THERMO KING

Maintenance Manual

Superfreezer CRR DF MP4000

Revision A

April 2021

TK 61915-4-MM-EN

TRANE TECHNOLOGIES

THERMO KING

Introduction

This manual is published for informational purposes only. Thermo King® makes no representations warranties express or implied, with respect to the information recommendations and descriptions contained herein. Information provided should not be regarded as all-inclusive or covering all contingencies. If further information is required, Thermo King Corporation Service Department should be consulted.

Thermo King's warranty shall not apply to any equipment which has been "so installed, maintained, repaired or altered as, in the manufacturer's judgment, to affect its integrity."

Manufacturer shall have no liability to any person or entity for any personal injury, property damage or any other direct, indirect, special, or consequential damages whatsoever, arising out of the use of this manual or any information, recommendations or descriptions contained herein. The procedures described herein should only be undertaken by suitably qualified personnel. Failure to implement these procedures correctly may cause damage to the Thermo King unit or other property or personal injury.

General Information

The maintenance information in this manual covers unit models:

Superfreezer CRR-40 DF with MP4000

For further information, refer to:

Superfreezer CRR DF Parts Manual	TK 61905
Diagnosing Thermo King Container Refrigeration Systems	TK 41166
Evacuation Station Operation and Field Application	TK 40612
Tool Catalog	TK 5955

The information in this manual is provided to assist owners, operators, and service people in the proper upkeep and maintenance of Thermo King units.

Revision History

Revision A (Apr 2021) New manual format, general updates throughout manual.

Recover Refrigerant

Note: *In the USA, EPA Section 608 Certification is required to work on refrigeration systems. In the EU, local F-gas Regulations must be observed when working on refrigeration systems.*

At Thermo King®, we recognize the need to preserve the environment and limit the potential harm to the ozone layer that can result from allowing refrigerant to escape into the atmosphere.

We strictly adhere to a policy that promotes the recovery and limits the loss of refrigerant into the atmosphere.

When working on transport temperature control systems, a recovery process that prevents or minimizes refrigerant loss to the atmosphere is required by law. In addition, service personnel must be aware of the appropriate European Union, National, Federal, State, and/or Local regulations governing the use of refrigerants and certification of technicians. For additional information on regulations and technician programs, contact your local THERMO KING dealer.

Service Tools - Use the proper service tools. Gauge manifold sets should include appropriate shutoff valves or disconnects near the end of each service line.

Recovery Equipment - Recovery equipment must be used. Proper recovering, storing and recycling of refrigerants is an important part of all service work.

Service Procedures - Recommended procedures must be used to minimize refrigerant loss.

Components may be isolated by closing service valves and performing system pump-downs.

Components unable to be isolated for service must be repaired only after refrigerant is properly recovered.

R-134a/R-23

NOTICE

Equipment Damage!

Use only Polyolester-based refrigeration compressor oil in R-134a/R-23 systems. See Thermo King Parts Manual for part number.

NOTICE

System Contamination!

Do not mix Polyolester and standard synthetic compressor oils. Keep Polyolester compressor oil in tightly sealed containers. If Polyolester oil becomes contaminated with moisture or standard oils, dispose of properly–DO NOT USE.

NOTICE

System Contamination!

When servicing Thermo King R-134a/R-23 unit, use only those service tools certified for and dedicated to R-134a/R-23 refrigerant and Polyolester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-134a/R-23 systems. Please check serial# plate for type and volume of Refrigerant charged. Please do not blend with other refrigerants than the original charged refrigerant

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Scan the Quick Response (QR) code or click or type the web address https://tranetechnologies.iad1.qualtrics.com/jfe/form/SV_2octfSHoUJxsk6x?Q_CHL=qr&Q_JFE=qdg to complete the survey.

THERMO KING

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Safety Precautions

Danger, Warning, Caution, and Notice

Thermo King® recommends that all service be performed by a Thermo King dealer and to be aware of several general safety practices.

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this unit depend upon the strict observance of these precautions. The four types of advisories are defined as follows:

⚠ DANGER

Hazard!

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Hazard!

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Hazard!

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury and unsafe practices.

NOTICE

Hazard!

Indicates a situation that could result in equipment or property-damage only accidents.

General Practices

⚠ DANGER

Hazard of Explosion!

Never apply heat to a sealed refrigeration system or container. Heat increases internal pressure, which might cause an explosion resulting in death or serious injury.

⚠ DANGER

Hazardous Gases - Personal Protective Equipment (PPE) Required!

Refrigerant in the presence of an open flame, spark, or electrical short produces toxic gases that are severe respiratory irritants which can cause serious injury or possible death. When working with or around hazardous chemicals, ALWAYS refer to appropriate Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

⚠ DANGER

Risk of Injury!

Keep your hands, clothing, and tools clear of fans and/or belts when working on a unit that is running or when opening or closing compressor service valves. Loose clothing might entangle moving pulleys or belts, causing serious injury or possible death.

⚠ DANGER

Refrigerant Vapor Hazard!

Do not inhale refrigerant. Use caution when working with refrigerant or a refrigeration system in any confined area with a limited air supply. Refrigerant displaces air and can cause oxygen depletion, resulting in suffocation and possible death. When working with or around hazardous chemicals, ALWAYS refer to appropriate Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

⚠ WARNING

Hazard of Explosion!

Never close the compressor discharge service valve when the unit is operating. Never operate the unit with the discharge valve closed (front seated). This condition increases internal pressure, which can cause an explosion.

⚠ WARNING

Proper Equipment Condition!

Gauge manifold hoses must be in good condition before using them. Never let them come in contact with moving belts, fans, pulleys or hot surfaces. Defective gauge equipment can damage components or cause serious injury.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Always wear goggles or safety glasses and proper PPE when working on a unit. Refrigerant liquid, oil, and battery acid can permanently damage your eyes. When working with or around hazardous chemicals, ALWAYS refer to appropriate Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

⚠ WARNING

Equipment Damage and Risk of Injury!

Never drill holes into the unit unless instructed by Thermo King. Holes drilled into high voltage cables could cause an electrical fire, severe personal injury, or even death.

⚠ WARNING

Risk of Injury!

When using ladders to install or service refrigeration systems, always observe the ladder manufacturer's safety labels and warnings. A work platform or scaffolding is the recommended method for installations and servicing.

⚠ CAUTION

Sharp Edges!

Exposed coil fins can cause lacerations. Service work on the evaporator or condenser coils should only be accomplished by a certified Thermo King technician.

NOTICE

Equipment Damage!

All unit mounting bolts must be installed, be the correct length for their application, and torqued to specifications. Missing bolts, incorrect bolt lengths and improper torque specifications can damage equipment and void the warranty.

Refrigerant Hazards

⚠ DANGER

Hazardous Pressures!

Always store refrigerant in proper containers, out of direct sunlight and away from intense heat. Heat increases pressure inside storage containers, which can cause them to burst and could result in severe personal injury.

⚠ DANGER

Combustible Hazard!

Do not use oxygen (O_2) or compressed air for leak testing. Oxygen mixed with refrigerant is combustible.

⚠ WARNING

Hazardous Gases!

Do not use a Halide torch. When a flame comes in contact with refrigerant, toxic gases are produced. These gases can cause suffocation, even death.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Refrigerant in a liquid state evaporates rapidly when exposed to the atmosphere, freezing anything it contacts. Wear butyl lined gloves and other clothing and eye wear when handling refrigerant to help prevent frostbite. When working with or around hazardous chemicals, ALWAYS refer to appropriate Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

NOTICE

Equipment Damage!

When being transferred, refrigerant must be in liquid state to avoid possible equipment damage.

Electrical Hazards

Electrical Precautions

- The possibility of serious or fatal injury from electrical shock exists when servicing a refrigeration unit. Extreme care must be used when working with a refrigeration unit that is connected to its power source.
- Extreme care must be used even if the unit is not running. Lethal voltage potentials can exist at the unit power cord, inside the control box, inside any high voltage junction box, at the motors and within the wiring harnesses.
- In general, disconnect the units power cord before repairing or changing any electrical components.
- Even though the controller is turned off, one of the phases is still live and represents a potential danger of electrocution.

High Voltage

⚠ DANGER

Hazardous Voltage!

Lethal amounts of voltage are present in some electrical circuits. Use extreme care when working on an operating refrigeration unit. If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other local, state, or country-specific requirements for arc flash protection PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASHING CLOTHING. ELECTRICAL METERS AND EQUIPMENT MUST BE PROPERLY RATED FOR INTENDED VOLTAGE.

⚠ WARNING

Hazardous Voltage!

Treat all wires and connections as if they were high voltage until a meter and wiring diagram indicate otherwise. Only use tools with insulated handles. Never hold uninsulated metal tools near exposed, energized conductors. If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other local, state, or country-specific requirements for arc flash protection PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASHING CLOTHING. ELECTRICAL METERS AND EQUIPMENT MUST BE PROPERLY RATED FOR INTENDED VOLTAGE.

⚠ WARNING

Hazardous Voltage!

Never work alone on high voltage circuits in the refrigeration unit. Another person should be nearby to shut off the unit and provide aid in the event of an accident. If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other local, state, or country-specific requirements for arc flash protection PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASHING CLOTHING. ELECTRICAL METERS AND EQUIPMENT MUST BE PROPERLY RATED FOR INTENDED VOLTAGE.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

In the event of an electrical accident, all required PPE should be near the work area in accordance with OSHA, NFPE 70E, or other local, state, or country-specific requirements for a Category 2 risk.

⚠ WARNING

Hazardous Voltage!

The unit On/Off switch must be turned Off before connecting or disconnecting the standby power plug. Never attempt to stop the unit by disconnecting the power plug.

⚠ WARNING

Risk of Injury!

The unit power plug must be clean and dry before connecting it to a power source.

⚠ WARNING

Risk of Injury!

Do not make rapid moves when working on high voltage circuits in refrigeration units. Do not grab for falling tools because you might accidentally touch a high voltage source.

Low Voltage

⚠ WARNING

Live Electrical Components!

Control circuits are low voltage (24 Vac and 12 Vdc). This voltage potential is not considered dangerous. Large amount of current available (over 30 amperes) can cause severe burns if shorted to ground. Do not wear jewelry, watch or rings. These items can shortcut electrical circuits and cause severe burns to the wearer.

Electrostatic Discharge Precautions

Precautions must be taken to prevent electrostatic discharge while servicing the microprocessor controller and related components. The risk of significant damage to the electronic components of the unit is possible if these precautionary measures are not followed. The primary risk potential results from the failure to wear adequate electrostatic discharge

preventive equipment when handling and servicing the controller. The second cause results from electric welding on the unit and container chassis without taking precautionary steps.

Electrostatic Discharge and the Controller

You must avoid electrostatic discharges when servicing the controller. Solid-state integrated circuit components can be severely damaged or destroyed with less than a small spark from a finger to metal object. You must rigidly adhere to the following statements when servicing these units. This will avoid controller damage or destruction.

- Disconnect all power to the unit.
- Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
- Do wear a static discharge wrist strap (refer to Tool Catalog) with the lead end connected to the controller's ground terminal. These straps are available at most electronic equipment distributors. *Do not* wear these straps with power applied to the unit.
- Avoid contacting the electronic components on the circuit boards of the unit being serviced.
- Leave the circuit boards in their static proof packing materials until ready for installation.
- Return a defective controller for repair in the same static protective packing materials from which the replacement component was removed.
- Check the wiring after servicing the unit for possible errors. Complete this task before restoring power.

Welding on Refrigeration Units or Containers

Electric welding can cause serious damage to electronic circuits when performed on any portion of the refrigeration unit, genset, container, or container chassis with the refrigeration unit attached. It is necessary to verify that welding currents are not allowed to flow through the electronic circuits of the unit. The procedures below MUST be strictly followed when servicing units to avoid damage or destruction of the microprocessor.

1. Disconnect the battery connections (if equipped) and lock out - tag out the unit according to local regulations.
2. Disconnect all power to or from the refrigeration unit or genset.
3. Disconnect all quick-disconnect wire harnesses from the back of the controller.
4. Disconnect all wire harnesses from the Remote Monitor Modem (RMM), if equipped.
5. Switch all of the electrical circuit breakers in the control box to the Off position.
6. When steps 1 through 5 are complete, weld the unit and/or container using normal welding procedures. Keep ground return electrode as close to the area to be welded as practical. This will reduce the likelihood of stray welding currents passing through any electrical or electronic circuits.
7. When welding is complete, restore the unit power cables, wiring, and circuit breakers to their normal condition.

First Aid

REFRIGERANT

- **Eyes:** For contact with liquid, immediately flush eyes with large amounts of water and get prompt medical attention.
- **Skin:** Flush area with large amounts of warm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection. Get prompt medical attention. Wash contaminated clothing before reuse.
- **Inhalation:** Move victim to fresh air and use Cardio Pulmonary Resuscitation (CPR) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.
- **Frost Bite:** In the event of frost bite , the objectives of First Aid are to protect the frozen area from further injury, warm the affected area rapidly, and to maintain respiration.

REFRIGERANT OIL

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention.
- **Skin:** Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.
- **Inhalation:** Move victim to fresh air and use Cardio Pulmonary Resuscitation (CPR) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.

- **Ingestion:** Do not induce vomiting. Immediately contact local poison control center or physician.

ENGINE COOLANT

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention.
- **Skin:** Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.
- **Ingestion:** Do not induce vomiting. Immediately contact local poison control center or physician.

BATTERY ACID

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention. Wash skin with soap and water.
- **INHALATION:** Provide fresh air. Rinse mouth and nose with water. Seek immediate medical assistance.
- **SKIN CONTACT:** Immediately remove contaminated clothing. Wash skin with large volumes of water, for at least 15 minutes. Wash skin with soap and water. Do not apply fatty compounds. Seek immediate medical assistance.
- **INGESTION:** If the injured person is fully conscious: make the person drink extensive amounts of milk. Do not induce vomiting. Take the injured person immediately to a hospital.

ELECTRICAL SHOCK

Take IMMEDIATE action after a person has received an electrical shock. Get quick medical assistance, if possible.

The source of the shock must be quickly stopped, by either shutting off the power or removing the victim. If the power cannot be shut off, the wire should be cut with an non-conductive tool, such as a wood-handle axe or thickly insulated cable cutters. Rescuers should wear insulated gloves and safety glasses, and avoid looking at wires being cut. The ensuing flash can cause burns and blindness.

If the victim must be removed from a live circuit, pull the victim away with a non-conductive material. Use wood, rope, a belt or coat to pull or push the victim away from the current. DO NOT TOUCH the victim. You will receive a shock from current flowing through the victim's body. After separating the victim from power source, immediately check for signs of a pulse and respiration. If no pulse is present, start Cardio Pulmonary Resuscitation (CPR). If a pulse is present, respiration might be restored by using mouth-to-mouth resuscitation. Call for emergency medical assistance.

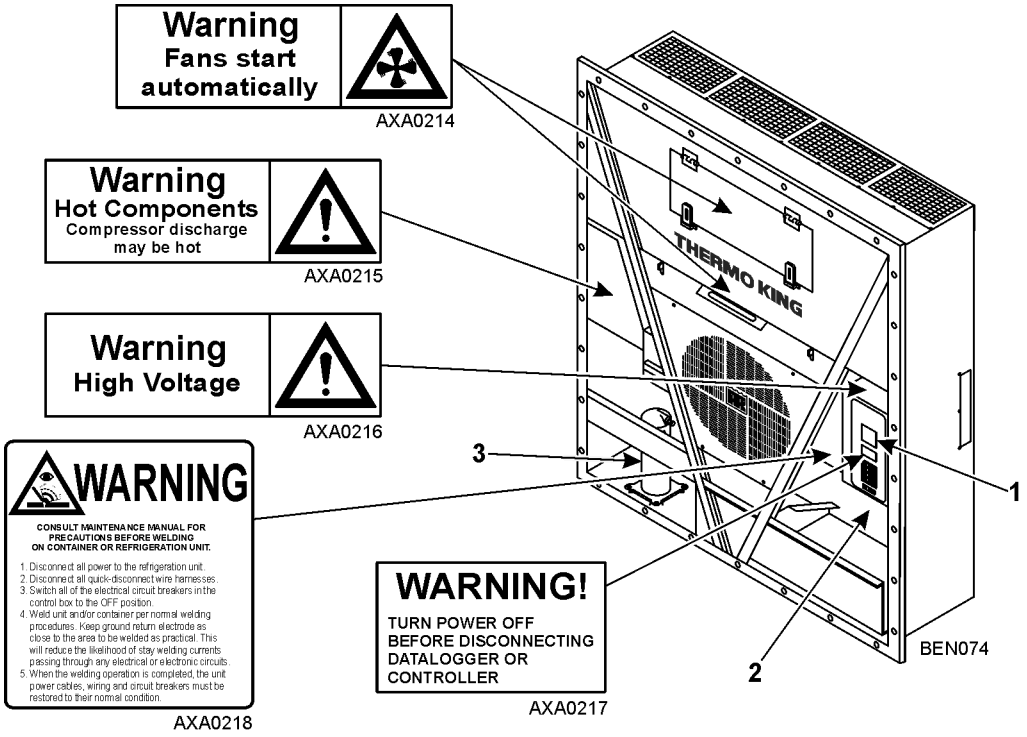
ASPHYXIATION

Move victim to fresh air and use Cardio Pulmonary Resuscitation (CPR) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.

Identifying Unit Safety and Warning Decals

Serial number decals, refrigerant type decals, and warning decals appear on all Thermo King® equipment. These decals provide information that may be needed to service or repair the unit. Service technicians should read and follow the instructions on all warning decals.

Figure 1. Nameplate and Warning Locations



1	Controller Nameplate
2	Unit Nameplate
3	Compressor Nameplate

Serial Number Location

Serial numbers can be found on the component's nameplate.

- Electric Motor: Attached to the motor housing.
- Compressor: On front of the compressor.
- Unit: On unit frame in power cord storage compartment.
- Controller: On top of controller.

Component Serial Number Identification

To better identify the different electronic components, our supplier has changed their serial number labeling on the MP4000 controller and power module. The label will show part number, date, and sequence.

MP4000 Controller: New label shows controller ID ABS782800212245390

Part number: ABS7828002; Date: 2012 24 wk 1224; Sequence 5390

ID in controller would show 1224-5390

Label on Controller

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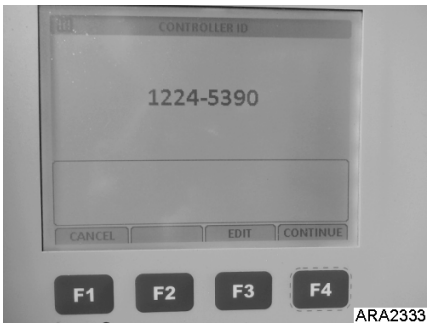
ID in Controller



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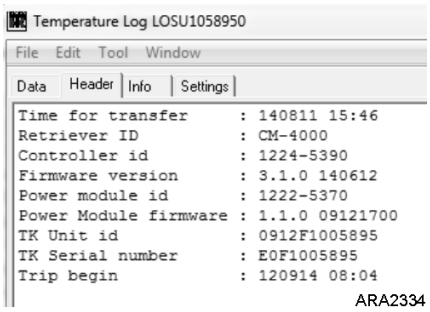
Controller ID Shown in Datalogger



ARA2334

Service Guide

A closely followed maintenance program will help to keep your Thermo King unit in top operating condition. The following table should be used as a guide when inspecting or servicing components on this unit.

Pretrip	Every 1,000 Hours	Annual/ Yearly	Inspect/Service These Items
			Electrical:
•			Perform a controller pretrip inspection (PTI) check.
•	•	•	Visually check condenser fan and evaporator fan.
•	•	•	Visually inspect electrical contacts for damage or loose connections.
•	•	•	Visually inspect wire harnesses for damage or loose connections.
	•	•	Download the data logger and check data for correct logging.
		•	Check operation of protection shutdown circuits.
			Refrigeration:
•	•	•	Check refrigerant charge.
	•	•	Check for proper discharge and suction pressures.
		•	Check filter drier/in-line filter for a restriction pressures.
			Structural:
•	•	•	Visually inspect unit for damaged, loose, or broken parts.
•	•	•	Tighten unit, compressor and fan motor mounting bolts.
	•	•	Clean entire unit including condenser and evaporator coils and defrost drains.
Note: *If a unit has been carrying cargo which contains a high level of sulphor or phosphorous (e.g., garlic, salted fish etc.), it is recommended to clean the evaporator coil after each trip.*			

Specifications

Full Cool Operation Net Cooling Capacity

Table 1. CRR DF Model - Air Cooled Condensing*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power				380V, 3 Phase, 50 Hz Power			
	Net Cooling Capacity			Power Consumption	Net Cooling Capacity			Power Consumption
	Watts Kcal/hr BTU/hr	Watts Kcal/hr BTU/hr	Watts Kcal/hr BTU/hr	kW @460V	Watts Kcal/hr BTU/hr	Watts Kcal/hr BTU/hr	Watts Kcal/hr BTU/hr	kW @380V
-30C (-22F)	8,250	7,094	28,175	16.3	7,112	6,115	24,289	13.6
**-70 C (-94 F)	3,744	3,219	12,786	9.6	3,228	2,775	11,023	7.7

*System net cooling capacity with a 37.8 C (100 F) ambient air temperature.

**Lowest possible set-point - provided Box Size is set to 10´ or 20´. -65C would be lowest possible set-point for Box Size 40´"

System Net Defrost Heating Capacity

Table 2. CRR DF Model - System Net Defrost Heating Capacity

Heater Type	460V, 3 Phase, 60 Hz Power			380V, 3 Phase, 50 Hz Power		
	Heating Capacity			Heating Capacity		
	Watts	Kcal/hr	BTU/hr	Watts	Kcal/hr	BTU/hr
Electric resistance rods	8,160	7,018	27,850	6,000	5,160	20,475

Evaporator Airflow

Table 3. CRR DF Model - Evaporator Airflow*

External Static Pressure (water column)	460V, 3 Phase, 60 Hz Power		380V, 3 Phase, 50 Hz Power	
	Low Speed		Low Speed	
	m3/hr	ft3/min	m3/hr	ft3/min
0 mm (0 in.)	3,700	1,835	2,900	1,708
10 mm (0.4 in.)	3,300	1,943	2,350	1,384
20 mm (0.8 in.)	2,800	1,649	1,750	1,031
30 mm (1.2 in.)	2,300	1,355	1,000	589

*22° pitch fan blades.

R-134a Refrigeration System

Table 4. CRR DF Model - R-134a Refrigeration System

Compressor Model No.	D3DST-075E-TFD, Semi-hermetic Reciprocating with Copeland Discus® Valve Design
Refrigerant Charge	3.5 Kg (7.7 lb) R-134a
Compressor Oil Capacity	4.6 liter (4.86 qt)*

Table 4. CRR DF Model - R-134a Refrigeration System (continued)

Compressor Oil Type	Polyol Ester Based Type (required), TK Part No. 203-433**
Typical System Pressures at 37.8 C (100 F) Ambient	
Standby (Unit Off, Empty Box): High Side	—
Low Side	—
-30 C (-22 F) Box, Unit Cooling: High Side	1500 to 1800 kPa, 15.0 to 18.0 bar, 218 to 261 psig
Low Side	60 to 90 kPa, 0.60 to 0.90 bar, 9 to 13 psig
-60 C (-76 F) Box, Unit Cooling: High Side	1380 to 1500 kPa, 13.8 to 15.0 bar, 200 to 218 psig
Low Side	20 to 50 kPa, 0.20 to 0.50 bar, 3 to 7 psig
High Pressure Cutout Switch	
Cutout	2410 ± 68kPa, 24.10 ± 0.68 bar, 350 ± 10 psig
Cutin	1640 ± 68kPa, 16.4 ± 0.68 bar, 238 ± 10 psig
Fusible Plug (High Pressure Relief) Relief Temp.	100 C (212 F)

R-23 Refrigeration System

Table 5. CRR DF Model - R-23 Refrigeration System

Compressor Model No.	ZM18K4E-TFD-N275, Hermetic Scroll
Refrigerant Charge Evacuated System **Add Partial Charge by Pressure**	3.2 Kg (7.05 lb) R-23 Charge to 1700 kPa, 17.00 bar, 247 psig
Compressor Oil Capacity	1.77 liter (60 oz.)*
Compressor Oil Type	Polyol Ester Based Type (required), TK Part No. 203-433**
Typical System Pressures at 37.8 C (100 F) Ambient Standby (Unit Off, Empty Box): High and Low Side	
0 C / 32 F 20 C / 68 F 38 C / 100 F	1600 kPa, 16.0 bar, 232 psig 1700 kPa, 17.0 bar, 2247 psig 1800 kPa, 18.0 bar, 261 psig
-30 C (-22 F) Box, Unit Cooling: High Side Low Side	2100 to 2300 kPa, 21.0 to 23.0 bar, 305 to 334 psig 250 to 280 kPa, 2.5 to 2.8 bar, 36 to 41 psig
-60 C (-76 F) Box, Unit Cooling: High Side Low Side	1400 to 1600 kPa, 14.0 to 16.0 bar, 203 to 232 psig 900 to 1100 kPa, 0.9 to 1.1 bar, 131 to 160 psig
High Pressure Cutout Switch	
Cutout Cutin	3250 ± 50 kPa, 32.5 ± 0.50 bar, 470 ± 7 psig 2590 ± 250 kPa, 25.90 ± 2.5 bar, 375 ± 38 psig
High Pressure Relief Valve	
Relief Pressure Reset	3447 +520/-104 kPa, 34.47 +5.20/-1.04 bar, 500 +75/-15 psig 2758 kPa, 27.58 bar, 400 psig

*When the compressor is removed from the unit, oil level should be noted or the oil removed from the compressor should be measured so that the same amount of oil can be maintained in the replacement compressor.
***Do not* use or add standard synthetic or mineral oils to the refrigeration system. If Ester based oil becomes contaminated with moisture or with standard oils, dispose of properly — *Do not use!*

Electrical System

Table 6. CRR DF Model - Electrical System

R-134a Circuit Compressor Motor:		
Type	Semi-hermetic Reciprocating	
Voltage	460/380V, 60/50 Hz, 3 Phase	
Kilowatts (60 Hz)	5.60 kW	
Horsepower (60 Hz)	7.5 hp	
RPM (60 Hz)	1750 rpm	
Full Load Amps	15.5 amps — 460V; 15.5 amps — 380V	
Locked Rotor Amps (60 Hz)	83 amps — 460V; 82 to 91 amps — 380V	
R-23 Circuit Compressor Motor:		
Type	Hermetic Scroll	
Voltage	460/380V, 60/50 Hz, 3 Phase	
Kilowatts (60 Hz)	4.48 kW	
Horsepower (60 Hz)	6.0 hp	
RPM (60 Hz)	3550 rpm	
Full Load Amps (60 Hz)	11 amps — 460V	
Locked Rotor Amps (60 Hz)	70 amps — 460V	
Condenser Fan Motor:		
Type	460/380V, 60/50 Hz, 3 Phase	460/380V, 60/50 Hz
Kilowatts (60 Hz)	1.5 kW	749 Watts
Horsepower (60 Hz)	2.0 hp	0.75 hp
RPM (60 Hz)	1725 rpm	1725 rpm
Full Load Amps (60 Hz)	3.1 amps — 460V	1.25 amps
Locked Rotor Amps (60 Hz)	25 amps — 460V	35.7 amps
Evaporator Fan Motors*:		
Type	460/380V, 60/50 Hz, 3 Phase	
Number	3	
Kilowatts (60 Hz) (Each)	0.75 kW	
Horsepower (60 Hz) (Each)	1.0 hp	
RPM (60 Hz) (Each)	3450 rpm, High Speed1725 rpm, Low Speed*	
Full Load Amps (60 Hz) (Each)	1.4 amps — 460V, High Speed0.5 amps — 460V, Low Speed	
Locked Rotor Amps (60 Hz)	10.3 amps — 460V, High Speed*2.9 amps — 460V, Low Speed*	
Electric Resistance Heater Rods:		
Type	460/380V, 60/50 Hz, 3 Phase	
Number	12	
Watts (60 Hz) (Each)	680 Watts	
Current Draw (Amps)	10 amps nominal (total) across each phase at the heater contactor	

Table 6. CRR DF Model - Electrical System (continued)

Control Circuit Voltage:	29 Vac @ 60 Hz; 24 Vac @ 50 Hz
Evaporator Overheat Switch:	
Opens	54 ±3 C (130 ±5 F)
Closes	38 ±4C (100 ±8 F)

*CRR DF applications operates the two-speed evaporator fan motors continuously on low speed. Evaporator fans stop during defrost.

Microprocessor Controller

Table 7. CRR DF Model - Microprocessor Controller

Temperature Controller:	
CRR-40 DF MP4000	MP4000 microprocessor
Description	MP4000 is a controller module for the Thermo King units. Additional requirements can be met by means of expansion modules. The MP4000 is solely responsible for temperature regulation of the reefer container, but other monitoring equipment can be used in conjunction with the MP4000, such as a chart recorder.
Setpoint Range	-65.0 to -10.0 C (-85.0 to +14.0 F)
Digital Temperature Display	-80.0 to +130.0 C (-112.0 to +266.0 F)
Controller Software (Original Equipment):	See controller identification decal
Defrost Initiation:	
Evaporator Coil Sensor Coil	Coil must be below 18 C (65 F) to initiate defrost by demand, timer or manual switch. -Manual Switch or Demand Defrost Initiation: Defrost cycle starts when technician or controller request defrost initiation. -Timed Defrost Initiation: Defrost cycle starts 1 minute after the hour immediately following a defrost timer request for defrost initiation. For example, if the defrost timer requests a defrost cycle at 7:35, the defrost cycle will start at 8:01. Datalogger will record a Defrost event for each interval in which a Defrost cycle is pending or active (i.e. both the 8:00 and 9:00 data logs).
Demand Defrost	Demand Defrost function initiates defrost when the temperature difference between the return air sensor and setpoint increases to a preset value and a minimum of 6 hours of compressor ON (running) time have elapsed since the previous defrost; indicating the presence of frost or ice
Defrost Timer: Frozen Mode	Initially every 12 hours of compressor operation. Then defrost interval increases 6 hours each time a timed defrost occurs without a demand defrost in between. Maximum time interval in frozen mode is 36 hours of compressor operation. Defrost timer resets if the unit is Off more than 12 hours or the setpoint is changed more than 5 C (9 F)
Defrost Termination:	
Evaporator Coil Sensor	Frozen mode: Terminates defrost when coil sensor temperature rises to 18 C (64 F) or exceeds 8 C (46 F) for 35 minutes above 440 volts and 45 minutes below 440 volts
Interval Timer	Terminates defrost 90 minutes after initiation if coil sensor has not terminated defrost (120 minutes if power supply is less than 55 Hz)
Time/Temperature Function	If the evaporator coil sensor exceeds 8 C (46 F) for 15 minutes, the controller terminates defrost
Power Off	Turning unit On/Off switch Off terminates defrost

Physical Specifications

Table 8. CRR DF Model - Physical Specifications

Base Unit Weight (net):	
CRR-40 DF MP4000	610 Kg (1344 lb)
Unit Dimensions:	
Width	2025.5 mm (79.75 in.)
Height	2235.2 mm (88.00 in.)
Depth	420.0 mm (16.54 in.) from back of flange

Compressor Torque — 3D Copeland Compressor Bolt Torque

Table 9. CRR DF Model - Compressor Torque

Bolt Usage	N.m	In.-lb.
Bottom Plate:		
Grade 5	45.2	400
Grade 8	59.3	525
Housing Cover	45.2	400
Oil Pump to Housing Cover	33.9	300
Bearing Cover to Housing Cover	33.9	300
Stator Cover:		
Grade 5	45.2	400
Grade 8	59.3	525
Cylinder Head	59.3	525
Oil Screen Cover	31.1	275
Crankcase Heater Plug	45.2	400
Discharge and Suction Valve:		
18 (5/16 in.)	25.4	225
13 (1/2 in.)	56.5	500
Pipe Plug:		
6.35 mm (0.25 in.)	33.9	300
3.175 mm (0.125 in.)	22.6	200
Oil Sight Glass:		
Grade 5	4.5	40
Grade 8	8.5	75
Terminal Plate	33.9	300
Nut on Top of Terminal Plate	5.1	45
Nut on Top of Jumper Bar	9.0	80

Metric Hardware Torque Charts

Bolt Type and Class*	Bolt Size			
	M6 N.m (Ft.-lb.)	M8 N.m (Ft.-lb.)	M10 N.m (Ft.-lb.)	M12 N.m (Ft.-lb.)
HH – CL 5.8	6-9 (4-7)	12-16 (9-12)	27-34 (20-25)	48-61 (35-40)
HH – CL 8.8	10-13 (7-10)	20-27 (15-20)	41-47 (30-35)	75-88 (55-65)
HH – CL 10.9	14-17 (10-13)	27-34 (20-25)	54-68 (40-50)	102-122 (75-90)
HH – CL 12.9	17-21 (12-16)	41-47 (30-35)	68-81 (50-60)	122-149 (90-110)
HH – SS (2)	10-13 (7-10)	20-27 (15-20)	41-47 (30-35)	75-88 (55-65)
*HH = Hex Head, CL = Class				

Bolt Type and Class*	Bolt Size			
	M14 N.m (Ft.-lb.)	M16 N.m (Ft.-lb.)	M18 N.m (Ft.-lb.)	M22 N.m (Ft.-lb.)
HH – CL 5.8	75-88 (55-65)	115-135 (85-100)	177-216 (130-160)	339-406 (250-300)
HH – CL 8.8	115-135 (85-100)	177-216 (130-160)	271-339 (200-250)	475-610 (350-450)
HH – CL 10.9	136-176 (100-130)	224-298 (180-220)	393-474 (290-350)	678-813 (500-600)
HH – CL 12.9	177-216 (130-160)	285-352 (210-260)	448-542 (330-400)	881-1016 (650-750)
HH – SS (2)	115-135 (85-100)	177-216 (130-160)	271-339 (200-250)	475-610 (350-450)
*HH = Hex Head, CL = Class				

Unit Description

General Description

Superfreezer Model CRR DF units are all-electric, single-piece, refrigeration units with bottom air supply. Each unit is designed for long distance, shipboard or overland transport of deep frozen or frozen cargoes. Each unit mounts in the front wall of the container. Fork lift pockets are provided for installation and removal of the unit.

The frame and bulkhead panels are constructed of aluminum and are treated to resist corrosion. A hinged, removable evaporator compartment door provides easy service access. All operating components except the evaporator coil and buffer receiver tanks can be replaced from the front of the unit.

The unit is equipped with an 18.3 m (60 ft) power cable for operation on 460-380V/3 Ph/60-50 Hz power. For operation on 460-380V/3 Ph/60-50 Hz power, plug the 460-380Vpower cable into the proper power supply.

Each unit is equipped with 460-380V/3 Ph/60-50 Hz electric motors. An automatic phase correction system provides the proper electrical phase sequence for condenser fan and evaporator fan motor operation. Unit power cable is stored below the control box in the condenser section.

CRR DF MP4000 units feature MP4000 microprocessor controller and a datalogger. Additional features include three evaporator fans; USDA Cold Treatment Temperature Recording; and a Remote Monitoring Modem (RMM). For additional unit feature information, see “CRR DF Model Features” on page v of the Introduction.

Cascade Refrigeration System

The CRR DF unit uses a basic cascade refrigeration system to achieve to frozen and deep frozen cargo temperatures between -10 C and -70 C (+14 F and -94 F). (-70 C is the Lowest possible set-point provided the Box Size is set to 10´ or 20´, -65C would be lowest possible set-point for Box Size of 40´). The CRR DF cascade refrigeration system design allows shippers to economically carry cargo at deep frozen temperatures using proven, reliable transport refrigeration system technology.

The CRR DF cascade systems consists of two separate, single-stage refrigeration systems with different refrigerants. One system is a low temperature stage system that uses a hermetic scroll compressor and R-23 refrigerant. The evaporator of the low temperature stage system cools the cargo air, achieving cargo temperatures down to -70 C (-76 F). (-70 C is the Lowest possible set-point provided the Box Size is set to 10´ or 20´, -65C would be lowest possible set-point for Box Size of 40´).

The second system is a high temperature stage system that uses a semi-hermetic reciprocating compressor and R-134a refrigerant. The evaporator of the high temperature stage system cools the condenser of the low temperature stage system through a special plate heat exchanger. The condenser of the high temperature stage system then transfers the cargo heat to the ambient air.

R-134a Semi-hermetic Reciprocating Compressor

The R-134a high temperature stage circuit features a semi-hermetic reciprocating compressor with forced feed lubrication system, ambient compensated internal overload protection and high temperature protection.

R-23 Hermetic Scroll Compressor

The R-23 low temperature stage circuit features a hermetic scroll compressor (one stationary and one orbiting member) with ambient compensated internal overload protection and high temperature protection.

Microprocessor Controller

The MP4000 is an advanced microprocessor controller that has been specially developed for the control and monitoring of refrigeration units. Refer to (“,”) for more detailed information.

Power Module Fuses

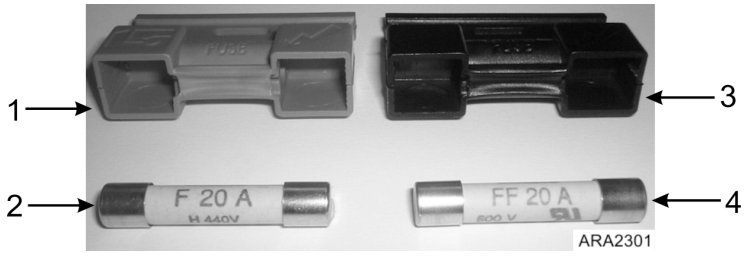
The PM-4000 Power Module in the unit uses Ultra Fast 20 amp fuses to protect the power module and are not interchangeable with the MP3000 MRB fuses. The fuses from the MP3000 MRB must never be used in the PM 4000 Power Module.

Part number for a PM 4000 Power Module fuse (FF 20 amp 500v and black fuse holder) is: P/N 419286 Fuse & Holder Blk MP4000.

Part number for the MP3000 MRB fuse (F 20 amp 500V and red fuse holder) is: P/N 419318 Fuse & Holder Red MP3000.

Fuse and fuse holder will be sold together as a kit. Individual fuse and holder part number for the MP3000 will supersedes to the kit number once inventory is used up.

Power Module Fuses



1	MP3000 MRB Red Holder
2	F 20 amp Fuse
3	PM 4000 Power Module Black Holder
4	FF 20 amp Fuse

Three Evaporator Fans

Three evaporator fans operate continuously to circulate air inside the container. Two-speed fans operate continuously on low speed for deep frozen and frozen cargo (setpoints of -10 C [+14 F] and below).

USDA Cold Treatment Temperature Recording

The datalogger includes provisions for the use of three USDA sensors. These sensors allow temperatures in various areas of the load to be monitored and recorded for United States Department of Agriculture use in monitoring Cold Treatment shipments. The USDA sensors record temperatures from -80.0 C to +10 C (-112.0 F to +50.0 F).

REFCON Remote Monitoring Modem (RMM)

A REFCON remote monitoring modem is provided to permit remote monitoring via the power cable. High speed transmission reads all controller information. Data can also be retrieved from the datalogger via high speed transmission.

Operating Modes

Note: *See Microprocessor Controller chapter for complete sequence of operation.*

A sequence start of the required loads occurs during initial start-up of the unit and when a control mode shift requires the compressors to start. As the controller relays and unit loads energize, the controller LCD display shows the setpoint temperature. The controller LED display shows the controlling (return) air sensor temperature.

Frozen Loads

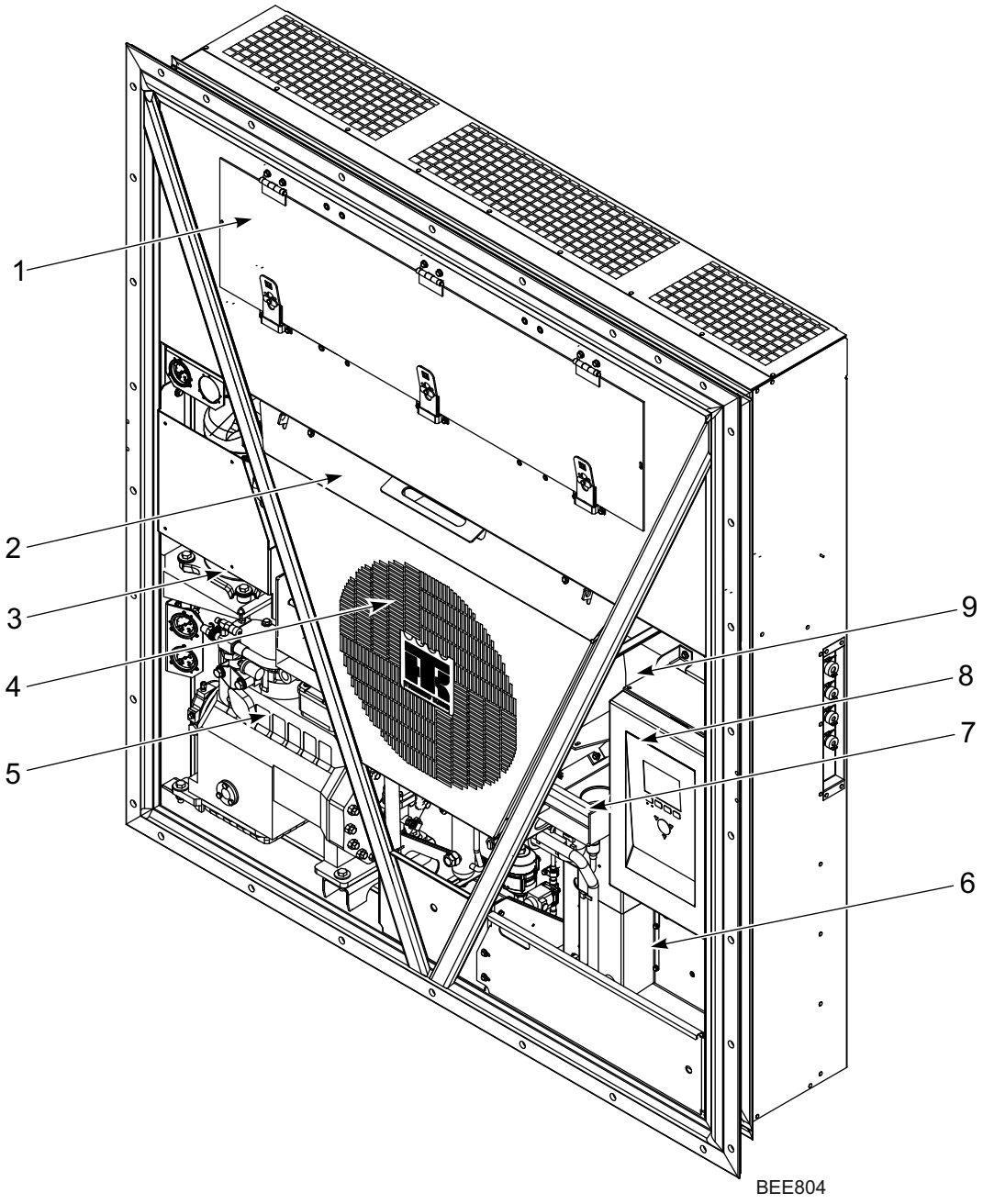
Temperature control by the controller is based on the return air sensor temperature. The evaporator fans operate continuously on low speed (except during defrost).

-
- Cooling until return air temperature decreases to 1 C (1.8 F) below setpoint. Minimum 6 minute compressor ON (running) time and 6 minute compressor OFF time prevents rapid cycling between Cool and Null modes.
- Null until return air temperature increases to 1 C (1.8 F) above setpoint. Both compressors and the condenser fan stop while the evaporator fans operate on low speed during the null mode.
- Defrost: Resistance heaters turn ON during defrost while the evaporator fans stop.

A Demand Defrost can be initiated by the controller when the temperature difference between the return air sensor and setpoint increases to a pre-set value and a minimum of 6 hours of compressor ON (running) time have elapsed since the previous defrost.

A Defrost Timer also initiates defrost every 12 hours. During extended unit operation, timed defrost intervals increase 6 hours each time a timed defrost occurs without a demand defrost in between. Maximum time interval is 36 hours. The Defrost Timer resets if the unit is OFF more than 12 hours or the setpoint is changed more than 5 C (9 F).

