal to or less than the Evaporator Fan Pulsing Temperature Setting, the defrost interval is set to 6 hours. Otherwise, the defrost interval is determined using the Automatic Defrost Interval Determination logic. In either case, “PuLS” remains displayed in this function select code.</p> <p>After a new Defrost Interval is selected, the previously selected Interval is used until the next defrost termination, the next time the DTT contacts are OPEN, or the next time power to the control is interrupted. If the previous value or the new value is “OFF”, the newly selected value will be used immediately.</p> <p>If any Auto Pretrip sequence is initiated, Cd27 will be set to 'AUTO' unless CnF49 (OEM Reset) is set to “Custom” AND CnF64 (Evaporator Fan Pulsing Logic) configuration variable is set to IN, in which case Cd27 will be set to “PuLS”.</p>
Cd28	Temperature Units (Degrees C or Degrees F)	This code determines the temperature units (C or F) that will be used for all temperature displays. The user selects C or F by selecting function code Cd28 and pushing the ENTER key. The factory default value is Celsius units. This function code will display “-----” if CnF34 is set to F.
Cd29	Failure Action (Mode)	<p>If all of the control sensors are out of range (alarm code AL26) or there is a probe circuit calibration failure (alarm code AL27), the unit will enter the shutdown state defined by this setting. The user selects one of four possible actions as follows:</p> <p>A - Full Cooling (Compressor is on, economized operation.)          b - Partial Cooling (Compressor is on, standard operation.)          C - Evaporator Fan Only (Evaporator fans on high speed, not applicable with frozen set points.)          d - Full System Shutdown - Factory Default (Shut down every component in the unit.)</p>
Cd30	In-Range Tolerance	<p>The in-range tolerance will determine the temperature band around the set point which will be designated as in-range.</p> <p>For normal temperature control, control temperature is considered in range if it is within setpoint in-range Tolerance. There are four possible values:</p> <p>1 = +/- 0.5°C (+/-0.9°F)          2 = +/- 1.0°C (+/-1.8°F)          3 = +/- 1.5°C (+/-2.7°F)          4 = +/- 2.0°C (+/-3.6°F) - Factory Default</p> <p>If the control temperature is in-range, the green IN-RANGE light will be illuminated.</p> <p>In-range tolerance shall be set to +/- 2.0°C upon activation of dehumidification or bulb mode (Cd33, Cd35, Cd48).</p> <p>When CCPC is actively controlling, in-range tolerance is not considered.</p> <p>“-----” will be displayed whenever Dehumidification is enabled or when CCPC with six hour re-activation is actively controlling.</p> <p>“-----” will be displayed whenever Frozen Economy Mode is operating.</p>

**Table 3–5 Controller Function Codes (Sheet 3 of 6)**

Cd31	Stagger Start Offset Time (Seconds)	The stagger start offset time is the amount of time that the unit will delay at start-up, thus allowing multiple units to stagger their control initiation when all units are powered up together. The eight possible offset values are 0 (Factory Default), 3, 6, 9, 12, 15, 18 or 21 seconds.
Cd32	Current Limit (Amperes)	The current limit is the maximum current draw allowed on any phase at any time. Limiting the unit's current reduces the load on the main power supply. When desirable, the limit can be lowered. Note, however, that capacity is also reduced. The five values for 460 VAC operation are: 15, 17, 19, 21, or 23 amperes. The factory default setting is 21 amperes.
Cd33	Humidity Setpoint	This is the value in percent to which the system will dehumidify. In the test mode, the setpoint will be temporarily set to 1%, allowing the test of dehumidification. After 5 minutes, the normal setpoint is restored. If Pretrip is initiated, this value will be set to "OFF" automatically.
Cd34	Economy Mode (On-Off)	The current state of the economy mode option, "----", On, or Off. CnF22 determines whether economy mode offered. Economy mode is a user selectable mode of operation provided for power saving purposes.
Cd35	(NOT USED)	----
Cd36	(NOT USED)	----
Cd37	(NOT USED)	----
<b>Display Only Functions</b> – Cd38 through Cd40 are display only functions.		
Cd38	Secondary Supply Temperature Sensor	Cd38 will display the current supply recorder sensor (SRS) reading for units configured for four probes. If the unit is configured with a DataCORDER, Cd38 will display "----." If the DataCORDER suffers a failure, (AL55) Cd38 will display the supply recorder sensor reading.
Cd39	Secondary Return Temperature Sensor	Cd39 will display the current return recorder sensor (RRS) reading for units configured for four probes. If the unit is configured with a DataCORDER, Cd39 will display "----." If the DataCORDER suffers a failure, (AL55) Cd39 will display the return recorder sensor reading.
Cd40	Container Identification Number	If a valid container id exists, the default display for Cd40 will be "cd40_XXXXX" where "XXXXX" is the 5th character through the 9th character of the container id. Pressing the Enter key on Cd40 will display "id_YYYYYYY" where "YYYYYYY" is the 5th character to the 11th character of the container id.  If no valid container id exists or the container id is blank, the default display will have Cd40 on the left display and the right display will alternate between "_nEEd" and "___id". Pressing the enter key while on Cd40 in the state will prompt the Set Id Interface.  On start up if the container id is not valid, Cd40 will be brought up on the display for the first minute of power up. This can be left by either entering a container id or leaving the code select normally.  Cd40 is configured at commissioning to read a valid container identification number. The reading will not display alpha characters; only the numeric portion of the number will display.
Cd41	Valve Override	<b>SERVICE FUNCTION:</b> This code is used for troubleshooting, and allows manual positioning of the economizer solenoid valve, electronic expansion valve, and digital unloader valve. Provides readings such as: Percent Capacity, EEV, Capacity Mode, LIV and DUV. Refer to paragraph 6.20 for operating instructions.
<b>Configurable Functions</b> – Cd43 is a user-selectable function. The operator can change the value of this function to meet the operational needs of the container.		
Cd43	(NOT USED)	----

**Table 3-5 Controller Function Codes (Sheet 4 of 6)**

<b>Display Only Function</b> – Cd44 is a display only function.		
Cd44	(NOT USED)	----
<b>Configurable Functions</b> – Cd45 through Cd48 are user-selectable functions. The operator can change the value of these functions to meet the operational needs of the container.		
Cd45	(NOT USED)	
Cd46	Airflow Display Units	<p>Selects the airflow units to be displayed by Cd45 if configured for Vent Position Sensor or displayed by “USER/FLO” under Cd43 if configured for Autoslide.</p> <p>CF= Cubic Feet per Minute                      CM=Cubic Meters per Hour</p> <p>bOth=Displays CF or CM depending on the setting of Cd28 (Metric/Imperial) or the pressing of the degree C/F key.</p>
Cd47	Variable Economy Temperature Setting	<p>Used when Economy Mode (CnF22) is set to 3–cust. Display will show “----” when the unit is not configured for Economy Mode.</p> <p>When the unit has a perishable setpoint and Economy Mode is active, at the start of each cooling or heating cycle, high speed evaporator fans will run for 3 minutes. After three minutes, the evaporator fans will be switched to low speed any time that the supply temperature is within +/- 0.25°C of the setpoint and the return temperature is less than or equal to the supply temperature + the user selected Cd47 (values are 0.5 °C – 4.0° C, default is 3.0 °C).</p>
Cd48	(NOT USED)	----
<b>Display Only Function</b> – Cd49 is a display only function.		
Cd49	Days Since Last Successful Pre-trip	<p>Displays the number of days since last successful pretrip sequence.</p> <p>Press ENTER to view the number of days since the last successful pretrip for Auto1, Auto2, and Auto2 in sequence.</p> <p>Press CODE SELECT to step back through the list and ultimately to exit the Cd49 display.</p>
<b>Configurable Functions</b> – Cd50 through Cd53 are user-selectable functions. The operator can change the value of these functions to meet the operational needs of the container.		
Cd50	(NOT USED)	----
Cd51	(NOT USED)	----

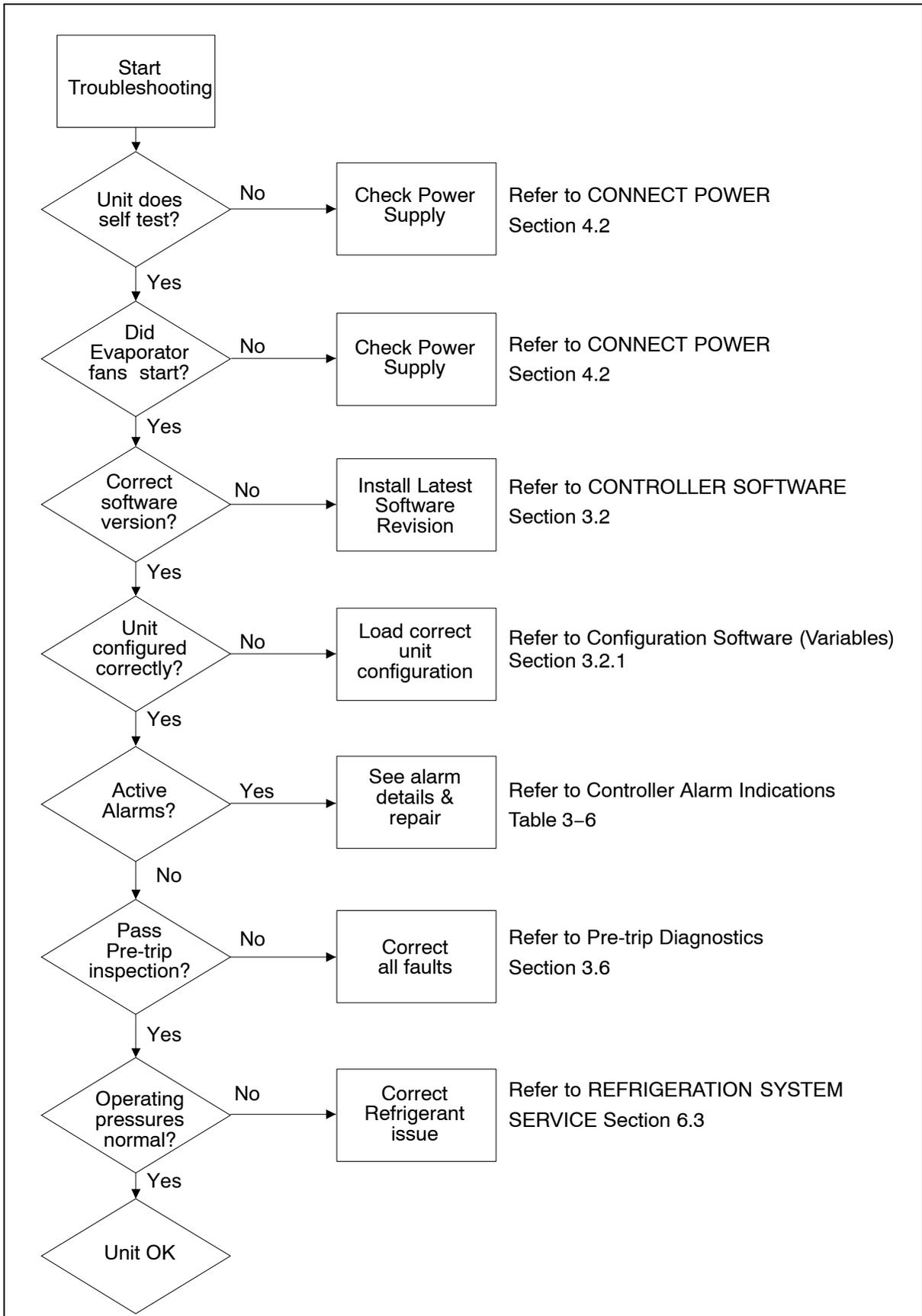
**Table 3-5 Controller Function Codes (Sheet 5 of 6)**

Cd53	Automatic Set point Change Mode Parameter Selection	<p>ASC-mode: Cd53 increments of (1 day)_(1hr), Display: default "0_0 " "done" mm-dd this will be display is ASC has completed "ASC" value "On" "OFF" Display /Select: default "OFF" "nSC" value "1 - 6" (This is the value "n" for the subsequent entries). "SP (n-1)" value °C / °F on 0.1 degree increments Display/Select: default "10.0°C" "DAY (n-1)" value "1 – 99" increments of 1 Display/Select: default "1" "SP (n)" value °C / °F on 0.1 degree increments Display/Select: default "10.0°C" Initially Cd53 will display current count down timer increments of (1 day)_(1hr), default "0_0" Pressing ENTER key will take the interface down into a hierarchy of parameter selection menus, (mode, act, treat, days, probe and spnew setting). Pressing ENTER key in any of the parameter selection menu selects the currently displayed parameter and causes the interface to descend into the next parameter selection menu. All parameter selection menus alternate between a blank display and the current selection in the right hand display. Pressing CODE SELECT key in a selection menu cancels the current selection activity and ascends back up to the next higher selection menu (or to Cd53 display mode if that is the next higher). If the operator does not press any key for five seconds the interface reverts to normal system display and the current selection menu is cancelled, but any previously committed changes are retained. Available parameters and parameter ranges are a function of configuration options and previously selected parameters as indicated above. Parameter with the exception of "ASC" may not be altered if Cd53 is re-entered if "ASC" is "On". When ASC has completed including reaching the last setpoint "done" on the left display and the MONTH DAY of completion on the right display will be displayed as the second entry in the menu. Turning ASC off clears this entry. This action also resets Cd53 to initial time remaining. ASC must then be turned on to view or modify the additional parameters. Whenever any auto pretrip test or Trip Start is initiated, ASC mode goes to OFF.</p>
<b>Display Only Functions</b> – Cd54 through Cd58 are display only functions.		
Cd54	Suction Port Superheat / Electronic Expansion Valve Status	<p>Reading for evaporator superheat (<i>suction temperature minus suction saturation temperature as calculated from suction pressure</i>) is shown on the right display. Press ENTER at Cd54 to show reading for EEV position (in %) on left display.</p>
Cd55	Discharge Super- heat	<p>Cd55 will display discharge superheat (<i>discharge temperature minus discharge saturation temperature as calculated from discharge pressure</i>) values in C /F as calculated by the discharge temperature minus the discharge saturation temperature as calculated from discharge pressure. "-----" will be displayed if selection is not valid.</p>
Cd58	(NOT USED)	----

**Table 3-5 Controller Function Codes (Sheet 6 of 6)**

**Configurable Functions** – Cd59 through Cd61 are user-selectable functions. The operator can change the value of these functions to meet the operational needs of the container.

Cd59	Pump Down Logic	<p>Cd59 allows operation of the pump down logic control. The display will flash between “STArT PdN” and “PrESS EnTEr”.</p> <p>Upon entering Cd59 the operator will be required to acknowledge that they <i>want</i> to initiate the pump down control. The display will flash between “STArT P dN” and “PrESS EnTEr”. Once the decision to continue is confirmed pump down logic will begin, and will take complete control of the unit until pump down either succeeds or fails. This operation can not be halted once it begins without power cycling the unit.</p> <p>After pump down logic has been initiated, the operator will be notified to close the Liquid Line Valve, the display will flash between “CLOSE LLV” and “PrESS EnTEr”. Once complete the display will read “P dN” to the left, and the current suction pressure to the right.</p> <p>If the automatic pump down logic succeeds within 20 minutes, the unit will turn itself off, and the display will notify the operator that pump down is complete by flashing between “P dN DOnE” and “SHUT OFF”. The operator must then shut off the unit.</p> <p>If the automatic pump down logic does not complete within 20 minutes, the unit will drop out of Cd59 and return to its previous control condition.</p>
Cd60	(NOT USED)	----
Cd61	(NOT USED)	----



**Figure 3-12 Alarm Troubleshooting Sequence**

### 3.10 CONTROLLER ALARM INDICATIONS

Table 3-6 Controller Alarm Indications (Sheet 1 of 8)

Alarm Code	Cause	Components	Troubleshooting	Corrective Actions
<b>AL03</b> Loss of Superheat Control	Superheat has remained below 1.66°C (3°F) degrees for five minutes continuously while compressor running. Compressor drawing more than 2.0 amps, compressor pressure ratio is greater than 1.8, and Electronic Expansion Valve (EEV) is at 0% open.	Electronic Expansion Valve (EEV)	Check the operation of the EEV using Cd41.	Replace EEV if defective.
		Evaporator Temperature Sensor(s) ETS & ETS1.	Verify accuracy of temperature sensors, refer to Sensor Checkout Procedure Section 6.22.	Replace ETS or ETS1 if defective.
		Evaporator Fans	Confirm fans operating properly.	Replace fan(s) if defective, refer to EVAPORATOR FAN MOTOR ASSEMBLY Section 6.14.
<b>AL05</b> Manual Defrost Switch Failure	Controller has detected continuous Manual Defrost Switch activity for five minutes or more.	Keypad	Power cycle the unit.	Resetting the unit may correct problem, monitor the unit. If the alarm reappears after 5 minutes replace the keypad.
<b>AL06</b> Keypad or Keypad Harness Fail	Controller has detected one of the keypad keys is continuously activity.	Keypad or Harness	Power cycle the unit.	Resetting the unit may correct problem, monitor the unit. If the alarm reappears replace the keypad and harness.
<b>AL07</b> Fresh Air Vent Open with Frozen Set Point	The VPS is reading greater than 0 CMH while unit is in frozen mode.	Vent Position Sensor (VPS)	Manually reposition vent and confirm using Cd45. Refer to VENT POSITION SENSOR SERVICE Section 6.23.	If unable to obtain zero reading, replace defective VPS.
<b>AL08</b> High Compressor Pressure Ratio	Controller detects discharge pressure to suction pressure ratio is too high.  The controller will attempt to correct the situation by restarting the compressor.	Discharge Pressure Transducer (DPT)	Confirm accurate DPT pressure readings, refer to MANIFOLD GAUGE SET Section 6.2.	Replace DPT if defective.
<b>AL10</b> (NOT USED)				
<b>AL14</b> Phase Sequence Detect Fault	Controller is unable to determine the correct phase relationship.	N/A	Power cycle the unit.	Resetting the unit may correct problem, monitor the unit.
		Wiring	Check unit wiring. Confirm pressure readings during start-up; suction pressure should decrease and discharge pressure should increase.	Correct wiring.
		Current Sensor	Check Cd41, right most digit:  If display is 3 or 4 check compressor / sensor wiring.  If display is 5 the current sensor is defective.	Replace current sensor if defective.

**Table 3–6 Controller Alarm Indications (Sheet 2 of 8)**

<b>Alarm Code</b>	<b>Cause</b>	<b>Components</b>	<b>Troubleshooting</b>	<b>Corrective Actions</b>
<b>AL16</b> Compressor Current High	Compressor current draw is over the calculated maximum for 10 minutes.	Current Sensor	Compare Cd3 to actual measured current at wire T1-T2 or T3 going to the compressor contactor. If there is a difference, determine whether this is caused by current sensor or amp clamp tool.	Replace current sensor if defective.
		Amperage is indeed too high.	Confirm supply voltage/frequency is within specification and balanced according to Electrical Data Section 2.3.	Correct power supply.
		Operating Conditions	Make sure system pressures are relevant to operating conditions.	Check air flow of condenser. Check Refrigerant charge, refer to REFRIGERATION SYSTEM SERVICE Section 6.3
		Monitor Unit	Alarm is display only the alarm may clear itself during operation	If alarm remains active or is repetitive replace compressor at next available opportunity, refer to COMPRESSOR Service Section 6.8.
<b>AL17</b> Compressor Pressure Delta Fault	Compressor has attempted to start in both directions and fails to generate sufficient pressure differential between SPT and DPT.	N/A	Controller will attempt restart every 20 minutes and deactivate the alarm if successful.	Resume normal operation.
		Discharge Pressure Transducer (DPT)	Confirm accurate DPT pressure readings, refer to MANIFOLD GAUGE SET Section 6.2.	Replace DPT if defective.
		Suction Pressure Transducer (SPT)	Confirm accurate SPT pressure readings, refer to MANIFOLD GAUGE SET Section 6.2.	Replace SPT if defective.
		Monitor unit	Alarm is display only the alarm may clear itself during operation.	If alarm remains active or is repetitive replace compressor at next available opportunity.

**Table 3–6 Controller Alarm Indications (Sheet 3 of 8)**

<b>Alarm Code</b>	<b>Cause</b>	<b>Components</b>	<b>Troubleshooting</b>	<b>Corrective Actions</b>
<b>AL18</b> Discharge Pressure High	Discharge pressure is over the maximum for 10 minutes within the last hour.	Restrictions in the refrigeration system.	Ensure Liquid Line Service Valve is fully open.	Open Liquid Line Service Valve as needed.
		Filter Drier	Check the filter drier, if it is iced up or very cold it indicates that the filter drier needs replacement.	Replace the filter drier if needed, refer to FILTER DRIER Service Section 6.12.
		Condenser Fan	Check Condenser Fan for proper operation.	Correct as required.
		Discharge Pressure Transducer (DPT)	Confirm accurate DPT pressure readings, refer to MANIFOLD GAUGE SET Section 6.2.	Replace DPT if defective.
		Non-condensables in the refrigeration system.	With the unit off allow system to stabilize to ambient temperature. Check system pressure against PT Chart for 134a, refer to Table 6–4.	Correct as required, refer to Refrigerant Charge Section 6.7.1.
		Refrigerant	Check refrigerant level.	Correct as required, refer to Refrigerant Charge Section 6.7.1.
<b>AL19</b> Discharge Temperature High	Discharge temperature exceeds 135°C (275°F) for 10 minutes within the last hour.	Restrictions in the refrigeration system.	Ensure the Discharge Service Valve is fully open.	Open the Discharge Service Valve as needed.
			Check the unit for air flow restrictions.	Clean or remove any debris from coils.
		Non-condensables in the refrigeration system.	With the unit off allow system to stabilize to ambient temperature. Check system pressure against PT Chart for 134a, refer to Table 6–4.	Correct as required, refer to Refrigerant Charge Section 6.7.1.
		Additional Alarms such as AL16, AL24.	Check compressor operation.	If the alarm persists, it may indicate a failing compressor, replace the compressor, refer to COMPRESSOR Service Section 6.8.
<b>AL20</b> Control Contactor Fuse (F3)	Control power fuse (F3A or F3B) is open.	Check F3A, if the fuse is open:	Check PA, PB, CH coils for short to ground, if short is found:	Replace the defective coil. Replace the fuse.
		Check F3B, if the fuse is open:	Check ESV coil resistance at TP7 to TP9, if short to ground, or if resistance is less than 4 ohms, coil is defective. Check CF, ES, EF, HR coils for short to ground, if short is found, coil is defective.	Replace the defective coil. Replace the fuse.
		Check Voltage at QC1:	If voltage is present, it indicates a defective microprocessor.	Refer to Controller Service Section 6.21.

**Table 3–6 Controller Alarm Indications (Sheet 4 of 8)**

<b>Alarm Code</b>	<b>Cause</b>	<b>Components</b>	<b>Troubleshooting</b>	<b>Corrective Actions</b>
<b>AL21</b> Control Circuit Fuse (F1/F2)	One of the 18 VAC controller fuses (F1/F2) is open. Refer to Cd08.	System Sensors	Check system sensors for short to ground.	Replace defective sensor(s)
		Wiring	Check wiring for short to ground.	Repair as needed.
		Controller	Controller may have an internal short.	Replace controller, refer to Controller Service Section 6.21.
<b>AL22</b> Evaporator IP	Evaporator motor internal protector (IP) is open.	Evaporator Motor	Shut down unit, disconnect power, & check Evaporator Motor IP at plug connection pins 4 & 6.	Replace defective evaporator fan motor, refer to EVAPORATOR FAN MOTOR Service Section 6.14.
<b>AL23</b> Loss of Phase B	Controller fails to detect current draw.	Incoming Power	Check incoming power source.	Correct power source as required.
<b>AL24</b> Compressor IP	Compressor internal protector (IP) is open.	Compressor	Shut down unit disconnect power, & check resistance of compressor windings at contactor T1-T2, T2-T3.	Monitor unit, if alarm remains active or is repetitive replace the compressor at the next available opportunity, refer to COMPRESSOR Service Section 6.8.
<b>AL25</b> Condenser IP	Condenser fan motor internal protector (IP) is open.	Insufficient Air Flow	Shut down unit and check condenser fan for obstructions.	Remove obstructions.
		Condenser Fan Motor	Shut down unit, disconnect power, & check Condenser Fan Motor IP at plug connection pins 1 & 2.	Replace defective condenser fan motor, refer to Condenser Fan Motor Assembly Service Section 6.11.
<b>AL26</b> All Sensors Failure: Supply/Return Probes	Sensors out of range.	All sensors. detected as out of range	Perform Pre-trip P5:	If P5 passes, no further action is required.
				If P5 fails, replace the defective sensor as determined by P5, refer to TEMPERATURE SENSOR Service Section 6.22.
<b>AL27</b> Analog to Digital Accuracy Failure	Controller AD converter faulty.	Controller	Power cycle the unit. If the alarm persists, it indicates a defective microprocessor.	Replace defective microprocessor, refer to Controller Service Section 6.21.

