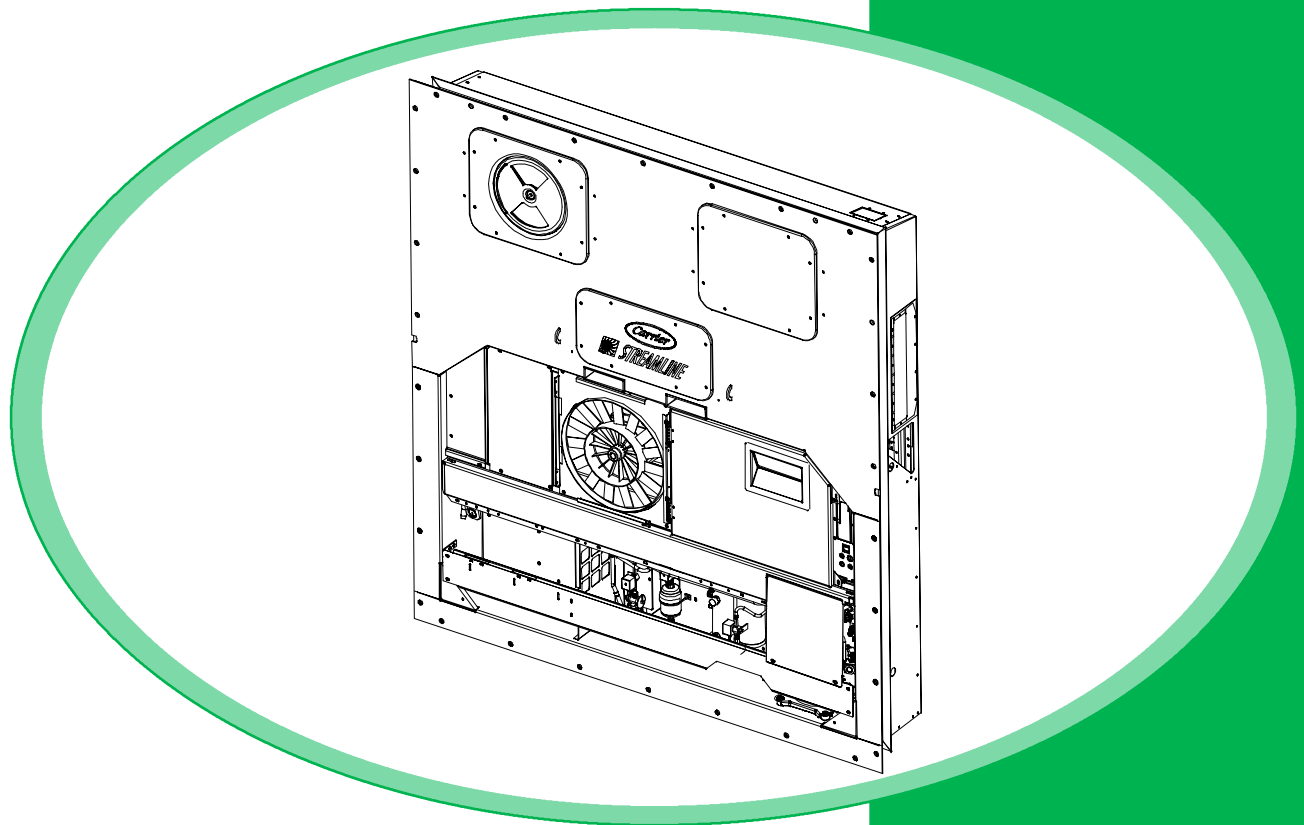


Carrier  
Transicold  
Container  
Refrigeration

# Model 69NT20-531-300 Streamline Scroll



Operation  
& Service



**TRANSICOLD**

# OPERATION AND SERVICE MANUAL CONTAINER REFRIGERATION UNIT

**MODEL  
69NT20-531-300  
Streamline Scroll**

Carrier Transicold. A member of the United Technologies Corporation family. Stock symbol UTX.  
Carrier Transicold Division, Carrier Corporation, P.O. Box 4805, Syracuse, N.Y. 13221 U. S. A.

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**Carrier**

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# SAFETY SUMMARY

## GENERAL SAFETY NOTICES

The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered herein. 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, start-stop switches are turned off, and power supply is disconnected.

Always work in pairs. Never work on the equipment alone.

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

## MAINTENANCE PRECAUTIONS

Beware of unannounced starting of the evaporator and condenser fans. Do not open the 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 both 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).

## UNIT LABEL IDENTIFICATION

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 which WILL result in severe personal injury or death.

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

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

## SPECIFIC WARNING AND CAUTION STATEMENTS

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

### 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 any power receptacle.**

**WARNING**

**Make sure that the unit circuit breaker(s) (CB-1 & CB-2) and the START-STOP switch (ST) are in the "O" (OFF) position before connecting to any electrical power source.**

**WARNING**

**Never use air for leak testing. It has been determined that pressurized, mixtures of refrigerant and air can undergo combustion when exposed to an ignition source.**

**WARNING**

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

**WARNING**

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

**WARNING**

**Oakite No. 32 is an acid. Be sure that the acid is slowly added to the water. DO NOT PUT WATER INTO THE ACID - this will cause spattering and excessive heat.**

**WARNING**

**Wear rubber gloves and wash the solution from the skin immediately if accidental contact occurs. Do not allow the solution to splash onto concrete.**

**WARNING**

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

**WARNING**

**Make sure power to the unit is OFF and power plug disconnected before removing capacitor(s).**

**WARNING**

**With power OFF discharge the capacitor before disconnecting the circuit wiring.**

**WARNING**

**Do not use a nitrogen cylinder without a pressure regulator. Do not use oxygen in or near a refrigeration system as an explosion may occur.**

**WARNING**

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

**WARNING**

**The Unit Power Plug Must Be Disconnected To Remove Power From Circuit Breaker Cb1**

**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**

**When condenser water flow is below 11 lpm (3 gpm) or when water-cooled operation is not in use, the CFS switch MUST be set to position "1" or the unit will not operate properly.**

**CAUTION**

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

**CAUTION**

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

**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 zero 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**

**Use only Carrier Transicold approved Polyol Ester Oil (POE) - Mobil ST32 compressor oil with R-134a. Buy in quantities of one quart or smaller. When using this hygroscopic oil, immediately reseal. Do not leave container of oil open or contamination will occur.**

**CAUTION**

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

**CAUTION**

**DO NOT disassemble piston from NEW suction modulating valve powerhead assembly. Doing so may result in damage to piston.**

**CAUTION**

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

**CAUTION**

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

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## SECTION 1

### INTRODUCTION

#### 1.1 INTRODUCTION

The Carrier Transicold model 69NT20-531-300 units are of lightweight aluminum frame construction, designed to fit in the front of a container and serve as the container front wall.

They are one piece, self-contained, all electric units which are fitted with 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 power. An optional autotransformer may be fitted to allow operation on nominal 190/230, 3 phase, 50/60 hertz power. Power for the control system 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 2i microprocessor. The controller will operate automatically to select cooling, holding or heating as required to maintain the desired set point temperature within very close limits.

The controller is fitted with 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 model plate located to the left of the economizer. The plate provides the unit model number and the unit parts identification number (PID). The model number identifies the overall unit configuration while the PID provides information on specific optional equipment, factory provision to allow for field installation of optional equipment and differences in detailed parts.

Configuration identification for the models covered herein are provided in the Carrier Transicold Container Unit Matrix manual, publication T-300. Printed copies of the T-300 may be obtained from Carrier Transicold. Also, a weekly updated copy may be found at the Carrier Web site, [www.carrier.refrigeration.com](http://www.carrier.refrigeration.com).

#### 1.3 OPTION DESCRIPTIONS

Various options may be factory or field fitted to the base unit. Brief descriptions of the options are provided in the following subparagraphs.

##### 1.3.1 Battery

The controller may be fitted with standard replaceable batteries or a rechargeable battery pack.

##### 1.3.2 Dehumidification

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

##### 1.3.3 Control Box

The control box is constructed of composite material and may be fitted with a lockable door.

##### 1.3.4 Temperature Readout

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

##### 1.3.5 Pressure Readout

The unit may be fitted with factory installed suction and discharge pressure gauges. The unit is fitted with suction and discharge transducers. The readings may be viewed on the controller display.

##### 1.3.6 Interrogator

Units that use the DataCORDER function are fitted with interrogator receptacles for connection of equipment to download the recorded data. Two receptacles may be fitted, one accessible from the front of the unit and the other mounted inside the container (with the USDA receptacles).

##### 1.3.7 Remote Monitoring

The unit may be fitted with a remote monitoring receptacle. This item allows connection of remote indicators for COOL, DEFROST and IN RANGE.

##### 1.3.8 Communications

The unit may be 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.

##### 1.3.9 Compressor

The unit is fitted with a scroll compressor.

##### 1.3.10 Back Panels

Back panel designs that may be fitted include panels of aluminum and stainless steel. Panels may be fitted with access doors and/or hinge mounting.

### 1.3.11 460 Volt Cable

Various power cable and plug designs are available for the main 460 volt supply. The plug options tailor the cables to each customer's requirements.

### 1.3.12 Cable Restraint

Various designs are available for storage of the power cables. These options are variations of the compressor section front cover.

### 1.3.13 Upper Air (Fresh Air Make Up)

The unit may be fitted with an upper fresh air makeup assembly. These assemblies are supplied in two designs, the standard design and the micro design. The openings may also be fitted with screens.

### 1.3.14 Evaporator

The unit is fitted with an evaporator coil and a hermetic thermal expansion valve.

### 1.3.15 Evaporator Fan Operation

The units are fitted with Normal Evaporator Fan Operation, opening of an evaporator fan internal protector will shut down the unit.

### 1.3.16 Labels

Operating Instruction and Function Code listing labels will differ depending on the options installed. For

example, additional operating instructions are required to describe start-up of a unit equipped with an autotransformer. Where the labels are available with additional languages, they are listed in the parts list.

### 1.3.17 Plate Set

Each unit is equipped with a tethered set of wiring schematic and wiring diagram plates.

The plate sets are ordered using a seven digit base part number and a two digit dash number. **(See Unit Matrix Manual, T-300)**

### 1.3.18 Controller

Replacement controllers may be ordered as a universal un-configured controller (without configuration software) or configured.

### 1.3.19 Stepper Drive

All the units covered by this manual have suction modulating valves which act to control system capacity. Units indicated as being fitted with "stepper drive" have digital control motors fitted to the suction modulating valve to open and close the valve in steps as required.

### 1.3.20 Condenser Grille

Two styles of condenser grilles are available, direct bolted grilles and hinged grilles.

## SECTION 2

### DESCRIPTION

#### 2.1 GENERAL DESCRIPTION

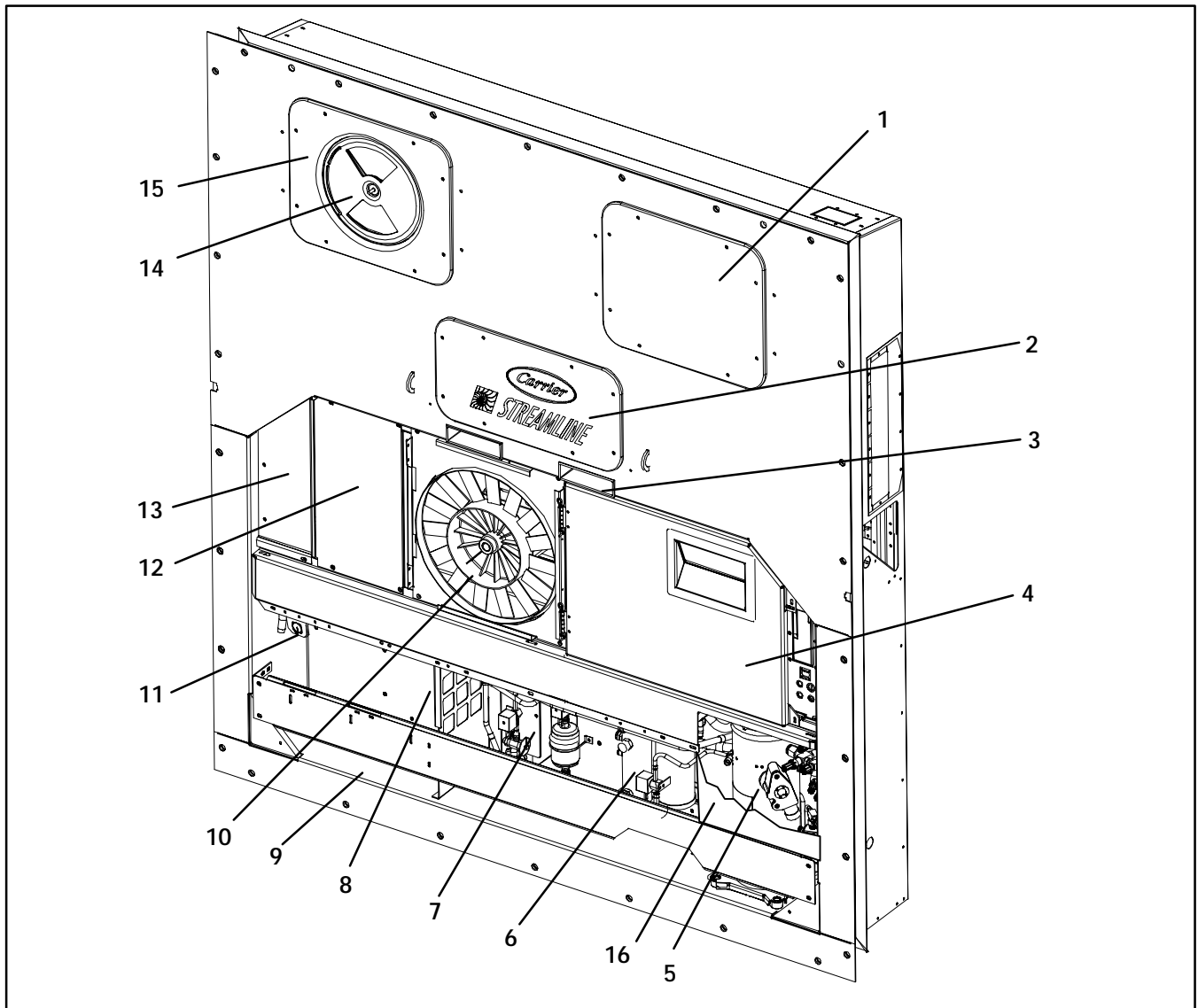
##### 2.1.1 Refrigeration Unit - Front Section

The unit is designed so that the majority of the components are accessible from the front, see Figure 2-1. The upper access panels allow entry into the evaporator section, and the center access panel allows access to the evaporator expansion valve, unloader

valve, suction modulation valve and evaporator coil heaters. The unit model number, serial number and parts identification number can be found on the serial plate to the left of the economizer.

##### 2.1.2 Fresh Air Makeup Vent

The function of the upper or lower makeup air vent is to provide ventilation for commodities that require fresh air circulation.



- |  |  |
|--|--|
| 1. Access Panel (Evap. Fan #1)   | 9. Power Cables and Plug                               |
| 2. Access Panel (Heaters, Suction Modulating Valve, Unloader Valve & Evaporator Expansion Valve) | 10. Condenser Fan                                      |
| 3. Fork Lift Pockets   | 11. Interrogator Connector (Front left)                |
| 4. Control Box   | 12. Blank Cover (Temperature Recorder Location)        |
| 5. Compressor  | 13. Blank Cover (Lower Fresh Air Makeup Vent Location) |
| 6. Receiver or Water Cooled Condenser  | 14. Upper Fresh Air Makeup Vent                        |
| 7. Economizer  | 15. Access Panel (Evap. Fan #2)                        |
| 8. Unit Serial Number, Model Number and  | 16. Compressor Protection Panel (cutaway view)         |

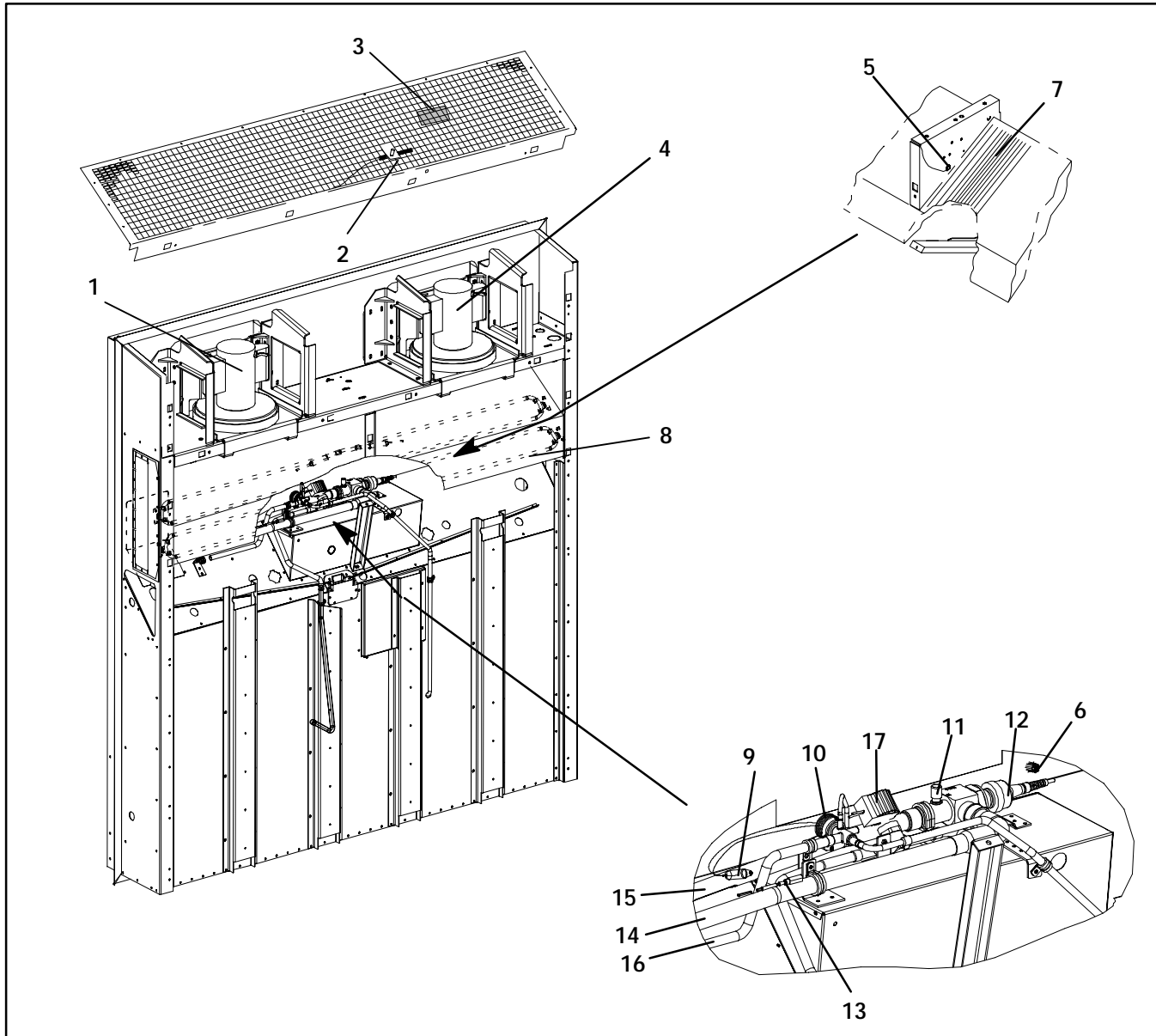
Figure 2-1 Refrigeration Unit - Front Section

### 2.1.3 Evaporator Section

The evaporator section (Figure 2-2) contains the return recorder sensor, return temperature sensor, evaporator expansion valve, unloader valve, suction modulation valve, dual-speed evaporator fans (EM1 and EM2), evaporator coil and heater, defrost heaters, defrost temperature sensor, heat termination thermostat and suction temperature sensor.

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.

The evaporator components are accessible by removing the upper rear panel (as shown in the illustration) or by removing the front access panels.



- |                                       |                                |
|---------------------------------------|--------------------------------|
| 1. Evaporator Fan Motor #1            | 10. Evaporator Expansion Valve |
| 2. Return Recorder/Temperature Sensor | 11. Low Side Access Valve      |
| 3. Humidity Sensor                    | 12. Suction Modulating Valve   |
| 4. Evaporator Fan Motor #2            | 13. Suction Temperature Sensor |
| 5. Defrost Temperature Sensor         | 14. To Compressor              |
| 6. Heater Termination Thermostat      | 15. From Coil                  |
| 7. Evaporator Coil                    | 16. To Coil                    |
| 8. Evaporator Coil Heaters            | 17. Unloader Solenoid Valve    |
| 9. Evaporator Expansion Valve Bulb    |                                |

Figure 2-2 Evaporator Section



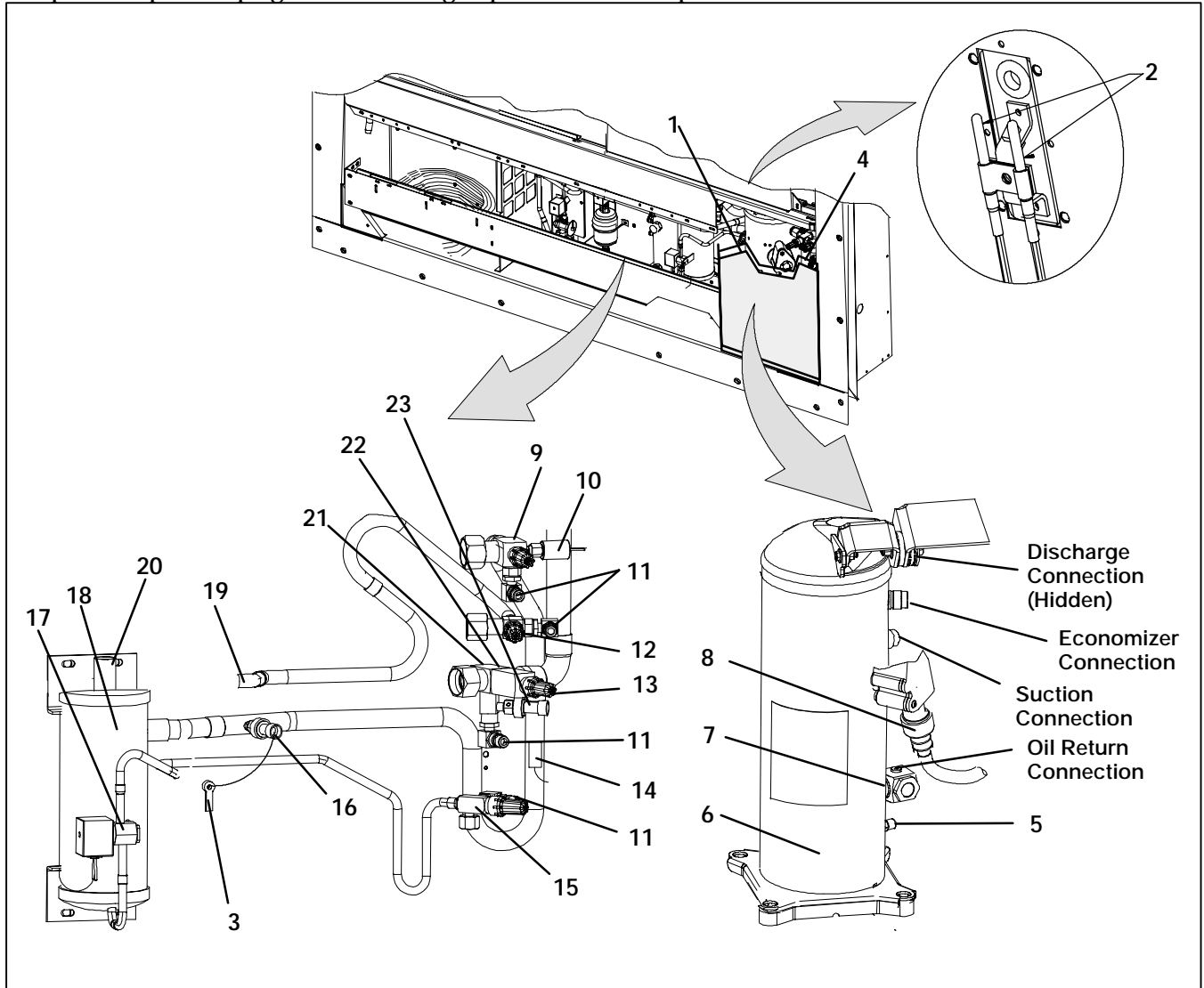
### 2.1.4 Compressor Section

The compressor section includes the compressor (with high pressure switch) and the oil separator.

This section also contains the oil return solenoid, compressor power plug, the discharge pressure

transducer, discharge temperature sensor and the suction pressure transducers.

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



- |   |                                   |
|---|-----------------------------------|
| 1. Compressor Guard                                   | 12. Economizer Service Valve      |
| 2. Supply Temperature/Supply Recorder Sensor Assembly | 13. Suction Service Valve         |
| 3. Ambient Sensor                                     | 14. Discharge Temperature Sensor  |
| 4. Supply Air Thermometer Port (location)             | 15. Oil Return Service Valve      |
| 5. Oil Drain  | 16. Discharge Pressure Transducer |
| 6. Compressor   | 17. Oil Return Solenoid Valve     |
| 7. Compressor Sight Glass                             | 18. Oil Separator                 |
| 8. Compressor Power Plug                              | 19. From Economizer               |
| 9. Discharge Service Valve                            | 20. To Condenser                  |
| 10. High Pressure Switch                              | 21. From Suction Modulating Valve |
| 11. Access Valve                                      | 22. Suction Strainer              |
|   | 23. Suction Pressure Transducer   |

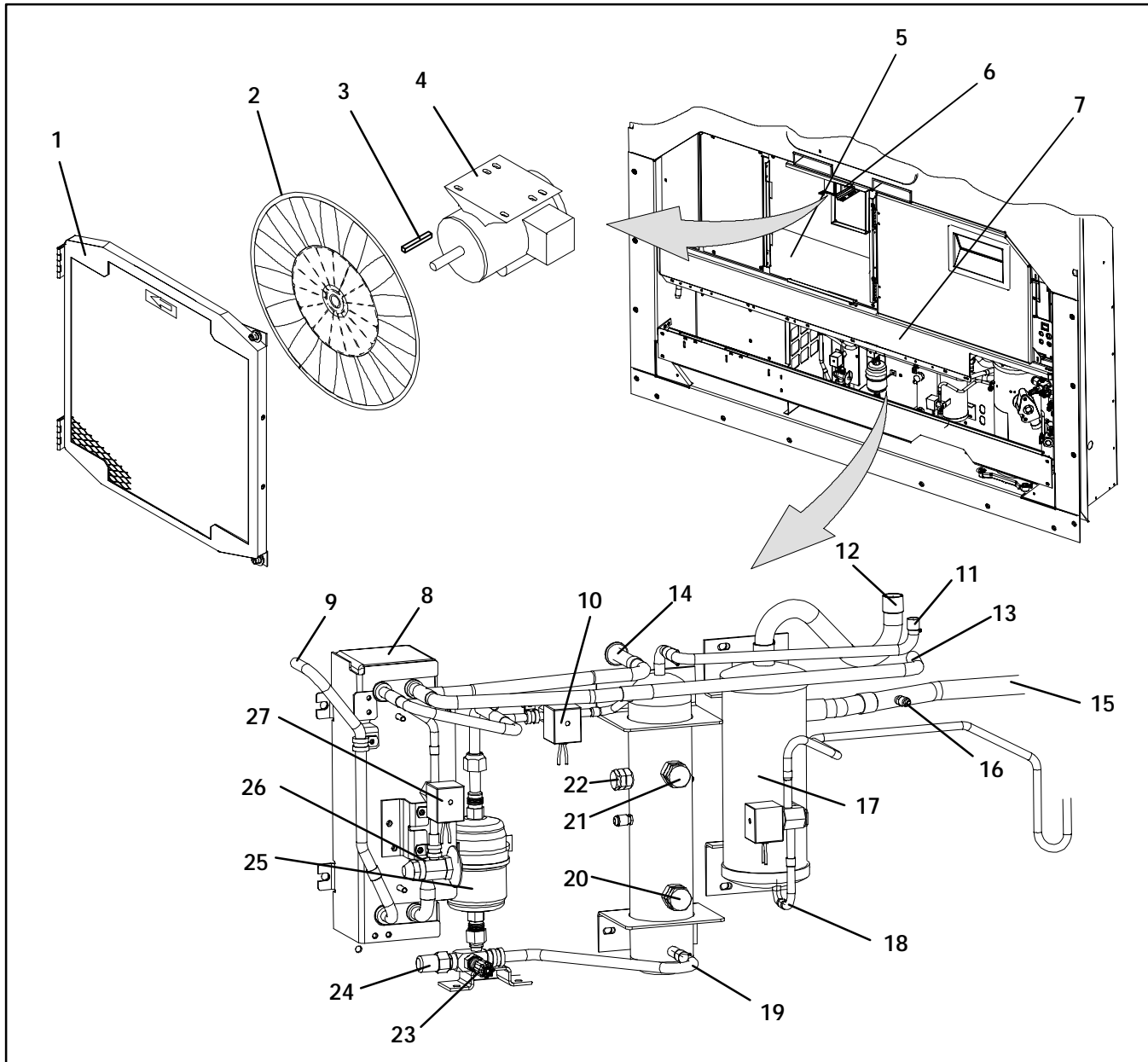
Figure 2-3 Compressor Section

## 2.1.5 Air Cooled Condenser Section

The air cooled condenser section (Figure 2-4) consists of the condenser fan, condenser coil, receiver, sight glass/moisture indicator, liquid line service valve, filter-drier and fusible plug.

The condenser fan pulls air in the bottom of the coil and it is discharged horizontally out through the condenser fan grille.

This section also contains the economizer, economizer solenoid valve, economizer expansion valve and the liquid injection solenoid valve.