Figure 2. Unit Front View



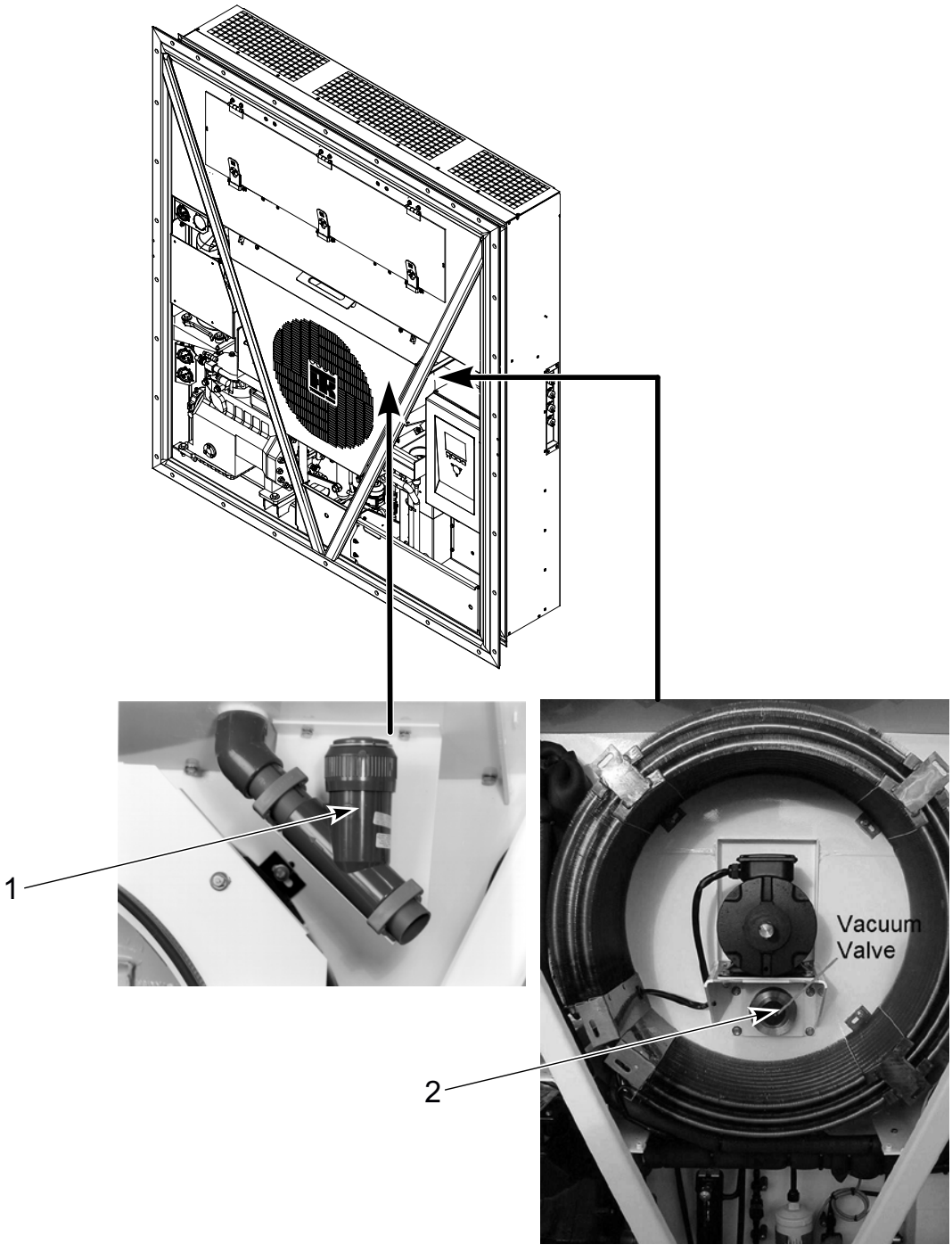
1.	Evaporator Access Door	6.	Power Cord Storage Compartment
2.	Heater Access Panel Location	7.	Supply Air Sensor Probe Holder
3.	Condenser Fan	8.	Control Box
4.	R-23 Compressor Compartment	9.	Vacuum Pressure Valve Location (for Box Ventilation)
5.	R-134a Compressor Compartment		

Figure 3. Evaporator Section — Front View

BEE714

1.	Evaporator Fan Blade	4.	Defrost (Evaporator Coil) Sensor Location
2.	Evaporator Fan Motor	5.	Return Air Sensor Probe Holder
3.	Evaporator Coil		

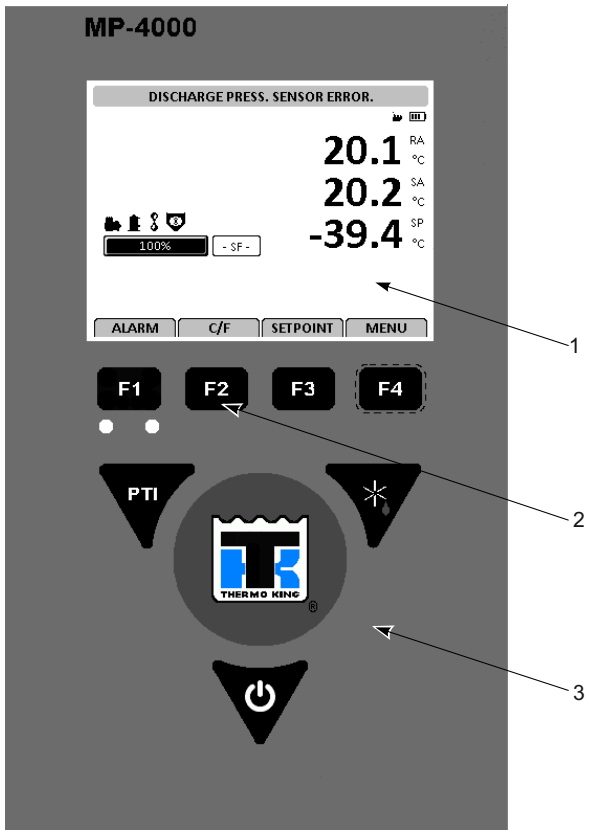
Figure 4. Vacuum Valve



BEE805

1.	Vacuum Valve (located behind condenser grille cover), earlier	2.	Vacuum Valve (located behind condenser grille cover), current

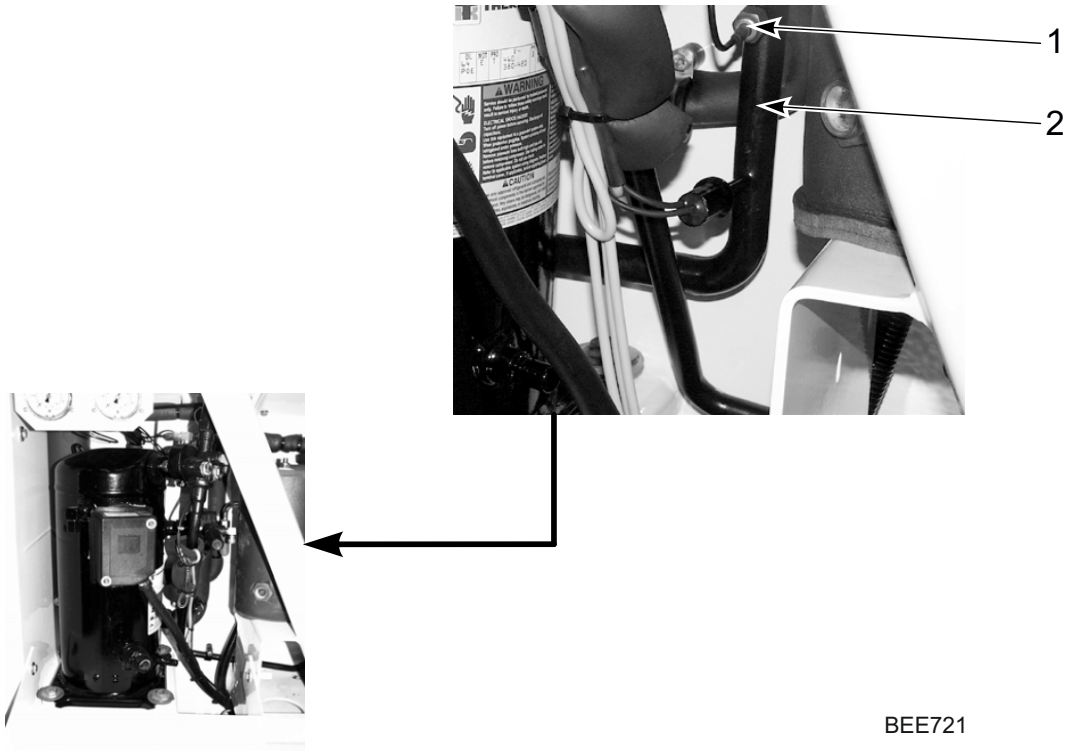
Figure 5. Control Box and Microprocessor Controller



BEE781

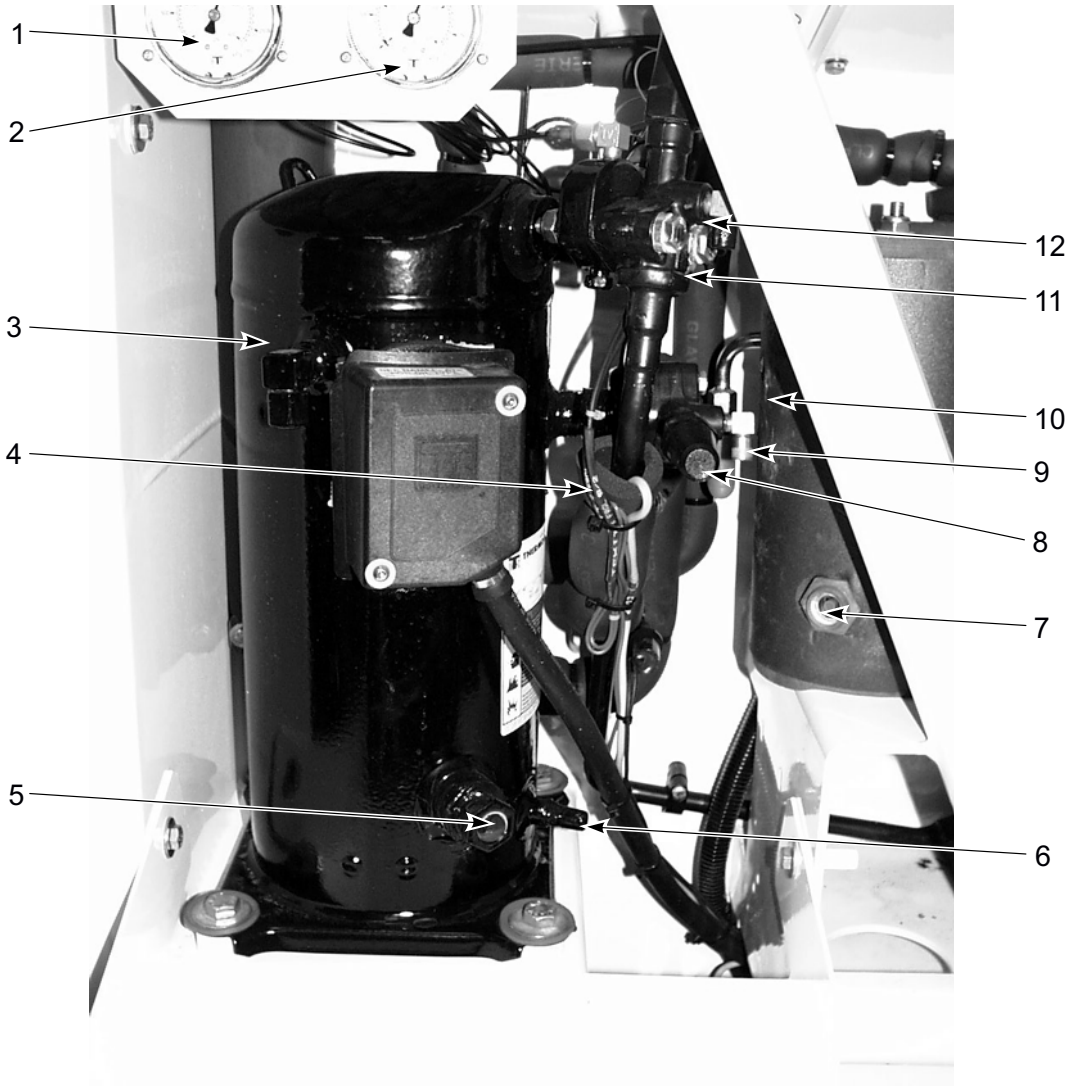
1.	Standard Display	3.	Special Function Keys
2.	Function Keys		

Figure 6. Refrigeration System



1.	R-23 Suction Pressure Gauge Line Connection	2.	R-23 Suction Line

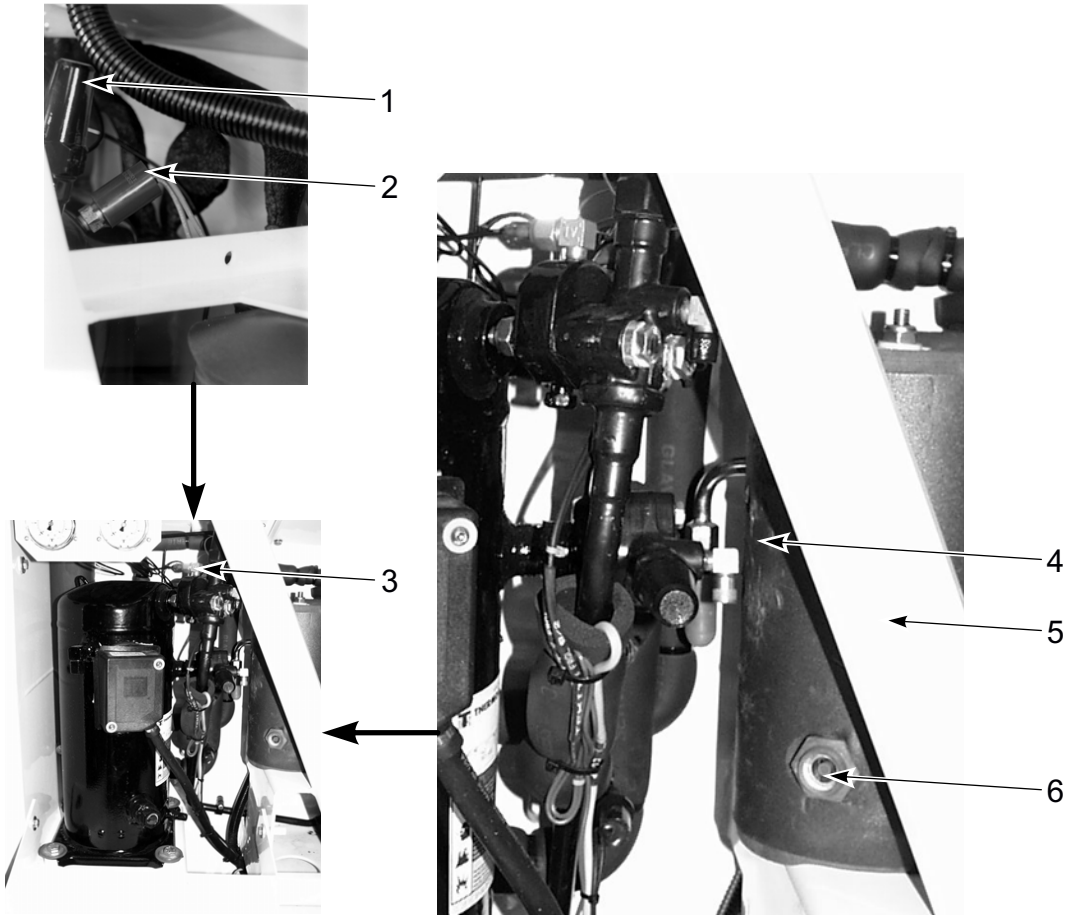
Figure 7. R-23 Compressor Compartment



BEE722

1.	R-23 Discharge Pressure Gauge	7.	R-23 Lower Receiver Tank Sight Glass
2.	R-23 Suction Pressure Gauge	8.	Suction Service Valve
3.	R-23 Scroll Compressor	9.	Suction Service Fitting
4.	Compressor Discharge Temperature Sensor	10.	R-23 Receiver Tank
5.	Compressor Oil Sight Glass	11.	Discharge Service Valve
6.	Oil Fill Fitting	12.	Discharge Service Fitting

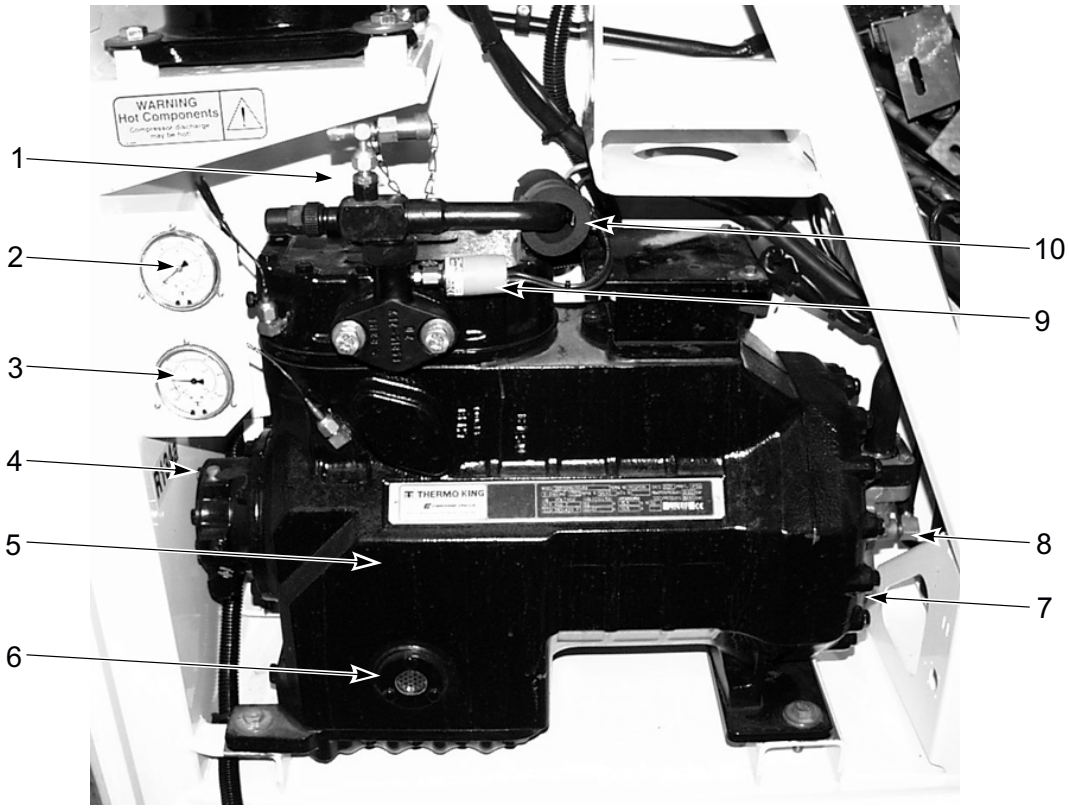
Figure 8. Additional R-23 Refrigeration System Components



BEE723

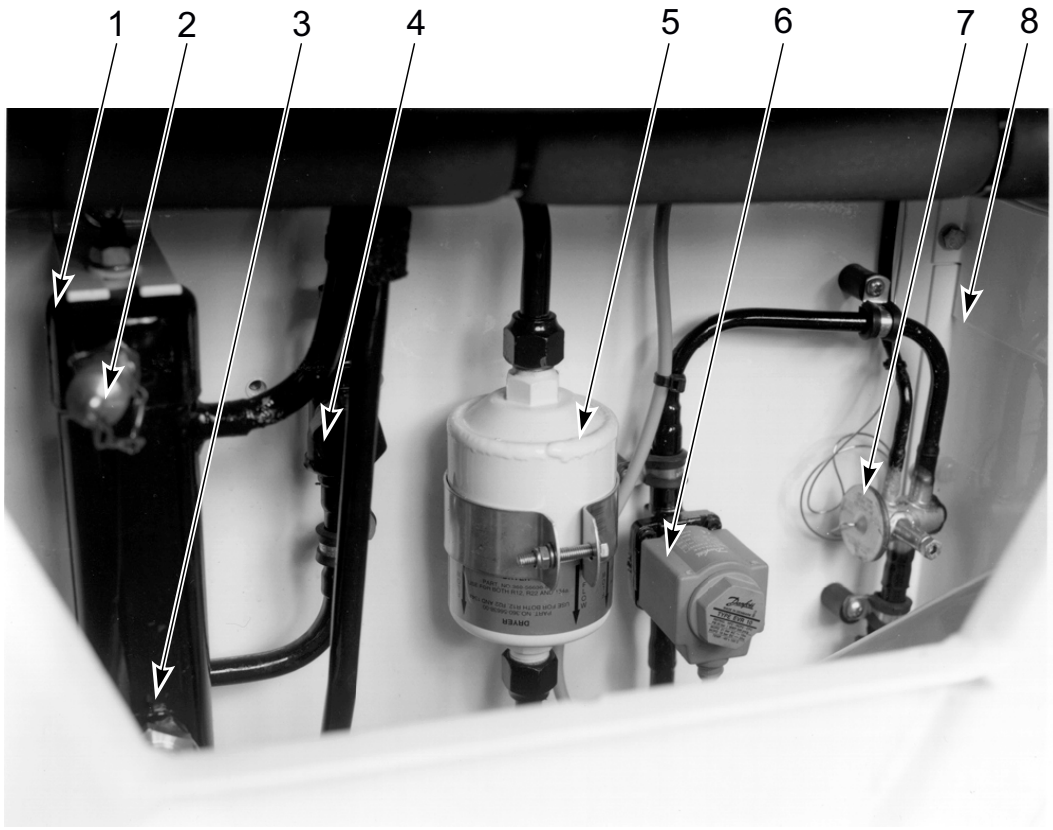
1.	R-23 Compressor Discharge Valve	4.	Receiver Tank
2.	R-23 High Pressure Cutout Switch	5.	Schrader Valve Service Fitting for R-23 Charging
3.	R-23 Expansion Valve	6.	Receiver Tank Sight Glass

Figure 9. R-134a Compressor Compartment



1.	Discharge Service Valve	6.	Compressor Oil Sight Glass
2.	R-134a Discharge Pressure Gauge	7.	Suction Service Valve
3.	R-134a Suction Pressure Gauge	8.	Suction Service Fitting
4.	Compressor Oil Fill Fitting	9.	R-134a High Pressure Cutout Switch
5.	R-134a Compressor	10.	Compressor Discharge Temperature Sensor

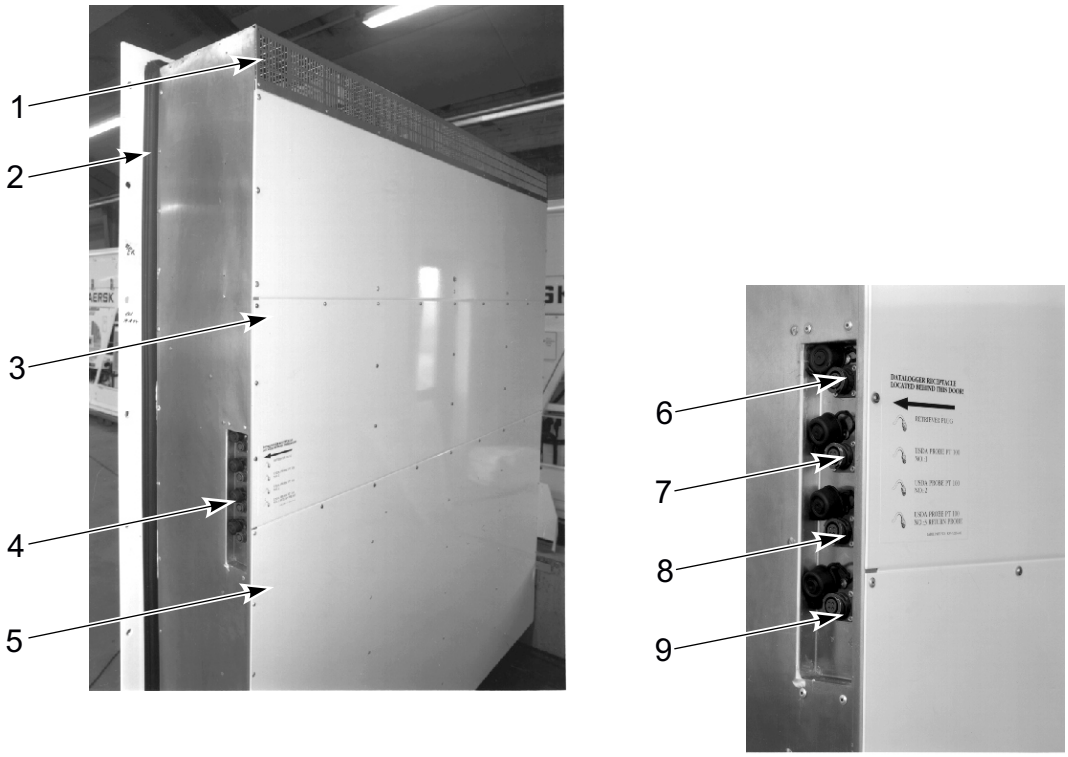
Figure 10. Additional R-134a Refrigeration System Components and Plate Heat Exchanger



BEE725

1.	R-134a Receiver Tank	5.	Dehydrator (Filter Drier)
2.	Receiver Tank Service Fitting	6.	Liquid Line Solenoid
3.	Receiver Tank Sight Glass	7.	R-134a Expansion Valve
4.	Liquid Line Ball (Service) Valve	8.	R-23/R-134a Plate Heat Exchanger (behind panel)

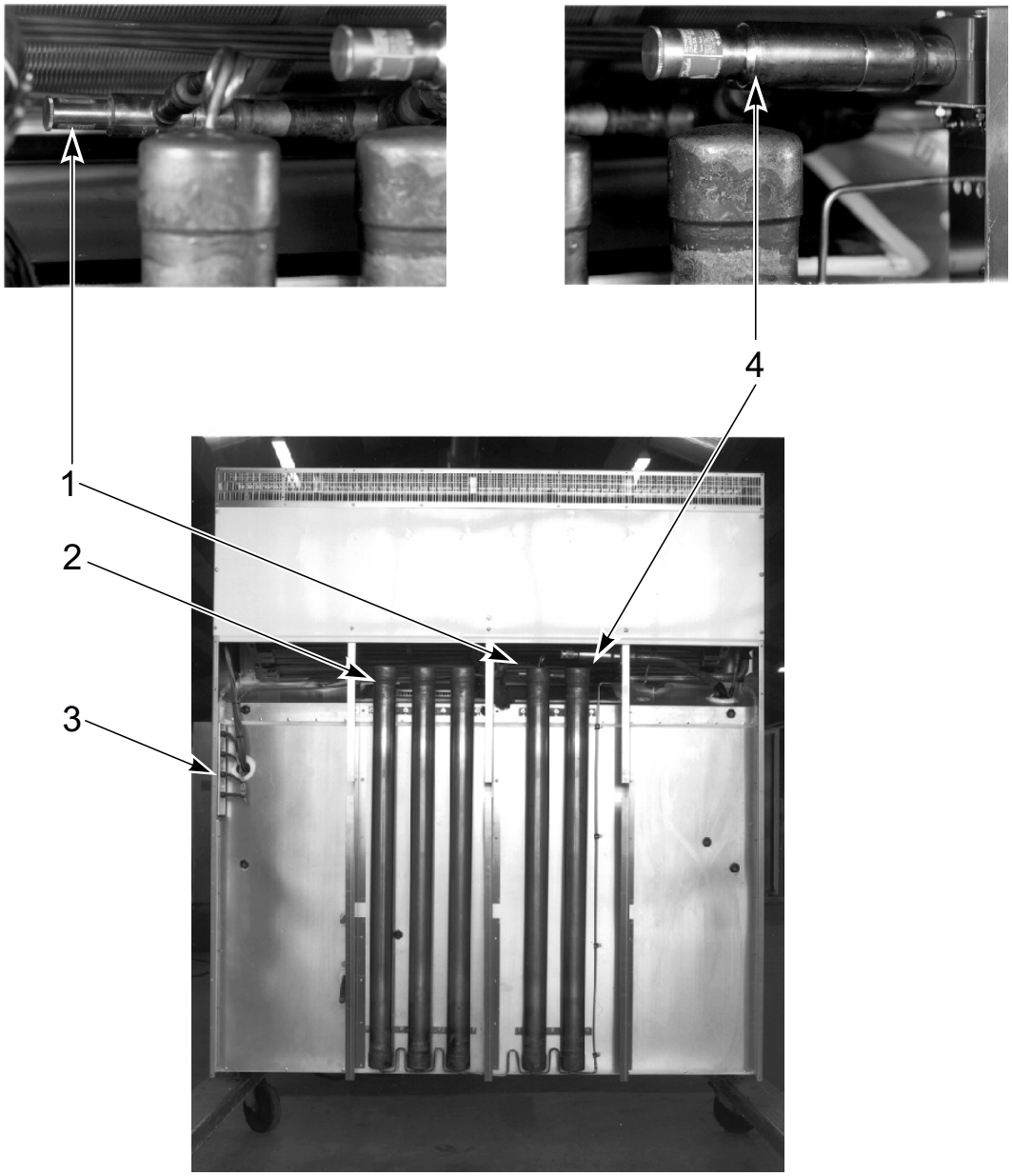
Figure 11. Unit Back View



BEE726

1.	Evaporator Grille	6.	Controller Communications and Data Retrieval Connection
2.	Unit Gasket	7.	USDA1 Sensor Connection
3.	Top Rear Plate	8.	USDA2 Sensor Connection
4.	Sensor Connector Assembly	9.	USDA3 Sensor Connection
5.	Bottom Rear Plate		

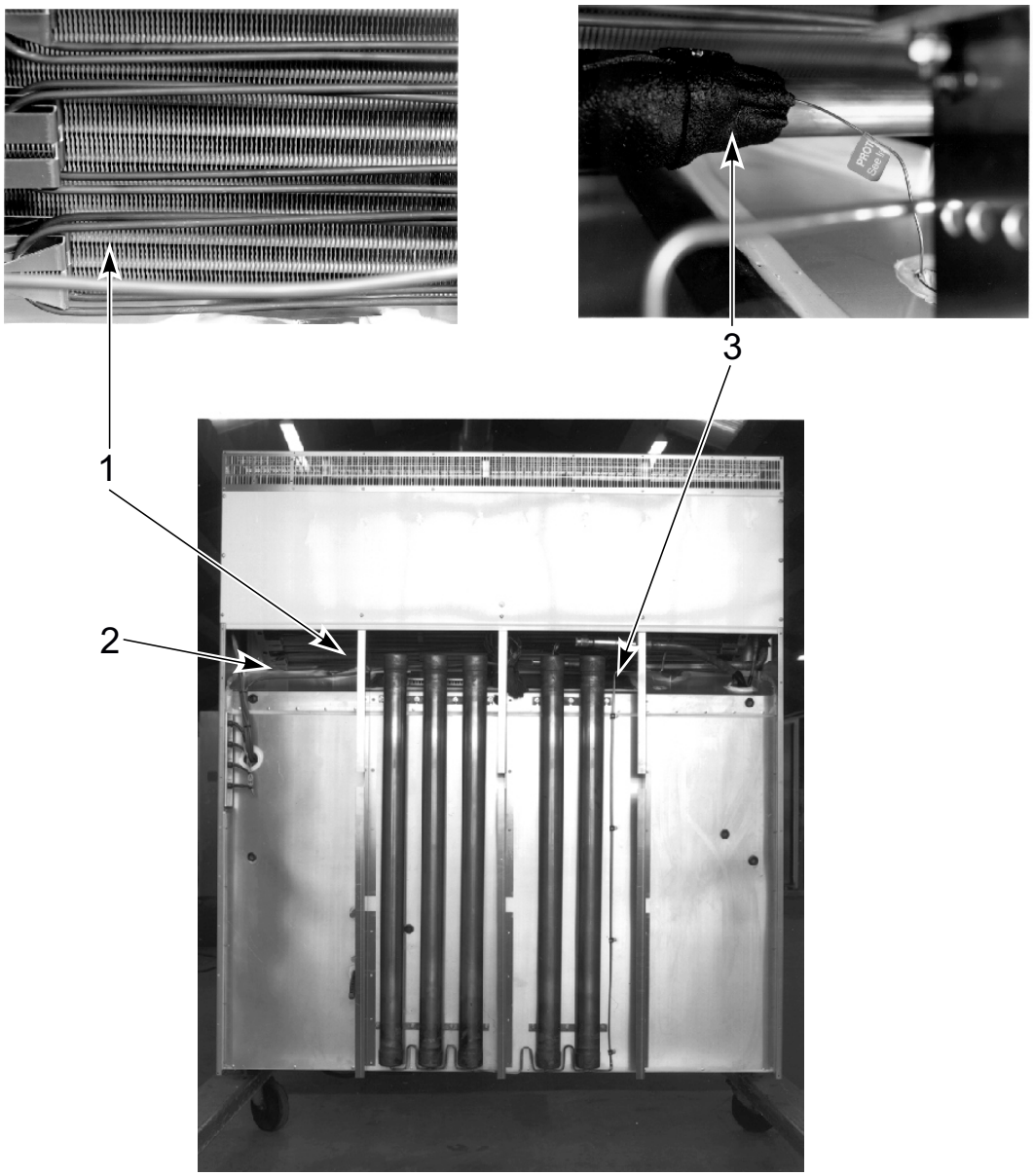
Figure 12. Unit Back View — Pressure Regulators and Buffer Tanks



BEE727

1.	Constant Pressure Regulator (R-23 System)	3.	Sensor Connector Assembly
2.	Buffer Receiver Tanks – 5 Total (R-23 System)	4.	Crankcase Pressure Regulator (R-23 System)

Figure 13. Unit Back View — Electric Heaters and Evaporator Coil



BEE728

1.	Electric Heaters	3.	Expansion Valve Feeler Bulb (R-23 System)
2.	Evaporator Coil (R-23 System)		

Unit Operation

Basic Unit Controls, Instruments and Protection Devices

MP4000 Controller

The MP4000 is an advanced microprocessor controller. It has been specially developed for the control and monitoring of refrigeration units. The controller contains the following basic features:

- Temperature/Message Status Display
  - Temperature area: Displays return air sensor, supply air sensor, and setpoint.
  - Message area: Displays alarms, message, and controller menu.
- Keypad
  - F1 - F4 Function keys navigate within the Status Display.
  - Two Status LED indicators.
  - Special function keys: ON/OFF, PTI, Defrost.

Back-up Battery

Every Controller has a Back-up Battery. This will allow the controller to be energized if the unit is not connected to shore power. The technician can change settings in the controller - Setpoint, etc.

Press the ON/OFF key, the controller will energize and stay energized for 25 sec, by pressing any of the Menu keys the 25 sec timer will reset to 20 sec.

R-134a Refrigeration System Controls, Instruments and Protection Devices

Compressor Discharge Line Temperature Sensor: The controller uses the compressor discharge line temperature sensor to protect the compressor from excessively high operating temperatures. If the discharge gas temperature rises above 148 C (298 F):

- Unit stops immediately; controller activates Alarm LED and records Alarm 146, Compressor 2 Temperature Too High.
- Controller will restart the unit when the sensor temperature is below 138 C (280 F).

High Pressure Cutout (HPCO) Switch: If the compressor discharge pressure rises above 2410 ± 68 kPa, 24.1 ± 0.68 bar, 350 ± 10 psig, the high pressure cutout opens to interrupt the ground circuit to the compressor contactor:

- R-134a compressor STOPS immediately.
- Evaporator and condenser fans continue normal operation.
- R-23 compressor stops.
- R-134a compressor will restart when the overload condition is corrected (switch closes) as long as power is available. The high pressure switch resets (closes) when the pressure drops to 1640 ± 68 kPa, 16.4 ± 0.68 bar, 238 ± 10 psig
- R-23 compressor will restart 30 seconds after R-134a compressor restarts.

Suction Pressure Gauge: A suction pressure gauge indicates the refrigerant pressure in the suction line returning to the compressor.

Discharge Pressure Gauge: A discharge pressure gauge indicates the refrigerant pressure in the discharge line leaving the compressor. Operating Instructions 49

Receiver Tank Sight Glass: A sight glass on the receiver tank contains three small balls that indicate the level of refrigerant in the tank for checking the refrigerant charge. A moisture indicator in the sight glass changes color to indicate the level of moisture in the system. Check the color of the indicator against the color decal in the sight glass. The dry eye in the sight glass is LIGHT GREEN when the system is dry and YELLOW when the system is wet (contains excessive moisture).

Fusible Plug For High Pressure Relief: A fusible plug is installed in the R-134a receiver tank to avoid excessive pressure build-up within the refrigeration system from extraordinary and unforeseen circumstances. The plug blows

when the plug temperature reaches 100 C (212 F). The plug is located so that refrigerant pressure expelled from the valve would be directed away from anyone servicing the unit. The plug is non-repairable and requires no adjustment. If the plug blows, recover the remaining refrigerant charge and replace the fusible plug.

Compressor Oil Sight Glass: A compressor oil sight glass indicates the relative level of compressor oil in the compressor sump.

R-23 Refrigeration System Controls, Instruments and Protection Devices

Compressor Discharge Line Temperature Sensor: The controller uses the compressor discharge line temperature sensor to protect the compressor from excessively high operating temperatures. If the discharge gas temperature rises above 148 C (298 F):

- Unit stops immediately; controller activates Alarm LED and records Alarm 56, Compressor Temperature Too High.
- Controller will restart the unit when the sensor temperature is below 138 C (280 F).

High Pressure Cutout (HPCO) Switch: If the compressor discharge pressure rises above 3250 ± 50 kPa, 32.5 ± 0.5 bar, 470 ± 7 psig, the high pressure cutout opens to interrupt the ground circuit to the compressor contactor:

- R-23 compressor STOPS immediately.
- Evaporator and condenser fans and R-134a compressor continue normal operation.
- R-23 compressor will restart when the overload condition is corrected (switch closes) as long as power is available. The high pressure switch resets (closes) when the pressure drops to 2590 ± 250 kPa, 25.9 ± 2.5 bar, 375 ± 38 psig.

Discharge Pressure Gauge: A discharge pressure gauge indicates the refrigerant pressure in the discharge line leaving the compressor.

Receiver Tank Sight Glass: Two sight glasses on the R-23 receiver tank contains three small balls that indicate the level of refrigerant in the tank for checking the refrigerant charge. A moisture indicator in the sight glass changes color to indicate the level of moisture in the system. Check the color of the indicator against the color decal in the sight glass. The dry eye in the sight glass is LIGHT GREEN when the system is dry and YELLOW when the system is wet (contains excessive moisture).

Compressor Oil Sight Glass: A compressor oil sight glass indicates the relative level of compressor oil in the compressor sump.

High Pressure Relief Valve: A high pressure relief valve is installed in the receiver tank. The relief valve protects against excessive pressure build-up within the refrigeration system from extraordinary and unforeseen circumstances. The valve is a spring-loaded piston that lifts when refrigerant pressure exceeds 3447 +520/-104 kPa, 34.47 +5.20/-1.04 bar, 500 +75/-15 psig. The valve is located so that refrigerant pressure expelled from the valve would be directed away from anyone servicing the unit. The valve will reset when this pressure drops to 2758 kPa, 27.58 bar, 400 psig. The valve is non-repairable and requires no adjustment. If the valve fails to reseat properly, recover the refrigerant charge and replace the valve.

Note: *Use only Lower R-23 sight glass to check or add refrigerant on unit unable to maintain -50 to -70 setpoint.*

Power Selection

⚠ CAUTION

Risk of Injury!

Power supply connections from the unit to the power source should always be made with the refrigeration unit On/Off key and the power supply On/Off key in the OFF position. Never attempt to start or stop the refrigeration unit using the power cord.

The refrigeration unit is designed to operate on 460/380V, 3 Phase, 60-50 Hz electric power from a 4-wire power source.

- To operate the refrigeration unit on 460/380V power, plug the 460/380V power cord into the proper power source.

Pre-load Operation

Pre-Trip Conditions

To properly perform a Full Pretrip Test, the following conditions must exist:

Pre-Trip Checks

1. With unit connected to the proper power supply, turn the power supply On/Off switch to ON.
2. Switch refrigeration unit On/Off key to ON position. A sequence start of the required loads occursduring initial start-up on cooling:

- Controller senses the incoming power phase and selects the correct power phase to unit components.
- Evaporator fan motors start and operate on low speed.
- R-134a compressor and condenser fan then start and the liquid line solenoid energizes (opens).
- R-23 compressor starts 30 seconds later.

Note: *If one or both compressors fail to start, turn the On/Off key OFF. Then repeat steps 1 and 2. If the unit still does not start, refer to "Alarm Codes, Descriptions and Corrective Actions" in the Microprocessor Controller chapter of this manual. Be sure to wait up to 1 minute for both compressors to start.*

3. Adjust controller setpoint to the desired temperature:

Note: *The setpoint temperature can be set between -10 C and -70 C (14 F and -94 F) in either F or C using the C/F key. Just press and hold the F/C key (to display the alternate temperature scale).*

- Press SETPOINT key to display cursor flashing in the "TEMP SETP" line.
- Press F3 key to enter new setpoint.
- With correct setpoint in display, press and hold F4. Controller places new setpoint in controller memory and shows new setpoint in LCD display.

Note: *New setpoint must be between -10 C and -70 C (14 F and -94 F) or controller will return to the previous setpoint display.*

Note: *If the F4 key is not pressed within 30 seconds, the controller will default (return) to the previous setpoint. If this occurs, repeat step 3.*

4. Check the direction of the condenser airflow (see "Condenser Fan and Evaporator Fan Rotation" in the Electrical Maintenance chapter of this manual).
5. Check direction of evaporator airflow (see "Condenser Fan and Evaporator Fan Rotation" in Electrical Maintenance chapter of this manual).
6. Allow the unit to operate one-half hour before loading. This will remove residual container heat and moisture, and pre-cool the container interior.
7. Perform a Pretrip (PTI) Test and check unit modes while the unit pre-cools:

⚠ CAUTION

Service procedure!

The PTI test should only be performed on an empty container!

Note: *Correct all existing alarm conditions and clear the alarm codes before performing a PTI test. The controller will automatically clear all existing alarms before beginning the PTI test.*

- Press PTI key to enter PTI menu.
- Select PTI.
- Press F4 to start the PTI (Pretrip) Test.
- The controller then performs the Pretrip Test.
- Observe the unit for proper operation and functions during pretrip test.
- LCD display shows PTI Test currently being performed. PTI test ends automatically. Press any key on the controller to return the unit to normal operation.
- If an operating problem occurs during the Pretrip Test, the Alarm LED will turn ON and FLASH. An "E" may also appear in the right side of the LED display. View and correct any alarm conditions. Then clear (acknowledge) the Alarm Code(s) and repeat the PTI Test.

Note: *Clear the Alarm codes ONLY after the alarm codes are documented and problems repaired. A permanent record of the alarm codes remains stored in the datalogger memory for retrieval via DRU-II or SmartSponge handheld data retriever.*

8. top the unit by moving the On/Off key to the OFF position.

Loading Procedure

1. Make sure the Unit On/Off key is OFF before opening the container doors. (The unit may be operating when loading the container from a warehouse with door seals.)
2. Spot check and record load temperature while loading. Especially note any off-temperature product.

Post Load Procedure

1. Make sure all doors are closed and locked.
2. Switch the Unit On/Off key to ON position.
3. Adjust controller setpoint to the desired temperature:

Note: *The setpoint temperature can be set between -10 C and -70 C (14 F and -94 F) in either F or C using the C/F key. Just press and hold the F/C key (to display the alternate temperature scale).*

Note: *New setpoint must be between -10 C and -70 C (14 F and -94 F) or controller will return to the previous setpoint display.*

Note: *If the F4 key is not pressed within 30 seconds, the controller will default (return) to the previous setpoint. If this occurs, repeat step 3.*

4. One-half hour after loading, initiate a manual defrost cycle:

- Press the DEFROST key.Select "Start DEFROST" and press F4 key. The unit enters in Defrost. Defrost will stop automatically.

Note: *The evaporator coil temperature must be below 18 C (64 F) to allow the unit the enter a defrost cycle. If the evaporator coil temperature is too high, the LCD display will read "Defrost Not Activated".*

Starting the Unit on Ship

⚠ CAUTION

Risk of Injury!

Power supply connections from the unit to the power source should always be made with the refrigeration unit On/Off key and the power supply On/Off key in the OFF position. Never attempt to start or stop the refrigeration unit using the power cord.

1. Connect the unit power cord to proper power source:

- 460/380V power cord to 460/380V, 60-50 Hz power source.
- Turn the power supply On/Off key ON.

2. Turn the unit On/Off key to ON position. Check for condenser fan and evaporator fan motor operation (see "Condenser Fan and Evaporator Fan Rotation" in the Electrical Maintenance chapter of this manual). If the unit was properly pretripped, correct condenser fan rotation will also indicate correct evaporator fan rotation.
3. Check the controller setpoint to make sure it is correct (agrees with shipping manifest).

Operating Instructions MP4000

Function Keys

Function Keys

1	PTI - Pre-trip Inspection
2	Defrost Key
3	ON/OFF Key
F1	Alarm Key
F2	C/F Key
F3	Setpoint Key
F4	Menu Key

Unit On/Off Key

ON - Unit will operate on Cool or Heat depending on the controller setpoint temperature and the container air temperature.

OFF - The unit will not operate.

Sequence of Operation

Unit Start-up

1. Connect unit to 460 Volt shore power or genset.
2. Turn circuit breaker on at post to apply power to unit. Display will show date and software revision.
3. Press and Hold ON/OFF key for two seconds.
   - Display shows RA, SA, SP
   - PM 4000 Setup
   - Power Module Init
   - Power Module Phase test - Shows heater icon
   - Power module Ready
   - Stop Plant

Note: *Random time delays during the initial unit start-up minimize peak current draw.*

Initiating a Manual Defrost

1. Turn the UNIT ON. Allow Unit to start and stabilize. Complete the following steps:
2. Press the Defrost Special Function key.
   - If the unit operating conditions allow a manual defrost (e.g., evaporator coil temperature is less than 18 C [64 F]), the unit enters Defrost.
3. The defrost cycle automatically terminates and returns the unit to normal operation.

Pretrip Inspection (PTI)

Turn the Unit ON. Allow Unit to start and stabilize. Complete the following steps:

1. Press the PTI Special Function key.
2. Press the F2/F3 keys to scroll down to select from the different PTI test.
3. Press the F4 key to ACCEPT and start the PTI or test.

   During testing the screen is divided into 3 sections.

   Section 1:

   - Shows the list of tests to be performed and their state.
   - List of possible states.
   - Awaiting: the test has not yet been performed.
   - Testing: the test is ongoing.
   - Pass: the test has been tested, with the result Pass.
   - Fail: the test has been tested, with the result Fail.
   - Skipped: the test is skipped, based on conditions.

   Section 2: Additional information, to explain the test, is shown together with a indication of the time frame.

   Section 3: This section displays actual readings and the expected power consumption.
4. Press the F2/F3 keys to scroll between each of the tests.
5. PTI test ends automatically. Pressing F1 (Exit) will not stop the PTI, but will allow the user to view and scroll through other menu's.Once the PTI is finished you will need to exit the PTI menu for the unit to go back to normal operation.