**Table 3–6 Controller Alarm Indications (Sheet 5 of 8)**

<b>Alarm Code</b>	<b>Cause</b>	<b>Components</b>	<b>Troubleshooting</b>	<b>Corrective Actions</b>
<b>AL28</b> Low Suction Pressure	Suction pressure too low for normal operation.	N/A	Power cycle the unit.	Resetting the unit may correct problem, monitor the unit.
		Suction Pressure Transducer (SPT)	Confirm accurate SPT pressure readings, refer to MANIFOLD GAUGE SET Section 6.2.	Replace SPT if defective.
		Discharge Pressure Transducer (DPT)	Confirm accurate DPT pressure readings, refer to MANIFOLD GAUGE SET Section 6.2.	Replace DPT if defective.
<b>AL29</b> (NOT USED)				
<b>AL50</b> Air Vent Position Sensor (VPS)	VPS Sensor out of range.	Vent Position Sensor (VPS)	Make sure VPS is secure.	Manually tighten panel.
			If the alarm persists, replace the sensor or the assembly.	Replace VPS.
<b>AL51</b> EEPROM Failure	Controller Memory Failure	Controller	Pressing the ENTER key when “CLEAR” is displayed will result in an attempt to clear the alarm.	If action is successful (all alarms are inactive), alarm 51 will be reset.
			Power cycle the unit. If the alarm persists, it indicates defective controller memory.	Replace defective controller, refer to Controller Service Section 6.21
<b>AL52</b> EEPROM Alarm List Full	Alarm list queue is full.	Active Alarms	Repair any alarms in the queue that are active. Indicated by “AA”.	Clear alarms, refer to CONTROLLER ALARMS Section 3.5.
<b>AL53</b> Battery Pack Failure	Battery voltage low	Battery	If this alarm occurs on start up, allow a unit fitted with rechargeable batteries to operate for up to 24 hours to charge rechargeable batteries sufficiently. Once fully charged, the alarm will deactivate.	To clear the alarm press ENTER and ALT simultaneously at the startup of Cd19 (Battery Check).  If alarm persists, replace the battery pack, refer to Section 6.21.5 Battery Replacement.
<b>AL54</b> Primary Supply Sensor (STS)	Invalid Supply Temperature Sensor (STS) reading.	Supply Temperature Sensor (STS)	Perform Pre-trip P5:	If P5 passes, no further action is required.
				If P5 fails, replace the defective sensor as determined by P5, refer to TEMPERATURE SENSOR Service Section 6.22.

**Table 3–6 Controller Alarm Indications (Sheet 6 of 8)**

<b>Alarm Code</b>	<b>Cause</b>	<b>Components</b>	<b>Troubleshooting</b>	<b>Corrective Actions</b>
<b>AL56</b> Primary Return Sensor (RTS)	Invalid Return Temperature Sensor (RTS) reading.	Return Temperature Sensor (RTS)	Perform Pre-trip P5:	If P5 passes, no further action is required.
				If P5 fails, replace the defective sensor as determined by P5, refer to TEMPERATURE SENSOR Service Section 6.22.
<b>AL57</b> Ambient Sensor (AMBS)	Invalid Ambient Temperature Sensor (AMBS) reading.	Ambient Temperature Sensor (AMBS)	Test the AMBS, refer to Sensor Checkout Procedure Section 6.22.1.	Replace AMBS if defective, refer to TEMPERATURE SENSOR Service Section 6.22.2.
<b>AL58</b> Compressor High Pressure Safety (HPS)	High pressure safety switch remains open for at least one minute.	High Pressure Switch (HPS)	Test the HPS; refer to Checking High Pressure Switch, Section 6.9.1.	Replace HPS if defective, refer to Sensor Replacement, Section 6.22.2.
		Refrigeration System	Check unit for air flow restrictions.	Clean or remove any debris from coils.
<b>AL59</b> Heater Termination Thermostat (HTT)	Heat Termination Thermostat (HTT) is open.	Heat Termination Thermostat (HTT)	Check for 24 volts at test point TP10, if no voltage at TP10 after unit has reached set point HTT is open.	Replace HTT if defective, refer to Sensor Replacement Section 6.22.2.
<b>AL60</b> Defrost Temperature Sensor (DTS)	Failure of the Defrost Temperature Sensor (DTS) to open.	Defrost Temperature Sensor (DTS)	Test the DTS; refer to Sensor Checkout Procedure Section 6.22.1.	Replace the DTS if defective, refer to Sensor Replacement Section 6.22.2.
<b>AL61</b> Heater Current Draw Fault	Improper current draw during heat or defrost mode.	Heater(s)	While in heat or defrost mode, check for proper current draw at heater contactors, refer to ELECTRICAL DATA Section 2.3.	Replace heater(s) if defective, refer to section 6.13.2 Evaporator Heater Removal and Replacement.
		Contactor	Check voltage at heater contactor on the heater side. If no voltage present:	Replace heater contactor if defective.
<b>AL63</b> Current Limit	Unit operating above current limit.	Refrigeration System	Check unit for air flow restrictions.	Clean or remove any debris from coils.
			Check unit for proper operation.	Repair as needed.
		Power supply	Confirm supply voltage/frequency is within specification and balanced according to ELECTRICAL DATA Section 2.3.	Correct power supply.
		Current limit set too low.	Check current limit setting Code Cd32.	The current limit can be raised (maximum of 23 amps) using Cd32.
<b>AL64</b> Discharge Temperature Sensor (CPDS)	Discharge Temperature sensor out of range.	Discharge temperature sensor (CPDS).	Test the CPDS; refer to Sensor Checkout Procedure, Section 6.22.1.	Replace the CPDS if defective, refer to Sensor Replacement Section 6.22.2.

**Table 3–6 Controller Alarm Indications (Sheet 7 of 8)**

<b>Alarm Code</b>	<b>Cause</b>	<b>Components</b>	<b>Troubleshooting</b>	<b>Corrective Actions</b>
<b>AL65</b> Discharge Pressure Transducer (DPT)	Compressor Discharge Transducer is out of range.	Compressor Discharge Transducer (DPT)	Confirm accurate DPT pressure readings, refer to MANIFOLD GAUGE SET Section 6.2.	Replace DPT if defective.
<b>AL66</b> (SPT) Suction Pressure Transducer, (EPT) Evaporator Pressure Transducer	Suction Pressure Transducer (SPT) out of range.	Suction Pressure Transducer (SPT)	Confirm accurate EPT and SPT pressure readings, refer to MANIFOLD GAUGE SET Section 6.2.  - <i>Performing a Pre-trip 5-9 test will also check the transducers.</i>	Replace EPT/SPT if defective.
			Monitor	If the alarm persists, it may indicate a failing compressor, refer to COMPRESSOR Service Section 6.8.
<b>AL67</b> Humidity Sensor	Humidity Sensor (HS) reading out of range.	Humidity Sensor (HS)	Make sure the humidity sensor is properly connected in the socket.  Make sure the humidity sensor wires have not been damaged.	Monitor, replace HS if alarm persists.
<b>AL69</b> Evaporator Temp Sensor (ETS1)	Evaporator Temperature Sensor (ETS1) out of range.	Evaporator Temperature Sensor (ETS1)	Test the ETS1, refer to Sensor Checkout Procedure Section 6.13.2.	Replace Evaporator Temperature Sensor (ETS1) if defective.
<b>AL70</b> Secondary Supply Sensor (SRS)	Secondary Supply Sensor (SRS) is out of range.	Secondary Supply Sensor (SRS)	Perform Pre-trip P5:	If P5 passes, no further action is required.
				If P5 fails, replace the defective sensor as determined by P5, refer to TEMPERATURE SENSOR Service Section 6.22.
<b>AL71</b> Secondary Return Sensor (RRS)	Secondary Return Sensor (RRS) is out of range.	Secondary Return Sensor (RRS)	Perform Pre-trip P5:	If P5 passes, no further action is required.
				If P5 fails, replace the defective sensor as determined by P5, refer to TEMPERATURE SENSOR Service Section 6.22.
<b>AL72</b> Control Temp Out of Range	After the unit goes in-range for 30 minutes then out of range for a continuous 120 minutes.	Refrigeration System	Ensure unit is operating correctly.	Power cycle unit. Control Temperature is in In-range. Any Pre-trip mode, resets the timers.

**Table 3–6 Controller Alarm Indications (Sheet 8 of 8)**

<b>NOTE</b>																								
<p>If the controller is configured for four probes without a DataCORDER, the DataCORDER alarms AL70 and AL71 will be processed as Controller alarms AL70 and AL71. Refer to Table 3–10, page 3–42.</p>																								
<b>ERR #</b>	Internal Microprocessor Failure	<p>The controller performs self-check routines. If an internal failure occurs, an “ERR” alarm will appear on the display. This is an indication the controller needs to be replaced.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">ERROR</th> <th style="text-align: left;">DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>ERR 0-RAM failure</td> <td>Indicates that the controller working memory has failed.</td> </tr> <tr> <td>ERR 1-Program Memory failure</td> <td>Indicates a problem with the controller program.</td> </tr> <tr> <td>ERR 2-Watchdog time-out</td> <td>The controller program has entered a mode whereby the controller program has stopped executing.</td> </tr> <tr> <td>ERR 3-N/A</td> <td>N/A</td> </tr> <tr> <td>ERR 4-N/A</td> <td>N/A</td> </tr> <tr> <td>ERR 5-A-D failure</td> <td>The controller’s Analog to Digital (A-D) converter has failed.</td> </tr> <tr> <td>ERR 6-IO Board failure</td> <td>Internal program/update failure.</td> </tr> <tr> <td>ERR 7-Controller failure</td> <td>Internal version/firmware incompatible.</td> </tr> <tr> <td>ERR 8-DataCORDER failure</td> <td>Internal DataCORDER memory failure.</td> </tr> <tr> <td>ERR 9-Controller failure</td> <td>Internal controller memory failure.</td> </tr> </tbody> </table> <p>In the event that a failure occurs and the display cannot be updated, the status LED will indicate the appropriate ERR code using Morse code as shown below.</p> <p style="text-align: center;">E R R 0 to 9</p> <p>ERR0 = . . . . . ----</p> <p>ERR1 = . . . . . .----</p> <p>ERR2 = . . . . . ..---</p> <p>ERR3 = . . . . . ...--</p> <p>ERR4 = . . . . . ....-</p> <p>ERR5 = . . . . . .....-</p> <p>ERR6 = . . . . . .....</p> <p>ERR7 = . . . . . ---...</p> <p>ERR8 = . . . . . ----.</p> <p>ERR9 = . . . . . -----.</p>	ERROR	DESCRIPTION	ERR 0-RAM failure	Indicates that the controller working memory has failed.	ERR 1-Program Memory failure	Indicates a problem with the controller program.	ERR 2-Watchdog time-out	The controller program has entered a mode whereby the controller program has stopped executing.	ERR 3-N/A	N/A	ERR 4-N/A	N/A	ERR 5-A-D failure	The controller’s Analog to Digital (A-D) converter has failed.	ERR 6-IO Board failure	Internal program/update failure.	ERR 7-Controller failure	Internal version/firmware incompatible.	ERR 8-DataCORDER failure	Internal DataCORDER memory failure.	ERR 9-Controller failure	Internal controller memory failure.
		ERROR	DESCRIPTION																					
		ERR 0-RAM failure	Indicates that the controller working memory has failed.																					
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		ERR 8-DataCORDER failure	Internal DataCORDER memory failure.																					
		ERR 9-Controller failure	Internal controller memory failure.																					
<b>Entr StPt</b>	Enter Set point (Press Arrow & Enter)	The controller is prompting the operator to enter a set point.																						
<b>LO</b>	Low Main Voltage (Function Codes Cd27-38 disabled and NO alarm stored.)	This message will be alternately displayed with the set point whenever the supply voltage is less than 75% of its proper value.																						

### 3.11 CONTROLLER PRE-TRIP TEST CODES

Table 3-7 Controller Pre-trip Test Codes (Sheet 1 of 6)

<b>NOTE</b>		
<p>“Auto” or “Auto1” menu includes the: P0, P1, P2, P3, P4, P5, P6 and rSLts. “Auto2” menu includes P0, P1, P2, P3, P4, P5, P6, P7, P8, P9, P10 and rSLts. “Auto3” menu includes P0, P1, P2, P3, P4, P5, P6, P7 and P8.</p>		
P0-0	Pre-Trip Initiated: Configuration Display, Indicator Lamps, LEDs, and Displays	<p>Container identifier code, Cd18 Software Revision Number, Cd20 Container Unit Model Number, &amp; configuration database identifier CFMMYYDD are displayed in sequence.</p> <p>Next the unit will indicate the presence or non-presence of an RMU according to whether any RMU inquiry messages have been received since the unit was booted.</p> <p>Units equipped with Autoslide Enabled (Cnf44) will cause the vent to seek to its closed position, followed by two sequences of opening to 100% and returning to the closed position. No other autoslide mode of operation will be available until the two cycles of opening and closing have completed.</p> <p>Since the system cannot recognize lights and display failures, there are no test codes or results associated with this phase of Pretrip. To know if the test passes the operator must observe that the LCD display elements and the indicator lights behave as described below.</p>

**P1 Tests - Heaters Current Draw:** Heater is turned on, then off. Current draw must fall within specified range. No other system components will change state during this test.

P1-0	Heaters Turned On	<p>Heater starts in the off condition, current draw is measured, and then the heater is turned on. After 15 seconds, the current draw is measured again. The change in current draw is then recorded.</p> <p>Test passes if the change in current draw test is in the range specified.</p>
P1-1	Heaters Turned Off	<p>Heater starts in the off condition, current draw is measured, and then the heater is turned on. After 15 seconds, the current draw is measured again. The change in current draw is then recorded.</p> <p>Test passes if the change in current draw test is in the range specified.</p>

**P2 Tests - Condenser Fan Current Draw:** Condenser fan is turned on, then off. Current draw must fall within specified range. No other system components will change state during this test.

P2-0	Condenser Fan On	<p>Condenser fan starts in the off condition, current draw is measured, and condenser fan is then turned on. After 15 seconds the current draw is measured again. The change in current draw is then recorded.</p> <p>Test passes if change in current draw test is in the specified range.</p>
P2-1	Condenser Fan Off	<p>Condenser fan is then turned off. After 10 seconds the current draw is measured. The change in current draw is then recorded.</p> <p>Test passes if change in current draw test is in the specified range.</p>

**P3 Tests - Low Speed Evaporator Fan Current Draw:** Low speed evaporator fan is turned on, then off. Current draw must fall within specified range. No other system components will change state during this test.

P3-0	Low Speed Evaporator Fan Motors On	<p>High speed evaporator fans will be turned on for 20 seconds, the fans will be turned off for 4 seconds, current draw is measured, and then the low speed evaporator fans are turned on. After 60 seconds the current draw is measured again. The change in current draw is then recorded.</p> <p>Test passes if change in current draw test is in the specified range.</p>
P3-1	Low Speed Evaporator Fan Motors Off	<p>Low speed evaporator fans are then turned off. After 10 seconds the current draw is measured. The change in current draw is then recorded.</p> <p>Test passes if change in current draw test is in the specified range.</p>

**Table 3–7 Controller Pre-trip Test Codes (Sheet 2 of 6)**

**P4 Tests - High Speed Evaporator Fans Current Draw:** High speed evaporator fans are turned on, then off. Current draw must fall within specified range and measured current changes must exceed specified ratios. No other system components will change state during this test.

P4-0	High Speed Evaporator Fan Motors On	Evaporator fans start in the off condition, current draw is measured, then high speed evaporator fans will be turned on. After 60 seconds the current draw is measured again. The change in current draw is then recorded. Test passes if change in current draw in the specified range AND measured current changes exceed specified ratios. If the three phase motors are configured IN, the change ratio test is skipped.
P4-1	High Speed Evaporator Fan Motors Off	High speed evaporator fans are then turned off. After 10 seconds the current draw is measured. The change in current draw is then recorded. Test passes if change in current draw test is in the specified range.

**P5 Tests - Air Stream Temperature Sensor Tests:** Tests the validity of the Air Stream Temperature Sensors.

P5-0	Supply/Return Probe Test	The High Speed Evaporator Fan is turned on and run for eight minutes, with all other outputs de-energized. A temperature comparison is made between the return and supply probes. Test passes if temperature comparison falls within the specified range.  <b>NOTE</b> If this test fails, “P5-0” and “FAIL” will be displayed. If both Probe tests (this test and the PRIMARY/ SECONDARY) pass, display will read “P5” “PASS.”
P5-1	Supply Probe Test	This test is for units equipped with secondary supply probe only. The temperature difference between primary supply probe and secondary supply probe is compared. Test passes if temperature comparison falls within the specified range.  <b>NOTE</b> If this test fails, “P5-1” and “FAIL” will be displayed. If both Probe tests (this and the SUPPLY/RETURN TEST) pass, because of the multiple tests, the display will read “P5” “PASS.”
P5-2	Return Probe Test	For units equipped with secondary return probe only. The temperature difference between return temperature sensor (RTS) and return temperature sensor (RRS) probe is compared. Test passes if temperature comparison falls within the specified range.  <b>NOTES</b> 1. If this test fails, “P5-2” and “FAIL” will be displayed. If both Probe tests (this test and the SUPPLY/RETURN) pass, because of the multiple tests, the display will read “P 5,” “PASS.”  2. The results of Pre-trip tests 5-0, 5-1 and 5-2 will be used to activate or clear control probe alarms.
P5-3	Evaporator Fan Direction Test	With evaporator fan running on high speed, measure the temperature difference between the primary supply and primary return probes. Turn the heaters on for 60 seconds then measure the temperature difference between the primary supply and primary return probes for up to 120 additional seconds. This is a Pass/Fail test. The test passes if differential of STS is 0.25°C higher than RTS. Test P5-0 must pass before this test is run.

**Table 3–7 Controller Pre-trip Test Codes (Sheet 3 of 6)**

P5-7	Primary .vs Secondary Evaporator Temperature Sensor Test	This is a Pass/Fail test of the primary evaporator temperature sensor (ETS1) and secondary evaporator temperature sensor (ETS2). Test passes if secondary evaporator temperature sensor (ETS2) is within +/- 0.5°C of the primary evaporator temperature sensor (ETS1).
P5-8	Primary Evaporator Pressure Transducer Test	This is a Pass/Fail test of the Primary Evaporator Pressure Transducer. Test passes if suction pressure transducer (SPT) is within +/- 0 psi of saturation pressure at current evaporator temperature. Also passes if SPT is within +/- 1 psi of discharge pressure 6 hours after a power interruption. Test P5-7 must pass before this test is run.
P5-9	Suction (Evaporator) Pressure Transducer Test	Units equipped with a secondary Evaporator pressure transducer. Test passes if suction pressure transducer (SPT) is within +/- 1.5 psi of the evaporator pressure transducer (EPT). Test P5-8 must pass before this test is run.
P5-10	Humidity Sensor Controller Configuration Verification Test	This is a Pass/Fail/Skip test of the humidity sensor configuration. Test passes if the controller configuration has humidity sensor in. Test fails if the controller configuration has humidity sensor out and Vout is greater than 0.20 Volts for the humidity sensor. Test is skipped if the controller configuration has the humidity sensor out and Vout is less than 0.20 Volts. Test P5-9 must pass before this test is run.
P5-11	Humidity Sensor Installation Verification Test	This is a Pass/Fail test of humidity sensor installation (sensor is present). Test passes if Vout is greater than 0.20 Volts for the humidity sensor. Test fails if Vout is less than 0.20 Volts for the humidity sensor. Test P5-10 must pass before this test is run.
P5-12	Humidity Sensor Range Check Test	This is a Pass/Fail test of the Humidity Sensor Range. Test passes if Vout for the humidity sensor is between 0.33 Volts and 4 Volts. Test fails if Vout is outside of this range. Test P5-11 must pass before this test is run.

**P6 Tests - Refrigerant Probes, Compressor and Refrigerant Valves:** Pass/Fail testing is performed for the compressor, EEV, DUUV, LIV (if equipped), ESV, and the refrigerant pressure and temperature sensors.

P6-0	Discharge Thermistor Test	If Alarm 64 is active the test fails. Otherwise, the test passes.
P6-1	Suction Thermistor Test	If the Suction Temperature Sensor (CPSS) both is configured ON and is invalid, the test fails. Otherwise the test passes.
P6-2	Discharge Pressure Transducer Test	If Alarm 65 is active any time during the first 45 second period, the test fails. Otherwise, the test passes.
P6-3	Suction Pressure Transducer Test	If Alarm 66 is active the test fails. Otherwise the test passes.
P6-4	Compressor Current Draw Test	Compressor current is tested before and 10 seconds after start up. If current does not increase, the test fails. P6-7 is run at the end of P6-4. If this test fails, P6-6 is skipped.
P6-5	Compressor Leak Test	Pre-trip P6-5 ensures that the compressor holds pressure. After compressor pump up and pump down, the compressor is turned off for 62 seconds. When suction side pressure holds (less than 8 psi rise) for 10 seconds, P6-5 passes, otherwise the Compressor Leak Test fails.

**Table 3-7 Controller Pre-trip Test Codes (Sheet 4 of 6)**

<b>NOTE</b>		
<p>P6-6 through P6-10 are conducted by changing status of each valve and comparing suction pressure change and/or compressor current change with predetermined values. Tests will cause compressor and condenser fans to cycle on and off as needed to generate the pressure required for individual Pre-trip sub tests. The compressor will start in order to build discharge pressure, followed by compressor pump down sequence. At the conclusion of compressor pump down sequence, the compressor will shut down and the valve test will start.</p>		
P6-6	Economizer Valve Test	Passes if suction pressure increases a minimum of 4 psia when the valve opens for 15 seconds.
P6-7	Digital Unloader Valve Test	Passes if pressure and current changes are within 3 seconds of DUV switch signal and either the pressure change or the current draw change is above 5 psi or above 1.5A, respectively.
P6-10	Electronic Expansion Valve Test	The test records the suction pressure during the open valve position and passes if the suction pressure increase is above 3 psi when the valve opens for 10 seconds.
<b>NOTE</b>		
<p>P7-0 &amp; P8 are included with "Auto 2 &amp; Auto 3" only. P9-0 through P10 are included with "Auto2" only.</p>		

**P7 Tests - High Pressure Tests:** Unit is run at full capacity without condenser fan running to make sure that the HPS opens and closes properly.

P7-0	High Pressure Switch (HPS) Opening Test	<p>Test is skipped if sensed ambient temperature is less than 7.2°C (45°F), return air temperature is less than -17.8°C (0°F), or the water pressure switch is open. With the unit running, the condenser fan is turned off and a 900 second (15 minute) timer is started. The right display shows Discharge Pressure if the sensor is configured and valid, else Discharge Temperature. The unit needs to disable Discharge Pressure limit and enable Current Limit checks.</p> <p>The test fails immediately if:</p> <ul style="list-style-type: none"> <li>-Ambient Temperature Sensor invalid</li> <li>-Composite Return Temperature Sensor invalid</li> <li>-HPS is open</li> </ul> <p>The test fails if:</p> <ul style="list-style-type: none"> <li>-HPS fails to open before 900 seconds total test time.</li> <li>-Evaporator or Compressor IP Alarm.</li> <li>-Calculated Dome Temperature exceeds 137.78°C (280°F).</li> <li>-Discharge pressure exceeds 370 psig.</li> <li>-Compressor Current exceeds limits</li> </ul> <p>The test passes if HPS opens within the 15 minute time limit.</p>
P7-1	High Pressure Switch (HPS) Closing Test	<p>If return temperature greater than -2.4°C (27.7°F), set setpoint to -5.0°C (23°F), else set setpoint to -30°C (-22°F). Restart unit according to normal startup logic. Run unit normally for 120 seconds.</p> <p>The test passes if the high pressure switch closes within 75 seconds after end of Test 7-0, else the test fails.</p> <p>Test P7-0 must pass for this test to execute.</p>

**Table 3–7 Controller Pre-trip Test Codes (Sheet 5 of 6)**

**P8 Tests - Perishable Mode Tests:** Pretrip tests P7-0 and P7-1 must have passed or have been skipped for these tests to execute.

