THERMO KING

Maintenance Manual

Container Edition
MAGNUM PLUS® with MP4000

Revision A

October 2019

TK 60275-4-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:

MAGNUM PLUS	098212	098582	098589
	098216	098583	098590
	098218	098585	098591
	098219	098586	098592
	098223	098587	098593
	098580	098588	098594
	098581		
Base Units	098203		

For further information, refer to:

MAGNUM Parts List Parts Manual	TK 54356
Diagnosing Thermo King Container Refrigeration Systems	TK 41166
Electrostatic Discharge (ESD) Training Guide	TK 40282
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 (Oct 2019) 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-404A/R-452A

NOTICE

Equipment Damage!

Use only Polyolester-based refrigeration compressor oil in R-134a/R-404A/R-452A 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-404A or R-452A units, use only those service tools certified for and dedicated to R-134a/R-404A/R-452A refrigerant and Polyolester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-134a/R-404A/R-452A systems.

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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

Table of Contents

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.

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

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

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

NOTICE 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!

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.

⚠ 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.

⚠ 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 when working on a unit. Refrigerant liquid, oil, and battery acid can permanently damage your eyes. See "First Aid".

⚠ 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 is best left to a certified Thermo King technician.

NOTICE

Equipment Damage!

All mounting bolts must be the correct length for their applications and torqued to specification. Incorrect bolt lengths and improper torque specifications can damage equipment.

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.

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.

⚠ 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.

⚠ 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.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Safety glasses, rubber-insulated gloves, and cable cutters should be near your work area in the event of an electrical accident.

⚠ 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 of Units or Containers

Electric welding can cause serious damage to electronic circuits when performed on any portion of the refrigeration unit, container, or container chassis with the refrigeration unit attached. It is necessary to ensure that welding currents are not allowed to flow through the electronic circuits of the unit. The following statements must be rigidly adhered to when servicing these units to avoid damage or destruction.

- Disconnect all power to the refrigeration unit.
- Disconnect all quick-disconnect wire harnesses from the back of the controller.
- Disconnect all wire harnesses from the Remote Monitor Modem (RMM).
- Switch all of the electrical circuit breakers in the control box to the Off position.

- Weld unit and/or container per 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.
- The unit power cables, wiring and circuit breakers must be restored to their normal condition when the welding operation is completed.

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.

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.

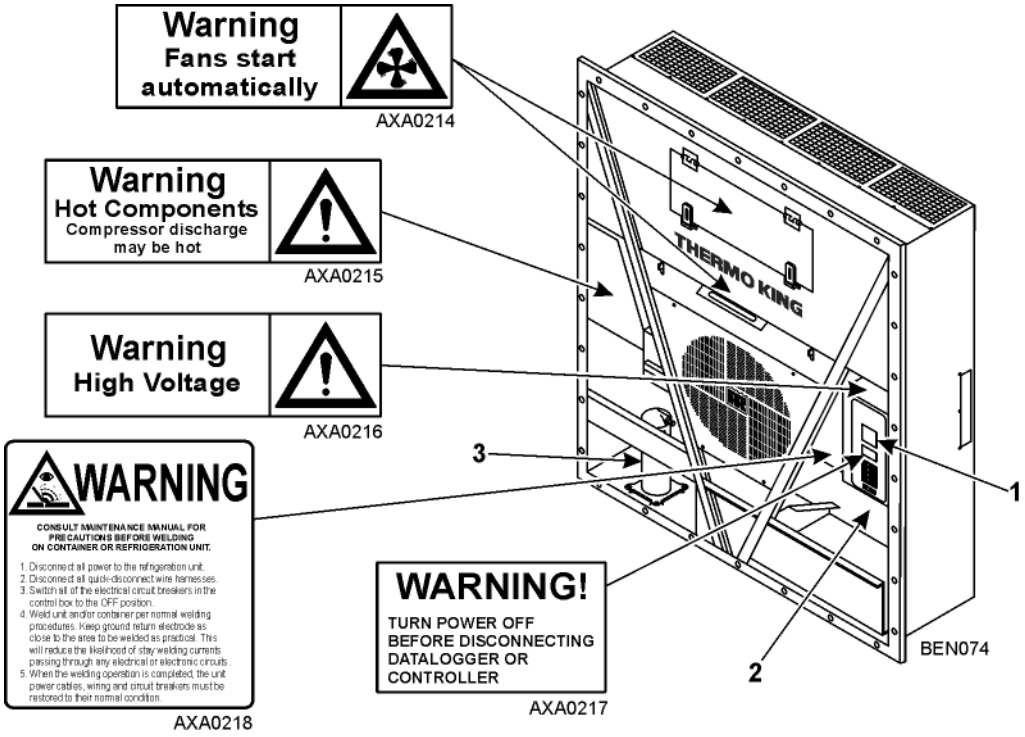
ASPHYXIATION

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

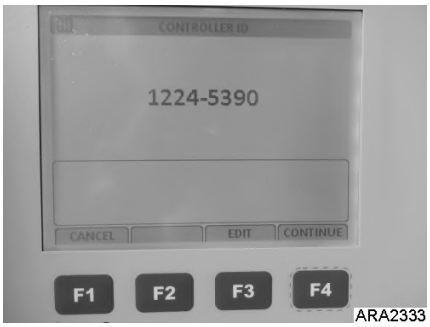
Part number: ABS7828002; Date: 2012 24 wk 1224; Sequence 5390

ID in controller would show 1224-5390

Label on Controller

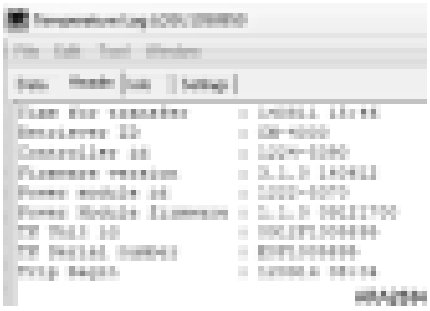
ARA2332

ID in Controller



ARA2333

Controller ID Shown in Datalogger



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

System Net Cooling Capacity - Full Cool

Table 1. MAGNUM PLUS Model - Air Cooled Condensing*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power		
	Net Cooling Capacity		Power Consumption
	60 Hz Capacity B/hr	60 Hz Capacity kW	60 Hz Power kW
21.1 C (70 F)	56,700	16.603	11.55
1.7 C (35 F)	40, 945	11.990	11.03
-17.8 C (0 F)	24,785	7.258	7.57
-29 C (-20 F)	17, 215	5,041	6.6
-35 C (-31 F)	14,000	4.104	6.03
*System net cooling capacity with a 38 C (100 F) ambient air temperature and R-404A/R-452A.			

Evaporator Airflow

Table 2. System Net Heating Capacity*

	460/230V, 3 Phase, 60 Hz Power			380/190V, 3 Phase, 50 Hz Power		
	Heating Capacity			Heating Capacity		
	Watts	Kcal/hr	BTU/hr	Watts	Kcal/hr	BTU/hr
MAGNUM PLUS normal	5,250	4,515	17,914	3,900	3,353	13,300
MAGNUM PLUS extended	7,250	6,234	24,738	5,550	4,772	18,937
*System net heating capacity includes electric resistance rods and fan heat.						

Table 3. MAGNUM PLUS

External Static Pressure (Pa)	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	High Speed		Low Speed		High Speed		Low Speed	
	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min
0	5613	3304	2895	1704	4752	2797	2415	1421
100	4930	2902	1335	786	3933	2315	473	278
200	4064	2392	—	—	2833	1667	—	—
300	3132	1844	—	—	1674	985	—	—
400	2055	1210	—	—	448	264	—	—
500	963	567	—	—	—	—	—	—

Electrical System

Compressor Motor	Type	460/380V, 60/50 Hz, 3 Phase
	Kilowatts	4.48 kW @ 460V, 60 Hz
	Horsepower	6.0 hp @ 460V, 60 Hz
	RPM	3550 RPM @ 460V, 60 Hz
	Locked Rotor Amps	70 amps @ 460V, 60 Hz
Condenser Fan Motor	Type	460/380V, 60/50 Hz, 3 Phase
	Kilowatts	0.55 kW @ 460V, 60 Hz
	Horsepower	0.75 hp @ 460V, 60 Hz
	Number (All Models)	1
	RPM	1725 RPM @ 460V, 60 Hz
	Full Load Amps	1.0 amps @ 460V, 60 Hz; 1.0 amps @ 380V, 50 Hz
	Locked Rotor Amps	3.9 amps @ 460V, 60 Hz; 3.7 amps @ 380V, 50 Hz
Evaporator Fan Motors	Type	460/380V, 60/50 Hz, 3 Phase
	Kilowatts	0.75 kW @ 460V, 60 Hz
	Horsepower	1.0 hp @ 460V, 60 Hz
	RPM (Each) High Speed	3450 RPM @ 460V, 60 Hz
	RPM (Each) Low Speed	1725 RPM @ 460V, 60 Hz
	Full Load Amps (Each) High Speed	1.6 amps @ 460V, 60 Hz
	Full Load Amps (Each) Low Speed	0.8 amps @ 460V, 60 Hz
	Locked Rotor Amps High Speed	10.5 amps @ 460V, 60 Hz
	Locked Rotor Amps Low Speed	9.0 amps @ 460V, 60 Hz
Electrical Resistance Heater Rods	Type	460/380V, 60/50 Hz, 3 Phase
	Number (Normal Capacity)	6 (18 ga wire)
	Number (Normal Capacity)	3 (18 ga wire)
	Number (Extended Capacity)	3 (16 ga wire)
	Watts (Each) (Normal Capacity)	680 Watts @ 460V, 60 Hz
	Watts (Each) (Normal Capacity)	1360 Watts @ 460V, 60 Hz
	Watts (Each) (Extended Capacity)	2000 Watts @ 460V, 60 Hz
	Current Draw (Amps) (Normal Capacity)	5 amps total @ 460V across each phase at heater contractor
	Current Draw (Amps) (Extended Capacity)	4.5 amps total @ 460V across each phase at heater contractor
Control Circuit Voltage		29 Vac @ 60 Hz

Refrigeration System

Compressor			ZMD18KVE-TFD-277, Scroll
Refrigerant Charge			4.0 Kg (8.0 lb.) R-404A/R-452A
Compressor Oil Capacity	***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 maintained in the replacement compressor.*		1.77 liter (60 oz.)
Compressor Oil Type	***Note:*** *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.*		Polyol Ester Based Type (required), (refer to Tool Catalog)
High Pressure Cutout Switch		Cutout Cutin	3240 ± 48 kPa, 32.4 ± 0.5 bar, 470 ± 7 psig 2586 ± 262 kPa, 25.9 ± 2.6 bar, 375 ± 38 psig
Low Pressure Cutout Switch		Cutout Cutin	-17 to -37 kPa, -0.17 to -0.37 bar, 5 to 11 in. Hg vacuum 28 to 48 kPa, 0.28 to 0.48 bar, 4 to 7 psig
High Pressure Relief Valve		Relief Temperature	99 C, 210 F

Vapor Injection Control	Modulation Cool or Power Limit	Vapor injection valve is energized (open) continuously when the compressor duty cycle (ON time) is 100 percent (Full Cool). High compressor discharge temperature may cause the vapor injection valve to energize (open) but only while the Compressor Digital Control valve is not energized (closed).
Compressor Discharge Temperature Control	Vapor Injection Valve Energizes (Opens) Vapor Injection Valve De-energizes (Closes)	138 C (280 F) 6 C (10.7 F) below energize temperature (132 C [123 F])
Vapor Injection Valve (Compressor)	Voltage Current Draw Cold Resistance	24 Vac 0.85 amps 5.6 ohms
Compressor Digital Control Valve	Voltage Current Draw	24 Vac 0.85 amps

Normal R-404A/R-452A System Operating Pressures (Scroll Compressor)

Container Temperature	Operating Mode	Ambient Temperature	Suction Pressure	Discharge Pressure
21 C (70 F)	Cool	27 to 38 C, 80 to 100 F	410 to 670 kPa, 4.10 to 6.70 bar, 59 to 97 psig	2140 to 2650 kPa, 21.40 to 26.50 bar, 310 to 385 psig
		16 to 27 C, 60 to 80 F	400 to 600 kPa, 4.00 to 6.00 bar, 58 to 87 psig	1725 to 2140 kPa, 17.25 to 21.40 bar, 250 to 310 psig
2 C (35 F)	Cool	27 to 38 C, 80 to 100 F	385 to 425 kPa, 3.85 to 4.25 bar, 56 to 62 psig	1860 to 2380 kPa, 18.60 to 23.80 bar, 270 to 345 psig
		16 to 27 C, 60 to 80 F	345 to 385 kPa, 3.45 to 3.85 bar, 50 to 56 psig	1450 to 1860 kPa, 14.50 to 18.60 bar, 210 to 270 psig**
-18 C (0 F)	Cool	27 to 38 C, 80 to 100 F	214 to 228 kPa, 2.14 to 2.28 bar, 31 to 33 psig	1515 to 2035 kPa, 15.15 to 20.35 bar, 220 to 295 psig**
		16 to 27 C, 60 to 80 F	200 to 215 kPa, 2.00 to 2.15 bar, 29 to 31 psig	1100 to 1515 kPa, 11.00 to 15.15 bar, 160 to 220 psig**
-29 C (-20 F)	Cool	27 to 38 C, 80 to 100 F	145 to 160 kPa, 1.45 to 1.60 bar, 21 to 23 psig	1450 to 1965 kPa, 14.50 to 19.65 bar, 210 to 285 psig**
		16 to 27 C, 60 to 80 F	130 to 145 kPa, 1.30 to 1.45 bar, 19 to 21 psig	1035 to 1450 kPa, 10.35 to 14.50 bar, 150 to 210 psig**

Suction and discharge pressures vary too greatly during Modulation Cool to use for evaluating or diagnosing refrigeration system performance. During the Modulation Cool mode, the suction pressure will vary between 100 and 450 kPa, 1.0 and 4.5 bar, 15 and 65 psig depending upon the percent (percent) cooling capacity.
**Discharge pressure is determined by condenser fan cycling.

MP4000 Controller Specifications

Temperature Controller	
Type	MP4000 is a controller module for the Thermo King MAGNUM PLUS unit. 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	-40.0 to +30.0 C (-31.0 to +86.0 F)
Digital Temperature Display	-60.0 to +80.0 C (-76.0 to +176.0 F)
Controller Software (Original Equipment)	
Version	Refer to controller identification decal
Defrost Initiation	
Evaporator Coil Sensor	• Manual Switch or Demand Defrost Initiation: Coil must be below 18 C (65 F). Defrost cycle starts when technician or controller requests defrost initiation. • Timed Defrost Initiation: Coil must be below 4 C (41 F). Defrost cycle starts one 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: • Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large for 90 minutes. • Temperature difference between the supply air sensors and return air sensor is too large.
Defrost Timer	
Chilled Mode	Evaporator Coil Temperature must be below 5C (41 F) to activate the defrost compressor hour timer. There is an interval set for defrosting, however, the defrost timer is built intelligent - it detects whether or not there is ice building up on the coil. If there is no ice building up on the coil, it extends the defrost interval, and if there is Ice building up earlier on the coil it reduces the defrost interval. The maximum interval is 48 hours.
Frozen Mode	Every eight hours of compressor operation. Defrost interval increases two hours each timed defrost interval. Maximum time interval in Frozen Mode is 24 hours.
Reset to Base Time	Defrost timer resets if the unit is off more than 12 hours, setpoint is changed more than 5 C (9 F) or PTI pretrip test occurs.
Defrost Termination	
Defrost (Coil) Sensor	• Chilled Mode: Terminates defrost when coil sensor temperature rises to 18 C (65 F). • Frozen Mode: Terminates defrost when coil sensor temperature rises to 18 C (65 F).
Termination Timer	Terminates defrost after 90 minutes at 60 HZ operation if coil sensor has not terminated defrost (120 minutes at 50 Hz operation).
Power Off	Turning Unit On/Off switch Off terminates defrost.
Compressor Shutdown Protection (Auto Reset)	
Stops Compressor	148 C (298 F)
Allows Compressor Start	90 C (194 F)
Bulb Mode	
Evaporator Fan Speed Settings	• Flow High: High speed only. • Flow Low: Low speed only. • Flow Cycle: Fans will cycle between low and high speed every 60 minutes.
Defrost Termination Temperature Setting	4 to 30 C (40 to 86 F)

Physical Specifications

Table 4. Fresh Air Exchange Venting System (Adjustable)

MAGNUM PLUS	0 to 225 m^3/hr (0 to 168 ft^3/min.) @ 60 Hz 0 to 185 m^3/hr (0 to 139 ft^3/min.) @ 50 Hz

Table 5. Evaporator Fan Blade

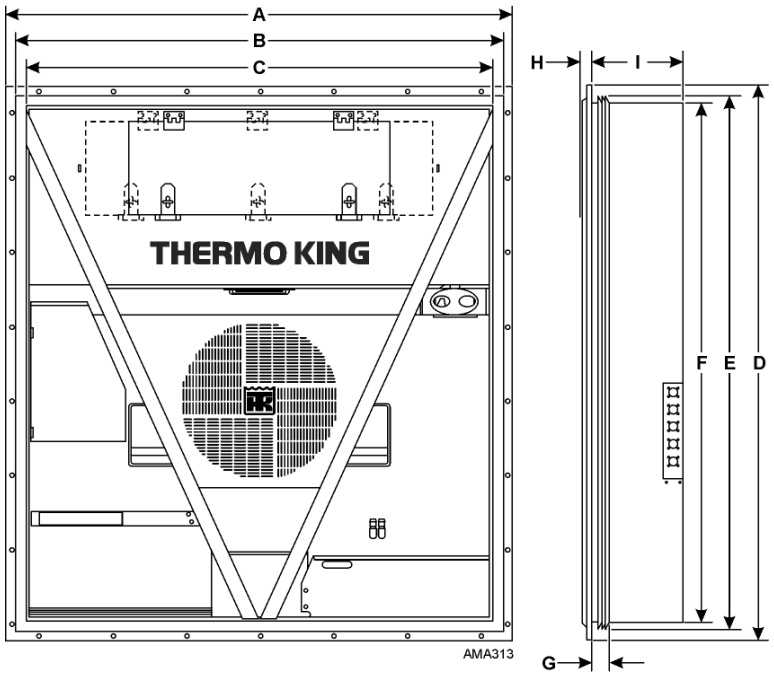
Diameter Pitch Number of Fans	355 mm (14.0 in.) 25° 2

Table 6. Weight (Net)

Base Unit Water-Cooled Condenser-Receiver Option	380 Kg (875 lb.) 13.6 Kg (30 lb.)

Table 7. Unit Dimensions

A	Flange Width	2025.5 mm (79.74 in.)
B	Gasket Width	1935 mm (76.18 in.)
C	Unit Width	1894 mm (74.57 in.)
D	Flange Height	2235.2 mm (88.00 in.)
E	Gasket Height	2140 mm (84.25 in.)
F	Unit Height	2094 mm (82.44 in.)
G	Gasket Depth	72 mm (2.83 in.) from back of flange
H	Maximum Protrusion	37 mm (1.46 in.) from back of flange
I	MAGNUM PLUS	420.0 mm (16.54 in.) from back of flange
J	MAGNUM PLUS	Evaporator Access Door



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

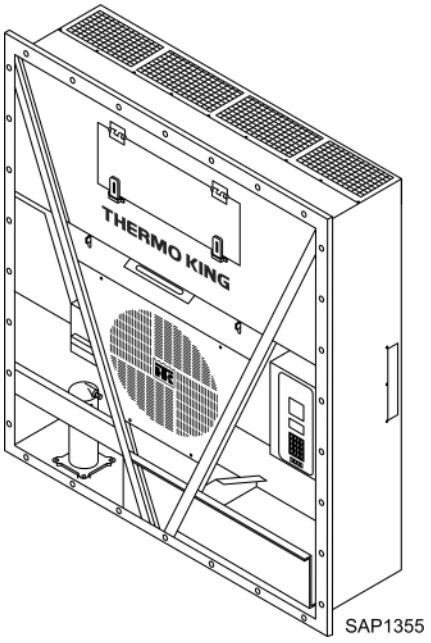
General Description

MAGNUM PLUS units are all-electric, single-piece, refrigeration units with bottom air supply. The unit is designed to cool and heat containers for shipboard or overland transit. The 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 removable evaporator compartment door provides service access. All components except the evaporator coil and electric heaters can be replaced from the front of the unit.

Each unit is equipped with an 18.3 m (60 ft.) power cable for operation on 460-380V/3 Ph/60-50 Hz power. The unit power cable is stored below the control box in the condenser section.

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, evaporator fan and compressor operation.

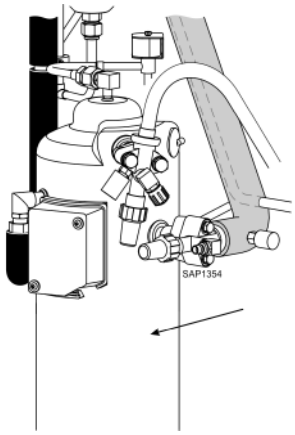


The MAGNUM PLUS container unit features the following components. Each component will be described briefly on the following pages.

Scroll Compressor	Receiver Tank Sight Glass	Remote Monitoring Receptacle Option (4-pin) (Optional)
Compressor Digital Control Valve	Evaporator Fans	Remote Monitoring Modem (RMM, RMM+) (Optional)
Economizer Heat Exchange System	Condenser Fan Control	USDA Cold Treatment Temperature Recording (Optional)
Temperature Sensors	Suction/Discharge Pressure Sensor (Optional)	Humidity Sensor (Optional after Sep 2019)
Fresh Air Exchange System	Water-Cooled Condenser (Optional)	Advanced Fresh Air Management (AFAM) and Advanced Fresh Air Management Plus (AFAM +) (Optional)

Scroll Compressor

The scroll compressor features a digital port and an intermediate suction port.



Digital Port

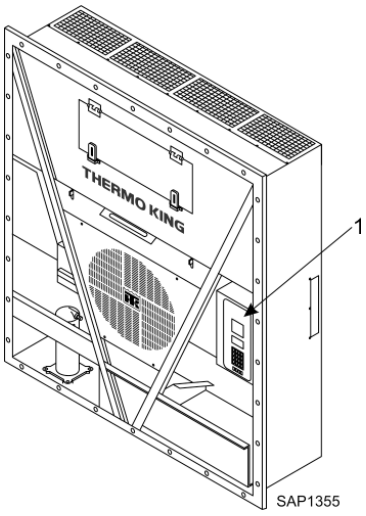
The digital port provides cooling capacity control. The digital port is located at the top of the scroll assembly on the compressor body. When energized, the Digital Control valve disengages the scroll set. This reduces pumping capacity to zero.

Intermediate Suction Port

The intermediate suction port draws suction gas from the economizer heat exchanger into the scroll assembly of the compressor. The scroll seals off the suction port. This prevents economizer gas from leaking back to the main suction port. It also prevents the economizer gas pressure from influencing the cooling capacity of the unit evaporator (main suction gas pressure).

MP4000 Controller

The MP4000 is an advanced microprocessor controller that has been specially developed for the control and monitoring of refrigeration units. Refer to ("MP4000 Controller," p. 36) for more detailed information.



1	MP4000 Controller

Power Module Fuses

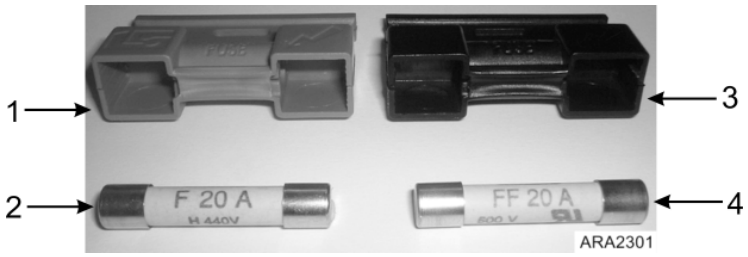
The PM-4000 Power Module in the MAGNUM Plus unit uses Ultra Fast 20 amp fuses to protect the power module and are not interchangeable with the MP3000 MRB fuses. The fuses from the MP3000 MRB must never be used in the PM 4000 Power Module.

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.

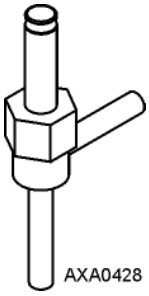
Power Module Fuses



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

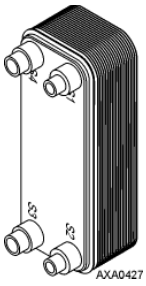
Compressor Digital Control Valve

The controller pulses the Compressor Digital Control solenoid valve between open and closed positions. This provides precise cooling capacity control. No pump down function or warm gas bypass control is used in conjunction with the Compressor Digital Control valve. Refer to ("Compressor Digital Control Valve," p. 99) for more detailed information.



Economizer Heat Exchange System

An economizer heat exchange system replaces the conventional heat exchanger. The economizer Heat Exchange system subcools the liquid refrigerant before it reaches the evaporator expansion valve. Subcooling liquid refrigerant increases the cooling efficiency and capacity of the evaporator. Refer to ("Economizer System," p. 100) for more detailed information.