Note: *Detailed PTI test results are stored in the MP4000 Datalogger for later viewing. Any alarm codes recorded during the test can be viewed through the controller's Alarm List menu at the end of the test.*

Lock Padlock

If PADLOCK is active, the technician must enter the correct key (number) to unlock the display. PADLOCK OPTION must be selected ON under the CONFIGURATION/UNIT SETTING for it to be active or visible.

Controller Back-up Battery

Every controller has a back-up battery. This will allow the controller to be energized if the unit is not connected to shore power. The technician can change settings in the controller (e.g., Setpoint etc.). Press the ON/OFF key, the controller will energize and stay energized for 25 seconds. By pressing any of the Menu keys the 25 second timer will reset to 20 seconds.

Controller Lockup Issue

Some MP4000 controllers with 2.5.4.0 software are not restarting while changing power sources without turning the unit off. If a controller is found with no display and unit not running, follow this procedure.

1. Unplug the unit or turn OFF the main circuit breaker in the control box.
2. Disconnect the battery found on the back side of the controller.
3. Wait 30 seconds then plug in the battery.
4. Plug in unit or turn the main CB back ON.
5. Turn unit ON by pressing the ON key.
6. Controller will now restart.

Install MP4000 software (3.1.0.0 or later) in the controller before releasing unit. If the unit has 2.5.4.0 software or older, install 3.0.0.0 software before loading 3.1.0.0.

Note: *The latest software can be found on the Thermoking.com website under iService/Global Marine Solution Info Central/Software Updates/MP4000/CM4000 Load to SD Card.zip. Download the zip file to your computer to unzip it, DO NOT unzip from the website.*

In order to load version 3.1.0.0 or later software, the MP4000 controller needs to have 3.0.0.0 software installed first. Load to SD Card file contains both 3.0.0.0 and 3.1.0.0 or later software.

If the controller has 3.0.0.0 software installed, insert SD card to load 3.1.0.0 or later software.

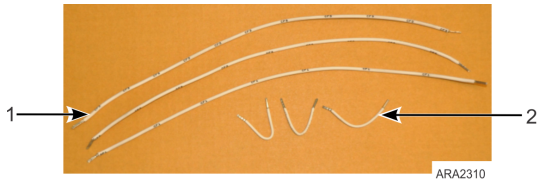
If the controller has 2.5.4.0 or older software, insert SD to load 3.0.0.0 software. Remove SD card and wait for the unit to shut down, restart, and auto configuration is completed. Reinsert SD card to load 3.1.0.0 or later software.

Emergency Run Mode

Use this procedure to run the unit in emergency mode if the Control Module (CM) or Power Module (PM) are found to be defective while under load and no replacement parts are available.

Rotation Check

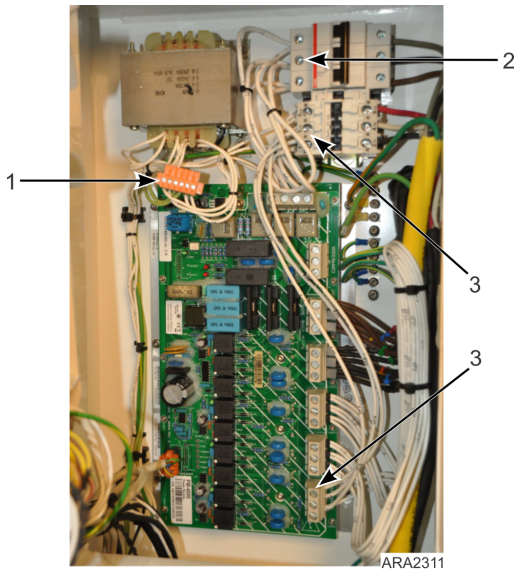
1. Unplug unit and turn OFF the main circuit breaker (CB) located in the controller box.
2. Remove compressor wires CP1, CP2, and CP3 from J5 on the PM and connect them to the output side (left side) of the main CB. Refer to Rotation Check as shown below.
3. Make up 3 16 GA (2 mm) jumper wires 16" long (400 mm), mark them CF1, CF2, CF3. Connect the wires from J11 terminal on the PM and connect the other end to the input (left side) of the compressor contactor. Verify to maintain the wiring 1-1, 2-2, 3-3. Refer to Rotation Check as shown below.



1	3 CF Wires 16 GA 16 in. long (400 mm)
2	3 Wires 18 GA 3 in. long (75 mm)

4. Locate J1 connector at top left side of PM and disconnect.

Rotation Check



1	J1 Connector Disconnect from PM
2	CP Wires Connected to Output Side of Main CB
3	CF Wires Connected at J11 and Input Side of Compressor Contactor

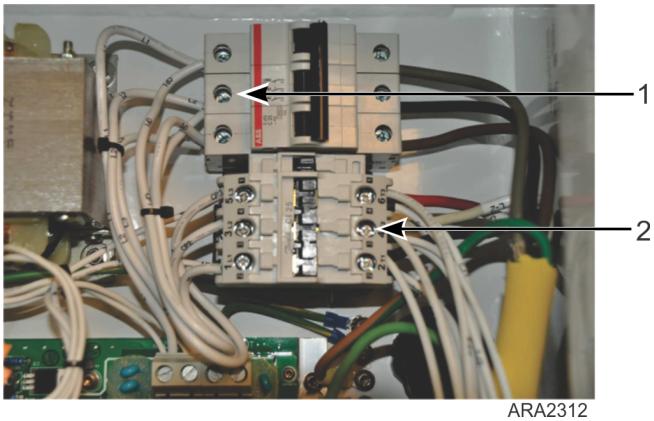
5. Plug unit in and turn CB ON. Observe the condenser fan rotation to be correct, air out of condenser grille, CCW. If wrong, turn CB OFF and unplug unit. Swap 2 of the CP wires and recheck for correct fan rotation.

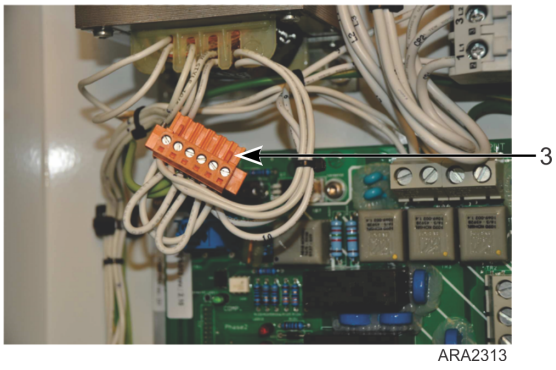
FULL COOL Mode

1. Unplug unit and turn off the CB located in the controller box.

2. Remove the Condenser Motor wires CF1, CF2, and CF3 from the input side of the compressor contactor, installed during the Rotation Check. Re-tighten input wires.
3. Remove the Low Speed Evaporator wires EF1, EF2, and EF3 from J10 on the PM.
4. Connect the CF and EF wires to the output side (right side) of the compressor contactor. Verify to maintain wiring 1-1 2-2 3-3. Refer to Rotation Check as shown above.
5. Locate J1 connector top left side of PM. Disconnect J1 connector from the PM. Install 3 18 GA 3" long jumper wires on the J1 connector. Leave J1 disconnected during cool mode. Refer to Rotation Check as shown above.
   a. Pin 1 (wire 29VAC 0) to pin 6 (wire CC1).
   b. Pin 2 (wire 29VAC 1) to pin 3 (wire HPCO-0).
   c. Pin 4 (wire HPCO-1) to pin 5 (wire CC0).
6. Emergency Run Mode for R134a Compressor:
   a. Remove CC3 wire from Pin 3 J9 (Controller Board) and connect to PIN 1 J1 (Power Module).
   b. Remove CC2 wire from PIN 4 J9 (Controller Board) and connect to PIN 2 J1 (Power Module).
7. Plug unit into, turn main CB ON and OFF to maintain box temperature. If compressor runs backward but the fans run correct, swap the Red and White wires on the output side of the compressor contactor.

If unit is running in high ambient with high box temperature, monitor compressor amperage using a amp probe. Maintain <12 amp by closing suction service to limit capacity.

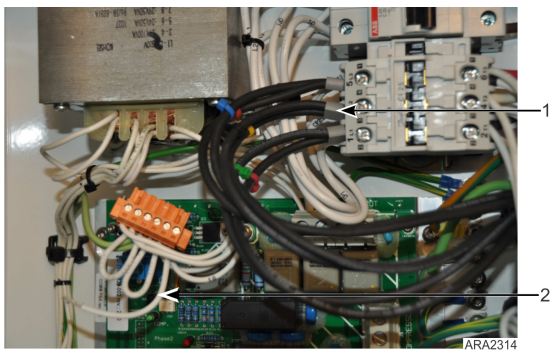




1	CP Wires Connected to Output Side of Main CB	3	J1 Connector Disconnect from PM
2	CF and EF Wires Connected to Output of Compressor Contactor		

DEFROST Mode

1. Unplug unit and turn main CB OFF located in the control box.
2. Locate J1 connector disconnected in the FULL Cool mode. Disconnect the jumper wire from pin 1 to pin 6.



1	Black Heater Wire Connected to Compressor Contactor Input Side
2	J1 Connector with Pin 1 Wire Disconnected

3. Disconnect CC3 wire from PIN 1 J1 (Power Module).
4. Disconnect wires from J7 on the PM and connect them to the input side (left side) of the compressor contactor.
5. Plug unit in and turn main CB ON to defrost coil and OFF once no water is flowing from drains.

   Important: *DO NOT LEAVE THE HEATERS ON FOR MORE THAN ONE HOUR. When running a unit in Defrost mode, DO NOT leave unit unattended.*
6. To return to the FULL COOL mode, turn main CB OFF and unplug the unit. Remove the heater wires from the compressor contactor and re-tighten the input wires. Reinstall the jumper wire on J1 connector pin 1 to pin 6.

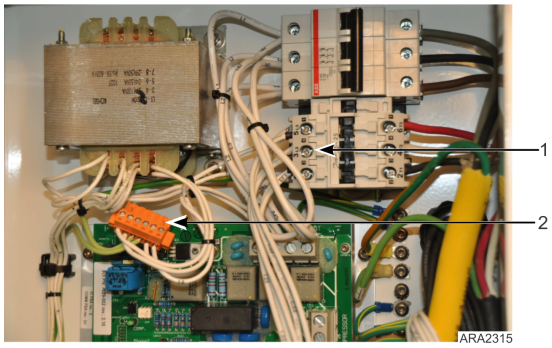
Low Speed Fans Only

NOTICE

Cargo Loss!

Running the unit with evaporator fans only will add heat to the box, do not leave unit unattended.

1. Unplug unit and turn main CB OFF located in the control box. 2. 3. 4. 5.
2. Locate J1 connector disconnected in the FULL Cool mode. Disconnect the jumper wire from pin 1 to pin 6.
3. Disconnect EF1, EF2, EF3 for low speed from J10.
4. Connect the EF to the output side of the compressor contactor (left side).
5. Plug unit in and turn main CB ON and OFF to maintain box temperature.



1	EF Wire Connected to Input Side of Compressor Contactor
2	J1 Connector Disconnected from PM

Controller Description

MP4000 Controller

The MP4000 is an advanced microprocessor controller. It has been specially developed for the control and monitoring of refrigeration units. The controller contains the following basic features:

- Temperature/Message Status Display
  - Temperature area: Displays return air sensor, supply air sensor, and setpoint.
  - Message area: Displays alarms, message, and controller menu.
- Keypad
  - F1 - F4 Function keys navigate within the Status Display.
  - Two Status LED indicators.
  - Special function keys: ON/OFF, PTI, Defrost.

Back-up Battery

Every Controller has a Back-up Battery. This will allow the controller to be energized if the unit is not connected to shore power. The technician can change settings in the controller - Setpoint, etc.

Press the ON/OFF key, the controller will energize and stay energized for 25 sec, by pressing any of the Menu keys the 25 sec timer will reset to 20 sec.

Input and Output Signals

The MP4000 microprocessor controls all unit functions to maintain the cargo at the proper temperature. The controller also monitors and records system faults and performs pretrip.

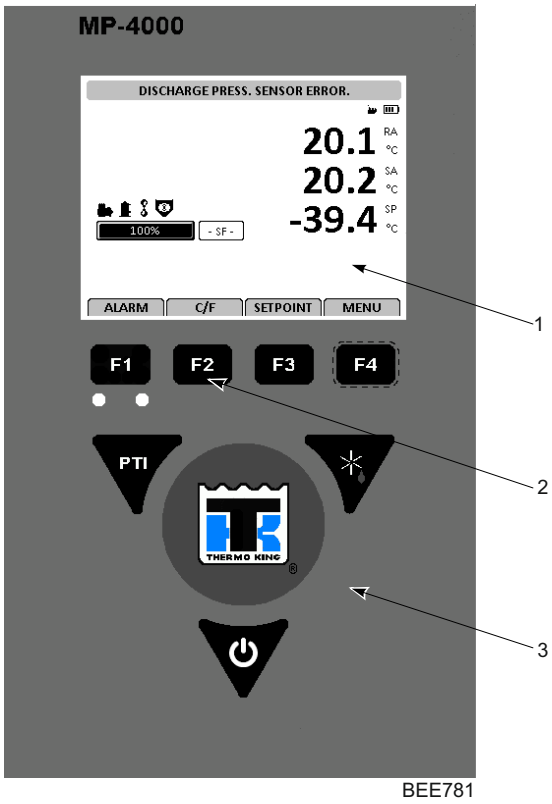
The MP4000 controller uses advanced solid-state integrated circuits to monitor and control unit functions. The controller monitors inputs from:

- Return Air Sensor
- Supply Air Sensor
- Evaporator Coil Sensor
- Ambient Sensor
- USDA (Spare) Sensors 1, 2, and 3
- High Pressure Cutout Switch/ Discharge Pressure Sensor
- Suction Pressure Sensor
- Phase measuring circuits
- Current measuring circuits
- Voltage measuring circuits
- Compressor Discharge Line LT Temperature Sensor (R23)
- Compressor Discharge Line HT Temperature sensor (R134a)
- Compressor HT feedback signal (R134a)

Output signals from the controller automatically regulate all unit functions including:

- Condenser fan operation
- Evaporator fan motor operation
- Electric heaters
- Phase selection
- Compressor LT operation
- Compressor HT operation
- Liquid Solenoid Valve

MP4000 Display Panel



1	Standard Display
2	Function Keys
3	Special Function Keys

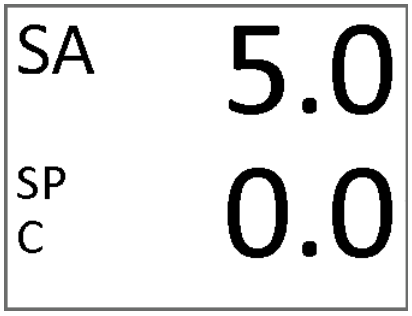
Standard Display

The Standard Display is a ¼ VGA graphical type display. The temperature can be displayed in Celsius or Fahrenheit.

The Standard Display will display the controlling sensor and Setpoint. The Setpoint will be the low reading with the C or F.

Once a key is pressed, the Standard Display will change to the Unit Status Display. After two minutes of no key activity, the display will return to the Standard Display.

Figure 14. Standard Display



Idle Screen and Check Symbol

After approximately 30 seconds of inactivity, the display will go into hibernation and one of the following symbols will be displayed. Display alternates between the idle screen and the standard display during this time.

Happy face = everything is OK

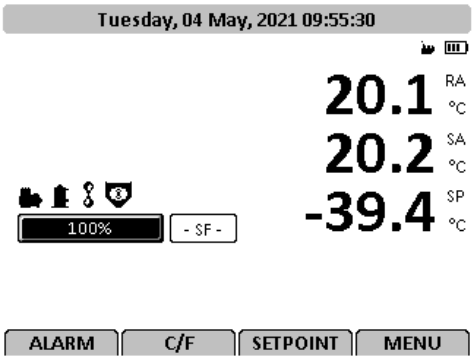
Disgruntled face = there is a message

Unhappy face = there is an alarm

The check symbol indicates that a Smart PTI has recently been running and no problems were found. The checkmark will only be shown in the normal operation state. This symbol will appear at the left hand corner of the idle screen display.

Unit Status Display

The Unit Status Display will show the following (looking from top to bottom):



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- Date and Time / Alarm Warning
- LoPrsH Low Pressure Transducer R134a
- RA Return air sensor
- SA Supply air sensor
- SP Setpoint
- Mode Icons Compressor ON, Heater ON, Evap Fan ON
- Capacity Bar Graph Percentage of mode (100% is full on)
- F1 - F4 Key Functions ALARM C/F SETPOINT MENU

Display Icons

Alarm

Pretrip Inspection / Test in Progress

Heating

Evaporator Fan High Speed

Evaporator Fan Low Speed

Condenser Fan On

SmartPTI has recently been running and no problems found

Controlling Mode Optimized

Controlling Mode Economy

Bluetooth®

Cell Phone

GPS Signal

	Watercooled		RMM
	Dehumidification		Battery Full (Datalogger Battery)
	Defrost		Battery Charging (Datalogger Battery)
	Compressor On Unloaded		Battery state not known. Temperature to low or high, charger suspended. (Datalogger Battery)
	Compressor On Loaded without Vapour Injection		Battery Error (Datalogger Battery)
	Compressor On Loaded with Vapour Injection		Refrigerant Type
	R134a compressor		Super Freezer Unit

Mode Descriptions

Frozen/Cooling Down

Frozen/cooling down mode where the unit setpoint is set to below -10C. The function here is to maintain setpoint temperature by controlling the temperature on the return air.

The condenser fan will operate in on. The evaporator fans will operate in low speed mode.

Defrost

Defrost is a situation where the unit either on demand or timing is defrosting the evaporator coil. The unit is heating with the heating elements awaiting 18C on the evaporator sensor.

When the set Defrost termination temperature is reached, the unit will return to the operation mode depending on the setpoint.

PTI

PTI is a pretrip inspection and is used to diagnose the condition of the unit. There are a possibility to chose between several type of PTI´s depending on the test needed to secure the functionality of the unit.

Viewing Alarms/Messages from Standard Display

To view the alarms that are present, turn the Unit ON. Allow the Unit to start and stabilize. Complete the following steps:

1. Press the F1 key. The Alarm List appears.
2. Press the F2/F3 keys to scroll between Alarms that are present.
3. Press the F4 key to acknowledge the Alarm. Press F1 again to exit.

Note: *Refer to ("Status Messages and Controller Actions," p. 125 and "Alarm Codes and Corrective Actions," p. 130).*

Display Alternate Fahrenheit (F) or Celsius (C) Temperatures

The controller can display temperatures in Celsius or Fahrenheit. Pressing the F2 function key will change the display to C or F. To change the display to C or F permanently, press and hold the F2 C/F key, then confirm "ARE YOU SURE YES or NO". Some customers do not allow the display to be change permanently.

Changing Setpoint

To change the controller setpoint, turn the Unit ON. Allow Unit to start and stabilize. Complete the following steps:

1. Press the F3 key at the main screen. The Setpoint Change menu appears.
2. Press the F2/F3 keys to scroll the Setpoint Up or down - depending on your required temperature.
3. Press and hold the F4 key until you are returned to the main screen. The new setpoint is recorded in the controller and appears in the display.

   Note: *The controller will default (return) to the previous setpoint if the setpoint is not entered within 30 seconds. Repeat steps 1 through 3 if this occurs.*

Note: *Defrost Terminate Temp, Defrost Internal, and USDA Trip can be set from the Setpoint menu. Refer to "Setpoint Menu" under "Menu Operating Instructions" in this chapter.*

Main Menu

To view the main menu, turn the Unit ON. Allow Unit to start and stabilize. To enter the main menu, Press F4. Refer to ("Navigating Controller Operating Menu," p. 55) for this operation.

Keys and Indicator LEDs

Function Keys

The function keys are the F1 - F4 keys located below the display. They allow the operator to move quickly to a specific area of the information or into the controller menu.

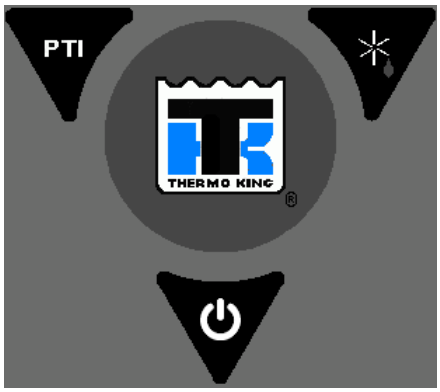
Note: *Function keys will change based on what menu is active in the display.*

- F1 ALARM Key: Press to view an explanation for the current alarms present.
- F2 C/F Key: Press to view alternate temperature scale Celsius or Fahrenheit in display.
- F3 SETPOINT Key: Press to enter Setpoint menu. Press F2 Up or F3 Down keys to increase or decrease the Setpoint. Press and Hold F4 until you are returned back to the main menu.
- F4 MENU Key: Press to view the extended Menu for the MP4000.

Special Function Keys

The Special Function keys are located around the Thermo King logo. These special function key allow the operator to move quickly to perform a specific function

- Pre-Trip Inspection
- Defrost
- Unit On/Off Control



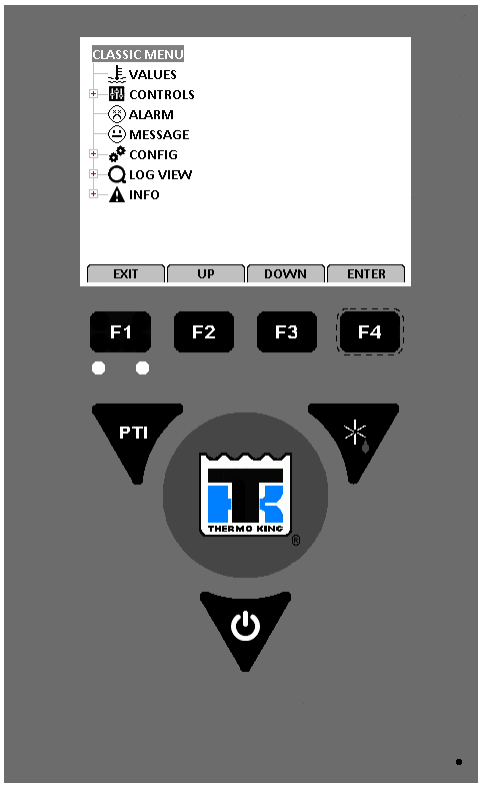
Indicator LEDs

Two status indicator LEDs are located just under the F1 - F4 function keys.

Green LED	Flashing	Temperature approaching in-range.
	Solid	Temperature in-range.
Red LED	Flashing	Alarm present and has not been acknowledged.
	Solid	Alarm present and has been acknowledged.

Navigating Controller Operating Menu

Figure 15. MP4000 Control Panel Display



Menu Scrolling Keys

Moving through these seven menus, their submenus, and entering commands requires the use of four keys:

EXIT - Press the F1 key each time you want to exit a submenu shown in the message display.

UP/ DOWN - Press the F2 or F3 key each time you want to scroll up or down in a menu or submenu shown in the Message Display; or scroll forward or backward in a menu line.

ENTER - Press the F4 key to enter a new menu or submenu.

The MP4000 contains an extensive operating menu. The main menu is divided into seven major areas that can be navigated via keypad.

- Values Menu - Menu screens in this group are used to display unit operating information including temperature values, pressure values, air values, unit electrical data, etc., and any input to the controller.
- Controls Menu – Menu screens in this group are used to enter allowable setpoints.
- Alarm Menu - Display a list of alarm code(s) present.

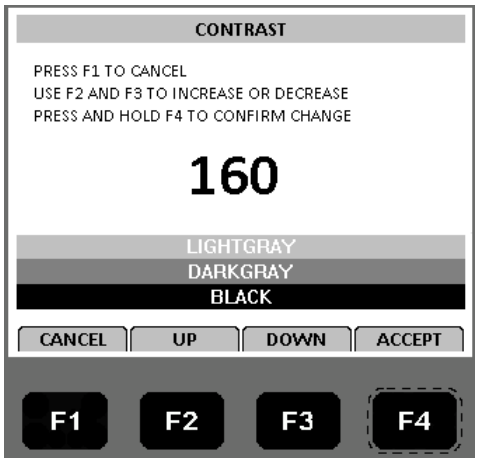
- Message Menu - Display a list of message(s) present.
- Configuration Menu - Menu screens in this group are used to change the functionality of the unit operation.
- Log View Menu - Menu screens in this group display log information or log function. Includes: Inspect Log, set Trip Start, and Set Log Interval.
- Info Menu - Menu screens in this group give information on software version and expansion slots.

A complete listing of the controller operating menu is located on an 11’ x 17’ fold out in the Diagrams chapter (). It is designed to be folded out so you can continuously view it as you are learning how to navigate the MP4000 Controller Menu. It is recommended to fold this menu out and leave it folded out until you become familiar with the controller menu.

Changing Screen Contrast

Change the screen contrast temporarily as follows:

1. Press and hold the F1 INFO KEY until the Contrast Screen appears.

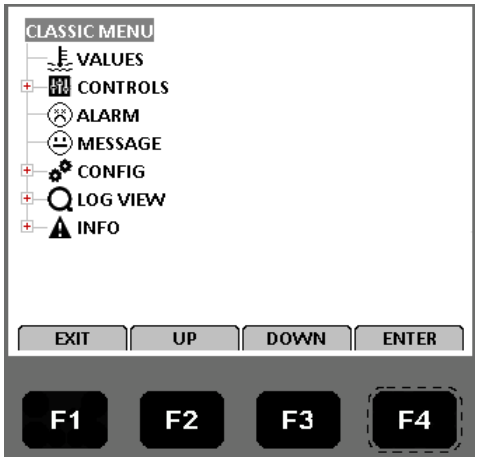


2. Press the F2 or F3 UP/DOWN KEYS to scroll the Contrast up or down.
3. Press and hold the F4 ACCEPT KEY to confirm the new Contrast Setting.

Main Menu

Main Menu

From the Standard Display, press the MENU F4 key to enter the Main Menu as shown below. The Main Menu allows access to several other submenus using the UP F3, DOWN F3, and ENTER F4 keys. The other submenus are described below.

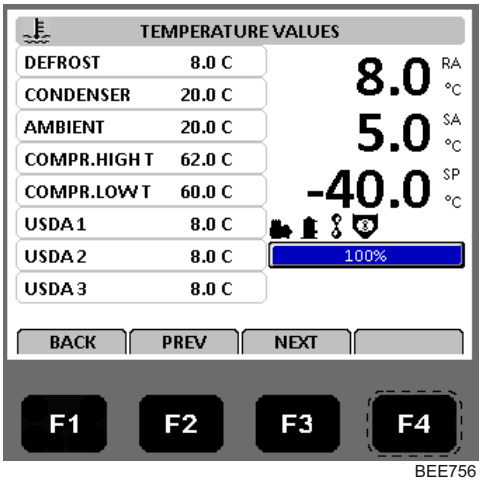


Values Menu

The Values menu displays general unit operating information including temperature values, pressure values, air values, unit electrical data, etc. A complete listing of the controller operating menu is located on an 11” x 17” foldout in the Diagrams chapter ().

Note: *The screens that are display on the controller are determined by the controller software setting and the options installed on the unit. All screens are NOT present on all units.*

Defrost	Cond. Press.	Fan R23 Heat 2	Heater
Condenser	Condenser	Fan R23 Heat 3	Evap Fan Low
Ambient	Suct. High T	Bat. Volt	Condenser Fan
Comp. High T	Disch. Low T	Bat. C. Curr	Compressor
Comp. Low T	Suct. Low T	Bat. Temp	Compressor High T
USDA 1	Voltage	Board Volt	Phase Direction Reverse
USDA 2	Frequency	Sensor Volt	HP Cut Out
USDA 3	Fan R23 Heat 1	PM Temp	LP Cut Out



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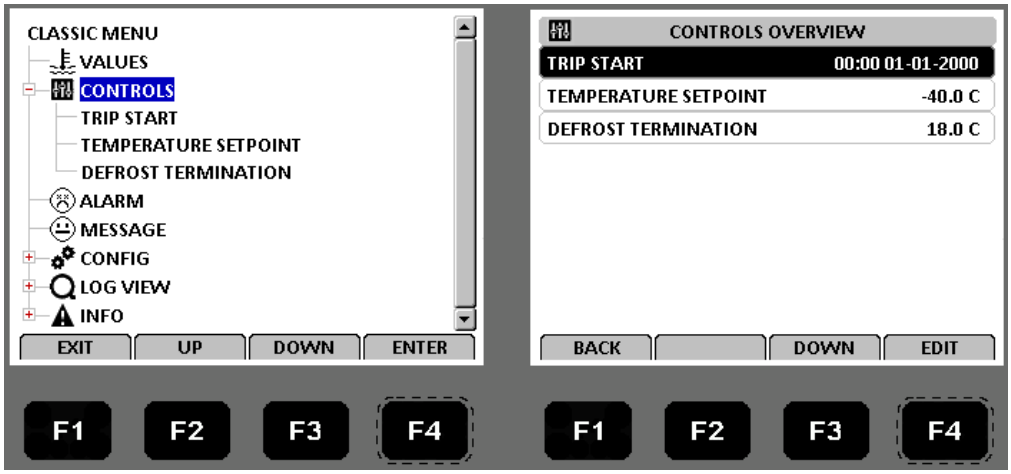
Controls Menu

Note: *When a submenu is highlighted, pressing the ENTER F4 key again will open a view showing how the unit is currently set up. In order to see some of these different selections, turn the option on and then enter the Controls menu again.*

Figure 16. Controls Menu and Controls Overview



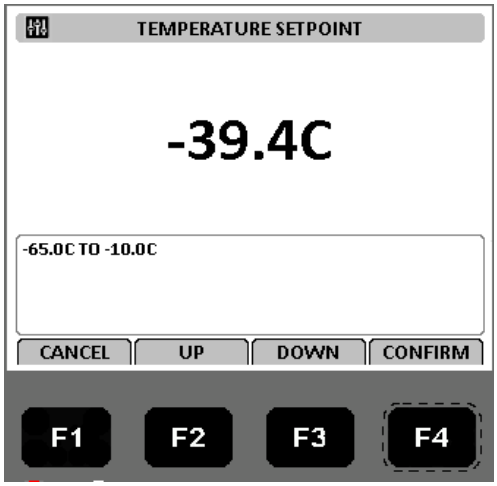
BEE757

Temperature Setpoint

Used to change the controller setpoint. The setpoint can also be changed from the Unit Status Display by pressing the Setpoint F3 key. The new setpoint is recorded in the controller datalogger and appears in the display.

Note: *The controller will default (return) to the previous setpoint if the new setpoint is not entered within 30 seconds.*

Figure 17. Temperature Setpoint

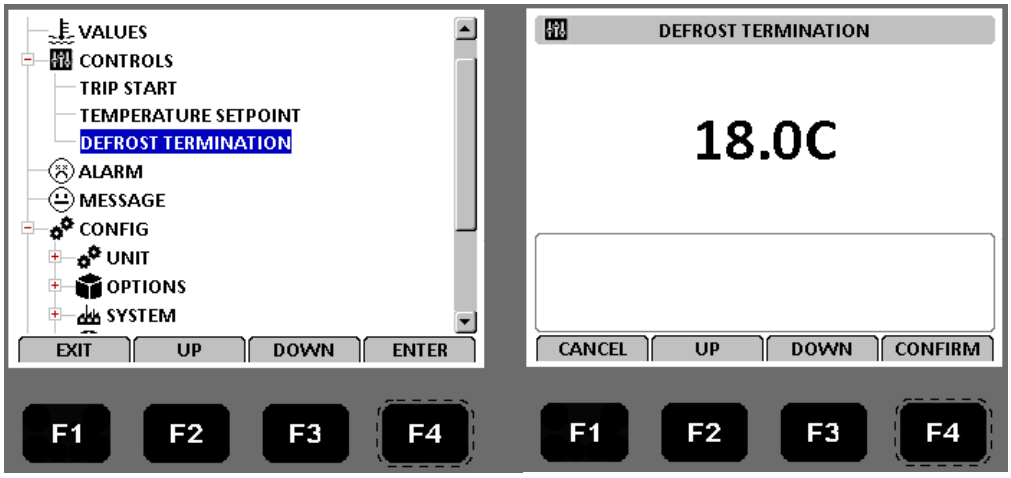


BEE802

Defrost Termination

Option lowering defrost termination temp, range 18 to 4°

Figure 18. Defrost Termination



BEE759

Alarm Menu

The Alarm menu displays the code conditions. Alarm codes are recorded in the controller memory to simplify unit diagnostic procedures. Some alarm codes are only recorded during a Pretrip (PTI) test or function test. Fault codes are retained by the controller in a non-volatile memory. If the Red LED is on or flashing, enter the Alarm menu to view the alarm.

Display will show either NO ALARMS or the newest ALARM. Alarm indicates corrective action should be taken. Red LED flashes and unit may stop or continue to run based on the alarm. Shutdown alarms are : 18, 51, 56, 127, 146, 147.

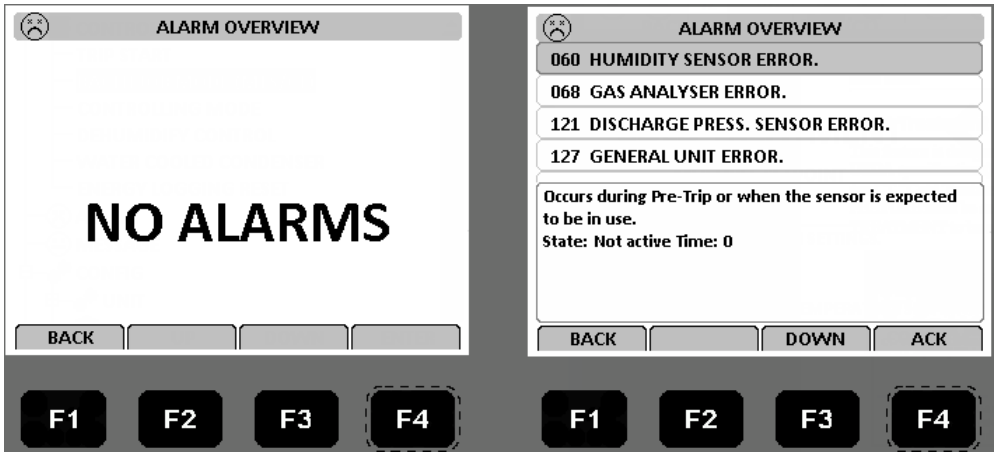
Shutdown alarms indicate the unit has been stopped to prevent damage to the unit or cargo. The condition must be corrected before restarting the unit. The Alarm description will be displayed across the top of the status display. To view the alarms press the Alarm key to go to the Alarm List Menu.

1. Press the F4 key to access the Alarm menu. The first alarm code number, alarm state, and alarm description appears in the Display.

   Note: *Alarm codes are displayed in sequential order, not in order of occurrence.*

2. Write down the first code. Then press the F2 or F3 Up/Down key to view next alarm code when more than one code has been recorded.
3. Repeat above step until all alarm codes have been recorded. Press the F2 key to scroll backward to return to a previous code.
4. To clear all alarm codes from the current display list and turn off the Alarm LED, all problems must be corrected and the alarm code “acknowledged” in the Alarm Overview.
5. To acknowledge an alarm, press F4 ACK KEY while code appears on screen. The alarm state will change from Active or Not Active to Acknowledge. If no key is pressed for 30 seconds, the controller returns to previous menu level or Unit status display.

Figure 19. No Alarms or Newest Alarm



Alarm Code States

There are three alarm code states for Shutdown and Check alarms:

- Active: A code condition has occurred and continues to exist in the unit or the code condition occurred within the past one hour but does not currently exist in the unit.
- Not Active: A code condition has occurred but no longer exists in the unit. Not Active means the code condition was corrected and did not reoccur for one hour, or the Unit On/Off switch was turned Off and then On.
- Acknowledge: A code condition has been viewed and acknowledged in the Alarm or Message list. If the Alarm code condition still exists in the unit, the Red LED will stay on and not flash. If the code condition is corrected, the Red LED will turn off and the code condition will disappear from the Alarm/Message list.

A complete listing of the controller operating menu is located on an 11" x 17" fold out in the Diagrams chapter ().

Alarm Codes

For a complete list of alarm codes and corrective actions, refer to (",").

Message Menu

The Message menu displays the code conditions. Messages are recorded in the controller memory to simplify unit diagnostic procedures.

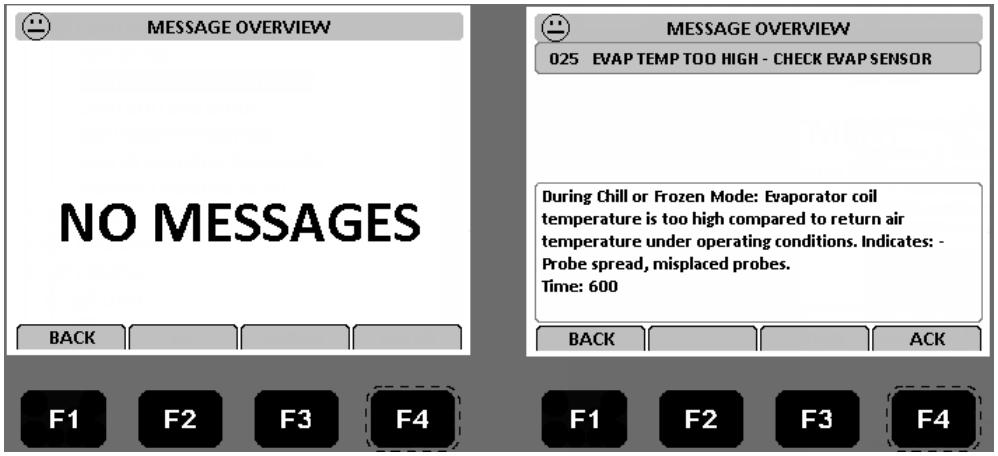
Display will show either NO MESSAGES or the newest MESSAGE. A Message indicates corrective action should be taken before a problem becomes severe. When a Message occurs, the controller will try to determine if the component or input is good or bad. The Message description will be displayed across the top of status display and the Red LED will not be illuminated. If the controls determine the component or input is bad, the Message will become an Alarm.

1. Press the F4 key to access the Message menu. The first alarm code number, alarm state, and alarm description appears in the Display.

   Note: *Messages are displayed in sequential order, not in order of occurrence.*
2. Write down the first message. Then press the F2 or F3 Up/Down key to view next message when more than one message has been recorded.
3. Repeat above step until all messages have been recorded. Press the F2 key to scroll backward to return to a previous message.
4. To clear all messages from the current display list and turn off the Alarm LED, all problems must be corrected and the message "acknowledged" in the Message Overview.
5. To acknowledge a message, press F4 ACK KEY while message appears on screen. The message state will change from Active or Not Active to Acknowledge. If no key is pressed for 30 seconds, the controller returns to previous menu level or Unit status display.

For a complete list of status messages and controller actions, refer to (",").

Figure 20. No Messages or Newest Message



Configuration Menu

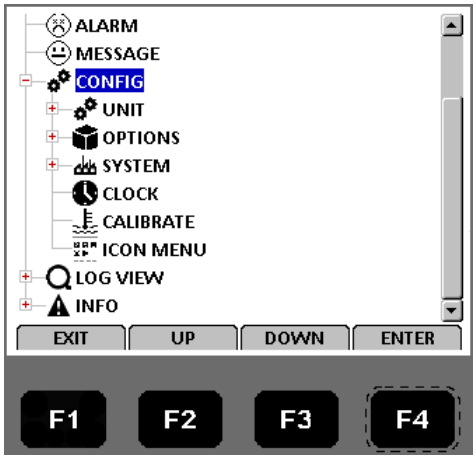
The Configuration menu displays a list of functions that identifies unit operating features and current settings. A complete listing of the controller Configuration menu is located on an 11" x 17" foldout in the Diagrams chapter ().

With the unit turned On, allow it to start and stabilize and the display showing the unit status display:

1. Press the F4 MENU key. Press the F3 key to scroll down to the CONFIG menu.
2. Press the F4 key to expand this menu.
3. Press the F2 OR F3 UP/DOWN key to scroll to view or reset the desired function.
4. To set a new Configuration screen value:
   a. Press the F4 key with cursor in the desired menu line.
   b. Press the F2 OR F3 UP/DOWN key to scroll the value to the desired setting.
   c. Press the F4 key and release when the entry is complete. Press the F1 key. The new value appears in the menu line.
5. Repeat steps 3 and 4 to reset additional configuration values.
6. Press the F1 key to exit the Configurations screen.

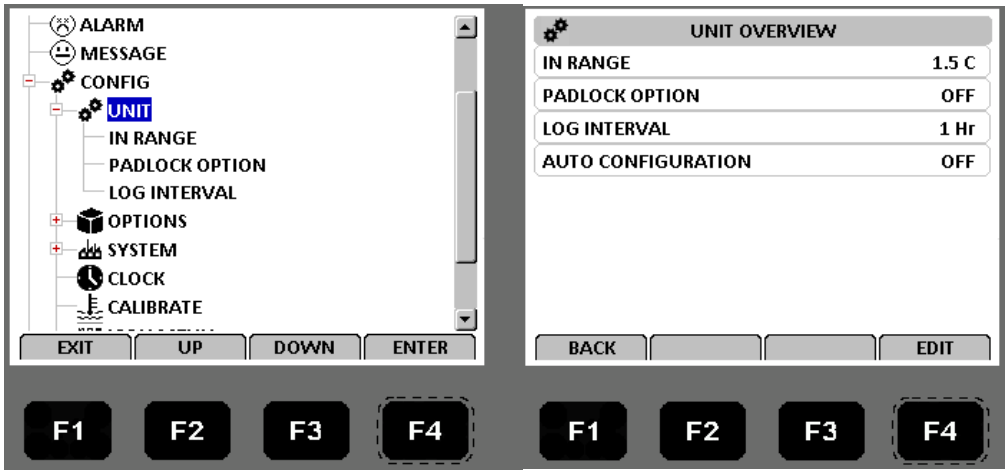
Note: *Pressing F4 again will display the Overview screen.*

Figure 21. Configuration Menu



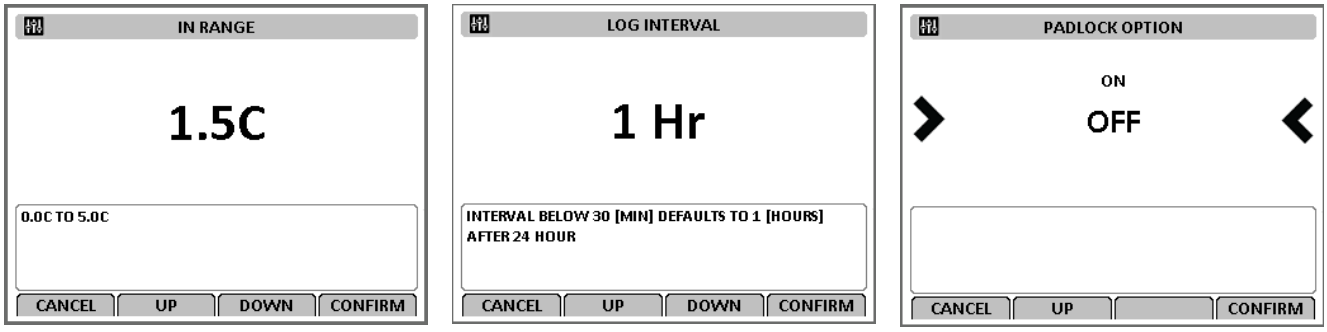
Unit

Figure 22. Unit Menu and Unit Overview



BEE758

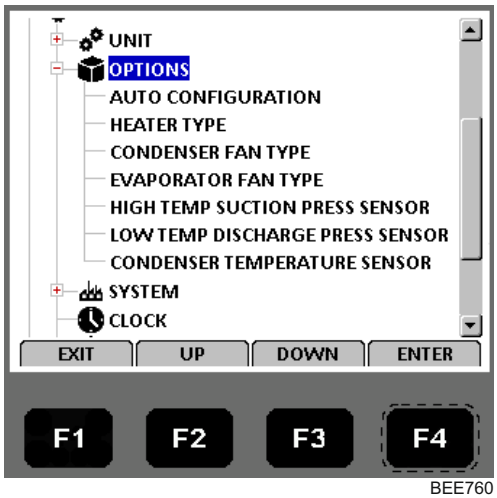
- In-Range Temperature limit: Sets the temperature value for the controller's in-range LED and datalogger functions (factory default = 1.5 C [2.7 F]). Enter a value from 0.5 to 5.0 C (0.9 to 8.9 F).
- Padlock Option : Select ON/OFF.
- Log Interval: Sets the data log interval (1 minute, 5 minutes, 10 minutes, 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours).



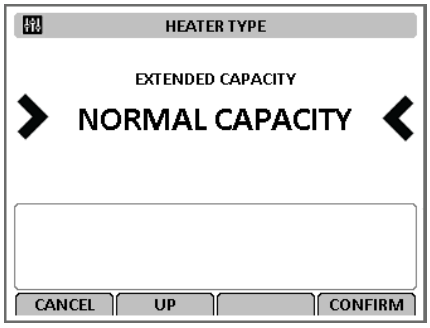
Options

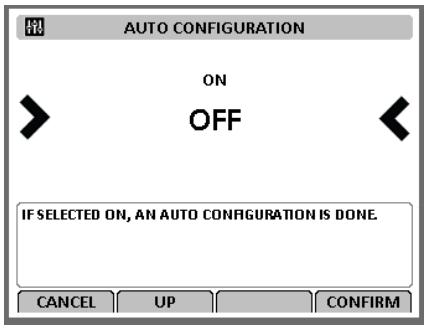
This menu is used to turn ON/OFF a Module/Feature, select a particular option within a module, and tell the controller when a sensor is mounted.