P8-0	Perishable Mode Test	<p>If the control temperature is below 15.6°C (60°F), the setpoint is changed to 15.6°C (60°F), and a 180 Minute timer is started. The control will then be placed in the equivalent of normal heating. If the control temperature is above 15.6°C (60°F) at the start of the test, then the test proceeds immediately to test 8-1. While in test 8-0 the right display will show the value of the control temperature.”</p> <p>The test fails if the 180 Minute timer expires before the control temperature reaches setpoint - 0.3°C. If the test fails, it will not auto-repeat. There is no pass display for this test. Once the control temperature reaches setpoint, the test proceeds to test 8-1.</p>
P8-1	Perishable Mode Pull Down Test	<p>Control temperature must be at least 15.6°C (60°F).</p> <p>The set point is changed to 0°C (32°F), and a 180-minute timer is started. The left display will read “P8-1,” the right display will show the supply air temperature. The unit will then start to pull down the temperature to the 0°C set point.</p> <p>The test passes if the container temperature reaches set point before the 180-minute timer expires.</p>
P8-2	Perishable Mode Maintain Temperature Test	<p>Test P8-1 must pass for P8-2 to execute.</p> <p>A fifteen minute timer is started, and the system will attempt to minimize control temperature error (supply temperature minus setpoint) until the timer expires. The control temperature will be sampled each minute starting at the beginning of P8-2.</p> <p>During P8-2, the left display will read “P8-2,” and the right display will show the supply air temperature.</p> <p>When the test is completed, the average control temperature error will be compared to the pass/fail criteria.</p> <p>Test passes if the average temperature error is within +/- 1.0°C.</p> <p>Test fails if the average temperature error is greater than +/- 1.0°C, or if the DataCORDER supply temperature probe is invalid. If the test fails, the control probe temperature will be recorded as -50.0°C.</p>

**Table 3-7 Controller Pre-trip Test Codes (Sheet 6 of 6)**

**P9 Test - DTT Close and Open Test:** The DTT in this control is not a physical device, with actual metallic contacts, it is a software function that acts similar to a thermostat. Using various temperature inputs, the DTT function determines whether a thermostat mounted on the Evaporator Coil would have OPEN or CLOSED contacts. Primarily, the DTT function operates based on the temperature reading from the Defrost Termination Sensor.

P9-0	DTT Closed and Open Test	<p>During P9-0 the defrost temperature sensor (DTS) reading will be displayed on the left display. The right display will show the supply air temperature.</p> <p>The unit will run FULL COOL for 30 minutes maximum until the DTT is considered closed. This step may not have to be executed. Once the DTT is considered closed, the unit simulates defrost by running the heaters for up to two hours, or until the DTT is considered open.</p> <p>Test fails if:</p> <ul style="list-style-type: none"> <li>The DTT is not considered closed after the 30 minutes of full cooling</li> <li>HTT opens when DTT is considered closed or if return air temperature rises above 248°C (120°F).</li> </ul> <p>Test passes if the DTT is considered open within the 2 hour heat cycle time limit.</p>
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**P10 Tests - Frozen Mode Tests:**

P10-0	Frozen Mode Heat Test	<p>If the container temperature is below 7.2°C (45°F), the setpoint is changed to 7.2°C., and a 180 Minute timer is started. The control will then be placed in the equivalent of normal heating. If the container temperature is above 7.2°C. at the start of the test, then the test proceeds immediately to test 10-1. During this test, the control temperature will be shown on the right display.</p> <p>The test fails if the 180 Minute timer expires before the control temperature reaches setpoint - 0.3°C. If the test fails, it will not auto-repeat. There is no pass display for this test. Once the control temperature reaches setpoint, the test proceeds to test 10-1.</p>
P10-1	Frozen Mode Pulldown Test	<p>Control temperature must be at least 7.2°C (45°F)</p> <p>The setpoint is changed to -17.8°C. The system will then attempt to pull down the control temperature to setpoint using normal frozen mode cooling. During this test, the control temperature will be shown on the right display.</p> <p>The test passes if the control temperature reaches setpoint minus 0.3°C before the 180 minute timer expires. Otherwise, the test fails. Upon failure and when initiated by an automatic Pre-trip sequence, P10-1 will auto-repeat once by starting P10-0 over again.</p>
P10-2	Frozen Mode Maintain Temperature Test	<p>Test P10-1 must pass for this test to execute.</p> <p>Same as for test 8-2 except the control temperature is the return probe temperature.</p> <p>The average error must be +/-1.6°C. If the DataCORDER supply temperature probe is invalid, the test fails and the control probe temperature will be recorded as -50°C (-58°F). Upon failure and when initiated by an automatic Pre-trip sequence, P10-2 will auto-repeat by starting P10-0 over again.</p>

**Table 3–8 DataCORDER Function Code Assignments**

<b>NOTE</b>		
<b>Inapplicable Functions Display “-----”</b>		
<b>To Access: Press ALT. MODE key then CODE SELECT key</b>		
<b>Code No.</b>	<b>TITLE</b>	<b>DESCRIPTION</b>
dC1	Recorder Supply Temperature	Current reading of the supply recorder sensor.
dC2	Recorder Return Temperature	Current reading of the return recorder sensor.
dC3-5	USDA 1,2,3 Temperatures	Current readings of the three USDA probes.
dC6-13	Network Data Points 1-8	Current values of the network data points (as configured). Data point 1 (Code 6) is generally the humidity sensor and its value is obtained from the controller once every minute.
dC14	Cargo Probe 4 Temperature	Current reading of the cargo probe #4.
dC15-19	Future Expansion	These codes are for future expansion, and are not in use at this time.
dC20-24	Temperature Sensors 1-5 Calibration	Current calibration offset values for each of the five probes: supply, return, USDA #1, #2, and #3. These values are entered via the interrogation program.
dC25	Future Expansion	This code is for future expansion, and is not in use at this time.
dC26,27	S/N, Left 4, Right 4	The DataCORDER serial number consists of eight characters. Function code dC26 contains the first four characters. Function code dC27 contains the last four characters. (This serial number is the same as the controller serial number.)
dC28	Minimum Days Left	An approximation of the number of logging days remaining until the DataCORDER starts to overwrite the existing data.
dC29	Days Stored	Number of days of data that are currently stored in the DataCORDER.
dC30	Date of Last Trip start	The date when a Trip Start was initiated by the user. In addition, if the system goes without power for seven continuous days or longer, a trip start will automatically be generated on the next AC power up. Press and hold “ENTER” key for five seconds to initiate a “Trip Start.”
dC31	Battery Test Results	Shows the current status of the optional battery pack. <b>PASS:</b> Battery pack is fully charged. <b>FAIL:</b> Battery pack voltage is low.
dC32	Time: Hour, Minute	Current time on the real time clock (RTC) in the DataCORDER.
dC33	Date: Month, Day	Current date (month and day) on the RTC in the DataCORDER.
dC34	Date: Year	Current year on the RTC in the DataCORDER.
dC35	Cargo Probe 4 Calibration	Current calibration value for the Cargo Probe. This value is an input via the interrogation program.

**Table 3–9 DataCORDER Pre-trip Result Records**

<b>Test No.</b>	<b>TITLE</b>	<b>DATA</b>
1-0	Heater On	Pass/Fail/Skip Result, Change in current for Phase A, B and C
1-1	Heater Off	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
2-0	Condenser Fan On	Pass/Fail/Skip Result, Water pressure switch (WPS) - Open/Closed, Change in currents for Phase A, B and C
2-1	Condenser Fan Off	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
3-0	Low Speed Evaporator Fan On	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
3-1	Low Speed Evaporator Fan Off	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
4-0	High Speed Evaporator Fan On	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
4-1	High Speed Evaporator Fan Off	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
5-0	Supply/Return Probe Test	Pass/Fail/Skip Result, STS, RTS, SRS and RRS
5-1	Secondary Supply Probe (SRS) Test	Pass/Fail/Skip
5-2	Secondary Return Probe (RRS) Test	Pass/Fail/Skip
6-0	Discharge Thermistor Test	Pass/Fail/Skip
6-1	Suction Thermistor Test	Pass/Fail/Skip
6-2	Discharge Pressure Transducer Test	Pass/Fail/Skip
6-3	Suction Pressure Transducer Test	Pass/Fail/Skip
6-4	Compressor Current Draw Test	Pass/Fail/Skip
6-5	Compressor Leak Test	Pass/Fail/Skip
6-6	Economizer Valve Test	Pass/Fail/Skip
6-7	Digital Unloader Valve Test	Pass/Fail/Skip
6-10	Electronic Expansion Valve Test	Pass/Fail/Skip
7-0	High Pressure Switch Closed	Pass/Fail/Skip Result, AMBS, DPT or CPT (if equipped) Input values that component opens
7-1	High Pressure Switch Open	Pass/Fail/Skip Result, STS, DPT or CPT (if equipped) Input values that component closes
8-0	Perishable Mode Heat Test	Pass/Fail/Skip Result, STS, time it takes to heat to 16°C (60°F)
8-1	Perishable Mode Pulldown Test	Pass/Fail/Skip Result, STS, time it takes to pull down to 0°C (32°F)
8-2	Perishable Mode Maintain Test	Pass/Fail/Skip Result, Averaged DataCORDER supply temperature (SRS) over last recording interval.
9-0	Defrost Test	Pass/Fail/Skip Result, DTS reading at end of test, line voltage, line frequency, time in defrost.
10-0	Frozen Mode Heat Test	Pass/Fail/Skip Result, STS, time unit is in heat.
10-1	Frozen Mode Pulldown Test	Pass/Fail/Skip Result, STS, time to pull down unit to -17.8°C (0°F).
10-2	Frozen Mode Maintain Test	Pass/Fail/Skip Result, Averaged DataCORDER return temperature (RRS) over last recording interval.

**Table 3–10 DataCORDER Alarm Indications**

<b>To Access: Press ALT. MODE key then ALARM LIST key</b>		
<b>Code No.</b>	<b>TITLE</b>	<b>DESCRIPTION</b>
dAL70	Recorder Supply Temperature Out of Range	The supply recorder sensor reading is outside of the range of -50°C to 70°C (-58°F to +158°F), or the probe check logic has determined there is a fault with this sensor.  <b>NOTE</b> The P5 Pre-trip test must be run to inactivate the alarm.
dAL71	Recorder Return Temperature Out of Range	The return recorder sensor reading is outside of the range of -50°C to 70°C (-58°F to +158°F), or the probe check logic has determined there is a fault with this sensor.  <b>NOTE</b> The P5 Pre-trip test must be run to inactivate the alarm.
dAL72-74	USDA Temperatures 1, 2, 3 Out of Range	The USDA probe temperature reading is outside of -50°C to 70°C (-58°F to +158°F) range.
dAL75	Cargo Probe 4 Out of Range	The cargo probe temperature reading is outside of -50°C to 70°C (-58°F to +158°F) range.
dAL76, 77	Future Expansion	These alarms are for future expansion and are not in use at this time.
dAL78-85	Network Data Point 1 - 8 Out of Range	The network data point is outside of its specified range. The DataCORDER is configured by default to record the supply and return recorder sensors. The DataCORDER may be configured to record up to eight additional network data points. An alarm number (AL78 to AL85) is assigned to each configured point. When an alarm occurs, the DataCORDER must be interrogated to identify the data point assigned. When a humidity sensor is installed, it is usually assigned to AL78.
dAL86	RTC Battery Low	The real time clock (RTC) backup battery is too low to adequately maintain the RTC reading. A real time clock failure is critical to the operation of the unit. If this alarm occurs, replace the RTC battery at the next available opportunity. After replacing the battery the following actions are required: <ul style="list-style-type: none"> <li>– Update the RTC setting</li> <li>– Update the unit’s software configuration</li> <li>– Update the operational software</li> <li>– Update all user selectable function code settings (defrost, setpoint, etc)</li> </ul>
dAL87	RTC Failure	An invalid time has been detected. Either the DataCORDER run time hour and minute have not changed at the start of the hour, or the real time clock (RTC) time has gained or lost more than 2 minutes in the hour. This situation may be corrected by cycling the power, setting the clock or meeting the above criteria for an hour.
dAL88	DataCORDER EEPROM Failure	A write of critical DataCORDER information to the EEPROM has failed.
dAL89	Flash Memory Error	An error has been detected in the process of writing daily data to the non-volatile FLASH memory.
dAL90	Future Expansion	This alarm is for future expansion, and is not in use at this time.
dAL91	Alarm List Full	The DataCORDER alarm queue is determined to be full (eight alarms).

## SECTION 4 OPERATION

### 4.1 INSPECTION (Before Loading)

#### WARNING

Beware of unannounced starting of the evaporator and condenser fans. The unit may cycle the fans and compressor unexpectedly as control requirements dictate.

- a. Check inside for the following:
  1. Check channels or “T” bar floor for cleanliness. Channels must be free of debris for proper air circulation.
  2. Check container panels, insulation and door seals for damage. Effect permanent or temporary repairs.
  3. Visually check evaporator fan motor mounting bolts for proper securement (refer to paragraph 6.14).
  4. Check for visible corrosion on the evaporator stator and fan deck (refer to paragraph 6.15).
  5. Check for dirt or grease on evaporator fans or fan deck and clean if necessary.
  6. Check evaporator coil for cleanliness or obstructions. Wash with fresh water (refer to Section 6.13).
  7. Check defrost drain pans and drain lines for obstructions and clear if necessary. Wash with fresh water.
  8. Check panels on refrigeration unit for loose bolts and condition of panels. Make sure T.I.R. devices are in place on access panels.
- b. Check condenser coil for cleanliness. Wash with fresh water (refer to Section 6.10.1).
- c. Open control box door. Check for loose electrical connections or hardware.
- d. Check color of moisture–liquid indicator.

### 4.2 CONNECT POWER

#### WARNING

Do not attempt to remove power plug(s) before turning OFF start–stop switch (ST), unit circuit breaker(s) and external power source.

#### WARNING

Make sure the power plugs are clean and dry before connecting to power receptacle.

#### 4.2.1 Connection To 380/460 VAC Power

1. Make sure start–stop switch (ST on control panel) and circuit breaker (CB–1 in the control box) are in position “0” (OFF).
2. Plug the 460 VAC (yellow) cable into a de–energized 380/460 VAC, 3–phase power source. Energize the power source. Place circuit breaker (CB–1) in position “1” (ON). Close and secure control box door.

### 4.3 ADJUST FRESH AIR MAKEUP VENT

The purpose of the fresh air makeup vent is to provide ventilation for commodities that require fresh air circulation. The vent *must be closed* when transporting frozen foods.

Air exchange depends on static pressure differential, which will vary depending on the container and how the container is loaded.

Units are equipped with a vent position sensor (VPS). The VPS determines the position of the fresh air vent and sends data to the controller display.

#### 4.3.1 Upper Fresh Air Makeup Vent

Two slots and a stop are designed into the Upper Fresh Air disc for air flow adjustments. The first slot allows for a 0 to 30% air flow; the second slot allows for a 30 to 100% air flow.

To adjust the percentage of air flow, loosen the wing nut and rotate the disc until the desired percentage of air flow matches with the arrow. Tighten the wing nut.

To clear the gap between the slots, loosen the wing nut until the disc clears the stop.

Figure 4–1 gives air exchange values for an empty container.

Higher values can be expected for a fully loaded container.

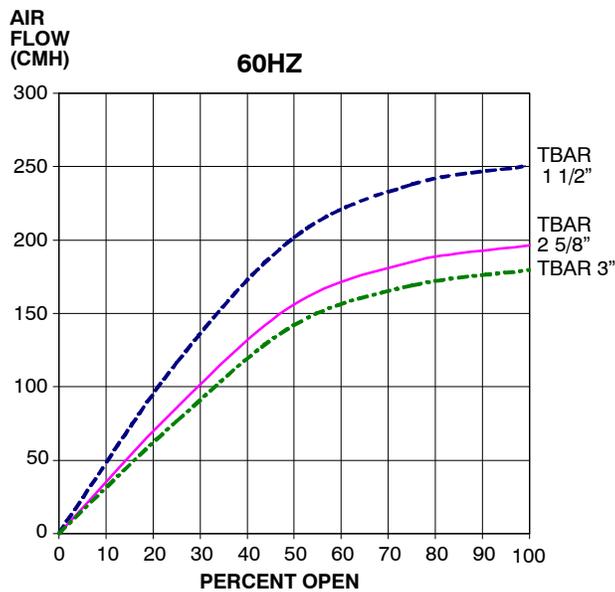
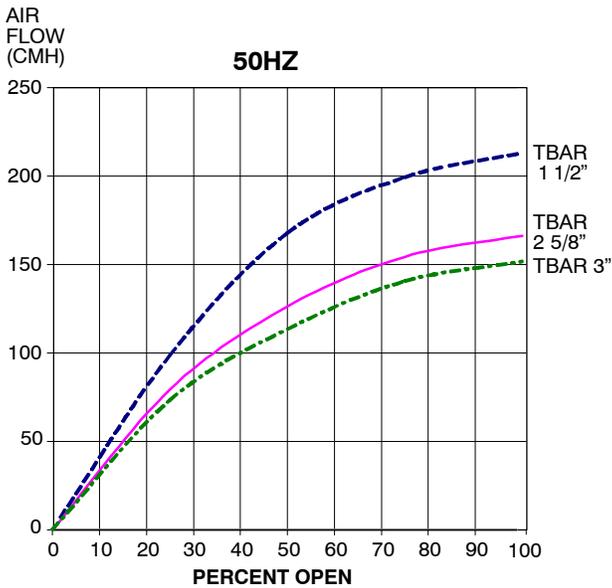


Figure 4-1 Upper Fresh Air Make Up Flow Chart

#### 4.3.2 Vent Position Sensor

The VPS allows the user to determine the position of the fresh air vent via Cd45. This function code is accessible via the Code Select key.

The vent position will display for 30 seconds whenever motion corresponding to 5 CMH (3 CFM) or greater is detected. It will scroll in intervals of 5 CMH (3 CFM). Scrolling to Cd45 will display the Fresh Air Vent Position.

The position of the vent will be recorded in the DataCORDER whenever the unit is running under AC power and any of the following:

- Trip start
- On every power cycle
- Midnight

Manual changes greater than 5 CMH (3 CFM) remaining in the new position for at least four minutes

#### NOTE

The user has four minutes to make necessary adjustments to the vent setting. This time calculation begins on the initial movement of the sensor. The vent can be moved to any position within the four minutes. On completion of the first four minutes, the vent is required to remain stable for the next four minutes. If vent position changes are detected during the four-minute stability period, AL50 will be generated. This provides the user with the ability to change the vent setting without generating multiple events in the DataCORDER.

#### 4.4 CONNECT REMOTE MONITORING RECEPTACLE

If remote monitoring is required, connect the remote monitor plug at the unit receptacle, see Figure 2-5.

When the remote monitor plug is connected to the remote monitoring receptacle, the following remote circuits are energized:

CIRCUIT	FUNCTION
Sockets B to A	Energizes remote cool light
Sockets C to A	Energizes remote defrost light
Sockets D to A	Energizes remote in-range light

#### 4.5 STARTING AND STOPPING INSTRUCTIONS



**Make sure that the unit circuit breaker CB-1 and the START-STOP switch (ST) are in the "O" (OFF) position before connecting to any electrical power source.**

#### NOTE

The electronic phase detection system will check for proper compressor rotation within the first 30 seconds. If rotation is not correct, the compressor will be stopped and restarted in the opposite direction. If the compressor is producing unusually loud and continuous noise after the first 30 seconds of operation, stop the unit and investigate.

##### 4.5.1 Starting the Unit

- a. With power properly applied and the fresh air vent position set, place the START-STOP switch to "I" (ON), see Figure 2-5.
- b. The Controller Function Codes for the container ID (Cd40), software version (Cd18) and unit model number (Cd20) will be displayed in sequence.
- c. Continue with Start Up Inspection, paragraph 4.6.

## 4.5.2 Stopping the Unit

To stop the unit, place the START–STOP switch in position “0” (OFF).

## 4.6 START–UP INSPECTION

### 4.6.1 Physical Inspection

Check rotation of condenser and evaporator fans.

### 4.6.2 Check Controller Function Codes

Check, and if required, reset controller Function Codes (Cd27 through Cd39) in accordance with desired operating parameters. Refer to Table 3–5.

### 4.6.3 Start Temperature Recorder

#### DataCORDER

- a. Check and, if required, set the DataCORDER Configuration in accordance with desired recording parameter. Refer to paragraph 3.7.3.
- b. Enter a “Trip Start.” To enter a “Trip Start,” do the following:
  1. Depress the ALT MODE key. When the left display shows, dC, depress the ENTER key.
  2. Scroll to Code dC30.
  3. Depress and hold the ENTER key for five seconds.
  4. The “Trip Start” event will be entered in the DataCORDER.

### 4.6.4 Complete Inspection

Allow the unit to run for five minutes to stabilize conditions, and then perform a Pre–trip diagnosis in accordance with Section 4.7.

## 4.7 PRE–TRIP DIAGNOSIS



### CAUTION

**Pre–trip inspection should not be performed with critical temperature cargoes in the container.**



### CAUTION

**When Pre–trip key is pressed, economy and dehumidification will be deactivated. At the completion of Pre–trip activity, economy and dehumidification must be reactivated.**

Pre–trip diagnosis provides automatic testing of the unit components using internal measurements and comparison logic. The program will provide a “PASS” or “FAIL” display to indicate test results.

The testing begins with access to a Pre–trip selection menu. The user may have the option of selecting one of two automatic tests.

These tests will automatically perform a series of individual Pre–trip tests. The user may also scroll down to select any of the individual tests.

When only the short sequence is configured, it will appear as “AUtO” in the display. Otherwise “AUtO1” will indicate the short sequence and “AUtO2” will indicate the long sequence. The test short sequence will run tests P0 through P6. The long test sequence will run tests P0 through P10.

A detailed description of the Pre–trip test codes is listed in Table 3–7, page 3–34. If no selection is made, the Pre–trip menu selection process will terminate automatically. However, dehumidification and bulb mode must be reactivated manually if required.

Scrolling down to the “rSLts” code and pressing ENTER will allow the user to scroll through the results of the last Pre–trip testing run. If no Pre–testing has been run (or an individual test has not been run) since the unit was powered up, “----” will be displayed.

To start a Pre–trip test, do the following:

#### NOTE

1. Prior to starting a Pre–trip test, verify that unit voltage (Cd07) is within tolerance and unit amperage draw (Cd04, Cd05, Cd06) are within expected limits. Otherwise, tests may fail incorrectly.
  2. All alarms must be rectified and cleared before starting tests.
  3. Pre–trip may also be initiated via communications. The operation is the same as for the keypad initiation described below except that should a test fail, the Pre–trip mode will automatically terminate. When initiated via communications, a Pre–trip test may not be interrupted with an arrow key, but the Pre–trip test can be terminated with the PRE–TRIP key.
- a. Press the PRE–TRIP key to access the Pre–trip test selection menu.
  - b. TO RUN AN AUTOMATIC TEST: Scroll through the selections by pressing the UP ARROW or DOWN ARROW keys to display AUTO, AUTO 1, AUTO 2 or AUTO 3 as desired, then press ENTER.
    1. The unit will execute the series of tests without any need for direct user interface. These tests vary in length, depending on the component under test.
    2. While tests are running, “P#–#” will appear on the left display; the #’s indicate the test number and sub–test. The right display will show a countdown time in minutes and seconds, indicating the amount of time remaining in the test.



## CAUTION

**When a failure occurs during automatic testing, the unit will suspend operation awaiting operator intervention.**

When an automatic test fails, it will be repeated once. A repeated test failure will cause “FAIL” to be shown on the right display, with the corresponding test number to the left.

The user may then press the DOWN ARROW to repeat the test, the UP ARROW to skip to the next test, or the PRE-TRIP key to terminate testing. The unit will wait indefinitely or until the user manually enters a command.



## CAUTION

**When Pre-trip test Auto2 runs to completion without being interrupted, the unit will terminate Pre-trip and display “Auto 2” “end.” The unit will suspend operation until the user depresses the ENTER key!**

When an Auto 1 Pre-trip test runs to completion without a failure, the unit will exit Pre-trip mode and return to normal control operation. However, dehumidification and bulb mode must be reactivated manually if required.

c. TO RUN AN INDIVIDUAL TEST: Scroll through the selections by pressing the UP ARROW or DOWN ARROW keys to display an individual test code. Pressing ENTER when the desired test code is displayed.

1. Individually selected tests, other than the LED/Display test, will perform the operations necessary to verify the operation of the component. At the conclusion, PASS or FAIL will be displayed. This message will remain displayed for up to three minutes, during which time a user may select another test. If the three minute time period expires, the unit will terminate pre-trip and return to control mode operation.
2. While the tests are being executed, the user may terminate the pre-trip diagnostics by pressing and holding the PRE-TRIP key. The unit will then resume normal operation. If the user decides to terminate a test but remain at the test selection menu, the user may press the UP ARROW key. When this is done, all test outputs will be de-energized and the test selection menu will be displayed.
3. During Pre-trip testing, current limiting and pressure limiting are both active, except during P-7 (High Pressure Switch Testing) when pressure limiting is turned off.

d. Pre-Trip Test Results

At the end of the pre-trip test selection menu, the message “P,” “rSLTs” (Pre-trip results) will be displayed. Pressing the ENTER key will allow the user to see the results for all subtests (i.e., 1-0, 1-1, etc).