- |   |                                    |
|---|------------------------------------|
| 1. Grille and Venturi Assembly          | 15. From Compressor Discharge      |
| 2. Condenser Fan                        | 16. Discharge Pressure Transducer  |
| 3. Key                                  | 17. Oil Separator                  |
| 4. Condenser Fan Motor                  | 18. To Oil Return Solenoid         |
| 5. Condenser Coil                       | 19. Receiver                       |
| 6. Condenser Motor Mounting Bracket     | 20. Sight Glass/Moisture Indicator |
| 7. Condenser Coil Cover                 | 21. Sight Glass                    |
| 8. Economizer                           | 22. Fusible Plug                   |
| 9. To Evaporator Expansion Valve        | 23. Access Valve                   |
| 10. Liquid Injection Solenoid Valve     | 24. Liquid Line Service Valve      |
| 11. From Condenser                      | 25. Filter-Drier                   |
| 12. To Condenser                        | 26. Economizer Expansion Valve     |
| 13. To Compressor Economizer Connection | 27. Economizer Solenoid Valve      |
| 14. To Unloader Solenoid Valve          |                                    |

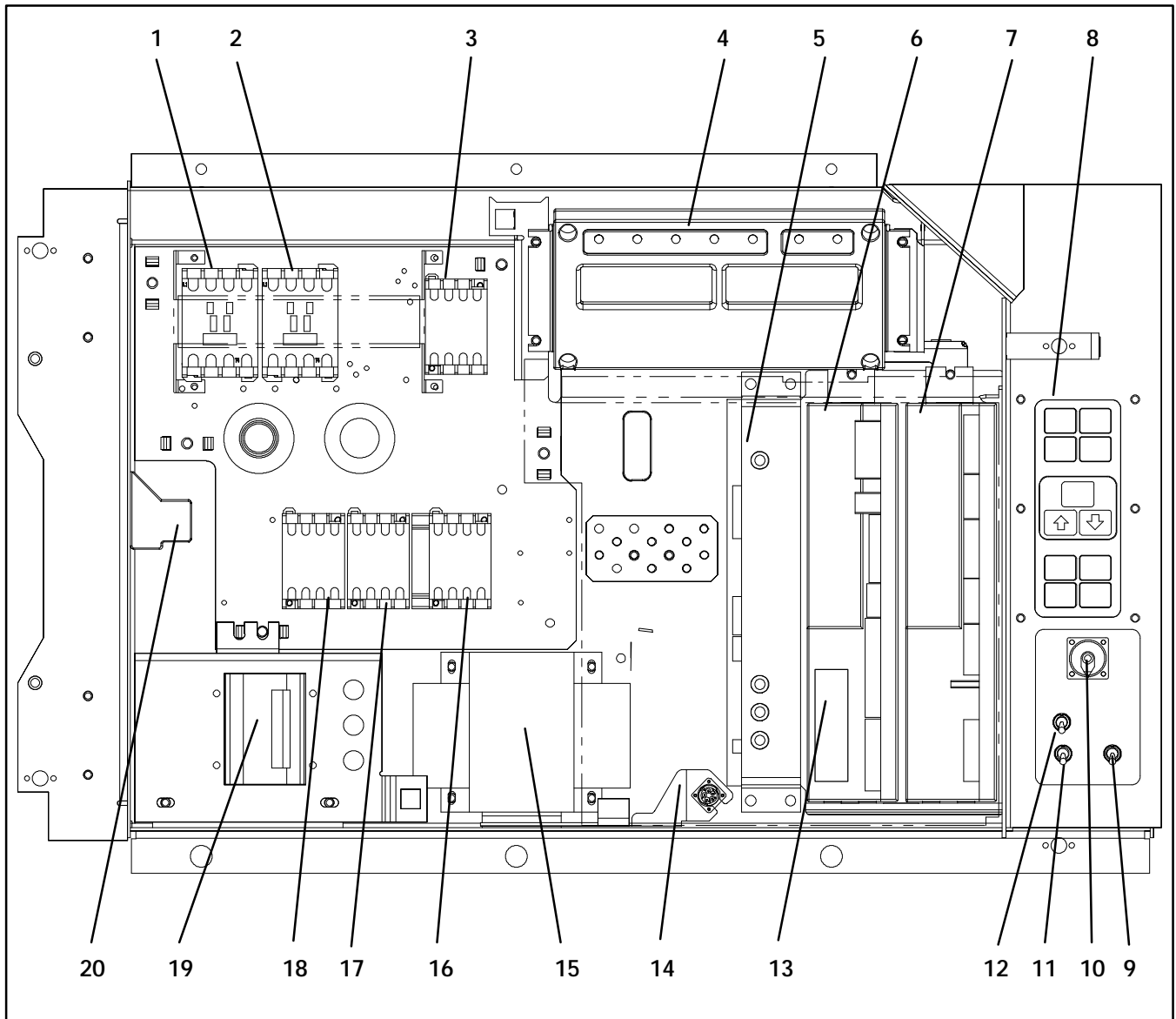
Figure 2-4 Condenser Section

### 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 expansion module and the communications interface module.

### 2.1.7 Communications Interface Module

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



- |  |   |
|--|---|
| 1. Compressor Phase A Contactor              | 11. Manual Defrost Switch                 |
| 2. Compressor Phase B Contactor              | 12. Condenser Fan Switch                  |
| 3. Heater Contactor                          | 13. Controller Battery Pack               |
| 4. Display Module                            | 14. Interrogator Connector (Box Location) |
| 5. Communications Interface Module           | 15. Control Transformer                   |
| 6. Controller/DataCORDER Module (Controller) | 16. Evaporator Fan Contactor - High       |
| 7. Expansion Module                          | 17. Evaporator Fan Contactor - Low        |
| 8. Key Pad                                   | 18. Condenser Fan Contactor               |
| 9. Start-Stop Switch                         | 19. Circuit Breaker - 460V                |
| 10. Remote Monitoring Receptacle             | 20. Current Sensor Module                 |

Figure 2-5 Control Box Section

## 2.2 REFRIGERATION SYSTEM DATA

a. Compressor/Motor Assembly	Model	RSH105
	Weight (Dry)	46.5 kg (103 lb)
	Approved Oil	Mobil ST32
	Oil Charge	2957 ml (100 ounces)
	Oil Sight Glass	The oil level range, with the compressor off, should be between the bottom and one-eighth level of the sight glass.
b. Evaporator Expansion Valve Superheat	Verify at -18 _C (0 _F) container box temperature	4.4 to 6.7 _C (8 to 12 _F)
c. Economizer Expansion Valve Superheat		4.4 to 11.1 _C (8 to 20 _F)
d. Heater Termination Thermostat	Opens	54 (   3) _C = 130 (   5) _F
	Closes	38 (   4) _C = 100 (   7) _F
e. High Pressure Switch	Cutout	25 (   1.0) kg/cm@ = 350 (   10) psig
	Cut-In	18 (   0.7) kg/cm@ = 250 (   10) psig
f. Refrigerant Charge	Unit Configuration	Charge Requirements - R-134a
	Water-Cooled Condenser	4-Row Coil
		5.33 kg (11.75 lbs)
	Receiver	4.99kg (11.0 lbs)
g. Fusible Plug	Melting point	99 _C = (210 _F)
	Torque	6.2 to 6.9 mkg (45 to 50 ft-lbs)
h. Sight Glass/Moisture Indicator	Torque	8.9 to 9.7 mkg (65 to 70 ft-lbs)
i. Rupture Disc	Bursts at	35   5% kg/cm@ = (500   5% psig)
	Torque	6.2 to 6.9 mkg (45 to 50 ft-lbs)
j. Unit Weight	Refer to unit model number plate.	
k. Water Pressure Switch	Cut-In	0.5   0.2 kg/cm@ (7   3 psig)
	Cutout	1.6   0.4 kg/cm@ (22   5 psig)

### 2.3 ELECTRICAL DATA

<b>a. Circuit Breaker</b>	CB-1 Trips at	29 amps	
	CB-2 (50 amp) Trips at	62.5 amps	
	CB-2 (70 amp) Trips at	87.5 amps	
<b>b. Compressor Motor</b>	Full Load Amps (FLA)	13 amps @ 460 vac	
<b>c. Condenser Fan Motor</b>		380 vac, Single Phase, 50 hz	460 vac, Single Phase, 60 hz
	Full Load Amps	1.3 amps	1.6 amps
	Horsepower	0.43 hp	0.75 hp
	Rotations Per Minute	1425 rpm	1725 rpm
	Voltage and Frequency	360 - 460 vac   2.5 hz	400 - 500 vac   2.5 hz
	Bearing Lubrication	Factory lubricated, additional grease not required.	
	Rotation	Counter-clockwise when viewed from shaft end.	
<b>d. Evaporator Coil Heaters</b>	Number of Heaters	4	
	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 Fan Motor(s)</b>		<b>380 vac/50 hz</b>	<b>460 vac/60 hz</b>
	Full Load Amps High Speed	1.6	2.0
	Full Load Amps Low Speed	0.8	1.0
	Nominal Horsepower High Speed	0.70	0.84
	Nominal Horsepower Low Speed	0.09	0.11
	Rotations Per Minute High Speed	2850 rpm	3450 rpm
	Rotations Per Minute Low Speed	1425 rpm	1750 rpm
	Voltage and Frequency	360 - 460 vac ± 1.25 hz	400 - 500 vac ± 1.5 hz
	Voltage & Frequency using power autotransformer	180 - 230 vac ± 1.25hz	200 - 250 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	10 amps (F3)	
	Controller/DataCORDER	5 amps (F1 & F2)	
	Expansion Module	10 amps (F4)	

**PARAGRAPH 2.3 - Continued**

<b>g. 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 the following table. 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 (F3/15A); or (c) Evaporator Fan Motor Internal Protector(s) - (IP-EM).

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

UNSAFE CONDITION	DEVICE	DEVICE SETTING
Excessive current draw	Circuit Breaker (CB-1) - Manual Reset	Trips at 29 amps (460 vac)
	Circuit Breaker (CB-2, 50 amp) -Manual Reset	Trips at 62.5 amps (230 vac)
	Circuit Breaker (CB-2, 70 amp) -Manual Reset	Trips at 87.5 amps (230 vac)
Excessive current draw in the control circuit	Fuse (F3)	10 amp rating
Excessive current draw by the controller	Fuse (F1 & F2)	5 amp rating
Excessive current draw by the expansion module	Fuse (F4)	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	93 _C = (200 _F)
	Rupture Disc - Used on the Water-Cooled Condenser	35 kg/cm@ = (500 psig)
Abnormally high discharge pressure	High Pressure Switch (HPS)	Opens at 25 kg/cm@ (350 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.

In the standard mode, both the economizer and unloader solenoid valves are closed. The gas flows through the discharge service valve into the oil separator. In the separator, oil is removed from the refrigerant and stored for return to the compressor when the oil return solenoid valve is opened by the controller. The oil return solenoid valve is a normally open valve which allows return of oil during the off cycle.

The refrigerant gas continues into the air-cooled condenser. When operating with the air-cooled condenser active, 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.

When operating with the water cooled condenser active (see Figure 2-6, lower schematic), the refrigerant gas passes through the air cooled condenser and enters the water cooled condenser shell. The water flowing inside the tubing cools the gas to saturation temperature in the same manner as the air passing over the air cooled condenser. The refrigerant condenses on the outside of the tubes and exits as a high temperature liquid. The water cooled condenser also acts as a receiver, storing excess refrigerant.

The liquid refrigerant continues through the liquid line service valve, the filter-drier (which keeps refrigerant clean and dry) and the economizer (which is not active during standard operation) to the evaporator expansion valve. As the liquid refrigerant passes through the variable orifice of the expansion valve, some of it vaporizes into a gas (flash gas). Heat is 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 modulation valve to the compressor.

The evaporator expansion valve is activated by the bulb strapped to the suction line near the evaporator outlet. The valve maintains a constant superheat at the coil outlet regardless of load conditions.

On systems fitted with a water pressure switch, the condenser fan will be off when there is sufficient pressure to open the switch. If water pressure drops below the switch cut out setting, the condenser fan will be automatically started. When operating a system fitted with a condenser fan switch, the condenser fan will be off when the switch is placed in the "O" position. The condenser fan will be on when the switch is placed in the "I" position.

### 2.5.2 Economized Operation

In the economized mode the frozen range and pull down capacity of the unit is increased by subcooling the liquid refrigerant entering the evaporator 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.

During economized operation, flow of refrigerant through the main refrigerant system is identical to the standard mode. (The unloader solenoid valve is de-energized [closed] by the controller.)

Liquid refrigerant for use in the economizer circuit is taken from the main liquid line as it leaves the filter-drier (see Figure 2-7). The flow is activated when the controller energizes the economizer solenoid valve. The liquid refrigerant flows through the economizer expansion valve and the economizer internal passages absorbing heat from the liquid refrigerant flowing to the evaporator expansion valve. The resultant "medium" temperature/pressure gas enters the compressor at the economizer service valve.

### 2.5.3 Unloaded Operation

The system will operate in the unloaded mode during periods of low load, during periods of required discharge pressure or current limiting, and during start-up.

During unloaded operation, flow of refrigerant through the main refrigerant system is identical to the standard mode. (The economizer solenoid valve is de-energized [closed] by the controller.)

In the unloaded mode, a portion of the mid-stage compressed gas is bypassed to decrease compressor capacity. The flow is activated when the controller opens the unloader solenoid valve (see Figure 2-7). Opening of the valve creates a bypass from the economizer service valve through the unloader solenoid valve and into the suction line on the outlet side of the suction pressure modulation valve.

As load on the system decreases, the suction modulating valve decreases flow of refrigerant to the compressor. This action balances the compressor capacity with the load and prevents operation with low coil temperatures. In this mode of operation, the liquid injection solenoid valve will open as required to provide sufficient liquid refrigerant flow into the suction line for cooling of the compressor motor.

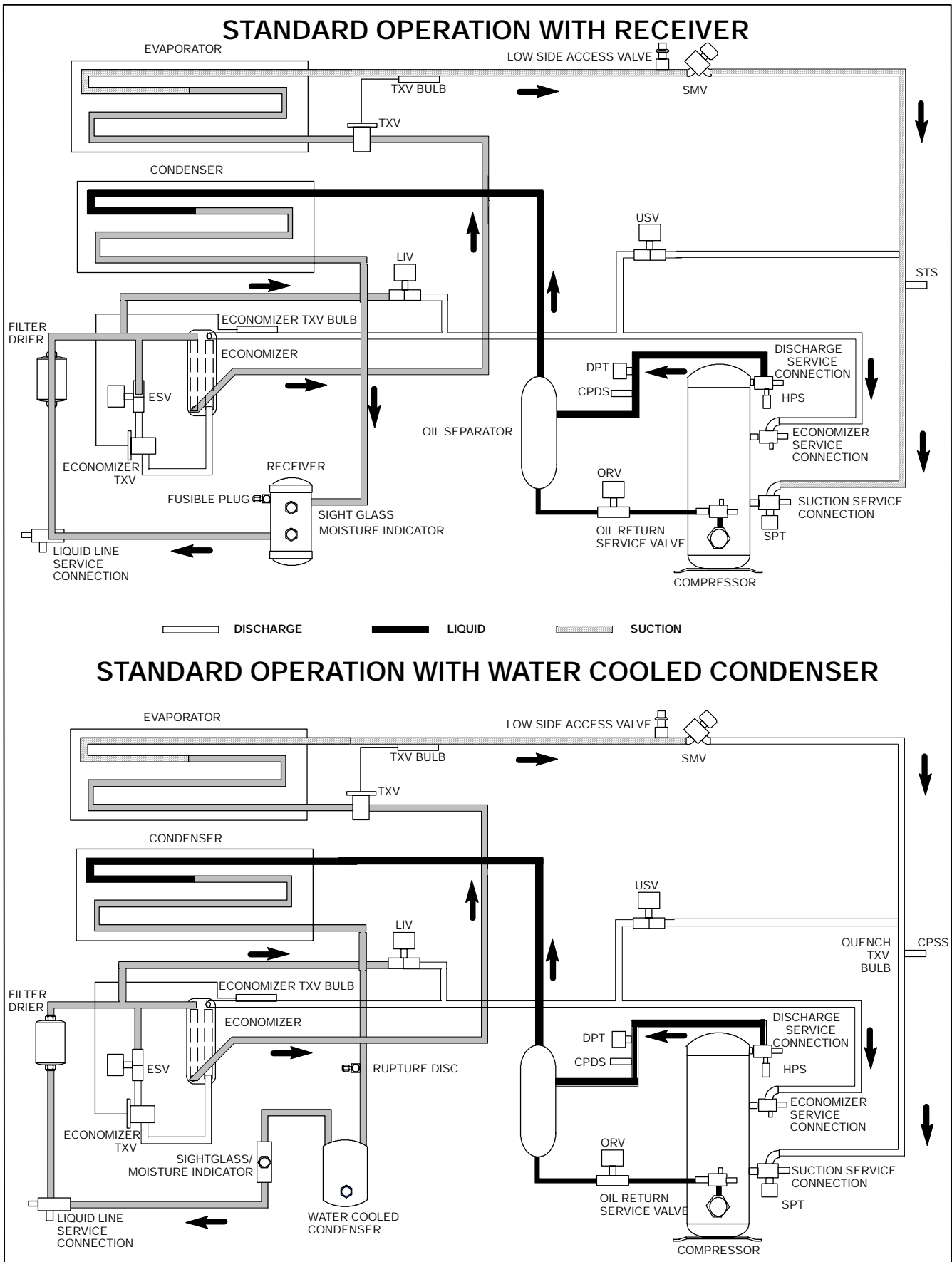


Figure 2-6 Refrigeration Circuit Schematic - Standard Operation



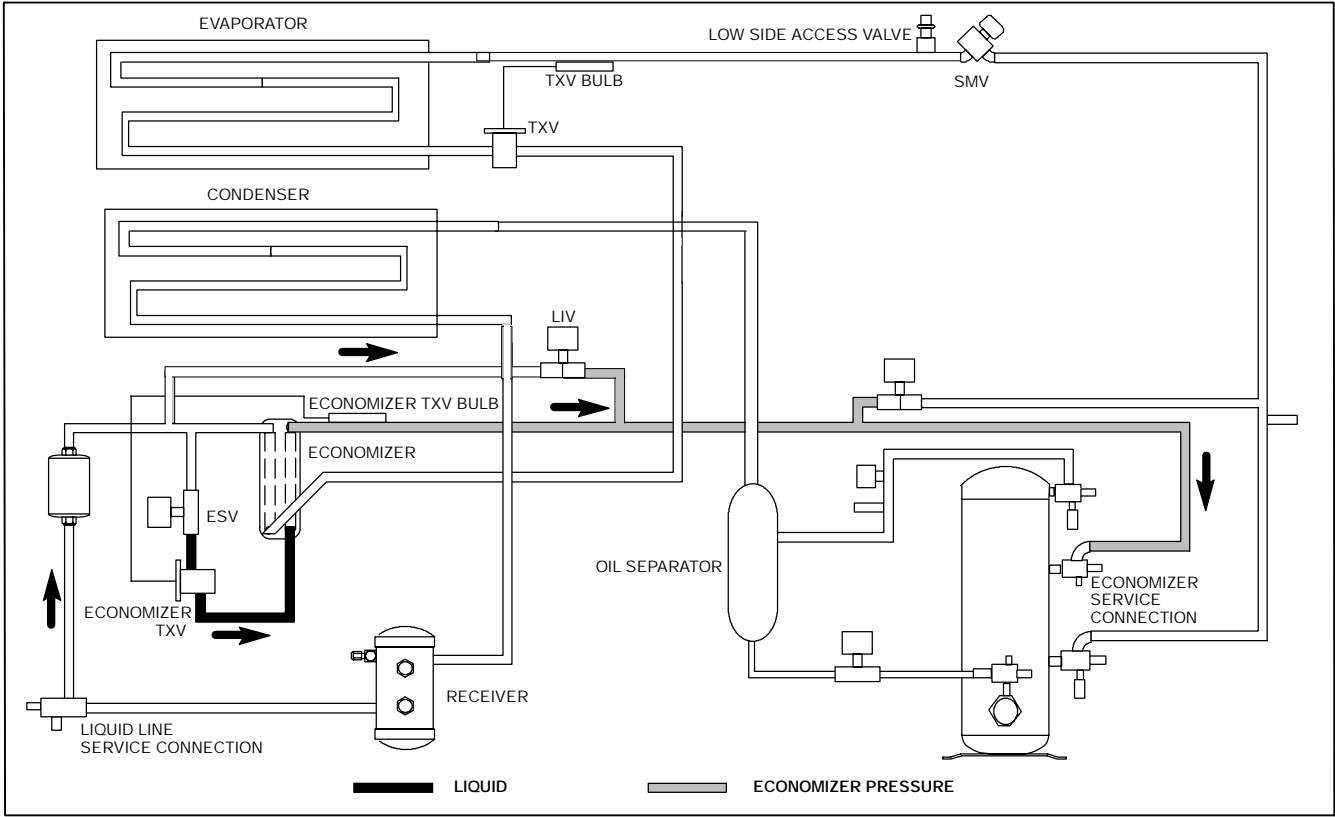


Figure 2-7 Refrigeration Circuit Schematic - Economized Operation

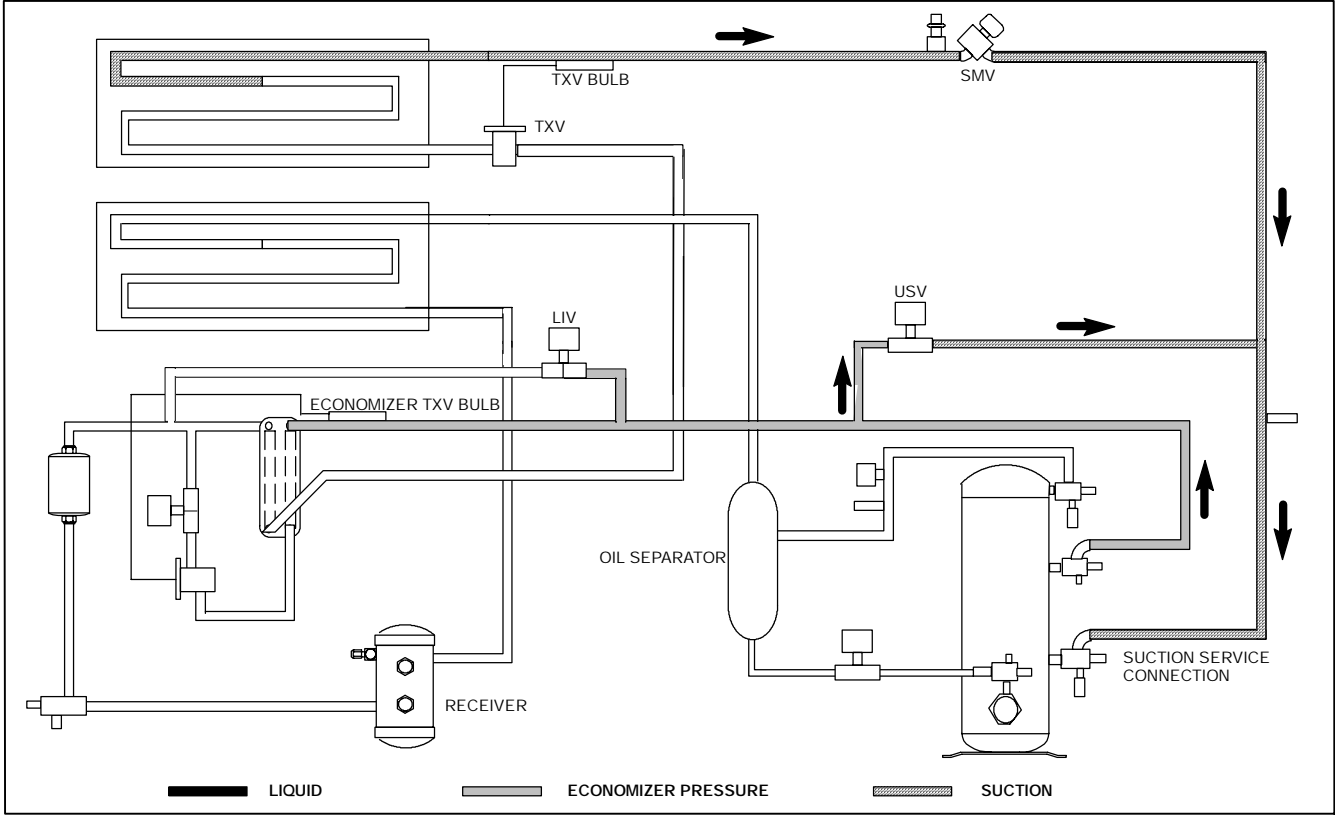


Figure 2-8 Refrigeration Circuit Schematic - Unloaded Operation

## SECTION 3 MICROPROCESSOR

### 3.1 TEMPERATURE CONTROL MICROPROCESSOR SYSTEM

The temperature control Micro-Link 2i microprocessor system (see Figure 3- 1) consists of a key pad, display module, the control module & expansion module set (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 3.6.

The key pad 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 key pad selections and viewed on the display module. The components are designed to permit ease of installation and removal.

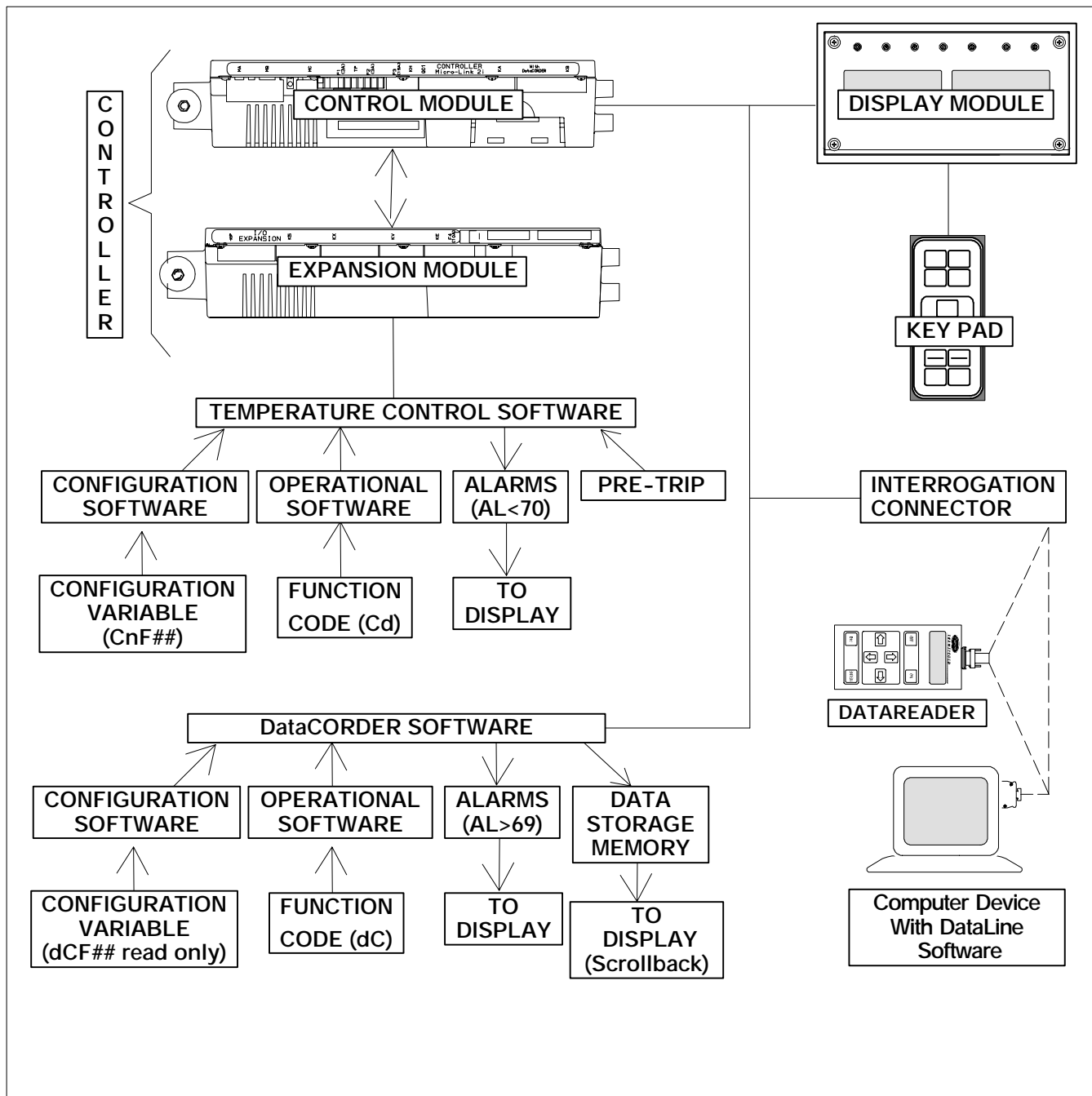


Figure 3- 1 Temperature Control System

### 3.1.1 Key Pad

The key pad (Figure 3- 2) is mounted on the right-hand side of the control box. The key pad 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.

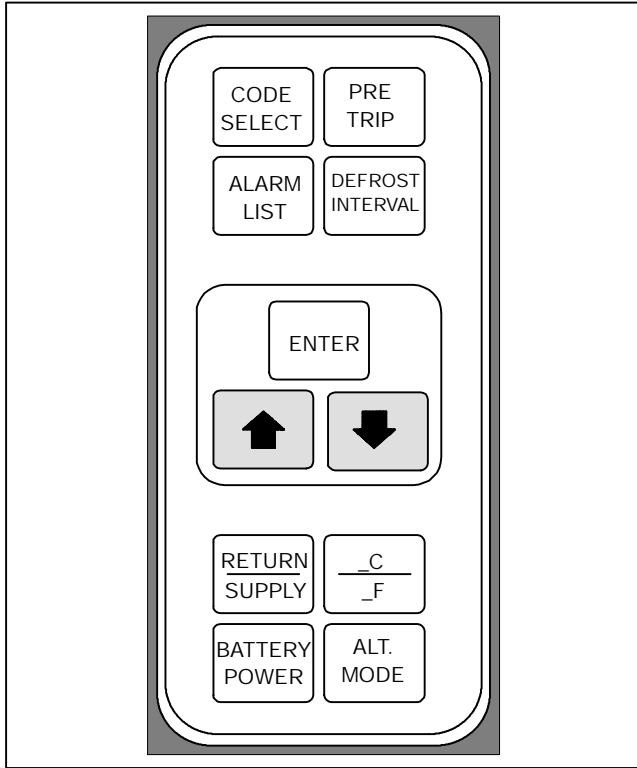


Figure 3- 2 Key Pad

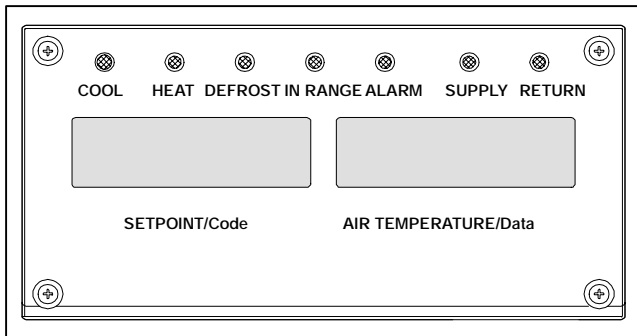


Figure 3- 3 Display Module

### 3.1.2 Display Module

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

1. Cool - White LED: Energized when the refrigerant compressor is energized.
2. Heat - Orange LED: Energized to indicate heater operation in the heat or defrost mode.
3. Defrost - Orange LED: Energized when the unit is in the defrost mode.
4. In-Range - Green LED: Energized when the controlled temperature probe is within specified tolerance of set point.