- Heater Type: Select from Extended Capacity and Normal Capacity
- Condenser Fan Type: condenser fan type 2, ¾ and ½ HP
- Evaporator Fan Type: evap motor selection 2 or 3
- High Temp Suction Press Sensor: HT system LP pressure transducer mounted or none
- Low Temperature Discharge Press Sensor: LT system HP pressure transducer mounted or none
- Condenser Temperature Sensor: condenser sensor fitted "on or off"

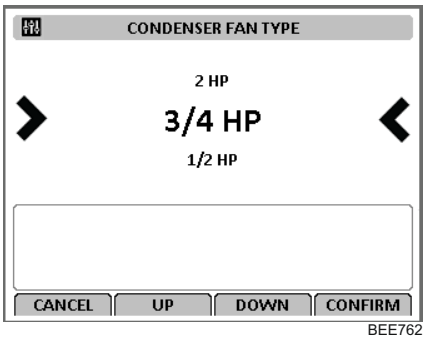


BEE760

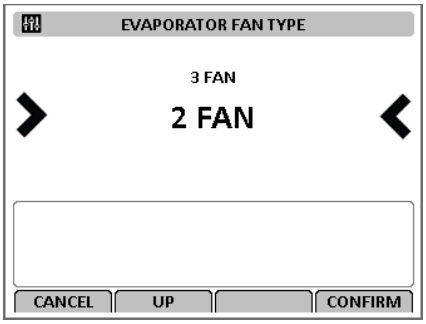




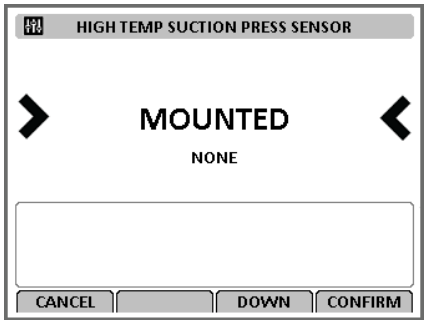
BEE761



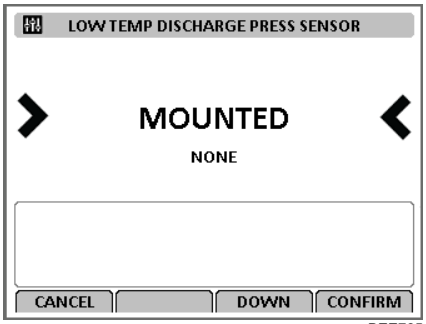
BEE762



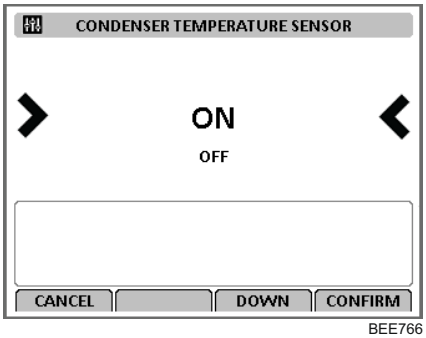
BEE763



BEE764



BEE765



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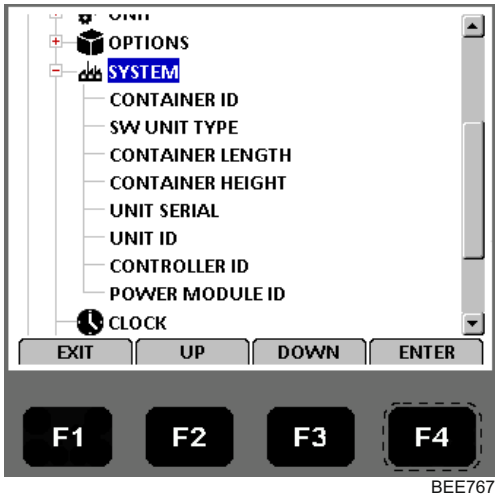
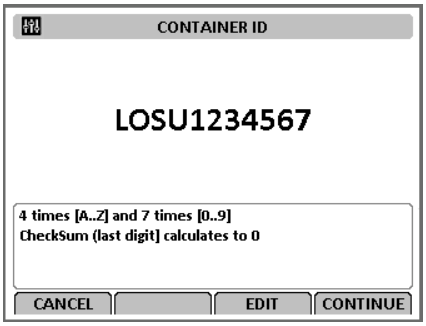
System

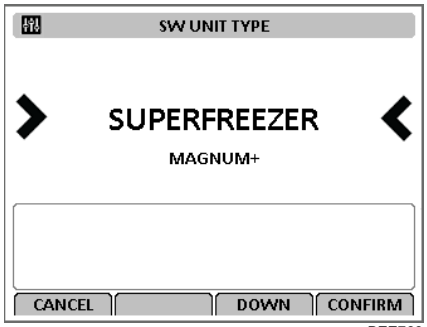
Figure 23. System



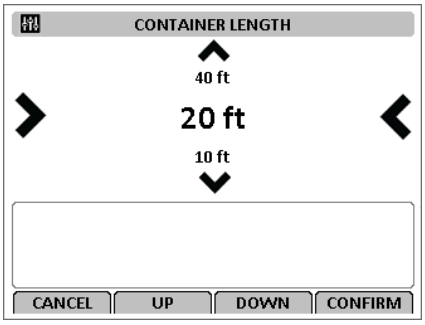
- Container ID: Sets the container identification number. Enter up to 11 characters (numbers or letters).
- SW Unit Type: Choose Unit Type
- Container length: 10, 20, 40, 43 or 45ft.
- Container height: Select Standard or High Cube
- Unit Serial ID: The TK serial number of the unit itself. This is a ten digit alphanumeric entry found under the UNIT Serial Number on the Serial Plate on the unit.
- Unit ID: A 12 digit alphanumeric unit serial number (old system).
- Controller ID: View and edit the Controller ID.
- Power Module ID: An 8 digit alphanumeric number found on the power module.



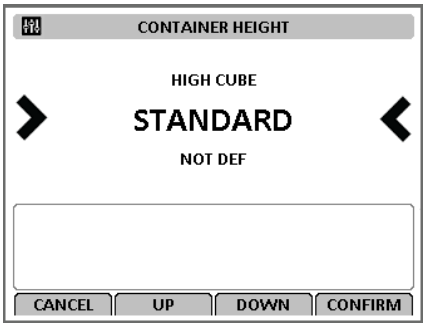
BEE768



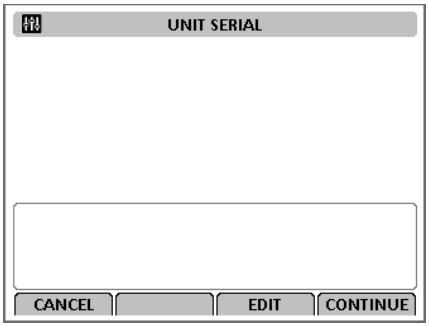
BEE769

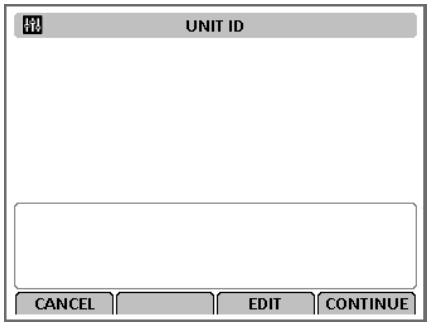


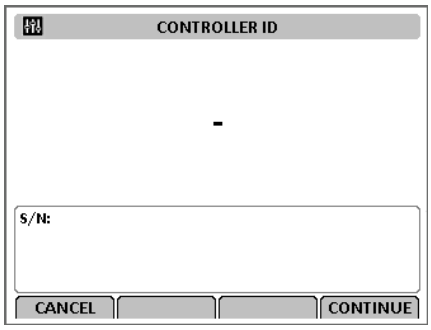
BEE770

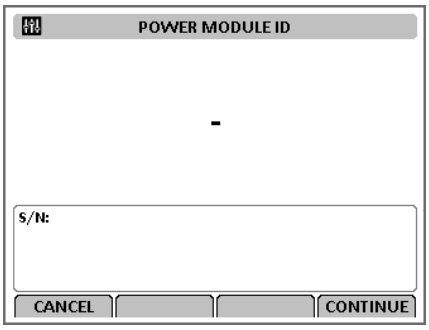


BEE771





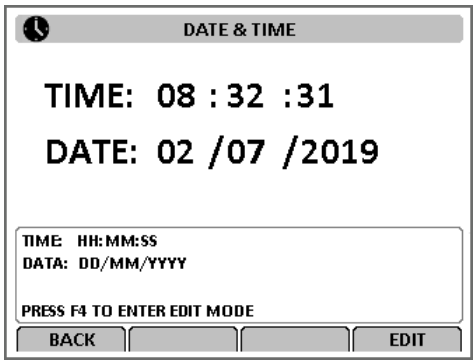




Clock

Displays current Date and Time, which can be edited.

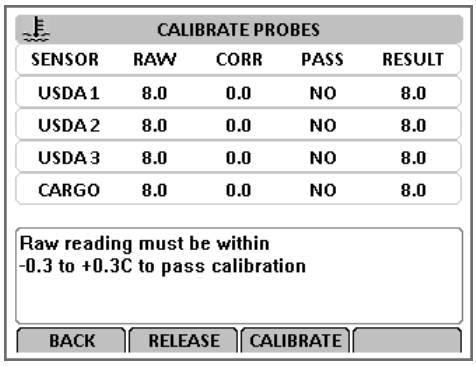
1. Press the F4 key. Press the F3 key to scroll down to the CONFIGURATION Menu.
2. Press the F4 key to access the CONFIGURATION menu. Press the F3 key to scroll down to the Clock Menu.
3. Press the F4 key to access the Date & Time screen.
4. Press the F4 key to edit.
5. Enter new time by: Using F2 or F3 Up/Down to change the digits and by pressing F4 to move the cursor on to the next digit.
6. Once you have scrolled the cursor through all the time and date digits, you get an option to Press the F4 key to save. Press and hold F4 until the main menu appears.
7. Press the F1 key to exit the Date & Time screen.



Calibrate

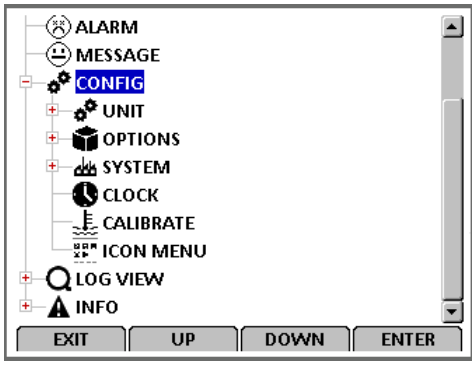
Used to calibrate sensor probes.

For Cld Treatment refer to ","

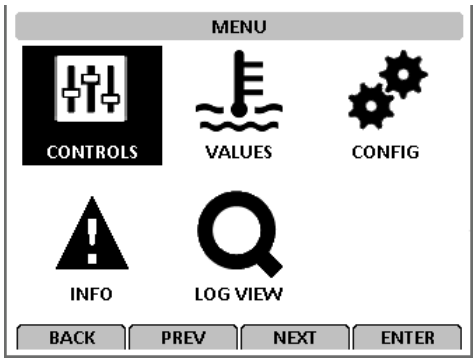


Icon Menu

1. Press the F2 or F3 UP/DOWN key to scroll to the Configuration selection and press the F4 key. The Configuration Menu will appear.

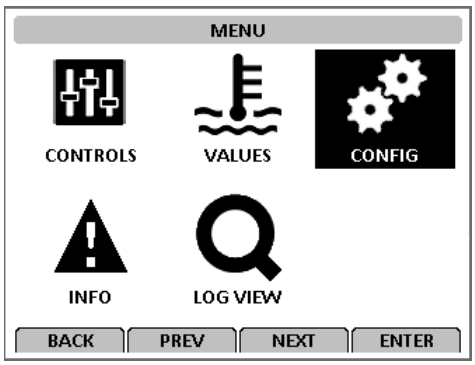


2. Press the F2 or F3 UP/DOWN key to scroll to the Icon Menu selection and press the F4 key. The Icon Menu will appear as shown below.

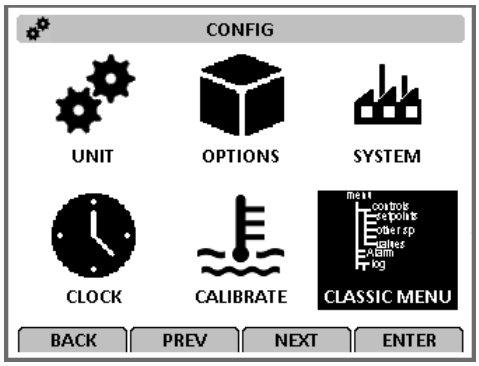


To change back to the Classic Menu:

1. Press the F4 key to display the Icon Menu.
2. Press the F2 or F3 UP/DOWN key to scroll to the Config selection.



3. Press the F4 key. The Configuration Menu will appear.
4. Press the F2 or F3 UP/DOWN key to scroll to the Classic Menu selection.



5. Press the F4 key. The Classic Menu will appear.

Log View Menu

This menu allows the user to check Temperature, Event, PTI, Smart, and Runtime logs. Displays results of last PTI, Event, and Temperature test including component volt and amps data and sensor temperatures.

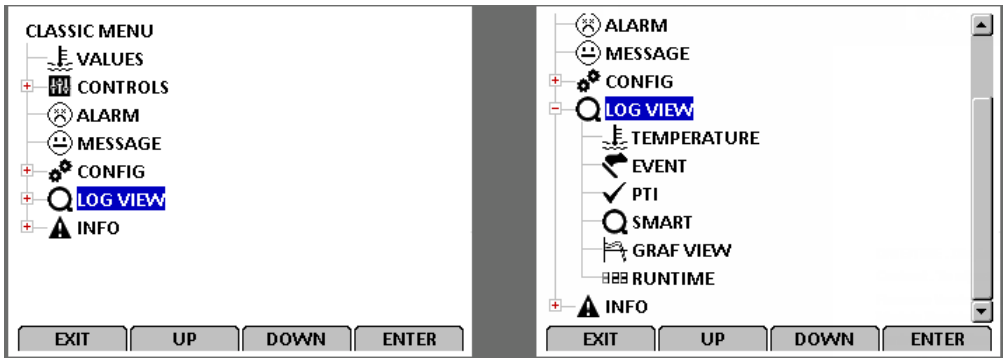
A complete listing of the controller operating menu is located on an 11" x 17" foldout in the Diagrams chapter ().

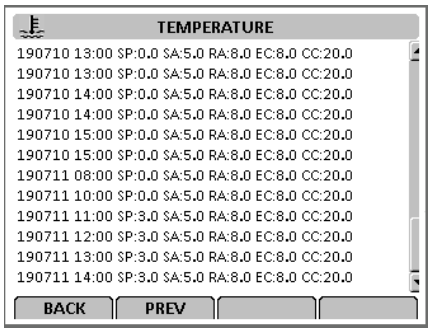
With the unit turned On, allow it to start and stabilize and the display showing the unit status display (setpoint):

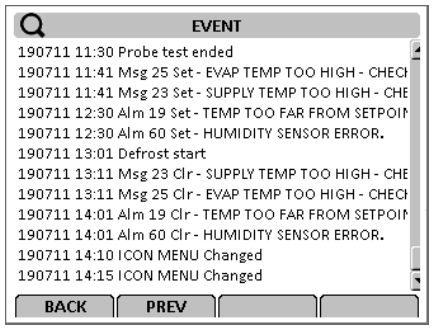
1. Press the F4 MENU key. Press the F3 key to scroll down to the Log View menu. 2. 3. :
2. Press the F4 key to access the Log View menu.
3. Press the F2 or F3 UP/DOWN key to scroll to the desired function.

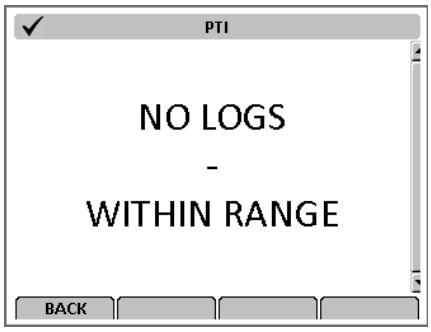
4. Press the F4 key to access the function selected.

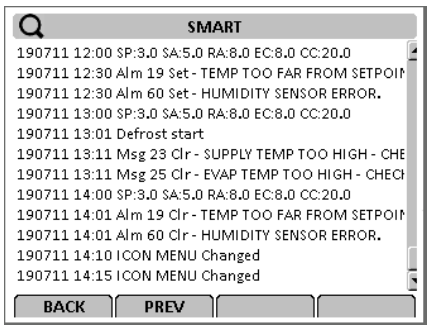
Figure 24. Log View Menu

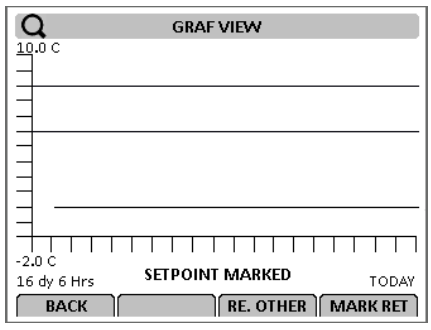


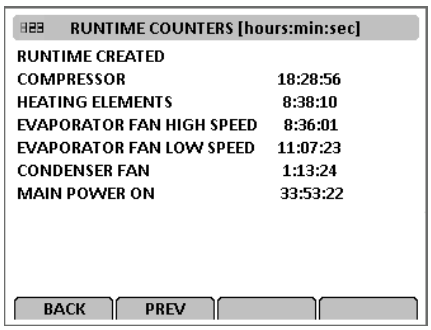








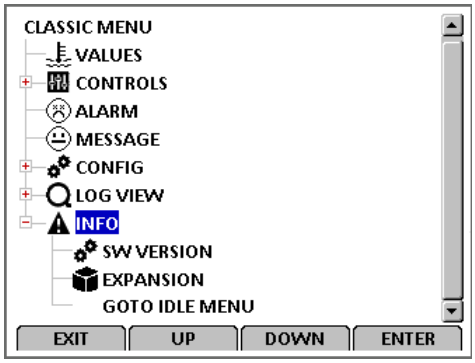




Info Menu

This menu displays controller software application version, bootloader version, power module version, serial number, and option file version. It also displays expansion slots if used.

Figure 25. Info Menu



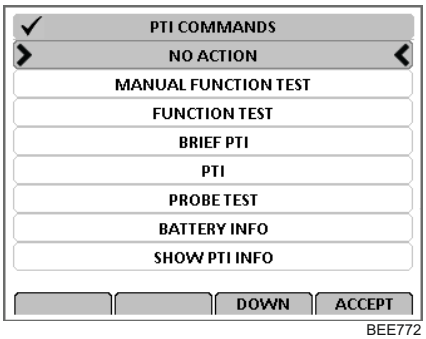
Special Function Keys - User Activated Commands

PTI Key

Pressing the PTI key will access various PTI Commands for selecting a user activated functionality.

- Manual Function Test: Refer to (",") for detailed information.
- Function Test: Refer to ("Function Test," p. 75) for detailed information.
- PTI: Refer to ("PTI (Pretrip) Tests," p. 72) for detailed information.

PTI Menu Screen



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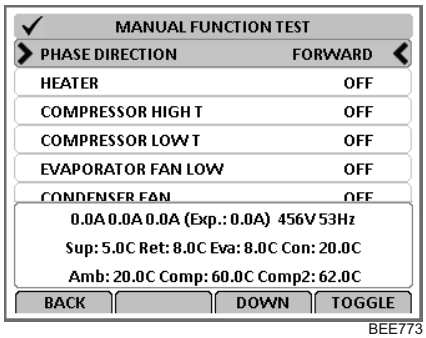
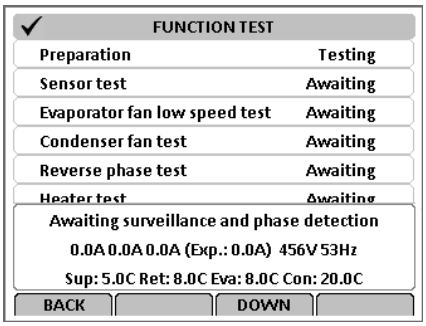
Manual Function Test



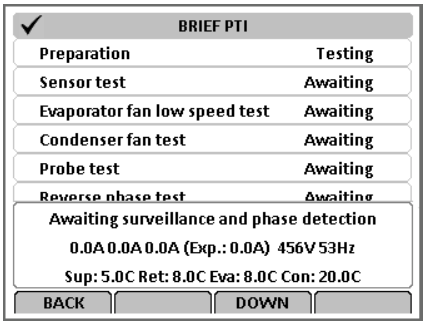
BEE773

Function Test



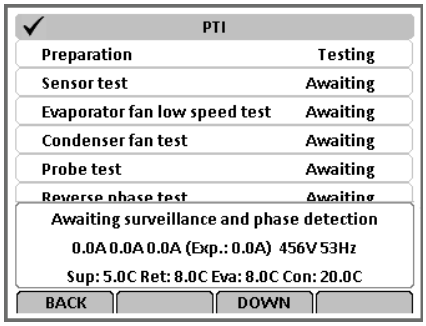
BEE774

Brief PTI



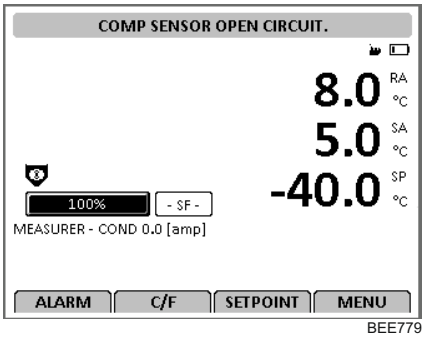
BEE775

PTI



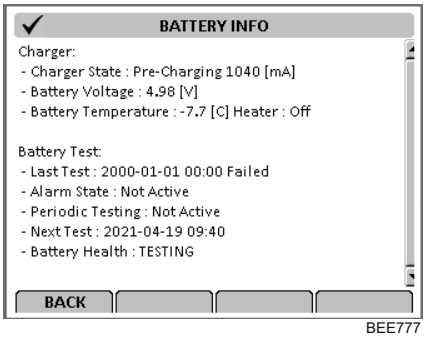
BEE776

Probe Test



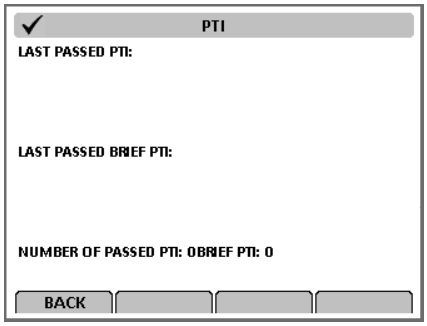
BEE779

Battery Info



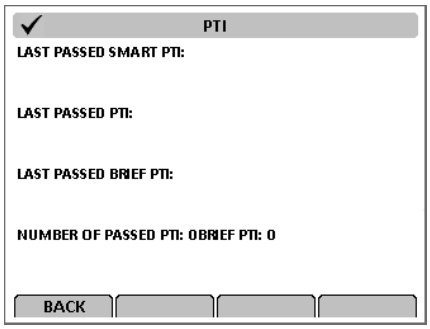
BEE777

Show PTI Info



BEE778

Show PTI Info



PTI (Pretrip) Test

⚠ CAUTION

Service procedure!

The PTI test should only be performed on an empty container!

The CRR DF controller contains a special PTI pretrip test that automatically checks unit refrigeration capacity, heating capacity, and individual components including the controller display, contactors, fans, protection devices and sensors. The test includes measurement of component power consumption and compares test results to expected values.

Note: *Correct all existing alarm conditions and clear the alarm codes before performing a PTI test. The controller will automatically clear all existing alarms before beginning the PTI test.*

During the PTI test, the LED display screen will show:

- Alarm LED flashes if an alarm condition occurs during the test.

Note: *Detailed PTI test results are stored in the Datalogger for later viewing. Any alarm codes recorded during the test can be viewed through the controller's Alarm List menu at the end of the test.*

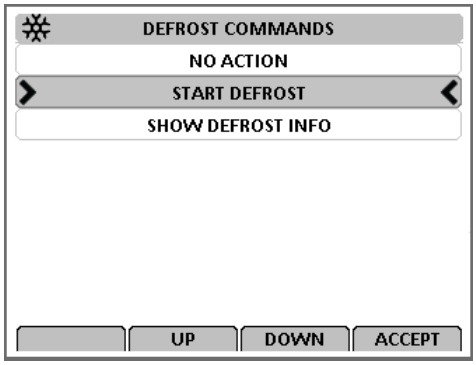
Note: *Auto PTI test omits HPCO test on R134a and R23 compressor, and cooling capacity is not verified by minimum temp difference between supply and return. Manually verify function HPCO functions and full cooling capacity.*

Defrost Key

To access the Defrost Menu, turn the unit On and allow the unit to start and stabilize and show the unit status display (setpoint).

1. Press the DEFROST (*) key to open the Defrost Menu.
2. Press the F2 OR F3 UP/DOWN key to scroll to "Start Defrost".

Figure 26. Defrost Menu

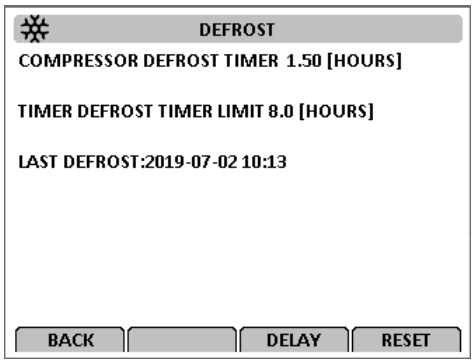


3. Press the F4 key to enter DEFROST function. If the unit operating conditions allow a manual defrost (e.g., evaporator coil temperature is less than 18 C [56 F]), the unit enters Defrost.

The defrost cycle automatically terminates and returns the unit to normal operation.

Select Show Defrost Info to display the Defrost Info Screen, which shows information about such as, Compressor Defrost Timer, Timer Defrost Timer Limit, and the Last Defrost as shown below.

Figure 27. Defrost Info Screen



PTI (Pretrip) Tests

NOTICE

Cargo Loss!

The PTI tests should only be performed on an empty container.

Note: *Units equipped with a water-cooled condenser must be set to operate on air-cooled condensing to perform a complete system capacity test.*

The MP4000 controller contains special PTI pretrip tests that automatically checks unit refrigeration capacity, heating capacity, temperature control, and individual components including the controller display, contactors, fans, protection devices, and sensors. The test includes measurement of component power consumption and compares test results to expected values.

The Full PTI test takes up to 2 to 12 hours to complete, depending on the container and ambient temperature.

Note: *Correct all existing alarm conditions and clear the alarm codes before performing a Full PTI test. The controller will automatically clear all existing alarms before beginning the Full PTI test.*

The Brief PTI test takes about 25-30 minutes to complete, depending on the container and ambient temperature.

Detailed PTI test results are stored in the MP4000 Datalogger for later viewing. Any alarm codes recorded during the test can be viewed through the controller's Alarm List menu at the end of the test.

Manual Function Test

The Manual Function Test menu allows technicians to perform specific diagnostic tests on individual components or turn several components on at the same time to perform a system test.

Poznámka: *THE UNIT STOPS when the Manual Function Test menu is entered. A technician can then select the control circuit or component to be checked/tested from the items shown in the menu.*

Complete the following steps to enter the Manual Function Test menu. With the unit turned On, allow it to start and stabilize and the display to show the unit status display (setpoint):

1. Press the PTI key to open the PTI Menu.
2. Press the F2 OR F3 UP/DOWN key to scroll to "Manual Function Test".
3. Press the F4 key to enter the Manual Function Test Menu.

Unit Component Test

1. Press the F2 OR F3 UP/DOWN key to scroll to desired component test:
   - [PHASE DIRECTION]
   - [HEATER]
   - [COMPRESSOR HIGH T] (R134a)

- [COMPRESSOR LOW T] (R23)
- [EVAPORATOR FAN LOW]
- [CONDENSER FAN]

2. Press the F4 key to start the component test. Display will change the component state from off to on.
3. Verify component performance: Display will show expected current and actual current on phase 1, 2, and 3.
4. Press the F4 key again to stop test. Display will change component state from on to off.

System Test (test multiple components at the same time)

1. Press the F2 OR F3 UP/DOWN key to scroll to the first component.
2. Press the F4 key to turn the component on
3. Press the F3 key to scroll to select next component. Press the F4 key to turn the component on.
4. Repeat step 3 until all required components are on. For example, to operate unit in Full Cool mode, start the following components:
   - Condenser Fan
   - Compressor
   - Evaporator Low
5. Observe current draw and system performance to verify component(s) performance.
6. Press the F4 key again to turn off components individually. Or press the F1 key to exit Manual Function Test menu and turn all components off.

Press the F1 key to exit the Manual Function Test submenu.

Table 10. PTI, Brief PTI, Function Tests

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
PTI START Activated 0.1A 0.0A 0.1A	Event Log for PTI begins. Awaits phase selection, and surveillance to start up. All alarms are turned off. Alarm list is cleared. All relays are turned off and air vent are closed.	18	1 to 100 seconds	X	X	X
SENSOR TEST Activated 0.1A 0.0A 0.1A	Testing sensor interface, All sensors must have values within their measuring range.	00, 01, 02, 03, 04, 05, 34, 35, 97, 98, 120, 121, 123, 144, 145, 148	Instant	X	X	X
EVAP FAN LOW SPEED TEST SUP RET EVA 5.1C 5.0C 5.1C 1.1A 1.0A 1.1A	With evaporator fan on low speed, amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency: • 1.1 Amps approx. at 50 Hz • 1.1 Amps approx. at 60 Hz	14, 15	5 seconds	X	X	X
COND FAN TEST SUP RET EVA 5.2C 5.0C 5.1C 1.3A 1.2A 1.3A	With condenser fan on, amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency. If the phase amp draw differs more than 1,0 Amp both alarm is set. • Expected Power Consumption: – 1.2 Amps approx. at 50 Hz – 1.3 Amps approx. at 60 Hz Amperes are recorded in the PTI log.	16, 17	5 seconds	X	X	X

Table 10. PTI, Brief PTI, Function Tests (continued)

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
PROBE TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	Evaporator fans operate on low speed for maximum 3 minutes. Then probe test runs until temperature difference between sensors stops increasing. Maximum temperature difference allowed: • Return/Evaporator: 1.5C (34.7F); return air sensor temperature must be 0.5C (32.9F) above evaporator sensor temperature. • Return/Supply: 0.8C (33.0F); return air sensor temperature must be 0.5C (32.9F) above supply air temperature.	52, 128, 129, 130	1 minute minimum to 13 minutes maximum	X	X	—
REVERSE PHASE TEST SUP RET EVA 1.3C 1.0C 1.3C 1.3A 1.2A 1.3A	With condenser fan on, reverse phase selector relay is energized. Condenser fan reverse current is measured.	58	30 seconds	X	X	X
HEATER TEST SUP RET EVA 1.3C 1.0C 1.3C 5.2A 5.1A 5.2A	Electric heaters are turned on. Amp draw is measured to the expected amp draw, in respect to voltage and frequency. • 9 Amps approx. at 400V • 10 Amps approx. at 460V Amperes are recorded in the PTI log.	10, 11	5 seconds	X	X	X
DEFROST TEST SUP RET EVA 5.0C 12.0C 15.0C 5.2A 5.1A 5.2A	If evaporator temperature is below +10C, heater remains on until evaporator temperature is above +18C. **Defrosting until EVA > 18C/64F**	20	0-90 Minutes at voltage above 440V 0-120 Minutes at voltage below 440V	X	—	—
COMPRESSOR R23 TEST 8.0C 15.0C 5.0C 9.1A 9.0A 9.1A	Compressor loaded, and condenser fan activated for 10 sec. Followed by compressor run alone for 7 sec before the amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency. Amperes are recorded in the PTI log. **Evaluating power consumption**	6, 7	18 seconds	X	X	X
COMPRESSOR 2 (R134a) FEEDBACK TEST	Running compressor 2 R134a. Checking if feedback signal from R134a contactor matches the output signal to activate the contactor.	147	25 to 35 seconds	X	X	X
PULLDOWN -30C	Unit operates in normal cool mode with -30 C (-22 F) setpoint. When return air temperature decreases to setpoint. Sensor temperatures are recorded in PTI log	23	Max 4 hours	X	-	-
PULLDOWN -60C	Unit operates in normal cool mode with -60 C (-76 F) setpoint. When return air temperature decreases to setpoint. Sensor temperatures are recorded in PTI log	22	Max 8 hours	X	-	-
DEFROST TEST	Test is skipped and Fail if either of alarm 4,5,130 is present. Test is skipped if evaporator temperature is at 5degC or above. With electric heaters turned on, the test will pass when evaporator temperature reach 18degC or above. **Defrosting until EVA > 18C/64F**	4, 5, 20, 130	0 to 90 minutes at voltage above 440V 0 to 120 minutes at voltages below 440V	X	—	—

Table 10. PTI, Brief PTI, Function Tests (continued)

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
PTI END	"PTI End" are recorded in PTI log and a Trip Start is automatically activated. All alarms are cleared and must be acknowledged by the user. Unit awaits an **ACCEPT** of the just ended test before returning to normal operation. **PASSED - PASSED - PASSED** **FAILED - FAILED - FAILED**	26	Max 90 seconds	X	X	X
PTI PASS – PRESS KEY	Unit will remain OFF until any key is pressed. If alarms occurred during PTI, Display shows "PTI FAIL – PRESS KEY". ***Note:*** *Controlling Sensor = Return*	None		X	X	X
***Readings may vary depending on voltage and temperature**						

Function Test

The MP4000 controller contains a special function test that automatically tests individual components including the controller display, sensors, condenser fan, evaporator fan, compressors, etc. The test includes measurement of component power consumption and compares test results to expected values.

Note: *The function test does not test the actual performance of the complete system. Therefore it is not a pretrip test and should not be used instead of the PTI test.*

With the unit turned On, allow it to start and stabilize and the display to show the unit status display (setpoint):

1. Press the PTI KEY to open the PTI Menu.
2. Press the F2 OR F3 UP/DOWN KEY to scroll to "Function Test".
3. Press the F4 key to start the Function Test. Display shows test currently being performed. The Function Test ends automatically. Press any key on the controller to return the unit to normal operation.

Any alarm codes recorded during the test can be viewed through the controller's Alarm List menu at the end of the test.

Operating Theory

Frozen Loads (Setpoint at -10 C [14 F] and Below)

The unit operates on Full Cool and Null to provide accurate control of frozen cargo. The controller uses the return air sensor temperature and setpoint temperature to regulate unit operation.

If the return air sensor becomes disconnected or fails, the controller uses the supply air sensors plus an offset for temperature control.

Cooling Capacity Display in Main Screen

The percent displayed in the main screen indicates the cool capacity that is currently provided.

High Temperature Protection

If the discharge gas temperature rises above 148 C (298 F), the unit stops immediately. The controller turns on the Alarm LED and records Alarm Code 56 (Compressor Temperature Too High) and Alarm Code 146 (Compressor 2 Temperature Too High). The controller will restart the unit when the sensor temperature is below 138 C (280 F).

Probe Test

The controller constantly monitors t supply sensor, return sensor and evaporator coil sensor to determine when to initiate a demand defrost. If a demand defrost is requested and defrost has occurred within last 90 minutes, the controller initiates a probe test to check for a defective sensor.

During a Probe test, the Display shows “PROBE TEST PLEASE WAIT”. The controller operates the unit on high speed evaporator fans only for 5 minutes. All sensor temperatures are then compared.

- Sensors with large temperature differences are discarded from the control algorithm. The controller then activates the appropriate Alarm codes to identify the defective sensor(s).
- If no sensors are found defective, controller display shows “RUNNING WITH HIGH SUPPLY DIFFERENCE” warning.

Sensor errors recorded during a probe test are cleared when the next Defrost is initiated or UNIT ON/OFF switch is turned OFF.

Note: *A manual probe test can be performed by a technician by selecting “SENSOR CHECK” from the Manual Test Function menu.*

Continuous Temperature Control Operation

Frozen Loads — Controller Setpoint at -10 C (14 F) and Below

The controller regulates compressor operation based the return air sensor and setpoint temperatures to determine operating mode switch points. The controller operates the unit on:

- Cool mode
- Null mode
- Defrost mode
- Evaporator fans operate on low speed to continuously circulate air inside the container (except during defrost).
- Controller LED display shows the return air sensor temperature.
- Controller LCD display shows the setpoint.

Cool

- After initial start-up and pull-down to 1.0 C (1.8 F) below setpoint, the controller calls for the Cool mode whenever the return air temperature increases more than 1.0 C (1.8 F) above setpoint.
- Unit operates in Cool mode for a minimum of 6 minutes to prevent rapid cycling between Cool and Null.
- After initial pull-down to setpoint, the controller keeps the In-range LED ON as long as the return air temperature remains less than 1.5 C (2.7 F) above setpoint.

Null

- The controller calls for Null when the Return Air Temperature decreases more than 1.0 C (1.8 F) below setpoint.

- The controller de-energizes the compressor contactors and condenser fan contactor, stopping the both compressors and the condenser fan.
- Units remains in Null mode for a minimum of 6 minutes to prevent rapid cycling between Cool and Null.
- The evaporator fans continue to operate in low speed.

Defrost

During the Cool or Null modes, the controller initiates the Defrost mode when the evaporator coil sensor temperature is below 18 C (65 F) and:

- Demand defrost function determines that defrost is required when the temperature difference between the return air sensor and setpoint increases to a preset value and a minimum of 6 hours of compressor ON (running) time have elapsed since the previous defrost.
- A manual defrost is initiated by pressing the Defrost special function key or by Refcon Remote Monitoring Modem (RMM).

  Note: *If unit operating conditions do not allow the unit to enter a defrost cycle, "Defrost Not Activated" appears on VGA display when the DEFROST key is pressed.*
- A Timed Defrost always starts at 1 minute past the hour immediately following a defrost timer request for defrost. For example, if the defrost timer requests a defrost cycle at 7:35, the defrost cycle will start at 8:01. The datalogger will record a Defrost event for each log interval in which a Defrost cycle is pending or active (i.e. both the 8:00 and 9:00 data logs on 1 hour logging interval).
- On Frozen Loads, the initial time interval is 12 hours. Six (6) hours are added to the time interval each time a timed defrost interval occurs without a demand defrost in between. Maximum accumulated time interval is 36 hours. Time interval resets to 12 hours when setpoint is changed more than 5 C (9 F); or if the unit is turned OFF for 12 hours.

When the defrost mode is initiated:

- The controller de-energizes both the R-134a and R-23 compressor contactors, the condenser fan contactor and the evaporator fan contactors; stopping the compressors, condenser fan and evaporator fans.
- When the compressors stop, the controller turns ON the heater output, turning on the electric heaters.

The controller terminates the defrost mode when:

- Frozen mode: Evaporator coil sensor temperature reaches 18 C (65 F).
- Time/temperature function: If the evaporator coil sensor exceeds 8 C (47 F) for 15 minutes, the controller terminates defrost.
- Interval timer: Controller terminates defrost 90 minutes after initiation if the coil sensor temperature has not terminated defrost (120 minutes if power supply is less than 55H). Alarm code 20 will be generated if this occurs.
- When the controller terminates Defrost, the heater contactor is de-energized. The controller starts the condenser fan and the R-134a compressor. After 30 seconds, the controller starts the R-23 compressor and the evaporator fans to minimize heat energy release into the container.

Data Recording and Downloading Data

The data logger can record sensor temperatures as well as loss of power, alarms, sensor failure, setpoint change and unit shutdown events. All data logs include the time and date; setpoint temperature; supply, return, ambient, USDA1, USDA2, USDA3. All temperature logs can be viewed from the controller's VGA message display.

Data logging intervals are selectable for 1 minute, 5 minutes, 10 minutes, 15 minutes, 30 minutes, 1 hour. 2 hours or 4 hours.

When a 1 hour logging interval is selected, the data logger memory can store approximately 680 days of information. The logging of USDA sensors is fixed at 1 hour intervals to comply with USDA requirements. A logging test of USDA sensors at 1 minute intervals is possible for 72 minutes. USDA data can not be downloaded during the logging test and can only be viewed on screen. After 72 minutes, controller returns to previous logging interval and clears USDA test data from data logger memory.

If the unit power supply is disconnected, the data logger will continue to register 100 temperature logs when battery voltage is above 4.2 volts. These will be maintained until the unit is re-connected to power, and the battery automatically recharged.

Trip data can be retrieved (but not erased) from the data-logger memory using a LOGMAN II handheld data retriever, LOGMAN II PC used on a laptop PC or a REFCON power line remote monitoring system. LOGMAN II data transfer rate

based on a 1 hour log interval is about 15 seconds per month of event logs and about 70 seconds per month of temperature logs. For example, downloading 90 days of data logs would take about 95 seconds for event logs only and about 210 seconds for temperature logs only.

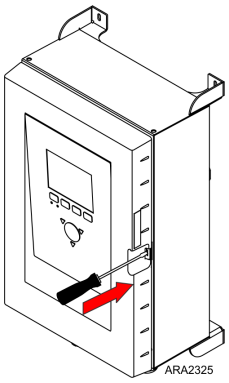
Trip data from separate units is denoted by the identification information entered into the controller at the beginning of the trip via the general purpose keypad. Identification data may include the container ID number, location B.R.T., contents, loading data, voyage no., ship, load port, discharge port and comments. The container ID number is stored in the Configuration submenu.

Controller Maintenance

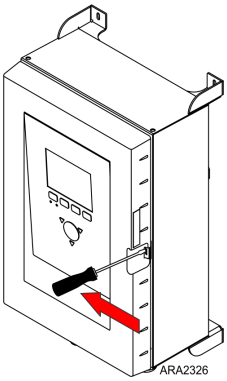
Controller Door Open and Close Instructions

Open

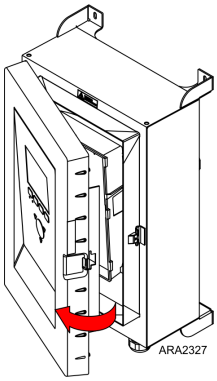
Insert a flat blade screwdriver into slot on side of control box door.



Move the screwdriver handle to the left to release the door catch from the box latch.

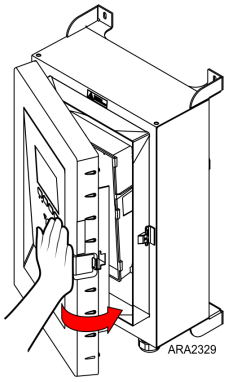


With the door catch released, pull door out and open.

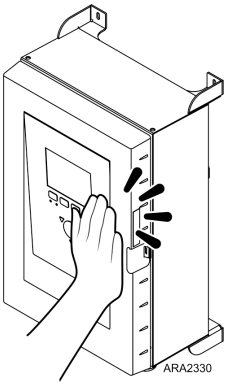


Close

Push firmly until a click sound is heard.



With hand, rap the door to confirm it is closed properly.



Flashloading Controller Software

Controller software must be flashloaded when software has been revised. Flashload software using the following procedure.

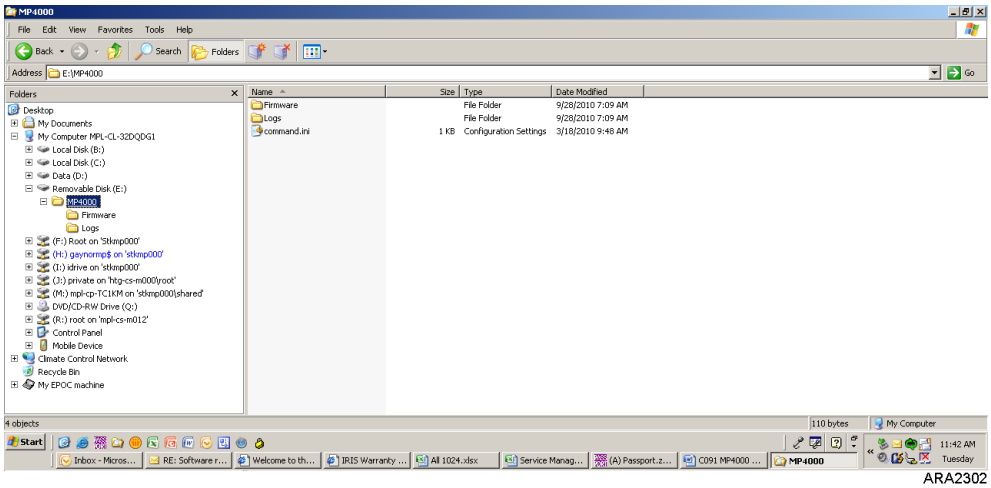
Download the latest software file from Global Marine Solution Info Central site/Software Update/MP4000. The CM4000 zip file will contain the latest software and command.ini file. Unzip them to a local drive.

SD Card Setup Structure

1. Verify the SD card is in the un-lock or writeable mode. Small tab on side slide forward is un-locked.
2. If card is new, format card so it is clean.
3. Create a new directory on the SD card titled MP4000. In the MP4000 directory, create two new sub directories titled Firmware and Logs.
4. Copy the command.ini file into the /MP4000 directory of the SD card.
5. Copy the latest software file (.strip) into the \ MP4000 \ Firmware sub directory. Refer to (Figure 28, p. 80 and Figure 29, p. 80).