Temperature Sensors

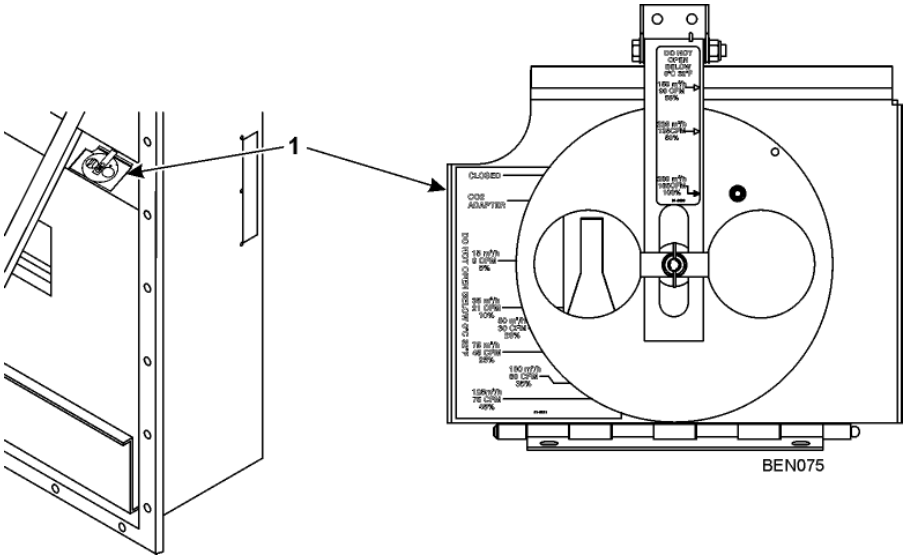
Each sensor element is connected to a cable and packaged in a sealed stainless steel tube. The temperature signal from the sensor is transmitted through the cable. PT.1000 type temperature sensors are used to sense temperatures for the following:

- Supply Air
- Return Air
- Evaporator Coil
- Condenser Coil

- Compressor Discharge Temperature Sensor
- Ambient Air

Fresh Air Exchange System

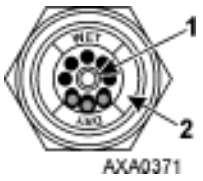
The fresh air exchange system removes harmful gases from containers carrying sensitive perishable commodities. The fresh air vent is located above the control box. The fresh air vent is adjustable to accommodate a variety of frozen and chilled load operating conditions.



1	Fresh Air Exchange Vent

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.



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

Evaporator Fans

MAGNUM PLUS models are equipped with either 2 or 3 evaporator fans. All models feature 2-speed motors. The evaporator fans operate continuously to circulate air inside the container. The evaporator fans operate on the following:

- High and low speed for chilled cargo at setpoints of -9.9 C (14.1 F) and above.
- Low speed for frozen cargo at setpoints of -10 C (14 F) and below.

The evaporator fan low speed RPM is one-half the high speed RPM. The controller determines evaporator fan motor speed based on the setpoint temperature and the Economy mode setting.

If Non-Optimized mode is on:

- Chill Loads: Evaporator fans operate on high speed.
- Frozen Loads: Evaporator fans operate on low speed.

If Optimized mode is on:

- Chill Loads: Evaporator fans operate on high and low speed - depending on the need for cooling.
- Frozen Loads: Evaporator fans operate on low speed and stops when there is no need for cooling.

Condenser Fan Control

The controller also uses a proportional-integral derivative algorithm to control the condenser temperature and ensure a constant liquid pressure at the expansion valve. The condenser fan operates continuously in high ambients. In low ambient conditions, the controller cycles the condenser fan on and off to maintain a minimum condenser temperature. The controller maintains a minimum 30 C (86 F) condenser temperature on Chill loads and a minimum 20 C (68 F) condenser temperature on Frozen loads.

USDA Cold Treatment Temperature Recording (Standard)

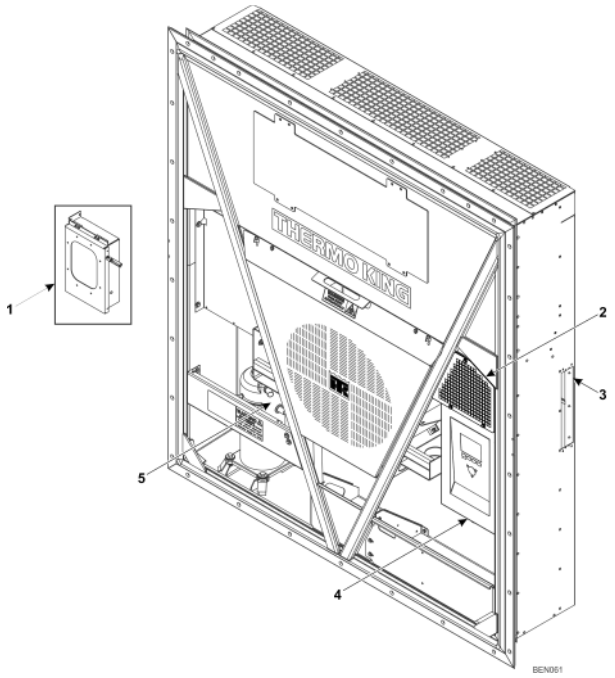
The controller includes provisions for the use of three or four USDA sensors. These sensors allow temperatures in various areas of the load to be monitored and recorded for United States Department of Agriculture use in monitoring Cold Treatment shipments.

When USDA sensors are installed, the controller will automatically detect each sensor and activate data logging. However, the USDA Type screen in the Configuration menu must be set to the correct sensor setting and each USDA sensor must be calibrated to comply with USDA temperature recording requirements.

Unit Options

This unit is available with several options that are listed in below. These options are specified when placing the order and are briefly described on the following pages.

Optional Components



1	Electronic Chart Recorder
2	AVL, AFAM, AFAM+
3	USDA Sensor Receptacle (Access from Inside Container)
4	Remote Monitor Modem for Power Line Communications (REFCON control modem inside Control Box)
5	Suction/Discharge Pressure Transducer

Electronic Chart Recorder (Optional)

The electronic chart recorder will take the datalogger data from the controller and print the return air sensor values.

Remote Monitoring Modem (RMM, RMM+) (Optional)

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 data logger via high speed transmission.

Suction and Discharge Pressure Sensors

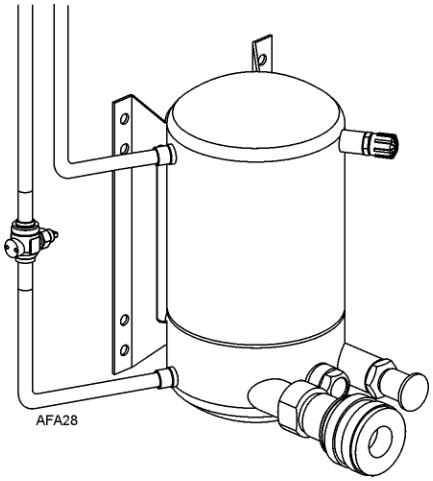
Pressure sensors can be added to the unit to display actual suction or discharge system pressure. The display will show a reading and a bar graph. Unit can be configured suction only, discharge only, or suction and discharge.

Water-Cooled Condenser/Receiver Tank

A water-cooled condenser/receiver provides the unit with above and below deck operating capabilities. Condenser fan control is provided in software or by a Condenser Fan Selection switch or a Water Pressure switch. Starting April 2005, Thermo King has added a shutoff valve on the outlet tube of the water-cooled condenser.

Condenser fan switch is a software key. This switch is provided on the control box with the water-cooled condenser option. Place the Condenser Fan On/Off switch in the Water position for water-cooled condenser operation.

Figure 2. Water-Cooled Condenser/Receiver Tank



Air Ventilation Logging (AVL)

AVL is used for detecting and logging the fresh air exchange position on the manual fresh air vent. The opening angle of the fresh air vent is converted to an output signal from approximately 2-5 volts. The disk opening is detected in steps of 0-125, 150, 175, 215, and 225 m^3/hr.

Refer to ("Air Ventilation Logging (AVL)," p. 83) for more information.

Advanced Fresh Air Management (AFAM) System

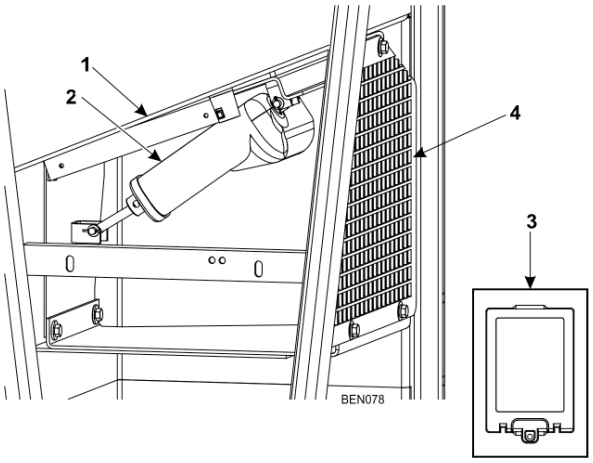
An advanced microprocessor controlled fresh air management system provides programmable control of air exchange rate, programmable delayed vent opening, automatic closure of air exchange vent during low ambient conditions, and data logging of air exchange rate and vent opening delay interval.

The AFAM system includes a door control module, vent door and vent grille. The controller sends a communication signal to the door control module to position vent door to desired position. The controller can also be set to delay opening of fresh air vent for up to 48 hours (in 1 hour increments). This allows faster product temperature pull-down. Refer to ("Starting the AFAM System," p. 84) for more information.

AFAM Operation

The system is pre-calibrated for air exchange rates of 0 to 225 m^3/hr. (0 to 132 ft^3/min.). The actual door position is based on the air exchange setting and the power supply frequency.

If the controller identifies a component failure during unit startup, an alarm is recorded in the controller display and data-logger memory. If a power loss occurs after the AFAM system is turned on, the controller automatically operates the vent door based on the previous AFAM Delay and AFAM Rate settings when power is restored.



1	Vent Door
2	Door Control Module
3	Interface Module Board and Cable (mounts in Control Box)
4	Grille

AFAM Vent Door Assembly

⚠ CAUTION

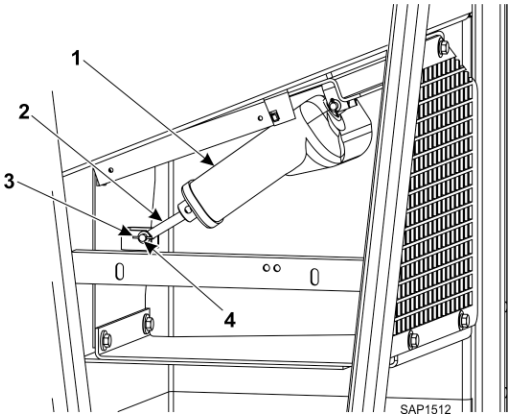
Risk of Injury!

After installing or servicing the AFAM door, remove all tools and install the vent grille before starting the AFAM system. Failure to replace the vent grille before turning the AFAM system on may result in personal injury or unit damage.

A microprocessor controlled vent door provides programmable control of the air exchange rate. The vent door is adjusted to the desired position by a vent door motor and linkage assembly (See figure below). The system is pre-calibrated for air exchange rates of 0 to 225 m^3/hr. (0 to 132 ft^3/min.). The use of the AFAM system should be established by the shipper.

The default setting for AFAM in the Setpoint menu is the last value set (Off, AFAM). The Fresh Air Vent Man submenu should be set to AFAM to control the vent door to the fresh air exchange rate setting.

If the controller identifies a component failure during unit startup, an alarm is recorded in the controller display and data-logger memory. If a power loss occurs after the AFAM system is turned on, the controller automatically operates the vent door based on the previous AFAM Delay and AFAM Rate settings when power is restored.

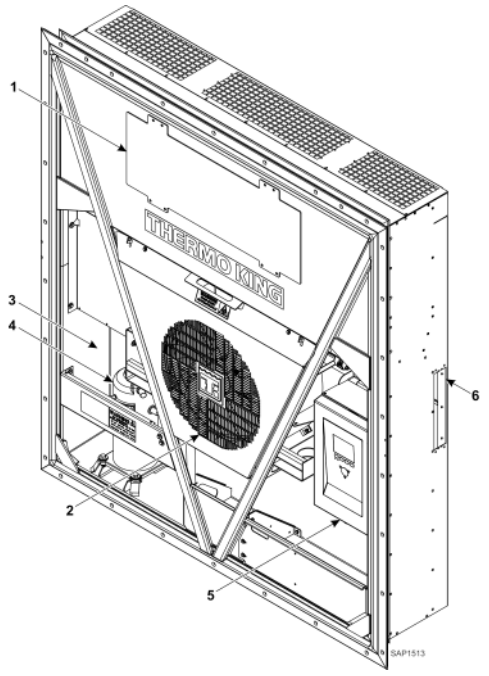


1	Actuator
2	Shaft
3	Cotter Pin
4	Pin Clevis

Advanced Fresh Air Management Plus (AFAM+) System

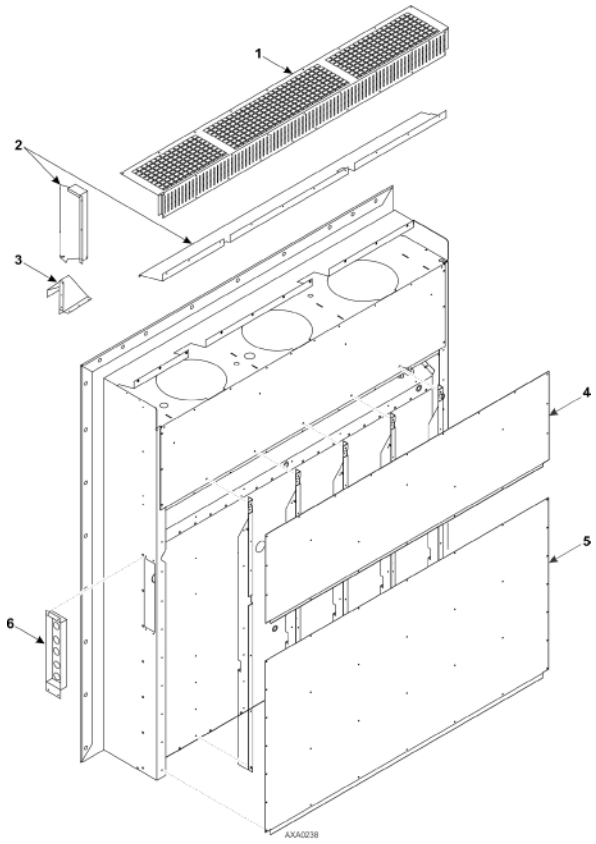
The Advanced Fresh Air Management Plus (AFAM+) System provides programmable control of the CO2 level in the container. The controller can be set to control the CO2 level in the container from 0 to 25 percent. Refer to ("Advanced Fresh Air Management Plus (AFAM+) System," p. 87) for more information.

Unit Front View



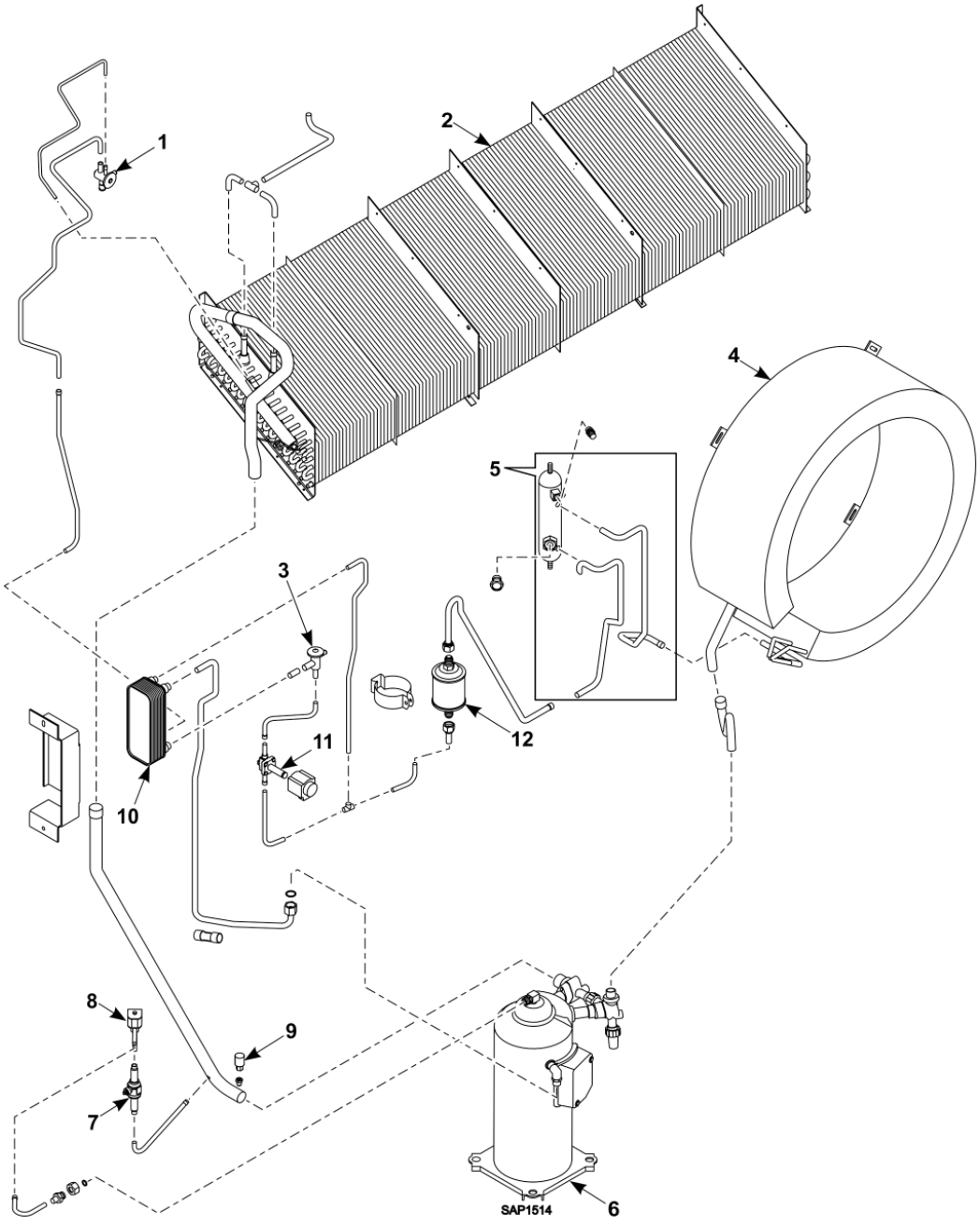
1	Evaporator Access Door
2	Condenser Fan
3	Compressor Compartment
4	Scroll Compressor
5	Control Box
6	Rear Download and USDA Receptacle Panel (Access from Inside Container)

Unit Rear View



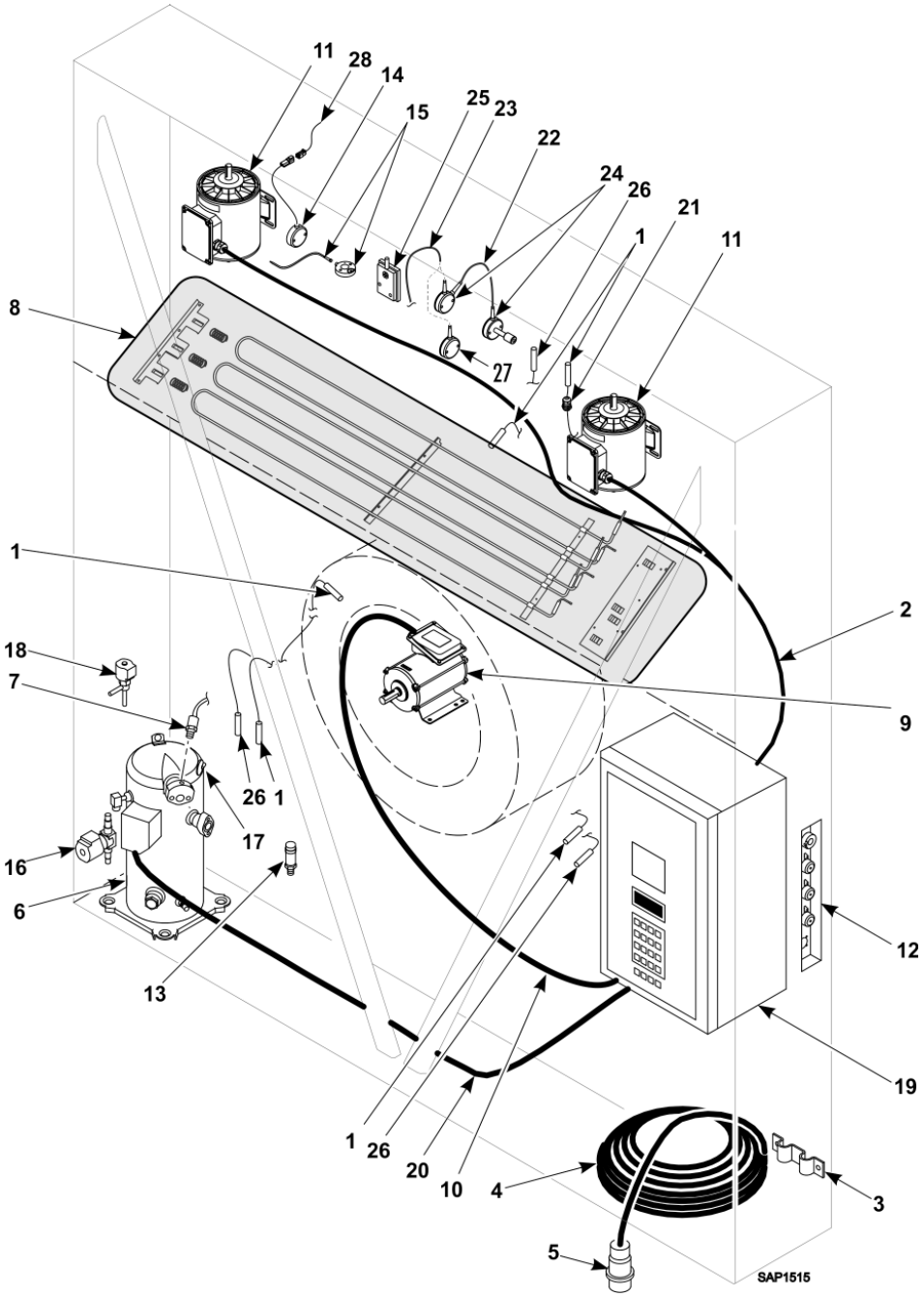
1	Evaporator Grille
2	Air Channels
3	Fresh Air Inlet
4	Top Rear Plate
5	Bottom Rear Plate
6	USDA Receptacle Panel: Controller Communications and Data Download Port, USDA1/Spare 1 Sensor Connection, USDA2/ Spare 2 Sensor Connection, USDA3/Spare 3 Sensor Connection, Cargo (Pulp) Sensor Connection

Figure 3. Refrigeration System



1	Expansion Valve	5	Receiver Tank	9	Low Pressure Cutout Switch
2	Evaporator Coil	6	Scroll Compressor	10	Economizer Heat Exchanger
3	Expansion Valve (Economizer)	7	Ball Valve	11	Vapor Injection Solenoid Valve
4	Condenser Coil	8	Digital Control Valve	12	Dehydrator

Figure 4. Electrical Components



1	Sensor Kit	8	Heater Group	15	Humidity Sensor	22	Cable Connection
2	Evaporator Fans Harness	9	Condenser Fan Motor	16	Vapor Injection Valve	23	Cable Supply
3	Power Cable Bracket	10	Condenser Fan Harness	17	Compressor Sensor	24	Kit CO2/O2 RS485 sensor
4	Power Cable	11	Evaporator Fan Motor	18	Digital Valve	25	Humidity Sensor (for OOCL)
5	Power Plug	12	USDA Receptacle Panel	19	Control Box	26	Temperature Sensor
6	Scroll Compressor	13	Suction Transducer	20	Compressor Cable	27	CO2 Sensor
7	HPCO Switch	14	Pocket Sensor	21	Liquid Tite Connector		

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.

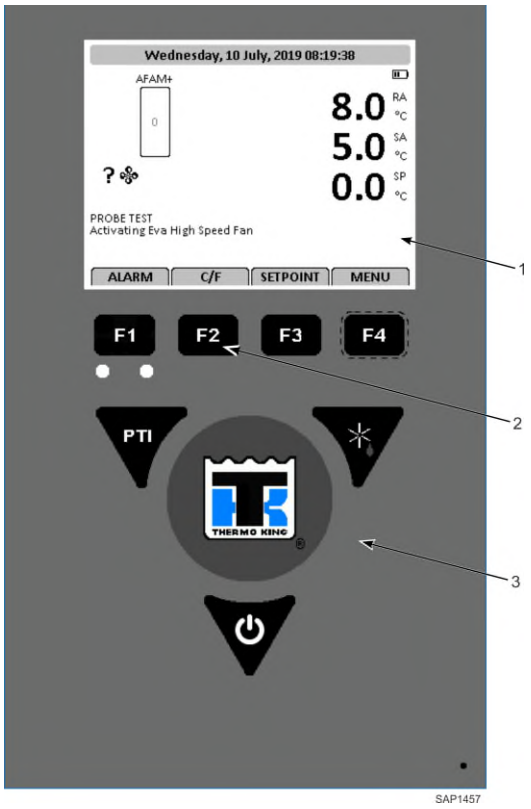
The MP4000 controller uses advanced solid-state integrated circuits to monitor and control unit functions. The controller monitors inputs from:

- Return Air Sensor
- Ambient Sensor
- High Pressure Cutout Switch/ Discharge Pressure Sensor
- Voltage measuring circuits
- Supply Air Sensor
- Humidity Sensor
- Low Pressure Cutout Switch/ Suction Pressure Sensor
- Evaporator Coil Sensor
- USDA (Spare) Sensors 1, 2, and 3
- Phase measuring circuits
- Condenser Coil Sensor
- Compressor Discharge Line Temperature Sensor
- Current measuring circuits

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

- Compressor operation
- Compressor digital valve
- Electric heaters
- Condenser fan operation
- Vapor injection valve
- Phase selection
- Evaporator fan motor operation
- Dehumidify valve

MP4000 Display Panel



1	Standard Display
2	Function Keys
3	Special Function Keys

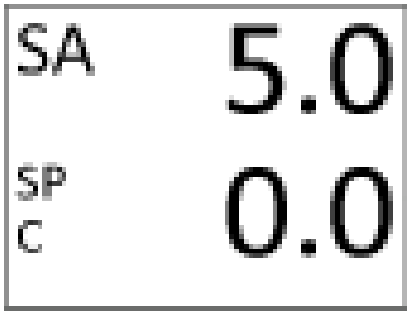
Standard Display

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 5. 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

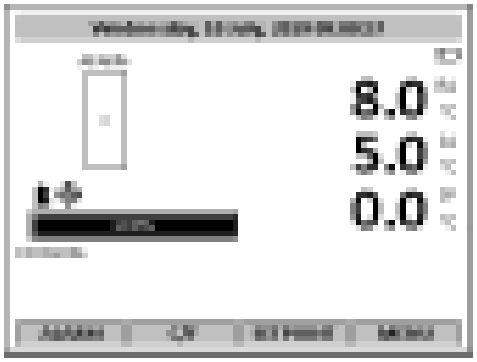
Disgruntled face = there is a message

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):



- Date and Time / Alarm Warning
- rH Relative Humidity sensor
- AVL Door Position/AFAM+
- LoPrs Low Pressure Transducer
- HiPrs High Pressure Transducer
- 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)
- Mode Description unit operation
- F1 - F4 Key Functions ALARM C/F SETPOINT MENU

Display Icons

Alarm

Pretrip Inspection / Test in Progress

Heating

Evaporator Fan High Speed

SmartPTI has recently been running and no problems found

Controlling Mode Optimized

Controlling Mode Economy

Bluetooth®

	Evaporator Fan Low Speed		Cell Phone
	Condenser Fan On		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		

Mode Descriptions

Chilled/Cooling

Chilled cooling is a mode where the unit setpoint is set to above -10C. The function here is to maintain setpoint temperature by controlling the temperature on the supply air.