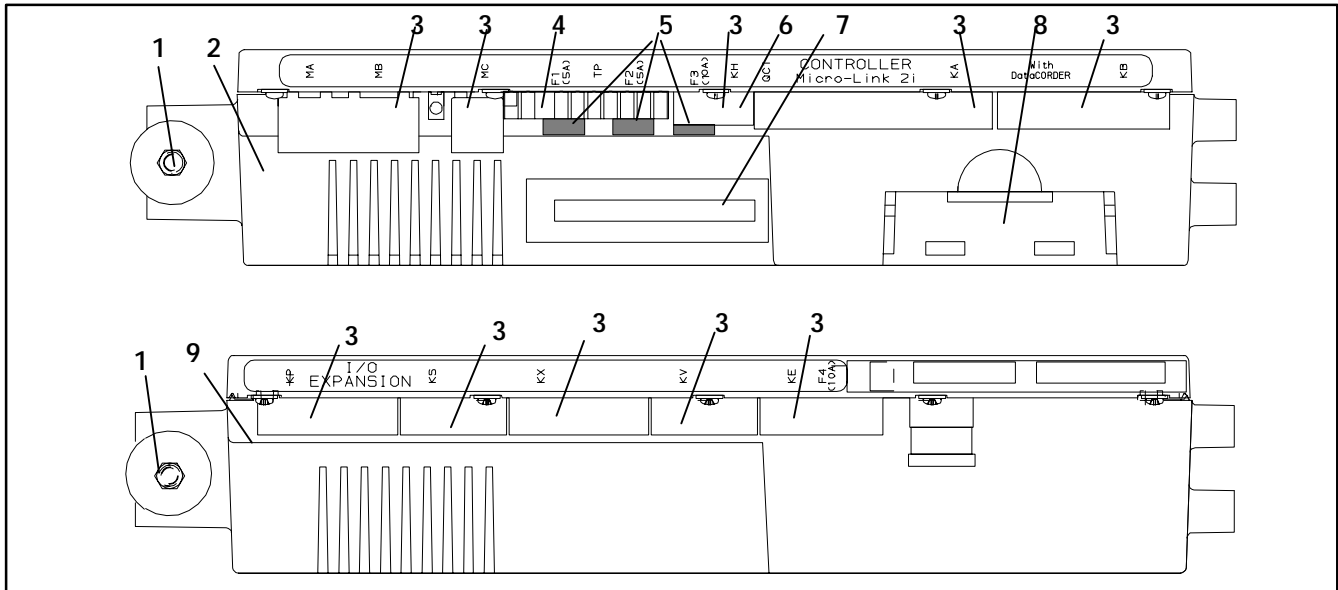
Table 3-1 Key Pad Function

KEY	FUNCTION
Code Select	Accesses function codes.
Pre-Trip	Displays the pre-trip selection menu. Discontinues pre-trip in progress.
Alarm List	Displays alarm list and clears the alarm queue.
Defrost Interval	Displays selected defrost interval.
Enter	Confirms a selection or saves a selection to the controller.
Arrow Up	Change or scroll a selection upward Pre-trip advance or test interruption.
Arrow Down	Change or scroll a selection downward. Pre-trip repeat backward.
Return/Supply	Displays non-controlling probe temperature (momentary display).
_C/_F	Displays 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 and function code selection if AC power is not connected.
ALT Mode	This key is pressed to switch the functions from the 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 the perishable range will be the SUPPLY air probe and the controlling probe in the frozen range will be 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. This LED will flash if dehumidification or humidification is enabled.
7. Alarm - Red LED: Energized when there is an active or an inactive shutdown alarm in the alarm queue



- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Mounting Screw</li> <li>2. Micro-Link 2i Control/DataCORDER Module</li> <li>3. Connectors</li> <li>4. Test Points</li> <li>5. Fuses</li> </ol> | <ol style="list-style-type: none"> <li>6. Control Circuit Power Connection (Location: In back of controller)</li> <li>7. Software Programming Port</li> <li>8. Battery Pack</li> <li>9. Expansion Module</li> </ol> |
|--|---|

Figure 3- 4 Control and Expansion Modules

### 3.1.3 Controller

#### 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.**

#### NOTE

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

The Micro-Link 2i controller is a dual module microprocessor as 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 the Configuration Software and the Operational Software. The controller software performs the following functions:

- a. 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 build up of frost and ice and ensure proper air flow across the coil.
- b. Provide default independent readouts of set point and supply or return air temperatures.

- c. Provide ability to read and (if applicable) modify the Configuration Software Variables, Operating Software Function Codes and Alarm Code Indications.

- d. 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.

- e. Provide battery powered ability to access or change selected codes and set point without AC power connected

- f. Provide the ability to reprogram the software through the use of a memory card. The memory card automatically downloads new software to the controller when inserted.

#### 3.2.1 Configuration Software (Configuration Variables)

The 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 communications.

### 3.2.2 Operational Software (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 operator 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, perform the following:

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

### 3.3 MODES OF OPERATION

The Operational Software responds to various inputs. These inputs come from the temperature and pressure sensors, the temperature set point, the settings of the the configuration variables and the function code assignments. The action taken by the Operational Software will change if any one of the inputs changes. 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 Temperature Control - Perishable Mode

With configuration variable CnF26 (Heat Lockout Temperature) set to -10\_C the perishable mode of operation is active with set points *at or above* -10\_C (+14\_F). With the variable set to -5\_C, the perishable mode is active at or above -5\_C (+23\_F). Refer to Table 3-4.

When in the perishable mode the controller maintains the supply air temperature at set point, the SUPPLY indicator light will be illuminated on the display module and the default reading on the display window will be the supply temperature sensor reading.

When the supply air temperature enters the in-range temperature tolerance (as selected at function code Cd30), the in-range light will energize.

#### 3.3.2 Defrost Interval

Function code Cd27 may be operator set to initiate defrost at intervals of 3, 6, 9, 12 or 24 hours. It may also be set to OFF (no defrost). The factory default is 12 hours. (Refer to Table 3-5).

#### 3.3.3 Failure Action

Function code Cd29 may be operator set to allow continued operation in the event the control sensors are reading out of range. The factory default is full system shutdown. (Refer to Table 3-5).

#### 3.3.4 Generator Protection

Function codes Cd31 (Stagger Start, Offset Time) and Cd32 (Current Limit) may be operator set to control 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.

#### 3.3.5 Compressor High Temperature, Low Pressure Protection.

The controller monitors compressor suction and discharge temperatures and pressures. If the discharge temperature exceeds a certain limit, the liquid injection valve is opened to provide sufficient liquid refrigerant flow into the economizer line to reduce the discharge temperature. If the liquid injection is unable to reduce the discharge temperature sufficiently and the temperature exceeds the allowed limit, the compressor will cycle off on a 3 minute timer. The compressor will also cycle off in a similar manner if the suction pressure falls below the allowed limit. Condenser and evaporator fans continue to operate during the compressor off cycle.

#### 3.3.6 Perishable Mode - Conventional

The unit is capable of maintaining supply air temperature to within  $\pm 0.25_C$  ( $\pm 0.5_F$ ) of set point. Supply air temperature is controlled by positioning of the suction modulation valve (SMV), cycling of the compressor and cycling of the heaters.

When cooling from a temperature that is more than 2.5\_C (4.5\_F) above set point, the system will be in the perishable pull down mode. It will be in economized operation with a target SMV position of 100% open. However, pressure and current limit functions may restrict the valve, if either exceeds the preset value.

Once set point is reached, the unit will transition to the perishable steady state mode. This results in unloaded operation with some restriction of the SMV. The SMV will continue to close and restrict refrigerant flow until the capacity of the unit and the load are balanced.

If the SMV is at minimum modulation, 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 the perishable idle mode. The compressor is turned off and the evaporator fans continue to run to circulate air throughout the container. If temperature rises above set point +0.2\_C, the unit will transition back to the perishable steady state mode

If the temperature drops to 0.5\_C (0.9\_F) below set point, the unit will transition to the perishable heating

mode and the heaters will be energized. The unit will transition back to the perishable idle mode when the temperature rises to 0.2\_C (0.4\_F) below the set point and the heaters will de-energize.

### 3.3.7 Perishable Mode - Economy

The economy mode is an extension of the conventional mode. The mode is activated when the setting of function code Cd34 is "ON". Economy mode is provided for power saving purposes. Economy mode could be utilized in the transportation of temperature tolerant cargo or non-respiration items which do not require high airflow for removing respiration heat. There is no active display indicator that economy mode has been activated. To check for economy mode, perform a manual display of code Cd34.

In order to achieve economy mode, a perishable set point must be selected prior to activation. When economy mode is active, the evaporator fans will be controlled as follows:

At the start of each cooling or heating cycle, the evaporator fans will be run in high speed for three minutes. They will then be switched to low speed any time the supply air temperature is within  $\pm 0.25_C$  (0.45\_F) of the set point and the return air temperature is less than or equal to the supply air temperature + 3\_C (5.4\_F). The fans will continue to run in low speed for one hour. At the end of the hour, the evaporator fans will switch back to high speed and the cycle will be repeated. If bulb mode is active, the economy fan activity will be overwritten.

### 3.3.8 Perishable Mode - Dehumidification

The dehumidification mode is provided to reduce the humidity levels inside the container. The mode is activated when a humidity value is set at function code Cd33. The display module SUPPLY led will flash ON and OFF every second to indicate that the dehumidification mode is active. Once the Mode 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 set point.
2. The unit is in the perishable steady state mode and supply air temperature is less than 0.25\_C 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 the evaporator fans will switch from high to low speed operation. The evaporator fan speed will switch every hour thereafter as long as all conditions are met (see Bulb Mode section for different evaporator fan speed options). If any condition except for 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.

In the dehumidification mode power is applied to the defrost and drain pan heaters. This added heat load

causes the controller to open the suction modulating valve to match the increased heat load while still holding the supply air temperature very close to the set point.

Opening the modulating valve reduces the temperature of the evaporator coil surface, which increases the rate at which water is condensed from the passing air. Removing water from the air reduces the relative humidity. When the relative humidity sensed is 2% below the 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 the mode 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 in the dehumidification mode to prevent rapid cycling and consequent contactor wear. They are:

1. Heater debounce timer (three minutes).
2. Out-of-range timer (five 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.

The out-of-range timer is started to maintain heater operation during a temporary out-of-range condition. If the 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 the temperature exceeds the in-range tolerance value set by function code Cd30.

### 3.3.9 Perishable, Dehumidification - Bulb Mode

Bulb mode is an extension of the dehumidification mode which allows changes to the evaporator fan speed and/or defrost termination set points.

Bulb mode is active when configuration code Cd35 is set to "Bulb". Once the bulb mode is activated, the user may then change the dehumidification mode evaporator fan operation from the default (speed alternates from low to high each hour) to constant low or constant high speed. This is done by toggling function code Cd36 from its default of "alt" to "Lo" or "Hi" as desired. If low speed evaporator fan operation is selected, this gives the user the additional capability of selecting dehumidification set points from 60 to 95% (instead of the normal 65 to 95%).

In addition, if bulb mode is active, function code Cd37 may be set to override the previous defrost termination thermostat settings. (Refer to paragraph 4.9.5.) The temperature at which the defrost termination thermostat will be considered "open" may be changed [in 0.1\_C (0.2\_F) increments] to any value between 25.6\_C (78\_F) and 4\_C (39.2\_F). The temperature at which the defrost termination thermostat is considered closed for interval timer start or demand defrost is 10\_C for "open" values from 25.6\_C (78\_F) down to a 10\_C setting. For "open" values lower than 10\_C, the "closed" values will decrease to the same value as the "open" setting. Bulb mode is terminated when:

1. Bulb mode code Cd35 is set to "Nor."
2. Dehumidification code Cd33 is set to "Off."
3. The user changes the set point to one that is in the frozen range.

When bulb mode is disabled by any of the above, the evaporator fan operation for dehumidification reverts to "alt" and the DTS termination setting resets to the value determined by controller configuration variable CnF41.

### 3.3.10 Temperature Control - Frozen Mode

With configuration variable CnF26 (Heat Lockout Temperature) set to -10\_C the frozen mode of operation is active with set points *at or below -10\_C (+14\_F)*. With the variable set to -5\_C, the frozen mode is active at or below -5\_C (+23\_F).

When in the frozen mode the controller maintains the return air temperature at set point, the RETURN indicator light will be illuminated on the display module and the default reading on the display window will be the return air probe reading.

When the return air temperature enters the in-range temperature tolerance as selected at function code Cd30, the in-range light will energize.

### 3.3.11 Frozen Mode - Conventional

Frozen range cargos are not sensitive to minor temperature changes. The method of temperature control employed in this range takes advantage of this fact to greatly improve the energy efficiency of the unit. Temperature control in the frozen range is accomplished by cycling the compressor on and off as the load demand requires.

When cooling from a temperature that is more than 2.5\_C (4.5\_F) above set point, the system will be in the frozen pull down mode. It will transition to economized operation with a target SMV position of 100% open. However, pressure and current limit functions may restrict the valve, if either exceeds the preset value.

Once set point is reached, the unit will transition to the frozen steady state mode. (Economized operation with maximum allowed suction modulating valve opening.)

When temperature drops to set point minus 0.2\_C and the compressor has run for at least five minutes, the unit will transition to the frozen idle mode. The compressor is turned off and the evaporator fans continue to run to circulate air throughout the container. If temperature rises above set point +0.2\_C, the unit will transition back to the frozen steady state mode.

If the temperature drops 10\_C below set point, the unit will transition to the frozen "heating" mode. In the frozen heating mode the evaporator fans are brought to high speed. The unit will transition back to the frozen steady state mode when the temperature rises back to the transition point.

### 3.3.12 Frozen Mode - Economy

In order to activate economy frozen mode operation, a frozen set point temperature must be selected. The economy mode is active when function code Cd34 is set

to "ON". When economy mode frozen is active, the system will perform normal frozen mode operations except that the entire refrigeration system, excluding the controller, will be turned off when the control temperature is less than or equal to the set point - 2\_C. After an off-cycle period of 60 minutes, the unit will turn on high speed evaporator fans for three minutes, and then check the control temperature. If the control temperature is greater than or equal to the set point + 0.2\_C., the unit will restart the refrigeration system and continue to cool until the previously mentioned off-cycle temperature criteria are met. If the control temperature is less than the set point + 0.2\_C, the unit will turn off the evaporator fans and restart another 60 minute off-cycle.

## 3.4 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:

- a. The red alarm light will illuminate for alarm code numbers 13, 17, 20, 21, 22, 23, 24, 25, 26, and 27.
- b. If a detectable problem is found to exist, its alarm code will be alternately displayed with the set point on the left display.
- c. 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 :

- a. 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.
- b. 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.
- c. The left display will show "AL##," where ## is the alarm number sequentially in the queue.
- d. 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.

- e. "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 the ENTER key. The alarm list will clear and "-----" will be displayed.

### 3.5. UNIT PRE-TRIP DIAGNOSTICS

Pre-Trip Diagnostics is an independent controller function which will suspend normal refrigeration controller activities and provide preprogrammed test routines. The test routines include Auto Mode testing, which automatically performs a pre programmed sequenced of tests, or Manual Mode testing, 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 Pre-Trip key is pressed, economy, dehumidification and bulb mode will be deactivated. At the completion of Pre-Trip activity, economy, dehumidification and bulb mode must be reactivated.**

Testing may be initiated by use of the Key Pad 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 the ENTER key will allow the user to see the results for all subtests. The results will be displayed as "PASS" or "FAIL" for all the tests 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.

### 3.6 DataCORDER

#### 3.6.1 Description

The Carrier Transicold "DataCORDER," software is integrated into the controller and serves to eliminate the temperature recorder and paper chart. The DataCORDER functions may be accessed by key pad 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 Data Reader to download data. A personal computer with Carrier Transicold Data View software 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 (w/wo battery pack)
  - Power Up (w/wo 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 Battery) Replacement
  - Real Time Clock Modification
  - Trip Start
  - ISO Trip Header (When entered via Interrogation program)
  - Economy Mode Start and End
  - "Auto 2" Pre-Trip Start and End
  - Bulb Mode Start
  - Bulb Mode changes
  - Bulb Mode End
  - USDA Trip Comment
  - Humidification Start and End
  - USDA Probe Calibration

#### 3.6.2 DataCORDER Software

The DataCORDER Software is subdivided into the Configuration Software, Operational 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. There are 35 functions (see Table 3-8) 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 & 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 time is desired, press the ENTER key to extend the time to 30 seconds.



Table 3-2 DataCORDER Configuration Variables

CONFIGURATION NO.	TITLE	DEFAULT	OPTION
dCF01	(Future Use)	--	--
dCF02	Sensor Configuration	2	2,5,6,9,54,64,94
dCF03	Logging Interval (Minutes)	60	15,30,60,120
dCF04	Thermistor Format	Short	Low, Normal
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

**b. Configuration Software**

The configuration software controls the recording and alarm functions of the DataCORDER. Reprogramming to the factory installed configuration is achieved via the same configuration card as the unit control module software. Changes to the unit DataCORDER configuration may be made using the Data View integration device. A listing of the configuration variables is provided in Table 3-2. Descriptions of DataCORDER operation for each variable setting are provided in the following paragraphs.

**3.6.3 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. Standard configuration variables, with descriptions, are listed in Table 3-3.

The six thermistor inputs (supply, return, USDA #1, #2, #3 and cargo probe) and the humidity sensor input will be generated by the DataCORDER. An example of a report using a standard configuration is shown in Figure 3- 5.

**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. Suction modulation 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. Compressor suction sensor
14. Compressor discharge sensor
15. Return temperature sensor
16. Supply temperature sensor
17. Defrost temperature sensor
18. Discharge pressure transducer
19. Suction pressure transducer
20. Condenser pressure transducer

Table 3-3 DataCORDER Standard Configurations

Standard Config.	Description
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 C.A. inputs (NOT APPLICABLE)

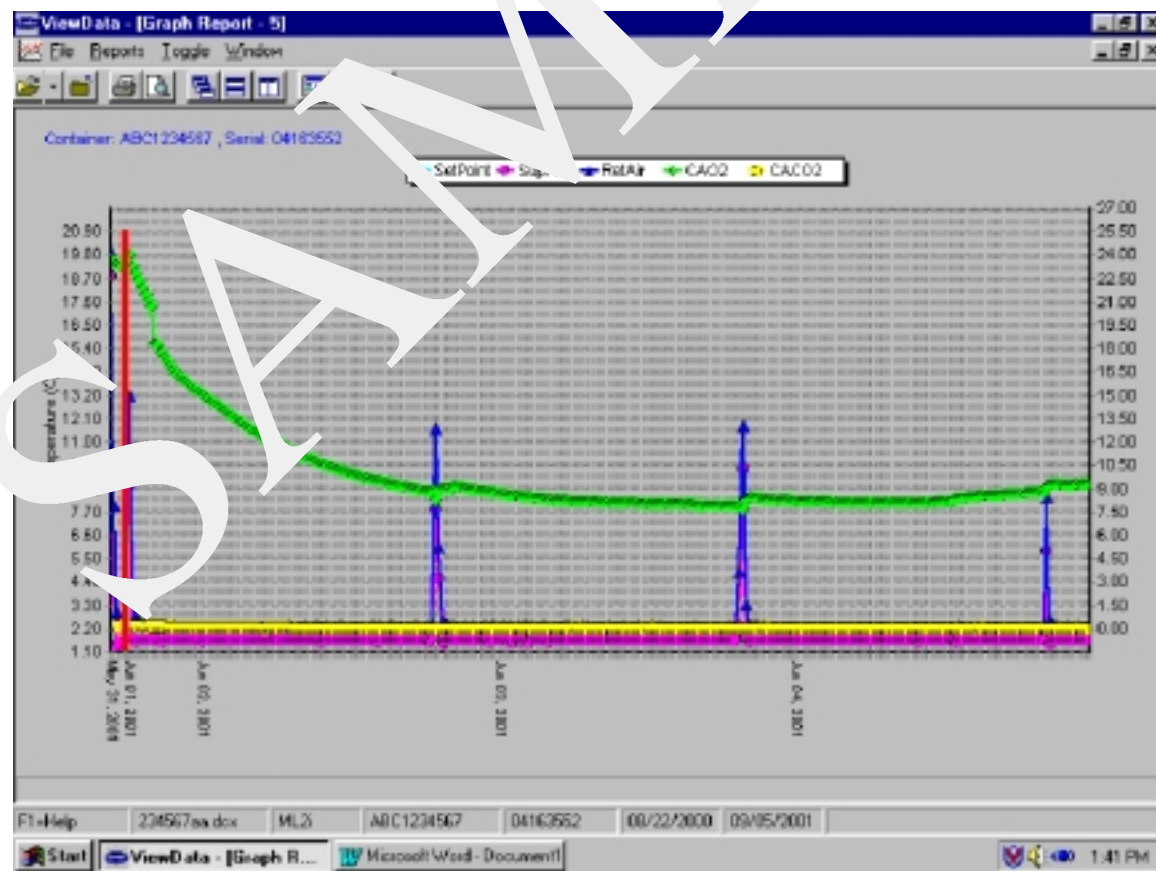
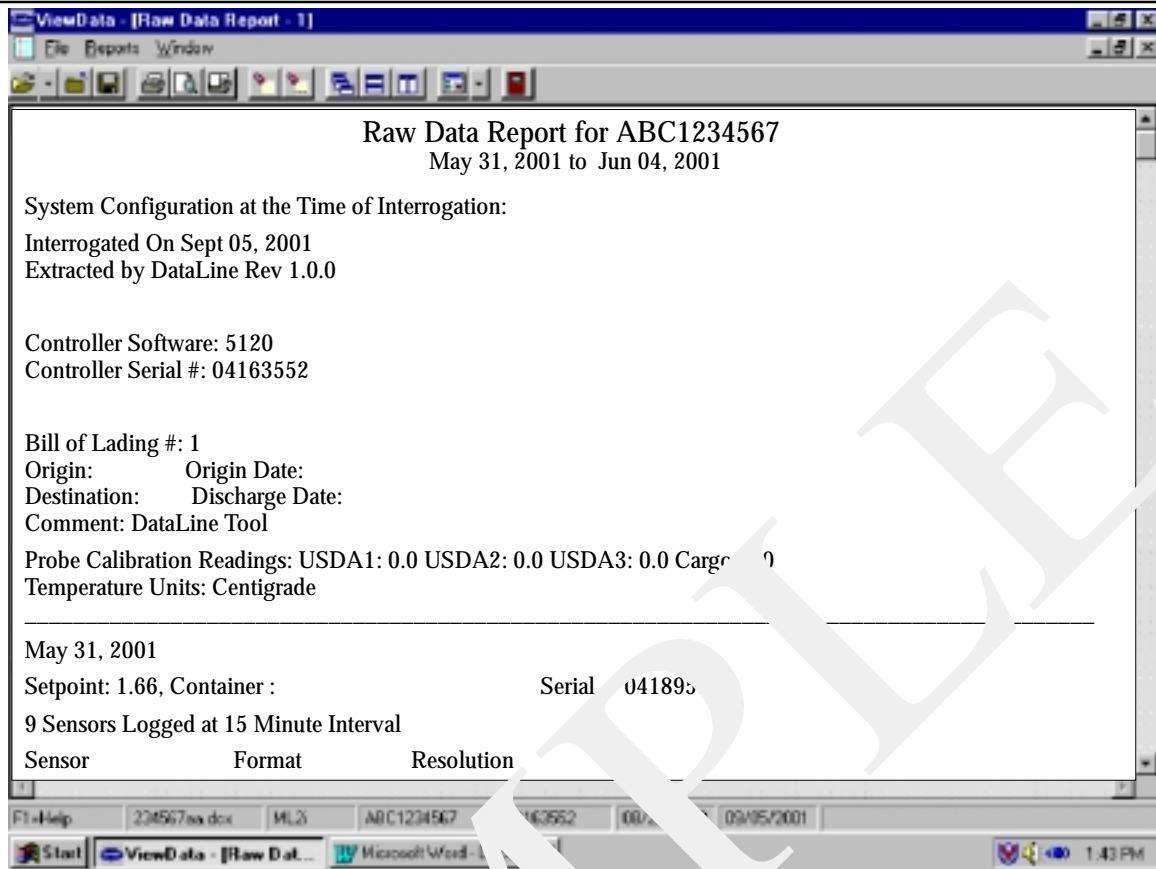


Figure 3- 5 Standard Configuration Download Report

### 3.6.4 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).

### 3.6.5 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 in 0.25°C (0.45°F) steps when in the perishable mode or 0.5°C (0.9°F) steps when in the frozen mode. The long records temperature in 0.01°C (0.02°F) steps for the entire range.

### 3.6.6 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 the supply and return temperature readings are averaged and the 3 USDA probe readings are snapshot.

### 3.6.7 Alarm Configuration (dCF07 - dCF10)

The USDA and cargo probe alarms may be configured to OFF, ON or AUTO.

If a probe alarm is configured to OFF, then the alarm for this probe is always disabled.

If a probe alarm is configured to ON, then the associated alarm is always enabled.

If the probes are configured to AUTO, they act as a group. This function is designed to assist users who keep their 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, then all of the alarms are enabled and the remaining probes that are not installed will give active alarm indications.

The DataCORDER will record the initiation of a pre-trip test (refer to paragraph 3.5) and the results of each of the tests 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.

### 3.6.8 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:* If the DataCORDER is equipped with a charged battery pack and 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, the battery pack needs replacement.

### 3.6.9 Pre-Trip Data Recording

The DataCORDER will record the initiation of a pre-trip test (refer to paragraph 3.5) and the results of each of the tests 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.

### 3.6.10 DataCORDER Communications

Data retrieval from the DataCORDER can be accomplished by using one of the following; DataReader, DataLine/DataView or a communications interface module.

#### a. DataReader

The Carrier Transicold Data Reader (see Figure 3- 6) is a simple to operate hand held device designed to extract data from the DataCORDER and then upload it to a personal computer. The Data Reader has the ability to store multiple data files. Refer to Data Retrieval manual 62-02575 for a more detailed explanation of the DataReader

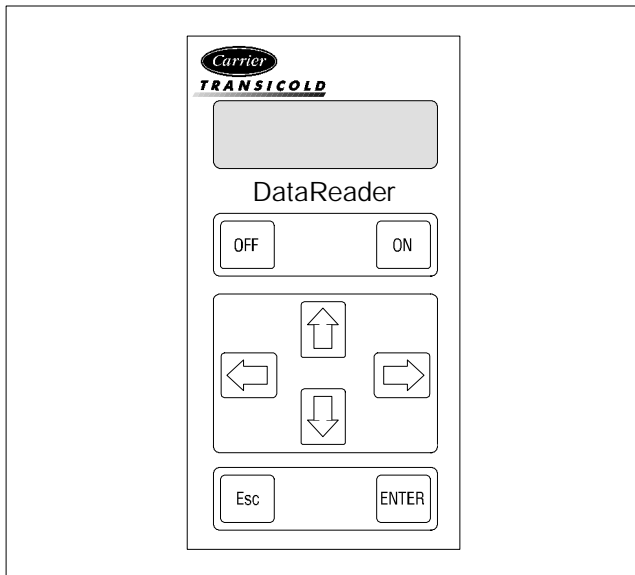


Figure 3- 6 Data Reader

### b. DataView

The DataView software for a personal computer is supplied on a floppy disk. This software allows interrogation, configuration variable assignment, screen view of the data, hard copy report generation, cold treatment probe calibration, cold treatment initialization and file management. Refer to Data Retrieval manual 62-02575 for a more detailed explanation of the DataView interrogation 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 remote monitoring unit 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.

### d. DataLine

The DataLINE software for a personal computer is supplied on both floppy disks and 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 net at [www.contaner.carrier.com](http://www.contaner.carrier.com)

#### 3.6.11 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 degrees Celsius (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 setpoint and record minute changes in product temperature within the DataCORDER memory, thus meeting USDA criteria. Information on USDA is provided in the following subparagraphs

#### 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 three-pin receptacles are for the probes. The five pin receptacle is the rear connection for the Interrogator. The probe receptacles are sized to accept plugs with tricam 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 is incorporated in DataLine/DataView which 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.

#### 3.6.12 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 DataReader, DataView or 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 62-02575 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 either the Data View or Data Line 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"

### 3.6.13 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 back 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 3-27. Refer to paragraph 3.6.7 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.

### 3.6.14 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 "X's". 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.

Table 3-4 Controller Configuration Variables

**NOTES**

1. 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.

CONFIGURATION NUMBER	TITLE	DEFAULT	OPTION
CnF02	Evaporator Fan Speed	dS (Dual)	SS (Single)
CnF04	Dehumidification Mode	On	OFF
CnF11	Defrost "Off" Selection	noOFF	OFF
CnF16	DataCORDER Present	On (Yes)	OFF (No)
CnF22	Economy Mode Option	OFF	Std, Full
CnF23	Defrost Interval Timer Save Option	noSAv	SAv
CnF24	Long Pre Trip Test Sequence Enabled	On	Off
CnF25	Pre-Trip Test Points/Results Recording Option	rSLtS	dAtA
CnF26	Heat Lockout Change Option	Set to -10_C	Set to -5_C
CnF28	Bulb Mode Option	NOr	bULb
CnF31	Probe Check Option	Std	SPEC
CnF33	Snap Freeze Option	OFF	SnAP
CnF34	Degree Celsius Lockout Option	bOth	_F
CnF37	Electronic Temperature Recorder	rEtUR (Return)	suPPI, BOth

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

Code No.	TITLE	DESCRIPTION
Note: If the function is not applicable, the display will read " - - - - - "		
<b>Display Only Functions</b>		
Cd01	Suction Modulation Valve Opening (%)	Displays the SMV percent open. The right display reads 100% when the valve is fully open. The valve will usually be at 10% on start up of the unit except in very high ambient temperatures.
Cd02	Not Applicable	Not used
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	Compressor Suction Temperature	Compressor suction temperature sensor reading is displayed.
Cd11	Compressor Discharge Temperature	Compressor discharge temperature sensor reading is displayed.
Cd12	Compressor Suction Pressure	Compressor suction pressure transducer reading is displayed.
Cd13	Not Applicable	Not used
Cd14	Compressor Discharge Pressure	Compressor discharge pressure transducer reading is displayed.
Cd15	Unloader Valve	The status of the valve is displayed (Open - Closed).
Cd16	Compressor Motor Hour Meter	Records total hours of compressor run time. Total hours are recorded in increments of 10 hours (i.e., 3000 hours is displayed as 300).
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 69NT40-531-100, the display will show "31100").
Cd21	Economizer Valve	The status of the valve is displayed (Open - Closed).

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

Cd22	Compressor State	The status of the compressor is displayed (Off, On).
Cd23	Evaporator Fan	Displays the current evaporator fan state (high, low or off).
Cd24	Controlled Atmosphere State	Not used in this application
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>		
<b>NOTE</b>		
Function codes 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)	<p>The defrost interval is the time between defrost cycles. Five selectable values are available: 3, 6, 9, 12 or 24 hours. The factory default value is 12 hours. Following a start-up or after termination of a defrost, the time will not begin counting down until the defrost temperature sensor (DTS) reading falls below set point. If the reading of DTS rises above set point any time during the timer count down, the interval is reset and the countdown begins over. If DTS fails, alarm code AL60 is activated and control switches over to the the return temperature sensor. The controller will act in the same manner as with the DTS except the return temperature sensor reading will be used.</p> <p><i>Defrost Interval Timer Value (Configuration variable CnF23):</i> If the software is configured to “SAv” (save) for this option, then 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.</p> <p style="text-align: center;"><b>NOTE</b></p> <p style="text-align: center;">The defrost interval timer counts only during compressor run time.</p>
Cd28	Temperature Units (_C or _F)	<p>This code determines the temperature units (_C or _F) which 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.</p> <p style="text-align: center;"><b>NOTE</b></p> <p style="text-align: center;">This function code will display “-----” if Configuration Variable CnF34 is set to _F.</p>
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. SMV subject to pressure and current limit.)</p> <p>B - Partial Cooling (Compressor is on, standard operation. SMV subject to pressure and current limit.)</p> <p>C - Evaporator Fan Only (Compressor is off, evaporator fans on high speed, not applicable with frozen set points.</p> <p>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 band of temperatures around the set point which will be designated as in-range. If the control temperature is in-range, the in-range light will be illuminated. There are four possible values:</p> <p>1 =   0.5_C (  0.9_F)</p> <p>2 =   1.0_C (  1.8_F)</p> <p>3 =   1.5_C (  2.7_F)</p> <p>4 =   2.0_C (  3.6_F) - Factory Default</p>



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

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. This is accomplished by reducing the SMV position until current draw is reduced to the set point. When desirable, the limit can be lowered. Note, however, that capacity is also reduced. The five values for 460vac operation are: 15, 17, 19, 21 (Factory Default), 23
Cd33	Perishable Mode Dehumidification Control (% RH)	Relative humidity set point is available only on units configured for dehumidification. When the mode is activated, the control probe LED flashes on and off every second to alert the user. If not configured, the mode is permanently deactivated and "-----" will display. The value can be set to "OFF," "TEST," or a range of 65 to 95% relative humidity in increments of 1%. [If bulb mode is active (code Cd35) and "Lo" speed evaporator motors are selected (code Cd36) then set point ranges from 60 to 95%.] When "TEST" is selected or test set point is entered, the heat LED should illuminate, indicating that dehumidification mode is activated. After a period of five minutes in the "TEST" mode has elapsed, the previously selected mode is reinstated.
Cd34	Economy Mode (On-Off)	Economy mode is a user selectable mode of operation provided for power saving purposes.
Cd35	Bulb Mode	Bulb mode is a user selectable mode of operation that is an extension of dehumidification control (Cd33). If dehumidification is set to "Off," code Cd35 will display "Nor" and the user will be unable to change it. After a dehumidification set point has been selected and entered for code Cd33, the user may then change code Cd35 to "bulb." After bulb has been selected and entered, the user may then utilize function codes Cd36 and Cd37 to make the desired changes.
Cd36	Evaporator Speed Select	This code is enabled only if in the dehumidification mode (code Cd33) and bulb mode (Cd35) has been set to "bulb". If these conditions are not met, "alt" will be displayed (indicating that the evaporator fans will alternate their speed) and the display cannot be changed. If a dehumidification set point has been selected along with bulb mode then "alt" may be selected for alternating speed, "Lo" for low speed evaporator fan only, or "Hi" for high speed evaporator fan only. If a setting other than "alt" has been selected and bulb mode is deactivated in any manner, then selection reverts back to "alt."
Cd37	Defrost Termination Temperature Setting (Bulb Mode)	This code, as with function code Cd36, is used with bulb mode and dehumidification. If bulb mode is active, this code allows the user to change the temperature defrost will terminate. It allows the user to change the setting within a range of 4_C to 25.6_C in 0.1_C (0.2_F) increments. This value is changed using the UP/DOWN ARROW keys, followed by the ENTER key when the desired value is displayed. If bulb mode is deactivated, the DTS setting returns to the default.
<b>Display Only Functions - Continued</b>		
Cd38	Secondary Supply Temperature Sensor	Code Cd38 will display the current secondary supply temperature sensor 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	Code Cd39 will display the current secondary return temperature sensor 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	Code 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, unloader, suction modulation and oil return valves. Refer to paragraph 6.19 for operating instructions.
Cd42	Oil Return Valve	The status of the valve is displayed (Open - Closed).