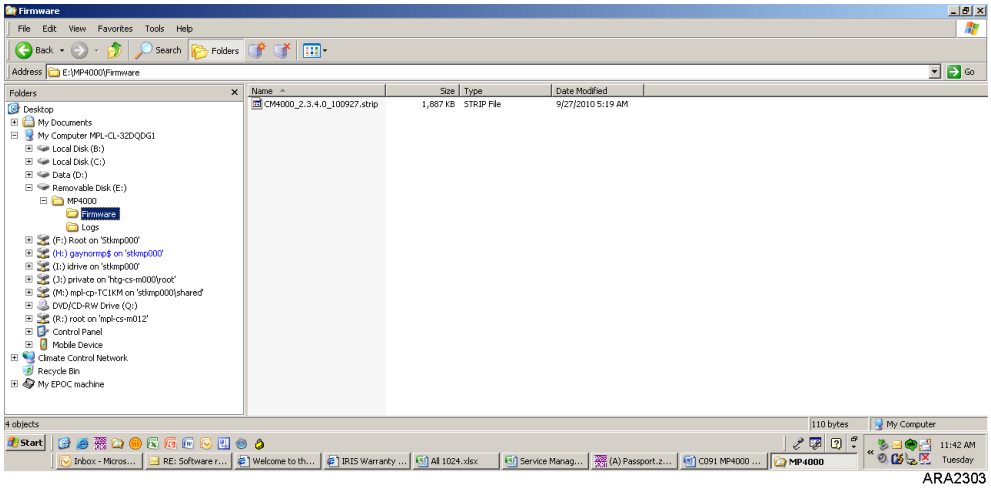
/ MP4000 / command.ini 3/18/2010 / Logs (Downloads will appear here) / Firmware CM4000_3.2.0.0_140822.strip

Figure 28. MP4000



ARA2302

Figure 29. MP4000/Firmware



ARA2303

Software File Format SIP

In version 3.0.0.0 the SIP file format was introduced for adding options like RMM to the unit. Version 3.1.0.0 120612 and later were released in this SIP format (e.g., CM4000_3.1.0.0.120612.srip.sip). In order to load version 3.1.0.0 or later software, the MP4000 controller needs to have 3.0.0.0 software installed first. Load to SD Card file contains both 3.0.0.0 and 3.1.0.0 or later software.

If controller has 3.0.0.0 software installed, insert SD card to load 3.1.0.0 or later. If controller has 2.5.4.0 or older software, insert SD to load 3.0.0.0 software, then reinsert SD card to load 3.1.0.0 or later software.

The MP4000 controller can be flashloaded using battery power or shore power. If the SD Card is not configured correctly, the MP4000 will display Command files not found.

ARA2331

Battery Power Flashload Procedures

1. Verify the unit is not active (no display).

2. Insert the SD card, with the latest software, into the slot on the side of the controller.
3. Activate the display using battery power by pushing the ON/OFF button. If the software on the SD card is newer then what is on the controller, the upload will take place and progress can be shown on the display.
4. When finished the display will shut down and the operation is finished.

Shore Power Flashload Procedures

1. Plug unit in and turn unit ON, let unit stabilize.
2. Insert SD card, with the latest software, into the slot on the side of the controller.
3. If the software on the SD card is newer then what is on the controller the display will show, PLEASE WAIT... EXACTING COMMAND FILE, then UPDATE FIRMWARE, then PREPARING, then UPDATING FIRMWARE 0-100%.
4. Once it shows 100%, unit will shut down and restart. Will show normal display and perform a AUTO CONFIGURATION, then normal start sequence.
5. Remove SD card and release unit.

Note: *After completing the flashload, check to verify the new Software/Application Revision and Option File Revision have been loaded. If not, reinsert the SD card to load the Option File. If it is still not showing the correct software revisions, turn controller OFF and back ON and recheck the software revisions.*

MP4000 Test System Tool

The MP4000 Test System Tool has the ability to test the following components:

- Controller Module (CM)
- Power Module (PM)
- Interconnect Cable
- Keypad
- Displays

Important: *As of February 1st, 2012, no failed Controller Module (CM) or Power Module (PM) will be accepted under Warranty without a 'Failed Component' report accompanying the claim and the part. The tester program generates this report. If no report is included on the claim it will be rejected. If no report is included with the part the part will be returned (at the sending location cost).*

Tool comes with all necessary test plugs required to perform all tests noted above. Software will be located on the JCI web site. www.myrefcon.com/support/mp-4000-tester/

The Tool is sold through Emerson Controls.

Ordering information (Contact)
Wilmor Halamani
Email: Wilmor.Halamani@Emerson.com
Phone 45 70234444
Fax 45 70236044.

1 MP-4000 Test System (item no. 8232- 010)
Delivery terms: ex works
Delivery mode: DHL
Delivery time: 2-3 days upon receipt of order
Payment terms: 14 days net

Please state purchase order number, invoice address and delivery address when ordering.

In the event of a MP4000 Tester Tool part failure, refer to the following information for replacement.

All of the test plugs are covered under warranty for one (1) year from date of purchase by Emerson Controls. To order a replacement test plug, please provide the following information:

- Part number of plug to be replaced.
- Original purchase date of test tool and serial number.
- Company name and shipping address.

- Contact Thermoking Aftermarket to order.

Controller Module Test Plugs
Analog 2 #J1 1934-001
Analog 3 #J3 1934-002
Analog 1 #J4 1934-003
Digital 1 #J9 1934-004
Com 2=3 J28=J2 1934-005

Power Module Test Plugs
PM test Adaptor #J1 1934-007

Expansion Module
Test Module 1934-006

Controller Replacement

1. Turn the Unit ON/OFF switch OFF.
2. Turn the unit 460/380V main circuit breaker off.

⚠ DANGER

Hazardous Voltage!

The unit will automatically start and operate if 460/380V power is present at the main power module when the controller is disconnected. Disconnect the supply power to the unit before replacing the controller to prevent personal injury from rotating machinery or dangerous electrical shock from high voltage controls.

3. Disconnect the unit power cord from the power supply.
4. At the same time, remove the controller from the door.
5. Install the replacement controller in the door.
6. Connect the keyboard cable to the controller.
7. Connect the Harness to the controller.
8. Recheck all connector plugs to verify they are fully seated.
9. Review the Configuration Menu instructions in the operating section. Reset information as required.
10. Review the Miscellaneous Functions Menu instructions in the operating section. Reset information as required.

Notes:

1. *Enter the container ID before releasing the unit for service. The container ID is required to identify the data downloaded from the controller datalogger.*
2. *Several programmable features may need to be set to completely configure the unit to customer specifications. Adjust any additional programmable settings to customer requirements before releasing the unit for service.*

Electrical Maintenance

Unit Wiring

Inspect unit wiring, wire harnesses, and the controller during pre-trip inspection and every 1,000 operating hours to protect against unit malfunctions due to open or short circuits. Look for loose, chaffed or broken wires on the unit; open or short circuits and damaged components on the controller printed circuit board.

Inspect electrical contactor points for pitting or corrosion every 1,000 operating hours. Repair or replace as necessary.

High Pressure Cutout Switch

A high pressure cutout switch is located on the compressor discharge service manifold of each compressor. If a high pressure cutout switch is suspected of being defective, replace it with a known good switch.

R-23 High Pressure Cutout Switch

If the R-23 compressor discharge pressure rises above 3250 ± 50 kPa, 32.5 ± 0.5 bar, 470 ± 7 psig, the high pressure cutout opens to interrupt the ground circuit to the compressor contactor:

- R-23 compressor STOPS immediately.
- LCD Display Message: No response to R-23 high pressure cutout.
- Evaporator and condenser fans and R-134a compressor continue normal operation.
- R-23 compressor will restart when the overload condition is corrected (switch closes) as long as power is available. The high pressure switch resets (closes) when the pressure drops to 2590 ± 250 kPa, 25.9 ± 2.5 bar, 375 ± 38 psig.

R-134a High Pressure Cutout Switch

If the R-134a compressor discharge pressure rises above 2410 ± 68 kPa, 24.1 ± 0.68 bar, 350 ± 10 psig, the high pressure cutout opens to interrupt the ground circuit to the compressor contactor:

- R-134a compressor STOPS immediately.
- LCD Display Message: R-134a high pressure cutout feedback missing.
- Evaporator and condenser fans continue normal operation.
- R-23 compressor stops.
- R-134a compressor will restart when the overload condition is corrected (switch closes) as long as power is available. The high pressure switch resets (closes) when the pressure drops to 1640 ± 68 kPa, 16.4 ± 0.68 bar, 238 ± 10 psig.
- R-23 compressor will restart 30 seconds after R-134a compressor restarts.

Low Pressure Transducer R23

A low pressure transducer R23 is located on the compressor suction line. The low pressure transducer R23 stops compressor: -33 to -54 kPa, -0.33 to -0.54 bar, 10 to 16 in. Hg vacuum; starts compressor: 24 to 58 kPa, 0.24 to 0.58 bar, 3.5 to 8.5 psig. If the suction pressure becomes too low, the low pressure transducer R23 stops compressor.

- Compressor stops immediately.
- Evaporator and condenser fans continue normal operation.
- Compressor will restart if the low refrigerant condition is corrected as long as power is available. The low pressure transducer R23 stats the compressor when the pressure increase to 24 to 58 kPa, 0.24 to 0.58 bar, 3.5 to 8.5 psig.

Removal

1. Disconnect the low pressure transducer R23 wires from the control box.
2. Remove the low pressure transducer R23 from the suction line. The fitting on the suction line has a shrader valve which will prevent refrigerant leakage.

Installation

1. Install low pressure transducer R23 in the suction line.

2. Route wires into the control box and connect to proper terminals.
3. Perform a controller pretrip test to verify system operation.

Pressure Transducer (Sensor)

The sensors are located on the discharge or suction tubes near the compressor. The controller will display the actual discharge or suction system pressure. The display will show a reading and a bar graph.

To configure a sensor in the unit, refer to ("Configuration Menu," p. 61).

Removal

1. Disconnect the sensor from the control box.
2. Remove the sensor from the discharge or suction tube. The fitting on the line has a Schrader valve which will prevent refrigerant leakage.

Installation

1. Apply Locktite to fitting threads (Red 277).
2. Install sensor on fitting.
3. Route wire harness to control box and connect in accordance with wiring diagram.

Condenser Fan and Evaporator Fan Rotation

Note: *If both the condenser fan and evaporator fans are rotating backwards, diagnose the automatic phase selection system.*

Check Condenser Fan Rotation

Check for proper condenser fan rotation by placing a small cloth or sheet of paper against the condenser fan grille on the front of the unit. Proper rotation will blow the cloth or paper away from the grille. Improper rotation will hold the cloth or paper against the grille.

If the condenser fan is rotating backwards, refer to the unit wiring diagram to correct fan motor wiring at the fan motor junction box or condenser fan contactor. To correct improper fan rotation, reverse any two fan power cord leads at the condenser fan contactor (disconnect power supply before reversing leads). Do not move the CH ground wire.

Check Evaporator Fan Rotation

Visually inspect the evaporator fan blades for proper rotation. Arrows located on the underside of the fan deck indicate the correct direction of rotation.

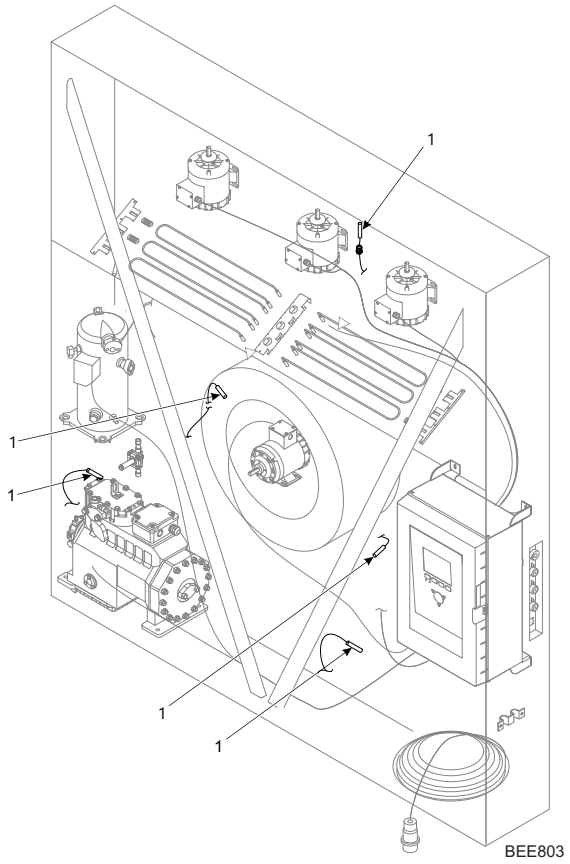
Check both high and low speed evaporator fan rotation by performing Evaporator High and Evaporator Low tests from the Manual Function Test menu.

If an evaporator fan is rotating backwards on one or both speeds, refer to the unit wiring diagram to correct motor wiring at the fan motor junction box or evaporator fan contactor (disconnect power supply before reversing leads). Do not move the ground wire which is labeled CH.

Temperature Sensors

Thermistor type temperature sensors are used. Each sensor is connected to a cable and placed in a sealed stainless steel tube. The temperature signal from the sensor is transmitted through the cable. Temperature sensors include the following:

- Supply Air
- Return Air
- Evaporator Coil
- Compressor LT Discharge Temperature Sensor
- Compressor HT Discharge Temperature Sensor
- Ambient Air



1	Temperature Sensors

Sensor Installation

All sensors should be properly installed as follows:

- Supply air sensors must be inserted to the bottom of the sensor tube and completely sealed by the grommet connection.
- Return air sensor installs in a grommet between the evaporator fans.
- Evaporator coil (defrost) sensor must be placed in the middle of the coil and 75 mm deep between the fins.
- Ambient sensor must be placed on the bottom plate of the right forklift pocket.
- Compressor discharge pressure transducer is attached to compressor head by adhesive. Refer to ("Pressure Transducer (Sensor)," p. 84).

Sensor Testing

The controller constantly monitors the left hand and right hand supply sensors, return sensor and defrost (evaporator coil) sensor to determine when to initiate a demand defrost. If a demand defrost is requested and defrost has occurred within the last 90 minutes, the controller initiates a probe test to check for a defective sensor.

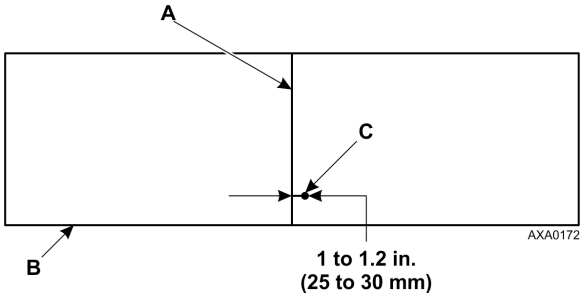
During a Probe test, the VGA display shows [PROBE TEST PLEASE WAIT]. The controller operates the unit on high speed evaporator fans only for five minutes. All sensor temperatures are then compared.

- Sensors with large temperature differences are discarded from the control algorithm. The controller then activates the appropriate Alarm codes to identify the defective sensor(s).

Sensor errors recorded during a probe test are cleared when the next Defrost is initiated or Unit On/Off switch is turned Off.

Note: *A manual probe test can be performed by a technician by selecting "SENSOR CHECK" from the Manual Test Function menu.*

Evaporator Coil (Defrost) Sensor Location



A	Coil Support Bracket
B	Front of Unit
C	Insert sensor at least 75 mm into coil between tube rows 2 and 3.

Resistance Values for Temperature Sensors

Sensors are permanently calibrated and can be checked using an ohmmeter. Ohm readings should agree with the data shown in the following sensor resistance tables.

Table 11. Supply, Return, Evaporator Coil

°F	°C	Ohms	°F	°C	Ohms
-40	-40	842,9	53.6	12	1046,8
-31	-35	862,5	57.2	14	1054,6
-22	-30	822,2	60.8	16	1062,4
-13	-25	901,9	64.4	18	1070,2
-4	-20	921,6	68	20	1077,9
5	-15	941,2	71.6	22	1085,7
10.4	-12	956,9	75.2	24	1093,5
14	-10	960,9	78.8	26	1101,2
17.6	-8	968,7	82.4	28	1109,2
21.2	-6	976,5	86	30	1116,7
24.8	-4	984,4	89.6	32	1124,5
28.4	-2	992,2	93.2	34	1132,2
32	0	1000,0	96.8	36	1139,9
35.6	2	1007,8	100.4	38	1147,7
39.2	4	1015,6	104	40	1155,4
42.8	6	1023,4	107.6	42	1163,1
46.4	8	1031,2	111.2	44	1170,8
50	10	1039,0	113	45	1174,7

Table 12. Ambient Air Sensor

°F	°C	Ohms	°F	°C	Ohms
-40	-40	42618	53.6	12	3360
-31	-35	32198	57.2	14	3094
-22	-30	24532	60.8	16	2852
-13	-25	18850	64.4	18	2632
-4	-20	14618	68	20	2431

Table 12. Ambient Air Sensor (continued)

°F	°C	Ohms	°F	°C	Ohms
5	-15	11383	71.6	22	2347
10.4	-12	9838	75.2	24	2079
14	-10	8941	78.8	26	1925
17.6	-8	8132	82.4	28	1785
21.2	-6	7406	86	30	1657
24.8	-4	6752	89.6	32	1539
28.4	-2	6164	93.2	34	1430
32	0	5634	96.8	36	1330
35.6	2	5155	100.4	38	1239
39.2	4	4721	104	40	1154
42.8	6	4329	107.6	42	1076
46.4	8	3907	111.2	44	1004
50	10	3652	113	45	970

Table 13. Compressor Discharge Sensors R32

°F	°C	Ohms	°F	°C	Ohms
-13	-25	1,121,457	185	85	9,202
-4	-20	834,716	194	90	7,869
5	-15	627,284	203	95	6,768
14	-10	475,743	212	100	5,848
23	-5	363,986	221	105	5,091
32	0	280,824	230	110	4,446
41	5	218,406	239	115	3,870
50	10	171,166	248	120	3,354
59	15	135,140	257	125	2,924
68	20	107,440	266	130	2,580
77	25	86,000	275	135	2,279
86	30	69,282	284	140	2,021
95	35	56,158	293	145	1,797
104	40	45,812	302	150	1,591
113	45	37,582	311	155	1,393
122	50	30,986	320	160	1,247
131	55	25,680	329	165	1,118
140	60	21,397	338	170	1,015
149	65	17,914	347	175	920
158	70	15,067	356	180	834
167	75	12,728	365	185	748
176	80	10,793	374	190	679

Table 14. Compressor Discharge Sensors R134a

°F	°C	Ohms	°F	°C	Ohms
32	0	351017	158	70	15502
35.6	2	315288	161.6	72	14410
39.2	4	283558	165.2	74	13405
42.8	6	255337	168.8	76	12479
46.4	8	230210	172.4	78	11625
50	10	207807	176	80	10837
53.6	12	187803	179.6	82	10110
57.2	14	169924	183.2	84	9438
60.8	16	153923	186.8	86	8817
64.4	18	139588	190.4	88	8242
68	20	126729	194	90	7710
71.6	22	115179	197.6	92	7216
75.2	24	104796	201.2	94	6759
78.8	26	95449	204.8	96	6335
82.4	28	87023	208.4	98	5941
86	30	79428	212	100	5574
89.6	32	72567	215.6	102	5234
93.2	34	66365	219.2	104	4917
96.8	36	60752	222.8	106	4623
100.4	38	55668	226.4	108	4348
104	40	51058	230	110	4092
107.6	42	46873	233.6	112	3854
111.2	44	43071	237.2	114	3631
114.8	46	39613	240.8	116	3423
118.4	48	36465	244.4	118	3229
122	50	33598	248	120	3047
125.6	52	30983	251.6	122	2877
129.2	54	28595	255.2	124	2718
132.8	56	26413	258.8	126	2569
136.4	58	24419	262.4	128	2430
140	60	22593	266	130	2299
143.6	62	20921	269.6	132	2176
147.2	64	19388	273.2	134	2118
150.8	66	17961	276.8	136	1953
154.4	68	16689	280.4	138	1852

Refrigeration Maintenance

Introduction

The following procedures involve servicing the refrigeration system. Some of these service procedures are regulated by Federal, and in some cases, by State and Local laws.

Note: *In the USA, EPA Section 608 Certification is required to work on refrigeration systems, using approved equipment and complying with all Federal, State, and Local laws. In the EU, local F-gas Regulations must be observed when working on refrigeration systems.*

Tools

NOTICE

System Contamination!

When servicing Thermo King R-134a, R-23, R-404A, R-452A or R-513A units, use only those service tools certified for and dedicated to R-134a/R-23/R-404A/R-452A/R-513A refrigerant and Polyolester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-134a/R-23/R-404A/R-452A/R-513A systems.Please check serial# plate for type and volume of Refrigerant charged. Please do not blend with other refrigerants than the original charged refrigerant

Vacuum Pump

A two-stage, three-stage, or five-stage pump is recommended for evacuation. Purging the system with dry nitrogen is recommended before evacuation. Because residual refrigerant may be present in used vacuum pumps, a new vacuum pump should be used and dedicated strictly as an R-134A refrigerant pump. Use only recommended vacuum pump oils and change oil after every major evacuation. Because vacuum pump oils are highly refined to obtain low vacuums, failure to follow these recommendations may result in acidic conditions that will destroy the pump.

Filters and Cartridges

Cleanup devices such as suction line filters and compressor oil filters may be used if they are properly cleaned and new filters and cartridges are used. All standard petroleum and synthetic compressor oils must be removed to prevent the contamination of R-134A systems.

Refrigerant Recovery Equipment

Use only refrigerant recovery equipment approved for and dedicated to HFC refrigeration recovery

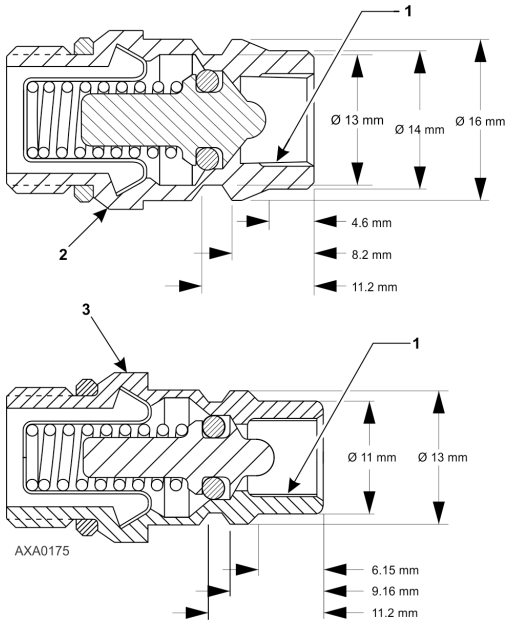
Detecting Leaks

Leaks can be detected with the use of soap bubbles and with Halogen leak detectors such as model H10G or model H10N (portable).

Special Service Fittings

Special fittings are used on HFC systems to prevent mixing of non-HFC refrigerants in HFC units. These fittings are located in three places on refrigeration systems:

- Low side near the compressor suction service valve (or suction adapter)
- High side near the compressor discharge service valve (or discharge manifold)
- Receiver Tank



1	Internal Threads for Cap
2	High Pressure Fitting
3	Low Pressure Fitting

Oil Acid Test

Perform an oil acid test (refer to Tool Catalog for oil test kit) whenever a unit has a substantial refrigerant loss, a noisy compressor or dark/dirty oil.

Checking Compressor Oil

The compressor oil should be checked during pretrip inspections and when there is evidence of oil loss (oil leaks) or when components in the refrigeration system have been removed for service or replacement.

Checking the Compressor Oil Level

Operate the unit on full COOL. After 15 minutes, observe the compressor oil level. The oil level should be 1/2 to 3/4 full in the sight glass of both compressors.

Adding Compressor Oil

1. Install gauge manifold set (refer to “Gauge Manifold Set Attachment and Purging”).
2. Do one of the following:
   a. R-134a Compressor: Pump the compressor down (refer to “Low Side Pump Down”).
   b. R-23 Compressor: Do NOT pump down a scroll compressor. Proceed to step 4 to add oil to a scroll compressor.
3. After stopping the compressor, adjust the low side pressure to 21 kPa, 0.21 bar, 3 psig using the service gauge set. (Pressure measured at the suction line service port.)
4. Remove the cap from oil pressure fitting on compressor.
5. Using a commercial hand pump, force oil in through the oil pressure fitting. Slowly add oil and allow 5 to 10 minutes for the oil to flow down through the compressor into the sump. Add Polyol Ester oil,
6. When the compressor oil sight glass is 1/2 to 3/4 full, remove hand pump and replace the cap on the oil pressure fitting.
7. R-134a Compressor: Open the compressor suction service valve (or liquid line service valve) and operate the unit. Recheck the refrigerant charge level and the oil level before returning the unit to service.

Removing Excess Compressor Oil

1. Install an access valve actuator on the oil pressure fitting.
2. Operate the unit and remove oil while watching the level in the compressor sight glass.

Note: *Heavy foaming of the oil as it leaves the compressor may indicate an excess of refrigerant in the oil. Remove the access valve actuator and operate the system for 15 minutes to ensure warm sump. Then recheck the oil level.*

3. When the compressor oil sight glass is 1/2 to 3/4 full, remove access valve and replace the cap on the oil pressure fitting.
4. Operate the unit and recheck the refrigerant charge level and the oil level before returning the unit to service.

Isolate Compressor

The discharge suction and digital ball service valves isolate the compressor from the high and low sides of the refrigeration system. Compressor isolation is needed for system diagnosis, service, and repair.

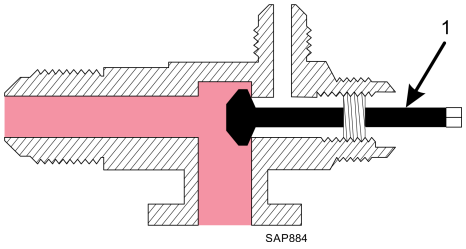
Note: *The valves are a permanently assembled unit and must be replaced in total if defective. The only maintenance possible on the discharge or suction service valve is to periodically tighten the packing nut or to replace the packing.*

⚠ WARNING

Hazard of Explosion!

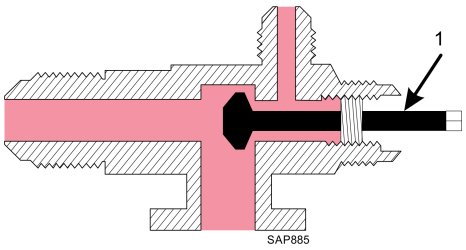
Do not start unit with discharge valve in front seated position.

Service Valve Back Seated (Operating Position)



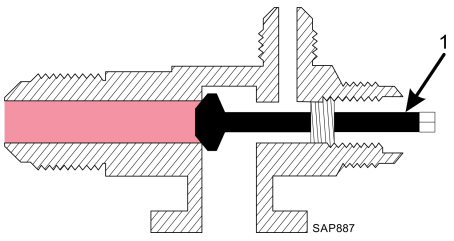
1	Full Counterclockwise

Service Valve Open to Port (Servicing Position)



1	1/2 Turn In

Service Valve Front Seated (Check or Remove Compressor)



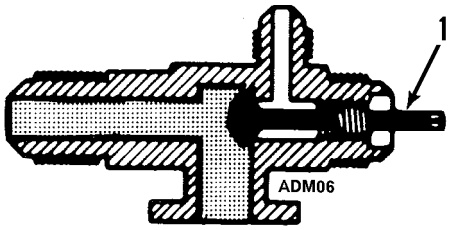
1	Full Clockwise

Service Valve Positions

The suction and discharge service valves provide connections for the gauge manifold to the compressor for system diagnosis, service, and repair. Familiarize yourself with these valve positions:

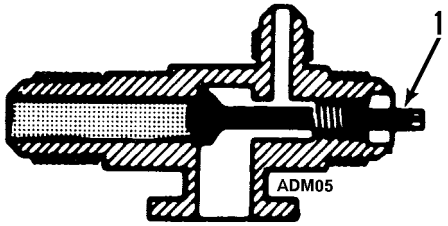
Back-seated: Normal operating position. The service valve is fully closed:

Figure 30. Valve Fully Counterclockwise (Back-seated)



Front-seated: Checking and removing the compressor. The service valve is open, and access to the system is closed:

Figure 31. Valve Fully Clockwise (Front-seated)



⚠ DANGER

Risk of Injury!

Anytime the suction service valve or the discharge service valve is front seated (closed), take precautions to ensure the unit and the bus will not accidentally start while you are servicing the system.

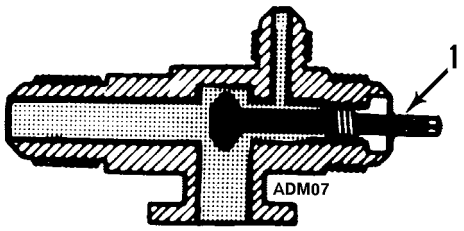
⚠ DANGER

Risk of Injury!

If the compressor is operated with the service valves closed, an explosion may occur that could result in serious injury or death.

Open to Service Port: Servicing position. Access to the system and the service ports:

Figure 32. Valve Turned Half Way In (Open to Service Port)



Gauge Manifold Connections

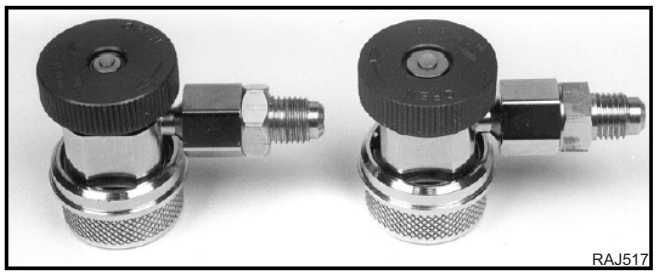
Before You Proceed

Note: *This procedure is only for units that contains R–134a refrigerant.*

Note: *To minimize refrigerant loss, use sealing-type quick connectors. These fittings restrict flow during evacuation.*

Read the following before you proceed with a gauge manifold connection.

- If a procedure requires the compressor to operate at a suction pressure below 5 inch vacuum (-17 kPa), place a jumper across the low pressure cutout switch to prevent compressor shutdown.
- Use of the quick disconnect access valve during evacuation increases the time required to reach the correct micron level.



2040791	Coupler - discharge, w/red knob
2040792	Coupler - suction, w/blue knob

Gauge Manifold Positions

The gauges indicate low and high side pressures. Operate one or both hand valves to perform the different service operations:

Figure 33. Hand Valves Open to Center Port

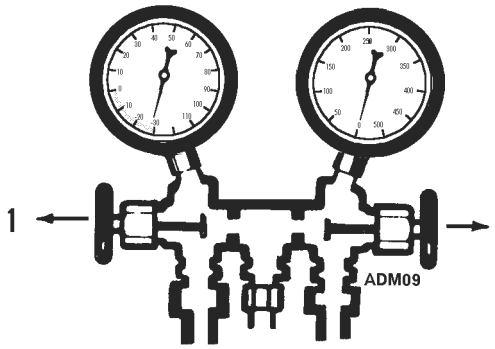
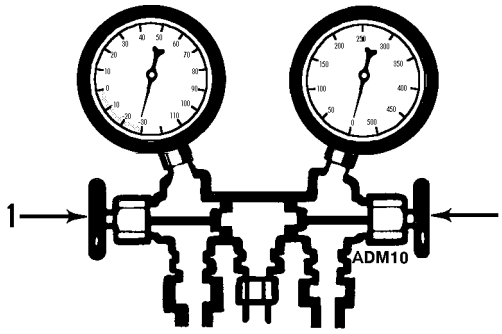


Figure 34. Hand Valves Closed to Center Port



Gauge Connections: Balancing Pressure, Removing Refrigerant, and Charging System

Figure 35. Balancing Pressure

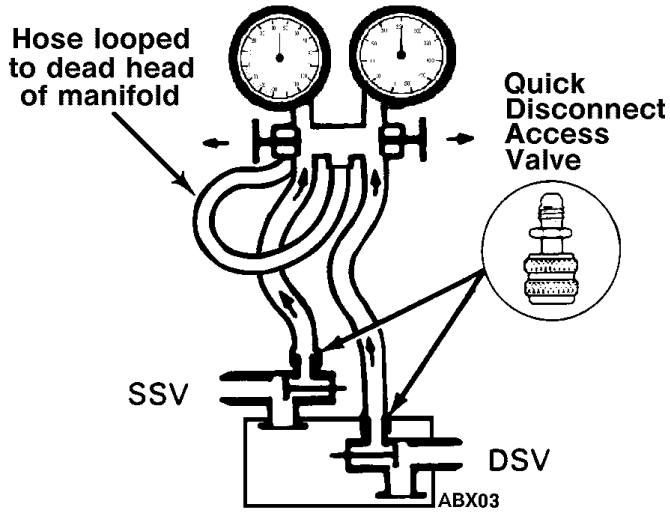


Figure 36. Removing Refrigerant

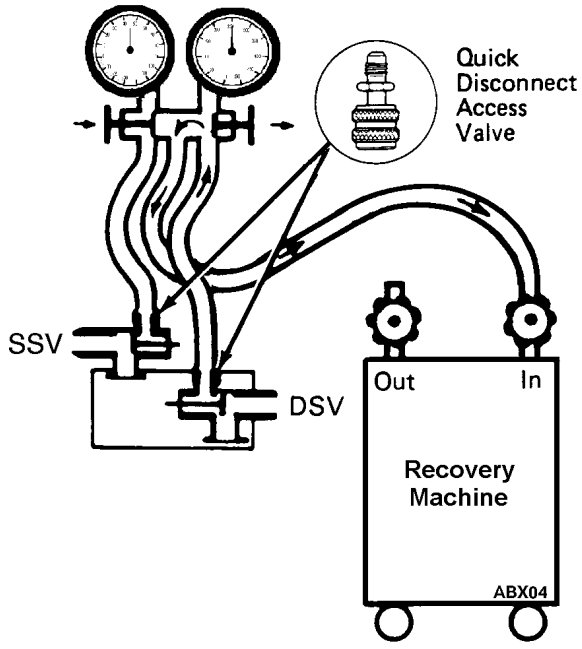
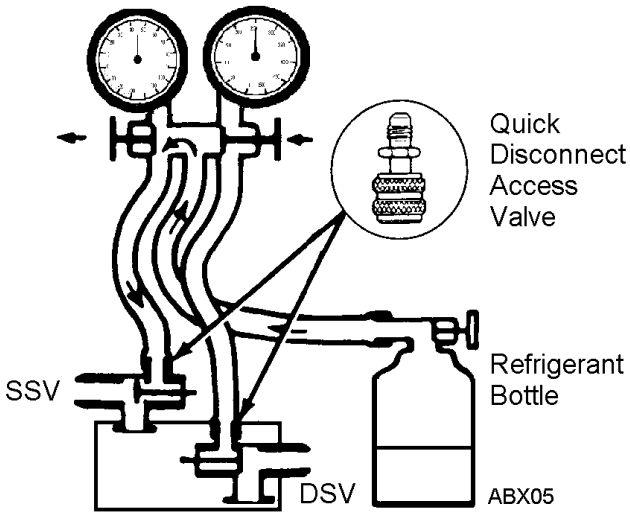


Figure 37. Charging the System



Low Side Pump Down (R-134a Compressor Only)

Note: *Do NOT pump down a scroll compressor. Reclaim the refrigerant when servicing the low side or high side of the R-23 refrigeration system.*

1. Install the gauge manifold on the compressor.
2. Set the controller setpoint temperature well below the return air temperature and operate the unit in the Cool mode until the temperature stabilizes (at least 5 minutes).
3. Close the receiver tank outlet valve. Allow the unit to operate until it reaches -15 to -40 kPa, -0.15 to -0.40 bar, 5 to 11 in. vacuum on the suction pressure gauge (3-5 minutes). Then shut the unit down manually with the On/Off switch.

NOTICE

Equipment Damage!

To prevent air and moisture contamination, do not open the low side of system while in vacuum.

4. To place the unit back in service, open the receiver tank outlet valve and turn the On/Off switch ON.

Gauge Manifold Set

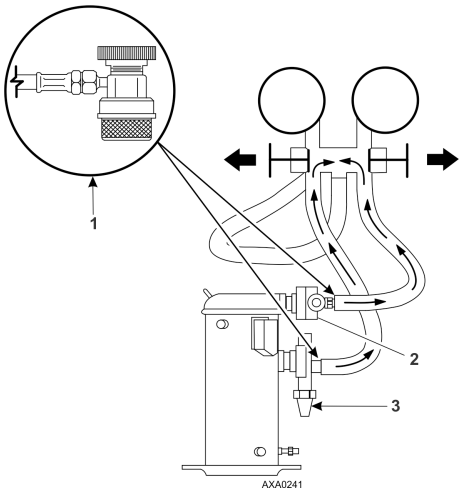
Using a New Gauge Manifold Set

A new gauge manifold set and gauge hoses (refer to Tool Catalog) should be dedicated for use with only R-134A refrigerant.

Gauge Manifold Valve Positions

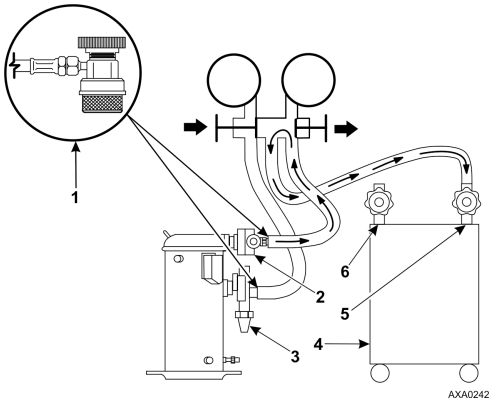
The gauges indicate low and high side pressures. Operate one or both hand valves to perform the different service operations.

Balancing the Pressure



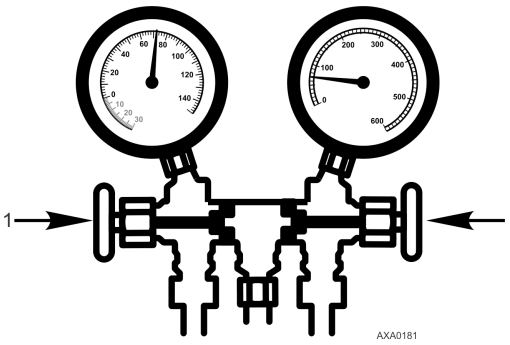
1	Quick Disconnect Access Valve
2	Discharge Service Valve (DSV)
3	Suction Service Valve (SSV)

Removing Refrigerant



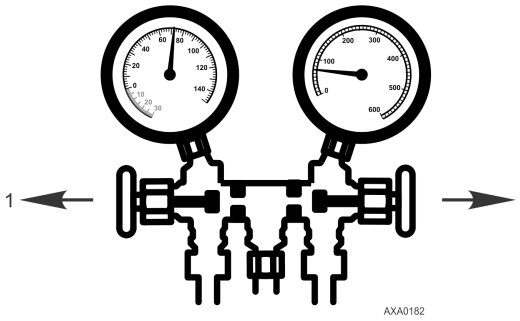
1	Quick Disconnect Access Valve
2	Discharge Service Valve (DSV)
3	Suction Service Valve (SSV)
4	Reclaimer
5	In
6	Out

Gauge Manifold Closed to Center Port



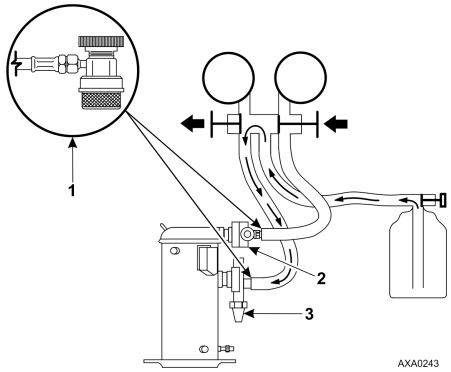
1	Close Hand Valves

Gauge Manifold Open to Center Port



1	Open Hand Valves

Charging the System



1	Quick Disconnect Access Valve
2	Discharge Service Valve (DSV)
3	Suction Service Valve (SSV)

Gauge Manifold Set Installation & Removal

Thermo King recommends the use of access valves or self-sealing, quick disconnect fittings. This limits the loss of refrigerant into the atmosphere. A separate gauge manifold set with low loss fittings (refer to Tool Catalog) should be dedicated for use with R-134A only. Gauge hoses should also be dedicated to R-134A.

Note: *Carefully check to verify that access connections are functioning properly when any of these devices are used.*

Installation

The following procedure purges the gauge hoses.The procedure must be followed when using new gauges or hoses for the first time. The system should be operating on Cool (10 psig [69 kPa] or greater suction pressure) when using this procedure to purge the low side hose. Gauge hoses may be removed and re-installed without additional purging so long as a slight positive pressure remains in the manifold and lines.

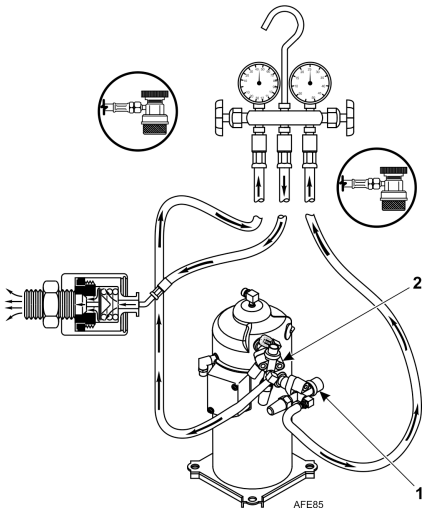
1. Inspect gauge manifold for proper hose and fitting connections.
2. Clean dirt and moisture from around service ports.
3. Remove small service port caps from suction and discharge service fittings. Save and reuse the caps and sealing washers or gaskets.
4. Rotate both hose coupler hand wheels counterclockwise to back the stem out of the high and low hose fittings. Attach low hose (compound gauge) to the suction line valve port.
5. Open the suction service manifold hand valve fully with 69 kPa, 0.69 bar, 10 psig or greater pressure in the low side (unit operating on Cool). Rotate the suction hose fitting hand wheel clockwise to open (depress) the suction line port valve to the low hose.
6. Slowly screw a 1/2 inch ACME fitting into the low loss fitting on the manifold's service (center) line to purge the suction and service hoses. Remove ACME fitting after purging.
7. Close the suction service manifold hand valve fully to center port.
8. Attach high side hose (pressure gauge) to the discharge service line port.
9. Open discharge service manifold hand valve fully. Rotate discharge fitting hand wheel clockwise to open (depress)

discharge line port valve to the high hose.

10. Slowly screw a 1/2 inch ACME fitting into the manifold's service (center) line to purge the high and service hoses. Remove ACME fitting after purging.
11. Close discharge service manifold hand valve fully to center port. You are now ready to use the gauge manifold to check system pressures or perform most service procedures.

Note: *These gauges may be removed and reinstalled without additional purging so long as a slight positive pressure remains in the manifold and hoses when removed from the unit.*

Purging Gauge Manifold



1	Suction Connection
2	Discharge Connection

Removal

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Protect your eyes from contact with refrigerant oil. The oil can cause serious eye injuries. Protect skin and clothing from prolonged or repeated contact with refrigerant oil. To prevent irritation, wash your hands and clothing thoroughly after handling the oil. Rubber gloves are recommended. When working with or around hazardous chemicals, ALWAYS refer to appropriate Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

Note: *THE SYSTEM SHOULD BE RUNNING to verify minimum refrigerant release to the atmosphere,. However, this is not possible in all cases, but the same procedure should be followed.*

1. Rotate discharge hose fitting hand wheel counterclockwise to withdraw the fitting stem from the discharge line port valve. Then open both service manifold valves to center port.
2. Operate the unit on Cool using the "CAPACITY 100 percent" test from the Manual Function Test menu of the controller.
3. Rotate the suction hose coupler hand wheel counterclockwise to withdraw the fitting stem from the suction line port valve. Then turn the unit off.
4. Remove the gauge lines from the suction and discharge service fittings and cap the service ports.
5. Secure all manifold lines to manifold hose anchors when the manifold is not in use.

Checking Refrigerant Charge

The refrigerant charge should be checked during pretrip and routine maintenance inspections. A low charge of refrigerant will cause the container temperature to rise due to the lack of liquid refrigerant at the expansion valve even though the unit is operating in a cooling mode. All units are charged with 4.0 kg (8.0 lbs) refrigerant at the factory. The refrigerant charge can be checked by inspecting the receiver tank sight glass.

1. Inspect the receiver tank sight glass with the unit operating in cool or modulation cool. If the ball floats in the bottom receiver tank sight glass when the compressor is engaged, the refrigerant charge level is correct.

NOTICE

Cargo Loss!

When adjusting the controller setpoint to check refrigerant charge, return controller to the setpoint indicated on the shipping manifest.

2. If the ball is not floating in the sight glass, the unit may be low on refrigerant charge. Adjust the controller setpoint to operate the unit on cool. Operate the unit on cool for five minutes. If the ball floats in the receiver tank sight glass, the refrigerant charge level is correct.
3. If the ball in the receiver tank sight glass does not float after operating the unit on cool for five minutes, the unit is low on refrigerant charge. With the unit operating on cool, add liquid refrigerant charge. With the unit operating in cool, add liquid refrigerant until the ball in the receiver tank sight glass floats in the sight glass.

   Note: *Inspect the unit for refrigerant leaks with a reliable leak detector if the unit is low on refrigerant charge.*

Checking the R-134a Refrigerant Charge

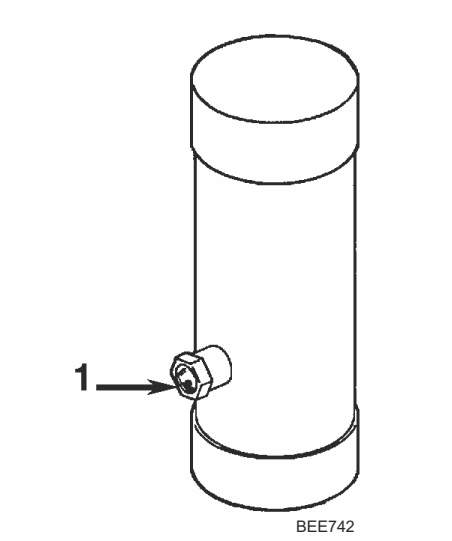
1. Inspect the receiver tank sight glass with the unit operating in COOL. If the balls FLOAT in the receiver tank sight glass, the R-134a charge level is correct.
2. If the balls are NOT FLOATING in the sight glass, the unit MAY be low on R-134a charge. Operate the unit on COOL for 5 minutes. If the balls float in the receiver tank sight glass, the R-134a charge level is correct.
3. If the balls do NOT FLOAT in the receiver tank sight glass after operating the unit on COOL for 5 minutes, the unit is low on R-134a charge. With the unit operating on COOL, add liquid R-134a until the balls FLOAT in the sight glass.