The supply air is not allowed to be lower than the setpoint. Chilled/cooling mode can operate the unit in different modes where the compressor can run loaded, unloaded/loaded and vapor injection depending on the need for cooling capacity. The condenser fan will operate in an on/off algoritim depending on the temperature on the condenser. The evaporator fans will operate in either high or low speed mode depending on the need for capacity.

Chilled/Heating

Chilled heating is a mode the unit setpoint is set to above -10C. The function here is to maintain setpoint temperature by controlling the temperature on the supply air.

The supply air is not allowed to be lower than the setpoint. Chilled heating mode can operate the unit where only the evaporator fan low speed is running, evaporator high speed is running or evaporator high speed and heat is on.

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.

Frozen/cooling down mode can operate the unit in different modes where the compressor is loaded and vapor injection is on/off. The condenser fan will operate in an on/off algorithm depending on the temperature on the condenser. The evaporator fans will operate in low speed mode or off.

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.

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.

Software Versions

The various software versions are listed below.

Table 8. Software Version 2.3.4 100927

Release Date	Features
September 2010	• Unit Running No Display. • OOCL Unit Features Added for MAGNUM SL 211. • RMM+ Added for TAL. • Shorter Logging Intervals Default OFF. • Index for Event with RMM+. • Refer to Software Bulletin MP4000 2.3.4 100927 for details.

Table 9. Software Version 2.3.6 110301

Release Date	Features
April 2011	• Cold Treatment (CT) has been added for all prefixes except OOLU. • Multi-Temperature settings has been added for all prefixes (including OOLU). • PTI test only has been added as a selection under the COMMANDS menu. Test will end after MAINTAINING 0C (32F) TEST is completed. • Cold Ambient Battery Issue. • Warning Message 39 Battery Error added. • PTI Pull Times Logged. • Warning 38 HIGH VOLTAGE ON LINE. • Power Limit Mode Based on Condenser Temperature. • AFAM Door Closes HLX. • MTS and CT Disabled after PTI. • RMM Enables for UACU Units. • Discharge Pressure now in Data Menu. • Mode Flags Added. • Defrost Termination Temperature and Interval Hours Limited. • Trip Start All Temperature Logged. • AFAM PTI added. • Gas Sensor to be OFF when not selected. • Backlight ON. • Event Log Available in display. • Display timer. • Refer to Software Bulletin MP4000 2.3.6 110301 for details.

Table 10. Software Version 2.3.7.0 110608

Release Date	Features
June 2011	• Cold Treatment (CT) has been added for all prefixes except OOLU. • MTS and CT Feature selectable. • MTS Feature Selects Present Setpoint. • USDA Trip Defaults OFF. • Dehumidify Improvement. • Battery Heater Disabled. • Compressor Temperature Reading. • Heating Element Type. • C to F or F to C Display Change. • Viewing Event or Temperature Logs in Display. • Refer to Software Bulletin MP4000 2.3.7.0 110608 for details.

Table 11. Software Version 2.3.8.0 110628

Release Date	Features
June 2011	• Cold Treatment (CT) has been added for all prefixes except OOLU. • Keypad Lock feature has been added. • Refer to Software Bulletin MP4000 2.3.8.0 110628 for details.

Table 12. Software Version 2.4.0.0 111220

Release Date	Features
January 2012	• Introduce field tester system tool (8232-010) functionality. • Alarm 127 GENERAL UNIT ERROR. • Alarm 52 PROBE ERROR. • Alarm 120 SUCTION PRESSURE SENSOR ERROR. • Alarm 31 LOW PRES CUTOUT. • Evaporator Fan Speed Option. • MTS Defaulted OFF on Power OFF. • COLD Treatment for HL. • Humidity Controller. • AFAM+, AFAM Disable in Frozen Mode. • AFAM Introduced. • RMM+ Controller Clock Update. • RMM Built in Option. • RMM+ Graphics. • Refer to Software Bulletin MP4000 2.4.0.0 111220 for details.

Table 13. Software Version 2.4.2.0 120313

Release Date	Features
April 2012	• RMM Built in Option. • Refer to Software Bulletin MP4000 2.4.2.0 120313 for details.

Table 14. Software Version 2.4.3.0 120628

Release Date	Features
June 2012	• RMM Built in Option. • Optimize (OPT). • Cooling Capacity Surveillance. • AFAM PTI Selectable. • Humidity Control Fan Change. • Humidity and AFAM+ PTI. • AFAM+ Auto Configuration. • HL AFAM. • PTI Aborted Event. • Setpoint Range +35C to -40C. • SmartPTI Event. • SmartPTI Thumbs Up. • Refer to Software Bulletin MP4000 2.4.3.0 120628 for details.

Table 15. Software Version 2.5.0.0 121121

Release Date	Features
November 2012	• RMM Built in Option. • Display Contrast Improvement. • Gas Sensor ON/OFF Handling. • Humidity Operation. • Setpoint Change on Battery. • Frozen Optimized Mode. • Modbus Handling Changed. • Refer to Software Bulletin MP4000 2.5.0.0 121121 for details.

Table 16. Software Version 2.5.1.0 130213

Release Date	Features
February 2013	• Alarm 137 Sensor System Overload. • Alarm 140 Evaporator Section Too Hot. • Alarm 98 Compressor Temperature Sensor Short Circuit. • Phase Check. • Setpoint of +45. • RMM Option. • SmartPTI Thumbs Up changed. • Refer to Software Bulletin MP4000 2.5.1.0 130213 for details.

Table 17. Software Version 2.5.3.0 130424

Release Date	Features
May 2013	• Cold Storage Defrost Feature. • SmartPTI Feature. • O2 Sensor Calibration AFAM+ PTI. • Refer to Software Bulletin MP4000 2.5.3.0 130424 for details.

Table 18. Software Version 3.1.0.0 140612

Release Date	Features
June 2014	• Software File Format SIP. • Alarm 60 Humidity Sensor. • Alarm 68 CO2/O2 Sensor Error. • Bulb Mode. • Refer to Software Bulletin MP4000 3.1.0.0 140612 for details.

Table 19. Software Version 3.2.0.0 140822

Release Date	Features
August 2014	• RMM Option. • SMART PTI Option. • Humidity Sensor Alarm 60. • PTI HPCO Test. • Refer to Software Bulletin MP4000 3.2.0.0 140822 for details.

Table 20. Software Version 3.4.0.0 150729

Release Date	Features
August 2015	• Dry Cargo - New controlling mode. • Automatic Dry Cargo option for YML container numbers. • Abandon sensor must disable optimized mode. • Missing logs - deletion of the first internal log file. • Alarm 68 occurs in standby mode. • Gas analyzer sensor is powered in standby mode. • Capacity limitation activates log flag for CA control. • Boot loader must support sip files. • Battery surveillance is not discovering open protection circuit. • Battery alarms must only occur in PTI. • A battery icon has been added to the main screen indicating: battery full charged, charging or error. • Coin battery surveillance. • Remove Chill PTI and rename PTI to Full PTI for SUDU prefix. • Differentiate set point and controlling temperature. • AFAM defaulting for Hapag Lloyd units. • Option Changes: RMM Option, SMART PTI Option • Refer to Software Bulletin MP4000 Appl 3.4.0.0 Opt 3.4.2.0 150729 for details.

Table 21. Software Version 3.5.0.0 151009

Release Date	Features
October 2015	• Dry Cargo - New controlling mode. Implemented in Version 3.3.0 Software. • Automatic Dry Cargo option for YML container numbers. Implemented in Version 3.3.0 Software. • Abandon sensor must disable optimized mode. Implemented in Version 3.3.0 Software. • Missing logs - deletion of the first internal log file. Implemented in Version 3.3.0 Software. • Alarm 68 occurs in standby mode. Implemented in Version 3.3.0 Software. • Gas analyzer sensor is powered in standby mode. Implemented in Version 3.3.0 Software. • Capacity limitation activates log flag for CA control. Implemented in Version 3.3.0 Software. • Boot loader must support sip files. Implemented in Version 3.3.0 Software. • Battery surveillance is not discovering open protection circuit. Implemented in Version 3.3.0 Software. • Battery alarms must only occur in PTI. Implemented in Version 3.3.0 Software. • Battery icon. Implemented in Version 3.3.0 Software. • Coin battery surveillance. Implemented in Version 3.3.0 Software. • Remove Chill PTI and rename PTI to Full PTI for SUDU prefix. Implemented in Version 3.3.0 Software. • Differentiate set point and controlling temperature. Implemented in Version 3.3.0 Software. • AFAM defaulting for Hapag Lloyd units. Implemented in Version 3.3.0 Software. • Option Changes: RMM Option - Implemented in Version 3.5.0 Software, SMART PTI Option - Implemented in Version 3.4.0 Software. • Refer to Software Bulletin MP4000 Appl 3.5.0.0 Opt 3.5.0.0 151009 for details.

Table 22. Software Version 3.5.0.0 151103

Release Date	Features
November 2015	• Option Changes: RMM Option - Implemented in Version 3.5.3.0 Software. • Refer to Software Bulletin MP4000 Appl 3.5.0.0 Opt 3.5.3.0 151103 for details.

Table 23. Software Version 3.6.0.0 20160128

Release Date	Features
February 2016	• AFAM vent door alarm 57. • MP4000 tester expansion slot test. • Error value for faulty battery. • Option Changes: 3.5.1.0: RMM activation for 250 TAL; 3.5.2.0: RMM activation for TAL, RMM activation for Braun; 3.5.3.0: RMM activation for Unit 45 (CMA); 3.5.4.0: Smart PTI for Braun; 3.6.0.0: RMM activated for CMA (unit 1); 3.6.1.0: Cold Store Defrost feature activated. • Refer to Software Bulletin MP4000 Appl 3.6.0.0 Opt 3.6.1.0 20160128 for details.

Table 24. Software Version 3.7.0.0 20160404

Release Date	Features
February 2016	• AFAM Door Closed on Power OFF. • Battery Power Management Enhancements. • PTI Performed without Battery. • Non Optimized default for CTAU prefix. • Bug in Menu on Battery Power. • Wall Clock Wakeup System not always turned OFF. • Prevent Temperature Below Set Point. • Option Changes: 3.7.1.0: Smart PTI activate for Braun BCHU930000, 930001, 930002 BCHU720000, 740000. • Refer to Software Bulletin MP4000 Appl 3.7.0.0 Opt 3.7.1.0 20160404 for details.

Table 25. Software Version 3.8.0.0 20160512

Release Date	Features
May 2016	• Evap Fan Control SUDU. • Controller and Power module serial number will now show old and new format. • Refer to Software Bulletin MP4000 Appl 3.8.0.0 Opt 3.8.0.0 20160512 for details.

Table 26. Software Version 3.9.0.0 20160530

Release Date	Features
May 2016	• Option File Missing After Power On • Option Changes: 3.9.0.0: Smart PTI enabled for TAL units. • Refer to Software Bulletin MP4000 Appl 3.9.0.0 Opt 3.9.0.0 20160530 for details.

Table 27. Software Version 3.10.0.0 20160708

Release Date	Features
July 2016	• AFAM Door Operation ON Battery Power. • PTI would pass with a Faulty Digital Valve. • Battery Test added to Brief PTI. • Alarm 57 FAE Device Error. • ICON or Menu Tree Display Change. • Refer to Software Bulletin MP4000 Appl 3.10.0.0 Opt 3.9.0.0 20160708 for details.

Table 28. Software Version 3.11.0.0 20170516

Release Date	Features
May 2017	• Missing Temperature Logs (USDA) on Battery Power. • Controller Reboot after retrieving download using SD Card. • Resetting of USDA Calibration after Flashloading. • USDA Calibration Reset Event. • Loading of the Wrong Option File. • SmartPTI Max Days minimum limit change to 2 days. • Option Changes: RMM enabled for the following container numbers: WHLU740001 to WHLU740200, SZLU989311 to SZLU989810, TEMU925730 to TEMU926229. • Refer to Software Bulletin MP4000 Appl 3.11.0.0 Opt 3.11.0.0 20170516 for details.

Table 29. Software Version 3.13.0.0 20170516

Release Date	Features
November 2017	• Optional AVL Full Range Disk 0-225 cmh. • Option Changes: Non-Optimized Mode as default for the following container IDs: TAL TLLU107760 to 107859 and TLLU108060 to 108259; Smart PTI option for BCHU 083040 to 083049 and BCHU 760015 to 760019. • Refer to Software Bulletin MP4000 Appl 3.13.0.0 Opt 3.13.2.0 20170516 for details.

Table 30. Software Version 3.14.0.0 20171220

Release Date	Features
January 2018	• High speed fans for TITAN prefix in frozen mode. • USDA mode to disable Optimized Mode. • Non-optimized mode when dehumidification is on. • Pressure sensors are tested when not mounted. • Too many battery events in Logger. • Controller shutting down. • Failing HCPO switch flushing data log. • Failing HCPO switch must trigger an alarm. • Stop charger when battery level is fully charged. • Option Changes: Option file read error triggering user type change. Debug information has been added to this version to catch the problem. • Refer to Software Bulletin MP4000 Appl 3.14.0.0 Opt 3.14.2.0 20171220 for details.

Table 31. Software Version 3.15.0.0 20180313

Release Date	Features
May 2018	• USDA Sensors Defaulting. • Energy Data Logging Feature. • Conditions to default (return to ON) for the "ENERGY LOGGING" option. • Manually turning ON the Energy Data Logging. • Menu Values ENERGY LOGGING screen. • Option Changes: Cold store defrost option enabled for prefix TITU and BXRU; RMM communication enabled for container prefix PCIU (PIL customer). • Refer to Software Bulletin MP4000 Appl 3.15.0.0 Opt 3.15.0.0 20180313 for details.

Table 32. Software Version 3.17.0.0 20180905

Release Date	Features
September 2018	• Smart PTI - Auto Acknowledge. • Skip Extended Defrost on CT and USDA shipments. • The option file read error after installing new firmware has been resolved. • Phase Error is now logged in the event log. • Option Changes: RMM communication enabled for container prefix CICU 827089 – 827106 (TCRC customer). • Refer to Software Bulletin MP4000 Appl 3.17.0.0 Opt 3.17.0.0 20180905 for details.

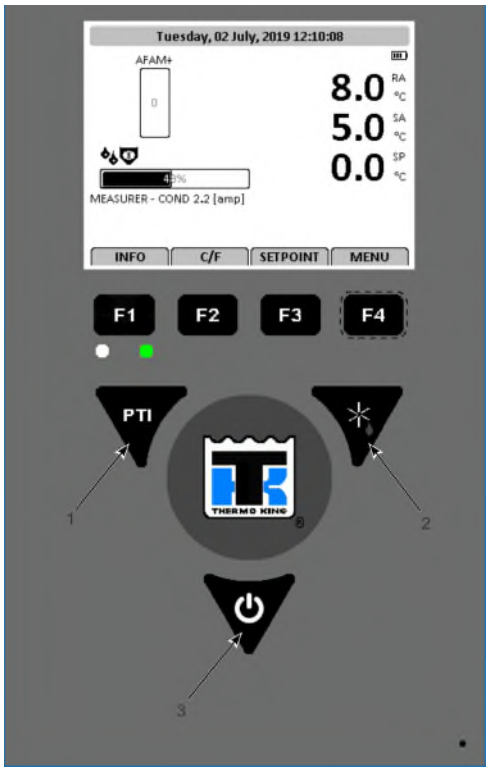
Table 33. Software Version 3.17.0.0 20181022

Release Date	Features
October 2018	• Option Changes: Extended set point range -40C to +45C enabled for prefix ZGRU; Cold store defrost option enabled for prefix ZGRU. • Refer to Software Bulletin MP4000 Appl 3.17.0.0 Opt 3.17.2.0 20181022 for details.

Operating Instructions

Function Keys

Function Keys



1	ON/OFF Key
2	Defrost Key
3	PTI - Pre-trip Inspection
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

4. Unit starts and shows CHILLED COOLING and shows mode of operation.

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 [56 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.*

Viewing Alarms/Messages

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. 155 and "Alarm Codes and Corrective Actions," p. 161).*

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: *Watercool, Humidity Control, Humidity Setpoint, 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. 54) for this operation.

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

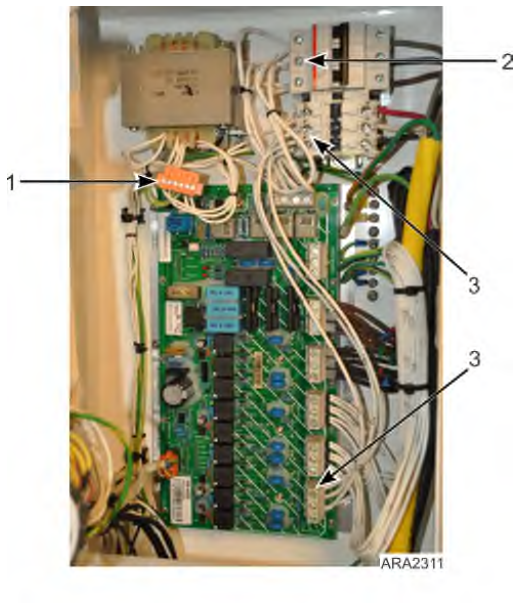
1. Unplug unit and turn OFF the main circuit breaker (CB) located in the controller box.

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.

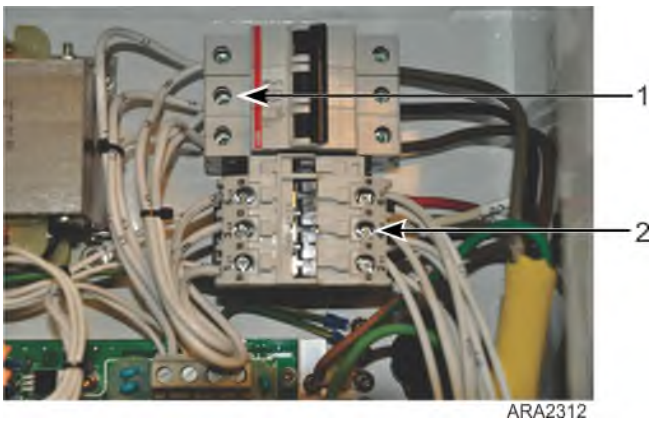
FULL COOL Mode

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. 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.

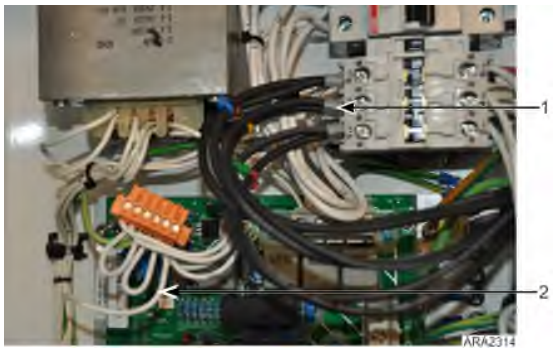
If unit is running in high ambient with high box temperature, monitor compressor amperage using a amp probe. Maintain <12 amp by closing suction service to limit capacity.



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 the black heater wires (not Brown wire) from J7 on the PM and connect them to the input side (left side) of the compressor contactor.
4. 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.*

5. 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.

High or Low Speed Fans Only

NOTICE

Cargo Loss!

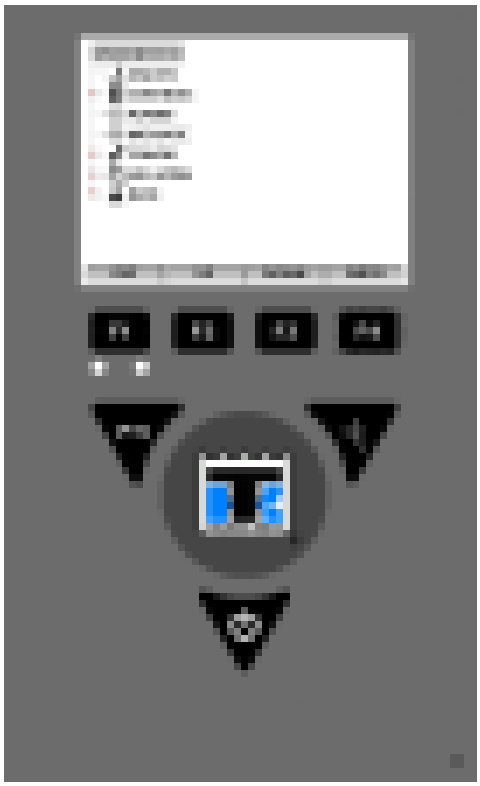
Running the unit with evaporator fans only will add heat to the box, do not leave unit unattended.

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 or EF11, EF12, EF13 for High speed from J9.
4. Depending on what speed 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

Navigating Controller Operating Menu

Figure 6. MP4000 Control Panel Display



Menu Scrolling Keys

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

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

F2 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.

F3

F4 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 (Figure 49, p. 193). 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 (Figure 49, p. 193).

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.*

Supply	USDA 3	AVL Position	CO_2
Return	CARGO	Bat.c.volt	O_2
Evaporator	Voltage	Bat. Curr	Dew Point
Condenser	Current Ph1	Bat. Temp.	Dish Pres
Compressor	Current Ph2	PT1000 spare	Suct Pres
Ambient	Current Ph3	Board Temp	SUPPLY
Humidity	Frequency	Board Volt	
USDA 1	Modulation	Sensor Volt	
USDA 2	Air Exchange	Radiator	

Controls Menu

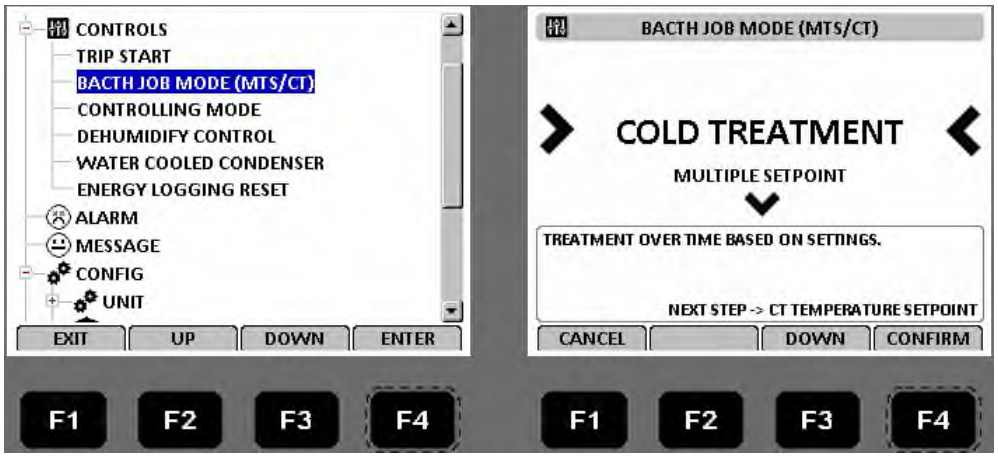
Note: *When a submenu is highlighted, pressing the ENTER F4 key again will open a view showing how the unit is currently set up. In order to see some of these different selections, turn the option on and then enter the Controls menu again.*

Figure 7. Controls Menu and Controls Overview

Cold Treatment (CT)

This feature is designed to maintain a temperature below the actual set point for a period of time, (per USDA specifications) and then increase the temperature to the final set point. For a complete description, refer to ("Cold Treatment (CT)," p. 101). CT FEATURE must be selected ON under the CONFIGURATION/OPTIONS/CT FEATURE for COLD TREATMENT to be active or visible.

Figure 8. Cold Treatment



Multiple Temperature Set (MTS)

This feature is designed to maintain up to nine different set points with eight timed periods in between the nine set points. MTS FEATURE must be selected ON under the CONFIGURATION/OPTIONS/MTS FEATURE for MULTIPLE TEMP SET to be active or visible. Refer to ("Multiple Temperature Setpoint (MTS)," p. 103).

Figure 9. Multiple Temperature Set

OptiSet™

Allows all the AFAM variable to be set by selecting a specify commodity. Refer to ("Change the AFAM+ Settings Using OptiSet™," p. 89) and AFAM+ Setting Guide TK51318. AFAM must be selected under the CONFIGURATION/OPTIONS/ AFAM MODULE for OptiSet to be active or visible.

Figure 10. OptiSet Display

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 11. Temperature Setpoint

Controlling Mode

To change the temperature and fan control of the unit. Select from OPTIMIZED or NON-OPTIMIZED.