Table 3-6 Controller Alarm Indications (Sheet 1 of 4)

Code No.	TITLE	DESCRIPTION
AL13	Expansion Module	Alarm 13 is triggered if the control module has lost communication with the expansion module for more than five minutes or communication fails within the first 15 seconds on power up. This alarm triggers failure action C (evaporator fan only) or D (all machinery off) of Function Code Cd29 if the unit has a perishable set point. Failure action D (all machinery off) is triggered if the unit has a frozen set point
AL14	Phase Sequence Failure - Electronic	Alarm 14 is triggered if the electronic phase detection system is unable to determine the correct phase relationship. DIRCHECK will be displayed while the relationship is determined. If the system is unable to determine the proper relationship alarm 14 will remain active. Additional information on phase detection may be displayed at Function Code Cd41. If the right most digit of Code Cd41 is 3 or 4, this indicates incorrect motor or sensor wiring. If the right most digit is 5, this indicates a failed current sensor assembly.
AL15	Loss Cooling	Future Expansion
AL16	Compressor Current High	Alarm 16 is triggered if compressor current draw is 15% over calculated maximum for 10 minutes out of the last hour. The alarm is display only and will trigger off when the compressor operates for one hour without over current.
AL17	Phase Sequence Failure - Pressure	Alarm 17 is triggered if a compressor start in both directions fails to generate sufficient pressure differential. The controller will attempt restart every twenty minutes and deactivate the alarm if successful. This alarm triggers failure action C (evaporator fan only) or D (all machinery off) of Function Code Cd29 if the unit has a perishable set point. Failure action D (all machinery off) is triggered if the unit has a frozen set point
AL18	Discharge Pressure High	Alarm 18 is triggered if discharge pressure is 10% over calculated maximum for 10 minutes within the last hour. The alarm is display only and will trigger off when the compressor operates for one hour without overpressure.
AL19	Discharge Temperature High	Alarm 19 is triggered if discharge temperature exceeds 135_C (275_F) for 10 minutes within the last hour. The alarm is display only and will trigger off when the compressor operates for one hour without over temperature.
AL20	Control Circuit Fuse Open (24 vac)	Alarm 20 is triggered by control power fuse (F3) opening and will cause the software shutdown of all control units. This alarm will remain active until the fuse is replaced.
AL21	Micro Circuit Fuse Open (18 vac)	Alarm 21 is triggered by one of the fuses (F1/F2) being opened on 18 volts AC power supply to the Controller. The suction modulation valve (SMV) will be opened and current limiting is halted. Temperature control will be maintained by cycling the compressor.
AL22	Evaporator Fan Motor Safety	Alarm 22 responds to the evaporator motor internal protectors. The alarm is triggered by opening of either internal protector. It will disable all control units until the motor protector resets and the unit is power cycled.
AL23	Loss of Phase B	Alarm 23 is triggered if low current draw is detected on phase B and IPCP, HPS or IPEM is not tripped. If the compressor should be running, the controller will initiate a start up every five minutes and trigger off if current reappears. If the evaporator fan motors only should be running, the alarm will trigger off if current reappears. This alarm triggers failure action C (evaporator fan only) or D (all machinery off) of Function Code Cd29 if the unit has a perishable set point. Failure action D (all machinery off) is triggered if the unit has a frozen set point
AL24	Compressor Motor Safety	Alarm 24 is triggered when compressor is not drawing any current. It also triggers failure action "C" or "D" set by function Code 29 for perishable setpoint, or "D" for frozen setpoint. This alarm will remain active until compressor draws current.

Table 3-6 Controller Alarm Indications (Sheet 2 of 4)

AL25	Condenser Fan Motor Safety	Alarm 25 is triggered by the opening of the condenser motor internal protector and will disable all control units except for the evaporator fans. This alarm will remain active until the motor protector resets. This alarm triggers failure action C (evaporator fan only) or D (all machinery off) of Function Code Cd29 if the unit has a perishable set point. Failure action D (all machinery off) is triggered if the unit has a frozen set point
AL26	All Supply and Return temperature Control Sensors Failure	Alarm 26 is triggered if the Controller determines that all of the control sensors are out-of-range. This can occur for box temperatures outside the range of -50_C to +70_C (-58_F to +158_F). This alarm triggers the failure action code set by Function Code Cd29.
AL27	A/D Accuracy Failure	The Controller has a built-in Analog to Digital (A-D) converter, used to convert analog readings (i.e. temperature sensors, current sensors, etc.) to digital readings. The Controller continuously performs calibration tests on the A-D converter. If the A-D converter fails to calibrate for 30 consecutive seconds, this alarm is activated. This alarm will be inactivated as soon as the A-D converter calibrates.
AL28	Low Suction Pressure	Alarm 28 is triggered if suction pressure is below 2 psia and alarm 66 (Suction Pressure Transducer Failure) is not active. This alarm will be inactivated when suction pressure rises above 2 psia for three continuous minutes. This alarm triggers failure action C (evaporator fan only) or D (all machinery off) as determined by User Selectable Failure Response if the unit has a perishable set point; Failure action D (all machinery off) if the unit has a frozen set point. Reset SMV.
AL51	Alarm List Failure	During start-up diagnostics, the EEPROM is examined to determine validity of its contents. This is done by testing the set point and the alarm list. If the contents are invalid, Alarm 51 is activated. During control processing, any operation involving alarm list activity that results in an error will cause Alarm 51 to be activated. Alarm 51 is a "display only" alarm and is not written into the alarm list. Pressing the ENTER key when "CLEAR" is displayed will result in an attempt to clear the alarm list. If that action is successful (all alarms are inactive), Alarm 51 will be reset.
AL52	Alarm List Full	Alarm 52 is activated whenever the alarm list is determined to be full; at start-up or after recording an alarm in the list. Alarm 52 is displayed, but is not recorded in the alarm list. This alarm can be reset by clearing the alarm list. This can be done only if all alarms written in the list are inactive.
AL53	Battery Pack Failure	Alarm 53 is caused by the battery pack charge being too low to provide sufficient power for battery-backed recording. Renew replaceable batteries. 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 to deactivate the alarm
AL54	Primary Supply Temperature Sensor Failure (STS)	Alarm 54 is activated by an invalid primary supply temperature sensor reading that is sensed outside the range of -50 to +70_C (-58_F to +158_F) or if the probe check logic has determined there is a fault with this sensor. If Alarm 54 is activated and the primary supply is the control sensor, the secondary supply sensor will be used for control if the unit is so equipped. If the unit does not have a secondary supply temperature sensor, and AL54 is activated, the primary return sensor reading, minus 2_C will be used for control.  <b>NOTE</b>  The P5 Pre-Trip test must be run to inactivate the alarm
AL55	DataCORDER Failure	This alarm activates to indicate the DataCORDER has a software failure. To clear this alarm, reconfigure the unit to the current model number. This failure may be the result of a voltage dip in excess of 25%.

Table 3-6 Controller Alarm Indications (Sheet 3 of 4)

AL56	Primary Return Temperature Sensor Failure (RTS)	<p>Alarm 56 is activated by an invalid primary return temperature sensor reading that is outside the range of -50_C (-58_F to +158_F). If Alarm 56 is activated and the primary return is the control sensor, the secondary return sensor will be used for control if the unit is so equipped. If the unit is not equipped with a secondary return temperature sensor or it fails, the primary supply sensor will be used for control.</p> <p style="text-align: center;"><b>NOTE</b></p> <p>The P5 Pre-Trip test must be run to inactivate the alarm.</p>
AL57	Ambient Temperature Sensor Failure	Alarm 57 is triggered by an ambient temperature reading outside the valid range from -50_C (-58_F) to +70_C (+158_F).
AL58	Compressor High Pressure Safety	Alarm 58 is triggered when the compressor high discharge pressure safety switch remains open for at least one minute. This alarm will remain active until the pressure switch resets, at which time the compressor will restart.
AL59	Heat Termination Thermostat	Alarm 59 is triggered by the opening of the heat termination thermostat and will result in the disabling of the heater. This alarm will remain active until the thermostat resets.
AL60	Defrost Temperature Sensor Failure	Alarm 60 is an indication of a probable failure of the defrost temperature sensor (DTS). It is triggered by the opening of the heat termination thermostat (HTT) or the failure of the DTS to go above set point within two hours of defrost initiation. After one-half hour with a frozen range set point, or one-half hour of continuous compressor run time, if the return air falls below 7_C (45_F), the Controller checks to ensure the DTS reading has dropped to 10_C or below. If not, a DTS failure alarm is given and the defrost mode is operated using the return temperature sensor. The defrost mode will be terminated after one hour by the Controller.
AL61	Heaters Failure	Alarm 61 is triggered by detection of improper amperage resulting from heater activation or deactivation. Each phase of the power source is checked for proper amperage. This alarm is a display alarm with no resulting failure action, and will be reset by a proper amp draw of the heater.
AL62	Compressor Circuit Failure	Alarm 62 is triggered by improper current draw increase (or decrease) resulting from compressor turn on (or off). The compressor is expected to draw a minimum of 2 amps; failure to do so will activate the alarm. This is a display alarm with no associated failure action and will be reset by a proper amp draw of the compressor.
AL63	Current Over Limit	Alarm 63 is triggered by the current limiting system. If the compressor is ON and current limiting procedures cannot maintain a current level below the user selected limit, the current limit alarm is activated. This alarm is a display alarm and is inactivated by power cycling the unit, changing the current limit via the code select Cd32, or if the current decreases below the activation level.
AL64	Discharge Temperature Over Limit	Alarm 64 is triggered if the discharge temperature sensed is outside the range of -60_C (-76_F) to 175_C (347_F), or if the sensor is out of range. This is a display alarm and has no associated failure action.
AL65	Discharge Pressure Transducer Failure	Alarm 65 is triggered if a compressor discharge transducer is out of range. This is a display alarm and has no associated failure action.
AL66	Suction Pressure Transducer Failure	Alarm 66 is triggered if a suction pressure transducer is out of range. This is a display alarm and has no associated failure action.
AL67	Humidity Sensor Failure	Alarm 67 is triggered by a humidity sensor reading outside the valid range of 0% to 100% relative humidity. If alarm AL67 is triggered when the dehumidification mode is activated, then the dehumidification mode will be deactivated.
AL69	Suction Temperature Sensor Failure	Alarm 69 is triggered by a suction temperature sensor reading outside the valid range of -60_C (-76_F) to 150_C (302_F). This is a display alarm and has no associated failure action.

Table 3-6 Controller Alarm Indications (Sheet 4 of 4)

<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.</p>			
<b>ERR #</b>	<b>Internal Microprocessor Failure</b>	<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>	
		<b>ERROR</b>	<b>DESCRIPTION</b>
		ERR 0 - RAM failure	Indicates that the Controller working memory has failed.
		EER 1 - Program Memory failure	Indicates a problem with the Controller program.
		EER 2 - Watchdog time-out	The Controller program has entered a mode whereby the Controller program has stopped executing.
		EER 3 - On board timer failure	The on board timers are no longer operational. Timed items such as; defrost, etc. may not work.
		EER 4 - Internal counter failure	Internal multi-purpose counters have failed. These counters are used for timers and other items.
		EER 5 - A-D failure	The Controller’s Analog to Digital (A-D) converter has failed.
<b>Entr StPt</b>	<b>Enter Setpoint (Press Arrow &amp; Enter)</b>	The Controller is prompting the operator to enter a set point.	
<b>LO</b>	<b>Low Main Voltage (Function Codes Cd27-38 disabled and NO alarm stored.)</b>	This message will be alternately displayed with the set point whenever the supply voltage is less than 75% of its proper value.	

Table 3-7 Controller Pre-Trip Test Codes (Sheet 1 of 4)

Code No.	TITLE	DESCRIPTION
<p><b>NOTE</b></p> <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.</p>		
P0-0	Pre-Trip Initiated	All lights and display segments will be energized for five seconds at the start of the pre-trip. Since the unit cannot recognize lights and display failures, there are no test codes or results associated with this phase of pre-trip.
P1-0	Heaters Turned On	<b>Setup:</b> Heater must start in the OFF condition, and then be turned on. A current draw test is done after 15 seconds. <b>Pass/Fail Criteria:</b> Passes if current draw change is within the range specified.
P1-1	Heaters Turned Off	<b>Setup:</b> Heater must start in the ON condition, and then be turned off. A current draw test is done after 10 seconds. <b>Pass/Fail Criteria:</b> Passes if current draw change is within the range specified.
P2-0	Condenser Fan On	<b>Requirements:</b> Water pressure switch or condenser fan switch input must be closed. <b>Setup:</b> Condenser fan is turned ON, a current draw test is done after 15 seconds. <b>Pass/Fail Criteria:</b> Passes if current draw change is within the range specified.
P2-1	Condenser Fan Off	<b>Setup:</b> Condenser fan is turned OFF, a current draw test is done after 10 seconds. <b>Pass/Fail Criteria:</b> Passes if current draw change is within the range specified.
P3	Low Speed Evaporator Fans	<b>Requirements:</b> The unit must be equipped with a low speed evaporator fan, as determined by the Evaporator Fan speed select configuration variable.
P3-0	Low Speed Evaporator Fan Motors On	<b>Setup:</b> The high speed evaporator fans will be turned on for 10 seconds, then off for two seconds, then the low speed evaporator fans are turned on. A current draw test is done after 60 seconds. <b>Pass/Fail Criteria:</b> Passes if change in current draw is within the range specified. Fails if AL11 or AL12 activates during test.
P3-1	Low Speed Evaporator Fan Motors Off	<b>Setup:</b> The low speed Evaporator Fan is turned off, a current draw test is done after 10 seconds. <b>Pass/Fail Criteria:</b> Passes if change in current draw is within the range specified. Fails if AL11 or AL12 activates during test.
P4-0	High Speed Evaporator Fan Motors On	<b>Setup:</b> The high speed Evaporator Fan is turned on, a current draw test is done after 60 seconds. <b>Pass/Fail Criteria:</b> Passes if change in current draw is within the range specified. Fails if AL11 or AL12 activates during test.
P4-1	High Speed Evaporator Fan Motors Off	<b>Setup:</b> The high speed Evaporator Fan is turned off, a current draw test is done after 10 seconds. <b>Pass/Fail Criteria:</b> Passes if change in current draw is within the range specified. Fails if AL11 or AL12 activates during test.
P5-0	Supply/Return Probe Test	<p><b>Setup:</b> The High Speed Evaporator Fan is turned on and run for eight minutes, with all other outputs de-energized. <b>Pass/Fail Criteria:</b> A temperature comparison is made between the return and supply probes.</p> <p style="text-align: center;"><b>NOTE</b></p> <p>If this test fails, “P5-0” and “FAIL” will be displayed. If both Probe tests (this test and the PRIMARY/ SECONDARY) pass, the display will read “P5” “PASS.”</p>

Table 3-7 Controller Pre-Trip Test Codes (Sheet 2 of 4)

P5-1	Supply Probe Test	<p><b>Requirements:</b> For units equipped with secondary supply probe only.  <b>Pass/Fail Criteria:</b> The temperature difference between primary and secondary probe (supply) is compared.</p> <p style="text-align: center;"><b>NOTE</b></p> <p>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 'P 5' 'PASS'.</p>
P5-2	Return Probe Test	<p><b>Requirements:</b> For units equipped with secondary return probe only.  <b>Pass/Fail Criteria:</b> The temperature difference between primary and secondary probe (return) is compared.</p> <p style="text-align: center;"><b>NOTES</b></p> <ol style="list-style-type: none"> <li>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."</li> <li>2. The results of Pre-Trip tests 5-0, 5-1 and 5-2 will be used to activate or clear control probe alarms.</li> </ol>
P6	Refrigerant Probes, Compressor and Refrigeration valves	<p><b>Setup:</b> The system is operated through a sequence of events to test the components. The sequence is: Step 1, de-energize all outputs; Step 2, start unit with unloader valve open. Open then close the suction modulation valve. Monitor suction pressure; Step 3, open suction modulation valve to a known position; Step 4, close suction modulation valve to a know position; Step 5, open economizer valve; Step 6, close unloader valve; Step 7, open unloader valve; Step 8, close economizer valve; Step 9, de-energize all outputs.</p>
P6-0	Discharge Thermistor Test	If alarm 64 is activated any time during the first 45 second period of Step 1, the test fails.
P6-1	Suction Thermistor Test	If alarm 69 is activated any time during the first 45 second period of Step 1, the test fails.
P6-2	Discharge Pressure Sensor Test	If alarm 65 is activated any time during the first 45 second period of Step 1, the test fails.
P6-3	Suction Pressure Sensor Test	If alarm 66 is activated any time during the first 45 second period of Step 1, the test fails.
P6-4	Compressor Current Draw Test	Compressor current is tested before and after start up. If current does not increase, the test fails.
P6-5	Suction Modulation Valve Test	Suction pressure is measured before and after the valve opens. If suction pressure does not increase, the test fails.
P6-6	Economizer Valve Test	Suction pressure is measured during Steps 4 and 5. If suction pressure does not increase, the test fails.
P6-7	Unloader Valve Test	Suction pressure is measured during Steps 6 and 7. If suction pressure does not increase, the test fails.

Table 3-7 Temperature Controller Pre-Trip Test Codes (Sheet 3 of 4)

<b>NOTE</b>		
P7-0 through P10 are included with the “Auto2” only.		
P7-0	High Pressure Switch Closed	<b>NOTE</b>
		<p>This test is skipped if the sensed ambient temperature is less than 7_C (45_F), the return air temperature is less than -17.8_C (0_F), the water pressure switch is open or the condenser fan switch is open.</p> <p><b>Setup:</b> With the unit running, the condenser fan is de-energized, and a 15 minute timer is started.</p> <p><b>Pass/Fail Criteria:</b> The test fails if high pressure switch fails to open in 15 minutes.</p>
P7-1	High Pressure Switch Open	<p><b>Requirements:</b> Test P7-0 must pass for this test to execute. Setup: The condenser fan is started and a 60 second timer is started.</p> <p><b>Pass/Fail Criteria:</b> Passes the test if the high pressure switch (HPS) closes within the 60 second time limit, otherwise, it fails.</p>
P8-0	Perishable Mode Heat Test	<p><b>Setup:</b> If the container temperature is below 15.6°C (60_F), the set point is changed to 15.6°C, and a 180 minute timer is started. The left display will read “P8-0.” The control will then heat the container until 15.6°C is reached. If the container temperature is above 15.6°C at the start of the test, then the test proceeds immediately to test P8-1 and the left display will change to “P8-1.”</p> <p><b>Pass/Fail Criteria:</b> The test fails if the 180 minute timer expires before the control temperature reaches set point. The display will read “P8-0,” “FAIL.”</p>
P8-1	Perishable Mode Pull Down Test	<p><b>Requirements:</b> Control temperature must be at least 15.6°C (60_F).</p> <p><b>Setup:</b> 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><b>Pass/Fail Criteria:</b> 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><b>Requirements:</b> Test P8-1 must pass for this test to execute. This test is skipped if the DataCorder is not configured or available.</p> <p><b>Setup:</b> The left display will read “P8-2,” and the right display will show the supply air temperature. A two hour timer is started. The unit will be required to maintain the temperature to within + or - 0.5_C (0.9_F) of set point until a DataCORDER recording is executed. The recorder supply probe temperature running total (and its associated readings counter) will be zeroed out for the remainder of the recording period at the start of this test, so that the actual value recorded in the DataCORDER will be an average of only this test’s results. Once a recording interval is complete, the average recorder supply temperature will be recorded in the DataCORDER, as well as stored in memory for use in applying the test pass/fail criteria.</p> <p><b>Pass/Fail Criteria:</b> If the recorded temperature is within +/- 0.5_C. of set point from test start to DataCORDER recording, the test passes. If the average temperature is outside of the tolerance range at the recording, the test fails and will auto-repeat by starting P8-0 over.</p>
P9-0	Defrost Test	<p><b>Setup:</b> The defrost temperature sensor (DTS) reading will be displayed on the left display. The right display will show the supply air temperature. The unit will run FULL COOL for 30 minutes maximum until the DTT is considered closed. 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><b>Pass/Fail Criteria:</b> The test fails if: the DTT is not considered closed after the 30 minutes of full cooling, HTT opens when DTT is considered closed or if return air temperature rises above 49/50_C (120/122_F).</p>



Table 3-7 Controller Pre-Trip Test Codes (Sheet 4 of 4)

P10-0	Frozen Mode Heat Test	<p><b>Setup:</b> If the container temperature is below 7.2_C (45_F), the set point 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 in the right display.</p> <p><b>Pass/Fail Criteria:</b> The test fails if the 180 minute timer expires before the control temperate reaches set point -0.3_C (0.17_F). If the test fails it will not auto-repeat. There is no pass display for this test, once the control temperature reaches set point, the test proceeds to test 10-1</p>
P10-1	Frozen Mode Pull Down Test	<p><b>Requirements:</b> Control temperature must be at least 7.2_C (45_F)</p> <p><b>Setup:</b> The set point is changed to -17.8_C (0_F). The system will then attempt to pull don the Control temperature to set point using normal frozen mode cooling. During this test, the control temperate will be shown on the right display</p> <p><b>Pass/Fail Criteria:</b> If the control temperature does not reach set point -0.3_C (0.17_F) before the 180 minute timer expires the test fails and will auto-repeat by starting P10-0 over..</p>
P10-2	Frozen Mode Maintain Temperature Test	<p><b>Requirements:</b> Test P10-1 must pass for this test to execute. This test is skipped if the DATAcorder is not configured or available.</p> <p><b>Setup:</b> During this test, the left display will read "P10-2," and the right display will show the supply air temperature. A two hour timer is started. The unit will be required to maintain the temperature to within + 0.5_C (0.9_F)/-1.3_C (2.3_F) of set point until a DataCORDER recording is executed. The recorder supply probe temperature running total (and its associated readings counter) will be zeroed out for the remainder of the recording period at the start of this test, so that the actual value recorded in the DataCORDER will be an average of only this test's results. Once a recording interval is complete, the average recorder supply temperature will be recorded in the DataCORDER, as well as stored in memory for use in applying the test pass/fail criteria.</p> <p><b>Pass/Fail Criteria:</b> If the recorded temperature is within +0.5_C (0.9_F)/-1.3_C (2.3_F) of set point from test start to DataCORDER recording, the test passes. If the average temperature is outside of the tolerance range at the recording, the test fails and will auto-repeat by starting P10-0 over.</p>

Table 3-8 DataCORDER Function Code Assignments

<b>NOTE</b>		
<b>Inapplicable Functions Display “- - - - -”</b>		
To Access: Press ALT. MODE key		
Code No.	TITLE	DESCRIPTION
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.
dC31	Battery Test	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

Test No.	TITLE	DATA
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 On	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 On	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 Test	Pass/Fail/Skip
5-2	Secondary Return Probe Test	Pass/Fail/Skip
6-0	Discharge Thermistor Test	Pass/Fail/Skip
6-1	Suction Thermistor Test	Pass/Fail/Skip
6-2	Discharge Pressure Sensor Test	Pass/Fail/Skip
6-3	Suction Pressure Sensor Test	Pass/Fail/Skip
6-4	Compressor Current Draw Test	Pass/Fail/Skip
6-5	Suction Modulation valve Test	Pass/Fail/Skip
6-6	Economizer Valve Test	Pass/Fail/Skip
6-7	Unloader 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 Pull Down 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 Pull Down 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

To Access: Press ALT. MODE key		
Code No.	TITLE	DESCRIPTION
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 sensed outside of -50 to 70°C (-58 to 158°F) range.
dAL75	Cargo Probe 4 Out of Range	The cargo probe temperature reading is outside of -50 to 70°C (-58 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 8 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.
dAL87	RTC Failure	An invalid date or time has been detected. This situation may be corrected by changing the Real Time Clock (RTC) to a valid value using the Data-View.
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 Starting)

#### 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. If container is empty, 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 6.17).
  4. Check for dirt or grease on evaporator fan or fan deck and clean if necessary.
  5. Check evaporator coil for cleanliness or obstructions. Wash with fresh water.
  6. Check defrost drain pans and drain lines for obstructions and clear if necessary. Wash with fresh water.
  7. 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.
- c. Open control box door. Check for loose electrical connections or hardware.
- d. Check color of moisture-liquid indicator.
- e. Check oil level in compressor sight glass.

### 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 any 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 "I" (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.

#### 4.3.1 Upper Fresh Air Makeup Vent

Two slots and a stop are designed into the disc for air flow adjustments. The first slot allows for a 0 to 30% air flow, and 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.

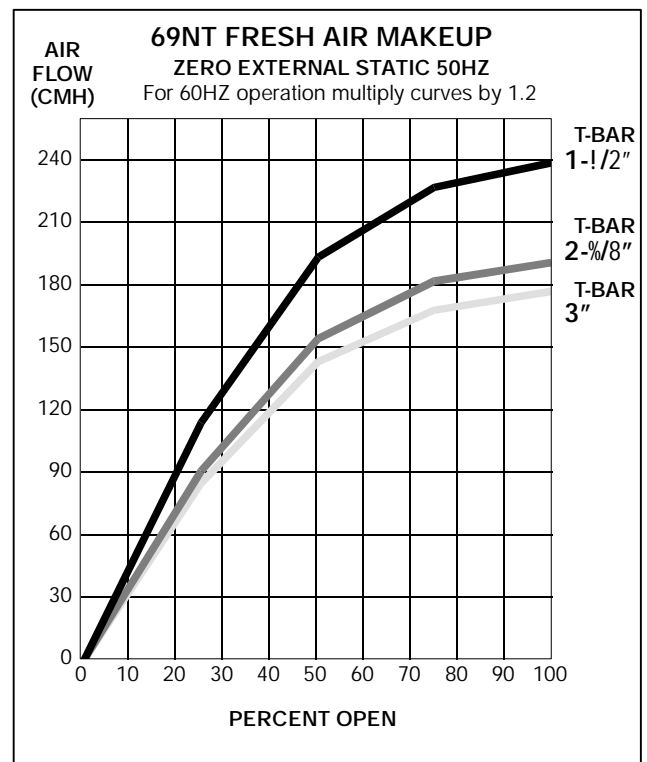


Figure 4-1 Make Up Air Flow Chart

#### 4.4 CONNECT REMOTE MONITORING RECEPTACLE

If remote monitoring is required, connect remote monitor plug at unit receptacle. (See item 9, 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

##### WARNING

**Make sure that the unit circuit breaker(s) (CB-1 & CB-2) and the START-STOP switch (ST) are in the “O” (OFF) position before connecting to any electrical power source.**

##### 4.5.1 Starting the Unit

1. With power properly applied, the fresh air damper set and (if required) the water cooled condenser connected, (refer to paragraphs 4.2 & 4.3) place the START-STOP switch to “I” (ON).

##### NOTE

Within the first 30 seconds the electronic phase detection system will check for proper compressor rotation. 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.

2. 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

- a. Check rotation of condenser and evaporator fans.
- b. Check compressor oil level. (Refer to paragraph 6.9.)

##### 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 paragraph 3.2.2.

##### DataCORDER

- a. Check and, if required, set the DataCORDER Configuration in accordance with desired recording parameter. Refer to paragraph 3.6.3.
- b. Enter a “Trip Start”. To enter a “trip Start”, do the following:

1. Depress the ALT MODE key and scroll to Code dC30.
2. Depress and hold the ENTER key for five seconds.
3. The “Trip Start” event will be entered in the DataCORDER.

##### 4.6.3 Complete Inspection

Allow unit to run for 5 minutes to stabilize conditions and perform a pre-trip diagnosis in accordance with the following paragraph.

#### 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, dehumidification and bulb mode will be deactivated. At the completion of Pre-Trip activity, economy, dehumidification and bulb mode 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 3-21. 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 tests, verify that unit voltage (Function Code Cd 07) is within tolerance and unit amperage draw (Function Codes 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 key pad initiation described below except that should a test fail, the pre-trip mode will automatically terminate. When initiated via communications, a test may not be interrupted with an arrow key, but the pre-trip mode can be terminated with the PRE-TRIP key.
  - a. Press the PRE-TRIP key. This accesses a 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 or AUTO 2 as desired and then press the AUTO key.
    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, where the #'s indicate the test number and sub-test. The right display will show a countdown time in minutes and seconds, indicating how much time there is left 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, until the user manually enters a command.

#### 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!**

When an Auto 1 runs to completion without a failure, the unit will exit the 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. Throughout the duration of any pre-trip test except the P-7 high pressure switch tests, the current and pressure limiting processes are active .
- 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 OBSERVE UNIT OPERATION

### 4.8.1 Probe Check

If the DataCORDER is off or in alarm the controller will revert to a four probe configuration which includes the DataCORDER supply and return air probes as the secondary controller probes. The controller continuously performs probe diagnosis testing which compares the four probes. If the probe diagnosis result indicates a probe problem exists, the controller will perform a probe check to identify the probe(s) in error.

#### a. Probe Diagnostic Logic - Standard

If the probe check option (controller configuration code CnF31) is configured for standard, the criteria used for comparison between the primary and secondary control probes is:

1\_C (1.8\_F) for perishable set points or 2\_C (3.6\_F) for frozen set points.

If 25 or more of 30 readings taken within a 30 minute period are outside of the limit, then a defrost is initiated and a probe check is performed.

In this configuration, a probe check will be run as a part of every normal (time initiated) defrost.