⚠ CAUTION

Service procedure!

When adding R-134a to the unit, STOP adding refrigerant when the balls float near the TOP of the sight glass. Continuing to add refrigerant after the balls float at the top of the sight glass will OVERCHARGE the unit. If necessary, recover refrigerant until the balls no longer float at the top of the sight glass.

Figure 38. R-134a Refrigeration System Receiver Tank



1.	Refrigerant charge is OK if the ball floats at any time: • If the ball does NOT float, the R-134a refrigeration system is unit is low on refrigerant		

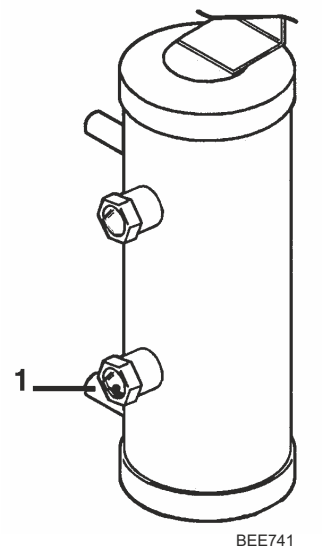
Checking the R-23 Refrigerant Charge

The R-23 refrigerant charge should be checked with the container empty, the unit OFF and all refrigeration system components above -5 °C (23 °F). The R-134a compressor must not have been operated within the past 30 minutes and there must not be frost on the plate-type R-134a / R-23 heat exchanger tubing.

Observe both the suction and discharge pressures. With the unit OFF, the suction and discharge readings should be equal. The R-23 refrigerant pressure in a fully charged system with the unit OFF will vary with the ambient temperature:

Ambient Temperature	R-23 System Pressure
O °C (32 °F)	1600 kPa, 16 bar, 232 psig
20 °C (68 °F)	1700 kPa, 17 bar, 247 psig
38 °C (100 °F)	1800 kPa, 18 bar, 261 psig

Figure 39. R-23 Refrigeration System Receiver Tank



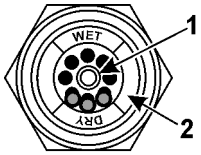
1.	The bottom sight glass ball will rarely float on a fully charged system during normal operation. • Check the refrigerant charge based on the R-23 system pressure with the container empty, the unit OFF and all refrigeration system components above ***Note:*** *Use the lower sight glass to check or add refrigerant only on a operating unit that is unable to maintain a -55 C to -65 C (-62 F to -94 F) low temperature.*		

- Correct Refrigerant Charge: If the R-23 system pressure stabilizes between 1500 and 2000 kPa, 15 and 20 bar, 220 and 290 psig, the unit will be fully functional. The R-23 refrigerant charge requires no adjustment.
- Low Refrigerant Charge: If the R-23 system pressure stabilizes between 1000 and 1500 kPa, 10 and 15 bar, 145 and 220 psig, the unit cooling capacity will be reduced but the unit should be able to maintain a -55 C to -70 C (-62 F to -94 F) load temperature. Additional R-23 should be added if possible, but do NOT add by operating the unit.
- Over Charge of Refrigerant: If the R-23 system pressure stabilizes above 2000 kPa, 20 bar, 290 psig, the R-23 system is overcharged and may cause the compressor to stop on high pressure cutout when started to precool a warm container. Remove refrigerant until the system pressure stabilizes at 2000 kPa, 20 bar, 290 psig or below.

Note: *Use the lower receiver tank sight glass to check or add refrigerant only on an operating unit that is unable to maintain a -55 °C to -70 °C (-62 °F to -94 °F) load temperature.*

Receiver Tank Sight Glass

The receiver tank contains a sight glass which has three small balls that indicate the level of refrigerant in the tank for checking the refrigerant charge. A moisture indicator in the sight glass changes color to indicate the level of moisture in the system. Check the color of the indicator against the color decal in the sight glass. The dry eye in the sight glass is light green when the system is dry and yellow when the system is wet (contains excessive moisture).



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1	Moisture Indicator: Light Green = Dry Yellow = Wet
2	Outer ring is color coded. Compare to indicator.

Leak Testing Refrigeration System

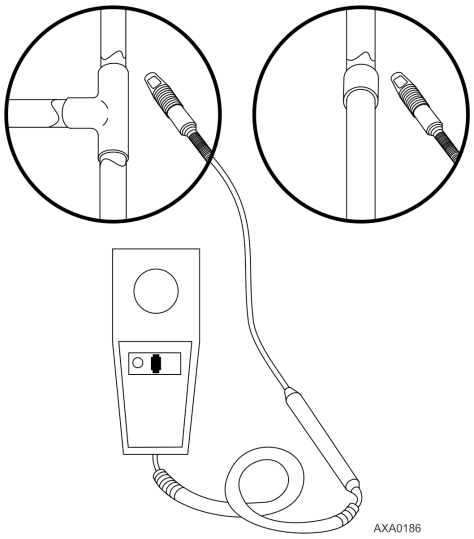
Use a reliable Halogen leak detector such as model H10G (refer to Tool Catalog), to leak test the refrigeration system. Inspect carefully for signs of compressor oil leakage which is the first sign of a leak in the refrigeration system.

Note: *Due to environmental concerns and personal safety, the use of a Halide torch is no longer recommended.*

If refrigerant has leaked or been removed from the unit:

1. Check entire system for possible component damage and refrigerant oil loss.
2. Attach gauge manifold set (Refer to "Gauge Manifold Set," p. 95 for proper procedures).
3. Attach refrigerant bottle charging hose to center of gauge manifold and purge charging hose of air.
4. Pressurize the system with refrigerant (gas only) until 345 kPa, 3.45 bar, 50 psig vapor pressure is achieved.
5. Leak check the system with an electronic leak detector to inspect all joints and connections (Use soap solution as an alternative test component). If no leaks are found but the system has lost its refrigerant charge, proceed to the next step.
6. Close both hand valves on gauge manifold (front seated).
7. Disconnect the refrigerant charging hose.
8. Connect the charging hose to a source of nitrogen. Adjust the pressure regulator to 1380 kPa, 13.80 bar, 200 psig. Refer to ("Using Pressurized Nitrogen," p. 103).
9. Pressurize the system with nitrogen to 1380 kPa, 13.80 bar, 200 psig.
10. Close the supply valve on the nitrogen bottle.
11. Use an electronic leak tester to inspect all joints and connections. Use a soap solution as an alternative test component.

    Note: *If system leakage is indicated, loosen supply line hose fittings to release pressure. Repair leakage condition.*
12. If system repair is necessary, recheck system after repairs are completed.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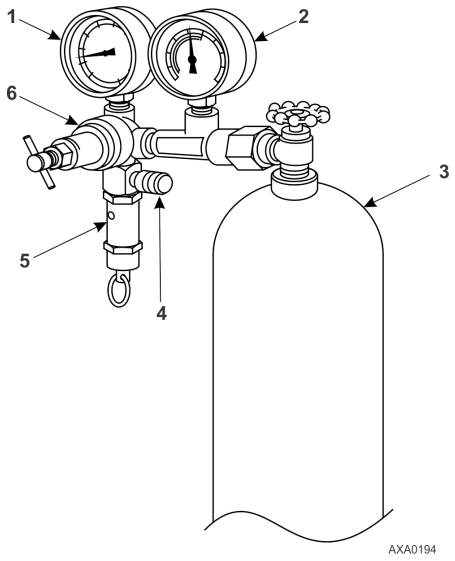
Using Pressurized Nitrogen

The improper use of high pressure cylinders can cause physical damage to components, or personal injury, or cause stress that would lead to failure of components.

Typical Pressurized Gas Bottle



1	Line Pressure
2	Tank Pressure
3	Tank
4	Pressure Test Line to System
5	Safety Valve
6	Pressure Regulator

Safety Precautions

Observe the proper handling of cylinders:

- Always keep protective cap on cylinder when not in use.
- Secure cylinder in proper storage area or fastened to cart.
- Do not expose to excessive heat or direct sun light.
- Do not drop, dent, or damage cylinder.
- Use a pressure regulator and a safety pressure relief valve as part of the pressure testing equipment. The safety pressure relief valve should be of the non-adjustable, non-tempering type. The valve should bypass any time the pressure exceeds its setting.
- Open valve slowly; use regulators and safety valves that are in good working order.
- The regulator should have two gauges; one to read tank pressure, the other to read line pressure. Properly maintained equipment will allow leak testing, purging, or dehydration to be done safely.

⚠ CAUTION

Risk of Injury!

Nitrogen (N_2) is under 15,170 kPa, 151.70 bar, 2200 psig, or greater. Pressure is for full cylinder at 21 C (70 F). DO NOT use Oxygen (O_2), acetylene, or any other types of pressurized gas on refrigeration systems or any component of a system.

Dehydration, pressure testing, purging, and soldering can be accomplished with the use of dry nitrogen (N2). The proper equipment and application of equipment is of greatest importance.

Purge High Side to Low Side

1. Attach gauge manifold set (Refer to "Gauge Manifold Set," p. 95 for proper procedure for connecting to compressor).
2. Close both hand valves on the gauge manifold (front seated).
3. Connect charging hose to a source of nitrogen. Adjust pressure regulator to the proper pressure for the required procedure.

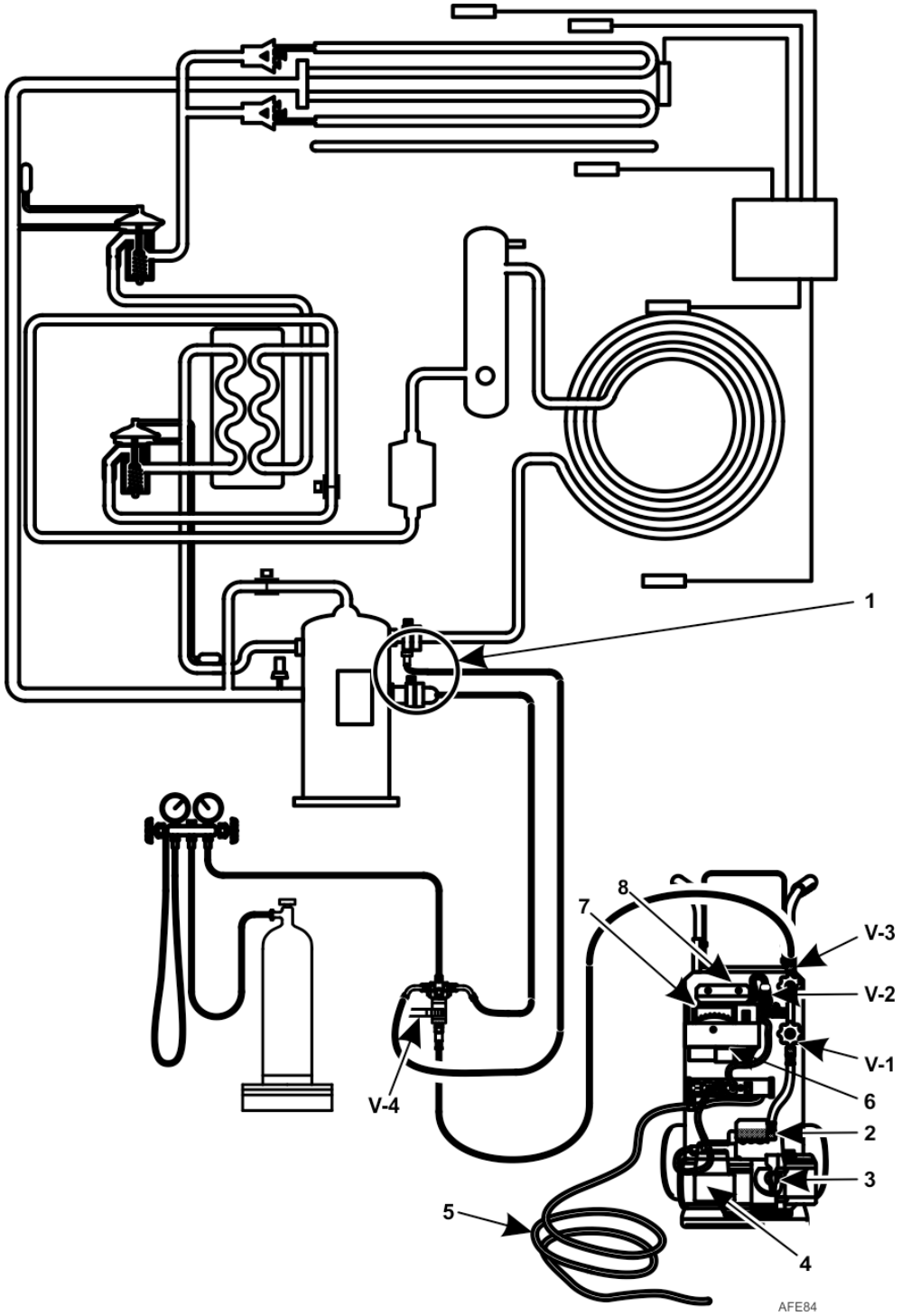
4. Purge system high side to low side.

Maximum Gas Pressures

The following procedures should utilize the following maximum gas pressure:

- Leak Testing: 1034 to 1200 kPa, 10.34 to 12.00 bar, 150-174 psig.
- Purging/Dehydration: 69 to 138 kPa, 0.69 to 1.38 bar, 10-20 psig.
- Soldering: 35 kPa, 0.35 bar, 5 psig.

Figure 40. Evacuation Station and Unit Hook-up



1	Special, self-sealing quick disconnect couplers are required for R-134A units	3	Iso Valve	5	To 220/190 Vac Power	7	Micron Meter
2	Gas Ballast Valve	4	Two-stage Vacuum Pump	6	Calibration Standard	8	Sensor

Recovering Refrigerant from System

NOTICE

Risk of Injury!!

Use only refrigerant recovery equipment approved for and dedicated to R-134A recovery.

When removing any refrigerant from a Thermo King refrigeration system, use a recovery process that prevents or absolutely minimizes the refrigerant escaping to the atmosphere. Typical service procedures that require removal of refrigerant from the unit includes the following:

- Reduce the refrigerant pressure to a safe working level when maintenance must be performed on high-pressure side components.
- Empty the unit of refrigerant when an unknown amount of charge is in the system and a proper charge is required.
- Empty the unit of contaminated refrigerant when the system has become contaminated.

Note: *Always refer to specific recovery equipment Operator and Service Manuals.*

Perform the following steps to recover vapor from the system.

1. Turn unit off.
2. Install a gauge manifold set on the unit.
3. Attach the service line to the recovery machine and properly purge the lines.
4. Set the recovery machine for vapor recovery.
5. Mid-seat the discharge service valve.
6. Turn on the recovery machine.
7. Open (back seat) both gauge manifold and hand valves.
8. Continue to operate the recovery machine until unit pressures drop to 0 kPa, 0 bar, 0 psig pressure.

Recovery for System Repair

Because R-23 has high working pressures, it must be recovered from the refrigeration circuit before any component, except the compressor, suction pressure gauge and discharge pressure gauge, can be repaired or replaced. Also, because of the high pressure in R-23 refrigerant bottles, the recovery of R-23 for re-use in the unit requires an empty refrigerant bottle at least 40 liters (42 quarts) in volume. The refrigerant bottle must be clean or dedicated to use with HFC refrigerants only.

Note: *Due to extremely high pressure in normal ambient R-23 cannot be reclaimed by use of reclaim station.*

1. Prepare an empty refrigerant bottle at lease 40 liters (42 quarts) in volume. Evacuate bottle if necessary to ensure it is clean.
2. Connect a refrigerant hose from the bottle to the R-23 compressor discharge service valve.
3. Midseat the discharge service valve. Then open the service valve on the bottle. Wait for 5-10 minutes to allow the pressures to equalize between the refrigeration system and the bottle. This will remove approximately 1/2 of the refrigerant charge from the unit.
4. Start the unit and use the Manual Test function submenu of the controller to start and operate the R-23 compressor only for approximately 2 minutes. This will quickly transfer most of the remaining R-23 refrigerant charge to the bottle.

⚠ CAUTION

Equipment Damage!

Do not allow the compressor suction pressure to decrease below 100 kPa, 1.00 bar, 15 psig.

⚠ WARNING

Equipment Damage!

Do not allow the pressure of the bottle to exceed 2500 kPa, 25 bar, 362 psig.

5. After approximately 2 minutes of R-23 compressor operation, slowly close the compressor suction service valve. When the compressor suction pressure decreases below 100 kPa, 1.00 bar, 15 psig, stop the R-23 compressor and turn the unit OFF.
6. Close the service valve on the R-23 recovery bottle.
7. Backseat the discharge service valve. Disconnect the refrigerant hose from the discharge valve.
8. With system pressures below 100 kPa, 1.00 bar, 15 psig, the R-23 system components can be serviced.

If necessary, set a recovery machine for vapor recovery. Connect the recovery machine to a separate, empty recovery bottle. Keep unit OFF and mid-seat the discharge service valve. Turn ON the recovery machine and open the service valve on the recovery machine. Operate the recovery machine until system pressures drop to 0 kPa, 0 bar, 0 psig pressure.

R-134a Vapor Recovery

1. Install a gauge manifold set on the R-134a refrigeration system. Attach the service line to the recovery machine and properly purge the lines. Set the recovery machine for vapor recovery.
2. Keep unit OFF and mid-seat the discharge service valve.
3. Turn ON the recovery machine and open (back seat) both gauge manifold and hand valves.
4. Continue to operate the recovery machine until system pressures drop to 0 kPa, 0 bar, 0 psig pressure.

R-134a Liquid Recovery

1. Install a gauge manifold's low-pressure line to the Schrader suction service valve on the suction service valve of the R-134a compressor. Attach the manifold's high-pressure line to R-134a receiver tank service valve port. Attach the service line to the recovery machine and purge the lines.
2. Set recovery machine for liquid recovery and turn it ON.
3. Open (back seat) high-pressure valve on gauge manifold.
4. Operate the recovery machine until the unit system pressures reach approximately 0 kPa, 0 bar, 0 psig.

Evacuation and Cleanup of Refrigeration System

A thorough clean up is required whenever contaminants have entered the system. This will prevent damage to the compressor.

The purpose of evacuation is to remove moisture and air from the refrigeration system after a system has been opened to the atmosphere. Evacuation must occur before recharging a system with new refrigerant. The importance of thorough evacuation and system preparation cannot be over emphasized. Even infinitesimal quantities of air or moisture in a system can cause severe problems.

The presence of moisture, oxygen, and heat can create many forms of damage. They can create corrosion, sludge, copper plating, oil breakdown, carbon formation, and eventual compressor failure.

Things that will contaminate a system are (in order of importance):

- Air: With oxygen as a contaminant: Oxygen in the air reacts with the oil. The oil begins to break down and can eventually lead to carbonization in the compressor and acid buildup. The longer this breakdown process goes on, the darker the compressor oil becomes until finally the color is black indicating major system contamination.
- Moisture: Moisture in a system will cause metal corrosion and metal plating. It can freeze in the expansion valve and cause intermittent operational problems. It reacts in the oil to begin acid buildup.
- Dirt, Dust, Metal Particles, other Foreign Materials: Particles of any kind left to float through the system will cause severe damage to all close tolerance items. Do not leave a system open to the infiltration of dirt. If you must open a system for any reason, seal off the open areas as soon as possible and do not work in a dirty environment.
- Acid: Air and moisture cause a chemical breakdown of the oil and/or the refrigerant itself. The acid will accelerate the deterioration of the softer metals (i.e., copper) and cause metal plating as the softer material begins to cover the inside of the system. If this condition is not stopped, it can result in the total destruction of your equipment.

Unit Preparation and Hookup

⚠ CAUTION

Risk of Injury!

Do not attempt to evacuate a unit until it is certain that the unit is leak free. A unit with less than a full charge of refrigerant should be thoroughly leak tested. Any leaks found must be repaired.

1. Recover all refrigerants from the unit and reduce the unit pressure to the proper level (US Federal Law requires a -17 to -34 kPa, -0.17 to -0.34 bar, 5 to 10 in. vacuum that is dependent upon the recovery equipment used).
2. Break vacuum with refrigerant and equalize system pressure to 0 kPa, 0 bar, 0 psig. Replace the liquid line filter drier if necessary.

   Note: *Replace the one-piece filter drier when major system contamination requires evacuation and cleanup of the refrigeration system.*
3. Confirm that the evacuation station functions properly. Determine "Blank Off" pressure. The "Blank Off" pressure of the vacuum pump is the deepest vacuum that the vacuum pump can attain when isolated from the rest of the system. The operator can be confident that the pump and oil are in good condition, if a vacuum pump (isolated from a system) is started and the micron meter responds quickly by going to a deep vacuum. If the vacuum pump fails to reach a deep vacuum within 5 minutes, the operator should suspect the condition of the oil or the pump. It is recommended that the pump oil be changed first to see if the rate of reaching a deep vacuum is improved.
4. Connect the evacuation station and refrigerant tank with gauge manifold (optional) to the unit as indicated in Figure 40, p. 105. Connect evacuation hoses to the compressor suction and discharge service fittings.
5. Open Evacuation Station valves (V1, V3, and V4). It is only necessary to open valve V2 when a reading on the micron meter is desired. This is especially true when starting to evacuate a unit and large amounts of moisture and oil will be passing by the sensor.
6. Open the vacuum pump Iso-Valve™ built into the pump housing below the handle. It is recommended that the valve be kept open at all times.
7. If connecting a refrigerant tank and gauge manifold to the evacuation station, close the gauge manifold and refrigerant tank valves to prevent refrigerant from being drawn from the tank.

Unit Evacuation

1. Turn on the vacuum pump. Open the gas ballast valve located on top of the pump housing behind the handle (the valve is fully open at two turns counterclockwise). Evacuate the system to 500 microns to achieve a final equilibrium pressure of 2000 microns or less. The final equilibrium pressure is determined with the Thermo King Evacuation Station using the following procedure (called a pressure rise test):
   a. Evacuate the system using the evacuation station until the vacuum level reaches 1000 microns. Then close the gas ballast valve.
   b. Continue evacuation to 500 microns or until vacuum stabilizes at its lowest level. Contamination may delay reaching the lowest level for a period of several hours or more.
   c. Close valve V1 to isolate the vacuum pump from the system.
   d. Observe the vacuum level on the micron meter.

   When the meter has stabilized, the value indicated on the micron meter is the equilibrium pressure. This reading must be 2000 microns or less.

   Note: *The presence of refrigerant in the compressor oil may prevent a low vacuum reading from being achieved. Compressor oil can continue to outgas for long periods of time.*
2. If the vacuum level appears to stall above 500 microns, back seat the discharge service valve and observe the micron meter.
   - A drop in pressure indicates that the compressor oil is out-gassing and further evacuation is necessary.
   - An increase in pressure indicates that a leak exists or there is moisture in the system. Perform a pressure rise test and evaluate.
3. Close valve V1 when the desired vacuum level has been reached.
4. Wait five minutes and read the micron meter.
   - A system that is leak free and dry will remain below 2000 microns for five minutes.

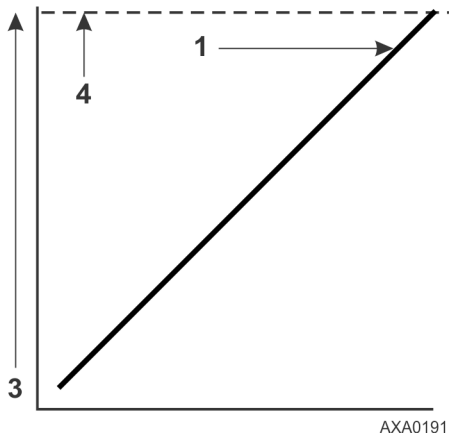
- A system that rises above 2000 microns but stabilizes below atmospheric pressure is probably contaminated with moisture or has refrigerant out-gassing from the compressor oil. Additional evacuation is required.
- A system that continues to rise without stabilizing has a leak and must be repaired.

5. If the vacuum level remained below 2000 microns for five minutes, the unit is ready to charge. Refer to ("Charging System with Refrigerant," p. 110).

Pressure Rise Test

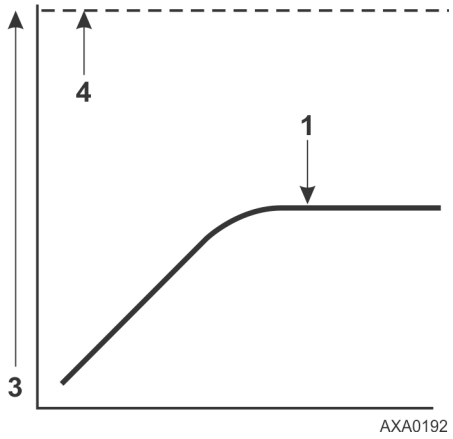
Evacuate the system and close valve V1. With valves V3 and V4 open, the pump is isolated and the system is held under a vacuum. If the micron meter rises, one of the following conditions exist:

- Leak: Watch the movement of the micron meter needle. If the needle continues to rise until it reaches atmospheric pressure, it is an indication that a leak exists somewhere in the system. When a leak is in a system, the vacuum will eventually stabilize at atmospheric pressure. Refer to figure shown below.



1	Close the vacuum valve and watch the movement of vacuum gauge needle. If needle continues to rise, this is an indication that a leak exists in the unit or connecting line. The leak must then be located and eliminated.
2	Time
3	Pressure (Vacuum)
4	Atmospheric Pressure

- Moisture: When the needle indicates a rise and then stabilizes at a level below atmospheric pressure, it is an indication that the system is vacuum tight, but is still wet and requires additional dehydration and pumping time. Refer to figure shown below.



1	Close the vacuum valve and watch the movement of vacuum gauge needle. If needle shows a pressure rise but finally levels off to a constant pressure, the system still contains too much moisture. Dehydration and additional evacuation time are required.
2	Time
3	Pressure (Vacuum)
4	Atmospheric Pressure

Factors Affecting Speed of System Evacuation

The time needed to evacuate a system can vary. Some factors that can influence evacuation time are listed below.

- System size
- Amount of moisture contained in the system
- Ambient temperature

- Internal restrictions within the system
- External restrictions between the system and the vacuum pump

Hose size, both diameter and length, affect evacuation times. Laboratory tests show that the evacuation time can be significantly reduced by larger diameter hoses and shorter hoses. For example, it takes eight times as long to pull a given vacuum through a 6 mm (1/4 inch) diameter hose as it does through a 12 mm (1/2 inch) diameter hose. It takes twice as long to pull a vacuum through a 2 meter (6 foot) long hose as it does through a 1 meter (3 foot) long hose.

Heat Saves Time

⚠ WARNING

Hazardous Gases!

Never use a torch or other concentrated heat source to heat the compressor or other refrigeration system component.

The application of heat to the system is a useful and practical time saver. Increasing the temperature of the compressor oil and refrigerant will speed up the vaporization of any water present in the system.

Heat lamps, electric heaters, or fans can be applied to the compressor crankcase and other parts of the system to increase the temperature of the refrigerant and compressor oil.

Charging System with Refrigerant

Unit Charging by Weight (from an Evacuated Condition)

1. Close valve V4.
2. Open the gas ballast valve (located on top of the pump housing behind the handle).
3. Stop the vacuum pump.
4. Mid-seat the discharge valve.
5. Connect the refrigerant tank with gauge manifold to the evacuation station (Refer to "Unit Preparation and Hookup," p. 108).
6. Weigh the tank of refrigerant.
7. Check the unit data plate for the required weight of refrigerant charge. Subtract the amount of the charge to be input to your unit from the total weight of the tank of refrigerant. This provides final tank weight after the unit receives a full system refrigerant charge.
8. Set the refrigerant tank for liquid removal. Open the hand valve on the tank.
9. Turn the unit off.
10. Open the gauge manifold hand valve and charge liquid refrigerant into the system.
11. Close the refrigerant tank hand valve when the correct amount (by weight) of refrigerant has been added or if the system will take no more liquid. The unit is now ready to have the evacuation station removed.

Evacuation Station Removal

1. Back seat the discharge service valves.
2. Close the high pressure hand valve on the gauge manifold.
3. Close the refrigerant tank hand valve.
4. Open the hand valve at the gauge manifold and read suction pressure.
5. Operate the unit in Cool mode until the suction pressure decreases below 385 kPa, 3.85 bar, 50 psig.
6. Back seat the suction line access service valve.
7. Stop the unit.
8. Remove the hoses from the suction and discharge line access service valves.
9. Start the unit and perform a controller pretrip test to verify correct refrigerant charge and unit operation.

R-134a Final Charging Procedure for Partially Charged Units

Note: *Final charge the R-23 system first when both the R-134a and R-23 systems require charging.*

1. Connect the gauge manifold to the suction line and discharge line service ports. Be sure to purge the air from the lines (see "Gauge Manifold Set Attachment and Purging" in the Refrigeration Maintenance chapter of this manual).
2. Back seat and crack the discharge service valve.
3. Connect a refrigerant tank to the gauge manifold service line.

⚠ CAUTION

Service Procedure!

Be sure to add the correct refrigerant to the system.

4. Set the R-134a refrigerant tank for liquid charging. Open the refrigerant tank hand valve.
5. Start and operate the unit in the COOL mode.

⚠ CAUTION

Equipment Damage!

Do NOT operate the unit on cooling unless: R-23 refrigeration system contains a FULL charge of refrigerant. R-134a refrigeration system contains a partial charge of refrigerant.

6. Read the suction pressure and slowly open the gauge manifold low pressure hand valve to permit suction pressure to increase approximately 170 kPa, 1.7 bar, 25 psig. This will meter liquid refrigerant slowly into the low side.
7. Add R-134a refrigerant until the receiver tank balls float at the top of the sight glass.
8. Close the hand valve on the refrigerant tank.
9. Operate the unit on COOL for 10 minutes and recheck refrigerant charge.
10. Remove the gauge manifold set.
11. Cap all service ports and valve stems.

⚠ CAUTION

Service Procedure!

Be sure to add the correct refrigerant to the system.

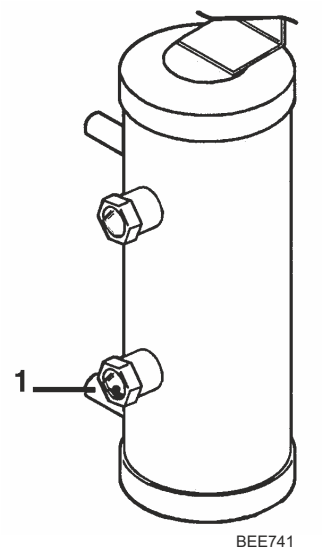
Checking the R-23 Refrigerant Charge

The R-23 refrigerant charge should be checked with the container empty, the unit OFF and all refrigeration system components above -5 °C (23 °F). The R-134a compressor must not have been operated within the past 30 minutes and there must not be frost on the plate-type R-134a / R-23 heat exchanger tubing.

Observe both the suction and discharge pressures. With the unit OFF, the suction and discharge readings should be equal. The R-23 refrigerant pressure in a fully charged system with the unit OFF will vary with the ambient temperature:

Ambient Temperature	R-23 System Pressure
O °C (32 °F)	1600 kPa, 16 bar, 232 psig
20 °C (68 °F)	1700 kPa, 17 bar, 247 psig
38 °C (100 °F)	1800 kPa, 18 bar, 261 psig

Figure 41. R-23 Refrigeration System Receiver Tank



1.	The bottom sight glass ball will rarely float on a fully charged system during normal operation. • Check the refrigerant charge based on the R-23 system pressure with the container empty, the unit OFF and all refrigeration system components above ***Note:*** *Use the lower sight glass to check or add refrigerant only on a operating unit that is unable to maintain a -55 C to -65 C (-62 F to -94 F) low temperature.*		

- Correct Refrigerant Charge: If the R-23 system pressure stabilizes between 1500 and 2000 kPa, 15 and 20 bar, 220 and 290 psig, the unit will be fully functional. The R-23 refrigerant charge requires no adjustment.
- Low Refrigerant Charge: If the R-23 system pressure stabilizes between 1000 and 1500 kPa, 10 and 15 bar, 145 and 220 psig, the unit cooling capacity will be reduced but the unit should be able to maintain a -55 C to -70 C (-62 F to -94 F) load temperature. Additional R-23 should be added if possible, but do NOT add by operating the unit.
- Over Charge of Refrigerant: If the R-23 system pressure stabilizes above 2000 kPa, 20 bar, 290 psig, the R-23 system is overcharged and may cause the compressor to stop on high pressure cutout when started to precool a warm container. Remove refrigerant until the system pressure stabilizes at 2000 kPa, 20 bar, 290 psig or below.

Note: *Use the lower receiver tank sight glass to check or add refrigerant only on an operating unit that is unable to maintain a -55 °C to -70 °C (-62 °F to -94 °F) load temperature.*

Final Charging Procedure for Partially Charged Units on Empty Containers R-23

Note: *The R-23 refrigerant should be charged with the container empty, the unit OFF and all refrigeration system components above -5 C (23 F). The R-134a compressor must not have been operated within the past 30 minutes and there must not be frost on the plate-type R-134a / R-23 heat exchanger tubing.*

1. Before attempting to add R23 refrigerant with loaded container check for good cooling capacity by verifying if Suction discharge pressure is in line with specification.
2. Connect a refrigerant hose to a R-23 refrigerant tank.
3. Connect the refrigerant hose to the suction line service port. Be sure to purge the air from the refrigerant hose.
4. Mid-seat the suction service valve.
5. Set the R-23 refrigerant tank for gas charging. Open the refrigerant tank hand valve.
6. Observe both the suction and discharge pressures on the unit gauges. When the unit pressure reaches 1700 kPa, 17 bar, 247 psig, close the hand valve on the refrigerant tank. With the unit OFF, the suction and discharge readings should be equal.

   The R-23 refrigerant pressure in the unit during charging with the unit OFF will vary with the ambient temperature:

Ambient Temperature	R-23 System Pressure
O °C (32 °F)	1600 kPa, 16 bar, 232 psig
20 °C (68 °F)	1700 kPa, 17 bar, 247 psig
38 °C (100 °F)	1800 kPa, 18 bar, 261 psig

7. Remove the gauge manifold set.
8. Cap all service ports and valve stems.

Charging Procedure for Partially Charged Units on Loaded Containers R-23

R-23 refrigerant should be added to an operating unit on a loaded container only if the unit is unable to maintain a -55 C to -70 C (-62 F to -94 F) load temperature. The risk of overcharging the system with R-23 is too large.

1. Connect a refrigerant hose to a R-23 refrigerant tank.
2. Connect the refrigerant hose to the receiver tank service fitting. Be sure to purge the air from the hose.
3. Set the R-23 refrigerant tank for gas charging. Open the refrigerant tank hand valve.
4. Observe the bottom receiver tank sight glass. When refrigerant is visible in the bottom of the lower sight glass, close the hand valve on the refrigerant tank.

Immediately stop adding refrigerant when refrigerant is visible in the bottom of the lower sight glass. Under normal operating conditions, R-23 refrigerant will rarely be visible in the lower sight glass on a fully charged system.

5. Remove the refrigerant hose from the receiver tank
6. Cap the receiver tank service port.
7. Check and correct the refrigerant charge level after the cargo has been unloaded and the unit is OFF.

Compressor Replacement

Removal

1. Close the suction service valve and pump down the compressor:

- R-134a Compressor: Pump down the compressor to -35 kPa, -0.35 bar, 10 in. vacuum.
- R-23 Compressor: Pump down the compressor to 0 to 21 kPa, 0.0 to 0.2 bar, 0 to 3 psig.

⚠ CAUTION

Equipment Damage!

Do NOT allow the R-23 scroll compressor to operate for more than 10-20 seconds.

2. Break the vacuum with nitrogen between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.

Note: *If the compressor does not operate, or the compressor is unable to pump the low side down, the refrigerant charge must be reclaimed before service can be performed on the refrigeration system.*

3. Front seat the discharge valve.

⚠ CAUTION

Equipment Damage!

Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.

4. Remove discharge service valve and suction service valve from the compressor.
5. Disconnect the wire connector for the high pressure cutout switch.
6. Remove the three-phase electric power connection.
7. Remove the compressor mounting tray bolts and nuts.
8. Slide the compressor from the unit.
9. Keep the compressor ports covered to prevent dust, dirt, etc., from falling into the compressor.

Note: *When the compressor is removed from the unit, oil level should be noted or the oil removed from the compressor should be measured so that the same amount of oil can be added before placing the new compressor or repaired compressor in the unit.*

Installation

1. Slide the compressor into the unit. Install mounting bolts, washers and nuts, and tighten.
2. Bolt the discharge valve to the compressor with a new gasket lightly coated with compressor oil. Bolt the suction service valve to the compressor using a new O-ring coated with compressor oil.
3. Apply refrigerant locktite to the threads of the high pressure cutout switch. Install the switch and connect the wire connectors.
4. Connect three-phase electric power to the compressor.
5. Pressurize the compressor with refrigerant gas:

- R-134 compressor with R-134a refrigerant.
- R-23 compressor with R-23 refrigerant.

⚠ CAUTION

Equipment Damage!

Be sure to add the correct refrigerant to the compressor.

6. Check for refrigerant leaks around the compressor assembly and gasket connections.
7. If no leaks are found, recover the refrigerant used for the leak test (see "Refrigerant Recovery" in this chapter). Because this refrigerant gas will contain some air, place it in a contaminated refrigerant bottle to be reclaimed later.
8. After all pressure is removed from the compressor, connection the evacuation equipment.
9. Evacuate the compressor (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
10. Back seat the discharge service valve and open the suction service valve fully.
11. Operate the unit at least thirty minutes and then inspect the oil level in the compressor. Add or remove oil if necessary.

⚠ CAUTION

Equipment Damage!

Do NOT operate the unit on cooling unless both the R-134a and the R-23 refrigeration systems contain a partial charge of refrigerant.

12. Check the refrigerant charge and add refrigerant if needed.

Condenser Coil Replacement

Removal

1. Recover the refrigerant charge from the unit.
2. Remove the condenser fan grille, condenser fan blade and condenser fan shroud.
3. Remove condenser coil support brackets from coil.
4. Unsolder coil inlet and liquid line connections.
5. Support the coil and unbolt the condenser coil mounting brackets. Slide coil from the unit.

Installation

1. Clean the tubes for soldering.
2. Slide the coil into the unit and install the bolts in the mounting brackets.
3. Solder the inlet line and liquid line connections.

Important: *It is strongly recommended that dry nitrogen be used to purge the system during any solder operations (Refer to "Using Pressurized Nitrogen," p. 103).*

4. Perform a controller pretrip test to verify system operation. Check compressor oil level.
5. Pressurize the system and test for leaks (Refer to "Leak Testing Refrigeration System," p. 101). Repair leak if required.
6. Recover the leak test gas if no leaks were found.
7. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 107).
8. Replace the condenser coil support brackets, condenser fan shroud and condenser fan grille.
9. Recharge the unit with R-134A (Refer to "Charging System with Refrigerant," p. 110).

Filter Drier Replacement

Removal

1. Do one of the following:

- R-134a System: Close the liquid line service valve and pump down the low side. Open the outlet valve slightly to equalize the pressure between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
- R-23 System: Recover the refrigerant charge from the unit (do NOT vent refrigerant to the atmosphere).

2. Place the new dehydrator near the unit for immediate installation.
3. Remove the filter bracket clamping nuts and bolts.
4. Do one of the following:

- R-134a System: Using two wrenches, "crack" both filter drier line mountings. Use two wrenches on flare fittings to prevent line damage. Separate the dehydrator line mountings.
- R-23 System: Unsolder filter drier from liquid line.

Note: *Perform the following four procedures as quickly as possible to prevent contamination.*

5. Remove the old dehydrator from the line.

Installation

1. Remove the sealing caps from the new dehydrator.
2. Do one of the following:

- R-134a System: Apply clean compressor oil to dehydrator threads. Assemble new dehydrator to lines. Finger tighten mounting nuts.
- R-23 System: Clean tubes for soldering. Position filter drier in liquid line. Solder filter drier in liquid line.

Note: *To prevent incorrect installation of the dehydrator, the inlet and outlet fittings are different sizes.*

3. Reinstall dehydrator clamping brackets, nut and bolts. Tighten the bolts.
4. Do one of the following:

- R-134a System:
  a. Tighten the dehydrator inlet line mounting nut. Open the liquid line service valve on the inlet side of the dehydrator slowly to release a small amount of refrigerant from the receiver tank to purge the air through the filter. Then tighten the outlet nut.

  Note: *R-134a — When removing or replacing the o-ring nuts on the dehydrator, always hold the body of the dehydrator near the flange fittings to prevent twisting the tubing when the nuts are being loosened or tightened.*

  b. Back seat (open) the liquid line service valve on the inlet side of the dehydrator.
  c. Test refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 101). Repair leaks if required.
  d. If no leaks are found, place the unit in operation.
- R-23 System:
  a. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 101). Repair leaks if required.
  b. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in this chapter)

c. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 107).

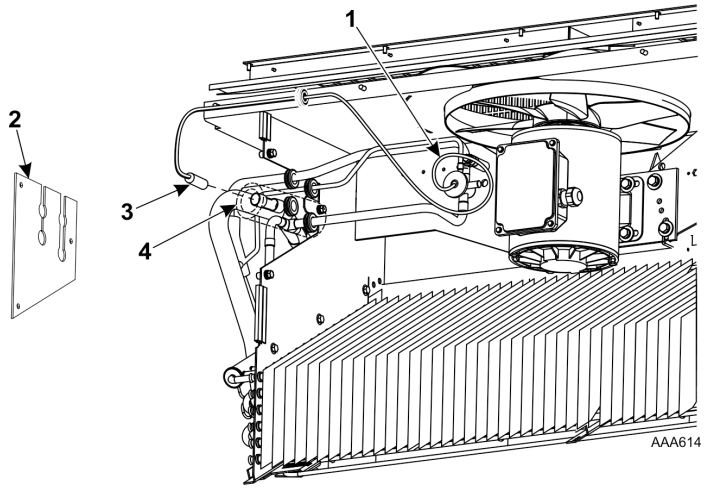
v

d. Recharge the unit with R-23 (Refer to "Charging System with Refrigerant," p. 110).

Evaporator Expansion Valve (TXV) Replacement

Note: *TXV can be accessed through the evaporator access door.*

1. Perform a low side pump down or reclaim charge depending on the unit. Release the 2-3 lbs pressure from the low side.
2. Open the evaporator access panel.
3. Install plywood or heavy cardboard on top of coil on the left and right side. This will protect the coil from damage.
4. Remove the left side motor and fan and position in right side opening. Do not unwire the motor the harness is long enough.
5. Remove TXV standoff mount.
6. Remove the panel to gain access to the TXV element.
7. Cut the one ty band off the insulation around the element. Peel back the insulation to expose the clamp holding the element. Loosen the clamp and remove the element from the tube.
8. Unsolder the three tubes to the TXV and remove the valve from the unit.
9. Prepare the tubes in the unit and on the new TXV for installation.
10. Solder in the new TXV. Use 15% silver solder 203-364.
11. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 101). Repair leak if required.
12. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 107).
13. Install element in tube on suction line. Tighten clamp. Reapply insulation around bulb and secure with a ty band.
14. Install the element access panel and install grommets. Install TXV mount.
15. Install left side motor and fan.
16. Open service valves or recharge unit with R-134A (Refer to "Charging System with Refrigerant," p. 110).
17. Perform a controller pretrip test to verify system operation.



1	TXV Mount
2	Access Panel
3	Element
4	Tube on Suction Line

Expansion Valve Replacement

Removal

1. Do one of the following:

- R-134a System: Close the liquid line service valve and pump down the low side. Open the outlet valve slightly to equalize the pressure between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
- R-23 System: Recover the refrigerant charge from the unit (do NOT vent refrigerant to the atmosphere).

2. Remove insulating tape and encamp feeler bulb from the suction line. Note the position of the feeler bulb on the side of the suction line.
3. Remove insulating tape from expansion valve outlet line.
4. Heat and unsolder the equalizer line from expansion valve.
5. Heat and unsolder the liquid line inlet and outlet connections to expansion valve.
6. Remove expansion valve from unit.

Installation

1. Clean the liquid lines and equalizer lines for soldering.
2. Place new expansion valve in position in liquid line.
3. Solder liquid line inlet and outlet line connections to valve.
4. Solder equalizer line to expansion valve.
5. Clean the suction line to a bright polished condition. Install the feeler bulb of new power head in the feeler bulb clamp on the suction line. Locate bulb on the suction line in former position. The feeler bulb must make good contact with the suction line or operation will be faulty. Cover with insulating tape.
6. Do one of the following:

- R-134a System:
  a. Open the liquid line service valve and pressurize the low side. Test for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
  b. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
  c. Evacuate the low side (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
  d. Cover expansion valve outlet line with insulating tape.
  e. Open the liquid line service valve and place the unit in operation.
  f. Operate the unit and note the suction pressure and container temperature to see that the expansion valve is properly installed and that the feeler bulb is properly located.
- R-23 System:
  a. Pressurize the system with R-23 and test for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
  b. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
  c. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
  d. Cover expansion valve outlet line with insulating tape.
  e. Recharge the unit with R-23 refrigerant and check the compressor oil level. Add oil if necessary.
  f. Operate the unit and note the suction pressure and container temperature to see that the expansion valve is properly installed and that the feeler bulb is properly located.