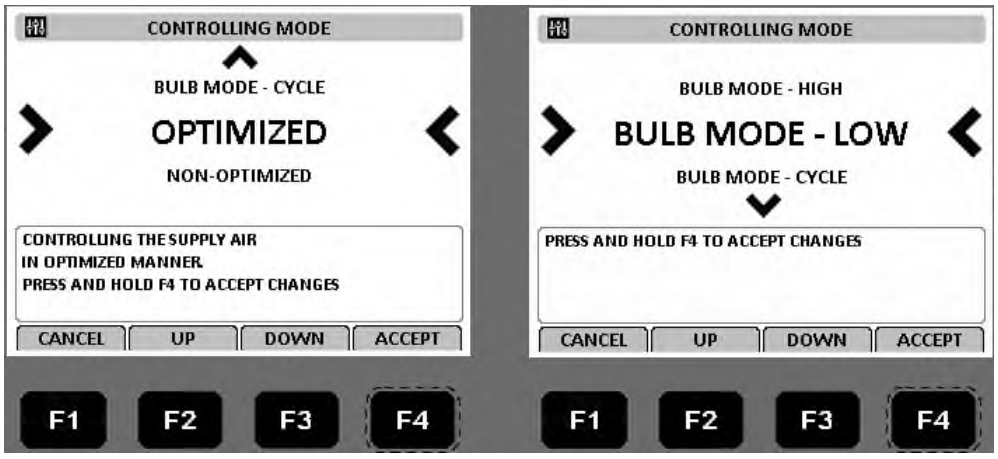
- Optimized: The default mode for the new MAGNUM PLUS for temperature and fan control.
- Non-Optimized: The default mode for the original Magnum for temperature and fan control.

  Note: *Enter setpoint temperature before selecting the Non-Optimized mode. The controller automatically turns the Non-Optimized mode off when setpoint is changed.*

Bulb mode allows the system user to select one of three evaporator fan operations as well as the defrost termination temperature.

- Bulb mode HIGH: Evaporator fan high speed only.
- Bulb mode LOW: Evaporator fan low speed only.
- Bulb mode CYCLE: Evaporator fan cycle - fans will cycle between low and high speed every 60 minutes, starting with the low speed fan operation first for 60 minutes.

Figure 12. Controlling Mode



Pull Down Selection

When the Pull Down Selection is ON, the unit runs with the fans in high speed for a period of time before allowing it to switch the fans to low speed.

Figure 13. Pull Down Selection

Water Cooled Condenser

This feature is turned ON when the unit is equipped with the optional water cooled condenser. If this feature is turned OFF, the condenser fan runs as required. If turned ON, the condenser fan does not run unless no cooling water is available, then the unit will trip off on HPCO and the condenser fan will run as required.

Figure 14. Water Cooled Condenser

Dehumidify Control

During Chill mode operation, a dehumidification function is available (optional after Sep 2019) to reduce the relative humidity in the container to the desired humidity setpoint.

HUMIDITY SENSOR mounted must be selected under the CONFIGURATION/OPTIONS/HUMIDITY SENSOR for DEHUMIDIFY CONTROL to be active or visible. Refer to ("Dehumidify Mode," p. 95) for a complete description.

Figure 15. Dehumidify Control

Dehumidify Setpoint

The relative humidity setpoint can be set from 50 to 99 percent.

HUMIDITY SENSOR mounted must be selected under the CONFIGURATION/OPTIONS/HUMIDITY SENSOR for DEHUMIDIFY SETPOINT to be active or visible. Refer to ("Dehumidify Mode," p. 95) for a complete description.

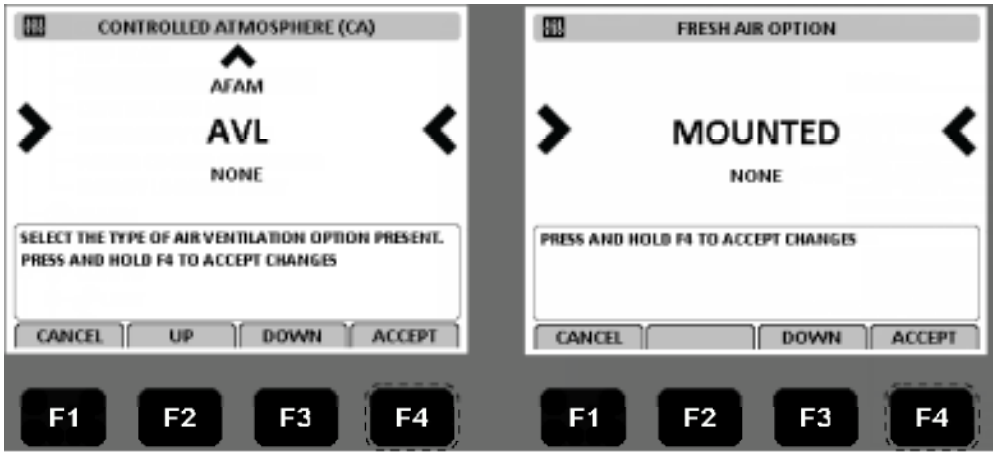
Figure 16. Dehumidify Setpoint

AVL (Air Ventilation Logging)

The Fresh Air Exchange Recorder (AVL) detects vent disk movement and automatically displays a value in the LCD display for values of 0 to 125 m3/h. For settings greater than 125 m3/h the technician must set the AVL Open Value to match the notched setting on the Fresh Air Exchange Vent.

AVL must be selected under the CONFIGURATION/OPTIONS/CONTROLLED ATMOSPHERE (CA) and FRESH AIR OPTION must be mounted under CONFIGURATION/OPTIONS/FRESH AIR OPTION for AVL to be active or visible.

Figure 17. Enabling AVL



Fresh Air Vent Man - AFAM Mode

Can be set to OFF or AFAM.

OFF - Will override all settings and keep the AFAM door completely closed.

AFAM - Will allow and air exchange Rate and or Delay to be set.

Refer to ("Starting the AFAM System," p. 84) for more information about setting up AFAM.

Figure 18. AFAM Mode

Fresh Air Vent Man - AFAM+ Mode

Can be set to OFF, AFAM, or AFAM+.

OFF - Will override all settings and keep the AFAM door completely closed.

AFAM - Will allow and air exchange Rate and or Delay to be set.

AFAM+ - Will allow a CO2 Max to be set. Some container prefix allow O2 MIN to be set.

Refer to ("Advanced Fresh Air Management Plus (AFAM+) System," p. 87) for more information about setting up AFAM +.

Figure 19. AFAM+ Mode

AFAM Delay

Hours the AFAM door will remain closed before opening to a desired AFAM Rate or due to gas sensor readings. Selectable from 1 to 48 hours. Active in AFAM and AFAM+ modes.

Figure 20. AFAM Delay

AFAM Rate

Use to set AFAM door opens to desired rate, selectable from 0 CMH to 225 CMH.

Figure 21. AFAM Rate

AFAM+ CO2 Max

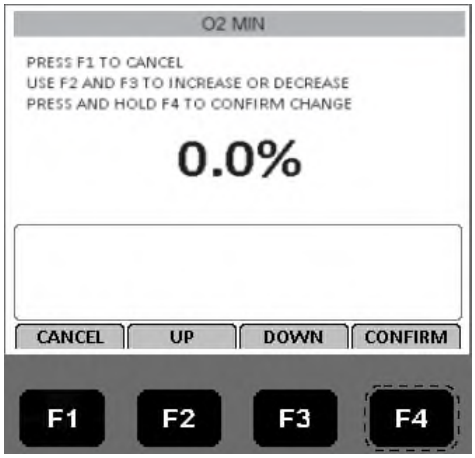
Used to set the highest level of Carbon Dioxide allowed in the container. The AFAM+ door will open or close to maintain this level. Active only when AFAM+ is enabled. Selectable from 0% to 25%. Refer to ("Change the CO2 Minimum and Maximum Setting," p. 88) for more information.

Figure 22. CO2 Max

AFAM+ O2 Min

Used to set the lowest level of Oxygen allowed in the container. The AFAM+ door will open or close to maintain this level. Active only when AFAM+ is enabled. Selectable from 0% to 21%.

Figure 23. O2 Min



Smart PTI

Use to enable ON or Disable OFF the Smart PTI surveillance. Smart PTI automatically monitors individual component performance during normal reefer operation and during defrost cycles. When a Smart PTI cycle is completed, the results are stored in the controller memory and a <SMART-PTI Pass> flag is logged. A timer is then automatically started to determine next cycle start. A menu point and a check mark symbol provide visual status of the last passed Smart PTI on the controller display. All checks are performed during normal reefer operation. There is no need for additional off-line operations and unnecessary energy consumption. The Smart PTI results logging can be requested anytime.

Figure 24. Smart PTI

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. Alarm 56 (Compressor Temperature too high) is a Shutdown alarm.

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 25. 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 (Figure 49, p. 193).

Alarm Codes

For a complete list of alarm codes and corrective actions, refer to ("Alarm Codes and Corrective Actions," p. 161).

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 ("Status Messages and Controller Actions," p. 155).

Figure 26. 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 (Figure 49, p. 193).

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.

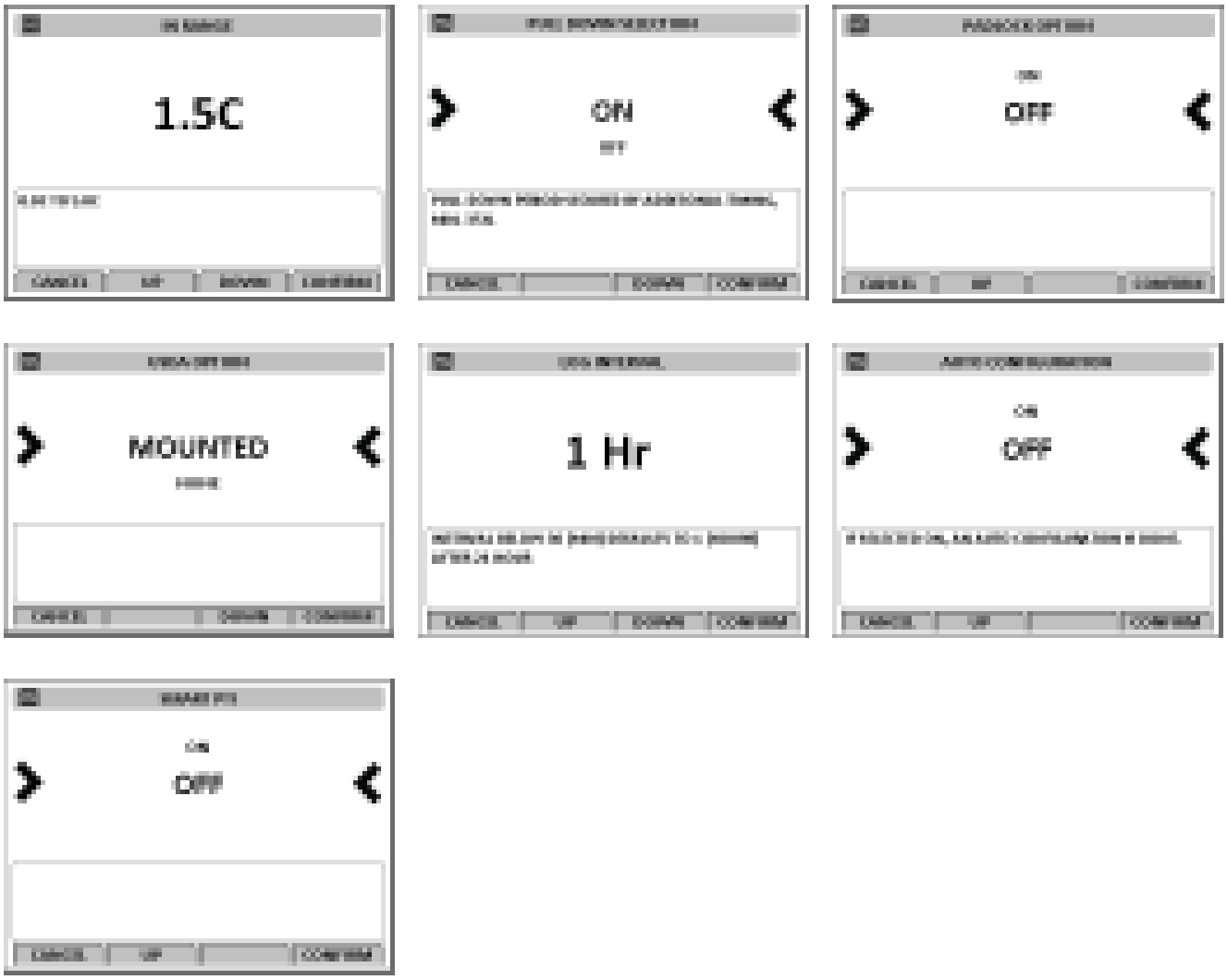
Note: *Pressing F4 again will display the Overview screen.*

Figure 27. Configuration Menu

Unit

Figure 28. Unit Menu and Unit Overview

- 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).
- Pull Down Selection: Select ON/OFF.
- Padlock Option : Select ON/OFF.
- USDA Option: When USDA sensor is mounted you can change the setting here.
- Log Interval: Sets the data log interval (1 minute or 1/2, 1, 2, or 4 hours).
- Auto Configuration: View display on or off value (factory default = off). Set value to on to automatically configure unit to installed components.
- Smart PTI: Select ON/OFF.



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
- Controlled Atmosphere (CA): This turns on the AVL option. Select from None, AVL, AFAM, and AFAM+. Selecting AFAM+ also turns OptiSet ON.
- Humidity Sensor: This setting can be changed when a humidity sensor is mounted.
- Suction Pressure Sensor: This setting can be changed when a suction pressure sensor is mounted.
- Discharge Pressure Sensor: This setting can be changed when a discharge pressure sensor is mounted.
- Multiple Setpoint (MTS): Selectable or Not Selectable.
- Cold Treatment (CT): Selectable or Not Selectable.
- Smart PTI Trial: Select ON/OFF.
- Energy Logging: On the MP4000 Controller: captures live Power Draw, in kW; Total Energy Consumed, in kWh; Trip Duration, (Days, hours, mins); Average kW per Hour; Trip Start Date. In the Download File: actual power draw and cumulative trip power draw; total kWh draw since reefer in service (or since software retrofitted, if applicable)


NORMAL CAPACITY


AVL


MOUNTED


MOUNTED


MOUNTED


SELECTABLE


NOT SELECTABLE


OFF


ON

System

Note: *MAGNUM units without a container number beginning with MAE, MSF, or MWC must be set for USDA temperature sensing.*

Figure 29. System

- Container ID: Sets the container identification number. Enter up to 11 characters (numbers or letters).
- 20 FT. Unit: Tells the controller that this is the option chosen.
- Controller ID: View and edit the Controller ID.
- Power Module ID: An 8 digit alphanumeric number found on the power module.
- 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).

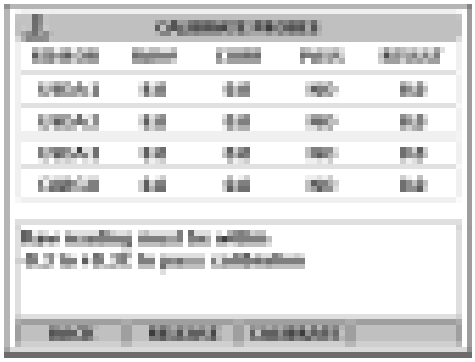
Clock

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

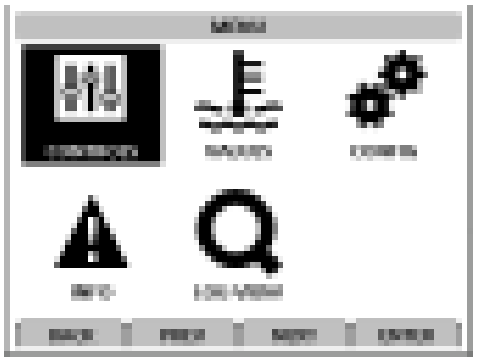
Used to calibrate sensor probes.



Icon Menu

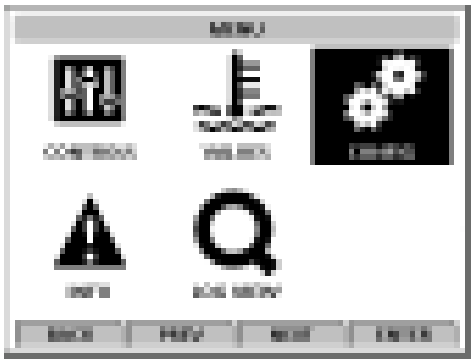
1. Press the F2 or F3 UP/DOWN key to scroll to the Configuration selection and press the F4 key. The Configuration Menu will appear.

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.

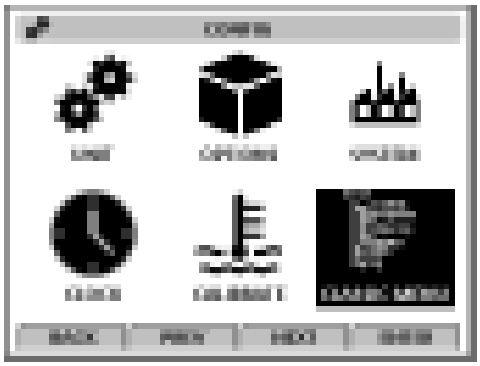


To change back to the Classic Menu:

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

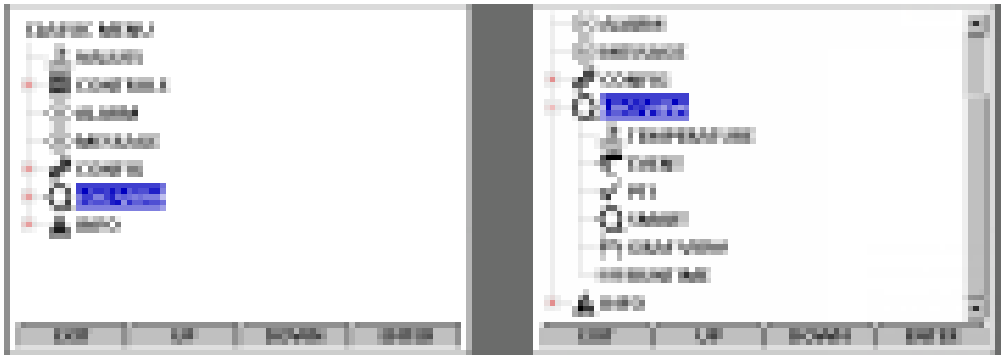
This menu allows the user to check Temperature, Event, PTI, Smart, and Runtime logs. Displays results of last PTI, Event, and Temperature test including component volt and amps data and sensor temperatures.

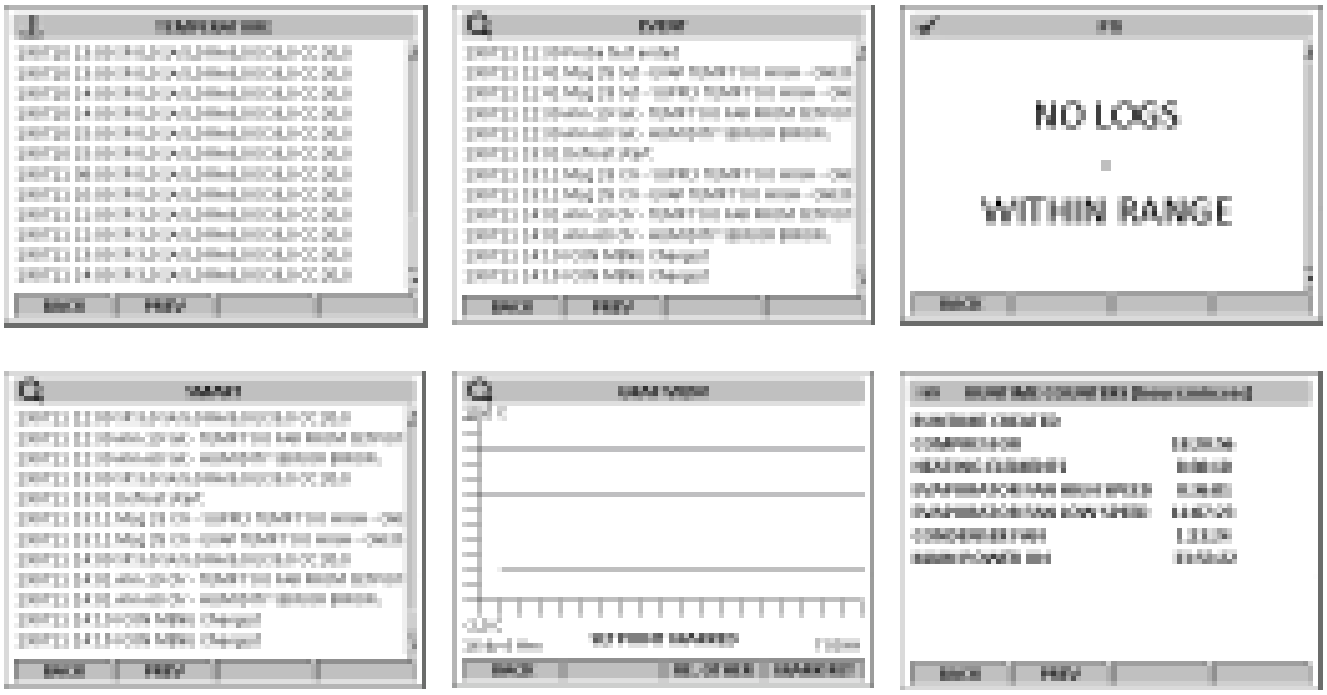
A complete listing of the controller operating menu is located on an 11" x 17" foldout in the Diagrams chapter (Figure 49, p. 193).

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 30. 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 31. 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 ("Manual Function Test," p. 78) for detailed information.
- Function Test: Refer to ("Function Test," p. 82) for detailed information.
- PTI: Refer to ("PTI (Pretrip) Tests," p. 78) for detailed information.

PTI Menu Screen

Manual Function Test

Function Test

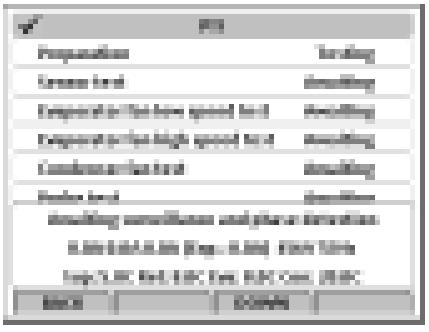
AFAM+ PTI

Humidity Sensor PTI

Brief PTI

Chilled PTI

PTI



Probe Test

Show PTI Info

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 32. 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 33. 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 2.5 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.

Note: *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]
   - [EVAPORATOR FAN HIGH]
   - [EVAPORATOR FAN LOW]
   - [CONDENSER FAN]
   - [ECONOMIZER VALVE]
   - [DIGITAL VALVE]
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
- Capacity 100 percent
- Evaporator High or 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 34. 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, 32, 33, 34, 35, 60, 97, 98, 120, 121, 123	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: • MAGNUM+ / MAGNUM+ 40'SL: – 1.0 Amps approx. at 50 Hz – 1.0 Amps approx. at 60 Hz • MAGNUM+ 20'SL: , – 1.5 Amps approx. at 50 Hz – 1.5 Amps approx. at 60 Hz Amperes are recorded in the PTI log.	14, 15	5 seconds	X	X	X
EVAP FAN HIGH SPEED TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	With evaporator fan on high speed, amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency. If the minimum phase amp draw is less than 70% of the maximal amp draw both alarm is set. • MAGNUM / MAGNUM 40'SL: – 2.1 Amps approx. at 50 Hz – 2.5 Amps approx. at 60 Hz • MAGNUM 20'SL: – 2.7 Amps approx. at 50 Hz – 3.2 Amps approx. at 60 Hz Amperes are recorded in the PTI log.	12, 13	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. • MAGNUM+ Expected Power Consumption: – 1.2 Amps approx. at 50 Hz – 1.5 Amps approx. at 60 Hz Amperes are recorded in the PTI log.	16, 17	5 seconds	X	X	X

Table 34. 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 high 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. • LH Supply/RH Supply (if equipped): 0.5C (32.9F).	115, 116, 117	1 minute minimum to 13 minutes maximum	X	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 and compressor 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. • 4.4 Amps approx. at 400V • 5.1 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	X	—
TEMPERATURE STABILISATION	With evaporator fan on high speed awaiting the supply, return and evaporator temperatures to stabilize. Delta SUP-RET and Delta RET-EVA must be stable, within 7 seconds. **Awaiting temperature stability**	None	20 to 180 seconds	X	X	—
PRE HEAT TEST SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	Test is skipped if return air temperature is at 5C or above. With electric heaters turned on and evaporator fan on high speed, the test will end when return air temperature is at 5C or above. **Heating until 5C/41F**	None	Instant to 2 hours	X	X	—
PRE COOL TEST SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	If the return air temperature is below 15C (68F) the test is skipped. Unit operates in cool until the return sensor is less then +15C (59F) or 1 hour Cooling until 15C/ 59F.	None	Instant to 2 hours	X	X	—
VENTILATING	If heater or compressor has been running in the preceding test, the unit is ventilated with evaporator fan on high speed. **Ventilating**	None	60 seconds	X	X	X
COMPRESSOR TEST AMB CON EVA 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

Table 34. PTI, Brief PTI, Function Tests (continued)

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
COMPRESSOR DIGITAL TEST AMB CON EVA 8.0C 25.0C 2.0C 9.1A 9.0A 9.1A	Compressor running loaded, evaporator fan at high speed, and condenser fan maintaining 30-35degC for 15 sec. Next the compressor is unloaded and running for 10 sec Amp draw difference is measured and expected to be at least 0,9 Amp (Con > 35C) or 1,5 Amp (Con < 35C).	119	25 to 35 seconds	X	X	X
COMPRESSOR ECONOMIZER TEST AMB CON EVA 8.0C 45.0C 1.0C 9.1A 9.0A 9.1A	With compressor on (loaded), condenser and evaporator fans at high speed are turned on for 30 seconds. If condenser fan temperature is below 30C (86F) then the test is aborted. Vapor injection valve is turned on. Amp draw difference is measured and verified to be minimum 0.4 amps. **Evaluating Power Consumption Increase**	26	Max 90 seconds	X	X	X
HIGH PRESSURE CUTOUT TEST	Running with compressor fully loaded and with evaporator fan at high speed, awaiting high pressure cut out. The test is ended if the condenser coil probe reads temperature above 70ºC and the HPCO does not occurs. The time observing is depending on the startup temperature and will be increased as long as the condenser temperature is increasing. After the HPCO the compressor signal is removed and the condenser fan is activated to lower the pressure in the condenser. When the temperature gets below 40ºC the compressor is also activated. The test will then look for when the HPCO gets back to normal in maximal 60 seconds. **Awaiting HPCO - Compressor stop**	53, 54	Max 200 seconds	X	X	—
CAPACITY TEST	With compressor fully loaded condenser fan on and evaporator fan at high speed running for the time period. At the end of the test is the cooling capability evaluated. **Evaluating cooling capability**	22	180 seconds for 40’ and 240 seconds for 20’ unit.	—	X	—
APPROACHING 0 TEST	Probe readings and time are recorded in the pti log when started. When supply air temperature is at 0 deg C / 32F the test is ended. If the test is not ended within the time limit the alarm is set. **Approaching 0C/32F**	23	Max 2 hours	X	—	—
MAINTAINING 0C TEST	With the unit running chilled – Non-Optimized, maintaining 0 deg C / 32F. After 30 minutes the probe readings and time are recorded in the pti log. **Maintaining 0C/32F**	None	30 minutes	X	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	X	X

Table 34. PTI, Brief PTI, Function Tests (continued)

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
PULLDOWN TO -18 C TEST	With the unit running frozen, approaching -18 deg C / 0F. Probe readings and time are recorded in the pti log when started and when ended. When return air temperature is at -18 deg C / 0F the test is ended. If the test is not ended within the time limit the alarm is set. **Approaching -18C/0F**	22	Max 3 hours	X	X	—
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
RUNNING PTI 0°C / 32°F 00:00:00 0.0C 10.0C 10.0C	Unit operates in normal mode with 0C (32F) setpoint for 30 minutes after previous test is completed. At the end of 30 minutes, "Chill End" temperatures are recorded in PTI log. Sensor values for supply, return and evaporator sensors are recorded in the event log. ***Note:*** *Controlling Sensor = Supply*	None	Max 120 minutes	X	—	—
RUNNING PTI DEFROST 00:00:00 -18.0C 10.0C 10.0C	Unit operates in normal mode with -18C (0F) setpoint and defrost activated. Defrost terminates when evaporator temperature increases to 18C (65F). ***Note:*** *Controlling Sensor = Return*	20	30 minutes	X	—	—
RUNNING PTI -18°C / 0°F 00:00:00 -18.0C 10.0C 10.0C	Unit operates in normal mode with -18C (0F) setpoint. When return air temperature decreases to setpoint, Frozen Arrival" temperatures are recorded in PTI log. "PTI End" are recorded in PTI log and a Trip Start is automatically activated. ***Note:*** *Controlling Sensor = Return*	22, 60	Max 90 minutes	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	Max 180 minutes	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.