#### b. Probe Diagnostic Logic - Special

If the probe check option is configured for special the above criteria are applicable. A defrost with probe check will be initiated if 25 of 30 readings or 10 consecutive readings are outside of the limits

In this configuration, a probe check will not be run as a part of a normal defrost, but only as a part of a defrost initiated due to a diagnostic reading outside of the limits.

- c. The 30 minute timer will be reset at each of the following conditions:

1. At every power up.
  2. At the end of every defrost.
  3. After every diagnostic check that does not fall outside of the limits as outlined above.
- d. Probe Check

A defrost cycle probe check is accomplished by energizing just the evaporator motors for eight minutes at the end of the normal defrost. At the end of the eight minute period the probes will be compared to a set of predetermined limits. The defrost indicator will remain on throughout this period.

Any probe(s) determined to be outside the limits will cause the appropriate alarm code(s) to be displayed to identify which probe(s) needs to be replaced. The P5 Pre-Trip test must be run to inactivate alarms.

#### 4.9 SEQUENCE OF OPERATION

General operation sequences for cooling, heating and defrost are provided in the following subparagraphs. Schematic representation of controller action are provided in Figure 4-2 and Figure 4-3. Refer to Section 3 for detailed descriptions of special events and timers that are incorporated by the controller in specific modes of operation.

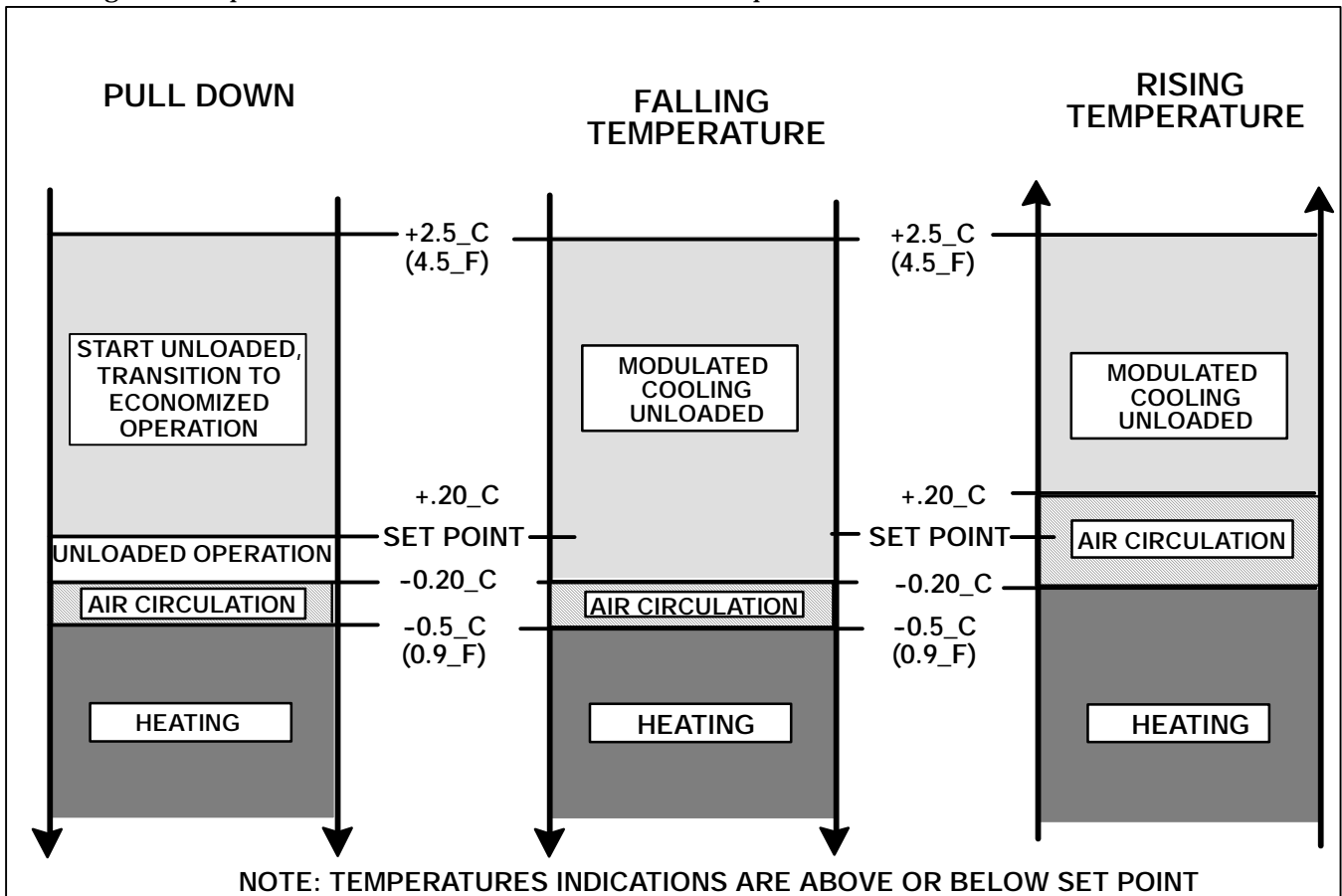


Figure 4-2 Controller Operation - Perishable Mode



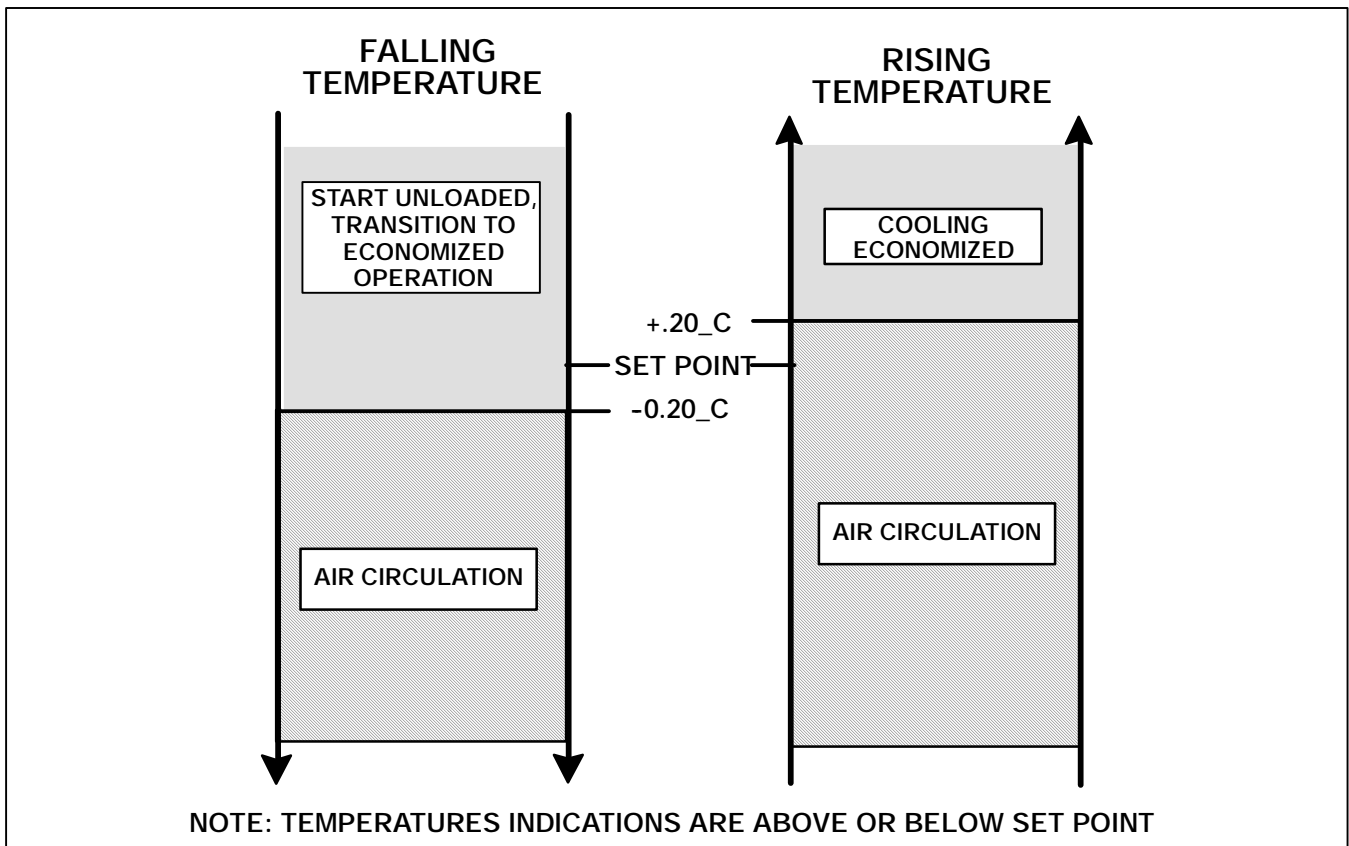


Figure 4-3 Controller Operation - Frozen Mode

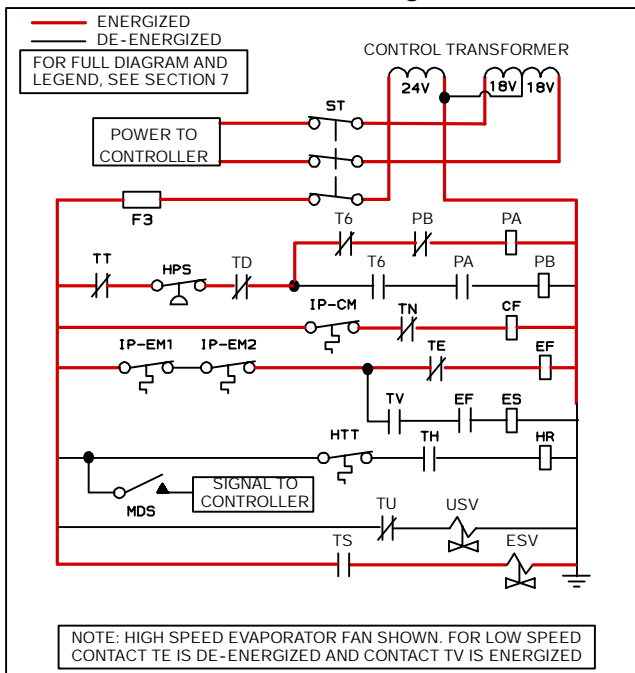


Figure 4-4 Perishable Mode

#### 4.9.1 Sequence Of operation - Compressor Phase Sequence

The controller logic will check for proper compressor rotation. If the compressor is rotating in the wrong direction, the controller will energize or de-energize relay T6 as required (see Figure 4-4). Energizing relay T6 will switch operation from compressor contactor PA to compressor contactor PB. De-energizing relay T6

will switch operation from compressor contactor PB to compressor contactor PA. Compressor contactors PA is wired to run the compressor on L1, L2, and L3. Compressor contactor PB is wired to run the compressor on L2, L1 and L3 thus providing reverse rotation .

#### 4.9.2 Sequence Of Operation - Perishable Mode Cooling

##### NOTE

In the Conventional Perishable Mode of operation the evaporator motors run in high speed. In the Economy Perishable Mode the fan speed is varied.

- a. With supply air temperature above set point and decreasing, the unit will be cooling with the condenser fan motor (CF), compressor motor (PA or PB), evaporator fan motors (EF) energized and the COOL light illuminated. (See Figure 4-4.) Also, if current or pressure limiting is not active, the controller will energize relay TS to open the economizer solenoid valve (ESV) and place the unit in economized operation.
- b. When the air temperature decreases to a predetermined tolerance above set point, the in-range light is illuminated.
- c. As the air temperature continues to fall, modulating cooling starts at approximately 2.5\_C (4.5\_F) above set point. (See Figure 4-2.) At set point, relay TS is de-energized to close the economizer solenoid valve and relay TU is energized to open the unloader solenoid valve.

noid valve changing from economized operation to unloaded operation. (As shown in Figure 4-5)

- d. The controller monitors the supply air. Once the supply air falls below set point the controller periodically records the supply air temperature, set point and time. A calculation is then performed to determine temperature drift from set point over time.
- e. If the calculation determines cooling is no longer required, contacts TD and TN are opened to de-energize compressor motor and condenser fan motor. The cool light is also de-energized.
- f. The evaporator fan motors continue to run to circulate air throughout the container. The in-range light remains illuminated as long as the supply air is within tolerance of set point.
- g. If the supply air temperature increases to 0.2\_C (0.4\_F) above set point and the three minute off time has elapsed, relays TD, TU and TN are energized to restart the compressor and condenser fan motors in unloaded operation. The cool light is also illuminated.

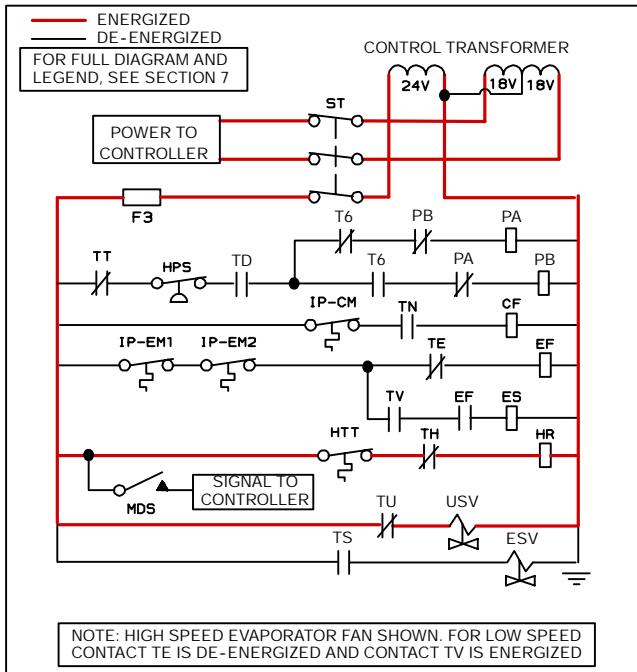


Figure 4-5 Perishable Mode Heating

#### 4.9.3 Sequence Of Operation - Perishable Mode Heating

- a. If the air temperature decreases 0.5\_C (0.9\_F) below set point, the system enters the heating mode. (See Figure 4-2). The controller closes contacts TH (see Figure 4-5) to allow power flow through the heat termination thermostat (HTT) to energize the heaters (HR). The HEAT light is also illuminated. The evaporator fans continue to run to circulate air throughout the container.
- b. When the temperature rises to 0.2\_C (0.4\_F) above set point, contact TH opens to de-energize the heaters. The HEAT light is also de-energized. The evapo-

rator fans continue to run to circulate air throughout the container.

- c. A safety heater termination thermostat (HTT), attached to an evaporator coil support, will open the heating circuit if overheating occurs.

#### 4.9.4 Sequence Of operation - Frozen Mode Cooling

- a. With supply air temperature 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 COOL light illuminated. (See Figure 4-6.)
- b. When the air temperature decreases to a predetermined tolerance above set point, the in-range light is illuminated.

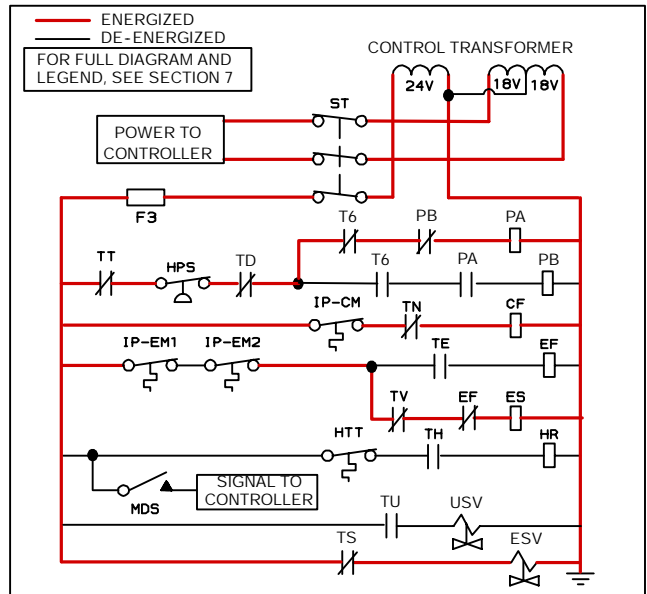


Figure 4-6 Frozen Mode

- c. When the return air temperature decreases to 0.2\_C (0.4\_F) below set point, contacts TD, TS and TN are opened to de-energize the compressor, economizer solenoid valve and condenser fan motors. The cool light is also de-energized.
- d. The evaporator fan motors continue to run in low speed to circulate air throughout the container. The in-range light remains illuminated as long as the return air is within tolerance of set point.
- e. When return air temperature is 10\_C (18\_F) or more below set point, the evaporator fans are brought to high speed.
- f. When the return air temperature increases to 0.2\_C (0.4\_F) above set point and the three minute off time has elapsed, relays TD, TS and TN are energized to restart the compressor and condenser fan motors. The cool light is illuminated.

#### 4.9.5 Sequence Of Operation - Defrost

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.

Defrost may be initiated by any one of the following methods:

1. The manual defrost switch (MDS) is closed by the user.
2. The user sends a defrost command by communications.
3. The defrost interval timer (controller function code Cd27) reaches the defrost interval set by the user.
4. The controller probe diagnostic logic determines that a probe check is necessary based on the temperature values currently reported by the supply and return probes.
5. If the controller is programmed with the Demand Defrost option (Future) and the option is set to "IN" the unit will enter defrost if it has been in operation for over 2.5 hours without reaching set point.

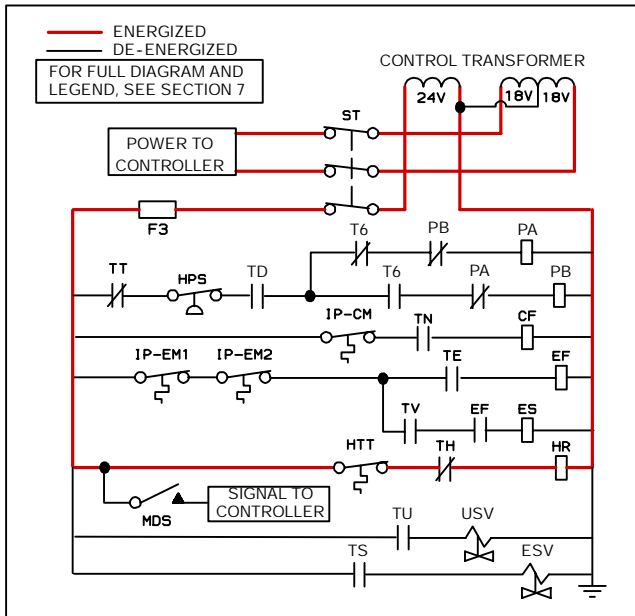


Figure 4-7 Defrost

Defrost may be initiated any time the defrost temperature sensor reading falls below the controller defrost termination thermostat set point. Defrost will terminate when the defrost temperature sensor reading rises above the defrost termination thermostat set point. The defrost termination thermostat is not a physical component. It is a controller setting that acts as a thermostat, "closing" (allowing defrost) when the defrost temperature sensor reading is below the set point and "opening" (terminating or preventing defrost) when the sensor temperature reading is above set point. When the unit is operating in bulb mode (refer to paragraph 3.3.9), special settings may be applicable.

If the controller is programmed with the Lower DTT setting option the defrost termination thermostat set point may be configured to the default of 25.6\_C (78\_F) or lowered to 18\_C (64\_F). When a request for defrost is made by use of the manual defrost switch, communications or probe check the unit will enter defrost if the defrost temperature thermostat reading is at or below the defrost termination thermostat setting. Defrost will terminate with the defrost temperature sensor reading rises above the defrost termination thermostat setting. When a request for defrost is made by the defrost interval timer or by demand defrost, the defrost temperature setting must be below 10\_C (50\_F).

When the defrost mode is initiated the controller opens contacts TD, TN and TE (or TV) to de-energize the compressor, condenser fan and evaporator fans. The COOL light is also de-energized.

The controller then closes TH to supply power to the heaters. The defrost light is illuminated.

When the defrost temperature sensor reading rises to the defrost termination thermostat setting, the de-icing operation is terminated.

If defrost does not terminate correctly and temperature reaches the set point of the heat termination thermostat (HTT) the thermostat will open to de-energize the heaters. If termination does not occur within 2.0 hours, the controller will terminate defrost. An alarm will be given of a possible DTS failure.

If probe check (controller function code CnF31) is configured to special, the unit will proceed to the next operation (snap freeze or terminate defrost). If the code is configured to standard, the unit will perform a probe check. The purpose of the probe check is to detect malfunctions or drift in the sensed temperature that is too small to be detected by the normal sensor out of range tests. The system will run for eight minutes in this condition. At the end of the eight minutes, probe alarms will be set or cleared based on the conditions seen.

When the return air falls to 7\_C (45\_F), the controller checks to ensure the defrost temperature sensor (DTS) reading has dropped to 10\_C or below. If it has not, a DTS failure alarm is given and the defrost mode is operated by the return temperature sensor (RTS).

If controller function code CnF33 is configured to snap freeze, the controller will sequence to this operation. The snap freeze consists of running the compressor without the evaporator fans in operation for a period of four minutes with the suction modulation valve fully open. When the snap freeze is completed, defrost is formally terminated.

## 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 (F3) blown	Check
	Start-Stop switch OFF or defective	Check
Component(s) Not Operating	Evaporator fan motor internal protector open	6.17
	Condenser fan motor internal protector open	6.12
	Compressor internal protector open	6.8
	High pressure switch open	5.7
	Heat termination thermostat open	Replace
	Loss of communication with expansion module	Check Wiring
	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	6.7.1
	Evaporator coil covered with ice	5.6
	Evaporator coil plugged with debris	6.15
	Evaporator fan(s) rotating backwards	6.15/6.17
	Defective evaporator fan motor/capacitor	6.18
	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	6.11
	Compressor worn	6.8
	Current limit (function code Cd32) set to wrong value	3.5.5
	Suction modulation valve lost track of step count	Power cycle
	Suction modulation valve malfunction	6.20
	Economizer solenoid valve or TXV malfunction	6.14, 6.19
Unloader valve stuck open	6.19	

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
<b>5.3 UNIT RUNS BUT HAS INSUFFICIENT COOLING</b>		
Refrigeration System	Abnormal pressures	5.7
	Abnormal temperatures	5.15
	Abnormal currents	5.16
	Controller malfunction	5.9
	Evaporator fan or motor defective	6.17
	Shortage of refrigerant	6.7.1
	Suction modulation valve lost track of step count	Power cycle
	Suction modulation valve malfunction	6.20
	Compressor service valves or liquid line shutoff valve partially closed	Open valves completely
	Economizer solenoid valve or TXV malfunction	6.14, 6.19
	Unloader valve stuck open	6.19
	Frost on coil	5.10
<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	6.17
	Heat relay defective	Check
	Heater termination thermostat open	6.15
Unit will not heat or has insufficient heat	Heater(s) defective	6.15
	Heater contactor or coil defective	Replace
	Evaporator fan motor(s) defective or rotating backwards	6.15/6.17
	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	6.15
<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

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
<b>5.6 UNIT WILL NOT DEFROST PROPERLY - Continued</b>		
Will not initiate defrost manually	Manual defrost switch defective	Replace
	Defrost temperature sensor open	4.9.5
Initiates but relay (DR) drops out	Low line voltage	2.3
Initiates but does not defrost	Heater contactor or coil defective	Replace
	Heater(s) burned out	6.15
Frequent defrost	Wet load	Normal
<b>5.7 ABNORMAL PRESSURES (COOLING)</b>		
High discharge pressure	Condenser coil dirty	6.11
	Condenser fan rotating backwards	6.12
	Condenser fan inoperative	6.12
	Refrigerant overcharge or noncondensibles	6.7.1
	Discharge service valve partially closed	Open
	Suction modulation valve malfunction	6.20
Low suction pressure	Faulty suction pressure transducer	Replace
	Suction service valve partially closed	Open
	Filter-drier partially plugged	6.13
	Low refrigerant charge	6.7.1
	Expansion valve defective	6.14
	No evaporator air flow or restricted air flow	6.15
	Excessive frost on evaporator coil	5.6
	Evaporator fan(s) rotating backwards	2.3
Suction modulation valve malfunction	6.20	
Suction and discharge pressures tend to equalize when unit is operating	Compressor operating in reverse	5.14
	Compressor cycling/stopped	Check
<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	5.14
	Loose mounting bolts or worn resilient mounts	Tighten/Replace
	Loose upper mounting	6.8.1 step r.
	Liquid slugging	6.14
	Insufficient oil	6.9
Condenser or Evaporator Fan	Bent, loose or striking venturi	Check
	Worn motor bearings	6.12/6.17
	Bent motor shaft	6.12/6.17

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
<b>5.9 CONTROLLER MALFUNCTION</b>		
Will not control	Defective Sensor	6.22
	Defective wiring	Check
	Fuse (F1, F2, F3) blown	Replace
	Stepper motor suction modulation valve circuit malfunction	6.20
	Low refrigerant charge	6.7
<b>5.10 NO EVAPORATOR AIR FLOW OR RESTRICTED AIR FLOW</b>		
Evaporator coil blocked	Frost on coil	5.6
	Dirty coil	6.15
No or partial evaporator air flow	Evaporator fan motor internal protector open	6.17
	Evaporator fan motor(s) defective	6.17
	Evaporator fan(s) loose or defective	6.17
	Evaporator fan contactor defective	Replace
<b>5.11 THERMOSTATIC EXPANSION VALVE MALFUNCTION</b>		
Low suction pressure with high superheat	Low refrigerant charge	6.7.1
	External equalizer line plugged	Open
	Wax, oil or dirt plugging valve or orifice Ice formation at valve seat	6.14
	Superheat not correct	6.7.1
	Power assembly failure	6.14
	Loss of element/bulb charge	
	Broken capillary	
	Foreign material in valve	
High suction pressure with low superheat	Superheat setting too low	6.14
	External equalizer line plugged Ice holding valve open	Open
	Foreign material in valve	6.14
Liquid slugging in compressor	Pin and seat of expansion valve eroded or held open by foreign material	6.14
Fluctuating suction pressure	Improper bulb location or installation	
	Low superheat setting	
<b>5.12 AUTOTRANSFORMER MALFUNCTION</b>		
Unit will not start	Circuit breaker (CB-1 or CB-2) tripped	Check
	Power source not turned ON	Check
<b>5.13 WATER-COOLED CONDENSER OR WATER PRESSURE SWITCH</b>		
Condenser fan starts and stops	Water pressure switch malfunction	Check
	Water supply interruption	Check

CONDITION	POSSIBLE CAUSE	REMEDY/ REFERENCE SECTION
5.14 COMPRESSOR OPERATING IN REVERSE		
<b>CAUTION</b> <b>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.</b>		
Electrical	Incorrect wiring of compressor	Check
	Incorrect wiring of compressor contactor(s)	
	Incorrect wiring of current sensor	
5.15 ABNORMAL TEMPERATURES		
High discharge temperature	Discharge temperature sensor drifting high	Replace
	Failed economizer, TXV or solenoid valve	Replace
	Plugged economizer, TXV or solenoid valve	Replace
	Loose or insufficiently clamped sensor	Replace
	Failed liquid injection solenoid valve	Replace
Low suction temperature	Discharge temperature sensor drifting low	Replace
	Loose or insufficiently clamped sensor	Replace
5.16 ABNORMAL CURRENTS		
Unit reads abnormal currents	Current sensor wiring	Check



## SECTION 6

### SERVICE

#### NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws. In the U.S.A., refer to EPA section 608.

#### WARNING

**Never use air for leak testing. It has been determined that pressurized, mixtures of refrigerant and air can undergo combustion when exposed to an ignition source.**

#### 6.1 SECTION LAYOUT

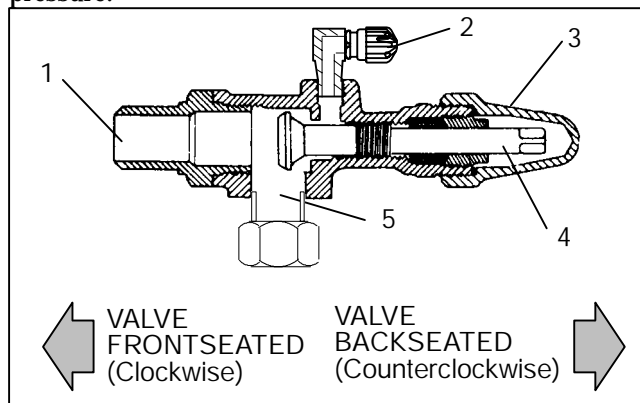
Service procedures are provided herein beginning with refrigeration system service, then refrigeration system component service, electrical system service, temperature recorder service and general service. Refer to the Table Of Contents to locate specific topics.

#### 6.2 SERVICE VALVES

The compressor suction, compressor discharge, compressor economizer, oil return and the liquid line service valves (see Figure 6-1) are provided with a double seat and an access valve which enable 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.

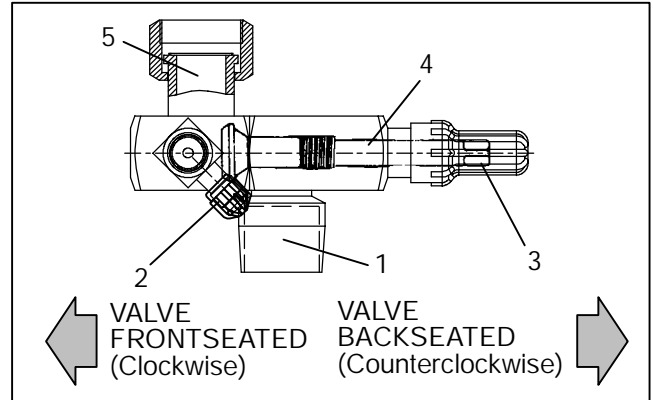
With the valve stem midway between frontseat and backseat, both of the service valve connections are open to the access valve path.

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 | 4. Valve stem                                  |
| 2. Access Valve    | 5. Compressor Or Filter Drier Inlet Connection |
| 3. Stem Cap        |  |

Figure 6-1 Service Valve



- |                    |                                |
|--------------------|--------------------------------|
| 1. Line Connection | 4. Valve stem                  |
| 2. Access Valve    | 5. Compressor Inlet Connection |
| 3. Stem Cap        |                                |

Figure 6-2 Suction Service Valve

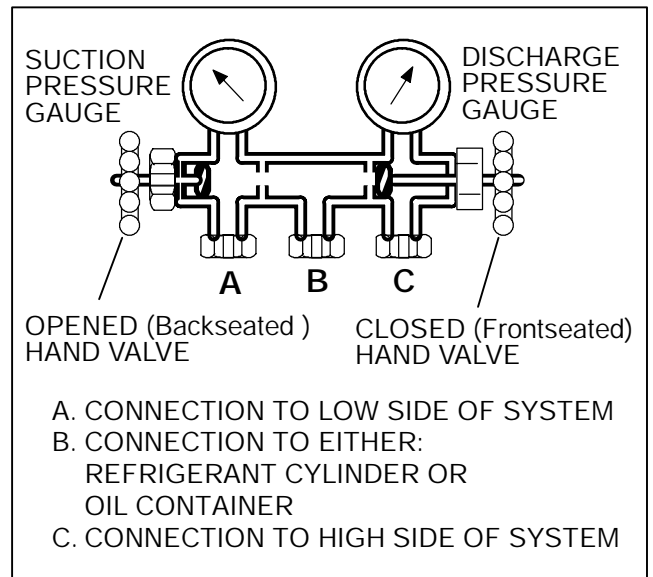


Figure 6-3 Manifold Gauge Set

#### 6.3. MANIFOLD GAUGE SET

The manifold gauge set (see Figure 6-3) is used to determine system operating pressure, add refrigerant charge, and to equalize or evacuate the system.