Heat Exchanger Replacement

Removal

1. Recover the refrigerant charge from the both refrigeration systems (see “Refrigerant Recovery” in this chapter).
2. Remove the panel that protects the heat exchanger assembly in the power cord storage compartment.
3. Heat and unsolder all system inlet and outlet line connections.
4. Remove the heat exchanger assembly from the unit.

Installation

1. Clean the tubes for soldering.
2. Place the heat exchanger assembly in the unit and position in refrigeration system tubing.

3. Solder all refrigerant line connections.

Note: *It is strongly recommended that dry nitrogen be used to purge the system during any solder operations (see "Using Pressurized Nitrogen" in this chapter).*

Note: *If pressurizing with nitrogen, front seat the discharge valve to prevent nitrogen from entering the refrigerant charge.*

⚠ CAUTION

Equipment Damage!

Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.

4. Do one of the following:

- Pressurize the R-134a system on the low side and check for leaks
- Pressurize the R-23 system on the high side and check for leaks.

5. If no leaks are found, recover the leak test gas from both systems (see "Refrigerant Recovery" in this chapter).
6. Evacuate both systems (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
7. Recharge both refrigerant systems (see "Refrigerant Charge" in this chapter).

Receiver Tank Replacement

Removal

1. Recover the refrigerant charge from the unit (see "Refrigerant Recovery" in this chapter).
2. Unsolder the outlet valve on the liquid outlet line.
3. Unsolder the liquid line inlet connection.
4. Loosen the mounting nuts and remove the tank.
5. Remove the outlet valve from the receiver tank.

Installation

1. Install a new tank in the unit and tighten the mounting bolts.
2. Solder the inlet line and outlet valve line with high temperature silver solder (30% silver).

Note: *It is strongly recommended that dry nitrogen be used to purge the system during any solder operations (see "Using Pressurized Nitrogen" in this chapter).*

Note: *If pressurizing with nitrogen, front seat the discharge valve to prevent nitrogen from entering the refrigerant charge.*

⚠ CAUTION

Equipment Damage!

Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.

3. Pressurize the refrigeration system and check for leaks (see "Refrigerant Leak Test Procedure" in this chapter).
4. Evacuate the system (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
5. Recharge the unit (see "Refrigerant Charge" in this chapter).

High Pressure Cutout Switch Replacement

Removal

1. Close the suction service valve and pump down the compressor:

- R-134a Compressor: Pump down the compressor to -35 kPa, -0.35 bar, 10 in. vacuum.
- R-23 Compressor: Pump down the compressor to 0 to 21 kPa, 0.0 to 0.2 bar, 0 to 3 psig.

2. Open the suction service valve slightly to equalize the pressure between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
3. Front seat the discharge service valve.
4. Purge the high pressure from the compressor head through the service port on the discharge line.
5. Disconnect the leads from the wire harness and remove the switch from the compressor discharge manifold (or remove the sensor from the compressor head).

Installation

1. Apply a refrigeration locktite (sealant) to the threads of the switch (or sensor).
2. Install and tighten the switch (or sensor). Connect the leads to the wire harness.
3. Open discharge service valve slightly to pressurize the compressor head and tube assembly. Check for leaks (see "Refrigerant Leak Test Procedure" in this chapter). Front seat the discharge service valve.
4. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in this chapter).
5. Open the suction service valve and compressor discharge service valve and place the unit in operation.

Liquid Line Solenoid Valve Replacement (R-134a System Only)

Removal

1. Close the liquid line service valve and pump down the low side to -35 kPa, -0.35 bar, 10 in. vacuum. Break the vacuum with nitrogen between 10 and 20 kPa, 0.10 and 0.20 bar, 1 and 3 psig.
2. Turn the unit On-Off switch OFF. Disconnect electrical connections to liquid line solenoid.

Note: *In most cases, only the coil requires replacement. No other repair is possible on the liquid line solenoid.*

3. Unsolder the liquid line connections from the valve.
4. Remove the valve from the unit.

Installation

1. Clean the tubes for soldering.
2. Place the new valve in position and solder the connections.

NOTICE

Equipment Damage!

Use a heat sink, P/N 204-584, or wrap the vibrasorber with wet rags to prevent damaging the vibrasorber.

3. Release a small amount of refrigerant from the receiver tank to pressurize the liquid line. Check for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
4. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
5. Evacuate the low side (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
6. Reconnect the electrical wires to the valve.
7. Open the liquid line service valve and place the unit in operation. Check the refrigerant charge and add refrigerant as required.

Diagnostics

Introduction

This section includes the following:

- Mechanical Diagnostics
- Refrigeration Diagnostics

The tables shown will help identify and fix unit problems.

MP4000 Diagnostics

The MP4000 can be a very helpful diagnostic tool. The following menu areas of the MP4000 controller will help you diagnose problems occurring with the unit.

Alarms/Warnings Menu: This menu displays the code conditions. Alarm/Warning codes are recorded in the controller memory to simplify unit diagnosis procedures. Some alarm codes are only recorded during a Pretrip (PTI) test or function test. Fault codes are retained by the controller in a non-volatile memory. If the Red LED is on or flashing, enter the alarm list to view the alarm.

Brief PTI Test: The MP4000 controller contains a special Brief PTI pretrip test that automatically checks unit refrigeration capacity, heating capacity, temperature control, and individual components including the controller display, solid state, contactor, fans, protection devices and sensors. The test includes measurement of component power consumption and compares test results to expected values. The test takes about 25-30 minutes to complete, depending on the container and ambient temperature. Refer to the Brief PTI Test in the Operating Instructions Section.

Full PTI Test: The MP4000 controller contains a special Full PTI pretrip test that automatically checks unit refrigeration capacity, heating capacity, temperature control, and individual components including the controller display, solid state, contactor, fans, protection devices and sensors. The test includes measurement of component power consumption and compares test results to expected values. The test takes up to 2 to 12 hours to complete, depending on the container and ambient temperature. Refer to the Full PTI Test Menu in the Operating Instructions Section.

Functions Test: The MP4000 controller contains a special function test that automatically tests individual components including the controller display, sensors, condenser fan, evaporator fan, compressors, etc. The test includes measurement of component power consumption and compares test results to expected values. Refer to the Functions Test Menu in the Operating Instructions Section.

Manual Functions Test: This menu allows technicians to perform specific diagnostic tests on individual components or turn several components on at the same time to perform a system test. Refer to the Manual Functions Test Menu in the Operating Instructions Section.

Data: This menu displays general unit operating information including sensor temperatures, unit electrical data, etc. Refer to the Data Menu in the Operating Instructions Section.

Mechanical Diagnostics

Condition	Possible Cause	Remedy
Compressor does not operate - no amperage draw.	Controller on; unit start sequence still timing.	Wait up to two minutes for compressor start-up.
	No power to unit (condenser and evaporator fans do not operate).	Locate fault and repair: power source, power plug, CB1 main circuit breaker, motor solid state, motor terminals, motor, fuses on power module.
	Open in 29 Vac control circuit.	Check fuses and On/Off switch. Replace or repair as required.
	Container temperature does not demand compressor operation.	Adjust controller setpoint.
	Compressor contactor inoperative.	Replace compressor contactor.
	No output signal from controller.	Diagnose and replace power module or controller.

Condition	Possible Cause	Remedy
	Unit on defrost.	Turn Unit On/Off switch Off and then On again.
	Detective high pressure or low pressure cutout switch.	Replace defective switch.
	High condenser head pressure causing high pressure cutout.	Check refrigeration system and correct fault.
	Defective compressor.	Replace compressor.
	Controller shut unit down on Compressor Over Temperature.	Let compressor cool and controller will reset automatically. Check vapor injection valve and compressor temperature sensor.
	Compressor motor internal thermal overload protection open.	If compressor contactor is energized, wait 60 minutes for protector to cool and reset.
Compressor does not operate - excessive amperage draw or intermittent cycling on overload.	Rotating scroll stuck. Piston Stuck.	Replace compressor.
	Seized or frozen compressor bearings.	Replace compressor.
	Improperly wired.	Check/correct wiring against wiring diagram.
	Low line voltage.	Check line voltage - determine location of voltage drop.
	High head pressure	Eliminate cause of high head pressure.
	Contacts in compressor contactor not closing completely.	Check by operating manually. Repair or replace.
	Open circuit in compressor motor winding.	Check motor stator connections. Check stator winding for continuity. If open, replace compressor.
	Defective compressor motor internal thermal overload protector.	Replace thermal overload protector or compressor.
	Refrigerant overcharge or high side restriction causing cycling on high pressure cutout.	Check for restricted filter drier, in-line filter or high side; or refrigerant overcharge.
	Inefficient condenser operation causing cycling on high pressure cutout.	Check condenser airflow, condenser fan motor, fan blade, condenser grille, condenser coil temperature sensor, water pressure switch (option), water flow rate (option) and water-cooled condenser-receiver tank (option).
R 23 compressor not running	Auxiliary contact on R134a open	Check curcuit, replace contact.
Compressor contactor burned out.	Low line voltage.	Increase line voltage to at least 90 percent of compressor motor rating.
	Excessive line voltage.	Reduce line voltage to at least 110 percent of compressor motor rating.
	Short cycling.	Eliminate cause of short cycling.
Unit short cycles.	Controller out of calibration	Check controller software program version; load new software in controller and recheck unit performance, replace controller
	Refrigerant overcharge causing cycling on high pressure cutout.	Purge system.
	Inefficient condenser operation causing cycling on high pressure cutout.	Check condenser airflow, condenser fan motor, condenser fan grille, condenser fan pressure switch, water pressure switch (option), water flow rate (option) and water-cooled condenser-receiver tank (option).
Noisy compressor	Insufficient compressor oil	Check compressor oil level on R-134a and R-23 system. Add oil to proper level.

Condition	Possible Cause	Remedy
	Loose mounting bolts.	Tighten mounting bolts.
	Oil slugging or refrigerant flooding back.	Perform controller pretrip test to check refrigerant charge. Check expansion valve adjustment. Check compressor for compressor oil.
	Scroll rotating backwards.	Check phase correction system and check unit wiring.
	Worn fan motor bearings	Replace bearings or motor.
	Defective compressor.	Repair or replace compressor.
Condenser fan motor does not operate.	Unit in Heat or Defrost.	Check indicator. If unit is in Heat or Defrost, unit operation is normal (no remedy required).
	Loose line connection.	Tighten connections.
	Open motor internal thermal overload protector.	Check for seized bearings or defective thermal overload protector. Repair or replace as necessary.
	Defective motor.	Replace motor.
	Detective condenser fan contactor.	Replace defective contactor
	No condenser fan output signal from controller.	Diagnose and replace condenser fan relay, power module or controller.
Evaporator fan motor(s) does not operate.	Unit on defrost.	Check operating mode indicator LEDs.
	Loose line connection.	Tighten connections.
	Open motor internal thermal overload protector.	Check for seized bearings or defective thermal overload protector. Repair or replace as necessary.
	Defective motor.	Replace motor.
	Defective low speed evaporator fan contactor	Replace defective contactor
	No low or high speed evaporator fan output signal from controller output module.	Diagnose and replace output module or controller.

Refrigeration Diagnostics

Condition	Possible Cause	Remedy
R-134a or R-23 System Compressor operating in a vacuum (unit not cooling)	Shortage of refrigerant	Repair leak and recharge
	Compressor motor contacts frozen (R-134a compressor only)	Clean points or replace contactor
	Defective liquid line solenoid valve	Repair or replace liquid line solenoid valve
	Compressor inefficient	Repair or replace liquid line solenoid valve
	(R-134a compressor only)	Check valve reeds and pistons
	Partial obstruction in low side or dehydrator	Locate obstruction and repair
	Iced or plugged evaporator coil	Defrost or clean evaporator coil
	Expansion valve partially closed by ice, dirt or wax	Replace expansion valve
	Expansion valve power element lost its charge	Replace expansion valve
	Defective container insulation	Correct or replace container insulation

Condition	Possible Cause	Remedy
	Poor fitting container doors	Repair or replace doors
	Partial obstruction in high side	Locate obstruction and repair
	Suction pressure gauge out of calibration	Replace service gauge
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact	Correct feeler bulb installation
Load temperature too high - unit not cooling.	One or both compressors do not operate	Refer to ("Mechanical Diagnostics," p. 120).
	Controller setpoint too high.	Adjust controller setpoint.
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Shortage of refrigerant.	Repair leak and recharge.
	Overcharge of refrigerant.	Purge system.
	Air in refrigeration system.	Evacuate and recharge.
	Vapor injection valve open.	Check vapor injection valve circuit and compressor discharge temperature sensor.
	Too much compressor oil in system.	Remove compressor oil from compressor.
	Iced or dirty evaporator coil.	Defrost or clean evaporator coil.
	Restricted lines on high side.	Clear restriction.
	Plugged filter drier/in-line filter.	Change filter drier.
	Compressor inefficient (R-134a system only)	Perform compressor efficiency test. Check valve reeds and pistons
	Condenser coil dirty or airflow restricted.	Clean condenser coil, clear restriction, or repair or replace fan motor or condenser fan blade.
	Expansion valve power element lost its charge.	Replace power element.
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact.	Correct feeler bulb installation.
Head pressure too low. ***Note:*** *This unit has a digital capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is in Modulation Cool (control temperature within 10 C (18 F) of setpoint or in Power Limit mode).*	Shortage of refrigerant.	Repair leak and recharge.
	Low ambient air temperature. (R-134a system only)	No remedy.
	Service gauge out of calibration.	Replace gauge.
	Compressor suction or discharge valve inefficient (R-134a system only)	Replace suction reeds and gaskets. Clean valve plate. If defective/restricted then replace.
Head pressure too high.	Refrigerant overcharge.	Purge system.
	Air in refrigeration system.	Evacuate and recharge.
	Dirty or restricted condenser coil.	Clean condenser coil.
	Condenser fan not operating.	Refer to "Condenser Fan Motor Does Not Operate" ("Mechanical Diagnostics," p. 120).
	Condenser fan grille damaged or missing.	Repair or replace grille.
	Condenser fan blade damaged.	Replace fan blade.
	High ambient air temperature.	No remedy.
	Restricted dehydrator or high side.	Replace filter drier or clear restriction.

Condition	Possible Cause	Remedy
	Defective service gauge.	Replace gauge.
Compressor loses oil.	Refrigerant leak.	Repair leak and recharge.
Compressor oil migrates to system.	Short cycling.	Refer to "Unit Short Cycles" ("Mechanical Diagnostics," p. 120).
Rapid cycling between Cool, Null, and Heat modes.	Air short cycling through evaporator.	Check and correct cargo load.
	Defective controller or power module.	Diagnose power module and controller. Replace defective component.
	Short cycling.	Refer to "Unit Short Cycles" ("Mechanical Diagnostics," p. 120).
Hot liquid line.	Shortage of refrigerant.	Repair or recharge.
	Expansion valve open too wide.	Adjust or replace expansion valve.
Frosted liquid line.	Liquid line restricted.	Remove restriction.
	Restricted filter drier.	Replace filter drier.
Frosted or sweating suction line.	Expansion valve admitting excess refrigerant.	Check feeler bulb and adjust expansion valve.
	Evaporator coil needs defrosting. (R-134a system only)	Check defrost circuit including controller and evaporator coil sensor.
	Evaporator fan does not operate. (R-23 system only)	Refer to "Evaporator Fan Motor Does Not Operate" ("Mechanical Diagnostics," p. 120).
Unit in vacuum - frost on expansion valve only.	Ice plugging expansion valve screen or orifice.	Apply hot wet cloth to expansion valve. Moisture indicated by increase in suction pressure. Replace filter drier.
High suction pressure.	Overcharge of refrigerant.	Purge system.
	Expansion valve open too much.	Adjust or replace valve.
	Defective controller or power module.	Diagnose power module and controller. Replace defective component.
	Service gauge out of calibration.	Adjust or replace service gauge.
Low suction pressure. ***Note:*** *This unit has a digital capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is in Modulation Cool (control temperature within 10 C (18 F) of setpoint or in Power Limit mode).*	Shortage of refrigerant.	Repair leak and recharge.
	Low ambient air temperature. (R-134a system only)	No remedy.
	Iced or dirty evaporator coil. (R-134a system only)	Defrost or clean evaporator coil.
	Restricted lines.	Locate and clear restriction.
	Plugged filter drier.	Replace filter drier.
	Expansion valve closed too much.	Adjust or replace valve.
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact.	Correct feeler bulb installation.
	Evaporator fans off.	Check evaporator fan motors and control circuit and correct fault.
	Defective controller or power module.	Diagnose power module and controller. Replace defective component.
	Service gauge out of calibration.	Adjust or replace gauge.

Status Messages and Controller Actions

The controller displays status messages (in Alarms Menu) on the display for several general faults. More than one status message may appear at a time. Press the F2 or F3 key to scroll through message displays.

Status Message	Description	Controller Action/Corrective Action
8	High Pressure Cut Out - Please Wait • When: – Unit stops due to high pressure cutout and the condensing temperature regulation has activated the condenser fan. • Indicates: – Poor cooling of the refrigerant.	• Controller auto clears message 10 minutes after compressor start-up. • Check for high ambient temperature. • Check condenser fan rotation. • Check for blocked condenser coil.
13	Evaporator High Temperature - Check Heater System • When: – If the state "Hot Evaporator Section" is active and the control calls for heat, the message is set. – The state "Hot Evaporator Section" is defined either by: • RA probe error and Defrost probe error. • RA, SA, or defrost probe is above 50C. – The message is held by a 60 second timer after the conditions clear. • Indicates: – Evaporator section temperatures are high. • Supply Air, Return Air, and Defrost indicates high temperature.	• Enter Manual Function Test menu and test (operate) heating element. Check volts and amps to determine problem. • Use DATA menu to evaluate evaporator section sensors. • Use PROBE TEST to evaluate if evaporator sensors are reading correctly.
14	R134a Compr Fault - Check Feedback • The FB signal does not correspond with the activation signal of the R134a compressor contactor. • The activation signal may be interrupted due to HPCO (R134a).	• Check the R134a discharge temperature and the HPCO switch. • Check wiring to the R134a contactor and the feedback wiring from the contactor.
20	Low Voltage On Line - Unit Stopped • When: – Low voltage observed, voltage has been below 330 VAC and has not risen above 340 VAC yet. – After 30 minutes this message will set the low voltage alarm. • Indicates: – Poor quality of power source.	• Enter Manual Function Test menu and test (operate) components to load the power source. • Check volts and amps to help determine the problem.
21	Current Too High - Check Compressor and Fans • When: – The component current draw exceeds expected. 50% above expected amps for four minutes. • Indicates: – Digital Control valve malfunction. – Compressor, evaporator fans motor, condenser fan motor or heater current too high. – Defective volt or amp meter on power module. – Power supply voltage too low.	• Enter Manual Function Test menu and test (operate) each component. • Check volts and amps to determine which component has high amp draw. • Check power supply volts. • Check volt and ampere meter. • When the message is set, the current power consumption is logged in the event log.

Status Message	Description	Controller Action/Corrective Action
22	Current Too Low - Check Compressor and Fans • When: – The component current draw exceeds expected. 50% below expected for four minutes. • Indicates: – Defective or open high pressure cutout switch. – Defective or open motor internal high temperature protection switch. – Unit on water-cooled condensing with no water flow. – Defective condenser coil sensor or sensor location.	• Check Display for High Pressure Cutout message. • Enter Manual Function Test menu and test (operate) each component. • Check volts and amps to determine which component has low amp draw. • Check volt and ampere meter.
23	Supply Temperature Too High - Check Sensors • When: – During Chill or Frozen Mode: Supply air temperature is too high compared to return air temperature under operating conditions. The state will by time request defrost or/and probe test. • Indicates: – Low refrigerant charge – Incorrect connection or location of supply or return air sensor – Air leakage at supply air sensor cable – Ice or frost on evaporator coil – Incorrect evaporator fan operation	• Use DATA menu to inspect readings. • Enter Manual Function Test menu and operate evaporator fan at high speed to evaluate probe spread.
24	Supply Temperature Too Low - Check Evaporator Coil • When: – During Chill or Frozen Mode: Supply air temperature is too low compared to return air temperature under operating conditions. The state will by time request extended defrost, defrost or/and probe test. • Indicates: – Incorrect connection or location of supply or return air sensor. – Air leakage at supply air sensor cable. – Incorrect evaporator fan operation.	• Use DATA menu to inspect readings. • Enter Manual Function Test menu and operate evaporator fan at high speed to evaluate probe spread.
25	Evaporator Temperature Too High - Check Evaporator Sensor • When: – During Chill or Frozen Mode: Evaporator coil temperature is too high compared to return air temperature under operating conditions. • Indicates: – Probe spread, misplaced probes.	• Use DATA menu to inspect readings. • Enter Manual Function Test menu and operate evaporator fan at high speed to evaluate probe spread.
26	Evaporator Coil Temperature Too Low - Check Evaporator Sensor • When: – During Chill or Frozen Mode: Evaporator coil temperature is too low compared to return air temperature under operating conditions. The state will by time request extended defrost, defrost or/and probe test. • Indicates: – Ice on the evaporator coil, need for defrost. – Probe error.	• Use DATA menu to inspect readings. • Enter Manual Function Test menu and operate evaporator fan at high speed to evaluate probe spread.

Status Message	Description	Controller Action/Corrective Action
30	High Pressure Cut Out - Please Wait • When: – Unit stop due to high pressure cutout signal from the HPCO switch. – The message will clear when the input signal indicates normal condition. • Indicates: – Poor or missing cooling of the refrigerant. • Action: – The state will stop / remove the compressor run signal. – The state will overrule regulation of the condenser fan and starts the fan. – This state will activate and hold message 31 as long as the input signal indicates HPCO.	• Controller clears message on compressor start-up. • No direct alarm action based on this situation. • If the state continues: – Check for airflow through the condenser coil, air flow might be blocked. – Check for condenser fan rotation and direction, must suction air through the coil and blow air out through the grill.
31	HPCO Timer Hold - Please Wait • When: – The message is timer based to protect the compressor from starting at high pressure. The message will go away when the holding time after HPCO gets normal has run out. • Indicates: – HPCO present or has just been present. • Action: – The state will stop / remove the compressor run signal. – The state will overrule regulation of the condenser fan and starts the fan. – This state will activate and hold message 31 as long as the input signal indicates HPCO.	• Controller clears message on compressor start-up. • No direct alarm action based on this situation. • If the state continues: – Check for airflow through the condenser coil, air flow might be blocked. – Check for condenser fan rotation and direction, must suction air through the coil and blow air out through the grill.
32	Low Pressure Cut Out - Please Wait • When: – Unit stops due to low pressure cutout signal from the HPCO switch or the suction pressure reading (if present). – If suction pressure sensor is mounted the signal level for LPCO is below -0.27 bar to activate LPCO state and above +0.38 bar to clear the state. – The message will clear when the input signal indicates normal condition. • Indicates: – Possible causes include low refrigerant charge, defective low pressure cutout switch or open circuit, block TXV or suction line restriction etc. • Action: – The state will stop / remove the compressor run signal. – This state will activate and hold status message 33 as long as the input signal indicates LPCO.	• Controller activates Alarm Code 31 after five minutes. • Controller clears message after compressor start-up.
33	LPCO Timer Hold - Please Wait • When: – The message is timer based to protect the compressor from starting before the pressure has risen from low pressure. The message will clear when the holding time after LPCO gets normal has run out. • Indicates: – LPCO present or has just been present.	• Controller clears message on compressor start-up. • No direct alarm action based on this situation.

Status Message	Description	Controller Action/Corrective Action
34	Compressor Too High Temperature Timer – Please Wait • When: – If the compressor temperature gets above 148C, the message is set. – The message will clear when the compressor temperature has been below 137C for 60 seconds. – The message will (also) clear when the compressor temperature gets below 132C. • Indicates: – Compressor stops because discharge temperature is above 148 C (300 F). Message remains in display until discharge temperature decreases to normal. • Action: – The state will stop / remove the compressor run signal. – The state will overrule regulation of the condenser fan and starts the fan.	• The message clears itself when the compressor temperature is normal.
35	Compressor High Temperature • When: – If the compressor temperature gets above 138C, the message is set. – The message will clear when the compressor temperature gets below 132C. • Action: – Compressor running at high discharge temperature results in economizer/vapor injection will be active until discharge temperature decreases to normal. – In temperature log the state will be represented by the char 'c' (small c).	• The message clears itself when the compressor temperature is normal.
38	High Voltage On Line • When: – High voltage observed, voltage has been above 515 Vac. The message will clear when voltage gets below 500 Vac. • Indicates: – When the message is set, a power line value log is made in the event log, i.e., "CURR: 0.2A PH1: 0.2A PH2: 0.2A PH3: 0.3A VOLT: 529V FREQ: 63Hz ".	• Enter Manual Function Test menu and test (operate) components to load the power source. • Check volts and amps to help determine the problem. • Possible cause for the problem is a wild running generator set.
39	Battery Charger/Heater - Check Battery • When: – The data logger battery charger reports battery charging suspended due to low temperature and the battery internal heater has been on for two hours, the message is set. • Indicates: – Fault in the data logger battery circuit.	• Check for battery position, placement, and wiring.
40	12V Sensor PSU Problem • When: – If the sensor supply (+ 12 Vdc) for the humidity or pressure transducers is not able of supplying the 12 Vdc. • Indicates: – Too high load on the sensor supply.	• Check humidity sensor or transducer.

Status Message	Description	Controller Action/Corrective Action
41	Power Module Heat Exchanger High Temperature • When: – If the power module heat exchanger temperature gets above 95C the heating element is bypassed and not energized. Since activating the heating element is the far most heat applying solid state switch, activating is bypassed to reduce temperature. • Indicates: – High temperature surrounding the control box. – Poor cooling to the back side of the control box.	• Check for blocked air flow to the back side of the control box. • Ambient temperature may be high.
45	Wall Clock Failure • When: – Occurs if the wall clock has been stopped or restarted as a result of insufficiently voltage.	• The wall clock battery must be replaced.
46	Battery Needs Charging • When: – Low battery voltage observed. The battery voltage has been below 3.7V. The voltage must be above 2.5V to trigger the message.	• Leave the unit on (could be standby mode) for four hours to charge the battery.
48	R134a Comp Too High Temp Timer - Please Wait • When: – If the R134a compressor temperature gets above 148 C (300 F) the warning is set. – The warning will go away when the compressor temperature has been below 137C for 60 seconds. • Indicates: – Compressor stops because discharge temperature is too high. – Message remains in display until discharge temperature decreases to normal. • Action – The state will stop / remove the compressor run signal. – The state will overrule regulation of the condenser fan and starts the fan.	• The warning clears itself when the compressor temperature gets normal.

Alarm Codes and Corrective Actions

Note: *Sensors used with the MP4000 controller do not require calibration. Check sensor resistance with an ohmmeter.*

Shutdown Alarm (Level 1 Alarm): Alarm light on display flashes and unit stops. Correct alarm condition and acknowledge alarm before restarting.

Check Alarm (Level 2 Alarm): Alarm light on display flashes until alarm is acknowledged.

Code	Description	Corrective Action
00	Supply Air Temperature Sensor Open Circuit • When the sensor circuit resistance is higher than 1300Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 1 and 2. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can't be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).
01	Supply Air Temperature Sensor Short Circuit • When the sensor circuit resistance is lower than 602Ω. • Indicates: – Short circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 1 and 2. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can't be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).

Code	Description	Corrective Action
02	Return Air Temperature Sensor Open Circuit • When the sensor circuit resistance is higher than 1300Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 3 and 4. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can't be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).
03	Return Air Temperature Sensor Short Circuit • When the sensor circuit resistance is lower than 602Ω. • Indicates: – Short circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 3 and 4. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can't be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).

Code	Description	Corrective Action
04	Evaporator Coil Temperature Sensor Open Circuit • When the sensor circuit resistance is higher than 1300Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 5 and 6. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can't be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).
05	Evaporator Coil Temperature Sensor Short Circuit • When the sensor circuit resistance is lower than 602Ω. • Indicates: – Short circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 5 and 6. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can't be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).

Code	Description	Corrective Action
06	Compressor Current Too High • Occurs during pretrip (PTI) or function test only. • During compressor test, if Compressor power consumption is 25% above expected current draw or compressor phase current level differs 33% or more. • If both alarm #6 and #7 is active this indicates too high phase difference. • Expected compressor current is a function of the surrounding conditions. • Indicates: – Defective Digital Control valve. – Defective compressor. – Defective volt or amp meter on power module. – Inaccurate ambient, condenser or evaporator temperature measurement. – Excessive condenser pressure due to air or wrong refrigerant in system, or refrigerant over charge.	• Check evaporator and condenser sensor temperatures for correct value (± 5 C [± 9 F]) by viewing Data menu. • To determine the current draw measurement, enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor full loaded, condenser fan and evaporator fan (high or low). • Check power supply volts on all three phases.
07	Compressor Current Too Low • Occurs during pretrip (PTI) or function test only. • During compressor test, if Compressor power consumption is 25% below expected current draw or compressor phase current level differs 33% or more. • If both alarm #6 and #7 is active this indicates too high phase difference. • Expected compressor current is a function of the surrounding conditions. • Indicates: – Defective or open high pressure cutout switch. – Defective or open low pressure cutout switch or transmitter if mounted. – Defective compressor relay. – Defective volt or amp meter on power module. – Low refrigerant charge. – Defective compressor. – Defective volt or amp meter on power module. – Inaccurate condenser or evaporator temperature measurement. – Defective or open compressor motor internal over temperature protection switch.	• Check evaporator, condenser sensor temperatures for correct value (± 5 °C [± 9 F]) by viewing Data menu. • To determine the current draw measurement, enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor full loaded, condenser fan and evaporator fan (high or low). • Check discharge and suction pressure gauge readings. • Check power supply volts on all three phases.
10	Heater Current Too High • Occurs during pretrip (PTI) or function test only. • Heater power consumption is 25% above expected current draw or phase current level differs 33% or more. • If both alarm #10 and #11 is active this indicates too high phase difference. • Expected heater current is a function of the heating element resistance and the power supply voltage. • The unit may be equipped with extended heating capability. • Normal heating element 4kw@460VAC - above approximately 6,3 Amp / 5,3 Amp. • Extended heating element 6kw@460VAC - above approximately 9,4Amp / 8,1Amp. • Indicates:	• Enter Manual Function Test and turn heaters on. Check current draw on each phase. Evaluate current draw in relation to expected values. • Enter configuration menu and check the heating element setting. • Check heater resistance. • The electrical resistance towards chassis must be above meg ohm (MΩ) range. • Normal heating element 4kw@460VAC – expects 5,0Amp@460VAC. – expects 4,3Amp@400VAC. – expected resistance 99Ω on each leg. • Extended heating element 6kw@460VAC – expects 7,5Amp@460VAC. – expects 6,5Amp@400VAC. – expected resistance 66Ω on each leg.

Code	Description	Corrective Action
11	Heater Current Too Low • Occurs during pretrip (PTI) or function test only. • Heater power consumption is 25% below expected current draw or phase current level differs 33% or more. • If both alarm #10 and #11 is active this indicates too high phase difference. • Expected heater current is a function of the heating element resistance and the power supply voltage. • The unit+ may be equipped with extended heating capability. • Normal heating element 4kw@460VAC: – below approximately 3,7Amp / 3,2Amp. • Extended heating element 6kw@460VAC: – below approximately 5,6Amp / 4,8Amp. • Indicates: – Incorrect heaters or heater connections. – Defective heating element. – Defective volt or amp meter on power module.	• Enter Manual Function Test and turn heaters on. Check current draw on each phase. Evaluate current draw in relation to expected values. • Enter configuration menu and check the heating element setting. • Check heater resistance. • The electrical resistance towards chassis must be above meg ohm (MΩ) range. • Normal heating element 4kw@460VAC: – expects 5,0Amp@460VAC – expects 4,3Amp@400VAC – expected resistance 99Ω on each leg. • Extended heating element 6kw@460VAC: – expects 7,5Amp@460VAC – expects 6,5Amp@400VAC – expected resistance 66Ω on each leg.
12	Evaporator Fan High Speed Current Too High • Occurs during pretrip (PTI) or function test only. • Fan power consumption is 33% above expected current draw or phase current level differs 33% or more. • If both alarm #12 and #13 is active this indicates too high phase difference. • Expected fan current is a function of the power line frequency and the supply voltage. • With 20’ setting above approximately: – 3,4Amp@400VAC/50Hz – 4,2Amp@460VAC/60Hz • With 40’ setting above approximately: – 2,7Amp@400VAC/50Hz – 3,4Amp@460VAC/60Hz • Indicates: – Defective or stuck evaporator fan motor. – Incorrect motor or motor connections. – Defective volt or amp meter on power module.	• Open evaporator door and make sure all fans rotate freely. • Enter Manual Function Test and start evaporator fans on high speed. Make sure all fans start on high speed. Check fan motor volts and amps. • With 20’ setting expect: – 2,4Amp@400VAC/50Hz – 3,1Amp@460VAC/60Hz • With 40’ setting expect: – 1,8Amp@400VAC/50Hz – 2,4Amp@460VAC/60Hz

Code	Description	Corrective Action
13	Evaporator Fan High Speed Current Too Low • Occurs during pretrip (PTI) or function test only. • Fan power consumption is 33% below expected current draw or phase current level differs 33% or more. • If both alarm #12 and #13 is active this indicates too high phase difference. • Expected fan current is a function of the power line frequency and the supply voltage. • With 20' setting below approximately: – 1,4Amp@400VAC/50Hz – 2,0Amp@460VAC/60Hz • With 40' setting below approximately: – 0,9Amp@400VAC/50Hz – 1,4Amp@460VAC/60Hz • Indicates: – Defective or open fan motor internal over temperature protection switch. – Incorrect motor or motor connections. – Defective volt or amp meter on power module.	• Open evaporator door and make sure all fans rotate freely. • Enter Manual Function Test and start evaporator fans on high speed. Make sure all fans start on high speed. If a motor does not start and is very hot, wait 10 minutes for internal over temperature switch to close. • Enter Manual Function Test and start evaporator fans on high speed. Make sure all fans start on high speed. Check fan motor volts and amps. • With 20' setting expect: – 2,4Amp@400VAC/50Hz – 3,1Amp@460VAC/60Hz • With 40' setting expect: – 1,8Amp@400VAC/50Hz – 2,4Amp@460VAC/60Hz
14	Evaporator Fan Low Speed Current Too High • Occurs during pretrip (PTI) or function test only. • Fan power consumption is 33% above expected current draw or phase current level differs 33% or more. • If both alarm #14 and #15 is active this indicates too high phase difference. • Expected fan current is a function of the power line frequency and the supply voltage. • With 20' setting above approximately: – 1,0Amp@400VAC/50Hz – 1,2Amp@460VAC/60Hz • With 40' setting above approximately: – 1,0Amp@400VAC/50Hz – 1,2Amp@460VAC/60Hz • Indicates: – Defective or stuck evaporator fan motor. – Incorrect motor or motor connections. – Defective volt or amp meter on power module.	• Open evaporator door and make sure all fans rotate freely. • Enter Manual Function Test and start evaporator fans on Low speed. Make sure all fans start on low speed. Check fan motor volts and amps. • With 20' setting expect: – 0,8Amp@400VAC/50Hz – 0,9Amp@460VAC/60Hz • With 40' setting expect: – 0,8Amp@400VAC/50Hz – 0,9Amp@460VAC/60Hz

Code	Description	Corrective Action
15	Evaporator Fan Low Speed Current Too Low • Occurs during pretrip (PTI) or function test only. • Fan power consumption is 33% below expected current draw or phase current level differs 33% or more. • If both alarm #14 and #15 is active this indicates too high phase difference. • Expected fan current is a function of the power line frequency and the supply voltage. • With 20' setting below approximately: – 0,5Amp@400VAC/50Hz – 0,6Amp@460VAC/60Hz • With 40' setting below approximately: – 0,5Amp@400VAC/50Hz – 0,6Amp@460VAC/60Hz • Indicates: – Defective or open fan motor internal over temperature protection switch. – Incorrect motor or motor connections. – Defective volt or amp meter on power module.	• Open evaporator door and make sure all fans rotate freely. • Enter Manual Function Test and start evaporator fans on low speed. Make sure all fans start on low speed. If a motor does not start and is very hot, wait 10 minutes for internal over temperature switch to close. • Enter Manual Function Test and start evaporator fans on high speed. Make sure all fans start on high speed. Check fan motor volts and amps. • With 20' setting expect: – 0,8Amp@400VAC/50Hz – 0,9Amp@460VAC/60Hz • With 40' setting expect: – 0,8Amp@400VAC/50Hz – 0,9Amp@460VAC/60Hz
16	Condenser Fan Current Too High • Occurs during pretrip (PTI) or function test only. • Fan power consumption is 33% above expected current draw or phase current level differs 33% or more. • If both alarm #16 and #17 is active this indicates too high phase difference. • Expected fan current is a function of the power line frequency and the supply voltage. • Above approximately: – 1,5Amp@400VAC/50Hz – 1,8Amp@460VAC/60Hz • Indicates: – Defective or stuck condenser fan motor. – Incorrect motor or motor connections. – Defective volt or amp meter on power module.	• Enter Manual Function Test and start condenser fan. Make sure the fan starts. • Check fan motor volts and amps. • Expect: – 1,0Amp@400VAC/50Hz – 1,2Amp@460VAC/60Hz
17	Condenser Fan Current Too Low • Occurs during pretrip (PTI) or function test only. • Fan power consumption is 33% below expected current draw or phase current level differs 33% or more. • If both alarm #16 and #17 is active this indicates too high phase difference. • Expected fan current is a function of the power line frequency and the supply voltage. • Above approximately: – 0,5Amp@400VAC/50Hz – 0,6Amp@460VAC/60Hz • Indicates: – Defective condenser fan motor relay. – Incorrect motor or motor connections. – Defective or open fan motor internal over temperature protection switch. – Defective volt or amp meter on power module.	• Enter Manual Function Test and start condenser fan. Make sure the fan starts. • Check fan motor volts and amps. • Expect: – 1,0Amp@400VAC/50Hz – 1,2Amp@460VAC/60Hz

Code	Description	Corrective Action
18	Power Supply Phase Error • Shutdown Alarm • The power module is not capable of detecting the rotation direction. • Indicates: – Phase(s) missing at the power supply line. – Defective fuse at power module. – Power module failure. – Heating element problem (used for current load to decide the rotation direction).	• Check fuses on the power module. • Check power line voltage on all three phases. • Use the tester to detect the problem. • Replace power module.
19	Temperature Too Far From Set Point • Occurs during Normal Run only. • After 75 minutes of operation, supply or return air temperature is not in-range and does not approach setpoint within preset pull-down rate. • Indicates: – Ice or frost on evaporator coil. – Low refrigerant charge. – Air exchange vent open too much. – Container air leakage (doors open).	• Use DATA menu to check supply and return air sensor temperatures. • Compare temperatures to evaluate unit cooling capacity and performance. • Temperature difference should be 4 C to 6 C (7.2 F to 10.8 F). • Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. • Check refrigerant charge. ***Note:*** *This alarm can be activated if the supply or return air temperature varies, even if the mean temperature does approach setpoint.*
20	Defrost Duration Too Long • May occur during any defrost. • Heat signal has been on for too long. • Time limit is 90 minutes with supply voltage above 440VAC and 120 minutes below 440VAC. • Indicates: – Low power supply voltage. – Defective heater elements. – Evaporator fans running during defrost. – Evaporator sensor placed wrong.	• Initiate a manual defrost and check amperage draw and evaporator coil temperature. Evaluate defrost performance. • Open evaporator door and check location of evaporator coil sensor. ***Note:*** *This alarm can be activated at low voltage and very low box temperature conditions, even under normal operating conditions.*
22	Capacity Test 1 Error • Occurs during pretrip (PTI) test only. • Difference between supply and return air temperature is too small with high speed evaporator fans (less than approximately 4.5 C [8 F]). • When the return air temperature does not reach -60 C (-76 F) within preset time. • Indicates: – Incorrect location of supply or return air sensor. – Air leakage at supply sensor cable. – Defective supply or return air sensor. – Interchanged sensor connections. – Incorrect evaporator fan rotation or high speed operation. – Incorrect refrigeration system operation. – Container/side panels defective, damaged or leaking. – Economizer circuit defective.	• Enter Manual Function Test and start evaporator fans on high speed and let operate fans for 5 minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (evaporator coil may be 0.5 C [1.0 F] lower due to fan motor heat). • Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on high speed. • Check the sensor connections. • Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, vapor on, condenser fan and evaporator fans (high). Check discharge and suction pressure readings. Also check the refrigerant charge. ***Note:*** *This alarm can be activated in ambient temperatures below -10 C (14 F), even under normal conditions.*

Code	Description	Corrective Action
23	Capacity Test 2 Error • Occurs during pretrip (PTI) test only. • When the supply air temperature does not reach –30 °C (–22 F) within preset time. • Indicates: – Incorrect location of supply air sensor. – Air leakage at supply sensor cable. – Defective supply air sensor. – Interchanged sensor connections. – Incorrect evaporator fan rotation or high speed operation. – Incorrect refrigeration system operation. – Container/side panels defective, damaged or leaking. – Air exchange vent open too much. – Low refrigerant charge. – Cooling circuit defective.	• Enter Manual Function Test and start evaporator fans on high speed and let operate fans for five minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (supply air may be 0.5 °C [1.0 F] higher due to fan motor heat). • Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on low and high speed. • Check the sensor connections. • Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, vapor on, condenser fan and evaporator fans (high). Check discharge and suction pressure readings. Also check the refrigerant charge.
31	Low Pressure Cut Out • If low pressure switch is mounted. – The switch is OPEN. • If pressure transducer is mounted. – The suction pressure has been measured below -0,33BarR and has not yet increased above +0,58BarR. • Indicates: – Low refrigerant charge. – Refrigeration system restriction at filter drier or expansion valve. – Defective low pressure cutout switch. – Defective low pressure transmitter.	• Check discharge and suction pressure gauge readings: – If refrigerant pressures are low, check for a restriction and leak check the refrigeration system. – If refrigerant pressures are high, check for a high refrigerant charge (see below). • Check for a restriction: – Check for frost on downstream side of the filter drier. – Check for high evaporator superheat using supply air sensor temperature readings in Data menu or a frost pattern on expansion valve side of the evaporator coil. A large temperature difference between the left hand and right hand supply air sensors indicates a possible evaporator restriction or incorrect superheat. • If low pressure switch is mounted: – Check low pressure cutout switch wiring. – Measure the voltage across the switch, located at J9 pin 6 and pin 5. • Switch closed (normal) voltage is 0VDC. • Switch open (LPCO) voltage is approx. 12VDC. – Replace switch. • If pressure transducer is mounted: – Measure the transducer supply voltage at J1 pin 8 related to J1 pin 9 (GND). Expects to be approx. 12VDC. – Measure the transducer output voltage at J1 pin 7 related to J1 pin 9 (GND). Expects to be above 0,5VDC (0BarR = 0,8VDC)

Code	Description	Corrective Action
32	Condenser Coil Temperature Sensor Open Circuit • When the sensor circuit resistance is above 1785Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 7 and 8. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can't be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +200°C (approx 1758Ω).
33	Condenser Coil Temperature Sensor Short Circuit • When the sensor circuit resistance is below 602Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 7 and 8. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can't be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +200°C (approx 1758Ω).

Code	Description	Corrective Action
34	Ambient Air Temperature Sensor Open Circuit • When the sensor circuit resistance is above 1785Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 9 and 10. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can't be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +200°C (approx 1758Ω).
35	Ambient Air Temperature Sensor Short Circuit • When the sensor circuit resistance is below 602Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 9 and 10. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can't be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +200°C (approx 1758Ω).
43	Return Air Temperature Too High • Occurs during defrost. • With dehumidify operation; during defrost the return air temperature increases above 38 °C (100 F). • Indicates: – Defective return or evaporator coil sensor. – Return and evaporator coil sensor connections are reversed.	• Check for sensor alarm codes. • Check supply and return sensor connections and locations.

Code	Description	Corrective Action
44	Return Air Temperature Too Low • Occurs during Normal Run only. • Only active with the surveillance active (OOCL option) • During dehumidify operation or if ambient air temperature is below set point: – If return air temperature is below set point -3C. • Else (other operation range): – If return air temperature is below set point -1C. • The alarm state has to be present for 15 minutes before the alarm is set. • Indicates: – Container/side panels defective, damaged or leaking.	• Using DATA menu to evaluate sensors. • Use PROBE TEST to help determine the problem. • Replace sensor.
51	Power Line Voltage Too Low • Shutdown Alarm • Occurs if line voltage has been below 330VAC and is below 340 volts for 30 minutes. • During the 30 minutes and until voltage gets back above 340VAC the compressor is stopped, for protecting the unit. • Indicates: – Poor power supply.	• Using DATA menu to evaluate the power line quality. • Refer to the electrical specifications in the Specifications Section for correct power requirements.
52	Probe Error • Occurs during pretrip (PTI) test or probe test in Chilled mode. • Temperature difference between supply and return air is above 1,5C and the system is not capable of pinpointing which probe is failing. • Temperature difference between supply and return air and evaporator coil is above 1,5C and the system is not capable of pinpointing which probe is failing. • Indicates: – Sensor error. – Sensor misplacement.	• Using MANUAL FUNCTION TEST, ventilate with evaporator fan high speed and evaluate the readings. • Check sensor connections. • Replace sensor. • Check sensor.
53	High Pressure Switch Off Error • Occurs during pretrip (PTI) test only. • Compressor does not stop during high pressure cutout switch test. • Indicates: – Faulty compressor contactor or control circuit. – Low refrigerant charge. – Defective high pressure cutout switch. – Strong winds causing cooling of condenser coil in low ambient conditions.	• Check discharge and suction pressure gauge readings and check refrigerant charge. • Enter Manual Function Test menu. – Start the following components together: compressor 100 percent, compressor and evaporator fans (high). Discharge pressure should increase and compressor should stop at 2302 kPa, 23 bar, 334 psig (high pressure cutout switch opens).
54	High Pressure Switch On Error • Occurs during pretrip (PTI) test only. • Compressor does not start within normal time during high pressure cutout switch test. • Indicates: – High pressure cutout switch did not respond to pressure change within five seconds. – Air in refrigeration system. – Defective high pressure cutout switch.	• Check discharge and suction pressure gauge readings. • Enter Manual Function Test menu. – Start the following components together: compressor 100 percent, compressor and evaporator fans (high). Discharge pressure should increase and compressor should stop at 2302 kPa, 23 bar, 334 psig (high pressure cutout switch opens). – Then start condenser fan. Discharge pressure must drop quickly (10 to 20 seconds) to 1550 kPa, 15.5 bar, 225 psig and compressor should start (switch closes).