Air Ventilation Logging (AVL)

The Air Ventilation Logging option detects vent disk movement and automatically displays a value on the display. This value is also logged in the datalogger. The entry records the time, date, and vent opening position. It is mounted on the fresh air vent door.

Configuration Instructions

The logging is automatic if the unit has been configured to record the vent door motion. To configure the unit, complete the following steps:

1. Press the F1 key until the display returns to the unit status display (setpoint).
2. Press the F4 key to enter the Main menu.
3. Press the F2 or F3 key to scroll to the CONFIG menu. Press the F4 key to access.
4. Press the F3 key to scroll to Options. Press the F4 key to expand this menu. Press F3 key to scroll to Controlled Atmosphere (CA).
5. Press the F2 or F3 key until AVL is selected. Press and hold the F4 key until the display returns to the Controlled Atmosphere (CA) selection. The unit is now configured to log the vent door motion.
6. Press the F1 key to exit the Options screen, and again to exit the Config screen.

Figure 34. AVL

Operating Instructions

The following automatically occurs when the vent recorder is enabled in the configurations menu and the vent door changes position:

1. The LCD screen displays (for one minute) the message: [FRESH AIR POSITION SETTING XX CFM:]. Scroll the C/F key to view the door position in CFM (cubic feet per minute) or CMH (cubic meters per hour).
2. An entry is automatically logged in the datalogger. The entry records the time, date, and vent opening position.

Advanced Fresh Air Management (AFAM) System

Starting the AFAM System

1. Press the F4 key to enter the main menu. Press the F2 or F3 key to scroll to Config menu and press F4 to expand the menu.
2. Press the F2 or F3 key to scroll to Options menu and press F4 to expand the menu.
3. Press the F2 or F3 key to scroll to Controlled Atmosphere (CA) menu and press F4 to enter the menu.
4. Press the F2 or F3 key to select AFAM and Press and hold F4 to accept the selection.

5. Press the F1 key several times to return to the standard display.
6. Press the F4 key to enter the main menu. Press the F2 or F3 key to scroll to Controls menu and Press F4 to expand the menu.
7. Press the F2 or F3 key to scroll to Fresh Air Vent Man menu. Press the F4 key to enter the Fresh Air Vent Man menu.

⚠ WARNING

Risk of Injury!

The vent door and motor actuator arm move immediately when the F4 key is pressed to turn the AFAM system to AFAM or Off. Keep hands and tools away from the air exchange system components to prevent personal injury or unit damage.

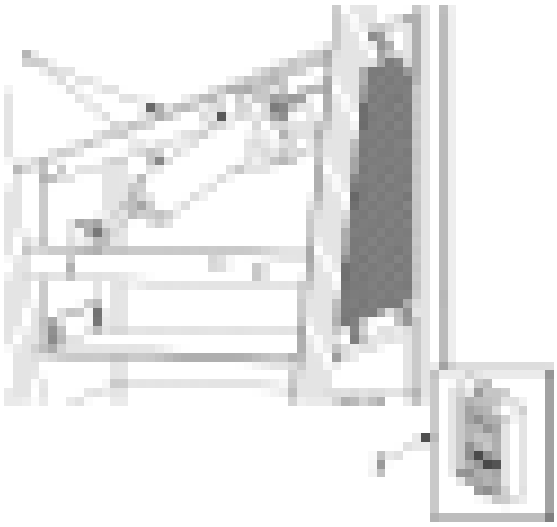
8. Press the F2 or F3 key to scroll between [OFF] and [AFAM].
   - [OFF]: Vent door closes and/or remains closed. AFAM Delay and AFAM Rate settings disappear.
   - [AFAM]: Controller uses enter AFAM DELAY and AFAM RATE time to adjust FAE door to user setting.

9. Press and hold the F4 key with the desired state in the menu line until you are returned to the Controls menu.
10. Press the F1 key several times to return to the standard display.

Change the AFAM Delay

Note: *The fresh air exchange time delay should be established by the shipper.*

The AFAM delay setting keeps the fresh air vent closed for a preset time when the unit starts. This allows faster product temperature pull-down. The AFAM delay can be set from 1 to 72 hours in 1-hour increments.



1	Vent Door Assembly and Damper Motor
2	AFAM+ Expansion Module (Mounts on Back of Controller in Control Box)

Note: *During unit startup, the AFAM delay prevents the AFAM door from opening until the delay times out. The AFAM delay prevents the AFAM door from opening due to the AFAM Rate or CO2 system settings.*

1. Press the F4 key to enter the main menu. Press the F2 or F3 key to scroll to Controls menu and Press F4 to expand the menu.
2. Press the F2 or F3 key to scroll to AFAM DELAY.

⚠ WARNING

Risk of Injury!

The vent door and motor actuator arm move immediately again when a delay is entered. Keep hands and tools away from the air exchange system components to prevent personal injury or unit damage.

3. Press the F4 key to enter the AFAM DELAY menu. The current setting (“0”) appears in the display.

4. Press the F2 or F3 key to increase or decrease the time delay.
5. Press and hold the F4 key until returned to the main menu. The new time delay is recorded in the controller and appears in the display.
6. Press the F1 key to exit the Controls menu.

Change the AFAM Rate

Note: *The fresh air exchange rate should be established by the shipper.*

The AFAM rate sets the desired air exchange rate. The actual door position is based on the AFAM rate and the power supply frequency (Hertz).

1. Press the F4 key to enter the main menu. Press the F2 or F3 key to scroll to Controls menu and Press F4 to expand the menu.
2. Press the F2 or F3 key to scroll to AFAM RATE. Press F4 to enter menu. The current rate and units (e.g. "0 CMH") appears in the display.

⚠ WARNING

Risk of Injury!

The vent door immediately closes and re-opens to the new position when a rate is entered. Keep hands and tools away from the air exchange system components to prevent personal injury or unit damage.

3. Press the F2 or F3 key to increase or decrease the AFAM Rate.
4. Press and hold the F4 key until returned to the main menu. The new rate is recorded in the controller and appears in the display.

Advanced Fresh Air Management Plus (AFAM+) System

An advanced microprocessor controlled fresh air management system that provides:

- programmable control of the CO2 level in the container
- data logging of the CO2 gas level reading
- gas sensor unit
- sensor filter
- vent loop

The controller can be set to control the CO2 level in the container from 0 to 25 percent.

Set AFAM+ System Values

The Controlled Atmosphere (CA) option submenu in the Config menu is factory set to AFAM+. The controller then adds the AFAM, AFAM Delay, AFAM Rate, and CO2 Max submenus to the Controls menu. If a replacement controller or new software is installed, a controller auto configuration will detect the AFAM+ option when the AFAM door control module and gas sensor are connected to the controller.

- AFAM+: This setting turns on the AFAM+ system to control the CO2 gas level. The controller then adds CO2 Max and AFAM Delay submenus to the Controls menu.

The default setting for AFAM in the Controls menu is the last value set (Off, AFAM, or AFAM+). Controlled Atmosphere (CA) and Fresh Air Vent Man must be set to AFAM+ to control the vent door to the CO2 gas level.

1. Press the F4 key to enter the main menu. Press the F2 or F3 key to scroll to Config menu and press F4 to expand the menu. 2. 3.
2. Press the F2 or F3 key to scroll to Options menu and press F4 to expand the menu.
3. Press the F2 or F3 key to scroll to Controlled Atmosphere (CA) menu and press F4 to enter the menu.
4. Press the F2 or F3 key to select AFAM+ and press and hold F4 to accept the selection.

5. Press the F1 key several times to return to the standard display.
6. Press the F4 key to enter the main menu. Press the F2 or F3 key to scroll to Controls menu and press F4 to expand the menu.
7. Press the F2 or F3 key to scroll to Fresh Air Vent Man.
8. Press the F4 key to enter the Fresh Air Vent Man menu.

⚠ WARNING

Risk of Injury!

The vent door and motor actuator arm move immediately when the F4 key is pressed to enable the AFAM+ system. Keep hands and tools away from the air exchange system components to prevent personal injury or unit damage.

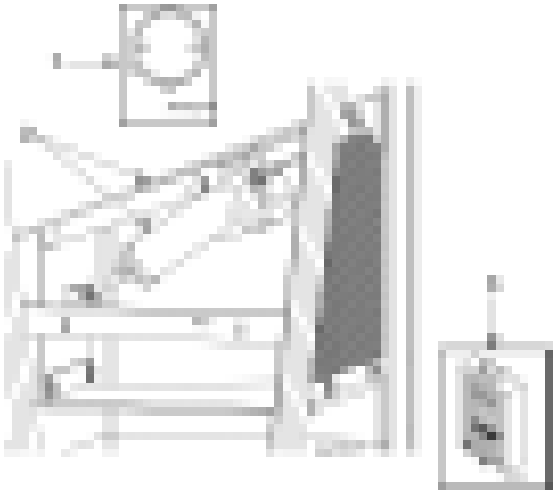
9. Press the F2 or F3 key to scroll between [OFF], [AFAM], and [AFAM+].
   - [OFF]: Vent door closes and/or remains closed. AFAM Delay and CO2 Max settings disappear.
   - [AFAM]: Controller uses enter AFAM DELAY and AFAM RATE time to adjust FAE door to user setting.
   - [AFAM]: Controller uses enter AFAM DELAY and CO2 Max to adjust FAE door to user setting.

10. Press and hold the F4 key with the desired state in the menu line until you are returned to the Controls menu.
11. Press the F1 key several times to return to the standard display.

Change the AFAM Delay

Note: *The fresh air exchange time delay should be established by the shipper.*

The AFAM delay setting keeps the fresh air vent closed for a preset time when the unit starts. This allows faster product temperature pull-down. The AFAM delay can be set from 1 to 72 hours in 1-hour increments. Refer to ("Change the AFAM Delay," p. 85) for the procedure to set the delay.



1	Gas Sensor Assembly (Mounts in Evaporator)
2	Vent Door Assembly and Damper Motor
3	AFAM+ Expansion Module (Mounts on Back of Controller in Control Box)

Note: *During unit startup, the AFAM delay prevents the AFAM door from opening until the delay times out. The AFAM delay prevents the AFAM door from opening due to the AFAM Rate or CO2 system settings.*

Change the CO2 Minimum and Maximum Setting

Note: *The minimum CO2 rate should be established by the shipper.*

The CO2 rate sets the desired CO2 level in the container when a gas sensor unit is installed. The actual AFAM door position is based on the CO2 level and AFAM delay.

1. Press the F4 key to enter the main menu. Press the F2 or F3 key to scroll to Controls menu and press F4 to expand the menu.
2. Press the F2 or F3 key to scroll to CO2 MAX.
3. Press the F4 key to enter the CO2 MAX menu. The current rate and units (e.g. “0.0 percent”) appears in the display.

4. To change the rate, press the F2 or F3 key to increase or decrease the CO2 Max setting.

⚠ WARNING

Risk of Injury!

The vent door and motor actuator arm may move immediately again when the rate is entered. Keep hands and tools away from the air exchange system components to prevent personal injury or unit damage.

5. Press and hold the F4 key until returned to the main menu. The new rate is recorded in the controller and appears in the display.

Change the AFAM+ Settings Using OptiSet™

1. Press the F4 key to enter the main menu. Press the F2 or F3 key to scroll to Controls menu and press F4 to expand the menu.
2. Press the F2 or F3 key to scroll to OptiSet Menu.
3. Press F4 key. The following screen will appear:

4. Use F2 or F3 keys to scroll to desired product.

5. Press and hold F4 key to auto enter product settings.

   Note: *If any of the auto product settings made by OptiSet are modified, the display will change from the selected product to CUSTOM. This signifies that some or all of the settings have been changed.*

6. Display will show selected product.

Modify OptiSet Product Settings

1. Press the F4 key to enter the main menu. Press the F2 or F3 key to scroll to Controls menu and Press F4 to expand the menu.
2. Press F3 key and scroll to the setting to be modified. Settings that can be modified:
   - Temperature Setpoint

     Note: *Setpoint changes > 5° C (9° F) will force the CO2 setting to 1%, O2 setting to 20%, cancel the AFAM DELAY, Optimized Mode, Humidity Control, and Humidity Setpoint.*
   - Evaporator Fan Speed
   - Defrost Termination Temperature
   - Humidity Control
   - Humidity Setpoint
   - AFAM DELAY
   - O2 Minimum (if applicable)
   - CO2 Maximum

NOTICE

Cargo Loss!

Do not modify any of the above settings without direct instructions from the shipper. Serious cargo damage could occur.

3. For example, to modify the O2 and CO2 settings, press F3 key to scroll to O2 MIN.
4. Press the F2 OR F3 key to increase or decrease the O2 Min supplied by the shipper.
5. Press and hold the F4 key until returned to the main menu. The new rate is recorded in the datalogger and appears on the display.
6. Press F2 or F3 key to scroll to CO2 MAX.
7. Press F4 key to enter the setting mode.
8. Enter the CO2 setting supplied by the shipper.
9. Press and hold the F4 key until returned to the main menu. The new rate is recorded in the datalogger and appears on the display.

Testing AFAM / AFAM+ System

The system consists of the following main parts:

- Gas Analyzer: Mounted in Evaporator Section
- Interface Board: Mounted on Power Module (MRB)
- Damper Motor: Mounted above Control Box
- Vent (FAE) Door: Opens to allow air exchange in and out of the container

AFAM+ Option Alarm Codes

- Code 122 - O2 Sensor Calibration Error (PTI Only) (if equipped)
- Code 124 - Power Module Sensor Error

System Operation Verification

If the system appears not to be operating properly, it is best to verify that the controller can recognize if the AFAM+ option is installed. Use the Auto Configuration function found in the Config menu. Select setting to ON. Allow the configuration steps to complete. The last step of the configuration will be AFAM. Watch the Display closely during this test. When to AFAM door opens and closes, the AFAM option will be set. The controller will now test communications to the gas analyzer. When the gas analyzer is found, the option will change to AFAM+.

Notes:

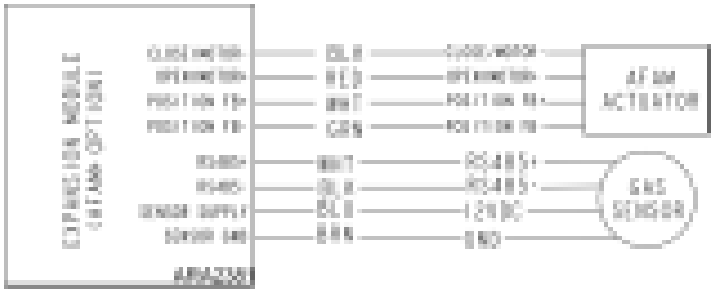
1. *Upgrade the controller software to the latest released version. Auto Configuration will be automatically initiated upon successful completion of a software flashload.*
2. *If only the AFAM option is found, then there is a communication problem with the gas analyzer.*
3. *If only Gas Analyzer is found, there is a problem with the operation of the damper motor.*

To select Auto Configuration:

1. Enter Config menu, select Unit, then Auto Configuration.
2. Turn Auto Configuration ON by using F2 key.

3. Press and hold F4 key to Accept.

Once the Auto Configuration is complete, and the AFAM+ system has been found and configured into controller memory, enter the desired settings. If the damper motor or the gas analyzer is not found during the Auto Configuration, use the diagram below (and the unit Schematic and Wiring Diagrams) to verify the connections, supply voltages, and communication wiring to the two components. Also verify that the AFAM+ Expansion Module is firmly attached to the back of the controller.



Alarm Codes and Actions

There is one (1) PTI alarm that could be generated on a unit equipped / utilizing an O2 sensor.

NOTICE

Equipment Damage!

If the inlet/outlet tubes or filter need to be cleared, disconnect from the gas analyzer BEFORE purging air through the tubes. If tubes remain connected, serious damage to the gas analyzer could occur.

Alarm	Possible Cause	Corrective Action(s)
Code 122 - O2 Sensor Calibration Error (if equipped) (PTI Only)	1. Stale atmosphere / Filter or inlet / outlet tubes restricted (See Notice Above). 2. O2 sensor reading < 17% or > 25%.	1. Open evaporator access door or fully open vent door and allow unit to operate on high speed fan for 20 to 30 minutes to purge any old, stale air trapped in the analyzer module before performing PTI. 2. If O2 reading is still out of calibration range after purge procedure noted above is performed, replace analyzer.

Values Menu	Possible Cause	Corrective Action(s)
CO2%	Open or Short	If no alarm has been generated, the system most likely has not communicated with or is verifying communications with the analyzer. Follow corrective action for Stale Atmosphere procedure above. If fault exists, an alarm will be generated.
O2%	Open or Short	If no alarm has been generated, the system most likely has not communicated with or is verifying communications with the analyzer. Follow corrective action for Stale Atmosphere procedure above. If fault exists, an alarm will be generated.

Pulsating Vent Door

AFAM+ Door Closes Automatically

On units equipped with the AFAM option, a harness from J_B12 to the on/off switch, and a container prefix of HLXU. If the AFAM door is open it will close automatically if the on/off switch is turned off. Unit and controller will shut off and the AFAM door will be power close.

Pulsating AFAM+ Door

In the past the AFAM door would open and stay at a fixed position. Now the AFAM door will open to the fully open position, and stay open for a calculated period of time.

AFAM+ set to "AFAM" and the AFAM Rate set to 75 CMH

In the past if you wanted 75 CMH, the door would open to the 75 CMH position and stay. Now the door will remain closed and then opens fully for 5 minutes every 15 minutes to achieve the same 75 CMH.

- When the door is closed, the display will read "PULSATING AFAM XXX SEC TO DOOR OPEN".
- When the door is open, the display will read "PULSATING AFAM DOOR OPEN".
- When the AFAM door opens, it remains open for a minimum of 30 seconds.

AFAM+ Enabled

In the past once the CO2 level reached the maximum setpoint, the door would start to ramp open. Once the CO2 level decrease the door would start to ramp closed. Now once the CO2 level reaches the maximum setpoint, the door opens fully for a calculated period of time. The door will then close for a calculated period time. If the CO2 level remains above the maximum setpoint, the calculated period of time the door is open will be increased and the period of time closed will decrease.

- When the door is closed, the display will read "PULSATING AFAM XXX SEC TO DOOR OPEN".
- When the door is open, the display will read "PULSATING AFAM DOOR OPEN".
- When the AFAM door opens, it remains open for a minimum of 30 seconds.

Operating Theory

Chill Loads (Setpoint at -9.9 C [14.1 F] and Above)

The unit operates on Cool with Modulation and Heat to provide accurate control of chill loads. During Cool with Modulation, the controller uses a proportional-integral derivative (PID) algorithm, and a Digital Control valve to provide accurate control of the container temperature in direct response to load demand.

The Digital Control valve engages and disengages the compressor to control capacity. The valve opens and closes in response to a controller voltage signal based on a control temperature differential. The controller uses the setpoint temperature, supply air sensor temperature and pull-down rate for the last 10 seconds, last 20 seconds and last 180 seconds to calculate the control temperature differential.

Supply Air Sensor Control

Temperature control is provided by using a PT1000 temperature sensor to determine the supply temperature used to calculate the control temperature.

If the supply air sensors fail, the controller uses the temperature of the return air sensor plus an offset for temperature control.

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. For example, when controller display shows 70 percent, this means the Digital Control valve is operating to reduce system cooling capacity from 100 percent to 70 percent (a 30 percent reduction).

Power Limit Management

Power Limit is active whenever the compressor is on in both the Chill and Frozen modes. When the total current draw or the condenser temperature exceeds a predetermined threshold, the controller limits unit power consumption by sending a voltage pulse to the Digital Control valve. The Digital Control valve then operates to control the compressor. This reduces the cooling capacity load on the compressor, thereby limiting the compressor motor current draw and the condenser temperature to a predetermined threshold.

Additional power limit management flexibility is available. A maximum total current draw (17, 15 or 13 amps) and power management time interval can be selected from the Power Management feature of the Commands menu. When the power management time interval expires, the unit returns to the standard power limit control algorithm.

Note: *Setting power management current at 13 amps can be used to provide slow pull-down of loads.*

Compressor Vapor Injection

During compressor operation, a vapor injection system injects refrigerant into the center scroll of the compressor to provide additional cooling capacity. When vapor injection is active, the controller energizes the vapor injection valve continuously. The controller activates vapor injection when the:

- Chill or Power Limit Mode: When the cool capacity is 100 percent (in the display), the controller energizes the vapor injection valve continuously.
- Compressor discharge temperature exceeds 138 C (280 F). Vapor injection stops when the compressor discharge temperature decreases 6 C (10.7 F).

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). The controller will restart the unit when the sensor temperature is below 90 C (194 F).

Power Limit Mode

The controller uses the total unit current and the condenser temperature to provide power limit control in both the Chill and Frozen modes. When the unit is on water-cooled operation, power limit control is based on the total unit current draw only.

Evaporator Fan Control

The controller determines evaporator fan motor speed based on the setpoint temperature and the mode setting.

Chill Loads (Setpoints of -9.9 C [14.1 F] and Above)

When the Optimized Mode is set to ON, the evaporator fans operate on low and high speed as needed to maintain the setpoint and save energy. Typically, the evaporator fans run in high speed during the initial pull-down to setpoint, but the evaporator fans may run in low speed at times during pull-down as determined by the controller. Once the setpoint has been reached, the evaporator fans usually run in low speed as long as the temperature is near the setpoint. If the controller determines it is necessary, the evaporator fans may shift back to high speed temporarily to bring the temperature back to setpoint or increase air circulation.

When the Non-Optimized mode is set to On, the evaporator fans operate continuously on high speed.

Frozen Loads (Setpoint at -10.0 C [14.0 F] or Below)

When the Optimized mode is set to On, the evaporator fans operate on low speed on and off. The evaporator fans run in low speed when the compressor is running. When the compressor is not running the evaporator fans are usually off, but periodically run in low speed to circulate air to evaluate when to start the compressor again.

When the Non-Optimized mode is set to On, the evaporator fans operate continuously on low speed.

Condenser Fan Control

The controller also uses a proportional-integral derivative algorithm to control the condenser temperature and ensure a constant liquid pressure at the expansion valve. The condenser fan operates continuously in high ambients. In low ambient conditions, the controller pulses the condenser fan on and off to maintain a minimum condenser temperature. The controller maintains a minimum 30 C (86 F) condenser temperature on Chill loads and a minimum 20 C (68 F) condenser temperature on Frozen loads. To do this the condenser fan pulses.

Note: *When the condenser fan is pulsing ON/OFF, the fan will come on just before the fan stops rotating.*

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.*

Dehumidify Mode

During Chill mode operation, a dehumidification system is available to reduce the relative humidity in the container to the desired humidity setpoint. The Dehumidify mode option is turned on from Setpoint menu of the controller. The relative humidity setpoint can be set from 60 to 99 percent from the Setpoint menu.

Note: *The use of the Dehumidify mode should be established by the shipper.*

Changing the humidity control from off to DEHUM in the setpoint menu activates the dehumidify control algorithm. When the Dehumidify mode is on, the supply air temperature must be in-range to activate dehumidification.

- When the humidity level is 2 percent or more above setpoint and the Digital Control valve has reduced the unit cooling capacity to 85 percent, the controller pulses the electric heaters on and off. This increases the cooling load on the evaporator coil, thereby causing the coil to become even colder and condense more moisture from the container air.