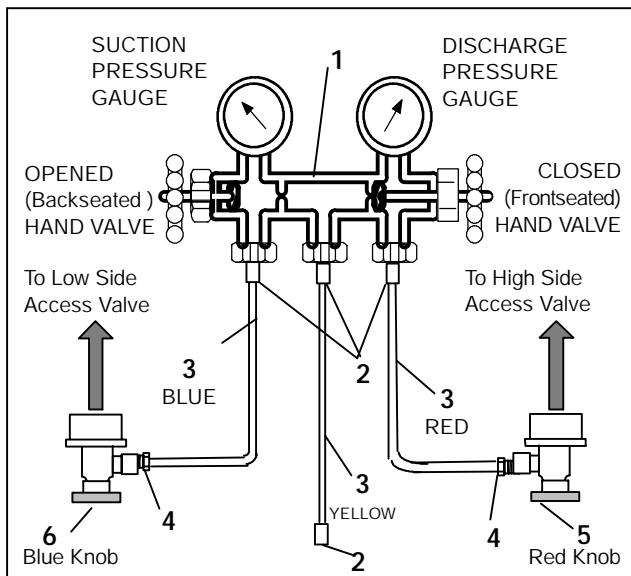
When the suction pressure hand valve is frontseated (turned all the way in), the suction (low) pressure can be checked. When the discharge pressure hand valve is frontseated, the discharge (high) pressure can be checked. When both valves are open (turned counter-clockwise all the way out), high pressure vapor will flow into the low side. When the suction pressure valve is open and the discharge pressure valve shut, the

system can be charged. Oil can also be added to the system.

A R-134a manifold gauge/hose set with self-sealing hoses (see Figure 6-4) is required for service of the models covered within this manual. The manifold gauge/hose set is available from Carrier Transicold. (Carrier Transicold P/N 07-00294-00, which includes items 1 through 6, Figure 6-4.) To perform service using the manifold gauge/hose set, do the following:

a. Preparing Manifold Gauge/Hose Set For Use

1. If the manifold gauge/hose set is new or was exposed to the atmosphere it will need to be evacuated to remove contaminants and air as follows:
2. Back seat (turn counterclockwise) both field service couplings (see Figure 6-4) and midseat both hand valves.
3. Connect the yellow hose to a vacuum pump and refrigerant 134a cylinder.



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

Figure 6-4 R-134a Manifold Gauge/Hose Set

7. 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).
8. Front seat both manifold gauge set valves and disconnect from cylinder. The gauge set is now ready for use.

b. Connecting Manifold Gauge/Hose Set

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

1. Remove service valve stem cap and check to make sure it is backseated. Remove access valve cap. (See Figure 6-1)

2. Connect the field service coupling (see Figure 6-4) to the access valve.
3. Turn the field service coupling knob clockwise, which will open the system to the gauge set.
4. To read system pressures: slightly midseat the service valve.
5. 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.**

c. Removing the Manifold Gauge Set

1. While the compressor is still ON, backseat the high side service valve.
2. Midseat both hand valves on the manifold gauge set and allow the pressure in the manifold gauge set to be drawn down to low side pressure. This returns any liquid that may be in the high side hose to the system.
3. Backseat the low side service valve. Backseat both field service couplings and frontseat both manifold set valves. Remove the couplings from the access valves.
4. Install both service valve stem caps and service port caps (finger-tight only).

6.4 PUMPING THE UNIT DOWN

To service the filter-drier, economizer, expansion valves, moisture-liquid indicator, suction modulation valve, economizer solenoid valve, unloader solenoid 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 operate the compressor in a deep vacuum, internal damage will result.**

- a. Attach manifold gauge set to the compressor suction and discharge service valves. Refer to paragraph 6.3.
- b. Start the unit and run in the frozen mode (controller set below -10°C) for 10 to 15 minutes.
- c. 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.
- d. Frontseat the oil return service valve then, frontseat the liquid line service valve. Place start-stop switch in the OFF position when the suction reaches a positive pressure of 0.1 kg/cm<sup>2</sup> (1.0 psig).
- e. Frontseat the economizer service valve and then frontseat the suction and discharge service valves. The refrigerant will be trapped between the compressor suction service valve and the liquid line valve.
- f. Before opening up any part of the system, a slight positive pressure should be indicated on the pressure

gauge. If a vacuum is indicated, emit refrigerant by cracking the liquid line valve momentarily to build up a slight positive pressure.

- g. 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 paragraph 6.5), and evacuate and dehydrate the low side (refer to paragraph 6.6).
- i. Check refrigerant charge (refer to paragraph 6.7).

## 6.5 REFRIGERANT LEAK CHECKING

### WARNING

**Never use air for leak testing. It has been determined that pressurized, air-rich mixtures of refrigerants and air can undergo combustion when exposed to an ignition source.**

- 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 kg/cm<sup>2</sup> (30 to 50 psig). To ensure complete pressurization of the system, refrigerant should be charged at the compressor suction and economizer service valves and the liquid line service valve. Also, the area between the suction modulating valve and evaporator expansion valve may not be open to these charging points. Pressure between these components may be checked at the low side access valve (item 11, Figure 2-2) or by checking that the suction modulating valve is more than 10% open at controller function code Cd01. The suction modulating valve may be opened by use of the controller function code Cd41 valve override control (refer to paragraph 6.19). 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.
- d. Evacuate and dehydrate the unit. (Refer to paragraph 6.6.)
- e. Charge unit per paragraph 6.7.

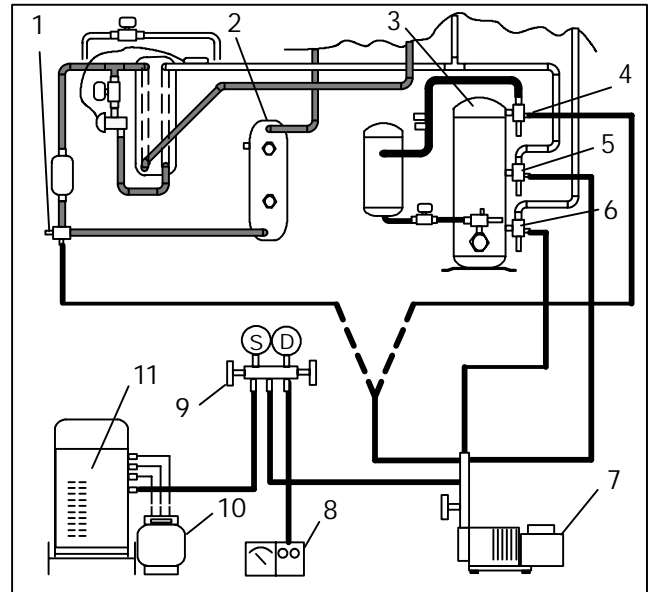
## 6.6 EVACUATION AND DEHYDRATION

### 6.6.1 General

Moisture is the deadly enemy of 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 paragraph 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.)
- 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.

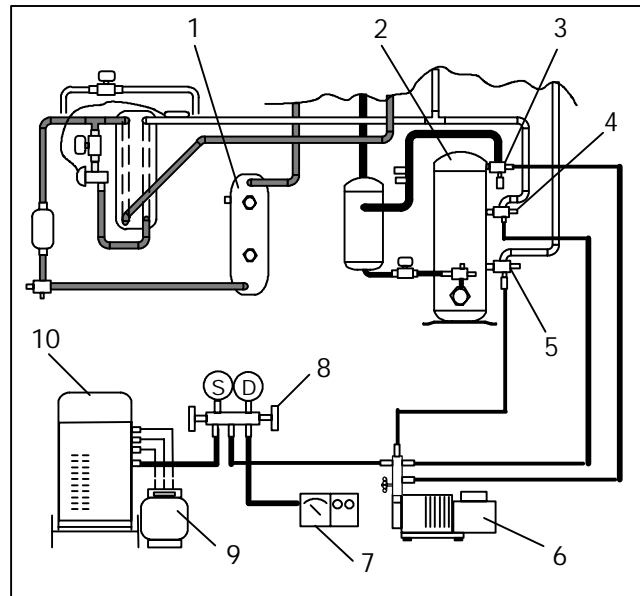


- |                                       |                            |
|---------------------------------------|----------------------------|
| 1. Liquid Service Valve               | 6. Suction Service Valve   |
| 2. Receiver or Water Cooled Condenser | 7. Vacuum Pump             |
| 3. Compressor                         | 8. Electronic Vacuum Gauge |
| 4. Discharge Service Valve            | 9. Manifold Gauge Set      |
| 5. Economizer Service Valve           | 10. Refrigerant Cylinder   |
|                                       | 11. Reclaimer Valve        |

Figure 6-5. Refrigeration System Service Connections

### 6.6.3 Procedure - Complete system

- 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, compressor economizer and liquid line service valve (see Figure 6-5). Be sure the service hoses are suited for evacuation purposes.
- c. The area between the suction modulating valve and evaporator expansion valve may not be open to the access valves. To ensure evacuation of this area, check that the suction modulating valve is more than 10% open at controller function code Cd01. If required, the suction modulating valve may be opened by use of the controller function code Cd41 valve override control. If power is not available to open the valve, the area may be evacuated by connecting an additional hose at the low side access valve (item 11, Figure 2-2).
- d. 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.
- e. Midseat the refrigerant system service valves.
- f. 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.
- g. Break the vacuum with clean dry refrigerant 134a gas. Raise system pressure to approximately 0.2 kg/cm<sup>2</sup> (2 psig), monitoring it with the compound gauge.
- h. Remove refrigerant using a refrigerant recovery system.
- i. Repeat steps f. and g. one time.
- j. 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.
- k. With a vacuum still in the unit, the refrigerant charge may be drawn into the system from a refrigerant container on weight scales. Continue to paragraph 6.7



- |                                       |                            |
|---------------------------------------|----------------------------|
| 1. Receiver or Water Cooled Condenser | 5. Suction Service Valve   |
| 2. Compressor                         | 6. Vacuum Pump             |
| 3. Discharge Service Valve            | 7. Electronic Vacuum Gauge |
| 4. Economizer Service Valve           | 8. Manifold Gauge Set      |
|                                       | 9. Refrigerant Cylinder    |
|                                       | 10. Reclaimer              |

Figure 6-6. Compressor Service Connections

#### 6.6.4 Procedure - Partial System

- a. If the refrigerant charge has been removed from the compressor for service, evacuate only the compressor by connecting the evacuation set-up at the compressor service valves. (See Figure 6-6.) Follow evacuation procedures of the preceding paragraph except leave compressor service valves frontseated until evacuation is completed.
- b. 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 and economizer service valves and the liquid service valve except leave the service valves frontseated until evacuation is completed.
- c. 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

### 6.7.1 Checking the Refrigerant Charge

#### NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws. In the U.S.A., refer to EPA section 608.

- a. Connect the gauge manifold to the compressor discharge and suction service valves. For units operating on a water cooled condenser, change over to air cooled operation.
- b. Bring the container temperature to approximately 1.7\_C (35\_F) or -17.8\_C (0\_F). Then set the controller set point to -25\_C (-13\_F) to ensure that the suction modulation valve is fully open. (Position of the suction modulating valve may be checked at controller function code Cd01.)
- c. Partially block the condenser coil inlet air. Increase the area blocked until the compressor discharge pressure is raised to approximately 12 kg/cm<sup>2</sup> (175 psig).
- d. On units equipped with a receiver, the level should be between the glasses. On units equipped with a water cooled condenser, the level should be at the center of the glass. 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.)
- 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. (Refer to section paragraph 6.7.3)

- d. Backseat manual liquid line valve (to close off gauge port). Close liquid valve on cylinder.

- e. Start unit in cooling mode. Run 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 - Model RSH105

#### WARNING

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

#### WARNING

**Before disassembly of the compressor make 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 zero 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.**

### 6.8.1 Removal and Replacement of Compressor

#### NOTE

Service compressor contains a nitrogen charge. Due to the hygroscopic nature of the oil, time the compressor is left open to the atmosphere should be minimized as much as possible.

- a. Procure a replacement compressor kit. A list of items contained in the compressor kit is provided in Table 6-1.
- b. If the compressor is operational, pump the unit down (refer to paragraph 6.4).

Table 6-1 Compressor Kit

Item	Component	Qty
1	Compressor	1
2	Service Valve Seal	3
3	Mylar Washers	4
4	Wire Tie	2
5	Oil Sight Glass Plug	1
6	Resilient Mount	4
7	Upper Shock Mount Ring	1
8	Upper Shock Mount Bushing	1
9	Compressor Power Plug O-Ring	1
10	SST Washers	8

c. If the compressor is not operational, turn the unit start-stop switch (ST) and unit circuit breaker (CB-1) OFF. Disconnect power to the unit and front-seat the discharge, suction, economizer, and oil return service valves.

Remove all remaining refrigerant from the compressor using a refrigerant recovery system. Connect hoses to suction, economizer and discharge service valves ports. Evacuate compressor to 500 microns (75.9 cm Hg vacuum = 29.9 inches Hg vacuum).

d. Make sure power to the unit is OFF and unit power plug disconnected. Disconnect the power plug from the compressor.

e. Loosen and break the seal at fittings from the suction, discharge, economizer, and the oil return service valves. Remove fittings and discard service valve seals, retain oil return valve O-ring.

f. Remove the entire compressor upper mounting bracket assembly, (see Figure 6-7) by removing the four cap screws attaching it to the unit and the 32-mm bolt from the compressor mounting bracket.

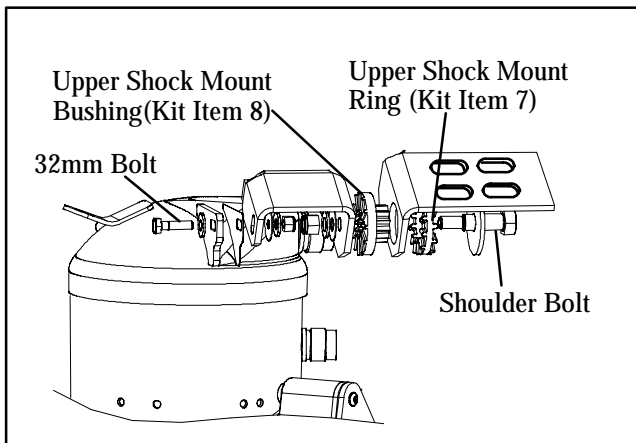


Figure 6-7 Compressor Upper Mounting

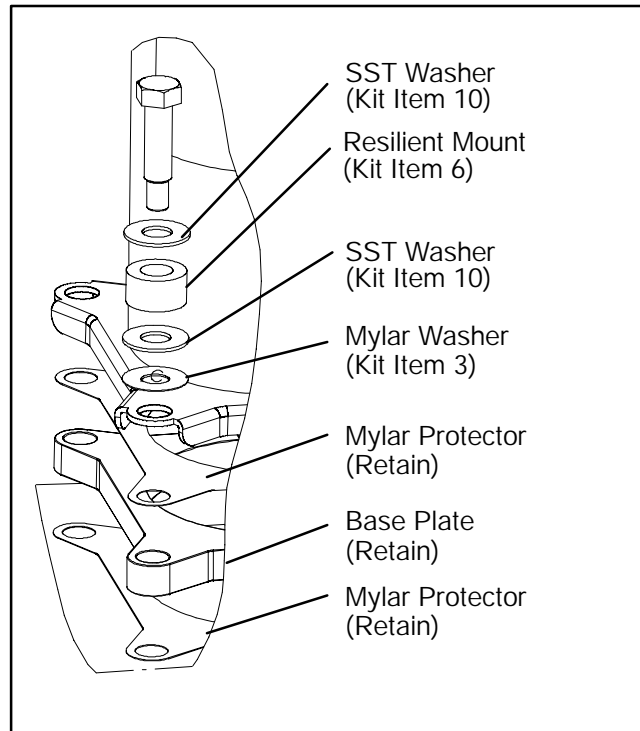


Figure 6-8 Compressor Lower Mounting

g. Replace the upper mounting bracket shock mount ring and bushing (kit items 7 and 8). Reassemble the bracket in the same manner as the original and torque the shoulder bolt to 2.8 mkg (20 ft.-lbs.).

h. Remove the male coupling from the top of the sight glass on the old compressor and hand assemble to the oil return valve coupling for safe keeping. Plug the top of the replacement compressor sight glass with the plug (kit item 5) to prevent spilling oil.

i. Remove the lower mounting bolts and hardware (see Figure 6-8). Using plugs from replacement compressor, plug connections on old compressor. Remove the old compressor. Refer to paragraph 2.2 for compressor weight. Return plugs to replacement compressor.

j. The replacement compressor is shipped with an oil charge of 591ml (20 ounces). Before sliding the new compressor in the unit, remove the oil sight glass plug and (using a small funnel) charge the compressor with an additional 1893ml (64 ounces) Castrol-Icematic SW20 (POE oil). Reassemble the oil sight glass plug to avoid spilling oil when sliding the compressor in the unit.

k. Secure the base plate and mylar protectors to the compressor with wire ties (kit item 4), and place the compressor in the unit.

l. Cut and remove the wire ties that were used to hold the base plate and protectors to the compressor. Using new resilient mounts, SST washers and mylar washers (kit items 3, 6 & 10). Install the four mounting screws loosely.

m. Install the male coupling (removed in step h.) into the sight glass port.

- n. Place the new service seals (kit item 2) at the compressor service ports, connect the four service valves loosely.
- o. Torque the four resilient mount screws to 6.2 mkg (45 ft-lbs).

p. Torque the four service valves to:

Service Valve	Torque
Suction or Discharge	11 to 13.8 mkg (80 to 100 ft-lbs.)
Economizer	6.9 to 8.3 mkg (50 to 60 ft-lbs.)
Oil Return	1.4 to 1.66 mkg (10 to 12 ft-lbs.)

- q. Reassemble the top mounting bracket (see Figure 6-7) by hand tightening the 32-mm (1¼-inch) bolt and torquing the four mounting screws to 0.9 mkg (6.5 ft-lbs). Align the mounting so that the ring and bushing assembly are free with no compression.
- r. Torque the 32mm bolt to 1.5 mkg (11 ft-lbs.). While maintaining the free movement of the shock mount, torque the four mounting screws to 0.9 mkg (6.5 ft-lbs.).
- s. Replace the power plug O-Ring with new ring (kit item 9). Insert the power plug into the compressor fitting. Be sure plug is fully seated into the fitting and then thread the coupling nut a minimum of 5 turns.
- t. Leak check and evacuate the compressor to 1000 microns. Refer to paragraphs 6.5 and 6.6
- u. Run the unit for at least 15 minutes and check the oil and refrigerant levels. Refer to paragraphs 6.7 and 6.9.

## 6.9 COMPRESSOR OIL LEVEL

### CAUTION

**Use only Carrier Transicold approved Polyol Ester Oil (POE) - Mobil ST32 compressor oil with R-134a. Buy in quantities of one quart or smaller. When using this hygroscopic oil, immediately reseal. Do not leave container of oil open or contamination will occur.**

- a. Checking the Oil Level in the Compressor
  - 1 Ideally, ambient temperature should be between 40\_F and 100\_F.
  - 2 Operate the unit in cooling mode for at least 20 minutes.
  - 3 Check the controller function code Cd1 for the suction modulation valve (SMV) position. It should be at least 20% open.
  - 4 Locate the oil sight glass on the side of the compressor (item 7, Figure 2-3).

- 5 Turn Start/Stop switch off and allow oil to drain into compressor sump. Oil level must be visible in the sight glass. If it is not visible, oil must be added to the compressor.

### b. Adding Oil with Compressor in System

1. The recommended method is to add oil using an oil pump at the oil return service valve (see item 15, Figure 2-3)
2. In an emergency where an oil pump is not available, oil may be drawn into the compressor through the oil return service valve.

Connect the suction connection of the gauge manifold to the compressor oil return valve port, and immerse the common connection of the gauge manifold in an open container of refrigeration oil. Extreme care must be taken to ensure the manifold common connection remains immersed in oil at all times. Otherwise air and moisture will be drawn into the compressor. Crack the oil return service valve and gauge valve to vent a small amount of refrigerant through the common connection and the oil to purge the lines of air. Close the gauge manifold valve.

With the unit running, turn the suction service valve toward frontseat and induce a vacuum in the compressor crankcase. Do not allow the compressor to pull below 127mm/hg (5 "/hg). SLOWLY crack the suction gauge manifold valve and oil will flow through the oil return service valve into the compressor. Add oil as necessary.

- 3 Run unit for 20 minutes in cooling mode. Check oil level at the compressor sight glass.

### c. Removing Oil from the Compressor:

- 1 If the oil level is above the sight glass, oil must be removed from the compressor.
- 2 Perform a compressor pump down, refer to section 6.4.
- 3 Remove the oil plug, and drain oil until a level can be seen in the sight glass.
- 4 Run unit for 20 minutes in cooling mode. Check oil level at the compressor sight glass.

## 6.10 HIGH PRESSURE SWITCH

### 6.10.1 Replacing High Pressure Switch

- a. Turn unit start-stop switch OFF. Frontseat the suction, discharge, economizer and oil return service valves to isolate compressor. Remove the refrigerant from the compressor.
- b. Disconnect wiring from defective switch. The high pressure switch is located on the discharge service valve and is removed by turning counterclockwise. (See Figure 2-3.)
- c. Install a new high pressure switch after verifying switch settings. (Refer to paragraph 6.10.2.)
- d. Evacuate and dehydrate the compressor per paragraph 6.6.

## 6.10.2 Checking High Pressure Switch

### WARNING

**Do not use a nitrogen cylinder without a pressure regulator. Do not use oxygen in or near a refrigeration system as an explosion may occur.**

### NOTE

The high pressure switch is non-adjustable.

- Remove switch as outlined in paragraph 6.10.1
- 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.
- Connect hose to a cylinder of dry nitrogen. (See Figure 6-9.)

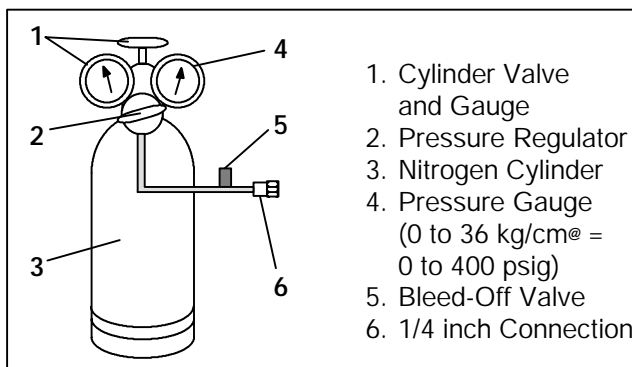


Figure 6-9 High Pressure Switch Testing

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

## 6.11 CONDENSER COIL

The condenser consists of a series of parallel copper tubes expanded into copper fins. The condenser coil must be cleaned with fresh water or steam so the air flow is not restricted. To replace the coil, do the following:

### WARNING

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

- Using a refrigerant reclaim system, remove the refrigerant charge.
- Remove the condenser coil guard.

- Unsolder discharge line and remove the line to the receiver or water-cooled condenser.
- Remove coil mounting hardware and remove the coil.
- Install replacement coil and solder connections.
- Leak-check the coil connections per paragraph paragraph 6.5. Evacuate the unit per paragraph 6.6 then charge the unit with refrigerant per paragraph 6.7.

## 6.12 CONDENSER FAN AND MOTOR ASSEMBLY

### WARNING

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

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

- Open condenser fan screen guard.
- Loosen two square head set screws on fan. (Thread sealer has been applied to set screws at installation.) Disconnect wiring from motor junction box.

### CAUTION

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

- Remove motor mounting hardware and replace the motor. It is recommended that new locknuts be used when replacing motor. Connect wiring per wiring diagram.
- Install fan loosely on motor shaft (hub side in). DO NOT USE FORCE. If necessary, tap the hub only, not the hub nuts or bolts. Install venturi. Apply "Loctite H" to fan set screws. Adjust fan within venturi so that the outer edge of the fan is within  $2.0 \pm .07$  mm ( $0.08" \pm 0.03"$ ) from the outside of the orifice opening. Spin fan by hand to check clearance.
- Close and secure condenser fan screen guard.
- Apply power to unit and check fan rotation. If fan motor rotates backward, reverse wire numbers 5 and 8.

## 6.13 FILTER-DRIER

On units equipped with a water-cooled condenser, if the sight glass appears to be flashing or bubbles are constantly moving through the sight glass when the suction modulation valve is fully open, the unit may have a low refrigerant charge or the filter-drier could be partially plugged.

- To Check Filter-Drier
  - 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 and 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.

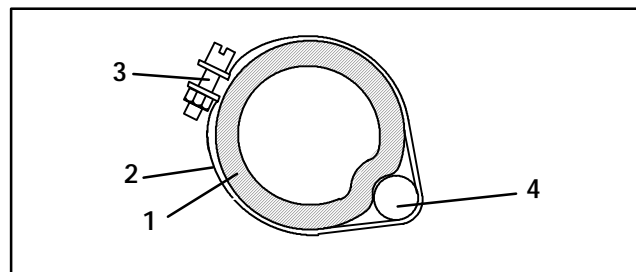
### 6.14 EXPANSION VALVES

Two expansion valves are used, the evaporator expansion valve (item 9, Figure 2-2), and the economizer expansion valve (item 26, Figure 2-4). The expansion valves are automatic devices which maintain constant superheat of the refrigerant gas leaving at the point of bulb attachment regardless of suction pressure.

The valve functions are:

1. Automatic control of the refrigerant flow to match the load.
2. Prevention of liquid refrigerant entering the compressor.

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. (See Figure 6-10.)



- |                   |                 |
|-------------------|-----------------|
| 1. Suction Line   | 3. Nut and Bolt |
| 2. TXV Bulb Clamp | 4. TXV Bulb     |

Figure 6-10 Thermostatic Expansion Valve Bulb

#### 6.14.1 Checking Superheat.

**NOTE**

Proper superheat measurement for the evaporator expansion valve should be completed at -18\_C (0\_F) container box temperature where possible. If the economizer valve is suspect, it should be replaced.

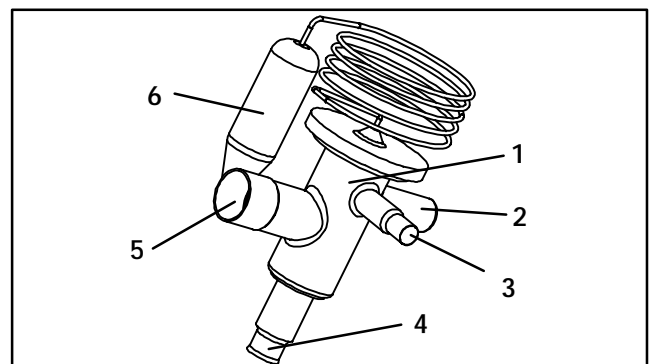
- a. Open the heater access panel (see Figure 2-1) to expose the evaporator expansion valve.
- b. Attach a temperature sensor near the expansion valve bulb and insulate. Make sure the suction line is clean and that firm contact is made with the sensor.
- c. Connect an accurate gauge to the service port directly upstream of the suction modulating valve.
- d. Set the temperature set point to -18\_C (0\_F), and run unit until conditions stabilize.
- e. The readings may cycle from a high to a low reading. Take readings of temperature and pressure every three to five minutes for a total of 5 or 6 readings
- f. From the temperature/pressure chart (Table 6-7), determine the saturation temperature corresponding to the evaporator outlet test pressures at the suction modulation valve.
- g. Subtract the saturation temperatures determined in step f. from the temperatures measured in step e.. The difference is the superheat of the suction gas. Determine the average superheat. It should be 4.5 to 6.7 °C (8 to 12 °F)

#### 6.14.2 Valve Replacement

##### a. Removing the Expansion Valve

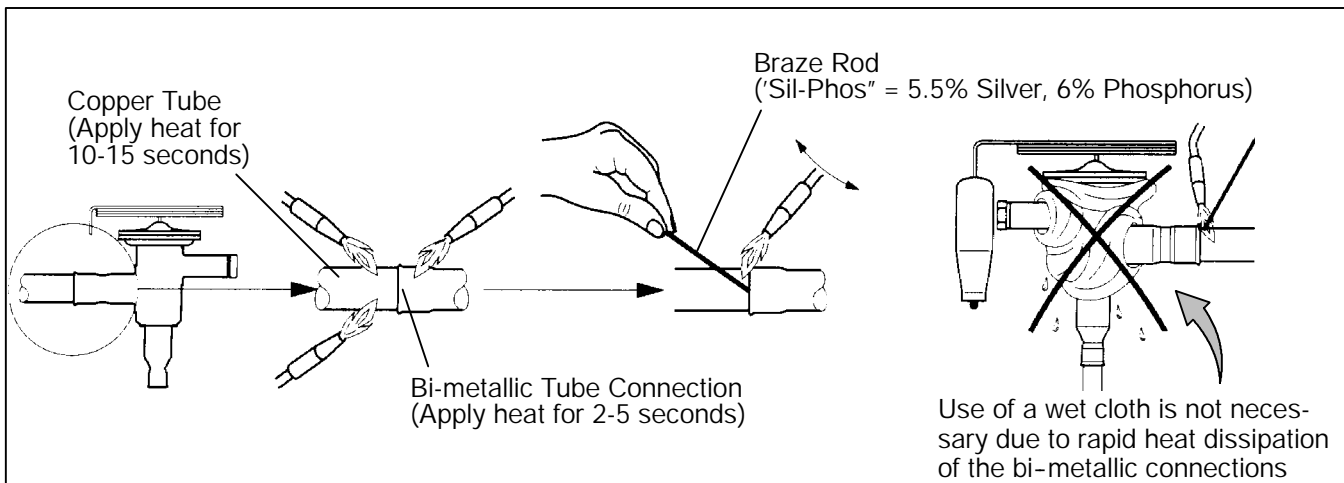
**NOTES**

1. The TXV's are hermetic valves and do not have adjustable superheat.
2. All connections on the evaporator TXV are bi-metallic, copper on the inside and stainless on the outside. When brazing, bi-metallic connections heat up very quickly.

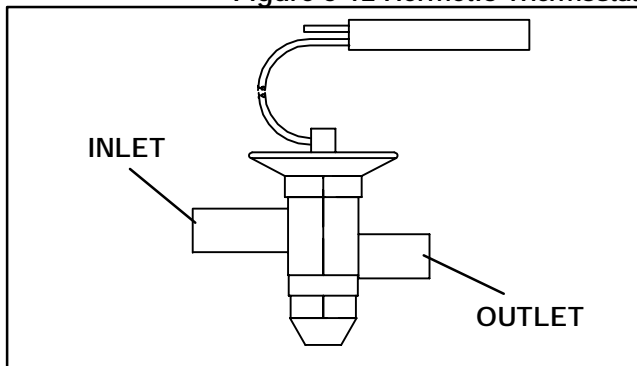


1. Evaporator Expansion Valve
2. Non-adjustable Superheat Stem
3. Equalizer Connection
4. Inlet Connection
5. Outlet Connection
6. Expansion Valve Bulb

Figure 6-11 Evaporator Expansion Valve



**Figure 6-12 Hermetic Thermostatic Expansion Valve Brazing Procedure**



**Figure 6-13 Economizer Expansion Valve**

1. Pump down the unit per paragraph 6.4.
2. Remove cushion clamps located on the inlet and outlet lines.
3. Unbrazed the equalizer connection (if applicable), the outlet connection and then the inlet connection.
4. Remove insulation (Presstite) from expansion valve bulb.
5. Unstrap the bulb, located below the center of the suction line (4 o'clock position), and remove the valve.
- b. Installing the Expansion Valve
  1. Clean the suction line with sandpaper before installing bulb to ensure proper heat transfer. Apply thermal grease to the indentation in the suction line.
  2. Strap the thermal bulb to the suction line, making sure bulb is placed firmly into the suction line. See Figure 6-10 for bulb placement.
  3. Insulate the thermal bulb.
  4. The economizer expansion valves should be wrapped in a soaked cloth for brazing. See Figure 6-12. Braze inlet connection to inlet line
  5. Braze outlet connection to outlet line.
  6. Reinstall the cushion clamps on inlet and outlet lines.