Code	Description	Corrective Action
56	Compressor Temperature Too High • Shutdown Alarm • Compressor discharge line temperature is above 148 C (298 F). Compressor stopped until discharge line temperature decreases to normal. • Indicates: – Air in refrigeration system. – Low refrigerant charge. – Defective compressor. – Defective vapor injection.	• Operate unit on Cool and check discharge and suction pressure gauge readings. • Enter Manual Function Test menu and test (operate) Vapor Injection Valve to determine if valve opens (energizes). • Check compressor discharge sensor resistance. Resistance must be approx. 86,000 ohms at 25 C (77 F). • Check discharge line temperature with a separate electronic thermometer and compare to "HIGH PR TEMP" shown in the Data menu of controller. ***Note:*** *Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.*
58	Phase Sensor Error • Occurs during pretrip (PTI) or function test only. • During Phase Sensor Test, while direction is reversed, the condenser fan and compressor is tested. – If the current consumption of the condenser fan is below 0,5A on each phase. – If the current consumption of the compressor is below 2,0A on each phase. • Indicates: – Defective phase relay. – Defective power module.	• Start a Manual Function Test. With reverse phase direction selected, check the condenser fan runs reversed direction and the compressor is activated and makes loud noise. Allow only for short time activation max. 5 sec.
59	Delta Current Error • 100% ampere difference between current phases, max reading must be above 1,5A. • The alarm is protected by a timer which demand the state to be present for three minutes before the alarm is set. • Indicates: – Open connection on one phase of power supply to a motor or heater element. – Blown fuse.	• Enter Manual Function Test menu and test (operate) each 3-phase component to locate defective connection. • Check fuses.

Code	Description	Corrective Action
97	Compressor temperature Sensor Open Circuit • When the sensor circuit resistance is above 1MΩ and the ambient air temperature is above -10°C. – Since the sensor is a NTC-type, readings above 1MΩ will occur when the temperature is below approximately -25°C. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check for sensor connections at controller. • The compressor temperature sensor is a NTC – 2 wire sensor. The sensor is located/connected to the MP- 4000 at connector J3 pin 13 and 14. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. • The sensor can't be examined without disconnecting it. • The electrical resistance towards chassis must be above mega ohm (MΩ) range. • The sensor is a NTC thermistor type - negative temperature coefficient, which in this case means that the resistance of the sensor decreases with temperature. – The sensor is defined to be 86000Ω@ 25°C. – Normal condition measuring with disconnected sensor is: • 475kΩ@-10°C • 280kΩ@0°C • 171kΩ@+10°C • 135kΩ@+15°C • 107kΩ@+20°C – The valid measuring limit for this sensor is -25°C (approx. 1MΩ) +185°C (approx. 550Ω). ***Note:*** *OPEN circuit state may not be reasonable since open indicates high electrical resistance, which with this type of sensor is possible at very low temperature. If the Ambient Air Temperature indicates temperatures above -10°C the sensor is expected not to be below -25°C and the alarm may be set. If the measured resistance gets above the limit the reading is replaced with -30°C. The needed protection compressor temperature vice is at the high temperature end of the scale.*
98	Compressor temperature Sensor Short Circuit • When the sensor circuit resistance is below 550Ω. • Indicates: – Short circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check for sensor connections at controller. • The compressor temperature sensor is a NTC – 2 wire sensor. The sensor is located/connected to the MP- 4000 at connector J3 pin 13 and 14. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. • The sensor can't be examined without disconnecting it. • The electrical resistance towards chassis must be above mega ohm (MΩ) range. • The sensor is a NTC thermistor type - negative temperature coefficient, which in this case means that the resistance of the sensor decreases with temperature. – The sensor is defined to be 86000Ω@ 25°C. – Normal condition measuring with disconnected sensor is: • 475kΩ@-10°C • 280kΩ@0°C

Code	Description	Corrective Action
		• 171kΩ@+10°C • 135kΩ@+15°C • 107kΩ@+20°C – The valid measuring limit for this sensor is -25°C (approx. 1MΩ) +185°C (approx. 550Ω).
120	Suction Pressure Sensor Error • Occurs during Normal Run if the sensor is detected to be out of range, open or short circuit. • Occurs during Pre-Trip (PTI) test if the sensor readings do not act correct during compressor activity. – Expected to decrease 0,15Bar from stopped to compressor running loaded. • Indicates: – Wrong location of the sensor. – Sensor failure. • Superfreezer: – The sensor is suction pressure for the R23 system.	• Using DATA menu evaluate sensor readings. • Check wiring to be correct and connected. • Check J1 plug is plugged into MRB. • Check voltage at J1 pin 1 to be 0.5 – 4.5 VDC. • Replace sensor.
121	Discharge Pressure Sensor Error • Occurs during Normal Run if the sensor is detected to be out of range, open or short circuit. • Occurs during Pre-Trip (PTI) test if the sensor readings do not act correct during compressor activity. – Expected to decrease 0,15Bar from stopped to compressor running loaded. • Indicates: – Wrong location of the sensor. – Sensor failure. • Superfreezer: – The sensor is suction pressure for the R23 system.	• Using DATA menu evaluate sensor readings. • Check wiring to be correct and connected. • Check J1 plug is plugged into MRB. • Check voltage at J1 pin 4 to be 0.5 – 4.5 VDC. • Replace sensor.
123	Data logger Battery Error • In cold ambient if the battery heater (battery internal) is not capable of heating up the battery, ready for charging within 2 hours. • If the battery is not connected. • If the battery voltage is below 3.0VDC.	• Using DATA menu to determine the state of the battery. Evaluate temperature and voltage. • Check the battery physically, dismount and examine wires and the connection to the controller. • Replace battery.

Code	Description	Corrective Action
127	General Unit Error • The surveillance has determined that the unit is not capable of continue running, and has shut down. • The reason is displayed at the controller main screen, and is stated at the event next to the alarm event. • Known reason to the shutdown state is: – "SET POINT OUT OF RANGE" – "VOLTAGE OUT OF RANGE" – "POWER LINE PHASE ERROR" – "REGULATION PROBE ERROR" – "COMPRESSOR TEMPERATURE HIGH"	"SET POINT OUT OF RANGE" • The temperature set point is outside valid operation range. +30°C to -40°C (+35°C with extended range). • Check configurations and settings on the controller. "VOLTAGE OUT OF RANGE" • The measured voltage is below 330VAC. • Check power line voltage while loaded. "POWER LINE PHASE ERROR" • The phase detection system detects phase error or not capable of securing the correct rotation. • Check power line voltage and quality. "REGULATION PROBE ERROR" • If supply and return air temperature sensor and evaporator coil temperature sensors ALL indicate OPEN or SHORT circuit, the software is not capable of determine a reasonable action related to the cargo. • Following steps related to the sensor alarms. "COMPRESSOR TEMPERATURE HIGH" • The compressor temperature is measured to be above 148°C. The state will stay until compressor temperature is measured to be below 132°C. • Check refrigerant level and flow through the cooling circuit.
128	Supply Air Temperature Sensor Error • Occurs during Pre-Trip (PTI) test and probe test only. • After ventilation with the evaporator fans. • If the supply and return air temperature sensor differs more than 1,5C and the return air temperature is within 1,5C of evaporator coil temperature. • If evaporator coil temperature sensor is failing, if the supply and return air temperature sensors differs more than 1,5C. Both alarm 129 and 128 will be set. • Indicates: – Failing sensors. – Misplaced sensors. – Failing controller.	• Use the DATA menu to detect the failing sensor. • Replace sensors. • Use the tester to determine the problem.
129	Return Air Temperature Sensor Error • Occurs during Pre-Trip (PTI) test and probe test only. • After ventilation with the evaporator fans. • If the supply and return air temperature sensor differs more than 1,5C and the supply air temperature is within 1,5C of evaporator coil temperature. • If evaporator coil temperature sensor is failing, if the supply and return air temperature sensors differs more than 1,5C. Both alarm 129 and 128 will be set. • Indicates: – Failing sensors. – Misplaced sensors. – Failing controller.	• Use the DATA menu to detect the failing sensor. • Replace sensors. • Use the tester to determine the problem.

Code	Description	Corrective Action
130	Evaporator Coil Temperature Sensor Error • Occurs during Pre-Trip (PTI) test and probe test only. • After ventilation with the evaporator fans. • If the evaporator coil temperature differs more than 1,5C from the mean value of supply and return air temperature. • Indicates: – Failing sensors. – Misplaced sensors. – Failing controller.	• Use the DATA menu to detect the failing sensor. • Replace sensors. • Use the tester to determine the problem.
131	Ambient Air – Condenser Coil Temperature Sensor Error • Occurs during Pre-Trip (PTI) test and probe test only. • After ventilation with the condenser fan. • If the ambient air and condenser coil temperature sensor readings differs more than 2.5C. • Indicates: – Failing sensors. – Misplaced sensors. – Failing controller.	• Use the DATA menu to detect the failing sensor. • Replace sensors. • Use the tester to determine the problem.
132	Power Module Sensor Error • The surveillance continually evaluates the measurements reported by the power module. • The surveillance includes a timer with a timeout at 60 seconds before the alarm is set. • Indicates: – Power module located readings outside allowed range.	• Use DATA menu to determine the failing reading. • The accepted limit for: – Line AC voltage is 180 to 700VAC. – Power line current is 0mA to 32A. – Radiator temperature is -100C to 200C. • Check for latest software revision. • Use tester to determine the problem.
133	Power Module Network Error • The surveillance has not received valid status communication from the power module for 10 seconds. • Indicates: – Communication problem.	• Check connection between controller and power module. • Use tester to determine the problem.
134	Controller Error • The surveillance has determined the state "controller internal error". • Indicates: – The controller is failing one way or another.	• Use the tester to determine the problem.
135	Power Module Error • The surveillance has determined the state "Power module error". • Indicates: – The power module is failing one way or another.	• Use the tester to determine the problem.
136	Controller Transducer Circuit Error • The controller is not capable of generating the expected voltage for the 12V LPCO and transducer sensors, (suction pressure and discharge pressure, AVL and humidity sensor).	• Replace Data logger Battery. • Use the tester to determine the problem.

Code	Description	Corrective Action
137	Sensor System Overload • The controller sensor measurement is overloaded. • This situation will probably introduce wrong readings at other sensors than the one introducing the overload. • Indicates: – Not intended voltage is introduced at one of the sensor inputs. – Transducer, connection or cabling with voltage supply for the sensor might short circuit this voltage supply onto the measuring input.	• Sensor input which might initiate the problem: – At connector J3: • Humidity sensor (4-20mA type) pin 15-16. – At connector J1: • AVL position pin 1-3. • Discharge pressure pin 4-6. • Suction pressure pin 7-9. • At least one of the sensors circuits holds a short between sensor voltage and sensor signal. • Problem might be located any were from the connection to the sensor itself. • Action: – Disconnect sensors and look for a non intended short between sensor voltage and the sensor line. – The sensor with the problem might show up with its own alarm.
139	Internal File Handling Error • Occurs if the read or write process of nonvolatile information (i.e., Configuration and settings) fails. • Indicates: – Internal file read or write failure.	• Replace controller.
140	Evaporator Section Too Hot • Occurs if supply air, return air or evaporator coil temperature reads temperature at or above 60C. • Indicates: – Failing heater circuit, hanging output. – Failing evaporator fan.	• Observe temperature readings to locate the problem. • Use manual function test to determine the failing component. • Use the tester to determine the problem.
141	Power Module Heat Exchanger Too Hot • Occurs if the power module heat exchanger temperature gets above 105C. – Since activating the heating element is the far most heat applying solid state switch, activating is bypassed to reduce temperature. • Indicates: – High temperature surrounding the control box. – Poor cooling to the back side of the control box.	• Check for blocked air flow to the back side of the control box. • Ambient temperature might just be high.

Code	Description	Corrective Action
144	Compressor 2 temperature Sensor Open Circuit • Superfreezer only • This sensor is in use with the Superfreezer 'High Temperature' compressor (R134a) • When the sensor circuit resistance is above 1MΩ and the ambient air temperature is above -10°C. – Since the sensor is an NTC-type, readings above 1MΩ will occur when the temperature is below approximately -25°C. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check for sensor connections at controller. • The compressor temperature sensor is a NTC – 2 wire sensor. The sensor is located/connected to the MP-4000 at connector J4 pin 7 and 8. CM-4000 low left connector J4, 8 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. • The sensor can't be examined without disconnecting it. • The electrical resistance towards chassis must be above mega ohm (MΩ) range. • The sensor is a NTC thermistor type - negative temperature coefficient, which in this case means that the resistance of the sensor decreases with temperature. – The sensor is defined to be 100kΩ@ 25°C. – Normal condition measuring with disconnected sensor is • 351kΩ@0°C, • 208kΩ@+10°C, • 127kΩ@+20°C, • 79kΩ@+30°C. • The valid measuring limit for this sensor is -25°C (approx. 1MΩ) +185°C (approx. 550Ω). ***Note:*** *OPEN circuit state may not be reasonable since open indicates high electrical resistance, which with this type of sensor is possible at very low temperature. If the Ambient Air Temperature indicates temperatures above -10°C the sensor is expected not to be below -25°C and the alarm may be set. If the measured resistance gets above the limit the reading is replaced with -30°C. The needed protection compressor temperature vice is at the high temperature end of the scale.*
145	Compressor 2 temperature Sensor Short Circuit • Superfreezer only • This sensor is in use with the Superfreezer 'High Temperature' compressor (R134a) • When the sensor circuit resistance is below 550Ω. – Since the sensor is an NTC-type, readings above 1MΩ will occur when the temperature is below approximately -25°C. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check for sensor connections at controller. • The compressor temperature sensor is a NTC – 2 wire sensor. The sensor is located/connected to the MP-4000 at connector J4 pin 7 and 8. CM-4000 low left connector J4, 8 pin wide, pin number 1 is the right pin, seen at the backside of the controller. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. • The sensor can't be examined without disconnecting it. • The electrical resistance towards chassis must be above mega ohm (MΩ) range. • The sensor is a NTC thermistor type - negative temperature coefficient, which in this case means that the resistance of the sensor decreases with temperature. – The sensor is defined to be 100kΩ@ 25°C. – Normal condition measuring with disconnected sensor is • 351kΩ@0°C, • 208kΩ@+10°C, • 127kΩ@+20°C,

Code	Description	Corrective Action
		• 79kΩ@+30°C. • The valid measuring limit for this sensor is -25°C (approx. 1MΩ) +185°C (approx. 550Ω).
146	Compressor 2 Temperature Too High • Shutdown Alarm • Superfreezer only • Compressor discharge line temperature is above 148 °C (298 F). Compressor stopped until discharge line temperature decreases to normal. • Indicates: – Air in refrigeration system. – Low refrigerant charge. – Defective compressor. – Not normal ambient condition.	• Operate unit and check discharge and suction pressure gauge readings. • Check refrigerant charge of R-134a system and R-23 system. • Check compressor discharge sensor resistance. Resistance must be approx. 100k ohms at 25 °C (77 F). • Check discharge line temperature with a separate electronic thermometer and compare to "HIGH PR TEMP" shown in the Data menu of controller. ***Note:*** *Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.*
147	Compressor 2 Feedback Error • Shutdown Alarm • Superfreezer only • The feedback signal from the R134a compressor contactor is wrong, does not match the output signal to activate the contactor. • HPCO2 (R134a) is part of the wiring. • Indicates: – HPCO 2 (R134a). – Wiring problem. – Defective contactor.	• Verify wiring and activation of contactor. • Check the HPCO switch, must be short in normal operation.
148	Suction 2 Pressure Sensor Error • Superfreezer only • Occurs during Normal Run if the sensor is detected to be out of range, open or short circuit. • Occurs during Pre-Trip (PTI) test if the sensor readings do not act correct during compressor activity. – Expected to decrease 0,15Bar from stopped to compressor running loaded. • Indicates: – Wrong location of the sensor. – Sensor failure.	• Using DATA menu evaluate sensor readings. • Check wiring to be correct and connected. • Check J1 plug is plugged into MRB. • Check voltage at J1 pin7 to be 0.5 – 4.5 VDC. • Replace sensor.
157	Data logger Battery Failure • Firmware version 3.3.0 or newer: – Occur if the battery is connected and the battery protection circuit is activated as a result of overcurrent, over-charge or over-discharge. – Battery voltage must stay below 2.5V after the battery has been charged for three minutes.	• Check the battery physically, dismount and examine wires and the connection to the controller. • Replace battery.
158	Data logger Battery Test FailureData logger Battery Failure • Firmware version 3.21.0 or newer: – Battery Test did not pass.	• Replace battery.

Diagrams

Diagram Index

Figure 42. SF MP4000 Wiring Diagram (Sheet 1 of 2)

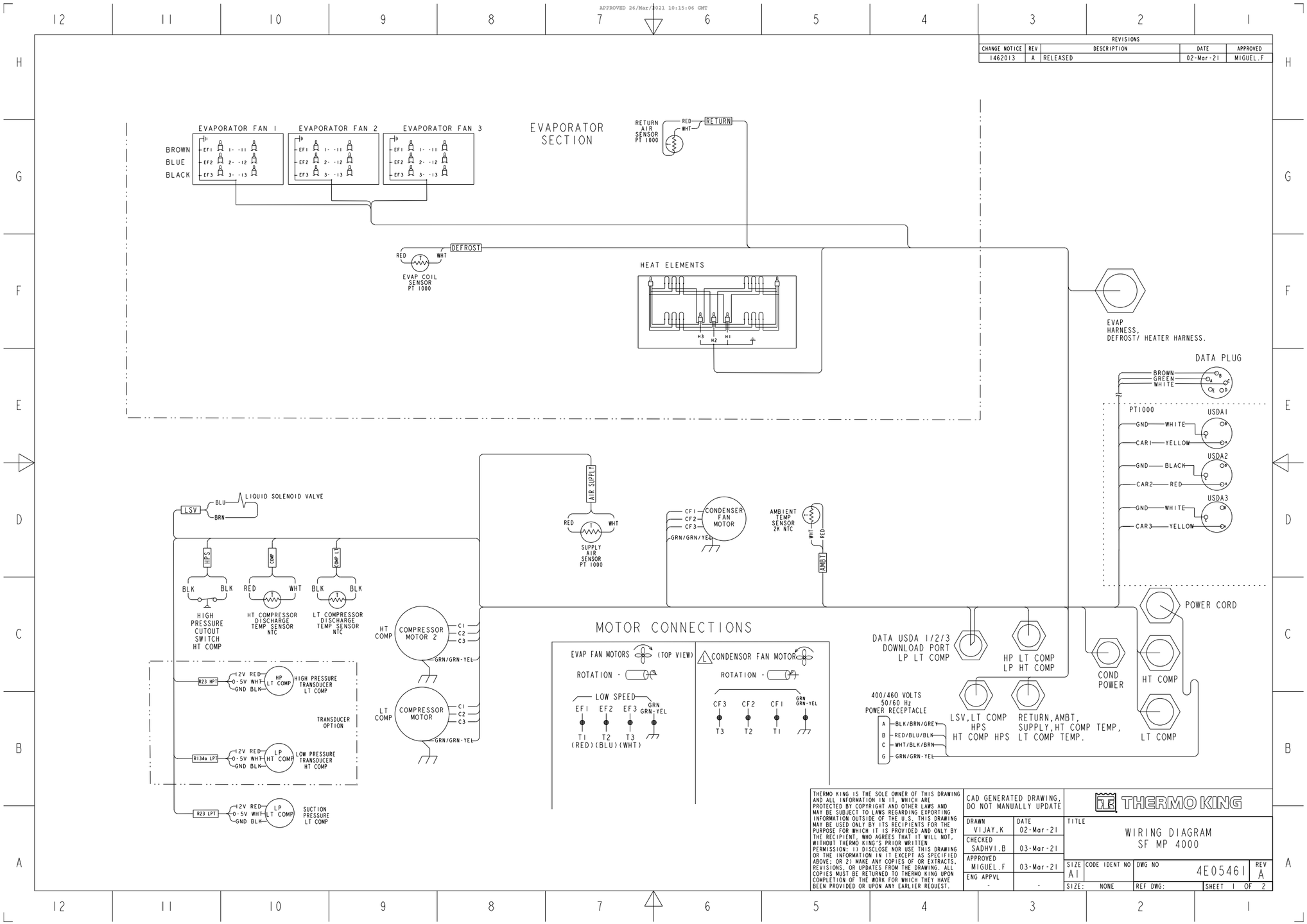


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Figure 43. SF MP4000 Wiring Diagram (Sheet 2 of 2)

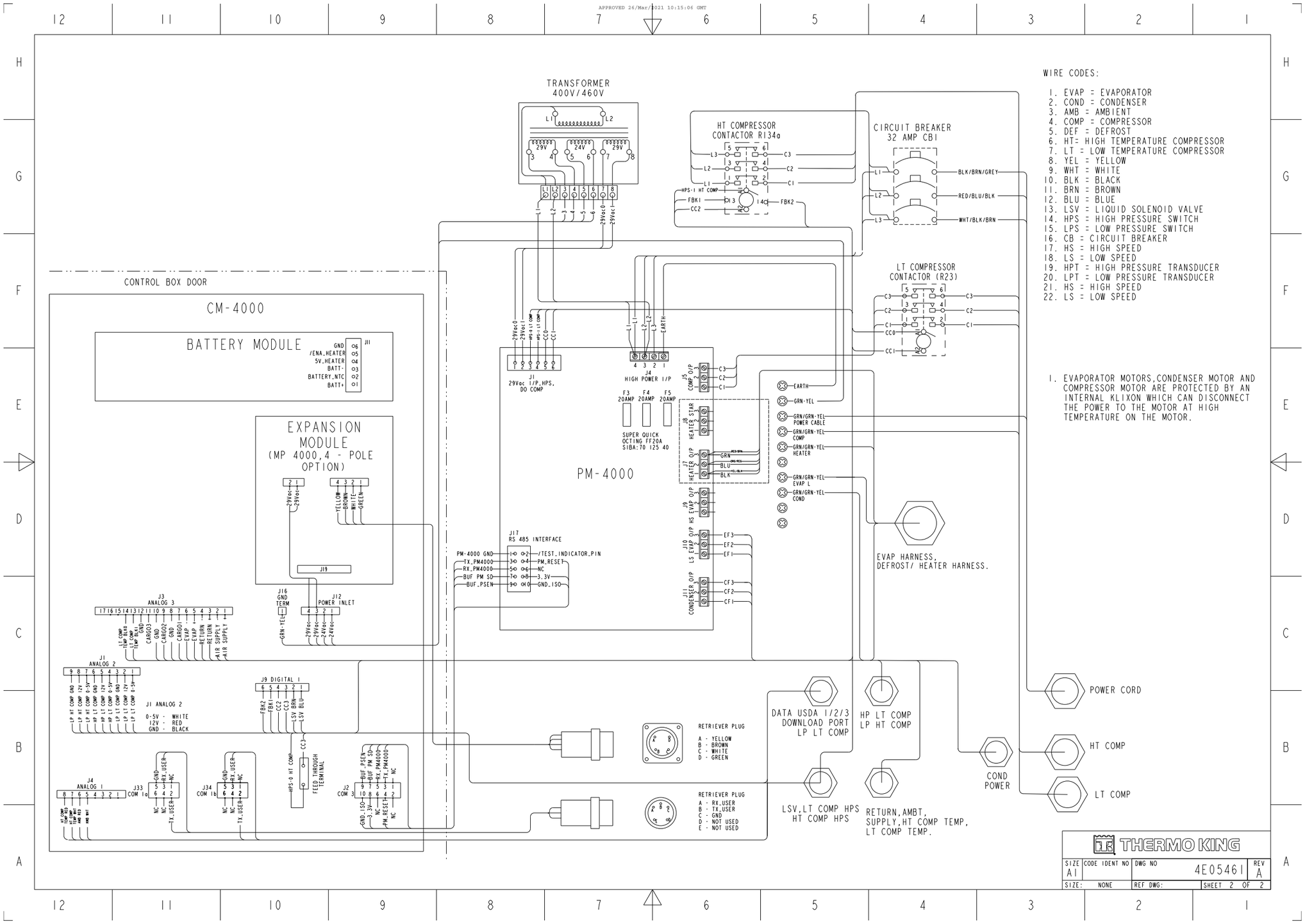

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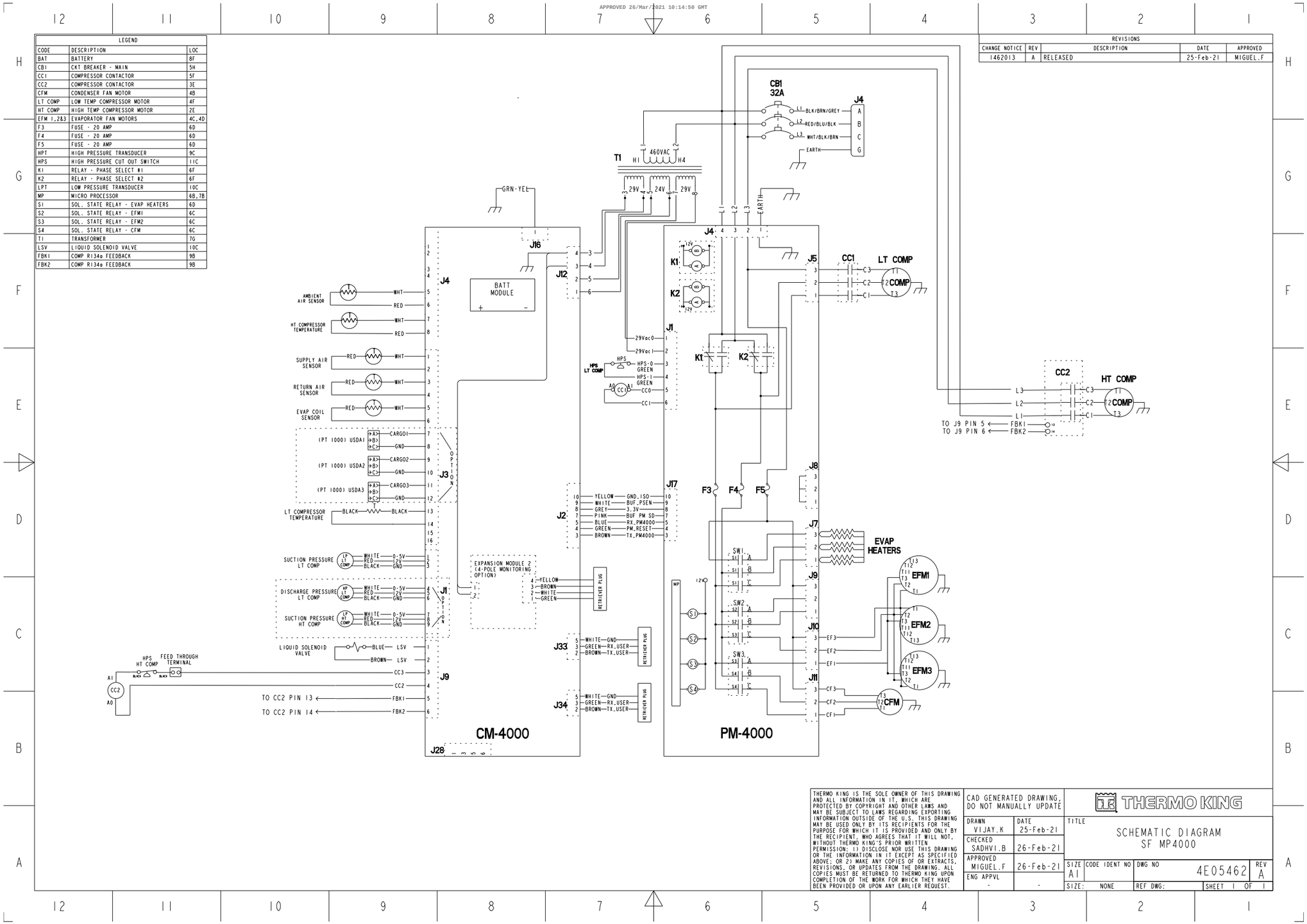
Figure 44. SF MP4000 Schematic Diagram



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CHECKED	SADHVI.B	26-Feb-21
APPROVED	MIGUEL.F	26-Feb-21
ENG APPVL	-	-

THERMO KING

TITLE: SCHEMATIC DIAGRAM SF MP4000

SIZE	CODE IDENT NO	DWG NO	REV
A1		4E05462	A
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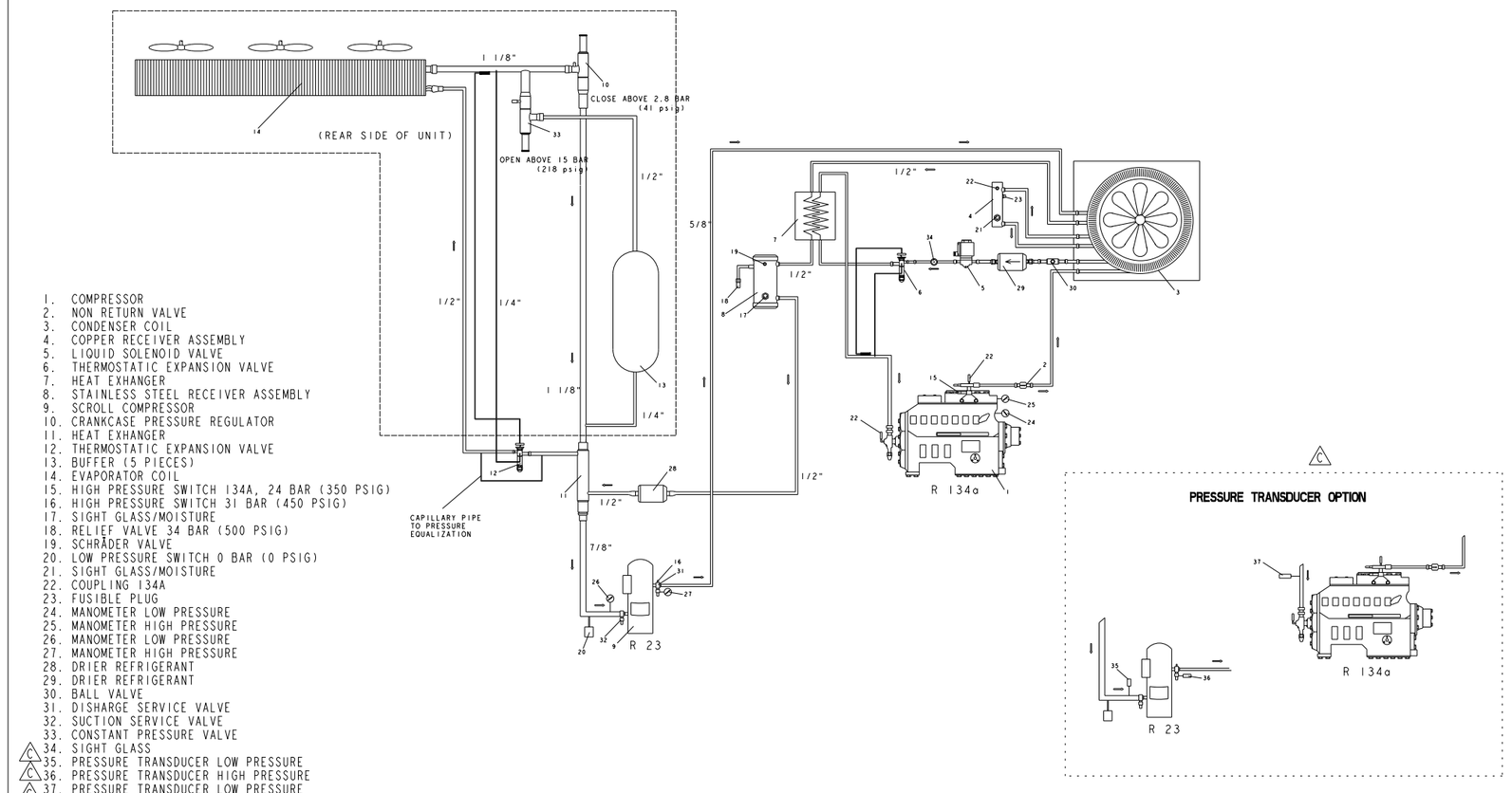
Figure 45. CRR40-DF Diagram Tube RTG

REVISIONS				
CHANGE NOTICE	REV	DESCRIPTION	DATE	APPROVED
75581	A	RELEASED	13-Jul-99	OT
508585	B	ADDED ITEM 34	06-Jan-05	KJP
1278317	C	TEMPLATE UPDATED,ADDED ITEM 35 TO 37 & ADDED PRESSURE TRANSDUCER DIAGRAM	04-Apr-18	CV



1. COMPRESSOR
2. NON RETURN VALVE
3. CONDENSER COIL
4. COPPER RECEIVER ASSEMBLY
5. LIQUID SOLENOID VALVE
6. THERMOSTATIC EXPANSION VALVE
7. HEAT EXHANGER
8. STAINLESS STEEL RECEIVER ASSEMBLY
9. SCROLL COMPRESSOR
10. CRANKCASE PRESSURE REGULATOR
11. HEAT EXHANGER
12. THERMOSTATIC EXPANSION VALVE
13. BUFFER (5 PIECES)
14. EVAPORATOR COIL
15. HIGH PRESSURE SWITCH 134A, 24 BAR (350 PSIG)
16. HIGH PRESSURE SWITCH 31 BAR (450 PSIG)
17. SIGHT GLASS/MOISTURE
18. RELIEF VALVE 34 BAR (500 PSIG)
19. SCHRÄDER VALVE
20. LOW PRESSURE SWITCH 0 BAR (0 PSIG)
21. SIGHT GLASS/MOISTURE
22. COUPLING 134A
23. FUSIBLE PLUG
24. MANOMETER LOW PRESSURE
25. MANOMETER HIGH PRESSURE
26. MANOMETER LOW PRESSURE
27. MANOMETER HIGH PRESSURE
28. DRIER REFRIGERANT
29. DRIER REFRIGERANT
30. BALL VALVE
31. DISHARGE SERVICE VALVE
32. SUCTION SERVICE VALVE
33. CONSTANT PRESSURE VALVE
34. SIGHT GLASS
35. PRESSURE TRANSDUCER LOW PRESSURE
36. PRESSURE TRANSDUCER HIGH PRESSURE
37. PRESSURE TRANSDUCER LOW PRESSURE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM. INTERPRET DIM AND TOL PER ASME Y14.5M - 1994

THIRD ANGLE PROJECTION

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UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS PER TKS09109

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CHECKED	OT	13-Jul-99
APPROVED	OT	13-Jul-99
ENG APPVL	-	-

THERMO KING

TITLE: PIPING DIAGRAM CRR40-DF

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SCALE 1.000		SHEET 1 OF 1	

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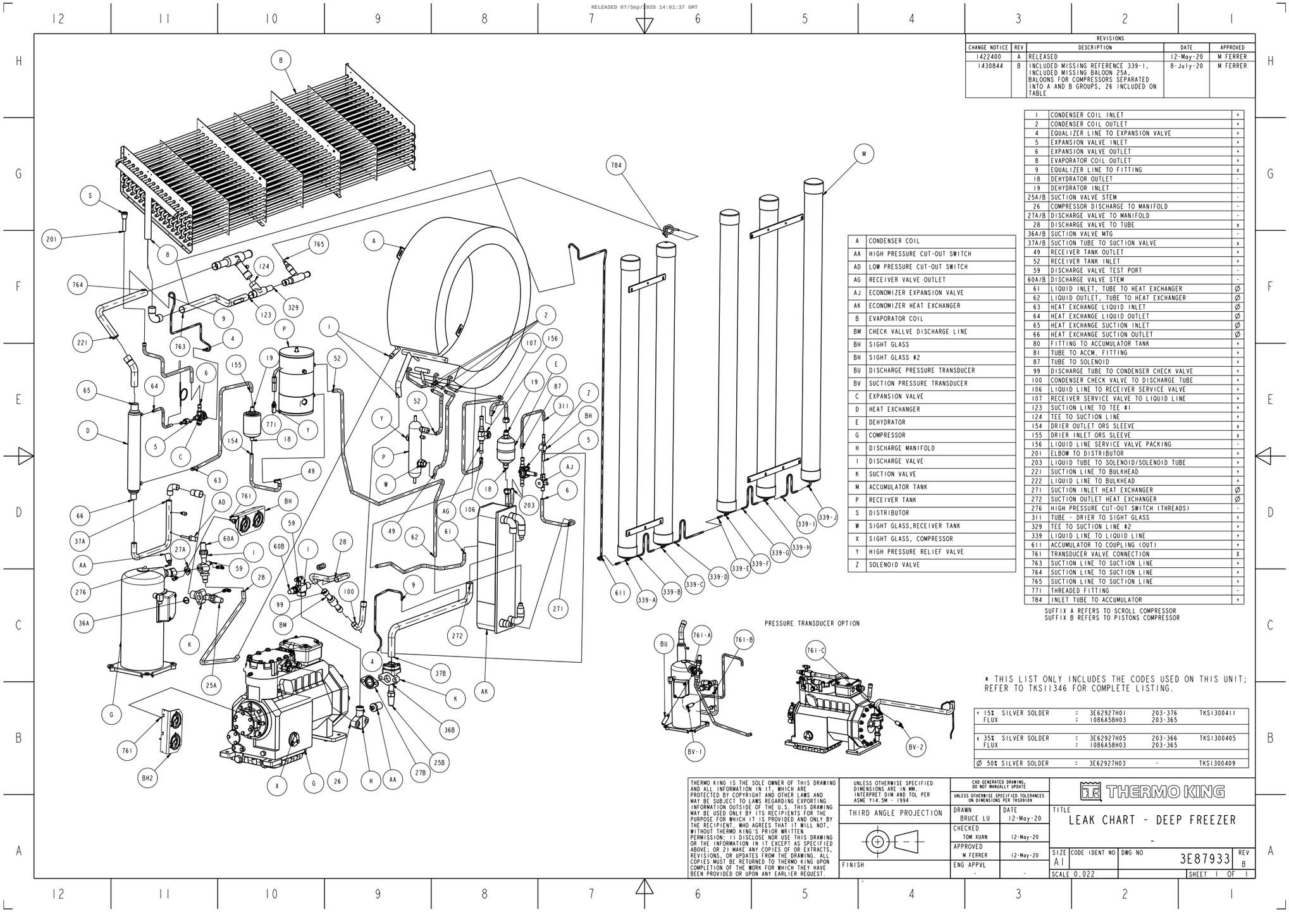
Figure 46. Deep Freezer Leak Chart



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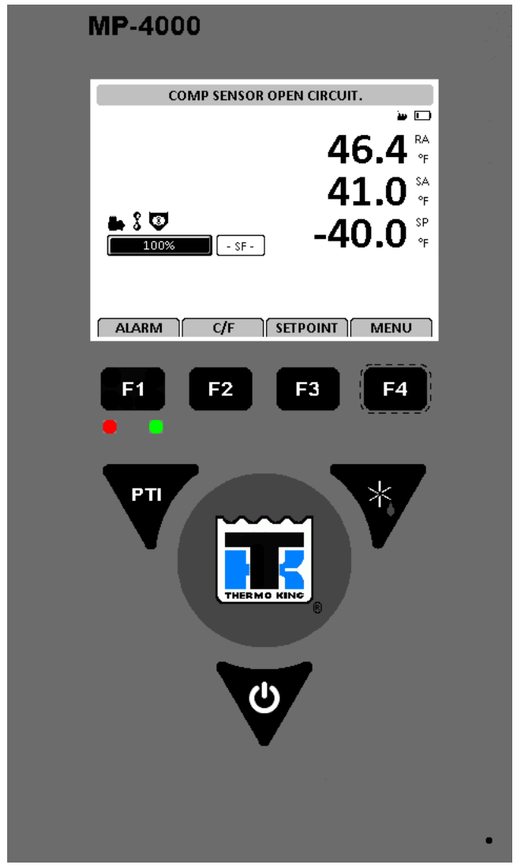


NOTE: All screens are NOT present on all units. The screen that display on the controller are determined by the Controller Software setting and the options installed on the unit.
NOTE: When a function key (F1, F3, F3 or F4) is pressed, the screen remains at that level until another function key is pressed.

To Enter a Controller Menu or Use Special Function Key:

- Press Alarm Key to Quickly view/Acknowledge Alarms (F1).
- Press C/F key to view alternate temperature scale in LED display (F2).
- Press SETPOINT Key to Quickly change Setpoint (F3)
- Press MENU Key to view the main menu (F4)
- Press DEFROST key to initiate a manual defrost. Evaporator coil temperature must be below 10C (50F) (*).
- Press PTI key to quick Start the Pre Trip Inspection (PTI)

To Enter a Submenu, a Command or a New Value in a Text Screen:

- Press F4 key.

To Scroll in a Menu or a Text Line:

- Press F2 key to scroll up or backward.
- Press F3 key to scroll down or forward.

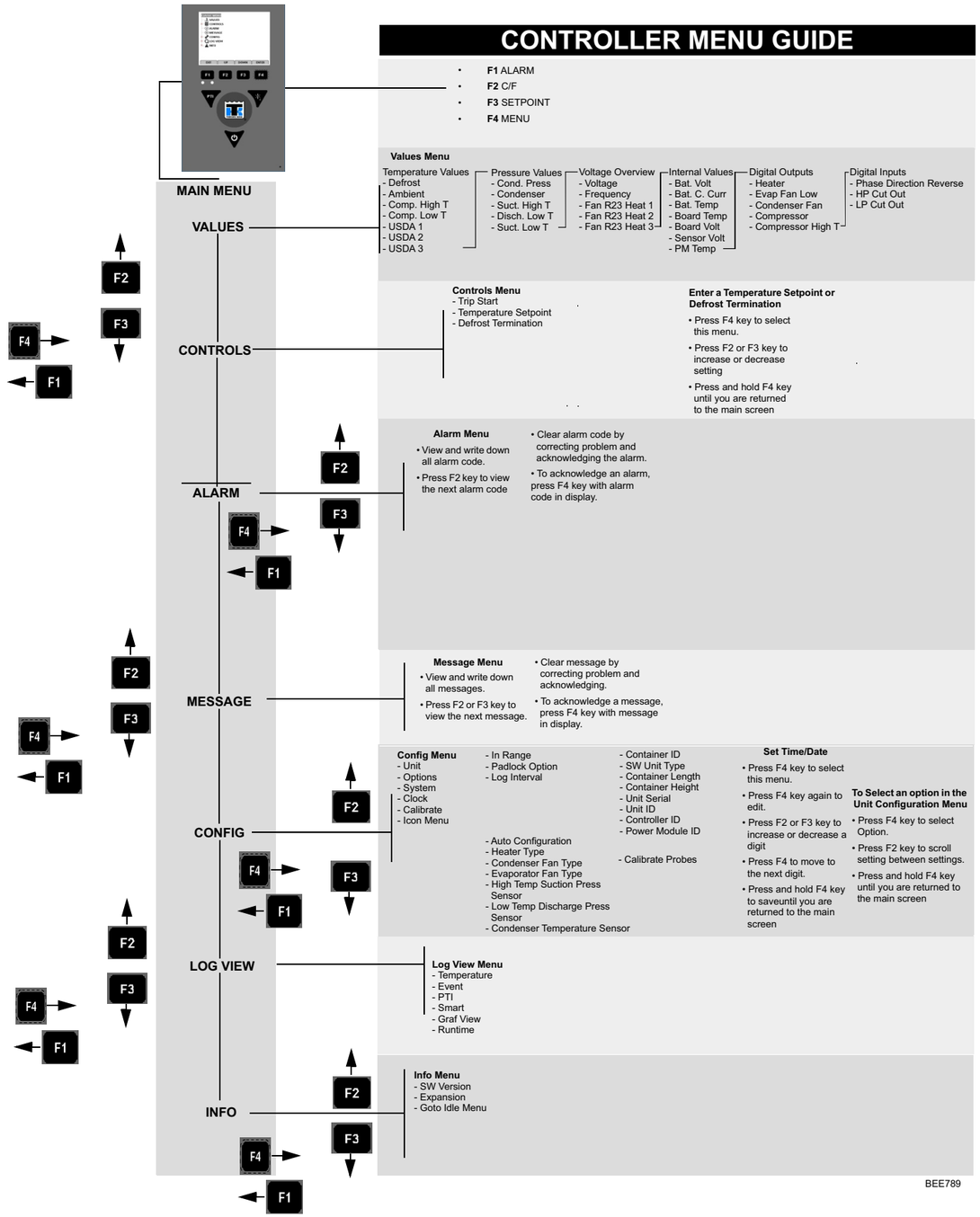
To Exit a Menu or Text Line:

- Press F1 key.

To Lock a LCD Data Screen Display:

Maximum display time is 30 minutes for data screens and 100 minutes for manual tests. Press F1 key to exit display.

Figure 47. MP4000 Controller Menu Guide



Notes

Thermo King – by Trane Technologies (NYSE: TT), a global climate innovator – is a worldwide leader in sustainable transport temperature control solutions. Thermo King has been providing transport temperature control solutions for a variety of applications, including trailers, truck bodies, buses, air, shipboard containers and railway cars since 1938. For more information, visit www.thermoking.com or www.tranetechnologies.com.

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