The results will be displayed as “PASS” or “FAIL” for all the tests run to completion since power up. If a test has not been run since power up, “-----” will be displayed.

Once all Pre-test activity is completed, dehumidification and bulb mode must be reactivated manually if required.

## 4.8 PROBE DIAGNOSTICS

A complete temperature probe check is performed during the P5 Pre-trip test. A probe check is also run at the end of a defrost cycle; the defrost light will remain on during this period. If supply probes are within limits and return probes are within limits, the unit will return to normal operation. During normal operation, the controller continuously monitors and compares adjacent temperature probe readings.

The probe check procedure consists of running the evaporator fans for up to eight minutes in order to compare the readings from the adjacent temperature probes. If a significant difference in temperature readings is detected between probes, a defrost cycle, followed by another probe check may be initiated. Any continued disagreement between probes will prompt the controller to invalidate the failed temperature probe, and the backup probe will be used for temperature control.

In Perishable Mode, both pairs of supply and return probes are monitored for probe disagreement. Probe disagreement is considered a difference of 0.5°C (0.9°F) or greater between the supply air sensors and/or a difference of 2.0°C (3.6°F) between the return air sensors. Probe disagreement found in either pair can trigger a defrost probe check.

In Frozen Mode, only the controlling probes are considered. Disagreement of the controlling probes can trigger a defrost probe check, which will occur when the difference between the sensors is greater than 2.0°C (3.6°F). Normally, the controlling probes are the return probes but if both return probes are invalidated, the supply probes are used for control purposes. Probe disagreement of the non-controlling probe pair will not trigger a defrost probe check.

If after the defrost probe check the supply probes agree and return probes agree, all supply and return sensors are considered valid and the unit returns to normal control.

### In the Case of Probe Disagreement:

If the supply probes disagree and the return probes agree, the controller will invalidate the worst supply probe. If the probe check is run as part of Pre-trip P-5, an alarm will be triggered for the invalidated probe. If it is a run time defrost probe check, the invalidated probe will be passed over and no alarm will be triggered. However, if the best supply probe is greater than 1.2°C (2.2°F) difference with respect to its return probes, the best supply probe is also invalidated. If unit is in Perishable Mode, a probe alarm will be triggered for both supply probes.

If the supply probes agree and the return probes disagree, invalidate the worst return probe. If the probe check is being run as part of Pre-trip P-5, an alarm will be triggered for the invalidated probe. If it is a run time defrost probe check, the invalidated probe will be passed over and no alarm will be necessary. If the best return probe is greater than 1.2°C (2.2°F) difference with respect to its supply probes, then the best return probe is also invalidated. If the unit is in perishable mode, a probe alarm will be triggered for both return probes.

## SECTION 5 TROUBLESHOOTING

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
<b>5.1 UNIT WILL NOT START OR STARTS THEN STOPS</b>		
No power to unit	External power source OFF	Turn on
	Start–Stop switch OFF or defective	Check
	Circuit breaker tripped or OFF	Check
Loss of control power	Circuit breaker OFF or defective	Check
	Control transformer defective	Replace
	Fuse (F3A/F3B) blown	Check
	Start–Stop switch OFF or defective	Check
Component(s) not operating	Evaporator fan motor internal protector open	6.14
	Condenser fan motor internal protector open	6.11
	Compressor internal protector open	6.8
	High pressure switch open	5.7
	Heat termination thermostat open	Replace
	Malfunction of current sensor	Replace
Compressor hums, but does not start	Low line voltage	Check
	Single phasing	Check
	Shorted or grounded motor windings	6.8
	Compressor seized	6.8
<b>5.2 UNIT OPERATES LONG OR CONTINUOUSLY IN COOLING</b>		
Container	Hot load	Normal
	Defective box insulation or air leak	Repair
Refrigeration system	Shortage of refrigerant	6.3
	Evaporator coil covered with ice	5.6
	Evaporator coil plugged with debris	6.13
	Evaporator fan(s) rotating backwards	6.13/6.14
	Air bypass around evaporator coil	Check
	Controller set too low	Reset
	Compressor service valves or liquid line shutoff valve partially closed	Open valves completely
	Dirty condenser	6.10
	Compressor worn	6.8
	Current limit (function code Cd32) set to wrong value	3.4.3
	Economizer solenoid valve malfunction	6.20
	Digital unloader valve stuck open	Replace
	Electronic expansion valve	Replace

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
<b>5.3 UNIT RUNS BUT HAS INSUFFICIENT COOLING</b>		
Refrigeration system	Abnormal pressures	5.7
	Abnormal temperatures	5.13
	Abnormal currents	5.14
	Controller malfunction	5.9
	Evaporator fan or motor defective	6.14
	Compressor service valves or liquid line shutoff valve partially closed	Open valves completely
	Frost on coil	5.10
	Digital unloader valve stuck open	Replace
	Electronic expansion valve	Replace
<b>5.4 UNIT WILL NOT HEAT OR HAS INSUFFICIENT HEATING</b>		
No operation of any kind	Start-Stop switch OFF or defective	Check
	Circuit breaker OFF or defective	Check
	External power source OFF	Turn ON
No control power	Circuit breaker or fuse defective	Replace
	Control Transformer defective	Replace
	Evaporator fan internal motor protector open	6.14
	Heat relay defective	Check
	Heater termination thermostat open	6.13
Unit will not heat or has insufficient heat	Heater(s) defective	6.13
	Heater contactor or coil defective	Replace
	Evaporator fan motor(s) defective or rotating backwards	6.13/6.14
	Evaporator fan motor contactor defective	Replace
	Controller malfunction	5.9
	Defective wiring	Replace
	Loose terminal connections	Tighten
	Low line voltage	2.3
<b>5.5 UNIT WILL NOT TERMINATE HEATING</b>		
Unit fails to stop heating	Controller improperly set	Reset
	Controller malfunction	5.9
	Heater termination thermostat remains closed along with the heat relay	6.13
<b>5.6 UNIT WILL NOT DEFROST PROPERLY</b>		
Will not initiate defrost automatically	Defrost timer malfunction (Cd27)	Table 3-5
	Loose terminal connections	Tighten
	Defective wiring	Replace
	Defrost temperature sensor defective or heat termination thermostat open	Replace
	Heater contactor or coil defective	Replace
Will not initiate defrost manually	Manual defrost switch defective	Replace
	Keypad is defective	Replace
	Defrost temperature sensor open	Replace
Initiates but relay (DR) drops out	Low line voltage	2.3

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
<b>5.6 UNIT WILL NOT DEFROST PROPERLY (Continued)</b>		
Initiates but does not defrost	Heater contactor or coil defective	Replace
	Heater(s) burned out	6.13
Frequent defrost	Wet load	Normal
<b>5.7 ABNORMAL PRESSURES</b>		
High discharge pressure	Condenser coil dirty	6.10
	Condenser fan rotating backwards	6.11
	Condenser fan inoperative	6.11
	Refrigerant overcharge or noncondensibles	6.3
	Discharge service valve partially closed	Open
	Electronic expansion valve (EEV) control malfunction	Replace
Low suction pressure	Incorrect software and/or controller configuration	Check
	Failed suction pressure transducer (SPT) or evaporator pressure transducer (EPT)	Replace
	Suction service valve partially closed	Open
	Filter drier partially plugged	6.12
	Low refrigerant charge	6.3
	No evaporator air flow or restricted air flow	6.13
	Excessive frost on evaporator coil	5.6
	Evaporator fan(s) rotating backwards	6.14.3
	EEV control malfunction	Replace
Failed digital unloader valve (DUV)	Replace	
Suction and discharge pressures tend to equalize when unit is operating	Compressor operating in reverse	5.12
	Compressor cycling/stopped	Check
	Failed digital unloader valve (DUV)	Replace
<b>5.8 ABNORMAL NOISE OR VIBRATIONS</b>		
Compressor	Compressor start up after an extended shutdown	Normal
	Brief chattering when manually shut down	
	Compressor operating in reverse	5.12
	Loose mounting bolts or worn resilient mounts	Tighten/Replace
	Loose upper mounting	6.8.1
	Liquid slugging	6.13
Condenser or Evaporator Fan	Bent, loose or striking venturi	Check
	Worn motor bearings	6.11/6.14
	Bent motor shaft	6.11/6.14
<b>5.9 MICROPROCESSOR MALFUNCTION</b>		
Will not control	Incorrect software and/or controller configuration	Check
	Defective sensor	6.22
	Defective wiring	Check
	Low refrigerant charge	6.3

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
<b>5.10 NO EVAPORATOR AIR FLOW OR RESTRICTED AIR FLOW</b>		
Evaporator coil blocked	Frost on coil	5.6
	Dirty coil	6.13
No or partial evaporator air flow	Evaporator fan motor internal protector open	6.14
	Evaporator fan motor(s) defective	6.14
	Evaporator fan(s) loose or defective	6.14
	Evaporator fan contactor defective	Replace
<b>5.11 ELECTRONIC EXPANSION VALVE MALFUNCTION</b>		
Low suction pressure	Incorrect software and/or controller configuration	Check
	Failed suction pressure transducer (SPT) or evaporator pressure transducer (EPT)	Replace
	Suction service valve partially closed	Open
	Filter drier partially plugged	6.12
	Low refrigerant charge	6.3
	No evaporator air flow or restricted air flow	6.13
	Excessive frost on evaporator coil	5.6
	Evaporator fan(s) rotating backwards	6.14.3
	EEV control malfunction	6.16
	Failed digital unloader valve (DUV)	Replace
	Loose or insufficiently clamped sensor	Replace
High suction pressure with low superheat	Foreign material in valve	6.16
	Failed suction pressure transducer (SPT) or evaporator pressure transducer (EPT)	Replace
	EEV control malfunction	Replace
	Improperly seated powerhead	Ensure power-head is locked and in place
Liquid slugging in compressor	Failed suction pressure transducer (SPT) or evaporator pressure transducer (EPT)	Replace
	Failed EEV	Replace

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
<p><b>5.12 COMPRESSOR OPERATING IN REVERSE</b></p> <p style="text-align: center;"><b>NOTE</b></p> <p>The compressor may start in reverse for up to 10 seconds to determine correct phase rotation if required for phase detection.</p>		
<p style="text-align: center;"><b>CAUTION</b></p> <p>Allowing the scroll compressor to operate in reverse for more than two minutes will result in internal compressor damage. Turn the start-stop switch OFF immediately.</p>		
Electrical	Incorrect wiring of compressor	Check
	Incorrect wiring of compressor contactor(s)	
	Incorrect wiring of current sensor	
<p><b>5.13 ABNORMAL TEMPERATURES</b></p>		
High discharge temperature	Condenser coil dirty	6.10
	Condenser fan rotating backwards	6.11
	Condenser fan inoperative	6.11
	Refrigerant overcharge or noncondensibles	6.3
	Discharge service valve partially closed	Open
	Electronic expansion valve (EEV) control malfunction	Replace
	Failed suction pressure transducer (SPT) or evaporator pressure transducer (EPT)	Replace
	Discharge temperature sensor drifting high	Replace
	Failed economizer expansion valve, economizer coil, or economizer solenoid valve	Replace
	Plugged economizer expansion valve, economizer coil, or economizer solenoid valve	Replace
Loose or insufficiently clamped sensor	Replace	
<p><b>5.14 ABNORMAL CURRENTS</b></p>		
Unit reads abnormal currents	Current sensor wiring	Check



## SECTION 6

### SERVICE

#### NOTE

Use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws. In the U.S.A., refer to EPA section 608.



#### WARNING

**EXPLOSION HAZARD** Failure to follow this **WARNING** can result in death, serious personal injury and / or property damage.

**Never use air or gas mixtures containing oxygen (O<sub>2</sub>) for leak testing or operating the product.**

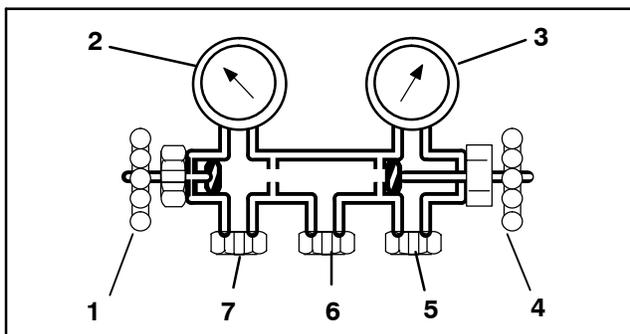
**Charge only with R-134a: Refrigerant must conform to AHRI Standard 700 specification.**

#### 6.1 SECTION LAYOUT

Service procedures are provided in this section beginning with refrigeration system service, then refrigeration system component service, electrical system service, temperature recorder service and general service. Refer to the Table of Contents to locate specific topics.

#### 6.2 MANIFOLD GAUGE SET

The manifold gauge set (see Figure 6-1) is used to determine system operating pressure, add refrigerant charge, and to equalize or evacuate the system.



1. Suction Pressure Valve (shown backseated)
2. Suction Pressure Gauge
3. Discharge Pressure Gauge
4. Discharge Pressure Valve (shown frontseated)
5. High Side Connection
6. Utility Connection to:
  - a. Refrigerant cylinder
  - b. Vacuum Pump
  - c. Oil Container
7. Low Side Connection

**Figure 6-1 Manifold Gauge Set**

When the Suction Pressure Valve (1) is frontseated (turned all the way in), the suction (low) pressure can be checked at the Suction Pressure Gauge (2).

When the Discharge Pressure Valve (4) is frontseated, the discharge (high) pressure can be checked at the Discharge Pressure Gauge (3).

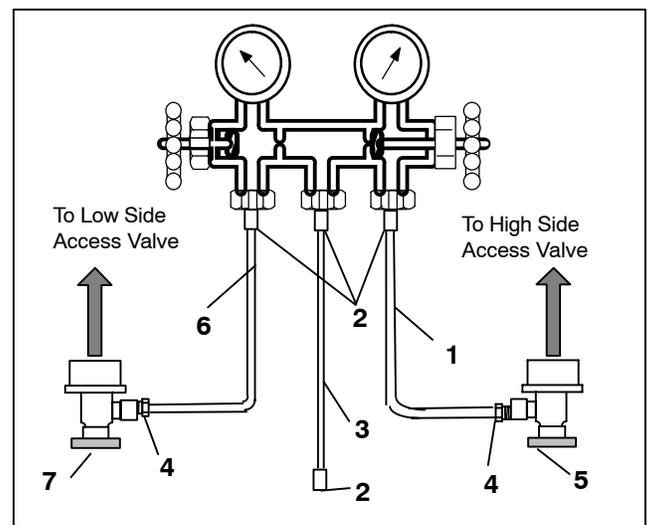
When both valves are backseated (all the way out), high pressure vapor will flow into the low side.

When the Suction Pressure Valve (1) is open and the Discharge Pressure Valve (4) shut, the system can be charged through the Utility Connection (6). Oil can also be added to the system.

A R-134a manifold gauge/hose set with self-sealing hoses (see Figure 6-2) is required for service of the models covered within this manual. The manifold gauge/hose set is available from Carrier Transicold. (Carrier Transicold part number 07-00294-00, which includes items 1 through 6, Figure 6-2.)

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:

1. Backseat (turn counterclockwise) both field service couplings (see Figure 6-2) and midseat both hand valves.
2. Connect the yellow hose to a vacuum pump and refrigerant 134a cylinder.
3. Evacuate to 10 inches of vacuum and then charge with R-134a to a slightly positive pressure of 0.1 kg/cm<sup>2</sup> (1.0 psig).
4. Frontseat both manifold gauge set valves and disconnect from cylinder. The gauge set is now ready for use.



1. RED Refrigeration and/or Evacuation Hose (SAE J2196/R-134a)
2. Hose Fitting (0.5-16 Acme)
3. YELLOW Refrigeration and/or Evacuation Hose (SAE J2196/R-134a)
4. Hose Fitting with O-ring (M14 x 1.5)
5. High Side Field Service Coupling (Red Knob)
6. BLUE Refrigeration and/or Evacuation Hose (SAE J2196/R-134a)
7. Low Side Field Service Coupling (Blue Knob)

**Figure 6-2 R-134a Manifold Gauge/Hose Set**

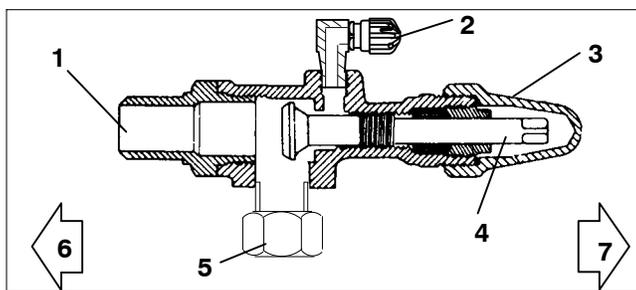
### 6.3 SERVICE CONNECTIONS

The compressor suction, compressor discharge, and the liquid line service valves (see Figure 6-3) are provided with a double seat and an access valve which enables servicing of the compressor and refrigerant lines.

Turning the valve stem clockwise (all the way forward) will frontseat the valve to close off the line connection and open a path to the access valve. Turning the stem counterclockwise (all the way out) will backseat the valve to open the line connection and close off the path to the access valve.

With the valve stem midway between frontseat and backseat, both of the service valve connections are open to the access valve path.

For example, the valve stem is first fully backseated when connecting a manifold gauge to measure pressure. Then, the valve is opened 1/4 to 1/2 turn to measure the pressure.



- |                    |  |
|--------------------|--|
| 1. Line Connection | 5. Compressor Or Filter Drier Inlet Connection |
| 2. Access Valve    | 6. Valve (Frontseated)                         |
| 3. Stem Cap        | 7. Valve (Backseated)                          |
| 4. Valve stem      |  |

**Figure 6-3 Service Valve**

Connection of the manifold gauge/hose set (see Figure 6-4) is dependent on the component being serviced. If only the compressor is being serviced, the high side coupling is connected to the discharge service valve.

For service of the low side (after pump down), the high side coupling is connected to the liquid line service valve. The center hose connection is brought to the tool being used (vacuum, tank, etc.).

Connecting the manifold gauge set:

- Remove service valve stem cap and to make sure the valve is backseated.
- Remove access valve cap (See Figure 6-3).
- Connect the field service coupling (see Figure 6-2) to the access valve.
- Turn the field service coupling knob clockwise, which will open the system to the gauge set.
- To read system pressures, slightly midseat the service valve.
- Repeat the procedure to connect the other side of the gauge set.



### CAUTION

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

Removing the Manifold Gauge Set:

- While the compressor is still ON, backseat the high side service valve.
- 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.
- Backseat the low side service valve. Backseat both field service couplings and frontseat both manifold hand valves. Remove couplings from access valves.
- Install both service valve stem caps and service port caps (finger-tight only).

### 6.4 PUMP DOWN THE UNIT

To service the filter drier, economizer, expansion valves, economizer solenoid valve, digital unloader valve or evaporator coil, pump the refrigerant into the high side as follows:



### CAUTION

**The scroll compressor achieves low suction pressure very quickly. Do not use the compressor to evacuate the system below 0 psig. Never operate the compressor with the suction or discharge service valves closed (frontseated). Internal damage will result from operating the compressor in a deep vacuum.**

- Attach manifold gauge set to the compressor suction and discharge service valves. Refer to paragraph 6.2.
- Start the unit and run in the frozen mode (controller set below -10°C (14°F) for 10 to 15 minutes.
- Check function code Cd21 (refer to paragraph 3.2.2). The economizer solenoid valve should be open. If not, continue to run until the valve opens.
- Frontseat the liquid line service valve. Place Start-Stop switch in the OFF position when the suction reaches a positive pressure of 0.1 bar (1.4 psig).
- Frontseat the suction and discharge service valves. The refrigerant will be trapped between the compressor discharge service valves and the liquid line valve.
- Before opening up any part of the system, a slight positive pressure should be indicated on the pressure gauge. Remove power from the unit before opening any part of the system. If a vacuum is indicated, emit refrigerant by cracking the liquid line valve momentarily to build up a slight positive pressure.
- When opening up the refrigerant system, certain parts may frost. Allow the part to warm to ambient temperature before dismantling. This avoids internal condensation which puts moisture in the system.

- h. After repairs have been made, be sure to perform a refrigerant leak check (refer to Section 6.5), and evacuate and dehydrate the low side (refer to paragraph 6.6.1).
- i. Check refrigerant charge (refer to Section 6.6).

## 6.5 REFRIGERANT LEAK CHECKING



**EXPLOSION HAZARD** Failure to follow this **WARNING** can result in death, serious personal injury and / or property damage.

**Never use air or gas mixtures containing oxygen (O<sub>2</sub>) for leak testing or operating the product.**

**Charge only with R-134a: Refrigerant must conform to AHRI Standard 700 specification.**

- a. The recommended procedure for finding leaks in a system is with a R-134a electronic leak detector. Testing joints with soapsuds is satisfactory only for locating large leaks.
- b. If the system is without refrigerant, charge the system with refrigerant 134a to build up pressure between 2.1 to 3.5 bar (30.5 to 50.8 psig). To ensure complete pressurization of the system, refrigerant should be charged at the compressor suction valve and the liquid line service valve. Remove refrigerant cylinder and leak-check all connections.

### NOTE

Only refrigerant 134a should be used to pressurize the system. Any other gas or vapor will contaminate the system, which will require additional purging and evacuation of the system.

- c. If required, remove refrigerant using a refrigerant recovery system and repair any leaks. Check for leaks.
- d. Evacuate and dehydrate the unit. (Refer to paragraph 6.6.1.)
- e. Charge unit per paragraph 6.7.1.

## 6.6 EVACUATION AND DEHYDRATION

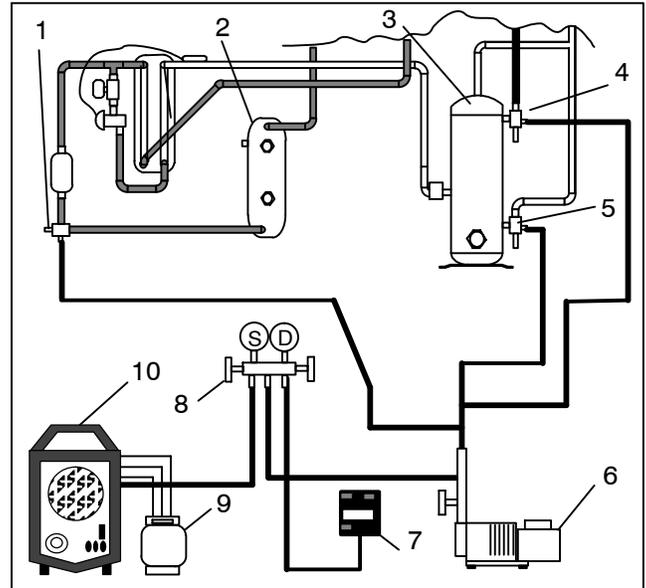
### 6.6.1 General

Moisture is detrimental to refrigeration systems. 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.

### 6.6.2 Preparation

- a. Evacuate and dehydrate only after pressure leak test (refer to Section 6.5).
- b. Essential tools to properly evacuate and dehydrate any system include a vacuum pump (8 m<sup>3</sup>/hr = 5 cfm volume displacement) and an electronic vacuum gauge. The pump is available from Carrier Transicold, P/N 07-00176-11. The micron gauge is P/N 07-00414-00.

- c. If possible, keep the ambient temperature above 15.6°C (60°F) to speed evaporation of moisture. If the ambient temperature is lower than 15.6°C (60°F), ice might form before moisture removal is complete. Heat lamps or alternate sources of heat may be used to raise the system temperature.
- d. Additional time may be saved during a complete system pump down by replacing the filter drier with a section of copper tubing and the appropriate fittings. Installation of a new drier may be performed during the charging procedure.



- |                                 |                            |
|---------------------------------|----------------------------|
| 1. Liquid Service Connection    | 6. Vacuum Pump             |
| 2. Receiver                     | 7. Electronic Vacuum Gauge |
| 3. Compressor                   | 8. Manifold Gauge Set      |
| 4. Discharge Service Connection | 9. Refrigerant Cylinder    |
| 5. Suction Service Connection   | 10. Reclaimer              |

**Figure 6-4 Refrigeration System Service Connections**

### 6.6.3 Complete System

### NOTE

Refer to Partial System procedure for information pertaining to partial system evacuation and dehydration.