7. If applicable, braze the equalizer connection to the equalizer line.
8. Check superheat (refer to step 6.14.1).

#### 6.15 EVAPORATOR COIL AND HEATER ASSEMBLY

The evaporator section, including the 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.

##### 6.15.1 Evaporator Coil Replacement

- a. Pump unit down. (Refer to paragraph 6.4.)
- 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. Disconnect the defrost temperature sensor (see Figure Figure 2-2 from the coil. .
- e. Remove middle coil support.
- f. Remove the mounting hardware from the coil.
- g. Unsolder the two coil connections, one at the distributor and the other at the coil header.
- 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 per paragraph 6.5. Evacuate the unit per paragraph 6.6 and add refrigerant charge per paragraph 6.7.

##### 6.15.2 Evaporator Heater Replacement

- a. Before servicing unit, make sure the unit circuit breakers (CB-1 & CB-2) and the start-stop switch (ST) are in the OFF position, and that the power plug and cable are disconnected.
- b. Remove the lower access panel (Figure 2-1) by removing the T.I.R. locking device lockwire and mounting screws.

- c. Determine which heater(s) need replacing by checking resistance on each heater. Refer to paragraph 2.3 for heater resistance values
- d. Remove hold-down clamp securing heaters 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.

#### 6.16 ECONOMIZER, UNLOADER, LIQUID INJECTION AND OIL RETURN SOLENOID VALVE

##### a. Replacing the Coil

#### NOTE

The coil may be replaced without removing the refrigerant.

- 1 Be sure electrical power is removed from the unit. Disconnect leads. Remove top screw and washer. Lift off coil. (See Figure 6-14 or Figure 6-15)
- 2 Verify coil type, voltage and frequency of old and new coil. This information appears on the coil housing.

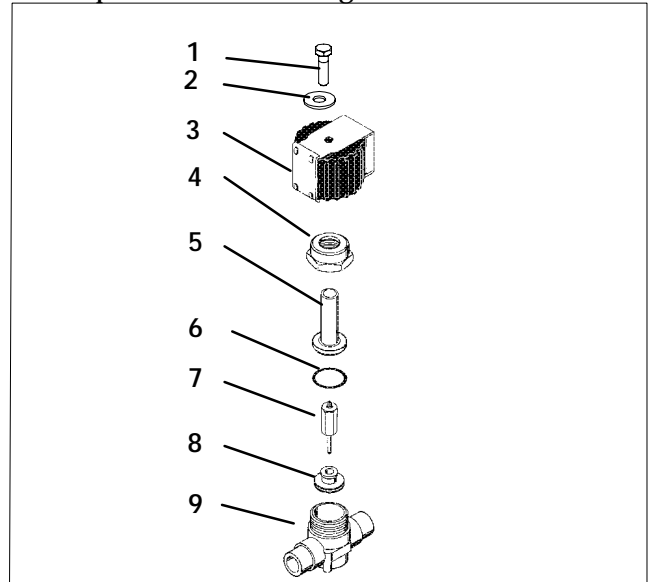
##### b. Replacing Valve Internal Parts (Unloader Solenoid Only)

- 1 Pump down the unit. Refer to paragraph 6.4.
- 2 Be sure electrical power is removed from the unit. Disconnect leads. Remove top screw and washer. Lift off coil. (See Figure 6-14)
- 3 Remove the top screw (see Figure 6-14), washer , and coil assembly.
- 4 Loosen the enclosing tube locknut.
- 5 Remove enclosing tube and locknut assembly. The gasket is inside the enclosing tube.
- 6 Remove seat disc from inside of body and check for obstructions and foreign material.
- 7 Place the seat disc into the valve body with the smaller diameter end facing up.
- 8 Install stem and plunger.
- 9 Place the enclosing tube locknut over the enclosing tube. Install spacer over enclosing tube making sure it is seated properly in the enclosing tube locknut. Tighten enclosing tube locknut to a torque value of 2.78 mkg (20 ft-lb). Do not overtighten.
- 10 Install coil assembly, washer and top screw.
- 11 Evacuate and dehydrate the system. (Refer to section 6.6.) Charge unit with refrigerant per section 6.7.
- 12 Start unit and check operation.

##### c. Replacing Valve

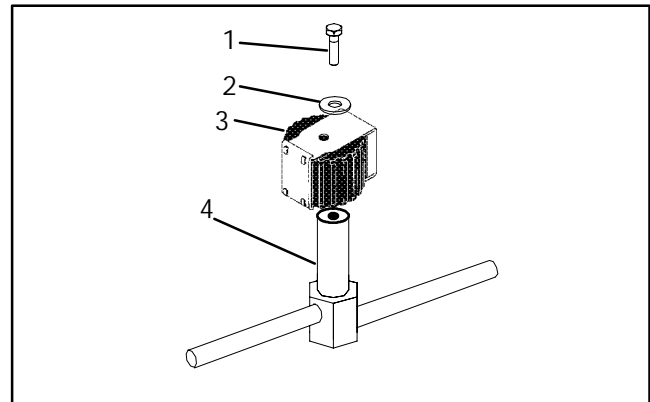
- 1 To replace the unloader, liquid injection or economizer valve, pump down the unit. Refer to paragraph 6.4. To replace the oil return valve, remove the refrigerant charge.

- 2 Be sure electrical power is removed from the unit. Disconnect leads. Remove top screw and washer. Lift off coil. (See Figure 6-14 or Figure 6-15)
- 3 Unbraid valve from unit and braid new valve in place
- 4 Install coil. Evacuate low side and place unit back in operation. Check charge.



- |                   |                     |
|-------------------|---------------------|
| 1. Top Screw      | 6. Gasket           |
| 2. Washer         | 7. Stem and Plunger |
| 3. Coil           | 8. Seat Disc        |
| 4. Locknut        | 9. Body             |
| 5. Enclosing Tube |                     |

Figure 6-14. Unloader Solenoid Valve



- |                  |                            |
|------------------|----------------------------|
| 1. Slotted Screw | 4. Enclosing Tube and Body |
| 2. Washer        |                            |
| 3. Coil          |                            |

Figure 6-15. Oil Return Solenoid Valve (ORV), Economizer Solenoid Valve (ESV), Liquid Injection Solenoid Valve (LIV)

#### 6.17 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.

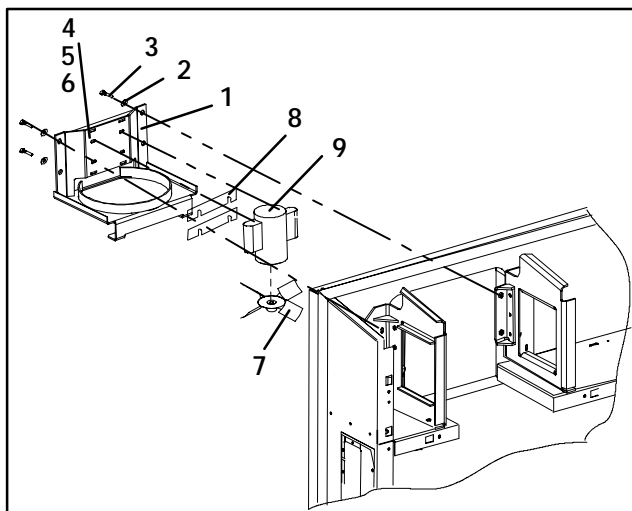
### 6.17.1 Replacing The Evaporator Fan Assembly

#### WARNING

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

- a. Remove upper access panel (see Figure 2-2) by removing mounting bolts and T.I.R. locking device. Reach inside of unit and remove the Ty-Rap securing the wire harness loop. Then unplug the connector by twisting to unlock and pulling to separate. NOTE: It may be easier to unplug the connector with the motor assembly partially pulled out (after step b).
- b. Remove the four mounting bolts that secure the motor-fan assembly to the unit.
- c. Slide the fan assembly out from the unit and place it on a sturdy work surface.
- d. Remove the motor and fan from the assembly.
- e. Replace the motor.
- f. Lubricate the fan motor shaft with a graphite-oil solution (Never-Seez) and apply thread sealer (Loctite H, brown in color) to the two fan set screws. Install fan on the motor shaft, so that the coupling surface will be even with the end of the motor shaft.
- g. Install the fan assembly in reverse order of removal. Apply power momentarily to check for proper fan rotation (refer to paragraph 2.3). If the fan spins backwards, than motor wiring or motor is defective.

Replace access panel making sure that panel does not leak. Lock-wire the T.I.R. locking device(s).



- |                        |                     |
|------------------------|---------------------|
| 1. Bracket             | 6. Cap Screw, Hxhd  |
| 2. Flat washer, 3/8    | 5/16-18 x 1.25      |
| 3. Bolt, 3/8-16 x 1.00 | 7. Fan              |
| 4. Locknut, 5/16-18    | 8. Shim             |
| 5. Flat washer, 5/16   | 9. Evaporator Motor |

Figure 6-16. Evaporator Fan Assembly

### 6.18 EVAPORATOR FAN MOTOR CAPACITORS

The evaporator fan motors are of the permanent-split capacitor type. The motor is equipped with one capacitor used in the high speed circuit and another capacitor used for the low speed circuit.

#### 6.18.1 When To Check For A Defective Capacitor

- a. Fan motor will not change speed. For example: in the conventional perishable mode, the motors should run in high speed. In the economy perishable mode they should switch speeds and in the frozen mode, the motors should run in low speed.

#### NOTE

The evaporator fan motors will always start in high speed.

- b. Motor running in wrong direction (after checking for correct wiring application).
- c. Motor will not start, and IP-EM's are not open.

#### 6.18.2 Removing The Capacitor

#### WARNING

**Make sure power to the unit is OFF and power plug disconnected before removing capacitor(s).**

The capacitors are located on the motor and above the evaporator fan deck they may be removed by two methods:

1. *If container is empty*, open upper rear panel of the unit. The capacitor may be serviced after disconnecting power plug.
2. *If container is full*, turn the unit power OFF and disconnect power plug. Remove the evaporator fan motor access panel. (See see Figure 2-1). For removal of the evaporator fan assembly, refer to section 6.17.

#### WARNING

**With power OFF discharge the capacitor before disconnecting the circuit wiring.**

#### 6.18.3 Checking The Capacitor

If the capacitor is suspected of malfunction, you may choose to simply replace it. Direct replacement requires a capacitor of the same value. Two methods for checking capacitor function are:

1. Volt-ohmmeter set on RX 10,000 ohms.

Connect ohmmeter leads across the capacitor terminals and observe the meter needle. If the capacitor is good, the needle will make a rapid swing toward zero resistance and then gradually swing back toward a very high resistance reading.

If the capacitor has failed open, the ohmmeter needle will not move when the meter probes touch the terminals. If the capacitor is shorted, the needle will swing to zero resistance position and stay there.

2. Capacitor analyzer:

The function of the analyzer is to read the microfarad value of a capacitor and to detect insulation breakdown

under load conditions. The important advantages of an analyzer are its ability to locate capacitors that have failed to hold their microfarad ratings, or those that are breaking down internally during operation. It is also useful in identifying capacitors when their microfarad rating marks have become unreadable.

### 6.19 VALVE OVERRIDE CONTROLS

#### CAUTION

**DO NOT disassemble piston from NEW suction modulating valve powerhead assembly. Doing so may result in damage to piston.**

Controller function code Cd41 is a configurable code that allows timed operation of the automatic valves for troubleshooting. Three test sequences are provided. The first, capacity mode (CAP), allows alignment of the unloader and economizer solenoid valves in the standard, unloaded and economized operating configurations. The second, SMV % Setting (SM) allows opening of the suction modulating valve to various percentages and the third, Oil Valve Setting (OIL) and Liquid Valve Setting (LIV) allows opening or closing of the oil return solenoid valve and the liquid injection solenoid valve. A fourth selection is also provided to enter a time period of up to three 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, override function is automatically terminated and the valves return to normal machinery control. To operate the override, do the following:

- 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.
- 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 and SELCt will appear in the left display.
- 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 the following table.
- 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.
- The above described sequence may be repeated during the timer cycle to change to another override.

Right Display	Available Selections
<b>CAP</b> (Capacity Mode)	<b>AUto</b> (Normal Control)
	<b>UnLd</b> (Unloader = Open Economizer = Closed)
	<b>Std</b> (Unloader = closed Economizer = closed)
	<b>ECO</b> (Unloader = closed Economizer = open)
<b>SM</b> (SMV % Setting)	<b>AUto</b> (Normal Control)
	0
	3
	4
	6
	12
	25
50	
100	
<b>OIL</b> (Oil Valve Setting)	<b>AUto</b> (Normal Control)
	<b>CLOSE</b>
	<b>OPEn</b>
<b>LIV</b> (Liquid Valve Setting, if applicable)	<b>AUto</b> (Normal Control)
	<b>CLOSE</b>
	<b>OPEn</b>
<b>tIM</b> (Timer)	<b>0 00</b> (0 minutes/0 Seconds) In 30 second increments to <b>3 00</b> (3 minutes/ 0 seconds)

### 6.20 SUCTION MODULATION VALVE

On start up of the unit, the valve will reset to a known open position. This is accomplished by assuming the valve was fully open, driving it fully closed, resetting the percentage open to zero, then opening to a known 10% staging position.

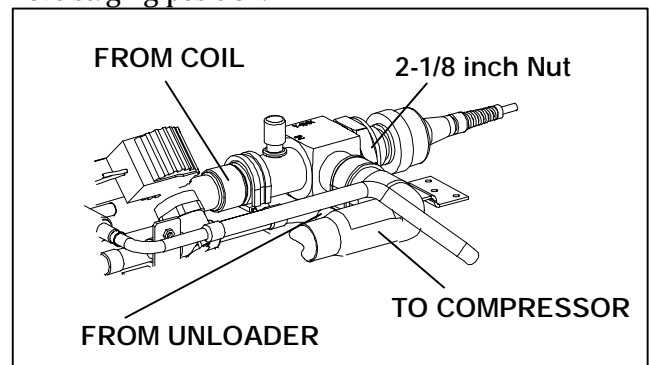


Figure 6-17 Suction Modulation Valve (SMV)

## 6.20.1 Precheck Procedure

- a. Check unit for abnormal operation.
- b. Check charge. If refrigerant is low repair as required and again check operation.
- c. If sufficient capacity cannot be maintained or unit is tripping excessively on high pressure switch (HPS) in high ambients, check coils and clean if required.
- d. If capacity or control cannot be maintained turn unit OFF, then back ON. This will reset the valve in the event the controller lost communication with the valve, and may correct the problem.

### NOTE

Carefully listen to the valve. During reset, the valve will make a ratcheting noise that may be heard or felt as it is attempting to close. If this can be heard or felt, it indicates that the controller and drive module are attempting to close the valve, and may serve as a quick indication that the drive is in working order.

- e. Operation of the valve may be checked using the controller valve override program, function code Cd41. Refer to paragraph 6.19 for valve override test instructions.

## 6.20.2 Checking The Stepper valve

### a. Checking with ohmmeter

Disconnect the four pin connector to the stepper SMV. With a reliable digital ohmmeter, check the winding resistance. In normal ambient, the valve should have 72 to 84 ohms measured on the red/green (a-b terminals) and on the white/black (c-d terminals) leads. If an infinite or zero reading occurs, check connections and replace the motor.

### b. Checking with SMA-12 portable stepper drive tester

The SMA-12 portable stepper drive tester (Carrier Transicold P/N 07-00375-00) is a battery operated stepper drive which will open and close the SMV, which allows a more thorough check of the operating mechanism.

To check operation:

1. Stop the unit, disconnect the four pin connector from the stepper module to the valve (see Figure 6-17) and attach the SMA-12 stepper drive to the connector going to the valve.
2. Set the SMA-12 pulse per second (PPS) to one PPS and either open or close valve. Each LED should light sequentially until all four are lit. Any LED fail-

ing to light indicates an open on that leg which indicates a poor connection or an open coil. Repair or replace as required to achieve proper operation.

### CAUTION

**The scroll compressor achieves low suction pressure very quickly. Do not operate the compressor in a deep vacuum, internal damage will result.**

3. Restart unit, set the step rate to 200 PPS on SMA-12 for the valve, and close stepper valve while watching the suction gauge. Within one minute the suction pressure will go into a vacuum. This is an indication that the valve is moving.
4. If no change in suction pressure is detected, check for resistance (refer to step 6.20.2), and check connections for proper continuity and retest. If the valve is functioning and all connections and motor resistance are good, check the controller and expansion module.

### CAUTION

**DO NOT disassemble piston from NEW suction modulating valve powerhead assembly. Doing so may result in damage to piston.**

5. If the valve is determined as faulty after completing the above steps, perform a low side pump down. Remove valve powerhead assembly, and replace with a NEW valve powerhead assembly, torque nut to 35 ft-lb, evacuate low side, and open all service valves.

## 6.21 CONTROLLER AND EXPANSION MODULE

### 6.21.1 Handling Modules

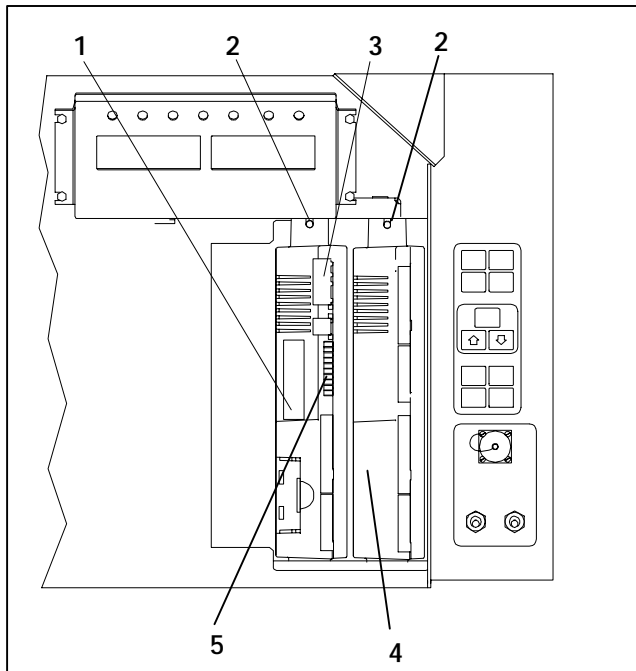
### CAUTION

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

### CAUTION

**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.



1. Controller Software Programming Port
2. Mounting Screw
3. Controller
4. Expansion Module
5. Test Points

**Figure 6-18 Controller Section of the Control Box**

- a. Obtain a grounding wrist strap (Carrier Transicold part number 07-00-304-00) and a static dissipation mat (Carrier Transicold part number 07-00304-00). The wrist strap, when properly grounded, will dissipate any potential buildup on the body. The dissipation mat will provide a static-free work surface on which to place and/or service the modules.
- b. Disconnect and secure power to the unit.
- c. Place strap on wrist and attach the ground end to any exposed unpainted metal area on the refrigeration unit frame (bolts, screws, etc.).
- d. Carefully remove the module. Do not touch any of the electrical connections if possible. Place the module on the static mat.
- e. The strap should be worn during any service work on a module, even when it is placed on the mat.

### 6.21.2 Controller Trouble-Shooting

A group of test points (TP, see Figure 6-18) are provided on the controller for trouble-shooting 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.

#### TP1

This test point enables the user to check if the controller unloader solenoid valve relay (TU) is open or closed.

#### TP2

This test point enables the user to check if the high pressure switch (HPS) is open or closed.

#### TP3

This test point enables the user to check if the water pressure switch (WP) contact is open or closed.

#### TP 4

This test point enables the user to check if the internal protector for the condenser fan motor (IP-CM) is open or closed.

#### TP 5

This test point 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

This test point is not used in this application.

#### TP 7

This test point enables the user to check if the controller economizer solenoid valve relay (TS) is open or closed

#### TP 8

This test point enables the user to check power to the suction modulator valve.

#### TP 9

This test point is the chassis (unit frame) ground connection.

#### TP 10

This test point enables the user to check if the heat termination thermostat (HTT) contact is open or closed.

### 6.21.3 Controller Programming Procedure

To load new software into the module, the programming card is inserted into the programming/software port.

#### CAUTION

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

#### NOTE

The metal door on the programming card must be facing to the left when inserting.

- a. Procedure for loading Operational Software

1. Turn unit OFF, via start-stop switch (ST).
2. Insert the programming card for Operational Software into the programming/software port. (See Figure 6-18)
3. Turn unit ON, via start-stop switch (ST).
4. The Display module will alternate back and forth between the messages "rEV XXXX" and "Press EntR". (If a defective card is being used the Display will blink the message "bAd cARd". Turn start-stop switch OFF and remove the card.)

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 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 programming card from the programming/software port and return the unit to normal operation by placing the start-stop switch in the ON position.

#### b. Procedure for loading Configuration Software

1. Turn unit OFF using start-stop switch (ST).
2. Insert the programming card, for Configuration Software, into the programming/software port. (See Figure 6-18.)
3. Turn unit ON using start-stop switch (ST).
4. The Display module will show "nt40" on the left LCD display and "531###" on the right LCD display. "###" will indicate the dash number for a given unit model number, use the UP or DOWN ARROW key to scroll through the list to obtain the proper model dash number. For example, to program a model number 69NT40-531-05, press the UP or DOWN ARROW key until the right display shows "nt40" on the right display and "53105" on the left. (If a defective card is being used, the Display will blink the message "bAd CARD". Turn start-stop switch OFF and remove the card.)
5. Press the ENTER key on the keypad.
6. When the software loading has successfully completed, the Display will show the message "EEPrM 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.)
7. Turn unit OFF using start-stop switch (ST).
8. Remove the programming card from the programming/software port and return the unit to normal operation by placing the start-stop switch in the ON position.

#### 6.21.4 Removing and Installing a Module

##### 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 6-18) 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 (item 2, see Figure 6-18) are 0.23 mkg (20 inch-pounds). Torque value for the connectors is 0.12 mkg (10 inch-pounds).

## 6.22 TEMPERATURE SENSOR SERVICE

Procedures for service of the Return Recorder, Return Temperature, Supply Recorder, Supply Temperature, Ambient, Defrost Temperature, Compressor Discharge and Compressor Suction temperature sensors are provided in the following sub paragraphs.

### 6.22.1 Sensor Checkout Procedure

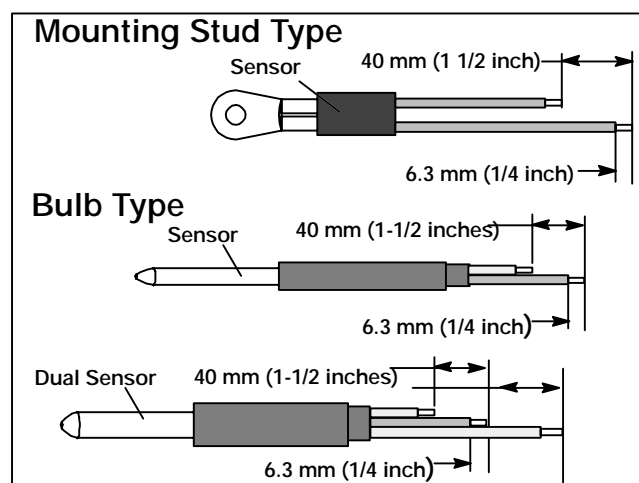


Figure 6-19 Sensor Types

To check a sensor reading, do the following:

- 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.



Table 6-2 Sensor Temperature/Resistance Chart  
(+/- .002%)

Temperature		Resistance	
_C	_F	(Ohms)	
		AMBS, CPSS, DTS, RTS, RRS, STS, SRS	CPDS
-30	-22	177,000	1,770,000
-25	-13	130,400	1,340,000
-20	-4	97,070	970,700
-15	5	72,900	729,000
-10	14	55,330	553,000
-5	23	43,200	423,300
0	32	32,650	326,500
5	41	25,390	253,900
10	50	19,900	199,000
15	59	15,700	157,100
20	68	12,490	124,900
25	77	10,000	100,000
30	86	8,060	80,600
35	95	6,530	65,300
40	104	5,330	53,300
45	113	4,370	43,700
50	122	3,600	36,000
55	131	2,900	29,000
60	140	2,490	24,900
65	149	2,080	20,800
65	158	1,750	17,500

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, CPDS OR CPSS 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.

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.

### 6.22.2 Sensor Replacement

a. Turn unit power OFF, disconnect power supply and remove sensor assembly from unit.

- b. Cut wire(s) 5 cm (2 inches) from shoulder of defective sensor and discard the defective probe only.
- c. Cut one wire of existing cable 40 mm (1-1/2 inch) shorter than the other wire.
- d. Cut one replacement sensor wire (opposite color) back 40 mm (1-1/2 inch). (See Figure 6-19.)
- e. Strip back insulation on all wiring 6.3 mm (1/4 inch).
- 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 6-20.

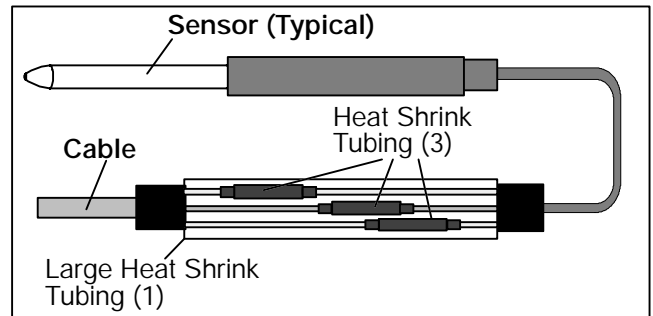


Figure 6-20 Typical Sensor and Cable Splice

- g. 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.
- h. Solder spliced wires with a 60% tin and 40% lead Rosincore solder.
- i. Slide heat shrink tubing over splice so that ends of tubing cover both ends of crimp as shown in Figure 6-20.
- j. Heat tubing to shrink over splice. Make sure all seams are sealed tightly against the wiring to prevent moisture.
- k. Slide large heat shrink tubing over both splices and shrink.

### CAUTION

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

- l. Position sensor in unit as shown in m. Figure 6-21 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. and re-check sensor resistance.
- n. Reinstall sensor, refer to paragraph 6.22.3.

### NOTE

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

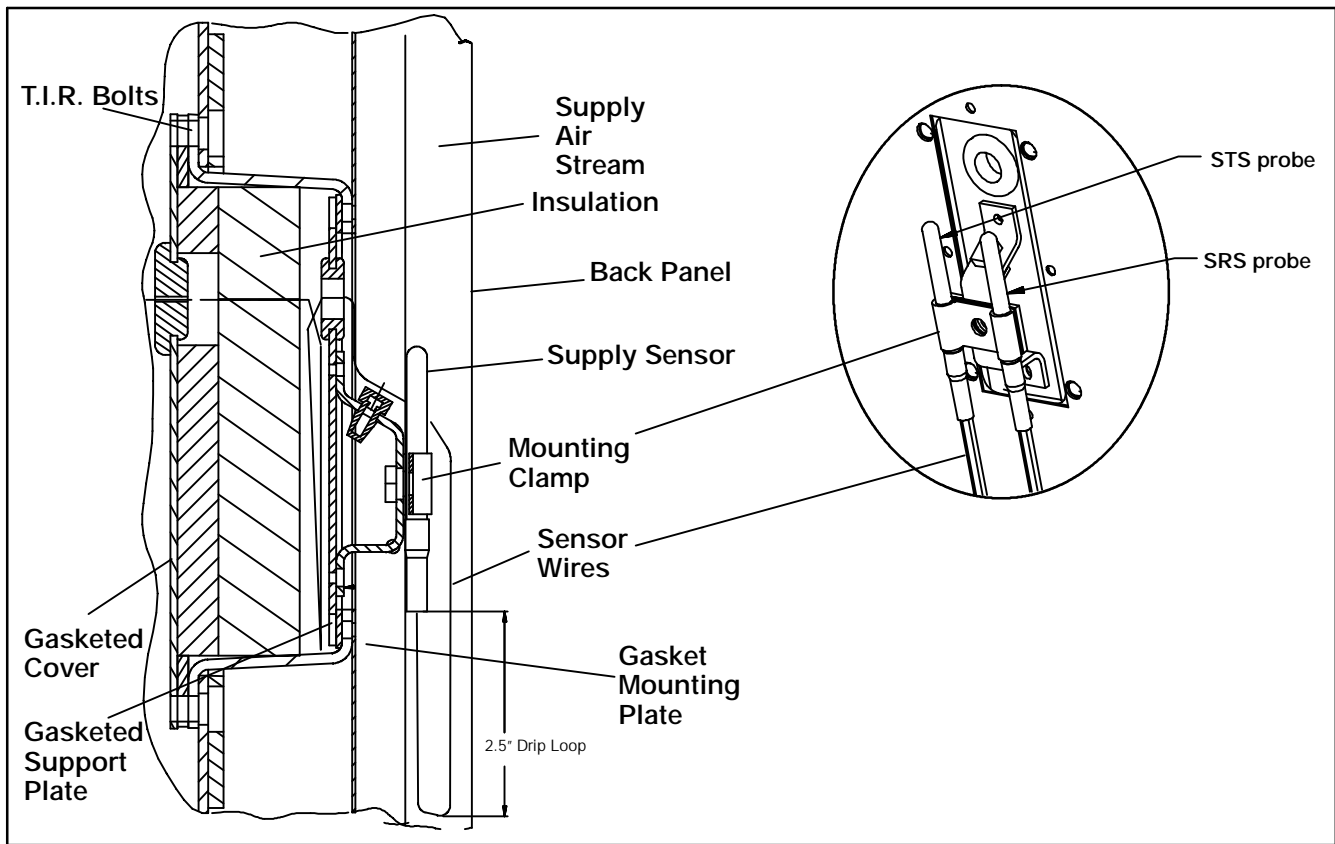


Figure 6-21 Supply Sensor Positioning  
c Sensor DTS

### 6.22.3 Sensor Re-Installation

#### a. Sensors STS and SRS

To properly position a supply sensor, the sensor must be fully inserted into the probe holder. Do not allow heat shrink covering to contact the probe holder. For proper placement of the sensor, be sure to position the enlarged positioning section of the sensor against the the side of the mounting clamp. This positioning will give the sensor the optimum amount of exposure to the supply air stream, and will allow the Controller to operate correctly. See Figure 6-21.

#### b Sensors RRS and RTS

Reinstall the return sensor as shown in Figure 6-22. 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.

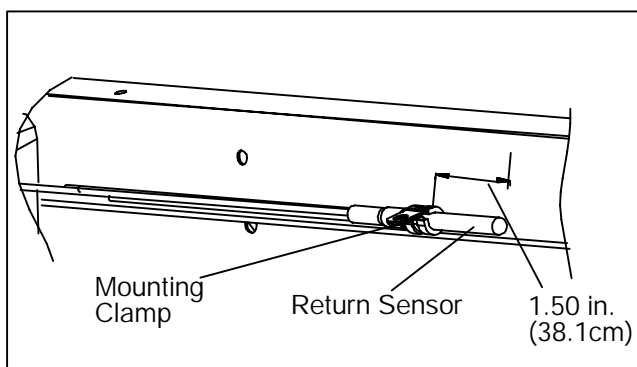


Figure 6-22 Return Sensor Positioning

The DTS sensor must have insulating material placed completely over the sensor to insure the coil metal temperature is sensed.