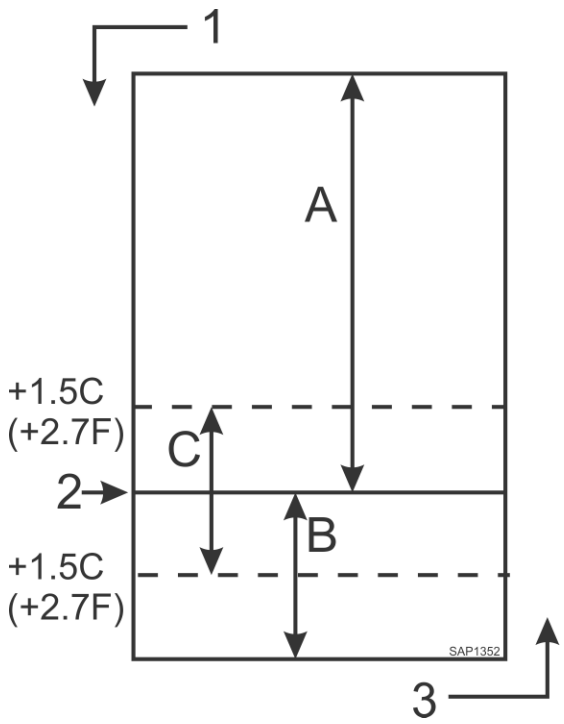
Continuous Temperature Control Operation

Chill Loads (Controller Setpoint at -9.9 C [14.1 F] and Above)

The controller regulates the compressor, digital control valve, and electric heaters based on a Control Temperature Differential (Refer to "Compressor Digital Control Valve," p. 99 for more detail). This means the unit operating mode can not be predicted based only on the setpoint and supply air temperature. At setpoints of -9.9 C (14.1 F) and above, the controller operates the unit on the following:

- Cool mode with Modulation.
- Controller energizes the vapor injection valve continuously when the cool capacity is 100 percent.
- Heat mode (electric heaters pulse on and off on a 60 second duty cycle).
- Defrost mode (electric heaters on, evaporator fans off).

Chill Load Control Sequence (Setpoints at -9.9 C [14.1 F] and Above)



A	Cool with Modulation (control temperature differential is above setpoint)
B	Heat (electric heaters pulse on and off on a 60 second duty cycle if the control temperature differential is below setpoint.)
C	In-range (based on supply air temperature)
1	Decreasing Temperature
2	Setpoint
3	Increasing Temperature

Table 35. MAGNUM PLUS Operating Mode Function Chart

Chill Loads Setpoints at -9.9 C (14.4 F) and Above			Frozen Loads Setpoints at -10 C (14 F) and Below			
Cool w/Mod	**Heat**	**Defrost**	**Cool**	**Null**	**Defrost**	**Unit Function**
•[1]	•					Evaporator Fans High Speed[1]
•[1]			•	•[1]		Evaporator Fans Low Speed[1]

Table 35. MAGNUM PLUS Operating Mode Function Chart (continued)

Chill Loads Setpoints at -9.9 C (14.4 F) and Above			Frozen Loads Setpoints at -10 C (14 F) and Below			
Cool w/Mod	**Heat**	**Defrost**	**Cool**	**Null**	**Defrost**	**Unit Function**
		•		•[1]	•	Evaporator Fans Off[1]
•	•					Proportional-integral Derivative (Supply Air) Control
			•	•		Return Air Sensor Control
		•			•	Evaporator Coil Sensor Control
•			•			Compressor On
•			•			Compressor Vapor Injection On (valve energized)[2]
•			•			Condenser Fan On[3]
•			•[4]			Digital Control Valve Modulating (energized)[4]
•[5]	•	•			•	Electric Heaters Pulsing or On (energized)[5]

[1]Setpoint temperature and controlling mode setting determine the evaporator fan speed:

- Normal Operation: Chill Loads - High or low speed fans; Frozen Loads - Low speed fans or no fans.

[2]Vapor injection valve:

- Chill, Frozen, or Power Limit Mode: When the cool capacity is 100 percent.
- Compressor High Temperature Protection: When the compressor discharge temperature exceeds 138 C (280 F).

[3]Condenser fan pulses on and off on a 30 second duty cycle to maintain a minimum condenser temperature:

- Chill Loads: Controller maintains a minimum 30 C (86 F) condenser temperature.
- Frozen Loads: Controller maintains a minimum 20 C (68 F) condenser temperature.

[4]Digital Control valve modulates:

- Chill Loads - whenever the unit is in a Cooling mode; Power Limit - whenever the unit is in Power Limit mode.
- Dehumidification: When the Dehumidify mode is set to On, the supply air temperature must be In-range to energize the electric heaters.
  - When the humidity is two percent or more above humidity setpoint, the controller (energizes) the heaters.

[5]Controller energizes electric heaters for heat, defrost and dehumidification:

- Heat mode (compressor off): If supply air temperature is too low, heaters pulse on and off on a 60 second duty cycle.
- Defrost mode: Heaters are on until evaporator coil temperature increases to terminate defrost.

Cool with Modulation

- Controller calls for the Cool mode whenever the Control Temperature Differential (based on supply air temperature) is above setpoint.
- Controller turns on the Compressor indicates when the compressor is operating.
- Controller opens and closes Digital Control valve to control the compressor load. The duty cycle of the Digital Control valve balances the unit cooling capacity against the actual load requirements.
- Controller turns the In-range LED solid when the supply air sensor temperature is within 1.5 C (2.7 F) of setpoint.
- Controller turns on the Heat indicator whenever the heaters are pulsed on and off.

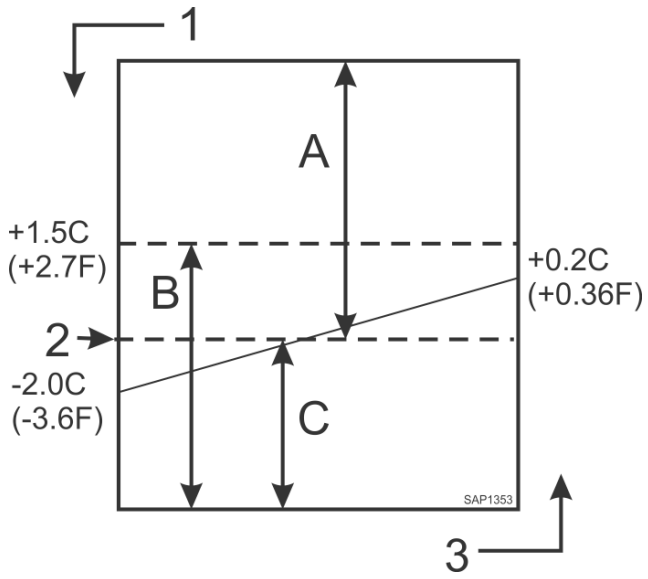
Heat

- If the supply air temperature is too low and the Control Temperature Differential is below the setpoint, the controller stops the compressor. The fans (low speed) are kept on to determine if fan heat is sufficient to increase temperature to setpoint. If not, switch to high speed. If not sufficient heat - increase with pulsating on the heaters until setpoint is reached.

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

At setpoints of -10 C (14 F) and below, the controller locks out the Modulation and Heat modes. The controller regulates compressor operation based the return air sensor and setpoint temperatures. The controller operates the unit on:

- Cool mode.
- Null mode.
- Defrost mode (electric heaters on, evaporator fans off).
- Evaporator fans operate on low speed and continuously circulate air inside the container (except during Defrost and in Null mode).
- Controller display shows the return air sensor temperature.
- Controller display shows the setpoint temperature.
- Controller cycles a single-speed condenser fan on for 2 to 30 seconds every 30 seconds when the unit is on air-cooled condenser operation. The amount of on time depends on the condenser coil, ambient and compressor discharge temperatures.
- Power limit is active during initial start-up and pull-down when the unit is cooling at return air temperatures above -10 C (14 F).



A	Cool
B	In-range
C	Null
1	Decreasing Temperature
2	Setpoint
3	Increasing Temperature

Cool

- After initial start-up and pull-down to 2.0 C (3.6 F) below setpoint, the controller calls for the Cool mode whenever:
  - Return air temperature increases more than 0.2 C (0.36 F) above setpoint.
  - Return air temperature is above setpoint and the compressor has been off for 30 minutes.
- Controller turns on the Compressor indicator when the compressor is operating.
- Compressor must operate for a minimum of 5 minutes after startup.
- After initial pull-down to setpoint, 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 2.0 C (3.6 F) below setpoint.
- The controller stops the compressor and condenser fan and evaporator fan.

Defrost

The evaporator coil sensor temperature must be below 18 C (65 F) to initiate a Demand Defrost or Manual Defrost. The evaporator coil sensor temperature must be below 4 C (39 F) to initiate a Timed Defrost.

- Demand Defrost function initiates Defrost immediately when:
  - Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large.
  - Temperature difference between the supply sensors and return air sensor is too large.
- Manual Defrost may be initiated immediately by pressing the DEFROST key or by REFCON Remote Monitoring Modem (RMM).
- 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 Chill Loads (setpoints at -9.9 C [14.1 F] and above), the conditions for this are:
  - Evaporator Coil Temperature must be below 4 C (41 F) to activate the defrost compressor hour timer.
  - There is an interval set for defrosting, however, the defrost timer is built intelligent - it detects whether or not there is ice building up on the coil.
  - If there is no ice building up on the coil, it extends the defrost interval, and if there is Ice building up earlier on the coil it reduces the defrost interval. The maximum interval is 48 hours.
- On Frozen Loads, the initial time interval is 8 hours. Two (2) hours are added to the time interval each timed defrost interval. Maximum accumulated time interval is 24 hours.
- Defrost timer resets if the unit is off more than 12 hours, setpoint is changed more than 5 C (8.9 F) or PTI (pretrip) test occurs.

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.*

When the Defrost mode is initiated:

- The controller stops the compressor, condenser fan and evaporator fans.
- When the compressor stops, the controller turns on the Defrost indicator, Heat indicator and energizes the solid state, turning on the electric heaters.

The controller terminates the Defrost mode when:

- Evaporator temperature:
  - Chill mode: Evaporator coil sensor temperature reaches 18 C (65 F).
  - Frozen mode: Evaporator coil sensor temperature reaches 18 C (65 F).
- Interval timer: Controller terminates defrost after 90 minutes on 60 Hz power (120 on 50 Hz power). Alarm Code 20 will be generated if this occurs.
- Power off: Turning UNIT ON/OFF switch OFF terminates defrost.

When the defrost mode is terminated:

- The Heat and Defrost indicators turn off and the solid state is de-energized. The controller starts the compressor to pre-cool the evaporator coil. The condenser fan starts if required.

The controller pre-cools the evaporator coil to the supply air temperature (or for 3 minutes maximum) to minimize heat energy release into the container. The controller then starts the evaporator fans.

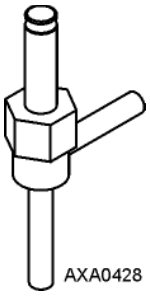
Compressor Digital Control Valve

The Compressor Digital Control valve is normally closed. The normally closed position provides full cooling capacity. When the controller energizes, it opens the Compressor Digital Control valve. Refrigerant gas flows from the digital port of the compressor back to the suction line. This disengages the compressor 100 percent and temporarily reduces the compressor pumping capability.

The controller uses a proportional-integral derivative (PID) algorithm to provide accurate temperature control. This is in direct response to load demand. However, instead of generating a voltage signal to position a suction line modulation valve to regulate cooling capacity, the algorithm establishes a pulse width signal to cycle the Compressor Digital

Control valve open and closed on a duty cycle. The percent ON time (compressor pumping time) in the duty cycle equals the cooling capacity percent required to meet the current load demand.

Remember that the percent ON time defines the time the compressor is engaged. The compressor is engaged (pumping) when the Compressor Digital Control valve is closed (OFF). Therefore, a duty cycle of 100 percent means the compressor is pumping 100 percent of the time and the Compressor Digital Control valve is ON (open) 0 percent of the time. A 60 percent duty cycle means the compressor is pumping 60 percent of the time and the Compressor Digital Control valve is ON (open) 40 percent of the time.

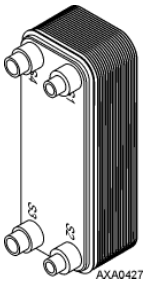


Economizer System

A vapor injection line tee is located in the liquid line between the filter drier/in-line filter and the economizer heat exchanger. A vapor injection valve controls refrigerant flow through the vapor injection line to the economizer expansion valve. When this normally closed valve is energized (open), a portion of liquid refrigerant flows through the economizer expansion valve and evaporates in the inner coiled tube of the economizer. This cools the rest of the liquid refrigerant that flows past the tee and through the economizer to the evaporator coil.

The economizer suction gas continues through the vapor injection circuit and returns to the intermediate suction port of the scroll compressor. Injecting the economizer suction gas into the compressor downstream from the suction port prevents the gas from affecting the suction pressure or cooling capacity of the evaporator coil. However, the economizer suction gas adds its heat and volume to the condenser side of the refrigeration system, increasing the discharge pressure.

Because the economizer system increases system cooling capacity, the vapor injection valve is energized (open) continuously when the compressor duty cycle (ON time) is 100 percent (Full Cool). High compressor discharge temperature may cause the vapor injection valve to energize (open) but only while the Compressor Digital Control valve is not energized (closed).



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 and cargo sensor temperatures; and humidity sensor. All temperature logs can be viewed from the controller's VGA message display.

Data logging intervals are selectable for 30 minutes, 1, 2 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 120 temperature logs (except humidity sensor) 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.

Cold Treatment (CT)

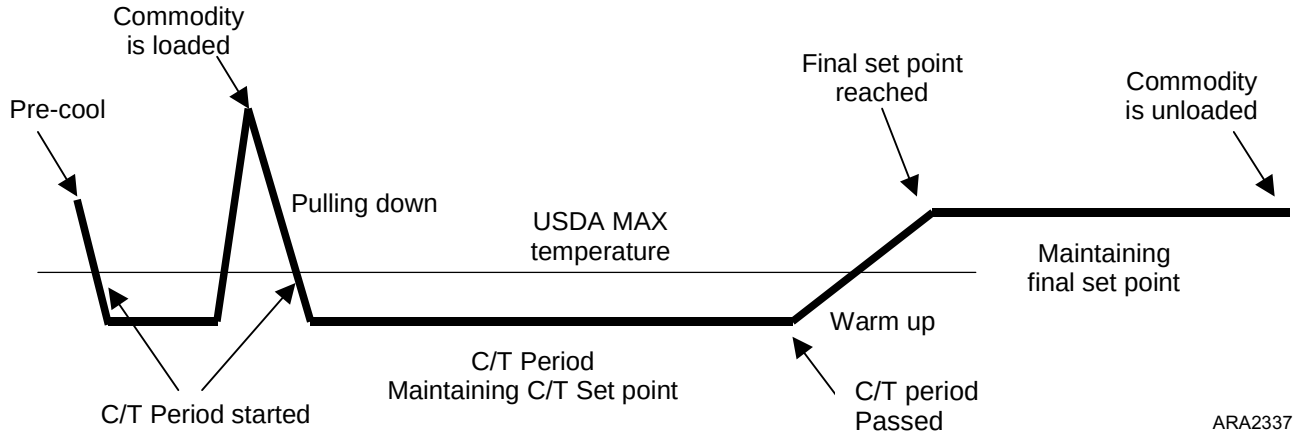
This feature is designed to maintain a temperature below the actual setpoint for a period of time (per USDA specifications), and then increase the temperature to the final setpoint. If at any time one of the USDA sensor temperature reading goes above the USDA Max the CT period will begin again.

To document the CT, a set of events and temperatures are recorded in the datalogger. When the CT has passed the controlling setpoint will be increased at slow rate to the final setpoint.

Controller Settings

- CT Temperature Setpoint - Setpoint temperature used during the CT period.
- CT Period - Number of days and/or hours accepted by the USDA max limit, to pass the CT period.
- CT MAX USDA Temperature - Maximum allowed USDA sensor temperature during the CT period.
- CT Final Temperature Setpoint - Final setpoint temperature after the CT passes.
- CT Heatup - Delay interval between each 0.1 C increase (normally 1 hour).

Figure 35. Details of CT Log



Trip Action and Unit Mode

- Container is prepared with CT settings and transported to be loaded. If the unit is running the container will pre-cooled.
- If unit is equipped with the UDSA sensors, once all the sensor temperature readings deceases to or below the USDA Max the CT period will start.
- Cargo is loaded and USDA sensors are placed in the cargo per the USDA specification.
- USDA sensor readings will increase to cargo temperature and a running CT period will be canceled. Pull down of the cargo temperature begins.
- Once all the USDA sensor temperature readings decease to or below the USDA Max the real CT period will start.

- If any of the USDA sensor temperature readings go above the USDA Max, the CT period will be canceled and the above action will repeat.
- When the specified number of days has finished the controlling setpoint is increase, 0.1 C per hour, until the final setpoint is reached.

During the CT a set of events and temperature readings are logged in the datalogger.

2005/04/27 11:33 KBD Cold Treatment Activity - Option made possible - not yet activated.
2005/04/27 11:33 KBD Cold Treatment Activity - C/t set point 0.0C.
2005/04/27 11:33 KBD Cold Treatment Activity - Period/Days 3days.
2005/04/27 11:34 KBD Cold Treatment Activity - USDA max 3.0C.
2005/04/27 11:34 KBD Cold Treatment Activity - Final set point 5.0C.
2005/04/27 11:39 KBD Cold Treatment Activity - DE-ACTIVATED/STOPPED before time.
2005/05/03 10:30 KBD Cold Treatment Activity - ACTIVATED.
2005/05/03 10:30 AUTO Cold Treatment Activity - Initiated. C/t SP:1.0C - USDA max:3.0C - Period:3days - Final SP:5.0C.
2005/05/03 13:32 AUTO Cold Treatment Activity - Period started. C/t SP:1.0C - USDA max:3.0C - Period:3days.
2005/05/04 14:31 AUTO Cold Treatment Activity - Period started. C/t SP:1.0C - USDA max:3.0C - Period:3days.
2005/05/07 15:00 AUTO Cold Treatment Activity - Period passed OK. 2005/05/08 10:30 AUTO Cold Treatment Activity - Ended. Final SP:5.0C.

Unit Requirements

To activate CT the unit must have:

- 1 - 3 UDSA or Cargo sensors
- Battery (Battery is required for off power logging)

Activating Cold Treatment

Go to the Configuration > Options Menu enter CT Feature and turn it ON.

Calibrate Probe (Optional)

Setting the USDA Type in the Configuration menu activates spare sensors 1, 2, 3, and 4 for USDA Cold Treatment Temperature Recording. USDA sensor temperatures are recorded in the datalogger memory.

The USDA sensors should be connected to the controller and located in the load as shown in USDA directives. When a USDA sensor is installed, the controller will automatically detect each sensor and activate data logging. However, the USDA Type screen in the Configuration menu must be set to the correct sensor setting and each USDA sensor must be calibrated to comply with USDA temperature recording requirements. Calibrate the sensors in an ice bath. MAGNUM units equipped for NTC style USDA sensors require USDA sensor P/N (refer to Tool Catalog). MAGNUM units equipped for PT100 style USDA sensors require USDA sensor P/N (refer to Tool Catalog).

Ice Bath Preparation

1. The ice bath should consists of an insulated container full of ice made from distilled water with enough distilled water added to cover the top of the ice during the test. A properly filled ice bath should be completely filled with ice all the way to the bottom of the container.
2. Stir the ice bath briskly for one minute before proceeding.
3. Insert the USDA sensors in the ice bath. Wait five minutes to allow the sensor temperatures to stabilize at 0 C (32 F).
4. Stir the ice bath frequently. As an option, test and verify ice bath temperature with a meter or measuring device meeting your accuracy requirements. Stirring 10 seconds every three minutes during the test procedure is adequate.

Calibrating the USDA Sensors

1. Insert all USDA sensors in an ice bath (see “Ice Bath Preparation” above).

   Note: *The sensors must be completely immersed in the ice bath without contacting the walls of ice bath container for five minutes.*
2. Press the F4 MENU key. Press the F3 key to scroll down to the CONFIGURATION Menu.
3. Press the F4 ENTER KEY to access the CONFIGURATION menu.
4. Press the F2 OR F3 UP/DOWN key to scroll to scroll down to the SENSOR Menu.
5. Press the F4 ENTER key to access the SENSOR Menu.
6. Press the F3 key to scroll down to CALIBRATE PROBES.
7. Press the F4 enter key to enter Calibrate function. The display shows [RAW] and [CORR] temperature off-sets for each sensor in two rows.

The controller displays [COOR] in place of a temperature offset until the sensor comes within 0.3 C (0.5 F) above or below 0 C (32 F).

The controller displays the actual temperature offset when the sensor temperature is within 0.3 C (0.5 F) above or below 0 C (32 F).

Note: *The sensors should be in the ice bath a total of 15 minutes or more to assure the sensor temperature has bottomed out.*

8. Press the F3 key to release the current actual temperature offsets from the controller memory. Observe the sensor temperatures in the [CORR] row.
9. Press the F4 ENTER KEY to accept the new temperature offsets when all sensor offsets read between + 0.3 C (+0.5 F) and - 0.3 C (-0.5) and have been stable for five minutes. The controller display will show the new offsets in the [RESULT] row.
10. Press the F1 key to exit the Calibrate menu.

Starting Cold Treatment

1. Go to the Setpoint/Control and enter Cold Treatment (CT).
2. Display will show the Cold Treatment setting list, scroll up and down to edit and enter the settings per the load specifications.

   Note: *Once Cold Treatment has been started, it must be stopped to change any of the settings.*
3. Select EXIT. The Standard Display will appear showing “CT In Progress”. CT is activated and the trip begins.

Stopping Cold Treatment

1. Press the CT Key.
2. Scroll down to ABORT CT - PRESS >STOP< and press STOP.
3. The Standard Display will appear and “CT In Progress” will disappear from the display.

Passed Cold Treatment - must be acknowledged: To verify the user observes the passed display, Acknowledge CT will be displayed until it is acknowledged by pressing the CT Key and them pressing the ACK Key.

Surveillance during cold treatment: During the CT period all USDA sensors can fail and the CT period will continue. The fail state will be shown in the temperature log. If all three probes fail, the period will continue based on time only.

RMM / Refcon: The RMM at no time during the CT is able to change any of the CT settings The RMM interface will show the final temperature as setpoint through out the trip, even when the period is running and another setpoint is used.

Economy mode: Running economy mode either manually or automatically by the AVL, will automatically be set to OFF during CT pull down and period. After the CT period ends the economy mode is reinstated (starting from warm up phase).

Associated tools: LogView must be updated to Version 5.8.2.0 to report the cold treatment events.

Various actions: When the user activates the cold treatment, a trips start mark and event is automatically made.

Multiple Temperature Setpoint (MTS)

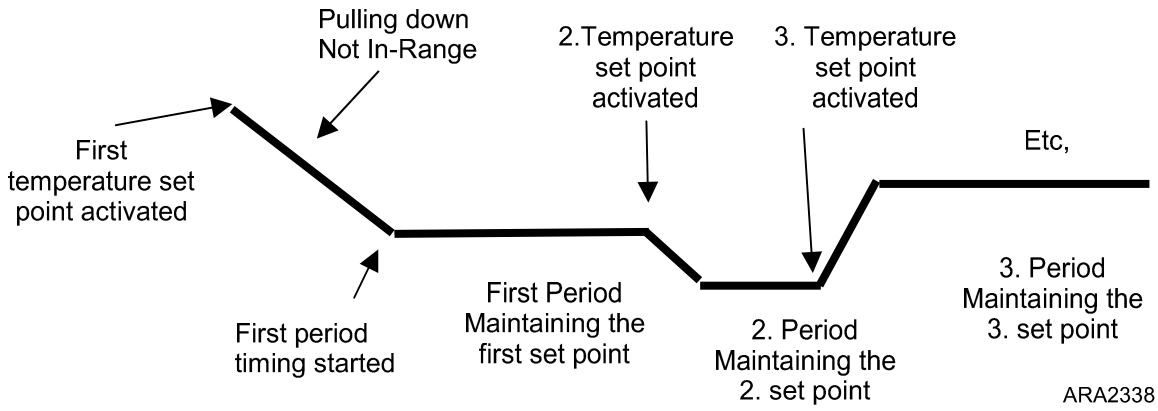
To be able of transporting a commodity under the best possible temperature scheme, the MP4000 is capable of controlling the temperature through a set of temperatures.

The scheme is defined by user pre programmed temperature setpoints and time periods.

The fix point list for the temperature scheme programming allows for up to nine different sets of temperatures and periods.

- Nine sets of temperature setpoints.
- Eight sets of timing in between the nine setpoints.

Figure 36. Example of MTS Log



Trip Actions and States

- The container is prepared, initiated with setpoints and parameters for the journey and transported to the loading location. The refrigeration unit will, if powered, start approaching the first setpoint.
- The next setpoint will be approached within the maximum capabilities of the unit, as if a user manually has changed the setpoint.
- The timing for any period will start when the supply air approach for the setpoint is within the IN RANGE setting. The timing will not stop or restart even though the supply air gets out range.
- The temperature setting will be kept through the specified period and when the period ends the next set of parameters will be activated.

During the treatment a set of events is made together with the temperature logging to document the journey.

2005/04/27 11:33 KBD Multi Temperature Setting Activity - Option made possible - not yet activated.
2005/04/27 11:33 KBD Multi Temperature Setting Activity – X. set point 0.0C.
2005/04/27 11:33 KBD Multi Temperature Setting – X. Period/Days 7 days.