- a. Remove all refrigerant using a refrigerant recovery system.
- b. The recommended method to evacuate and dehydrate the system is to connect evacuation hoses at the compressor suction and liquid line service valve (see Figure 6-4). Be sure the service hoses are suited for evacuation purposes.

- c. Test the evacuation setup for leaks by backseating the unit service valves and drawing a deep vacuum with the vacuum pump and gauge valves open. Shut off the pump and check to see if the vacuum holds. Repair leaks if necessary.
- d. Midseat the refrigerant system service valves.
- e. Open the vacuum pump and electronic vacuum gauge valves, if they are not already open. Start the vacuum pump. Evacuate unit until the electronic vacuum gauge indicates 2000 microns. Close the electronic vacuum gauge and vacuum pump valves. Shut off the vacuum pump. Wait a few minutes to be sure the vacuum holds.
- f. Break the vacuum with either clean dry refrigerant 134a or dry nitrogen. Raise system pressure to roughly 0.14 bar (2 psig), monitoring it with the compound gauge.
- g. If R134a was used, remove refrigerant using a refrigerant recovery system. If nitrogen was used, relieve the pressure.
- h. Repeat steps e. and f. one time.
- i. Remove the copper tubing and change the filter drier. Evacuate unit to 500 microns. Close the electronic vacuum gauge and vacuum pump valves. Shut off the vacuum pump. Wait five minutes to see if vacuum holds. This procedure checks for residual moisture and/or leaks.
- j. With a vacuum still in the unit, the refrigerant charge may be drawn into the system from a refrigerant container on weight scales.

#### 6.6.4 Partial System

- a. If refrigerant charge has been removed from the low side only, evacuate the low side by connecting the evacuation set-up at the compressor suction valve and the liquid service valve but leave the service valves frontseated until evacuation is completed.
- b. Once evacuation has been completed and the pump has been isolated, fully backseat the service valves to isolate the service connections and then continue with checking and, if required, adding refrigerant in accordance with normal procedures.

### 6.7 REFRIGERANT CHARGE



**EXPLOSION HAZARD** Failure to follow this **WARNING** can result in death, serious personal injury and / or property damage.

Never use air or gases containing oxygen (O<sub>2</sub>) for leak testing or operating the product.

Charge only with R-134a: Refrigerant must conform to AHRI Standard 700 specification.

### 6.7.1 Checking the Refrigerant Charge

#### NOTE

Use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws. In the U.S.A., refer to EPA Section 608.

- a. Connect the gauge manifold to the compressor discharge and suction service valves.
- b. Bring the container temperature to approximately 0°C (32°F) or below. Then set the controller set point to -25°C (-13°F).
- c. Partially block the condenser coil inlet air. If covering the lower portion of the coil is not sufficient, remove the left hand infill panel and cover the left side of the coil. Increase the area blocked until the compressor discharge pressure is raised to approximately 12.8 bar (185 psig).
- d. The refrigerant level should be between the glasses on the receiver. If the refrigerant level is not correct, continue with the following paragraphs to add or remove refrigerant as required.

### 6.7.2 Adding Refrigerant to System (Full Charge)

- a. Evacuate unit and leave in deep vacuum. (Refer to paragraph 6.6.1.)
- b. Place cylinder of R-134a on scale and connect charging line from cylinder to liquid line valve. Purge charging line at liquid line valve and then note weight of cylinder and refrigerant.
- c. Open liquid valve on cylinder. Open liquid line valve half-way and allow the liquid refrigerant to flow into the unit until the correct weight of refrigerant (refer to paragraph 2.2) has been added as indicated by scales.

#### NOTE

It may be necessary to finish charging unit through suction service valve in gas form, due to pressure rise in high side of the system.

- d. Backseat manual liquid line valve (to close off gauge port). Close liquid valve on cylinder.
- e. Start unit in cooling mode. Run for approximately 10 minutes and check the refrigerant charge.

### 6.7.3 Adding Refrigerant to System (Partial Charge)

- a. Examine the unit refrigerant system for any evidence of leaks. Repair as necessary. (Refer to paragraph 6.5.).
- b. Maintain the conditions outlined in paragraph 6.7.1.
- c. Fully backseat the suction service valve and remove the service port cap.
- d. Connect charging line between suction service valve port and cylinder of refrigerant R-134a. Open VAPOR valve.
- e. Partially frontseat (turn clockwise) the suction service valve and slowly add charge until the refrigerant appears at the proper level. Be careful not to frontseat the suction valve fully, if the compressor is operated in a vacuum, internal damage may result.

## 6.8 COMPRESSOR

### WARNING

Make sure power to the unit is OFF and power plug disconnected before replacing the compressor.

### WARNING

Before disassembly of the compressor, be sure to relieve the internal pressure very carefully by slightly loosening the couplings to break the seal.

### CAUTION

The scroll compressor achieves low suction pressure very quickly. Do not use the compressor to evacuate the system below 0 psig. Never operate the compressor with the suction or discharge service valves closed (frontseated). Internal damage will result from operating the compressor in a deep vacuum.

### CAUTION

The PrimeLINE unit has a hermetically sealed compressor that should not be opened and/or repaired. Doing so can cause a loss in performance and premature system failure due to the precision machinery and assembly required within the compressor. To repair the unit, remove the faulty compressor and replace with an approved Carrier compressor. If the return of the compressor is not required, follow local waste collection and recycling regulations in discarding the compressor.

### 6.8.1 Removal and Replacement of Compressor

- a. Turn the unit ON and run it in full cool mode for 10 minutes.

#### NOTE

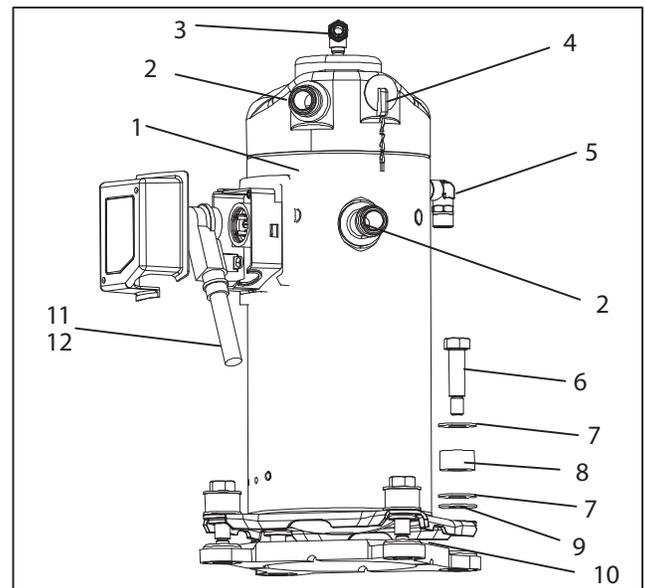
If the compressor is not operational, front-seat the suction and discharge service valves and go to step e. below.

- b. Frontseat the manual liquid line valve and allow the unit to pull-down to 0.1 kg/cm<sup>2</sup> (1 psig).
- c. Turn the unit start-stop switch (ST) and unit circuit breaker (CB -1) OFF, and disconnect power to the unit.
- d. Frontseat the discharge and suction service valves.
- e. Remove all remaining refrigerant from the compressor using a refrigerant recovery system.
- f. Remove the compressor terminal cover, disconnect the ground wire and pull the cable plug from the compressor terminals. Install the terminal cover back after removing the power cable.

#### NOTE

Inspect the power cable (plug) terminals to ensure they are not deformed or have any signs of heat or arcing. If any damage is noted, replace the power cable.

- g. Remove the Rotalock fittings from the suction and discharge service connections, and uncouple the unloader and economizer lines from the compressor.
- h. Cut the dome temperature sensor (CPDS) wires. The replacement compressor comes with a CPDS already assembled.
- i. Remove and save the compressor base mounting bolts. Discard the 4 top resilient mounts and washers.
- j. Remove (slide out) the old compressor from the unit.
- k. Inspect compressor base plate for wear. Replace, if necessary.
- l. Wire tie the compressor base plate to the compressor, and slide the new compressor into the unit. Refer to Figure 6 -5.



- |  |  |
|--|--|
| 1. Compressor                              | 7. SST Washers                                 |
| 2. Teflon Seal for Valve Connection (2)    | 8. Resilient Mount                             |
| 3. O-Ring (Unloader Connection)            | 9. Mylar Washers                               |
| 4. Compressor Discharge Temperature Sensor | 10. Wire Ties                                  |
| 5. O-Ring (Economizer Connection)          | 11. Power Cable Gasket                         |
| 6. Base Mounting Bolts                     | 12. Ground Connection Screw                    |
|  | 13. Power Cable Lubricant - Krytox (Not Shown) |

Figure 6 -5 Compressor Kit

#### NOTE

DO NOT add any oil to the replacement compressor. Replacement compressor is shipped with full oil charge of 60 oz.

- m. Cut and discard the wire ties used to hold the base plate to the compressor.
- n. Place the new SST washers on each side of the resilient mounts, and the new Mylar washer on the bottom of it as shown in Figure 6 -5. Install the four base mounting bolts loosely.

- o. Place the new Teflon seals at the compressor suction and discharge ports as well as the O-rings at the unloader and economizer line connection ports. Hand tighten all four connections.
- p. Torque the four base-mounting screws to 6.2 mkg (45 ft-lbs).
- q. Torque the compressor ports / connections to:

Service Valve / Connection	Torque Value
Suction and Discharge Rotalocks	108.5 to 135.5 Nm (80 to 100 ft-lbs.)
Unloader connection	24.5 to 27 Nm (18 to 20 ft-lbs.)
Economized connection	32.5 to 35 Nm (24 to 26 ft-lbs.)

- r. Connect (butt-splice and heat shrink) the new compressor dome temperature sensor with the old sensor wires removed in step h. Wire-tie any loose wiring as appropriate.
- s. Evacuate the compressor to 1000 microns if the unit was pumped down before the replaced compressor was removed. Otherwise, evacuate the complete unit and charge it with R-134a refrigerant (see Sections 6.6.1 and 6.7.1).
- t. Open the compressor terminal cover and connect the compressor power cable following the steps below:
  - 1. Liberally coat the orange gasket surfaces with the Krytox lubricant.
  - 2. Install the orange gasket part onto the compressor fusite with the grooved or threaded side out. Ensure that the gasket is seated onto the fusite base.
  - 3. Coat the inside of the power plug (female) connector pins with the Krytox lubricant, and insert the plug onto the compressor terminal connections. Make sure, the orange gasket has bottomed out onto the fusite and it fits securely onto the terminal pins while fully inserted into the orange plug.
  - 4. Connect the green ground wire to the grounding tab located inside the terminal box of the compressor using the self-tapping grounding screw. Close the compressor terminal box using the terminal cover removed in step t.
- u. Backseat all service valves, connect the power to the unit and run it for at least 20 minutes.
- v. Perform a leak check of the system.

## 6.9 HIGH PRESSURE SWITCH

### 6.9.1 Checking High Pressure Switch

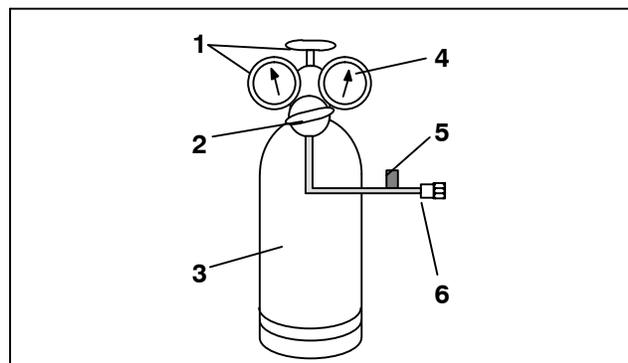


**Do not use a nitrogen cylinder without a pressure regulator.**

#### NOTE

The high pressure switch is non-adjustable.

- a. Remove switch as outlined in paragraph 6.9.2.
- b. Connect ohmmeter or continuity light across switch terminals. Ohm meter will indicate no resistance or continuity light will be illuminated if the switch closed after relieving compressor pressure.
- c. Connect hose to a cylinder of dry nitrogen. (See Figure 6-6.



- |                             |  |
|-----------------------------|--|
| 1. Cylinder Valve and Gauge | 4. Pressure Gauge (0 to 36 kg/cm <sup>2</sup> = 0 to 400 psig) |
| 2. Pressure Regulator       | 5. Bleed-Off Valve   |
| 3. Nitrogen Cylinder        | 6. 1/4 inch Connection   |

**Figure 6-6 High Pressure Switch Testing**

- d. Set nitrogen pressure regulator at 26.4 kg/cm<sup>2</sup> (375 psig) with bleed-off valve closed.
- e. Close valve on cylinder and open bleed-off valve.
- f. Open cylinder valve. Slowly close bleed-off valve to increase pressure on switch. The switch should open at a static pressure up to 25 kg/cm<sup>2</sup> (350 psig). If a light is used, the light will go out. If an ohmmeter is used, the meter will indicate open circuit.
- g. Slowly open bleed-off valve to decrease the pressure. The switch should close at 18 kg/cm<sup>2</sup> (250 psig).

### 6.9.2 Replacing High Pressure Switch

- a. Remove the refrigerant charge.
- b. Disconnect wiring from defective switch. The high pressure switch is located on the discharge connection or line and is removed by turning counterclockwise.
- c. Install a new high pressure switch after verifying switch settings.
- d. Evacuate, dehydrate and recharge the system.
- e. Start the unit, verify refrigeration charge and oil level.

## 6.10 CONDENSER COIL

The condenser coil consists of a series of parallel copper tubes expanded into copper fins and formed into a "C" shape with the fourth side of the square formed by the side support bracket.

### 6.10.1 Condenser Coil Cleaning

To ensure optimal efficiency of the unit the condenser coil must be clean. The condenser coil should be cleaned at least once a year, but more frequent cleaning may be required depending on operating conditions. The coil is cleaned with fresh water sprayed in the reverse direction of the air flow to remove any debris from the coil. A high pressure washer is not required, mains water pressure is sufficient. To clean the condenser coil perform the following procedure:



### WARNING

**Do not remove the condenser fan grille before turning power OFF and disconnecting the power plug.**

- Make sure the unit is powered off and the plug is disconnected.
- Remove the condenser fan grille.
- Starting from the top of the coil, use a water hose with a nozzle to wash the coil from the inside out.
- Systematically wash across the inside top face of the coil until the water runs clean.
- Wash down the center section, and then through the bottom of the coil, continue washing until the water runs clear.
- After the coil is clean, rinse the condenser fan to remove any dirt build up from the blades.
- Replace the condenser fan grille ensuring that it is centered around the fan.

### 6.10.2 Condenser Coil Removal

- Using a refrigerant reclaim system remove the refrigerant charge.



**Do not remove the condenser fan grille before turning power OFF and disconnecting the power plug.**

- Remove the condenser fan grille, retain all bolts and washers for reuse.
- Remove the condenser fan.
- Remove the infill panels to the left and right of the condenser fan shroud.
- Remove the condenser fan shroud.
- Unplug the condenser fan motor.
- Remove and retain sufficient putty from around the motor wire harness to allow the harness to be slid back through the side support bracket.

- Cut the top and bottom drain lines midway between the side support bracket and the first cable tie, approx 150mm (6") from the side support bracket.
- Remove and retain sufficient putty from around the drain lines to allow the tubes to be slid back through the side support bracket.
- Remove filter drier.
- Unbrazed the inlet connection to coil.
- Remove the cushion clamps securing the liquid line to the top and bottom receiver brackets, retain all clamps and securing hardware.
- Place a support under the condenser coil before releasing the coil from the frame.
- Remove the lower mounting bracket bolts from the inside of the coil.
- Remove the top mounting bracket bolts and grille extension mount from inside the coil.
- Remove the side support bracket mounting bolts.
- Slide the condenser assembly with receiver out of the unit.

### 6.10.3 Condenser Coil Preparation

Before installing the new condenser coil, the receiver assembly and mounting hardware must be removed from the old coil assembly:

- From the old coil, unbolt the receiver assembly from side support bracket.
- Unbrazed the receiver assembly from the coil outlet line and remove from the coil assembly.
- Unbolt the side support bracket from the top and bottom coil supports and remove from old coil.
- Refit the side support bracket to the new coil ensuring that the top and bottom are flush mounted with the coil support.
- Insert the receiver pipe work onto the coil outlet and loosely secure the receiver assembly to the side support bracket with the retained hardware.
- Braze the outlet connection to the receiver assembly.

### 6.10.4 Condenser Coil Installation

Once the receiver and mounting hardware have been secured to the new condenser coil, the entire assembly is ready to be installed into the unit:

- Slide the new condenser coil into place ensuring the coil inlet connection is mated to the pipework and that the coil is fully supported.
- Secure the condenser coil into the unit using the retained hardware; refit the mylar and fender washers:
  - Refit the side support bracket bolts.
  - Refit the top support bracket bolts as well as the top grille extension support.
  - Refit the bottom support bracket bolts.
- Braze the condenser coil inlet connection.
- Install a new filter drier.
- Replace the liquid line cushion clamps.
- Secure the receiver assembly to the side support bracket.

- g. Slide the top and bottom drain lines back into place through the side support bracket.
- h. Using the two supplied straight connectors and contact adhesive reconnect the drain lines.
- i. Slide the condenser fan motor wiring harness back through the side support bracket and refit to condenser motor.
- j. Replace all wire ties that were removed to properly secure the drain line and wiring.
- k. Reseal the wire harness and drain line penetrations with the putty.
- l. Slide the condenser fan onto the motor shaft reversed but do not secure.
- m. Refit the condenser fan shroud to the unit. Use the condenser fan as a guide to ensure the shroud is properly centered around the fan.
- n. Remove the condenser fan, and place it on the shaft facing the correct direction. Adjust the fan to the correct position, 37mm (1.5") from the fan shroud.
- o. Use Loctite "H" on the fan set screws, and tighten.
- p. Refit left and right infill panels.
- q. Refit the condenser fan grille, ensuring the grille is properly centered around the condenser fan.
- r. Pressure / leak test the coil and filter drier connections, refer to Section 6.5.
- s. Evacuate the entire unit, refer to Section 6.6.
- t. Recharge the unit with the charge shown on the unit serial plate, refer to Section 6.7. It is important for proper unit operation that the charge is weighed into the unit.

## 6.11 CONDENSER FAN AND FAN MOTOR

The condenser fan rotates counter-clockwise (viewed from front of unit). The fan pulls air through the condenser coil, and discharges the air horizontally through the front of the unit.

### 6.11.1 Condenser Fan Motor Remove/Replace

## WARNING

**Do not remove the condenser fan grille before turning power OFF and disconnecting the power plug.**

- a. Remove the condenser fan grille, retain all bolts and washers for reuse.
- b. Remove the condenser fan by loosening the two set screws.
- c. Disconnect the condenser fan motor wiring.



## CAUTION

**Take necessary steps (place plywood over coil or use sling on motor) to prevent motor from falling into condenser coil.**

- d. Note the number of shims on each side of the motor as the same configuration will be required to refit the new motor.
- e. Remove the fan motor mounting hardware and remove motor.
- f. Loosely mount the new motor using new lock nuts.
- g. Connect the fan motor wiring to the new fan motor.
- h. Replace the shims in the same configuration as they were removed.
- i. Tighten the fan motor mounting bolts to properly secure the motor.
- j. To make sure that the motor is aligned properly, slide the condenser fan onto the motor shaft reversed but do not secure.
- k. Rotate the fan to make sure the fan blades do not contact the shroud:
  1. If the fan motor is misaligned vertically, add or remove shims to align.
  2. If the fan motor is not properly centered, loosen the mounting bolts, and adjust the motor position on the bracket, and then secure the motor.
- l. Remove the condenser fan, and connect the fan motor wiring to the fan motor.
- m. Place the condenser fan on the shaft facing the correct direction. Adjust the fan to the correct position, 37mm (1.5") from the fan shroud.
- n. Use Loctite "H" on the fan set screws, and tighten.
- o. Refit the left and right infill panels.
- p. Refit the condenser fan grille, ensuring the grille is properly centered around condenser fan.

## 6.12 FILTER DRIER

### a. To check filter drier:

1. Test for a restricted or plugged filter drier by feeling the liquid line inlet and outlet connections of the drier cartridge. If the outlet side feels cooler than the inlet side, then the filter drier should be changed.
2. Check the moisture-liquid indicator if the indicator shows a high level of moisture, the filter drier should be replaced.

### b. To replace filter drier:

1. Pump down the unit (refer to paragraph 6.4). Evacuate if unit is not equipped with service valves. Then replace filter drier.
2. Evacuate the low side in accordance with paragraph 6.6.
3. After unit is in operation, inspect for moisture in system and check charge.

### 6.13 EVAPORATOR COIL & HEATER ASSEMBLY

The evaporator section, including the evaporator coil, should be cleaned regularly. The preferred cleaning fluid is fresh water or steam. Another recommended cleaner is Oakite 202 or similar, following *manufacturer's instructions*.

The two drain pan hoses are routed behind the condenser fan motor and compressor. The drain pan line(s) must be open to ensure adequate drainage.

#### 6.13.1 Evaporator Coil Replacement

- a. Pump unit down. (Refer to paragraph 6.4) Refer to paragraph 6.6.1.



**Always turn OFF the unit circuit breaker (CB-1) and disconnect main power supply before working on moving parts.**

- b. With power OFF and power plug removed, remove the screws securing the panel covering the evaporator section (upper panel).
- c. Disconnect the defrost heater wiring.
- d. Unsolder the two coil connections, one at the distributor and the other at the coil header.
- e. Disconnect the defrost temperature sensor (see 6.22) from the coil.
- f. Remove middle coil support.
- g. Remove the mounting hardware from the coil and remove the coil.
- h. After defective coil is removed from unit, remove defrost heaters and install on replacement coil.
- i. Install coil assembly by reversing above steps.

- j. Leak check connections. Evacuate and add refrigerant charge.

#### 6.13.2 Evaporator Heater Replacement

The heaters are wired back to a terminal block. If a heater failure occurs during a trip, the heater set containing that heater may be disconnected at the terminal block. When isolating an individual heater it is important to ensure it is disconnected from the terminal block and the heater contactor to isolate it completely.

The next Pre-trip (P1) will detect that a heater set has been disconnected and indicate that the failed heater should be replaced. To remove a heater, do the following:



**Always turn OFF the unit circuit breaker (CB-1) and disconnect main power supply before removing electrical parts.**

- a. Before servicing unit, make sure the unit circuit breakers (CB-1) and the start-stop switch (ST) are in the OFF position, and that the power plug is disconnected.
- b. Remove the upper back panel.
- c. Determine which heater(s) need replacing by checking resistance of each heater set. Refer to paragraph 2.3 for heater resistance values. Once the set containing the failed heater is determined, cut the splice connection and retest to determine the actual failed heater(s).
- d. Remove hold-down clamp securing heater(s) to coil.
- e. Lift the bent end of the heater (with the opposite end down and away from coil). Move heater to the side enough to clear the heater end support and remove.

To replace a heater, do steps a through e in reverse.

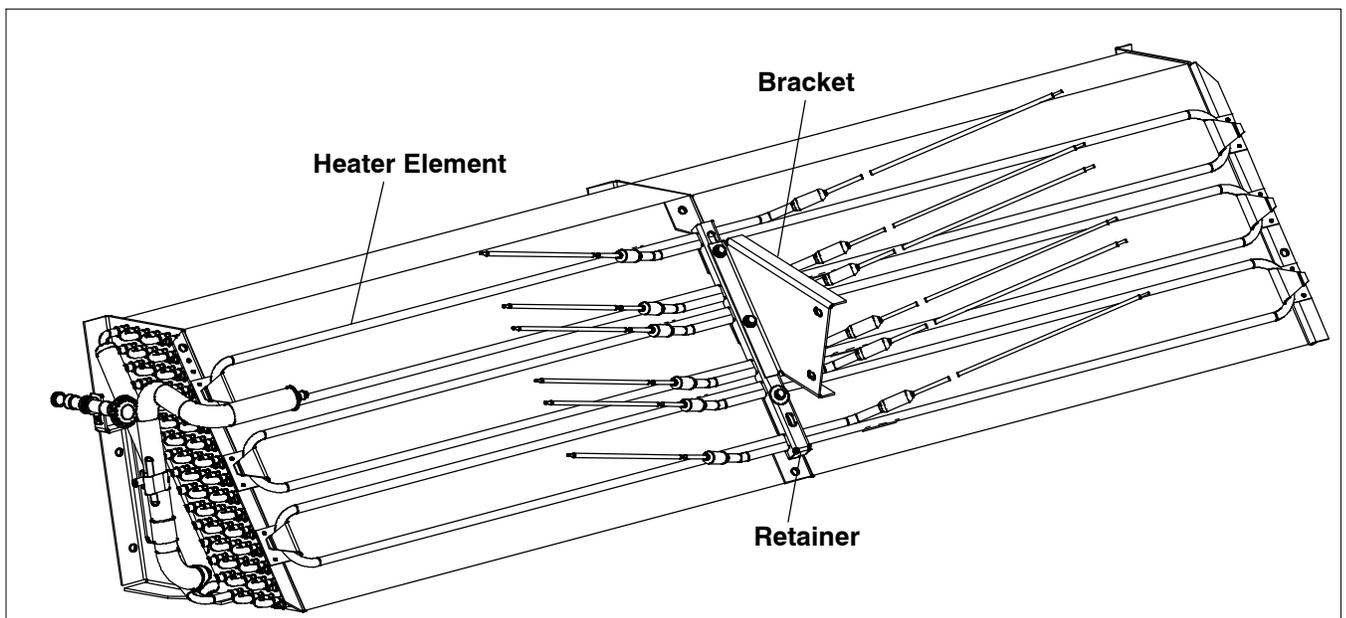


Figure 6-7 Heater Arrangement

## 6.14 EVAPORATOR FAN AND MOTOR ASSEMBLY

The evaporator fans circulate air throughout the container by pulling air in the top of the unit. The air is forced through the evaporator coil where it is either heated or cooled and then discharged out the bottom of the refrigeration unit into the container. The fan motor bearings are factory lubricated and do not require additional grease.