### 6.23 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 area to bare metal using a wire brush, emery paper or equivalent cleaning method. Immediately following cleaning, apply 2-part epoxy paint to the area. and allow to dry. After the first coat dries, apply a second coat.

### 6.24 COMPOSITE CONTROL BOX REPAIRS

#### 6.24.1 Introduction

This procedure provides instructions for repair of the Carrier Transicold composite control box. Damage to the control box may be in the form of a chip or hole, a crack, a damaged thread insert or damage to the door hinge inserts. Generally, the object of the repair must be to ensure sufficient strength is restored to the damaged area and the repair must keep the box water tight. Information on repair kits and repair procedures for each type of damage is provided in the following paragraphs. Ambient temperature must be above 7°C (45°F) for proper curing of epoxy repairs.

### 6.24.2 Cracks

Cracks in the control box are repaired using a fiberglass patch over the damaged area. Materials required are included in the Fiberglass Patch Kit supplied with Crack Repair Kit, Carrier Transicold part number 76-00724-00SV (see Table 6-3).

- a. The surface must be clean and dry. Roughen the surface with sandpaper to ensure a good bond.
- b. Cut the fiberglass cloth to allow a 25mm (1-inch) overlap around the area to be repaired.
- c. Stretch and position the cloth over the area to be repaired and secure it with masking tape.
- d. Make up sufficient epoxy glue to cover the cloth by mixing equal parts of resin and hardener. Saturate the cloth with the epoxy glue, spreading evenly.
- e. Remove the tape and overlap the edge of the cloth approximately 6 to 12 mm (1/4" to 1/2") with glue.
- f. Epoxy will dry in 45-60 minutes. When completely cured (12 hours), use sandpaper to smooth edges of the patch.

### 6.24.3 Chips And Holes

Chips and holes in the control box are repaired using a piece of aluminum or stainless steel to cover the damaged area. The material can be cut to suit and riveted in place. An adhesive sealant must be used to make the repair watertight. The adhesive sealant (Sikaflex 221) is included in Crack Repair Kit Carrier Transicold part number 76-00724-00SV (see Table 6-3). **Do not use an acetone based silicone sealant** (Which can be identified by a vinegar-like odor).

- a. To make up the patch, cut a piece of aluminum or stainless steel so that it will overlap the damaged area by at least 40 mm (1 1/2") on all sides.
- b. Choose rivet locations and drill the rivet holes in the corresponding locations on the control box and patch piece.
- c. Apply the adhesive sealant around the damaged area to form a seal between the control box and the patch piece.
- d. Rivet the patch piece in place.
- e. File smooth any rough edges (including rivets) that may come into contact with wires.

### 6.24.4 Inserts

The threaded brass inserts that are molded into the control box will need to be replaced if the threads become stripped, or if the insert becomes loose. The inserts and epoxy are contained in repair kit, Carrier Transicold part number 76-50084-00 (see Table 6-4). There are 6 different inserts used in the control box. Refer to Figure 6-24 for the locations of the various inserts.

#### NOTE

An epoxy application gun is also needed, Carrier Transicold part number 07 - 00391 - 00.

The damaged insert must be removed from the control box. Table 6-5 identifies the drill size and drill depth to be used for each insert. A stop ring should be used on the drill bit to limit the depth.

- a. Center the drill bit on the insert and drill to the prescribed depth.
- b. Remove the chips from the drilled hole.
- c. Mix the two component epoxy and fill the hole 1/2 way to the top with epoxy.
- d. Press the insert in until it is flush with the surface.
- e. Wipe away any excess epoxy. The part is ready for service after the bond material has hardened and is tack free (approximately 20 minutes)

### 6.24.5 Door Hinge Inserts

If the door hinges have been pulled from the control box drill and reinstall the hinge as shown in Figure 6-23 and described in the following steps.

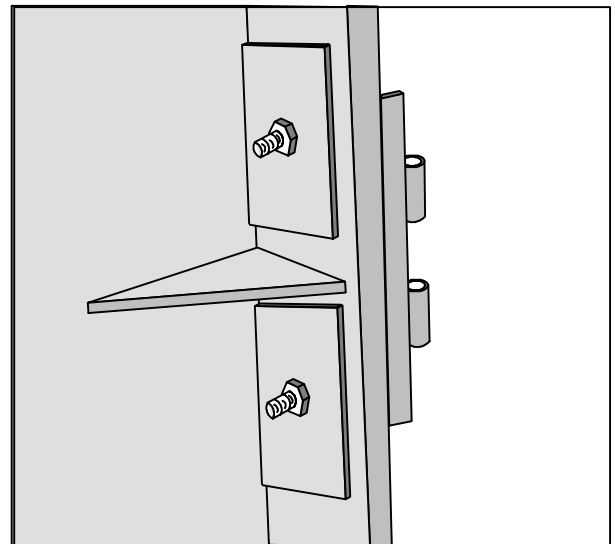


Figure 6-23 Door Hinge Repair

Materials needed:

1. Cut two square pieces of 3 mm thick (1/8 inch) aluminum or stainless steel approximately 40 mm (1 5/8") square. These squares will serve as backing plates.
2. Two nuts, bolts (10 - 24 x 1") and washers for each insert that needs repair.
  - a. Drill a 1/4" hole in the center of each square backing plate.
  - b. Pass the bolts through the bolts holes in the door hinge, then through the control box at the location where the hinge insert pulled out.
  - c. From inside the control box, slide the backing plates over the bolts and secure in place with the washers and nuts.

**Table 6-3 Crack, Chip & Hole Repair Kit**

ITEM	DESCRIPTION	PART NUMBER	Qty
1	Crack Repair Kit - Includes	76-00724-00SV	1
2	. . . Fiberglass Patch Kit (Loctite FK-98 or 80265)	76-00724-00Z	10
3	. . . Sikaflex 221 Adhesive Sealant (Sikaflex 232-361)	02-00067-02Z	10
4	. . . Instruction Sheet	98-02339-00	10

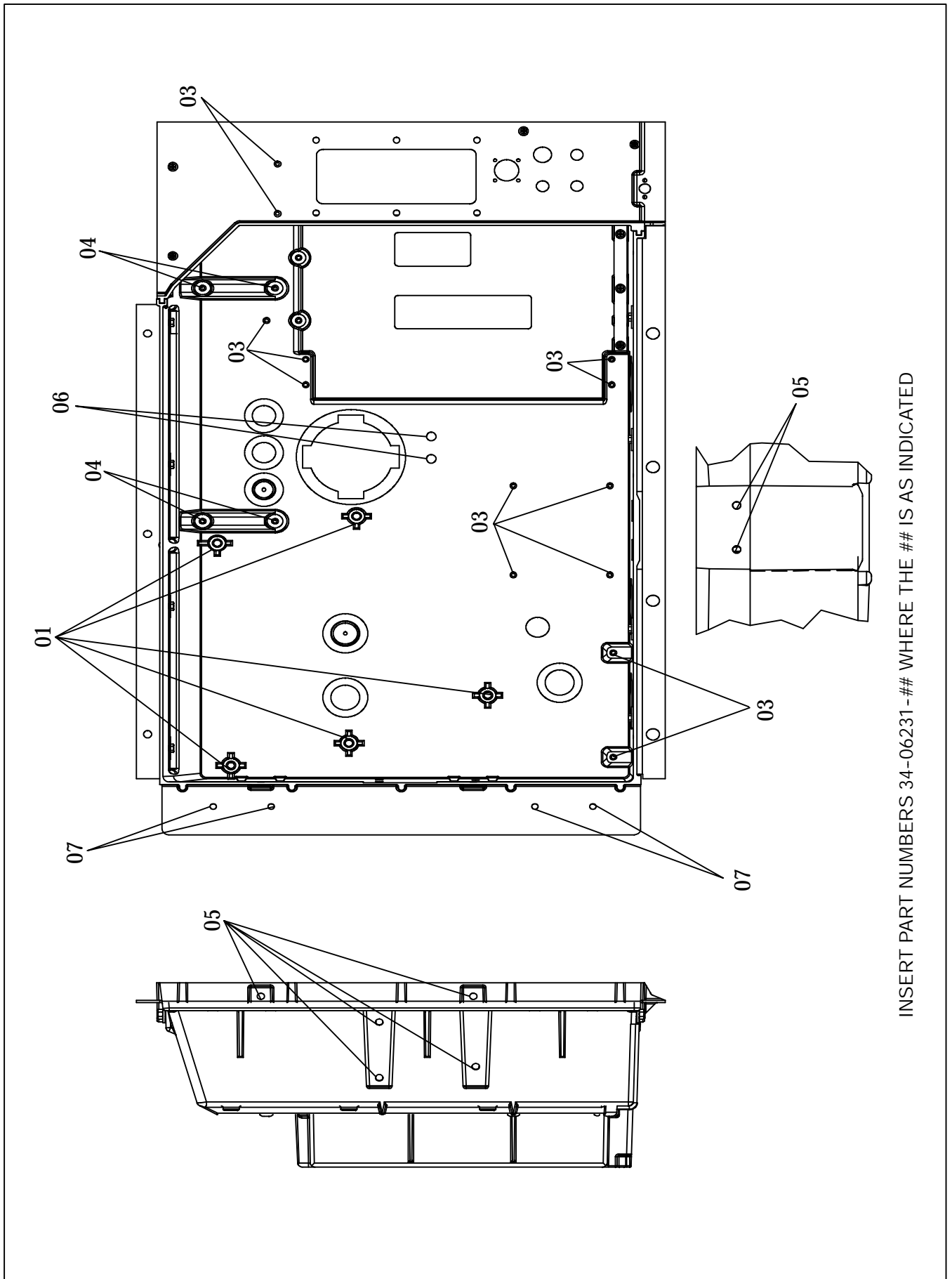
**Table 6-4 Insert Repair Kit**

ITEM	DESCRIPTION	PART NUMBER	Qty
1	Insert Repair Kit - Includes	76-50084-00	1
2	. . . Insert - 17.53 x 9.91 mm (.690 x .390 in) 1/4-20 Threads	34-06231-01	10
3	. . . Insert - 15.88 x 6.35 mm (.625 x .250 in) 10-24 Threads	34-06231-03	10
4	. . . Insert - 25.15 x 7.54 mm (.990 x .297 in) 10-24 Threads	34-06231-04	10
5	. . . Insert - 10.16 x 9.53 mm (.400 x .375 in) 10-24 Threads	34-06231-05	10
6	. . . Insert - 12.7 x 9.91 mm (.5 x .390 in) 1/4-20 Threads	34-06231-06	10
7	. . . Insert - 9.53 x 6.76 mm (.375 x .266 in) 10-24 Threads	34-06231-07	10
8	. . . Durabond Epoxy E20-HP (Loctite 29314)	02-0082-00	1
9	. . . Static Mixing Tube (Loctite 983440)	07-00390-00	1
10	. . . Instruction Sheet	98-02338-00	1

Note: Insert repair procedures require use of an Application Gun, Carrier part number 07-00391-00

**Table 6-5 Drill Information**

Item	Insert part number	Drill size and depth
1	34- 06231- 01	10.3 mm x 17.8 mm deep (.404 in. x .700 in. deep)
2	34- 06231- 03	6.8 mm x 16.3 mm deep (.266 in. x .640 in. deep)
3	34- 06231- 04	7.9 mm x 25.4 mm deep (.3125 in. x 1.0 in. deep)
4	34- 06231- 05	6.9 mm (.270 in.) Drill completely through.
5	34- 06231- 06	10.3 mm (.404 in.) Drill completely through.
6	34- 06231- 07	6.8 mm (.266 in.) Drill completely through.



INSERT PART NUMBERS 34-06231-## WHERE THE ## IS AS INDICATED

Figure 6-24. Insert Location

## 6.25 COMMUNICATIONS INTERFACE MODULE INSTALLATION

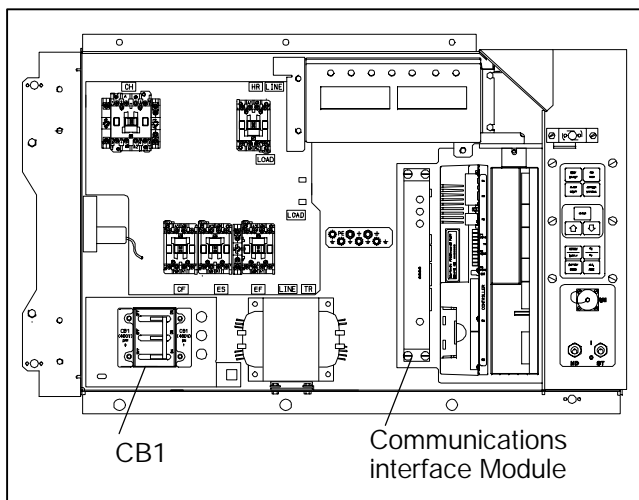


Figure 6-25. Communications Interface Installation

Units with communication interface module provision have the required wiring installed. The provision wiring kit (part number 76-00685-00), includes three pre-addressed wires installed between the circuit breaker and communication interface module locations. These wires are to be connected to the module and circuit breaker to allow the module to communicate over the power system. To install the module, do the following:

### WARNING

**The Unit Power Plug Must Be Disconnected To Remove Power From Circuit Breaker Cb1**

- a.. 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.
- b.. Open control box, see Figure 6-25 and remove low voltage shield. Open high voltage shield.

- c.. Remove the circuit breaker panel, with circuit breaker, from the control box.
- d.. 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.
- e.. Attach the three wires as addressed to the LOAD side of the circuit breaker.
- f.. Refit the circuit breaker panel.
- g. Fit the new RMU into the unit.
- h. Remove plugs CIA, CIB and CID from the wiring harness and attach to the module.
- i. Replace the low voltage shield.

Table 6-6 Recommended Bolt Torque Values

BOLT DIA.	THREADS	TORQUE	MKG
FREE SPINNING			
#4	40	5.2 in-lbs	0.05
#6	32	9.6 in-lbs	0.11
#8	32	20 in-lbs	0.23
#10	24	23 in-lbs	0.26
1/4	20	75 in-lbs	0.86
5/16	18	11 ft-lbs	1.52
3/8	16	20 ft-lbs	2.76
7/16	14	31 ft-lbs	4.28
1/2	13	43 ft-lbs	5.94
9/16	12	57 ft-lbs	7.88
5/8	11	92 ft-lbs	12.72
3/4	10	124 ft-lbs	17.14
NONFREE SPINNING (LOCKNUTS ETC.)			
1/4	20	82.5 in-lbs	0.95
5/16	18	145.2 in-lbs	1.67
3/8	16	22.0 ft-lbs	3.04
7/16	14	34.1 ft-lbs	4.71
1/2	13	47.3 ft-lbs	6.54
9/16	12	62.7 ft-lbs	8.67
5/8	11	101.2 ft-lbs	13.99
3/4	10	136.4 ft-lbs	18.86

Table 6-7 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

## SECTION 7

### ELECTRICAL WIRING SCHEMATIC

#### 7.1 INTRODUCTION

This section contains the Electrical Schematics and Wiring Diagrams. The diagrams are presented as follows:

Figure 7-1 Provides the legend for use with all figures.

Figure 7-2 Provides the basic schematic diagram.

Figure 7-3 Provides the basic wiring diagram.

Sequence of operation descriptions for the various modes of operation are provided in paragraph 4.9

<b>LEGEND</b>			
SYMBOL	DESCRIPTION (Schematic Location)	SYMBOL	DESCRIPTION (Schematic Location)
AMBS	AMBIENT SENSOR (C-21)	ORV	OIL RETURN SOLENOID VALVE (N-24, H-9)
C	CONTROLLERS (H-21, H-23)	PA	COMPRESSOR PHASE CONTACTOR (L-11, M-10, P1)
CB1	CIRCUIT BREAKER - 460 VOLT (J-1)	PB	COMPRESSOR PHASE CONTACTOR (L-10, M-11, P2)
CB2	CIRCUIT BREAKER - AUTOTRANSFORMER (C-1)	PR	PROBE RECEPTACLE [USDA] D-21, L-22, M-22)
CF	CONDENSER FAN CONTACTOR (M-12, N-5)	RM	REMOTE MONITORING RECEPTACLE (J-6, J-7, K-6, K-7, K-8)
CI	COMMUNICATIONS INTERFACE MODULE (A-3)	RRS	RETURN RECORDER SENSOR (K-21)
CL	COOL LIGHT (J-7)	RTS	RETURN TEMPERATURE SENSOR (B-21)
CM	CONDENSER FAN MOTOR (H-12, T-5)	SMV	SUCTION MODULATING VALVE (K-24)
CP	COMPRESSOR MOTOR (T-1)	SPT	SUCTION PRESSURE TRANSDUCER (H-21)
CPDS	COMPRESSOR DISCHARGE SENSOR (A-22)	SRS	SUPPLY RECORDER SENSOR (K-22)
CPSS	COMPRESSOR SUCTION SENSOR (D-21)	ST	START - STOP SWITCH (K-4)
CR	CHART RECORDER [TEMPERATURE RECORDER] (K-16)	STS	SUPPLY TEMPERATURE SENSOR (A-21)
CS	CURRENT SENSOR (M-1)	TCC	TransFRESH COMMUNICATIONS CONNECTOR (D-4)
DHBL	DEFROST HEATER - BOTTOM LEFT (T-4)	TD	CONTROLLER RELAY - COOLING (H11)
DHBR	DEFROST HEATER - BOTTOM RIGHT (R-4)	TE	CONTROLLER RELAY - HIGH SPEED EVAPORATOR FANS (K-13)
DHTL	DEFROST HEATER - TOP LEFT (T-4)	TFC	TransFRESH CONTROLLER (G-5)
DHTR	DEFROST HEATER - TOP RIGHT (R-4)	TH	CONTROLLER RELAY - HEATING (K-15)
DL	DEFROST LIGHT (J-6)	TN	CONTROLLER RELAY - CONDENSER FAN (K-12)
DPT	DISCHARGE PRESSURE TRANSDUCER (J-22)	TP	TEST POINT (F-17, G-12, H-11, J-12, J-13, J-15, M-19)
DTS	DEFROST TEMPERATURE SENSOR (B-22)	TR	TRANSFORMER (M-3)
DVM	DUAL VOLTAGE MODULE (D-1)	TRANS	AUTO TRANSFORMER 230/460 (D-1)
DVR	DUAL VOLTAGE RECEPTACLE (F-1)	TRC	TransFRESH REAR CONNECTOR (E-5)
E1	EVAPORATOR FAN CONTACTOR [HIGH] (L-13, L-14, P-7, P-10)	TS	CONTROLLER RELAY - ECONOMIZER SOLENOID VALVE (E-17)
EM	EVAPORATOR FAN MOTOR (E-13, G-13, T-8, T-11)	TT	CONTROLLER RELAY - COOLING (C-11)
ES	EVAPORATOR FAN CONTACTOR [LOW] (M-14, P-7, P-11)	TU	CONTROLLER RELAY - UNLOADER SOLENOID VALVE (E-16)
ESV	ECONOMIZER SOLENOID VALVE (K-17)	TV	CONTROLLER RELAY - LOW SPEED EVAPORATOR FANS (K-14)
F	FUSE (C-6, D-20, E-20, H-4)	T1	CONTROLLER RELAY - RM COOL (G-7)
FLA	FULL LOAD AMPS	T2	CONTROLLER RELAY - RM DEFROST (G-6)
HPS	HIGH PRESSURE SWITCH (G-11)	T4	CONTROLLER RELAY - RM INRANGE (G-8)
HR	HEATER CONTACTOR (L-15, N-3)	T6	CONTROLLER RELAY - COMPRESSOR PHASE SEQUENCING (K-10, K-11)
HS	HUMIDITY SENSOR (F-21)	USV	UNLOADER SOLENOID VALVE (K-16)
HTT	HEAT TERMINATION THERMOSTAT (G-15)	WP	WATER PRESSURE SWITCH (E-12)
IC	INTERROGATOR CONNECTOR [FRONT/REAR] (P-22, P-21)		
IP	INTERNAL PROTECTOR (E-13, G-13, H-12)		
IRL	IN RANGE LIGHT (J8)		
LIV	LIQUID INJECTION SOLENOID VALVE (K-18)		
MDS	MANUAL DEFROST SWITCH (E-19)		

**Figure 7-1 LEGEND**



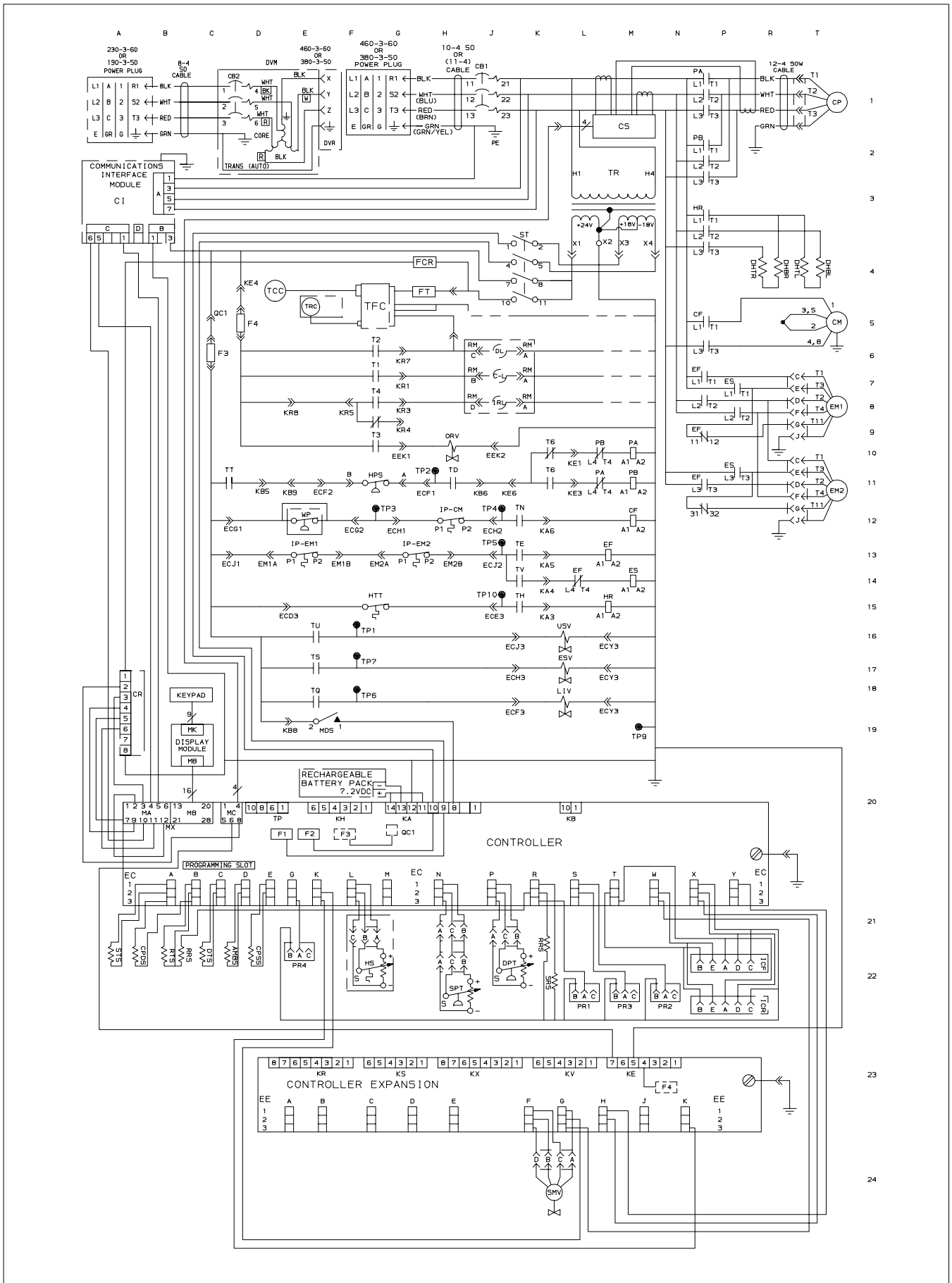


Figure 7-2 SCHEMATIC DIAGRAM

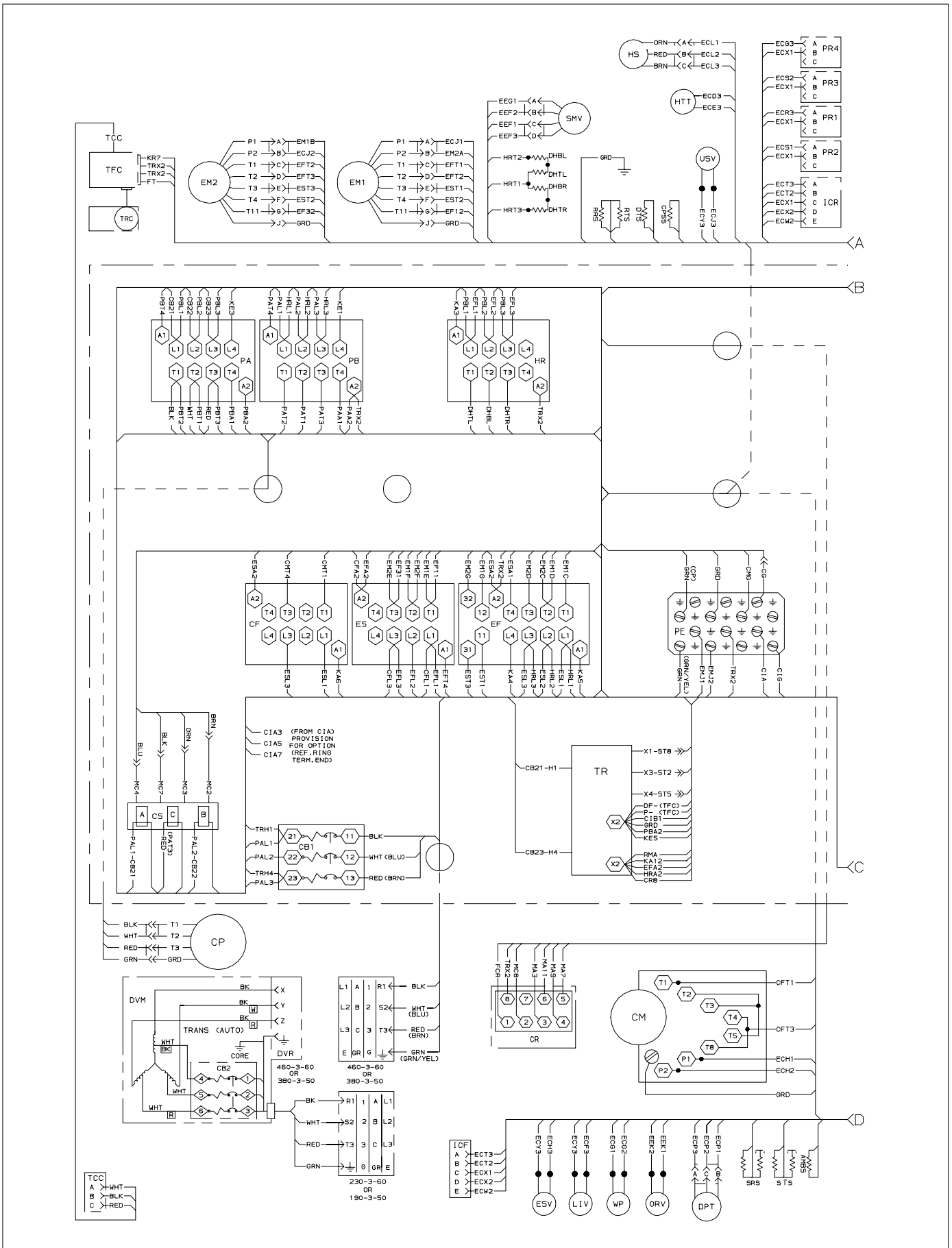


Figure 7-3 WIRING DIAGRAM (Sheet 1 of 2)

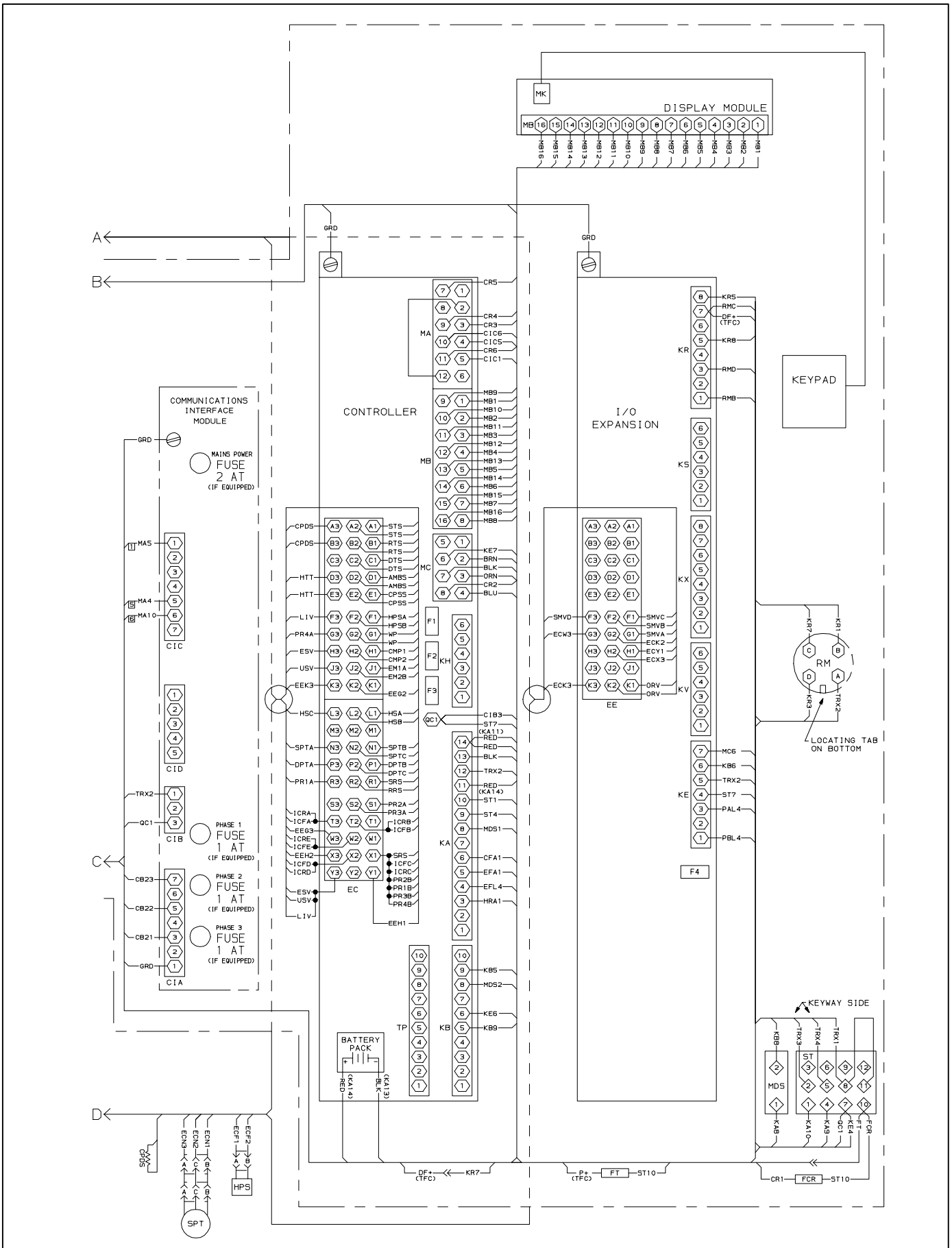


Figure 7-3 WIRING DIAGRAM (Sheet 2 of 2)

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