Activating Multiple Temperature Setpoint

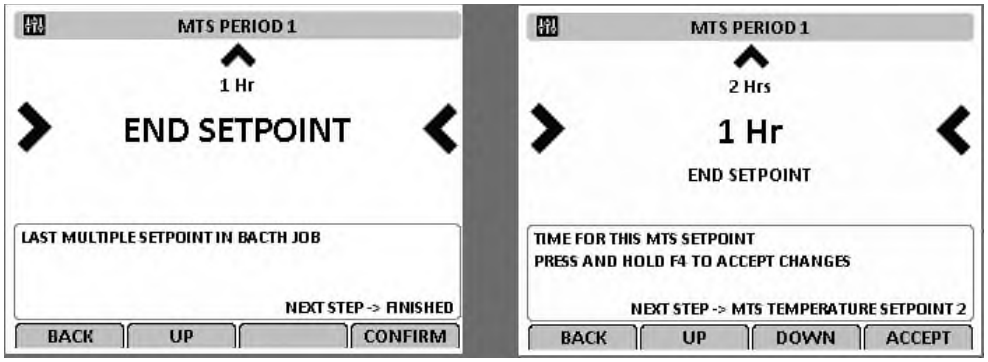
Go to the Configuration > Options Menu enter MULTIPLE SETPOINT (MTS) and choose SELECTABLE.

Starting and Setting Multiple Temperature Setpoint

1. Go to the Controls menu and enter MTS/CT.
2. The display will show the Multiple Setpoint selection. Select MULTIPLE SETPOINT and press CONFIRM.

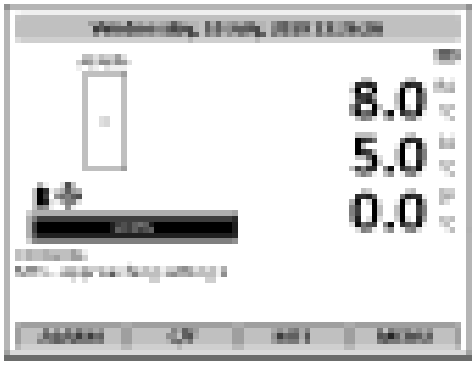
3. The following screen will appear. Press UP and/or DOWN to change the setpoint to the desired setting, then press and hold CONFIRM to enter the setpoint.

4. Select MTS Period 1 and press CONFIRM. The following screen will appear. Press UP and/or DOWN to change the period to the desired setting, then press and hold CONFIRM to enter that period.



5. The following screen will appear. Repeat steps 3 and 4 for Setpoint 2 and Period 2, and for each additional setpoint that is required. Leave the Period Setting at "MTS END" for the final period.

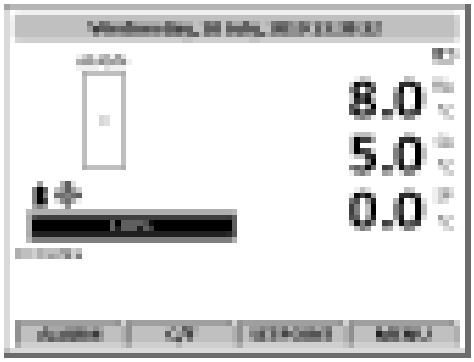
6. Select BACK as necessary. The Standard Display will appear showing "MTS - Approaching setting 1" indicating MTS is active.



Stopping Multiple Temperature Setpoint

1. Go to the Controls menu and enter MTS/CT.
2. The display will show the Multiple Setpoint selection. Select NONE and press and hold ACCEPT.

3. The Standard Display will appear and "MTS - Approaching setting 1" will disappear. After stopping MTS, the unit will continue running with the last MTS setpoint in action.



Surveillance during the multi-temperature setting trip: During the treatment the normal unit surveillance is kept.

Associated interfaces RMM / REFCON: The RMM must at no time during the journey be able of changing any involving parameters and settings on the controller. The RMM interface will show the ending final/last set point through out the trip, even when setting 1 or 2 etc. is running as active with another set point in use.

Associated tools: LogView must be updated to Version 5.8.2.0 to report the Multi-Temperature Setting events.

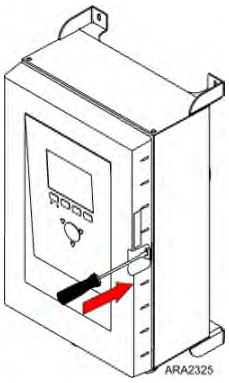
Various actions: When the user activates the treatment, a trips start mark and event is automatically made.

Controller Maintenance

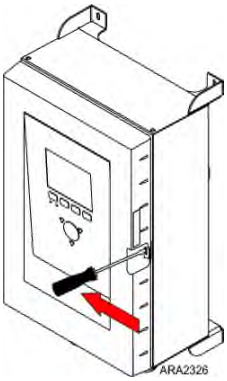
Controller Door Open and Close Instructions

Open

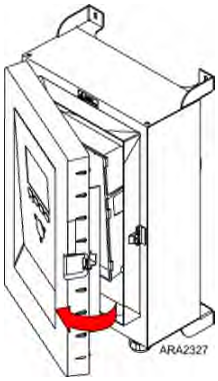
Insert a flat blade screwdriver into slot on side of control box door.



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

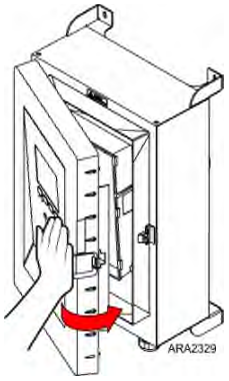


With the door catch released, pull door out and open.

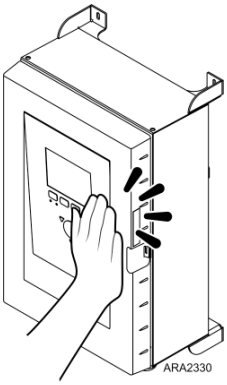


Close

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.

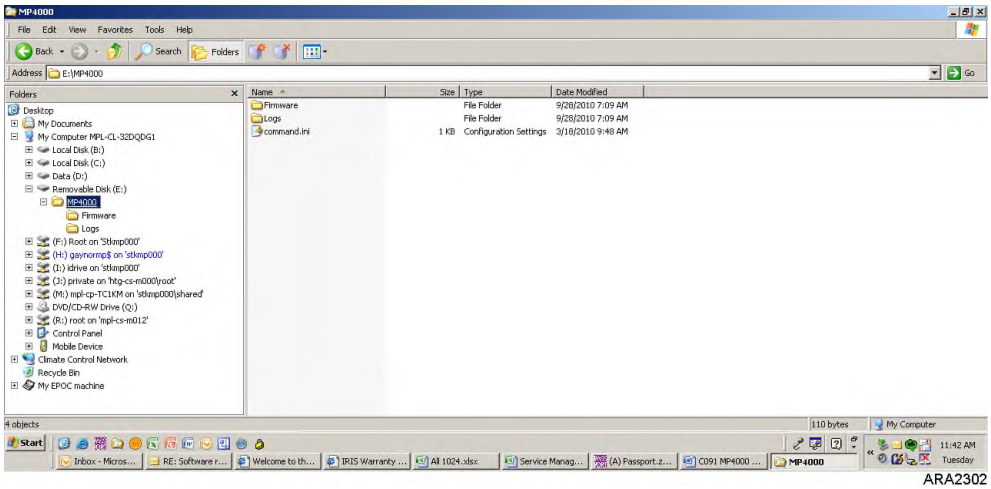
Download the latest software file from Global Marine Solution Info Central site/Software Update/MP4000. The CM4000 zip file will contain the latest software and command.ini file. Unzip them to a local drive.

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 37, p. 108 and Figure 38, p. 108).

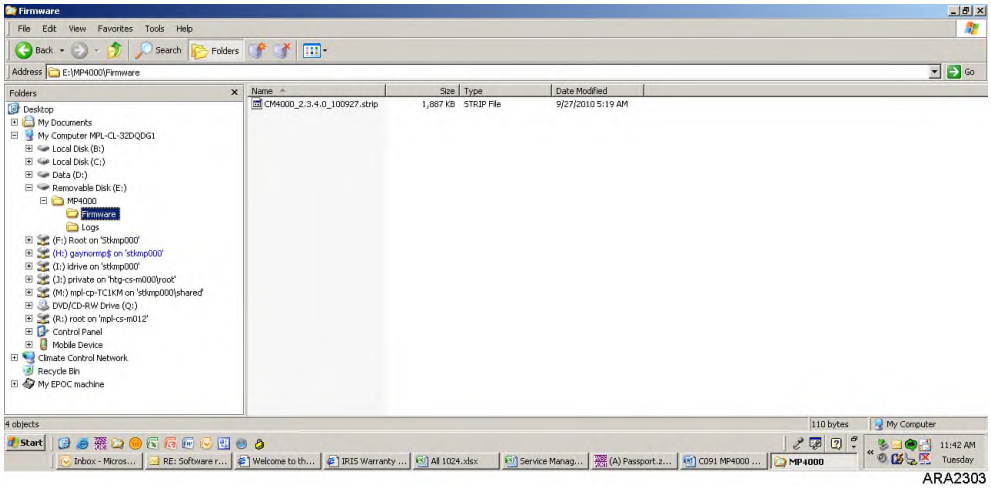
/ MP4000 / command.ini 3/18/2010 / Logs (Downloads will appear here) / Firmware CM4000_3.2.0.0_140822.strip

Figure 37. MP4000



ARA2302

Figure 38. 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.

- Email or fax the information above to: (JCI will respond with payment terms, if applicable)

Wilmor Halamani
Email: Wilmor.Halamani@Emerson.com
Fax 45 70236044
Part Numbers:

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:

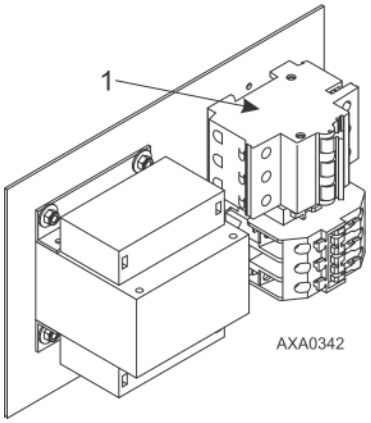
1. *Enter the container ID before releasing the unit for service. The container ID is required to identify the data downloaded from the controller datalogger.*
2. *Several programmable features may need to be set to completely configure the unit to customer specifications. Adjust any additional programmable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

Electrical Maintenance

Unit Protection Devices

Main Circuit Breaker

The main power circuit breaker is located in the control box. The 25 ampere manual reset circuit breaker is located in the Control Box. It protects the 460/380V power supply circuit to the unit electric motors and control system transformer.



1	Main Circuit Breaker

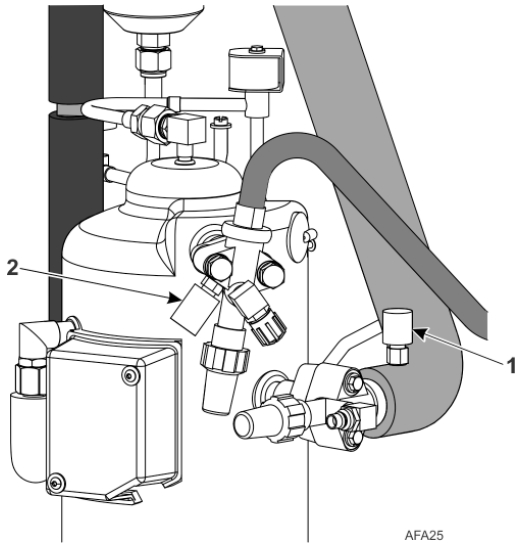
Evaporator Overheat Protection

The Heaters are protected from overheating surveillance from the supply, return, and evaporator sensor. If one or more reaches 50 C, it will automatically terminate the heaters.

High Pressure Cutout Switch

A high pressure cutout switch is located on the compressor discharge service manifold of the compressor. If the discharge pressure becomes too high, the switch opens the ground circuit to the compressor contactor coil.

- Compressor stops immediately. Evaporator and condenser fans continue normal operation.
- Controller determines that a high pressure cutout switch or compressor motor internal overload protector is open when the unit current draw during compressor operation is normal and then decreases by 7 amps for more than three seconds.
- After one minute, controller VGA display shows a High Pressure Cutout message:
  - "HIGH PRESSURE CUTOUT CHECK CONDENSER PROBE": Water pressure switch is open and the condenser temperature is low.
  - "HIGH PRESSURE CUTOUT CHECK CONDENSER FAN": Water pressure switch is open and the condenser temperature is high.
  - "HIGH PRESSURE CUTOUT CHECK WATER COOLING": Water pressure switch is closed.



1	Low Pressure Cutout Switch
2	High Pressure Cutout Switch

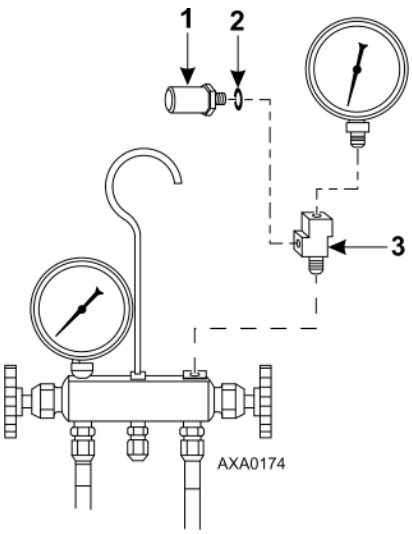
- The controller continues to call for cooling so the compressor will restart when the overload condition is corrected (switch resets) if power is available.
- If the switch remains open for five minutes, the controller also turns on the Alarm indicator and records Alarm 37 (Total Power Consumption Too Low).

The high pressure cutout switch opens at 3243 ± 7 kPa, 32.43 ± 0.48 bar, 470 ± 7 psig, and closes at 2586kPa, 25.9 bar, 375 psig. To test the switch, rework a gauge manifold in accordance with "High Pressure Cutout Manifold," p. 112.

High Pressure Cutout Manifold

1. Connect the manifold gauge to the compressor discharge service valve with a heavy duty, black jacketed thick wall #HCA 144 hose with 6024 kPa, 60.24 bar, 900 psig working pressure rating.
2. Operate the unit in Cool by performing a Capacity 100 percent test from the Manual Function Test menu of the controller.

High Pressure Cutout Manifold



1	Relief Valve
2	O-ring
3	Adapter Tee (Weather Head)

3. Raise the discharge pressure f the compressor by blocking the condenser coil airflow. Temporarily cover the compressor compartment, control box and power cord storage compartment with cardboard to reduce condenser

coil airflow. This should increase the discharge pressure enough to cause the switch to open. When the switch opens, The compressor should stop immediately.

Note: *The discharge pressure should never be allowed to exceed 3,447 kPa, 34.4 bar, 500 psig.*

4. Verify removal of the cardboard installed in step 3.

Note: *If the HPCO switch fails to stop compressor operation, replace the switch and repeat steps 1 through 4.*

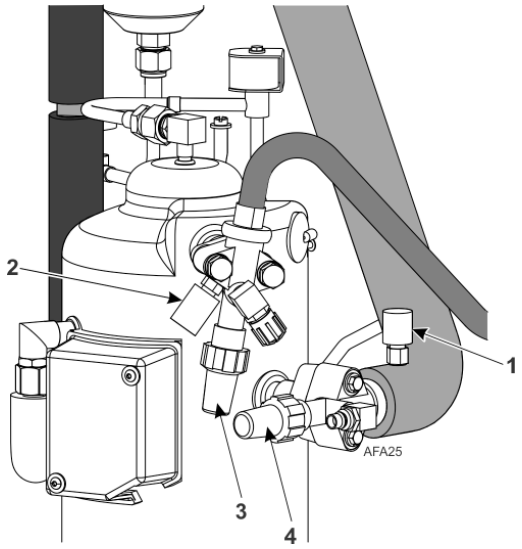
High Pressure Cutout Switch Removal/Installation

Removal

1. Isolate the compressor from the system.
   a. Front seat the discharge service valve by turning the valve fully clockwise.
   b. Front seat the suction service valve by turning the valve fully clockwise. Turn the digital service valve one quarter turn to the right.
2. Recover the refrigerant from the compressor. Refer to ("Recovering Refrigerant from System," p. 133).
3. Disconnect the high pressure cutout switch wires from the control box.
4. Remove the high pressure cutout switch from the compressor flange.

Installation

1. Apply Locktite sealant to the threads of the switch.
2. Install switch in compressor flange.
3. Pressurize the compressor with refrigerant and check for leaks.
4. Evacuate the compressor. Refer to ("Evacuation and Cleanup of Refrigeration System," p. 133).



1	Low Pressure Cutout Switch
2	High Pressure Cutout Switch
3	Discharge Service Valve
4	Suction Service Valve

5. Route wires into the control box and connect to proper terminals.
6. Back seat the discharge service valve by turning the valve fully counter-clockwise.
7. Back seat the suction service valve by turning the valve fully counter-clockwise.
8. Turn the digital service valve one quarter turn to the left.
9. Perform a controller pretrip test to verify system operation.

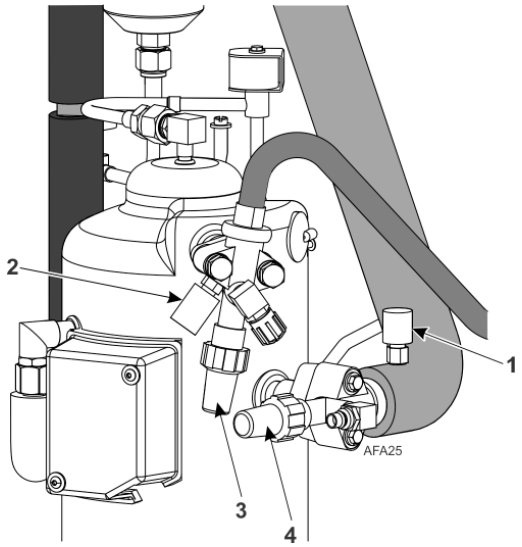
Low Pressure Cutout Switch

A low pressure cutout switch is located on the compressor suction line. The low pressure cutout switch opens: -17 to -37 kPa, -0.17 to -0.37 bar, 5 to 11 in. Hg vacuum; closes: 28 to 48 kPa, 0.28 to 0.48 bar, 4 to 7 psig. If the suction pressure becomes too low, the switch opens to stop the compressor.

- Compressor stops immediately.
- Evaporator and condenser fans continue normal operation.
- Compressor will restart if the low refrigerant condition is corrected (switch closes) as long as power is available. The low pressure switch resets (closes) when the pressure increases to 28 to 48 kPa, 0.28 to 0.48 bar, 4 to 7 psig.

Removal

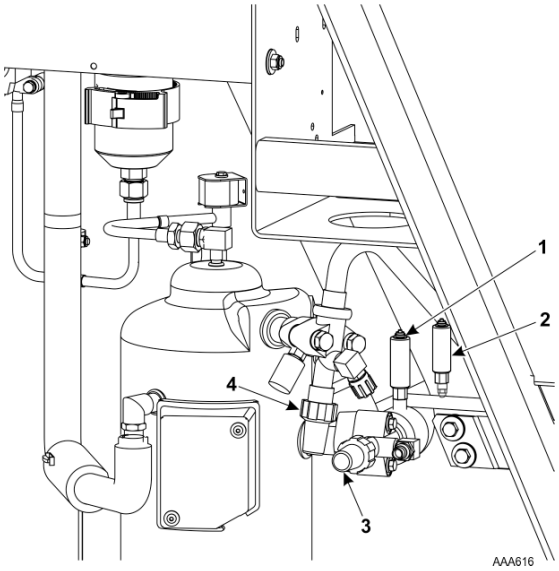
1. Disconnect the low pressure cutout switch wires from the control box.
2. Remove the low pressure cutout switch from the suction line. The fitting on the suction line has a shrader valve which will prevent refrigerant leakage.



1	Low Pressure Cutout Switch
2	High Pressure Cutout Switch
3	Discharge Service Valve
4	Suction Service Valve

Installation

1. Install low pressure cutout switch 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.



1	Suction Transducer
2	Discharge Transducer
3	Suction Service Valve
4	Discharge Service Valve

Low Pressure Cutout Switch or Suction Transducer Configuration

These units could have either a Low Pressure Cutout switch (41-4473) or a Suction Transducer (41-6150) installed.

Low Pressure Cutout Switch Installed

Suction Transducer Installed

The Low Pressure Cutout Switch or Suction Transducer will have the same function, since the unit only has one fitting on the suction tube, the unit can have either a Low Pressure Cutout Switch or Suction Transducer but not both.

The following procedure is to replace a Low Pressure Cutout Switch (LPCO) with a Suction Transducer. To replace a Suction Transducer with a Low Pressure Cutout Switch follow instructions in reverse.

1. Remove LPCO switch from suction tube. Fitting on the suction tube has a Schrader valve in it, unscrew the LPCO.
2. Disconnect the LPCO wires from J9 pins 5 and 6, remove switch and harness from unit.
3. Install a jumper wire on J9 pins 5 to 6.
4. Screw the Suction Transducer on the fitting on the suction tube.
5. Route wire harness into control box.

6. Connect wires to J1 pins 7, 8, 9.
   a. White wire to pin 7.
   b. Red wire to pin 8.
   c. Black wire to pin 9.
7. Secure harness.

Alarm 31 LOW PRESS CUTOUT OOCL only, logged in the data logger

Alarm 120 SUCTION PRESSURE SENSOR ERROR output of sensor outside limits

Alarm 136 TRANSDUCER CIRCUIT ERROR detects no 12V output to sensor

Message 32 LOW PRESS CUTOUT- PLEASE WAIT Suction pressure < 5-11 in. vacuum Message 33 LPCO TIMER HOLD – PLEASE WAIT Suction pressure > 4-7 psig with 30 second delay

NOTICE

Equipment Damage!

Repair when parts are available. Do not run without low pressure protection.

If no LPCO or transducer is available for repair, add jumper wire for LPCO or configure transducer NONE.

Discharge and Low Pressure Sensors (Optional)

The unit can be configured discharge only, suction only, or discharge and suction. 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. If the unit is configured with a suction sensor, the LPCO will be eliminated.

To configure a sensor in the unit, refer to ("Configuration Menu," p. 67).

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.

Note: *Evaporator fan motor wires EF1, EF2, and EF3 are used on low speed fan operation. Wires EF11, EF12, and EF13 are used on high speed fan operation.*

Reversing Power Phase on MAGNUM Units

Use the incoming power cable leads to reverse the power phase. This is recommended on MAGNUM units because the Jumper J18 does not reverse power to the scroll compressor. This protects against the possibility that the compressor will be out of phase with the condenser and evaporator fans when the unit is plugged into a new power supply.

To reverse the Power Phase, complete the following steps:

1. 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. To prevent personal injury from rotating machinery or dangerous electrical shock from high voltage controls, disconnect the supply power to the unit before preparing the unit for manual emergency mode operation.

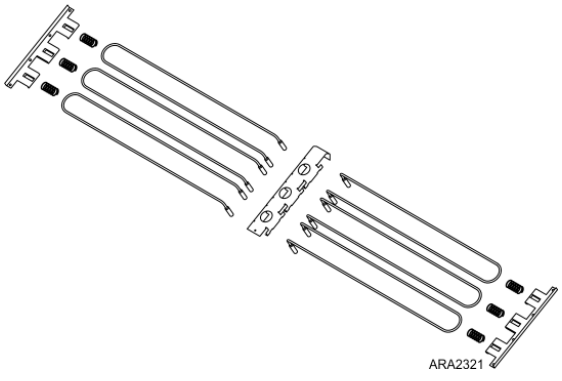
2. Disconnect unit power cord from power supply.
3. Relocate the position of the white and black incoming power cord leads at the 460/380V main circuit breaker.
4. Connect unit power cord to proper power supply.
5. Start the unit again by turning the unit 460/380V main circuit breaker on and the Unit turned On and allow Unit to start and stabilize.
6. Check condenser airflow again to confirm correct fan rotation.

Evaporator Heater Selection

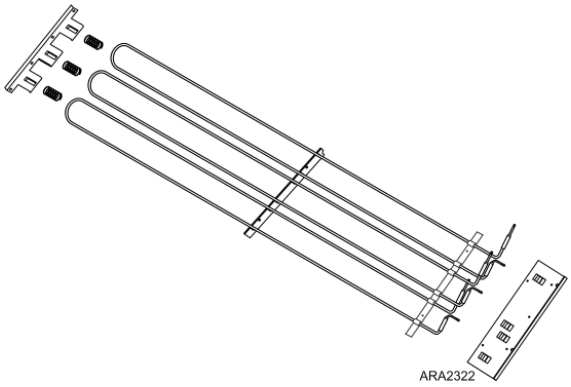
MAGNUM PLUS units are being built with different length and wattage heaters. Use the following information to determine what heater to use for replacement.

- Heater short 680 Watts (Normal) 45-1927
- Heater Long 1360 Watts (Normal) 45-2441
- Heater Long 2000 Watts (Extended) 45-2451 (OOCL)

Six Short Length Heaters (680 Watts Each)



Three Longer Heaters (1360 or 2000 Watts Each)



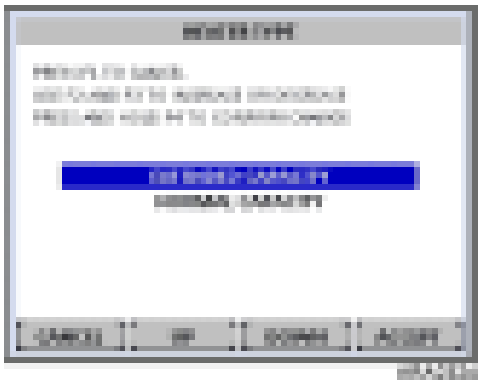
Extended Capacity Heaters

If a unit is equipped with the Extended Capacity heaters (2000 Watts) the main CB (42-0352) is adjustable and set to 27 amps. When changing out a controller, the HEATER ELEMENT TYPE needs to be changed in the configuration menu from NORMAL CAPACITY to EXTENDED CAPACITY. If the heater type is not change the unit will alarm during a PTI on

heater capacity low. The only difference between the 1360 Watt (18 GA) and 2000 Watt (16 GA) heater is the wire gauge size. So care should be taken to confirm correct heater element is used when replacement is required.