### 6.14.1 Replacing the Evaporator Fan Assembly

#### **WARNING**

**Always turn OFF the unit circuit breakers (CB-1 & CB-2) and disconnect main power supply before working on moving parts.**

- Remove access panel by removing mounting bolts and TIR locking device. Reach inside of unit and remove the Ty-Rap securing the wire harness loop. Disconnect the connector by twisting to unlock and pulling to separate.
- Loosen four 1/4-20 clamp bolts that are located on the underside of the fan deck at the sides of the fan assembly. Slide the loosened clamps back from the fan assembly.
- Slide the fan assembly out from the unit and place on a sturdy work surface.

### 6.14.2 Disassemble the Evaporator Fan Assembly

- Attach a spanner wrench to the two 1/4-20 holes located in the fan hub. Loosen the 5/8-18 shaft nut by holding the spanner wrench stationary and turning the 5/8-18 nut counter-clockwise (see Figure 6-8).
- Remove the spanner wrench. Use a universal wheel puller and remove the fan from the shaft. Remove the washers and key.
- Remove the four 1/4-20 x 3/4 long bolts that are located under the fan that support the motor and stator housing. Remove the motor and plastic spacer.

### 6.14.3 Assemble the Evaporator Fan Assembly

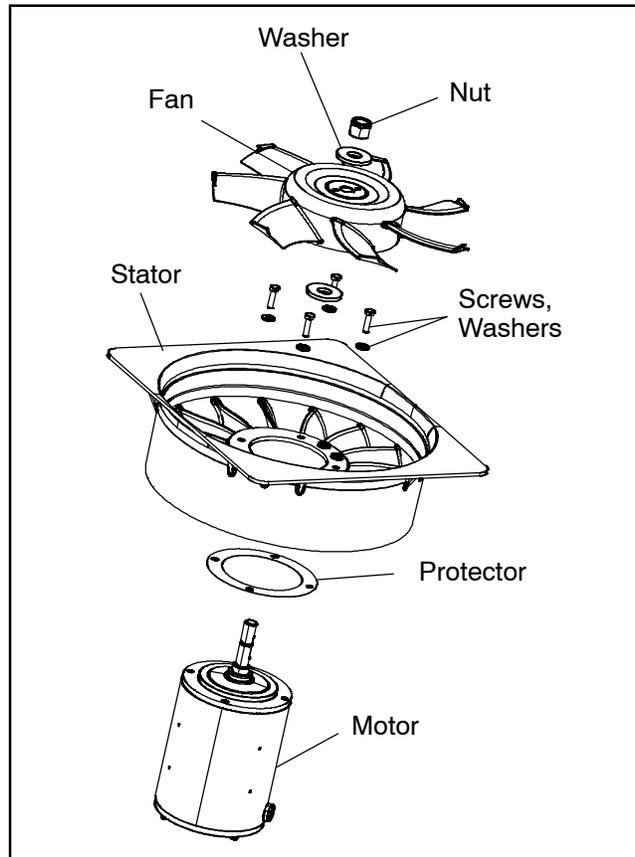
- Assemble the motor and plastic spacer onto the stator.

#### **NOTE**

When removing the black nylon evaporator fan blade, care must be taken to assure that the blade is not damaged. In the past, it was a common practice to insert a screwdriver between the fan blades to keep it from turning. This practice can no longer be used, as the blade is made up of a material that will be damaged. It is recommended that an impact wrench be used when removing the blade. Do not use the impact wrench when reinstalling, as galling of the stainless steel shaft can occur.

- Apply Loctite to the 1/4-20 x 3/4 long bolts and torque to 0.81 mkg (70 inch-pounds).
- Place one 5/8 flat washer on the shoulder of the fan motor shaft. Insert the key in the keyway and lubricate the fan motor shaft and threads with a graphite-oil solution (such as Never-seez).

- Install the fan onto the motor shaft. Place one 5/8 flat washer with a 5/8-18 locknut onto the motor shaft and torque to 40 foot-pounds.



**Figure 6-8 Evaporator Fan Assembly**

- Install the evaporator fan assembly in reverse order of removal. Torque the four 1/4-20 clamp bolts to 0.81 mkg (70 inch-pounds). Connect the wiring connector.
- Replace access the panel making sure that the panel does not leak. Make sure that the TIR locking device is lockwired.

## 6.15 EVAPORATOR SECTION CLEANING

Containers and Container units that are exposed to certain fumigants may develop visible surface corrosion. This corrosion will show up as a white powder found on the inside of the container and on the reefer unit evaporator stator and fan deck.

Analyses by Carrier Transicold environmental specialists have identified the white powder as consisting predominantly of aluminum oxide. Aluminum oxide is a coarse crystalline deposit most likely the result of surface corrosion on the aluminum parts within the container. If left untreated over time, it may build up in thickness and eventually flake as a light-weight white powder.

The surface corrosion of aluminum is brought about by exposure to chemicals such as sulfur dioxide and possibly other fumigants that are commonly used for fumigation and protection of some perishable cargo such as grapes, for example. Fumigation is the process by which a chemical is released into an enclosed area to eliminate infestations of insects, termites, rodents, weeds and soil-born disease.

Typically any aluminum oxide that becomes detached from evaporator fan stators will be blown into the wet evaporator coil where it will be caught and then flushed out of the unit during routine defrost cycles.

However, it is still highly recommended that after carrying cargo subject to fumigation procedures, that the inside of the unit be thoroughly cleansed prior to reuse.

Carrier Transicold has identified a fully biodegradable and environmentally safe alkaline cleaning agent (Tri-Pow'r® HD) for the unit. This will assist in helping to remove the corrosive fumigation chemicals and dislodging of the corrosive elements.

This cleaner is available from the Carrier Transicold Performance Parts Group (PPG) and can be ordered through any of the PPG locations; Part Number NU4371-88.

As a general safety precaution, before using this product, refer to and retain the Material Safety Data (MSDS) sheet. This document can be found at:

[www.nucalgon.com/products/coil\\_cleaners\\_tripower.htm](http://www.nucalgon.com/products/coil_cleaners_tripower.htm)

#### Prior to Cleaning:

- Always wear goggles, gloves and work boots.
- Avoid contact with skin and clothing, and avoid breathing mists.
- When mixing, add water to the sprayer first, then the cleaner. Mix at a ratio of 5 parts water / 1 part cleaner.
- ALWAYS provide for proper ventilation when cleaning indoor evaporator coils (rear doors must be open).
- Be aware of surroundings – food, plants, etc., and the potential for human exposure.
- Always read directions and follow recommended dilution ratios. More is not always better. Using non-diluted cleaner is not recommended.

#### Cleaning Procedure:

- a. Remove the upper evaporator access panel inside of the unit.
- b. Spray the surface with water before applying the cleaning solution. This helps the cleaner work better.
- c. Liberally apply the prepared cleaner solution.
- d. Allow the cleaner to soak in for 5 to 7 minutes.
- e. Assess area for rinsing. Follow all local regulations regarding disposal of waste water.
- f. Thoroughly rinse the cleaner and surrounding area, floor, etc. When rinsing where heavy foaming solution is present, it is very important to take the time to thoroughly rinse the equipment and surroundings.
- g. Always rinse the empty coil cleaner bottle, cap tightly and dispose of properly.

### 6.16 ELECTRONIC EXPANSION VALVE

The electronic expansion valve (EEV) is an automatic device which maintains required superheat of the refrigerant gas leaving the evaporator. The valve functions are: (a) automatic response 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.

### 6.16.1 Replacing Electronic Expansion Valve and Screen

- a. Removing an EEV:



**Always turn OFF the unit circuit breaker (CB-1) and disconnect main power supply before working on moving parts.**

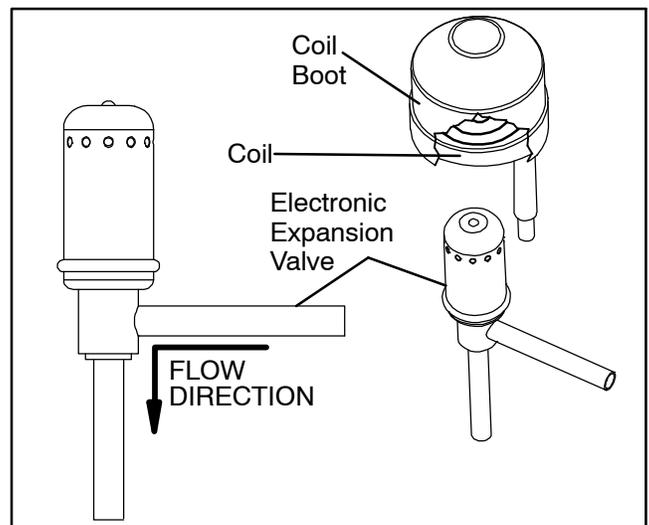
1. Pump down the compressor (refer to paragraph 6.4) and frontseat both suction and discharge valves.
2. Turn unit power off and remove power from the unit.
3. Remove EEV coil.
4. VALVE REMOVAL: The preferred method of removing the valve is to cut the connection between the brazed section and the valve, using a small tube cutter. Remove valve.

Alternately, use a wet rag to keep valve cool. Heat inlet and outlet connections to valve body and remove valve.

5. Clean the valve stem with mild cleaner, if necessary.

- b. Installing an EEV

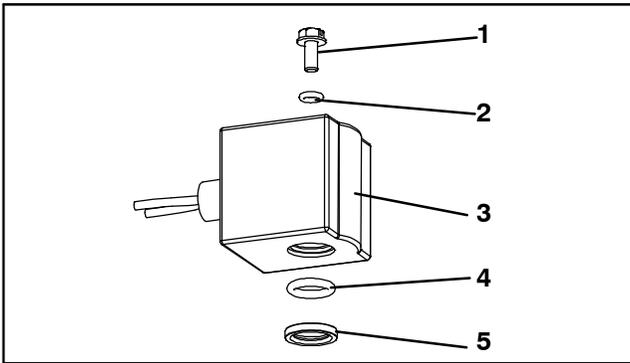
1. Reverse steps 1 through 4 above to install a new valve. Install valve and screen with cone of screen pointing into liquid line at inlet to the valve.
2. During installation, make sure the EEV coil is snapped down fully, and the coil retention tab is properly seated in one of the valve body dimples. Also, ensure that coil boot is properly fitted over valve body. See Figure 6-9.



**Figure 6-9 Electronic Expansion Valve**

3. Replace filter drier.
4. Evacuate to 500 microns by placing vacuum pump on liquid line and suction service valve.
5. Open liquid line service valve and check refrigerant level.
6. Check superheat. (Refer to Section 2.2).
7. Check unit operation by running Pre-trip (Refer to Section 3.7).

## 6.17 ECONOMIZER SOLENOID VALVE



1. Slotted Screw
2. Top Coil (small) O-ring
3. Solenoid Coil, Enclosing Tube and Body
4. Bottom Coil (large) O-ring
5. Brass Spacer

**Figure 6-10 Coil View of Economizer Solenoid Valve (ESV)**

### a. Removing a Solenoid Valve Coil:



**Always turn OFF the unit circuit breaker (CB-1) and disconnect main power supply before working on moving parts.**

1. Turn unit power off and remove power from the unit. Disconnect leads.
  2. Remove top screw and o-ring. Remove coil and save mounting hardware, seals and spacer for re-use. (See Figure 6-10). Refer to step d. for valve coil replacement.
- ### b. Removing the Solenoid Valve:
1. Pump down the compressor (refer to paragraph 6.4) and frontseat both suction and discharge valves.
  2. **VALVE REMOVAL:** The preferred method of removing the solenoid valve is to cut the connection between the brazed section and the valve, using a small tube cutter. Remove valve.  
  
Alternately, heat inlet and outlet connections to valve body and remove valve.
  3. Clean the valve stem with mild cleaner, if necessary.
- ### c. Installing the Solenoid Valve:
1. Fit the new solenoid valve into position and braze. Use a wet rag to keep valve cool whenever brazing.
- ### d. Installing the Solenoid Valve Coil:
1. Install the brass spacer on the valve stem.
  2. Lubricate both o-rings with silicone provided in the kit.
  3. Install bottom coil o-ring on the valve stem.
  4. Install the solenoid coil on the valve stem.

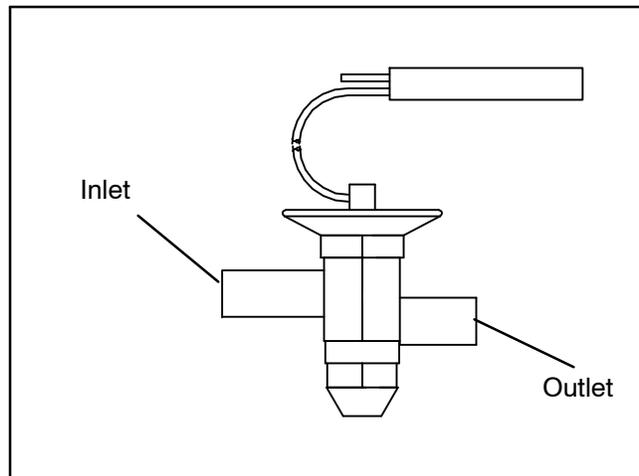
5. Place the top coil o-ring on the coil mounting screw and secure the coil to the valve using a torque-wrench. Torque the screw to 25 in-lbs.
6. Connect coil wires using butt-splices and heat-shrink tubing.

## 6.18 ECONOMIZER EXPANSION VALVE

The economizer expansion valve is an automatic device that maintains constant superheat of the refrigerant gas leaving at the point of bulb attachment, regardless of suction pressure.

Unless the valve is defective, it seldom requires maintenance other than periodic inspection to ensure that the thermal bulb is tightly secured to the suction line and wrapped with insulating compound.

### 6.18.1 Economizer Expansion Replacement



**Figure 6-11 Economizer Expansion Valve**

### a. Removing the Economizer Expansion Valve:

#### NOTE

The economizer expansion valve is a hermetic valve, it does not have adjustable superheat (See Figure 6-11).

1. Pump down the compressor (refer to paragraph 6.4) and frontseat both suction and discharge valves. Evacuate if unit is not equipped with service valves. Refer to paragraph 6.6.1.
2. Turn unit power off and remove power from the unit.
3. Remove cushion clamps located on the inlet and outlet lines.
4. Remove insulation (Presstite) from expansion valve bulb.
5. Unstrap the bulb, located on the economizer line.

6. VALVE REMOVAL: The preferred method of removing the valve is to cut the connection between the brazed section and the valve, using a small tube cutter. Remove valve.

Alternately, use a wet rag to keep valve cool. Heat inlet and outlet connections to valve body and remove valve.

7. Clean the valve stem with mild cleaner, if necessary.

b. Installing the Economizer Expansion Valve:

1. The economizer expansion valve should be wrapped in a soaked cloth for brazing.
  2. Braze inlet connection to inlet line.
  3. Braze outlet connection to outlet line.
  4. Reinstall the cushion clamps on inlet and outlet lines.
- c. Replace filter drier, (Refer to Section 6.12).
- d. Evacuate to 500 microns by placing vacuum pump on liquid line and suction service valve.
- e. Check economizer expansion valve superheat (see Section 2.2).

### 6.19 DIGITAL UNLOADER VALVE

a. Removing the DUV:

1. Pump down the compressor (refer to paragraph 6.4) and frontseat both suction and discharge valves. In the event the DUV is stuck open and compressor cannot pump down, remove charge.



**The scroll compressor achieves low suction pressure very quickly. Do not use the compressor to evacuate the system below 0 psig. Never operate the compressor with the suction or discharge service valves closed (frontseated). Internal damage will result from operating the compressor in a deep vacuum.**

2. Turn unit power off and remove power from the unit.
3. Loosen bolt on top of the DUV and remove coil assembly.

#### NOTE

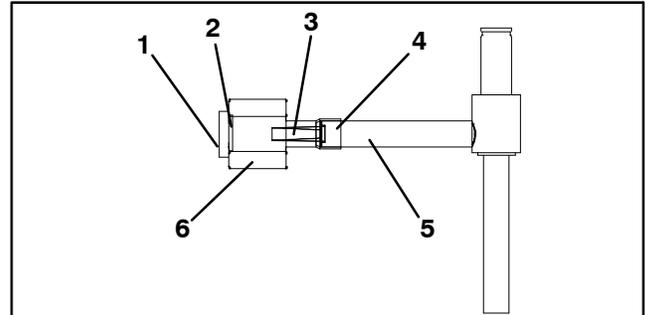
There is a small spacer tube between the top of the valve and the 12 VDC coil that needs to be reinstalled into the solenoid valve coil. When removing the coil, it may fall out when lifted from the valve body. Take care that the spacer is not lost; the valve will not function correctly without it.

4. Remove clamps holding the DUV to the discharge line.

5. Loosen the nuts attaching the DUV to the top of the compressor.

6. VALVE REMOVAL: The preferred method of removing the solenoid valve is to cut the connection between the brazed section and the valve, using a small tube cutter. Remove valve. (See Figure 6-12).

Alternately, use a wet rag to keep valve cool. Heat outlet connection to valve body and remove valve.



- |                          |                        |
|--------------------------|------------------------|
| 1. Sleeve                | 4. Tube                |
| 2. O-ring (hidden)       | 5. Solenoid Valve Body |
| 3. Screen Valve Strainer | 6. Hex Nut, 1/2 OD     |

**Figure 6-12 View of Digital Unloader Valve (DUV) Assembly**

7. Examine compressor and service valves. Ensure that the o-ring is not stuck in the gland of the valve.
  8. Discard the o-ring on the o-ring face seal connection.
- b. Installing the DUV:

1. Lubricate the gland shoulder area and o-ring with refrigerant oil.
2. Fit new valve in position and hand-tighten the o-ring nut.
3. Use a wet rag to keep valve cool while brazing. Braze DUV to service valve connection.
4. Reinstall and tighten the brackets that secure the valve body to the discharge line.
5. Torque o-ring face seal connections to 18 to 20 ft-lbs.
6. Install the coil onto the valve body and tighten the attachment bolt.

#### NOTE

Confirm that the small spacer tube is inserted into the coil prior to attaching it to the valve body. The valve will not function correctly without it.

7. Leak check and evacuate low side of unit as applicable. Refer to paragraph 6.6.1.
8. Open service valves.

## 6.20 VALVE OVERRIDE CONTROLS

Controller function code Cd41 is a configurable code that allows timed operation of the automatic valves for troubleshooting. Test sequences are provided in Table 6–1. Capacity mode (CAP) allows alignment of the economizer solenoid valve in the standard and economized operating configurations. DUV Capacity Modulation, % Setting (PCnt) and Electronic Expansion Valve (EEV) allows opening of the digital unloader valve and electronic expansion valve, respectively, to various percentages. If the unit is equipped with an LIV, the Liquid Valve Setting allows the LIV to be automatically controlled, or manually opened and closed.

The Override Timer (tIM) selection is also provided to enter a time period of up to five minutes, during which the override(s) are active. If the timer is active, valve override selections will take place immediately. If the timer is not active, changes will not take place for a few seconds after the timer is started. When the timer times out, the override function is automatically terminated and the valves return to normal machinery control. To operate the override:

- a. Press the CODE SELECT key then press an ARROW key until Cd41 is displayed in the left window. The right window will display a controller communications code.
- b. Press the ENTER key. The left display will show a test name alternating with the test setting or time remaining. Use an ARROW key to scroll to the desired test. Press the ENTER key, SELct will appear in the left display.
- c. Use an ARROW key to scroll to the desired setting, and then press the ENTER key. Selections available for each of the tests are provided in Table 6–1.
- d. If the timer is not operating, follow the above procedure to display the timer. Use an ARROW key to scroll to the desired time interval and press ENTER to start the timer.
- e. The above described sequence may be repeated during the timer cycle to change to another override.

**Table 6–1 Valve Override Control Displays**

Left Display	Controller Communications Codes (Right Display)	Setting Codes (Right Display)
<b>Cd 41/SELct</b>	<b>tIM</b> (Override Timer)	<b>0 00</b> (0 minutes/0 Seconds) In 30 second increments to <b>5 00</b> (5 minutes/ 0 seconds)
	<b>PCnt</b> (% Setting – DUV Capacity Modulation)	<b>AUto</b> (Normal Machinery Control) 0 3 6 10 25 50 100
	<b>EEV</b> (% Setting – Electronic Expansion Valve)	<b>AUto</b> (Normal Machinery Control) <b>CLOSE</b> (Closed) 0 3 6 10 25 50 100
	<b>CAP</b> (Capacity Mode)	<b>AUto</b> (Normal Control) <b>Std UnLd</b> (Economizer = Closed) <b>ECON</b> (Economizer = Open)

## 6.21 CONTROLLER

### 6.21.1 Handling Modules



**Do not remove wire harnesses from module unless you are grounded to the unit frame with a static safe wrist strap.**



**Unplug all module connectors before performing arc welding on any part of the container.**

The guidelines and cautions provided herein should be followed when handling the modules. These precautions and procedures should be implemented when replacing a module, when doing any arc welding on the unit, or when service to the refrigeration unit requires handling and removal of a module.

- Obtain a grounding wrist strap (Carrier Transicold P/N 07-00304-00) and a static dissipation mat (Carrier Transicold P/N 07-00277-00). The wrist strap, when properly grounded, will dissipate any potential static buildup on the body. The dissipation mat will provide a static-free work surface on which to place and/or service the modules.
- Disconnect and secure power to the unit.
- Place strap on wrist and attach the ground end to any exposed unpainted metal area on the refrigeration unit frame (bolts, screws, etc.).
- Carefully remove the module. Do not touch any of the electrical connections if possible. Place the module on the static mat.
- The strap should be worn during any service work on a module, even when it is placed on the mat.

### 6.21.2 Controller Troubleshooting

A group of test points (TP, see Figure 6-13) are provided on the controller for troubleshooting electrical circuits (see schematic diagram, section 7). A description of the test points follows:

#### NOTE

Use a digital voltmeter to measure AC voltage between TP's and ground (TP9), except for TP8.

**TP 1** – Not used in this application.

**TP 2** – Enables the user to check if the high pressure switch (HPS) is open or closed.

**TP 3** – Enables the user to check if the water pressure switch (WP) contact is open or closed.

**TP 4** – Enables the user to check if the internal protector for the condenser fan motor (IP-CM) is open or closed.

**TP 5** – Enables the user to check if the internal protectors for the evaporator fan motors (IP-EM1 or IP-EM2) are open or closed.

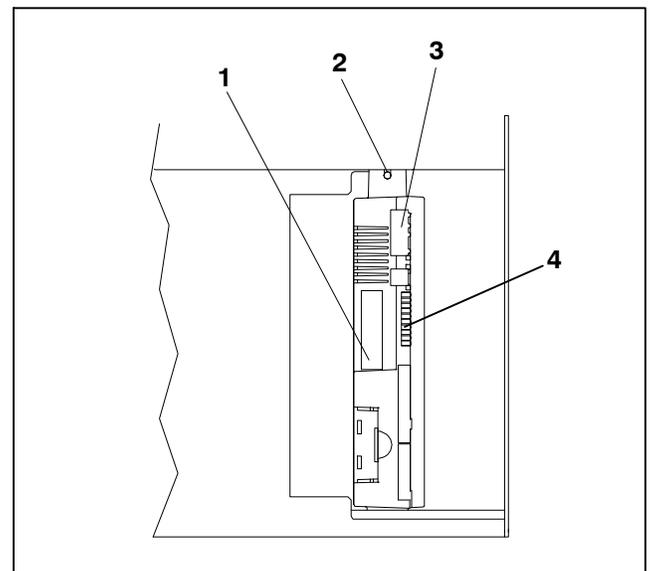
**TP 6 (IF EQUIPPED)** – Enables the user to check if the controller liquid injection valve relay (TQ) is open or closed.

**TP 7** – Enables the user to check if the controller economizer solenoid valve relay (TS) is open or closed.

**TP 8** – Not used in this application.

**TP 9** – The chassis (unit frame) ground connection.

**TP 10** – Enables the user to check if the heat termination thermostat (HTT) contact is open or closed.



- Controller Software Programming Port
- Mounting Screw
- Controller
- Test Points

**Figure 6-13 Controller Section of the Control Box**

### 6.21.3 Programming Procedure for Software Versions 5354 and Greater & With Updated Menu Option (menu0115.ml)

#### NOTE

Units must be loaded with software version 5354 or higher. See the label in the control box door for factory installed software version.

The updated menu option allows the operational software to be loaded, and time and container identification to be set.

#### a. Procedure for loading operational software:

1. The display module will display the message Set UP.
2. Press the UP or DOWN arrow key until the display reads, LOAd 53XX for Scroll.
3. Press the ENTER key on the keypad.
4. The display will alternate to between PrESS EntR and rEV XXXX.
5. Press the ENTER key on the keypad.
6. The display will show the message "Pro SoFt". This message will last for up to one minute.
7. The display module will go blank briefly, then read "Pro donE" when the software loading has loaded. (If a problem occurs while loading the software: the display will blink the message "Pro FAIL" or "bad 12V." Turn start-stop switch OFF and remove the card.)
8. Turn unit OFF, via start-stop switch (ST).
9. Remove the PCMCIA card from the programming/software port and return the unit to normal operation by placing the start-stop switch in the ON position.
10. Turn power on and wait about 15 seconds for the new software to load into the controller memory. The status LED will flash quickly and the display will remain blank as the controller loads the new software.  
When complete, the controller will reset and power up normally.
11. Wait for default display, setpoint on the left, and control temperature on the right.
12. Confirm software is correct using keypad code select 18 to view Cd18 XXXX.
13. Turn power off. Operational software is loaded.

#### b. Procedure for loading configuration software:

1. Turn unit OFF using start-stop switch (ST).
2. Insert software/programming PCMCIA card containing the following (example) files into the programming/software port. (See Figure 6-13):  
menuDDMM.ml3, this file allows the user to select the file/program to upload into the controller.  
cfYYMMDD.ml3, multi-configuration file.
3. Turn unit ON using start-stop switch (ST).
4. Press the UP or DOWN arrow key until display reads Set UP.
5. Press the ENTER key on the keypad.
6. Press the UP or DOWN arrow key until display reads XXXX the message ruN COnFG. (If a defective card is being used the display will blink the message "bAd

Card." Turn start-stop switch OFF and remove the card.)

7. Press the ENTER key on the keypad.
  8. The display module will go blank briefly and then display "551 00", based on the operational software installed.
  9. Press the UP or DOWN ARROW key to scroll through the list to obtain the proper model dash number. (If a defective card is being used, the display will blink the message "bAd CArd." Turn start-stop switch OFF and remove the card.)
  10. Press the ENTER key on the keypad.
  11. When software loading has successfully completed, the display will show the message "EEPROM donE." (If a problem occurs while loading the software, the display will blink the message "Pro FAIL" or "bad 12V." Turn start-stop switch OFF and remove the card.)
  12. Turn unit OFF using start-stop switch (ST).
  13. Remove the PCMCIA card from the programming/software port and return the unit to normal operation by placing the start-stop switch in the ON position.
  14. Confirm correct model configuration using the keypad to choose code 20 (CD20). The model displayed should match the unit serial number plate.
- #### c. Procedure for setting the date and time:

#### NOTE

If you are performing this procedure by itself, you must start with steps 1-5 of b. Procedure for loading configuration software.

1. Press the UP or DOWN arrow key until display reads Set TIM.
  2. Press the ENTER key on the keypad.
  3. The first value to be modified is the date in YYYY MM-DD format. The values will be entered from right to left. Press the UP or DOWN ARROW key to increase or decrease the values. The ENTER key will enter the information for the current field and move to the next value; the CODE SELECT key will allow modification of the previous value.
  4. Press the ENTER key on the keypad.
  5. The next value to be modified is the time in HH MM format. The values will be entered from right to left. Press the UP or DOWN ARROW key to increase or decrease the values. The ENTER key will enter the information for the current field and move to the next value; the CODE SELECT key will allow modification of the previous value.
  6. Press the ENTER key on the keypad. The date and time will not be committed until start up procedures are completed on the next power up.
- #### d. Procedure for setting the container ID:

#### NOTE

If you are performing this procedure by itself, you must start with steps 1-5 of b. Procedure for loading configuration software.

1. Press the UP or DOWN arrow key until display reads Set ID.
2. Press the ENTER key on the keypad.

3. Values will be entered from right to left. Press the UP or DOWN ARROW key to increase or decrease the values. ENTER will enter the information for the current field and move to the next value; CODE SELECT will allow modification of the previous value.
4. When the last value is entered, press the ENTER key to enter the information to the controller; the CODE SELECT key will allow modification of the previous value.

#### 6.21.4 Removing and Installing a Controller

##### a. Removal:

1. Disconnect all front wire harness connectors and move wiring out of way.
2. The lower controller mounting is slotted, loosen the top mounting screw (see Figure 6–13) and lift up and out.
3. Disconnect the back connectors and remove module.
4. When removing the replacement module from its packaging, note how it is packaged. When returning the old module for service, place it in the packaging in the same manner as the replacement. The packaging has been designed to protect the module from both physical and electrostatic discharge damage during storage and transit.

##### b. Installation:

Install the module by reversing the removal steps.

Torque values for mounting screws (see Figure 6–13) are 0.23 mkg (20 inch-pounds). Torque value for the connectors is 0.12 mkg (10 inch-pounds).

#### 6.21.5 Battery Replacement



**Use care when cutting wire ties to avoid nicking or cutting wires.**

- a. Turn unit power OFF and disconnect power supply.
- b. Disconnect battery wire connector from control box.

- c. Slide out and remove old battery and bracket. (See Figure 3–4, Item 8.)
- d. Slide new battery pack and bracket into the control box slot.
- e. Reconnect battery wire connector to control box and replace wire ties that were removed.

## 6.22 TEMPERATURE SENSOR SERVICE

Service procedures for the return recorder, return temperature, supply recorder, supply temperature, ambient, defrost temperature, evaporator temperature, and compressor discharge temperature sensors are provided in the following sub paragraphs.

### 6.22.1 Sensor Checkout Procedure

To verify that accuracy of a temperature sensor:

- a. Remove the sensor and place in a 0°C (32°F) ice-water bath. The ice-water bath is prepared by filling an insulated container (of sufficient size to completely immerse bulb) with ice cubes or chipped ice, then filling voids between ice with water and agitating until mixture reaches 0°C (32°F) measured on a laboratory thermometer.
- b. Start unit and check sensor reading on the control panel. The reading should be 0°C (32°F). If the reading is correct, reinstall sensor; if it is not, continue with the following.
- c. Turn unit OFF and disconnect power supply.
- d. Refer to paragraph 6.21 and remove controller to gain access to the sensor plugs.
- e. Using the plug connector marked “EC” that is connected to the back of the controller, locate the sensor wires (RRS, RTS, SRS, STS, AMBS, DTS, or CPDS as required). Follow those wires to the connector and using the pins of the plug, measure the resistance. Values are provided in Table 6–2 and Table 6–3.

Due to the variations and inaccuracies in ohmmeters, thermometers or other test equipment, a reading within 2% of the chart value would indicate a good sensor. If a sensor is defective, the resistance reading will usually be much higher or lower than the resistance values given.

**Table 6–2 Sensor Resistance**

<b>Sensors AMBS, DTS, ETS, RRS, RTS, SRS, STS</b>											
<b>°C</b>	<b>°F</b>	<b>Ohms</b>	<b>°C</b>	<b>°F</b>	<b>Ohms</b>	<b>°C</b>	<b>°F</b>	<b>Ohms</b>	<b>°C</b>	<b>°F</b>	<b>Ohms</b>
-40	-40	336,500	-7.8	18	49,060	24.4	76	10,250	56.7	134	2,809
-38.9	-38	312,600	-6.7	20	46,230	25.6	78	9,760	57.8	136	2,697
-37.8	-36	290,600	-5.6	22	43,580	26.7	80	9,299	58.9	138	2,590
-36.7	-34	270,300	-4.4	24	41,100	27.8	82	8,862	60.0	140	2,488
-35.6	-32	251,500	-3.3	26	38,780	28.9	84	8,449	61.1	142	2,390
-34.4	-30	234,200	-2.2	28	36,600	30.0	86	8,057	62.2	144	2,297
-33.3	-28	218,200	-1.1	30	34,560	31.1	88	7,686	63.3	146	2,208
-32.2	-26	203,400	0	32	32,650	32.2	90	7,334	64.4	148	2,124
-31.1	-24	189,700	1.1	34	30,850	33.3	92	7,000	65.6	150	2,042
-30	-22	177,000	2.2	36	29,170	34.4	94	6,684	68.3	155	1,855
-28.9	-20	165,200	3.3	38	27,590	35.6	96	6,384	71.1	160	1,687
-27.8	-18	154,300	4.4	40	26,100	36.7	98	6,099	73.9	165	1,537
-26.7	-16	144,200	5.5	42	24,700	37.8	100	5,828	76.7	170	1,402
-25.6	-14	134,800	6.6	44	23,390	38.9	102	5,571	79.4	175	1,281
-24.4	-12	126,100	7.7	46	22,160	40.0	104	5,327	82.2	180	1,171
-23.3	-10	118,100	8.9	48	20,990	41.1	106	5,095	85.0	185	1,072
-22.2	-8	110,500	10	50	19,900	42.2	108	4,874	87.8	190	983
-21.1	-6	103,600	11.1	52	18,870	43.3	110	4,665	90.6	195	902
-20	-4	97,070	12.2	54	17,900	44.4	112	4,465	93.3	200	829
-18.9	-2	91,030	13.3	56	16,980	45.5	114	4,275	96.1	205	762
-17.8	0	85,400	14.4	58	16,120	46.7	116	4,095	98.9	210	702
-16.7	2	80,160	15.5	60	15,310	47.8	118	3,923	101.7	215	647
-15.6	4	75,270	16.6	62	14,540	48.9	120	3,759	104.4	220	598
-14.4	6	70,720	17.7	64	13,820	50.0	122	3,603	107.2	225	553
-13.3	8	66,460	18.9	66	13,130	51.1	124	3,454	110.0	230	511
-12.2	10	62,500	20.0	68	12,490	52.2	126	3,313	112.8	235	473
-11.1	12	58,790	21.1	70	11,880	53.3	128	3,177	115.6	240	438
-10.0	14	55,330	22.2	72	11,310	54.4	130	3,049	118.3	245	406
-8.9	16	52,090	23.3	74	10,760	55.6	132	2,926	121.1	250	378

**Table 6-3 Sensor Resistance (CPDS)**

°C	°F	Ohms	°C	°F	Ohms	°C	°F	Ohms
-40	-40	2,889,600	38	100.4	49,656	116	240.8	3,759
-38	-36.4	2,532,872	40	104.0	45,812	118	244.4	3,550
-36	-32.8	2,225,078	42	107.6	42,294	120	248.0	3,354
-34	-29.2	1,957,446	44	111.2	39,078	122	251.6	3,173
-32	-25.6	1,724,386	46	114.8	36,145	124	255.2	3,004
-30	-22.0	1,522,200	48	118.4	33,445	126	258.8	2,850
-28	-18.4	1,345,074	50	122.0	30,985	128	262.4	2,711
-26	-14.8	1,190,945	52	125.6	28,724	130	266.0	2,580
-24	-11.2	1,056,140	54	129.2	26,651	132	269.6	2,454
-22	-7.6	938,045	56	132.8	27,750	134	273.2	2,335
-20	-4.0	834,716	58	136.4	23,005	136	276.8	2,223
-18	-0.4	743,581	60	140.0	21,396	138	280.4	2,119
-16	3.2	663,593	62	143.6	19,909	140	284.0	2,021
-14	6.8	593,030	64	147.2	18,550	142	287.6	1,928
-12	10.4	530,714	66	150.8	17,294	144	291.2	1,839
-10	14.0	475,743	68	154.4	16,133	146	294.8	1,753
-8	17.6	426,904	70	158.0	15,067	148	298.4	1,670
-6	21.2	383,706	72	161.6	14,078	150	302.0	1,591
-4	24.8	345,315	74	165.2	13,158	152	305.6	1,508
-2	28.4	311,165	76	168.8	12,306	154	309.2	1,430
0	32.0	280,824	78	172.4	11,524	156	312.8	1,362
2	35.6	253,682	80	176.0	10,793	158	316.4	1,302
4	39.2	229,499	82	179.6	10,122	160	320.0	1,247
6	42.8	207,870	84	183.2	9,494	162	323.6	1,193
8	46.4	188,494	86	186.8	8,918	164	327.2	1,142
10	50.0	171,165	88	190.4	8,376	166	330.8	1,096
12	53.6	155,574	90	194.0	7,869	168	334.4	1,054
14	57.2	141,590	92	197.6	7,404	170	338.0	1,014
16	60.8	129,000	94	201.2	6,972	172	341.6	975
18	64.4	117,656	96	204.8	6,571	174	345.2	938
20	68.0	107,439	98	208.4	6,197	176	348.8	902
22	71.6	98,194	100	212.0	5,848	178	352.4	867
24	75.2	89,916	102	215.6	5,529	180	356.0	834
26	78.8	82,310	104	219.2	5,233	182	359.6	798
28	82.4	75,473	106	222.8	4,953	184	363.2	764
30	83.0	69,281	108	226.4	4,692	186	366.8	733
32	89.6	63,648	110	230.0	4,446	188	370.4	706
34	93.2	58,531	112	233.6	4,204	190	374.0	697
36	96.8	53,887	114	237.2	3,977			

## 6.22.2 Sensor Replacement

### **WARNING**

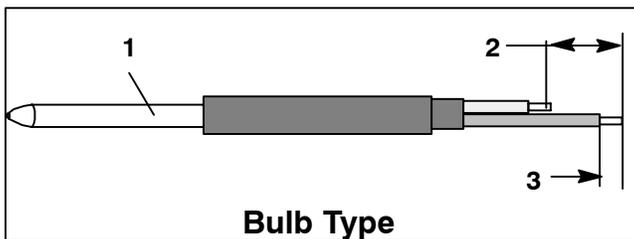
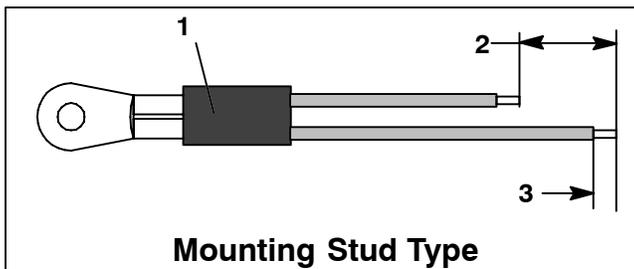
Always turn OFF the unit circuit breaker (CB-1) and disconnect main power supply before removing electrical parts.

- a. Turn unit power OFF and disconnect power supply.

#### NOTE

Include white date code label when cutting out and removing defective sensors. The label could be required for warranty returns.

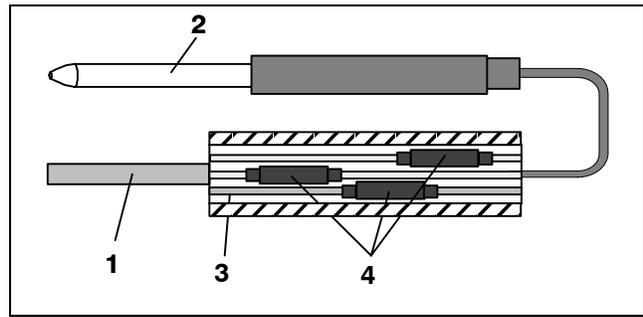
- b. Cut cable. Slide the cap and grommet off a bulb type sensor and save for reuse. **Do not cut the grommet.**
- c. Cut one wire of existing cable 40 mm (1-1/2 inches) shorter than the other wire.
- d. Cut replacement sensor wires (opposite colors) back 40 mm (1-1/2 inches). (See Figure 6-14.)
- e. Strip back insulation on all wiring 6.3 mm (1/4 inch).



1. Sensor  
2. 40 mm (1 1/2 in), 2 or 3 wires as required  
3. 6.3 mm (1/4 in).

**Figure 6-14 Sensor Types**

- f. Slide a large piece of heat shrink tubing over the cable, and place the two small pieces of heat shrink tubing, one over each wire, before adding crimp fittings as shown in Figure 6-15.



1. Cable  
2. Sensor (Typical)  
3. Large Heat Shrink Tubing (1)  
4. Heat Shrink Tubing, 2 or 3 as required

**Figure 6-15 Sensor and Cable Splice**

- g. If required, slide the cap and grommet assembly onto the replacement sensor.
- h. Slip crimp fittings over dressed wires (keeping wire colors together). Make sure wires are pushed into crimp fittings as far as possible and crimp with crimping tool.
- i. Solder spliced wires with a 60% tin and 40% lead Rosincore solder.
- j. Slide heat shrink tubing over each splice so that ends of tubing cover both ends of crimp as shown in Figure 6-15.
- k. Heat tubing to shrink over splice. Make sure all seams are sealed tightly against the wiring to prevent moisture seepage.

### **CAUTION**

**Do not allow moisture to enter wire splice area as this may affect sensor resistance.**

- l. Slide large heat shrink tubing over both splices and shrink.
- m. Position sensor in unit as shown:  
Figure 6-14 – Return Sensor Positioning  
Figure 6-16 – Supply Sensor Positioning  
Figure 6-18 – ETS Sensor Positioning

- in Figure 6-15 and re-check sensor resistance.
- n. Reinstall sensor, refer to:  
6.22.3 – For STS and SRS Re-Installation  
6.22.4 – For RRS and RTS Re-Installation  
6.22.5 – For DTS Re-Installation  
6.22.6 – For ETS1 and ETS2 Re-Installation

#### NOTE

The P5 Pre-Trip test must be run to deactivate probe alarms (refer to paragraph 4.7).

### 6.22.3 Sensors STS and SRS Re-Installation

To properly position a unit supply sensor (Supply Temperature Sensor STS or Supply Recorder Sensor SRS), the sensor must be fully inserted into the probe holder. This positioning will give the sensor the optimum amount of exposure to the supply air stream, and will allow the Controller to operate correctly. Insufficient probe insertion into the probe holder will result in poor temperature control due to the lack of air flow over the sensor.

It is also necessary to ensure that the probe tip does not contact the back panel. The design minimum clearance of 6 mm (1/4 inch) should be maintained (see Figure 6-16).

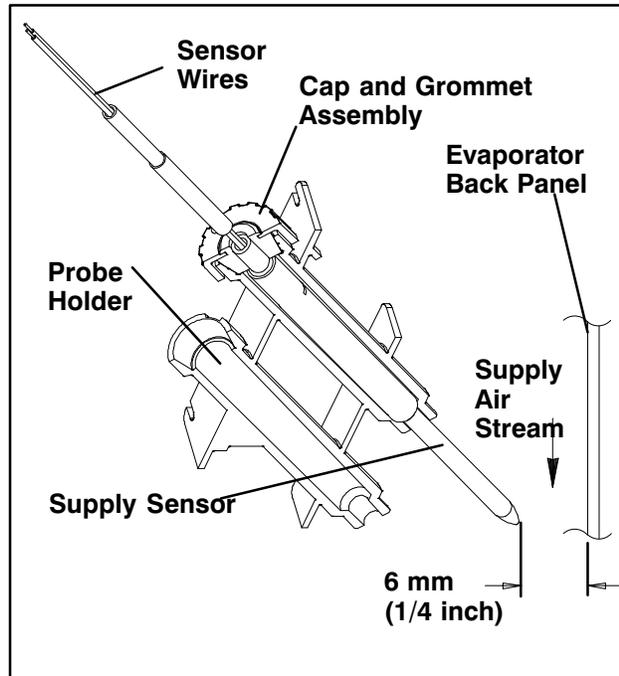


Figure 6-16 Supply Sensor Positioning

### 6.22.4 Sensors RRS and RTS Re-Installation

Reinstall the return sensor (Return Temperature Sensor RTS or Return Recorder Sensor RRS), as shown in Figure 6-17. For proper placement of the return sensor, be sure to position the enlarged positioning section of the sensor against the the side of the mounting clamp.

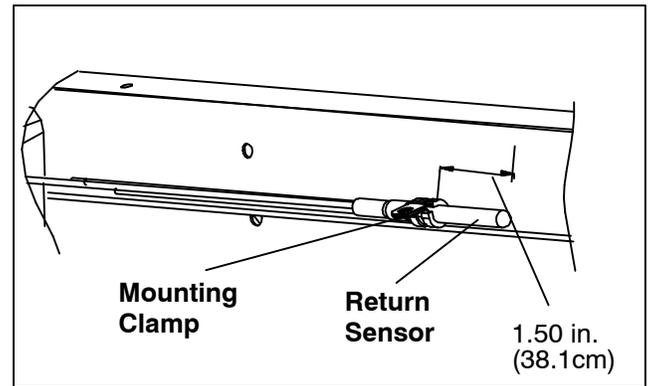


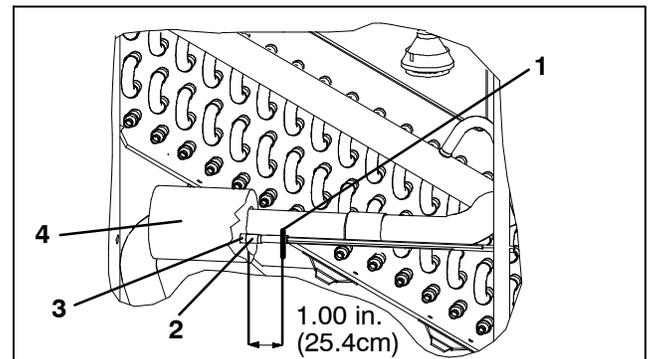
Figure 6-17 Return Sensor Positioning

### 6.22.5 Sensor DTS Re-Installation

The Defrost Temperature Sensor (DTS) must have insulating material placed completely over the sensor to ensure the coil metal temperature is sensed.

### 6.22.6 Sensors ETS1 and ETS2 Re-Installation

The Evaporator Temperature Sensors, ETS1 and ETS2 are located in a tube holder under insulation, as illustrated in Figure 6-18. When the combo sensor is removed and reinstalled, it must be placed in a tube holder by applying thermal grease. Insulating material must completely cover the sensor to ensure the correct temperature is sensed.



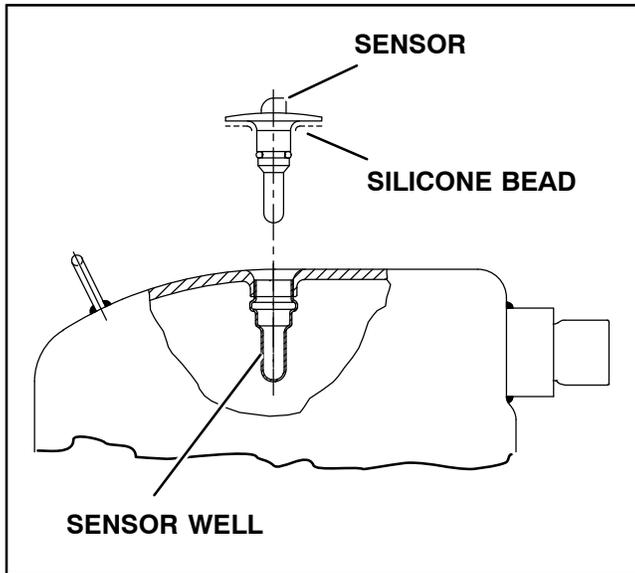
- |                   |                    |
|-------------------|--------------------|
| 1. Wire Tie       | 3. ETS Tube Holder |
| 2. ETS1 and ETS 2 | 4. Insulation      |

Figure 6-18 Evaporator Temperature Sensor Positioning

### 6.22.7 Sensor, CPDS Re-Installation

To replace the Compressor Discharge Temperature Sensor, see Figure 6–19:

1. Ensure the unit is disconnected from the power source and that ST is in OFF position.
2. Remove the existing sensor. Clean all silicone sealer and dielectric compound from the sensor well. Ensure well is clean and dry. The top of the compressor, where the sensor seals, must also be clean and dry.



**Figure 6–19 Compressor Discharge Temperature Sensor**

3. Using the syringe supplied with the replacement sensor, squeeze all of the dielectric compound into the sensor well.

4. Place a bead of the silicone sealer supplied with the replacement sensor around the sensor sealing ring. Insert sensor into the well with the leads parallel to the suction fitting.
5. Reconnect the sensor (see Figure 6–15) and run Pre-trip P5.

### 6.23 VENT POSITION SENSOR (VPS)

The vent position sensor (VPS) determines the position of the fresh air vent in near real-time via the Cd55.

The fresh air vent position sensor alarm (AL50) will occur if the sensor reading is not stable for four minutes or if the sensor is outside of its valid range (shorted or open). This can occur if the vent is loose or the panel is defective. To confirm a defective panel, assure that the wing nut is secure and then power cycle the unit. If the alarm immediately reappears as active, the panel should be replaced.

The alarm should immediately go inactive, check the 4-minute stability requirement. If the alarm reoccurs after the four minutes and the panel was known to have been stable, then the sensor should be replaced.

#### Upper VPS:

In order to replace the Upper VPS, the panel must be removed and replaced with another upper fresh air panel equipped with VPS.

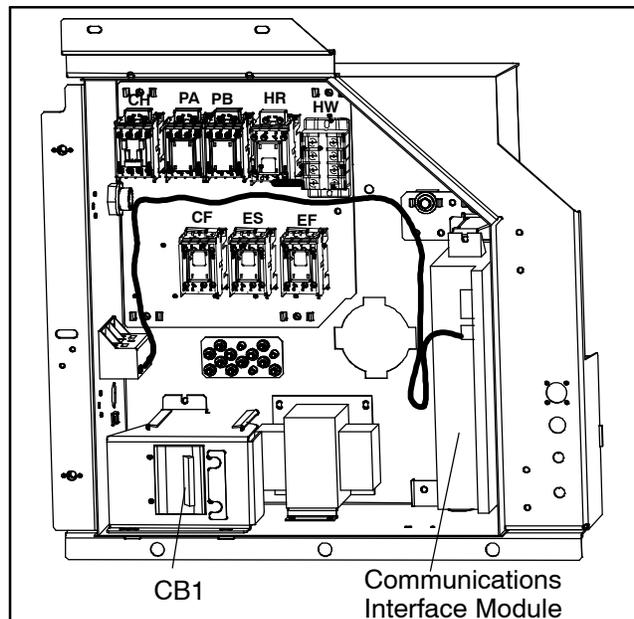
Upon installation, a new VPS assembly requires calibration as follows:

1. Rotate the vent to the 0 CMH/ CFM position.
2. Cd45 will automatically display. Press the Enter key and hold for five seconds.
3. After the enter key has been pressed the display will read CAL (for calibration).
4. Press the ALT MODE key and hold for five seconds.
5. After the calibration has been completed, Cd45 will display 0 CMH / CFM.

## 6.24 MAINTENANCE OF PAINTED SURFACES

The refrigeration unit is protected by a special paint system against the corrosive atmosphere in which it normally operates. However, should the paint system be damaged, the base metal can corrode. In order to protect the refrigeration unit from the highly corrosive sea atmosphere, or if the protective paint system is scratched or damaged, clean the area to bare metal using a wire brush, emery paper or equivalent cleaning method. Immediately following cleaning, apply paint to the area, and allow to dry. Refer to the Parts List for proper paint selection.

## 6.25 COMMUNICATIONS INTERFACE MODULE INSTALLATION



**Figure 6-20 Communications Interface Installation**

Units that have been factory provisioned for installation of a Communication Interface Module (CIM) have the required wiring installed. If the unit is not factory provisioned, a provision wiring kit (Carrier Transicold part number 76-00685-00) must be installed. Installation instructions are packaged with the kit.

To install the module:



**Installation requires wiring to the main unit circuit breaker, CB1. Make sure the power to the unit is off and power plug disconnected before beginning installation.**

- CB1 is connected to the power system, see wiring schematic. Ensure that the unit power is off AND that the unit power plug is disconnected.
- Open control box, (see Figure 6-20) and remove low voltage shield. Open high voltage shield.
- If using factory provisioned wiring, remove the circuit breaker panel, with circuit breaker, from the control box. Locate, wires CB21/CIA3, CB22/CIA5 and CB23/CIA7 that have been tied back in the wire harness. Remove the protective heat shrink from the ends of the wires.
- Refit the circuit breaker panel.
- Fit the new Communication Interface Module into the unit.
- Attach three wires CB21/CIA3, CB22/CIA5 and CB23/CIA7 to the CIM at connection CIA.
- Locate connectors CIA and CIB, remove plugs if required, and attach to the module.
- Replace the low voltage shield.

**Table 6-4 R-134a Temperature - Pressure Chart**

Temperature		Vacuum			
F	C	"/hg	cm/hg	kg/cm <sup>2</sup>	bar
-40	-40	14.6	49.4	37.08	0.49
-35	-37	12.3	41.6	31.25	0.42
-30	-34	9.7	32.8	24.64	0.33
-25	-32	6.7	22.7	17.00	0.23
-20	-29	3.5	11.9	8.89	0.12
-18	-28	2.1	7.1	5.33	0.07
-16	-27	0.6	2.0	1.52	0.02
Temperature		Pressure			
F	C	psig	kPa	kg/cm <sup>2</sup>	bar
-14	-26	0.4	1.1	0.03	0.03
-12	-24	1.2	8.3	0.08	0.08
-10	-23	2.0	13.8	0.14	0.14
-8	-22	2.9	20.0	0.20	0.20
-6	-21	3.7	25.5	0.26	0.26
-4	-20	4.6	31.7	0.32	0.32
-2	-19	5.6	36.6	0.39	0.39
0	-18	6.5	44.8	0.46	0.45
2	-17	7.6	52.4	0.53	0.52
4	-16	8.6	59.3	0.60	0.59
6	-14	9.7	66.9	0.68	0.67
8	-13	10.8	74.5	0.76	0.74
10	-12	12.0	82.7	0.84	0.83
12	-11	13.2	91.0	0.93	0.91
14	-10	14.5	100.0	1.02	1.00
16	-9	15.8	108.9	1.11	1.09
18	-8	17.1	117.9	1.20	1.18
20	-7	18.5	127.6	1.30	1.28
22	-6	19.9	137.2	1.40	1.37
24	-4	21.4	147.6	1.50	1.48
26	-3	22.9	157.9	1.61	1.58

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

**Table 6-5 Recommended Bolt Torque Values**

<b>BOLT DIA.</b>	<b>THREADS</b>	<b>TORQUE</b>	<b>Nm</b>
<b>FREE SPINNING</b>			
#4	40	5.2 in-lbs	0.6
#6	32	9.6 in-lbs	1.1
#8	32	20 in-lbs	2.0
#10	24	23 in-lbs	2.5
1/4	20	75 in-lbs	8.4
5/16	18	11 ft-lbs	15
3/8	16	20 ft-lbs	28
7/16	14	31 ft-lbs	42
1/2	13	43 ft-lbs	59
9/16	12	57 ft-lbs	78
5/8	11	92 ft-lbs	127
3/4	10	124 ft-lbs	171
<b>NONFREE SPINNING (LOCKNUTS ETC.)</b>			
1/4	20	82.5 in-lbs	9.3
5/16	18	145.2 in-lbs	16.4
3/8	16	22.0 ft-lbs	23
7/16	14	34.1 ft-lbs	47
1/2	13	47.3 ft-lbs	65
9/16	12	62.7 ft-lbs	86
5/8	11	101.2 ft-lbs	139
3/4	10	136.4 ft-lbs	188

## SECTION 7

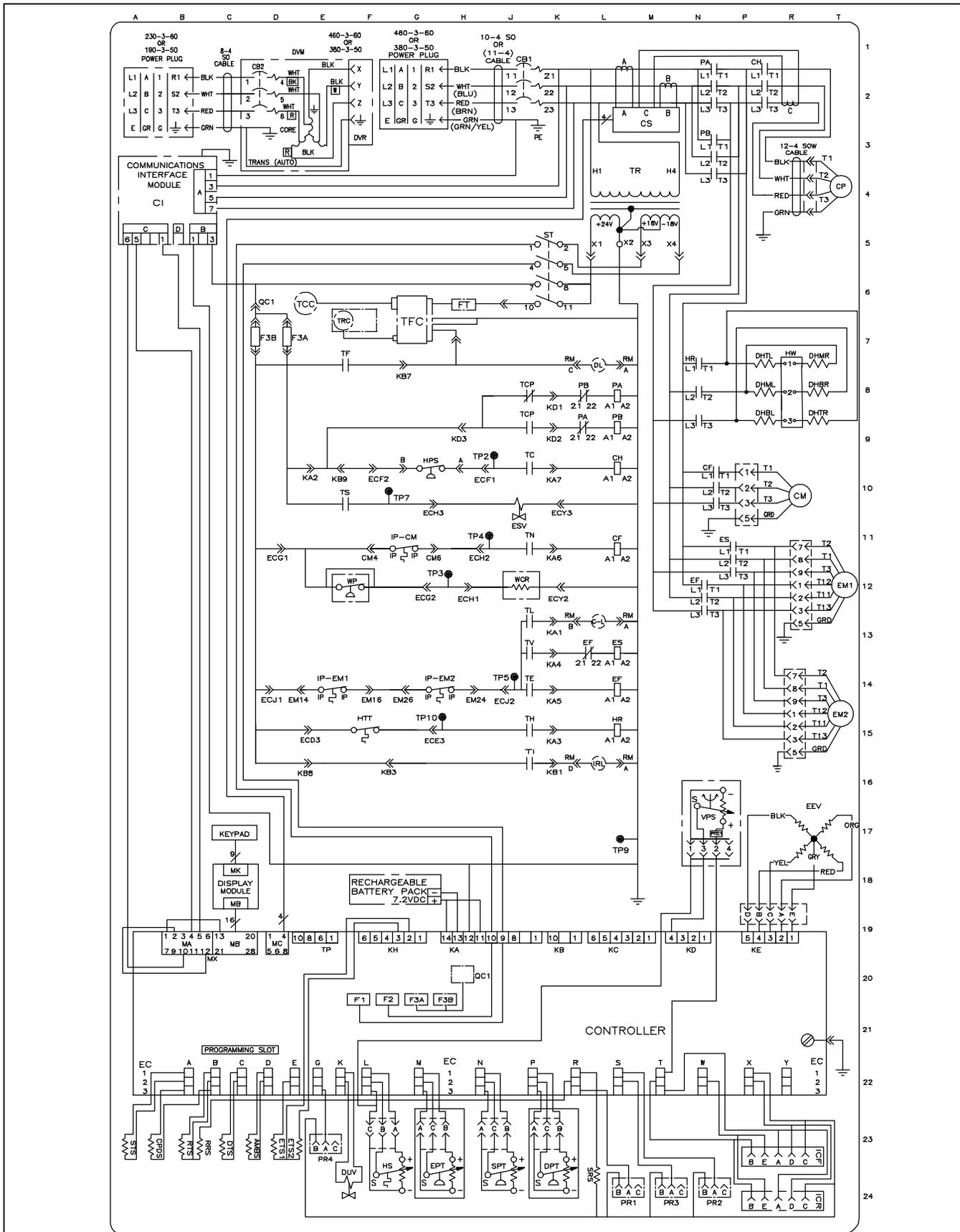
### ELECTRICAL WIRING SCHEMATICS

#### 7.1 INTRODUCTION

This section contains the Electrical Schematics and Wiring Diagrams.

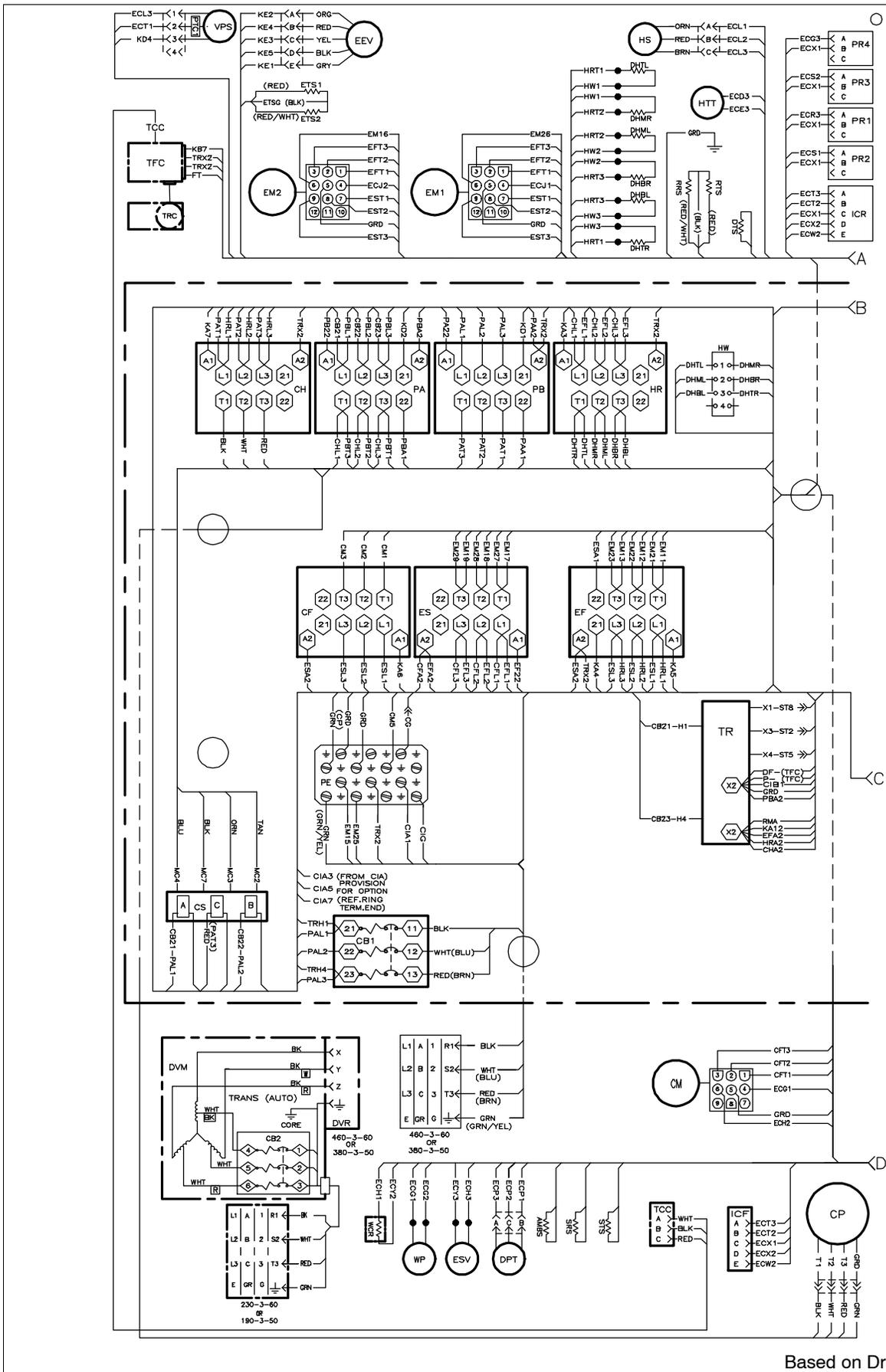
<b>LEGEND</b>	
<b>SYMBOL DESCRIPTION</b>	<b>SYMBOL DESCRIPTION</b>
AMBS	AMBIENT SENSOR (C-22)
C	CONTROLLER (L-21)
CB1	CIRCUIT BREAKER – 460 VOLT (J-1)
CB2	OPTIONAL CIRCUIT BREAKER – DVM (OPTION) (D-1) TERMINAL BLOCK WHEN CB2 NOT PRESENT
CF	CONDENSER FAN CONTACTOR (N-8, L-11)
CH	COMPRESSOR CONTACTOR (L-10, P-1)
CI	COMMUNICATIONS INTERFACE MODULE (OPTION) (A-4)
CL	COOL LIGHT (OPTION) (L-12)
CM	CONDENSER FAN MOTOR (E-11, G-11, R-9)
CP	COMPRESSOR MOTOR (T-4)
CPDS	DISCHARGE TEMPERATURE SENSOR (A-23)
CS	CURRENT SENSOR (M-2)
DHBL	DEFROST HEATER – BOTTOM LEFT (R-8)
DHBR	DEFROST HEATER – BOTTOM RIGHT (T-7)
DHML	DEFROST HEATER – MIDDLE LEFT (R-7)
DHMR	DEFROST HEATER – MIDDLE RIGHT (T-7)
DHTL	DEFROST HEATER – TOP LEFT (R-7)
DHTR	DEFROST HEATER – TOP RIGHT (T-8)
DL	DEFROST LIGHT (OPTION) (L-7)
DPT	DISCHARGE PRESSURE TRANSDUCER (K-23)
DTS	DEFROST TEMPERATURE SENSOR (C-23)
DUV	DIGITAL UNLOADER VALVE (F-24)
DVM	DUAL VOLTAGE MODULE (OPTIONAL) (D-1)
DVR	DUAL VOLTAGE RECEPTACLE (OPTIONAL) (F-2)
EEV	ELECTRONIC EXPANSION VALVE (R-16)
EF	EVAPORATOR FAN CONTACTOR-HIGH SPEED (N-11, K-13)
EM	EVAPORATOR FAN MOTOR (T-11, T-13, E-14, F-14, G-14)
EPT	EVAPORATOR PRESSURE TRANSDUCER (H-23)
ES	EVAPORATOR FAN CONTACTOR-LOW SPEED (P-10, L-13)
ETS	EVAPORATOR TEMPERATURE SENSOR (SUCTION) (D-23)
ESV	ECONOMIZER SOLENOID VALVE (J-11)
F	FUSE (C-7, D-7, F-21, G-21)
FLA	FULL LOAD AMPS
HPS	HIGH PRESSURE SWITCH (G-9)
HR	HEATER CONTACTOR (N-7, L-15)
HW	HEATER CONTACTOR (R-8)
HS	HUMIDITY SENSOR (OPTIONAL) (F-23)
HTT	HEAT TERMINATION THERMOSTAT (E-15)
ICF	INTERROGATOR CONNECTOR FRONT (T-23)
ICR	INTERROGATOR CONNECTOR REAR (T-24)
IP	INTERNAL PROTECTOR (E-14, F-11, G-14)
IRL	IN RANGE LIGHT (OPTION) (K-15)
PA	UNIT PHASE CONTACTOR (K-9, L-7, K-12)
PB	UNIT PHASE CONTACTOR (K-8, L-9, N-3)
PR	USDA PROBE RECEPTACLE (M-24, N-24, P-24)
PTC	PTC FOR VENT POSITIONING SENSOR (N-17)
RM	REMOTE MONITORING RECEPTACLE (OPTION) (K-7, L-7, K-12, L-12, K-15, L-15)
RRS	RETURN RECORDER SENSOR (C-23)
RTS	RETURN TEMPERATURE SENSOR (B-23)
SPT	SUCTION PRESSURE TRANSDUCER (H-23)
SRS	SUPPLY RECORDER SENSOR (L-23)
ST	START – STOP SWITCH (K-5)
STS	SUPPLY TEMPERATURE SENSOR (A-23)
TC	CONTROLLER RELAY-COOLING (J-9)
TCC	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION) (D-6)
TCP	CONTROLLER RELAY – PHASE SEQUENCING (J-8, J-9)
TE	CONTROLLER RELAY – HIGH SPEED EVAPORATOR FANS (J-14)
TH	CONTROLLER RELAY – HEATING (J-15)
TF	CONTROLLER RELAY – DEFROST (E-7)
TI	IN-RANGE RELAY (J-15)
TL	CONTROLLER RELAY – COOL LIGHT (J-12)
TN	CONTROLLER RELAY – CONDENSER FAN (J-11)
TP	TEST POINT (H-9, F-10, H-11, G-12, H-13, G-15, L-17)
TR	TRANSFORMER (M-3)
TRANS	AUTO TRANSFORMER 230/460 (OPTION) (D-3)
TRC	TRANSFRESH REAR CONNECTOR (OPTION) (E-7)
TS	CONTROLLER RELAY – ECONOMIZER SOLENOID VALVE (E-10)
TV	CONTROLLER RELAY – LOW SPEED EVAPORATOR FANS (J-13)
VPS	VENT POSITION SENSOR (UPPER) (N-17)
WCR	WETTING CURRENT RESISTOR (OPTION) (J-12)
WP	WATER PRESSURE SWITCH (OPTION) (E-12)

**Figure 7-1 LEGEND – Standard Unit Configuration**



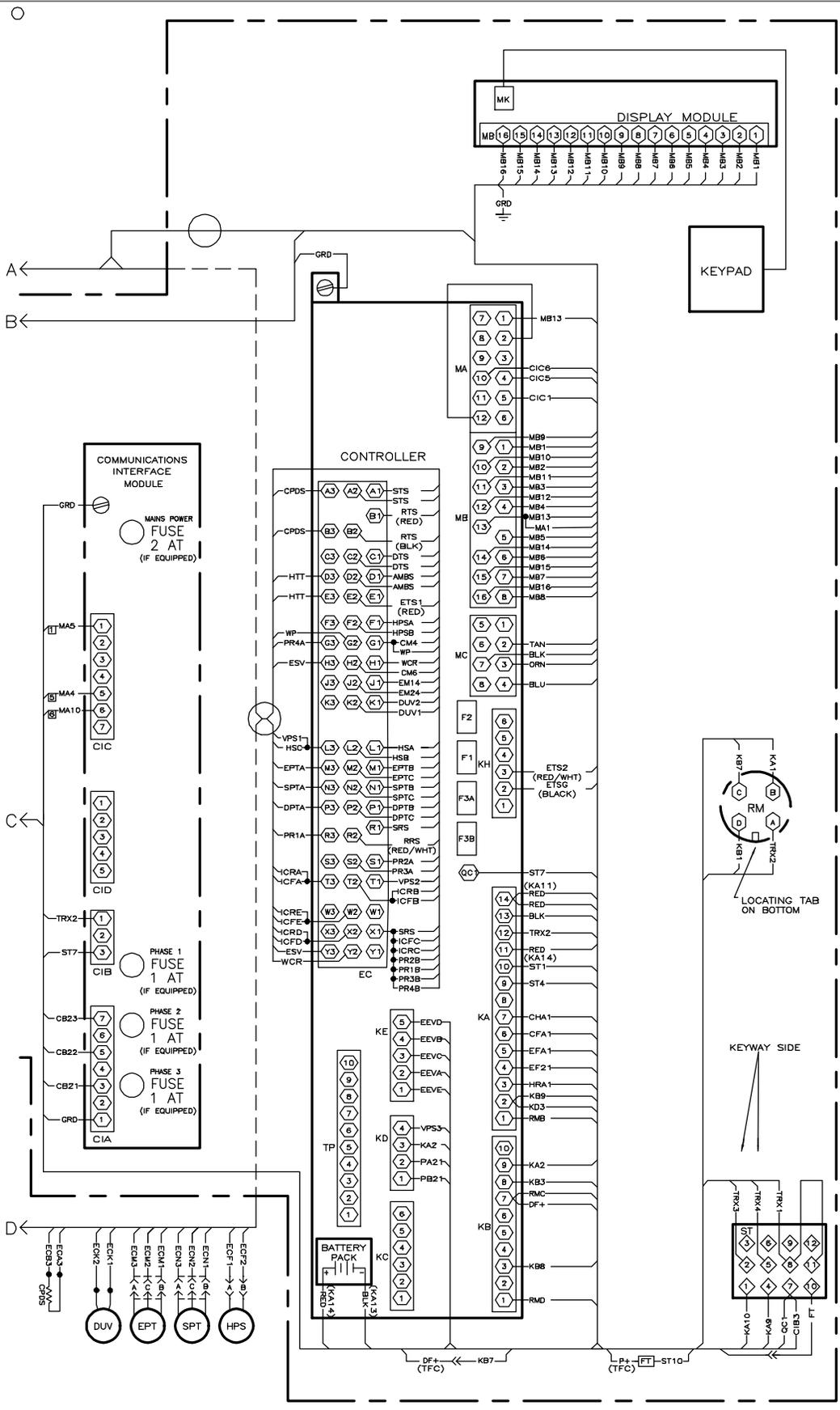
Based on Drawing 62-11753

Figure 7-2 SCHEMATIC DIAGRAM



Based on Drawing 62-11753

Figure 7-3 UNIT WIRING DIAGRAM (Sheet 1 of 2)



Based on Drawing 62-11753

Figure 7-3 UNIT WIRING DIAGRAM (Sheet 2 of 2)



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Syracuse, NY 13221 USA

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