Unit Configuration Menu

Heater Type



Electric Heaters Malfunction

Three or six electric heater elements are located underneath the evaporator coil. If a heater element is suspected of malfunctioning, check the resistance of each individual heater element by performing the following procedure:

1. Turn unit power supply off.
2. Remove unit power plug from power supply receptacle.
3. Open the control box door.
4. Test the insulation of each individual heater element.
   a. Test all three legs of the heater circuit to a good ground connection. Connect a calibrated 500 Vdc insulation tester between each outgoing heater contactor terminal and ground.
   b. If the resistance between any contactor terminal and ground is below 0.8 meg ohms, isolate and check the resistance of each individual heater element.
5. Check the resistance of each individual heater element.
   a. Disconnect and isolate each heater from the circuit in the control box.
   b. Check resistance of each heater with an insulation tester between each heater and ground. If the resistance between each heater and ground is below 0.8 meg ohms, the heater element is defective. On a loaded container, remove the defective heater from service by disconnecting at the control box. If the container is empty, remove the evaporator cover from the rear of the unit and replace the heater or correct any defective wiring. Repeat step 5a.

      Note: *When repairing heater connections, protect the new connections from the ingress of moisture with heat shrink tubing. All heaters should be secured to prevent contact with sharp metal edges.*

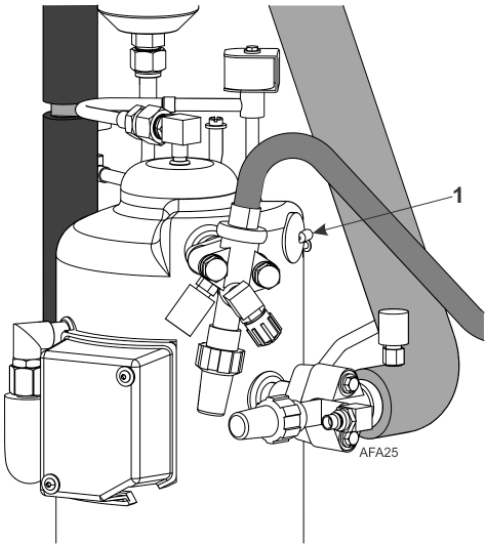
Compressor Discharge Temperature Sensor

A refrigerant injection system uses the compressor discharge temperature to protect the compressor from excessively high operating temperatures.

If the vapor injection valve is off and the compressor discharge gas temperature increases to 138 C (280 F), the valve will be turned on.

When the discharge gas temperature decreases to 132 C (270 F), the vapor injection will be turned off unless it is required to be on for other reasons.

The controller immediately stops unit operation if the discharge gas temperature increases to 148 C (298 F). The controller activates the Alarm indicator and records Alarm Code 56 (Compressor Temperature Too High). The controller will restart the unit when sensor temperature is below 90 C (194 F).



1	Compressor Discharge Temperature Sensor

Replacement

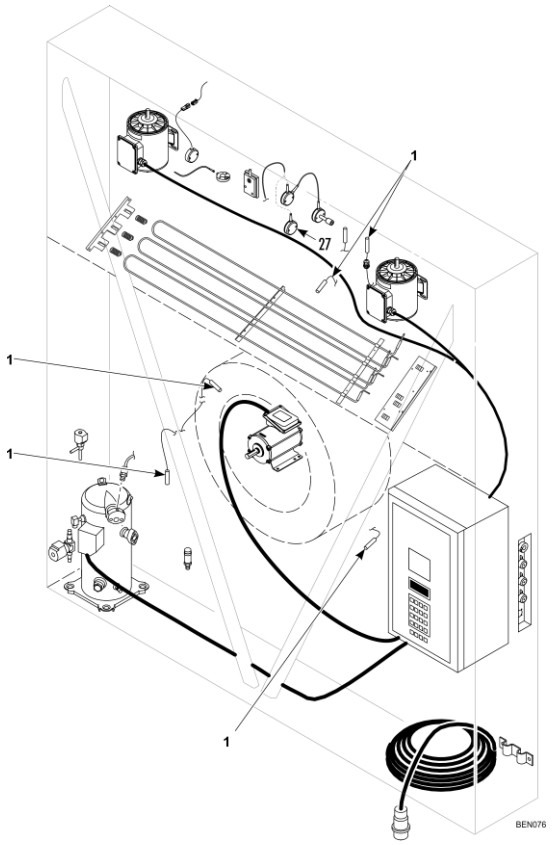
The compressor discharge temperature sensor is mounted externally on the compressor head. To remove:

1. Shut off power to system.
2. Disconnect the compressor discharge sensor wires from J-15 pins 9 & 10 located in the control box on the main power module.
3. Cut silicone seal under rim of sensor using razor blade.
4. Remove old sensor and sensor wires.
5. Clean sensor seat using wire brush.
6. Blow out all debris using compressed air.
7. Apply 0.25 to 0.5 cc thermal grease to mounting position of new sensor.
8. Add a bead of RTV silicone approximately 5 mm in diameter around area.
9. Press new sensor into position.
10. Route the new sensor wires into the control box. Connect wires to J-15 pins 9 & 10 on the main power module.

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
- Condenser Coil
- Compressor 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.
- Condenser sensor must be placed on the upper left side of the condenser coil and 70 mm deep between the fins.
- Ambient sensor must be placed on the bottom plate of the right forklift pocket.
- Compressor discharge temperature sensor is attached to compressor head by adhesive. Refer to ("Compressor Discharge Temperature Sensor," p. 118).

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.

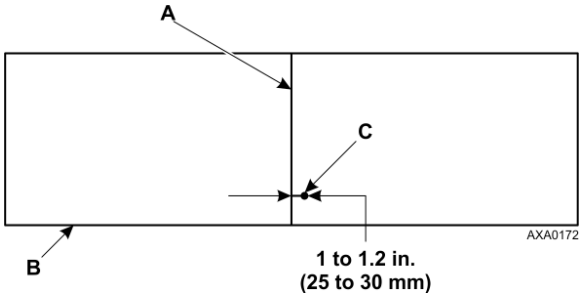
During a Probe test, the VGA display shows [PROBE TEST PLEASE WAIT]. The controller operates the unit on high speed evaporator fans only for five minutes. All sensor temperatures are then compared.

- 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.

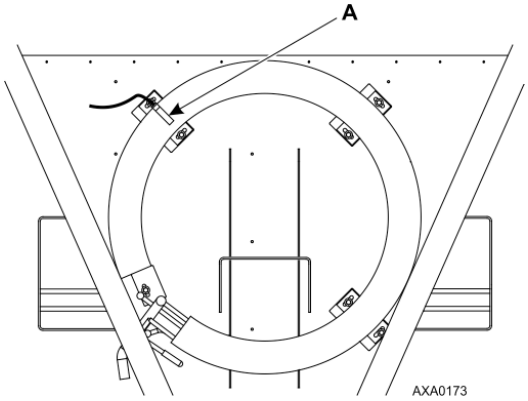
Note: *A manual probe test can be performed by a technician by selecting "SENSOR CHECK" from the Manual Test Function menu.*

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.

Condenser Coil Sensor Location



A	Insert sensor into condenser coil between tube Rows 1 and 2.

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 36. Supply, Return, Evaporator Coil, Condenser Coil, and Ambient Air Sensors

°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

Table 36. Supply, Return, Evaporator Coil, Condenser Coil, and Ambient Air Sensors (continued)

°F	°C	Ohms	°F	°C	Ohms
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 37. Compressor Discharge Sensors

°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

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-404A or R-452A units, use only those service tools certified for and dedicated to R-134a/R-404A/R-452A refrigerant and Polyolester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-134a/R-404A/R-452A systems.

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-404A/R-452A 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-404A/R-452A systems.

Refrigerant Recovery Equipment

Use only refrigerant recovery equipment approved for and dedicated to R-404A/R-452A recovery.

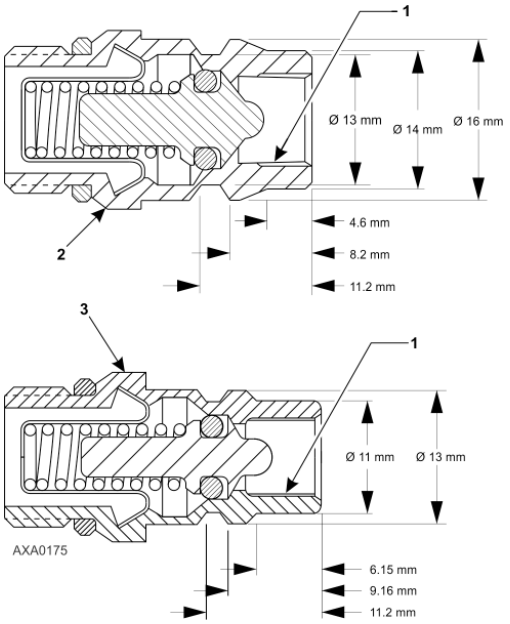
Detecting Leaks

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 MAGNUM 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.

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.

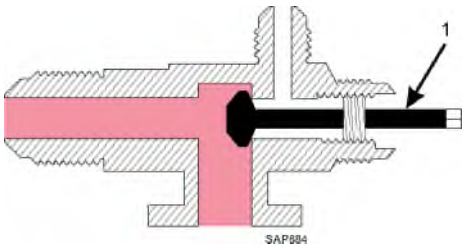
Note: *The valves are a permanently assembled unit and must be replaced in total if defective. The only maintenance possible on the discharge or suction service valve is to periodically tighten the packing nut or to replace the packing.*

⚠ WARNING

Hazard of Explosion!

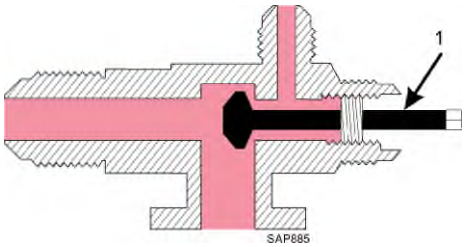
Do not start unit with discharge valve in front seated position.

Service Valve Back Seated (Operating Position)



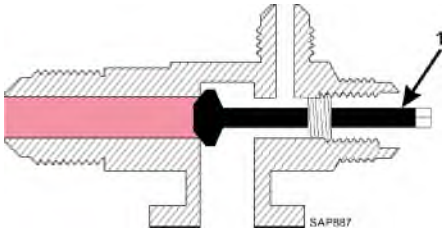
1	Full Counterclockwise

Service Valve Open to Port (Servicing Position)



1	1/2 Turn In

Service Valve Front Seated (Check or Remove Compressor)



1	Full Clockwise

Gauge Manifold Set

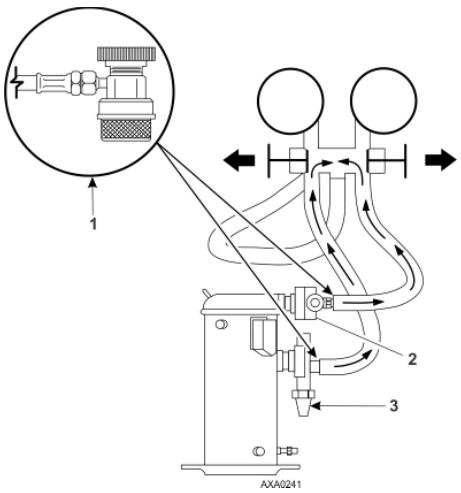
Using a New Gauge Manifold Set

A new gauge manifold set and gauge hoses (refer to Tool Catalog) should be dedicated for use with only R-404A/R-452A refrigerant.

Gauge Manifold Valve Positions

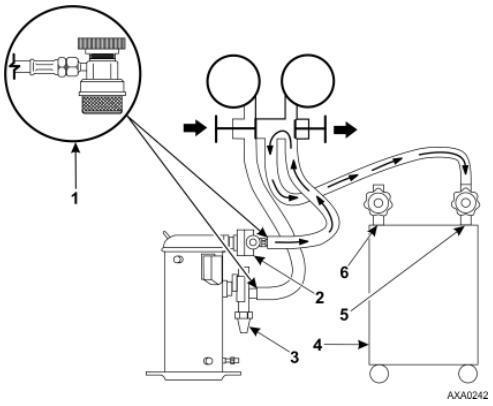
The gauges indicate low and high side pressures. Operate one or both hand valves to perform the different service operations.

Balancing the Pressure



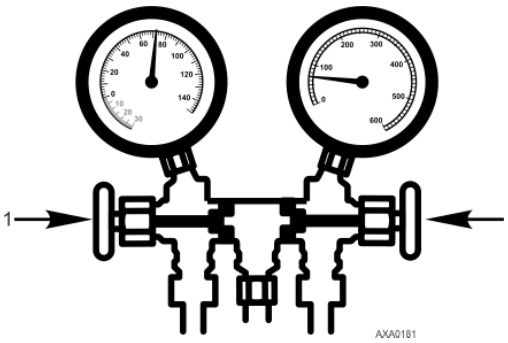
1	Quick Disconnect Access Valve
2	Discharge Service Valve (DSV)
3	Suction Service Valve (SSV)

Removing Refrigerant



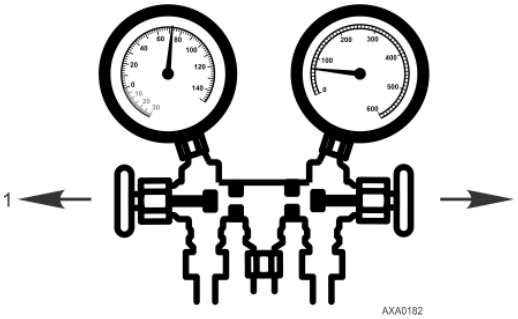
1	Quick Disconnect Access Valve
2	Discharge Service Valve (DSV)
3	Suction Service Valve (SSV)
4	Reclaimer
5	In
6	Out

Gauge Manifold Closed to Center Port



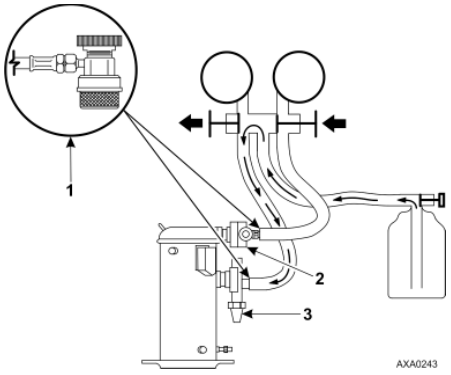
1	Close Hand Valves

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-404A/R-452A only. Gauge hoses should also be dedicated to R-404A/R-452A.

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

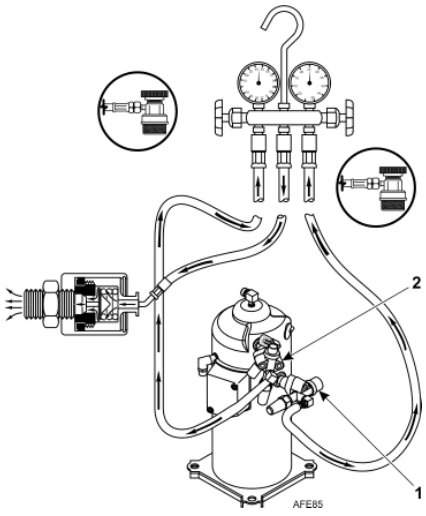
Installation

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.

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 Magnum units are charged with 4.0 kg (8.0 lbs) R-404A/R-452A 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 R-404A/R-452A charge level is correct.

NOTICE

Cargo Loss!

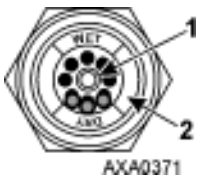
When adjusting the controller setpoint to check refrigerant charge, return controller to the setpoint indicated on the shipping manifest.

2. If the ball is not floating in the sight glass, the unit may be low on R-404A/R-452A 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 R-404A/R-452A 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 R-404A/R-452A charge. With the unit operating on cool, add liquid R-404A/R-452A charge. With the unit operating in cool, add liquid R-404A/R-452A 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 R-404A/R-452A charge.*

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).



AXA0371

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

Leak Testing Refrigeration System

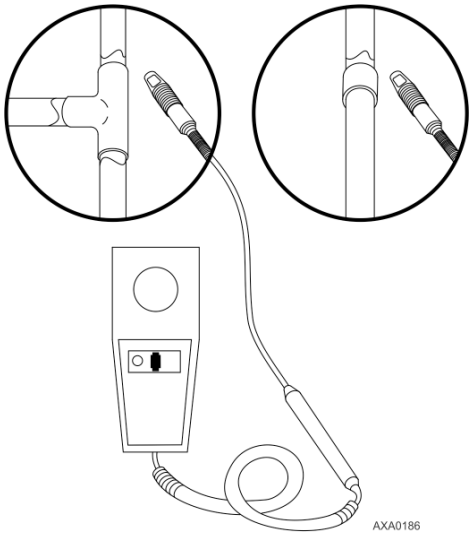
Use a reliable Halogen leak detector such as model H10G (refer to Tool Catalog), to leak test the refrigeration system. Inspect carefully for signs of compressor oil leakage which is the first sign of a leak in the refrigeration system.

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. 125 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. 130).
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.

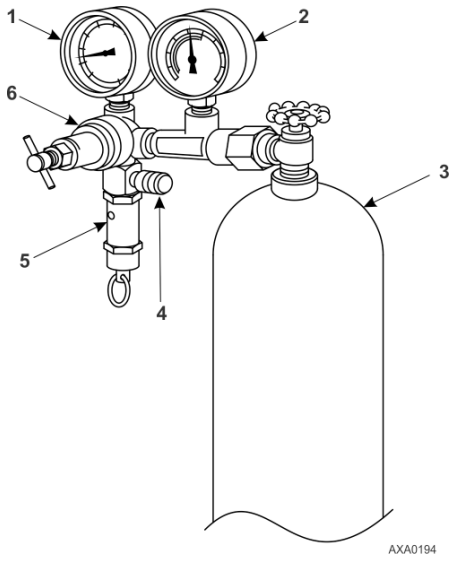
    Note: *If system leakage is indicated, loosen supply line hose fittings to release pressure. Repair leakage condition.*
12. If system repair is necessary, recheck system after repairs are completed.



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. 125 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.

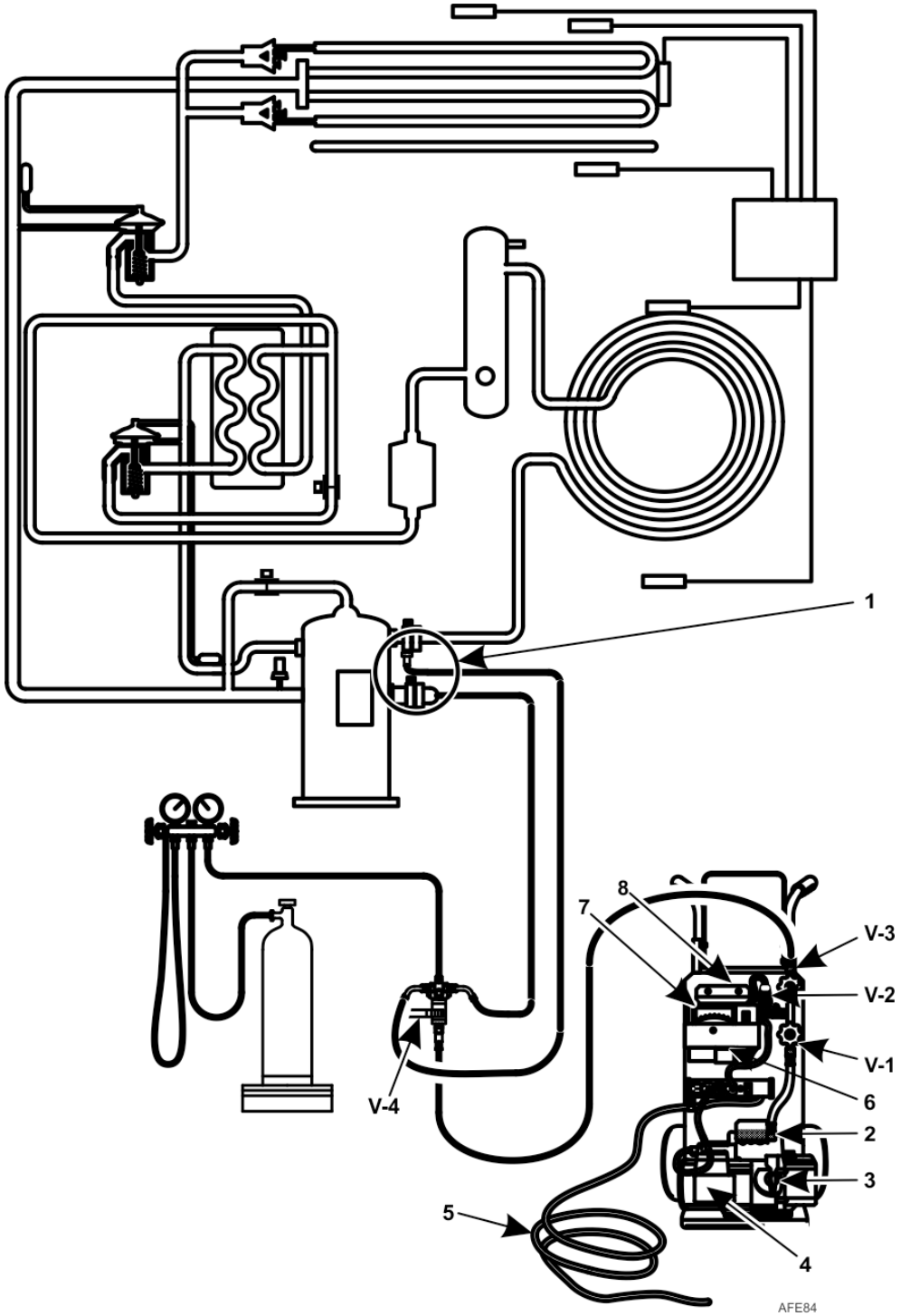
4. Purge system high side to low side.

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 39. Evacuation Station and Unit Hook-up



1	Special, self-sealing quick disconnect couplers are required for R-404A/R-452A 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-404A/R-452A 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.

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 39, p. 132. 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.

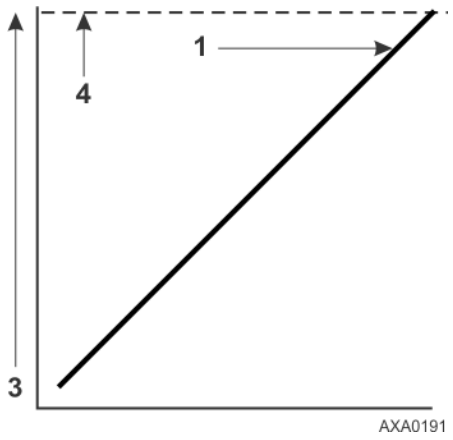
- A system that rises above 2000 microns but stabilizes below atmospheric pressure is probably contaminated with moisture or has refrigerant out-gassing from the compressor oil. Additional evacuation is required.
- A system that continues to rise without stabilizing has a leak and must be repaired.

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. 136).

Pressure Rise Test

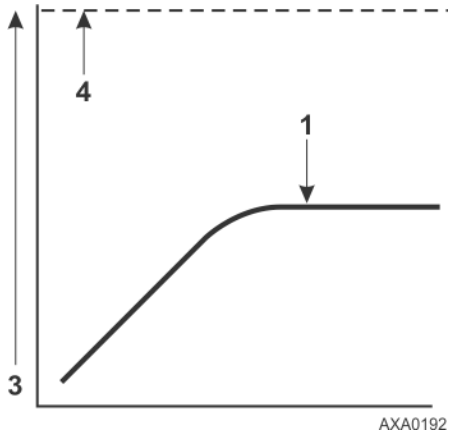
Evacuate the system and close valve V1. With valves V3 and V4 open, the pump is isolated and the system is held under a vacuum. If the micron meter rises, one of the following conditions exist:

- 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. 134).
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.

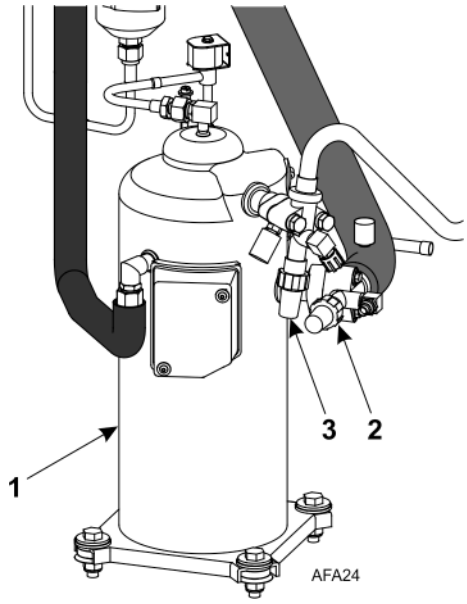
Compressor Replacement

Removal

1. Remove the compressor compartment bracket.
2. Isolate the compressor from the system.
   a. Front seat the discharge service valve by turning the valve fully clockwise.
   b. Front seat the suction service valve by turning the valve fully clockwise.
   c. Turn the digital service valve one quarter turn to the right. Refer to "Isolate Compressor," p. 124 for additional information.
3. Recover the refrigerant charge from the compressor. Refer to "Recovering Refrigerant from System," p. 133
4. Remove discharge service valve, suction service valve, digital control valve line and vapor injection valve line from the compressor.
5. Remove compressor discharge temperature sensor from the discharge valve manifold.
6. Disconnect the unit from the three-phase power supply.
7. Remove the three-phase electric power connection from the compressor.
8. Remove the compressor mounting tray bolts and nuts.
9. Slide the compressor from the unit.
10. Keep compressor ports covered to prevent dust, dirt, etc., from falling into compressor.

Installation

1. Slide the compressor into the unit. Install mounting bolts, washers and nuts, and tighten.
2. Bolt the discharge and suction service valves to the compressor. Use a new gasket coated with compressor oil on the discharge valve.
3. Connect vapor injection line and digital control valve line to compressor body.
4. Apply refrigerant locktite to the threads of the compressor discharge temperature sensor. Install the switches.
5. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 129).
6. If no leaks are found, recover the refrigerant used for the leak test (Refer to "Leak Testing Refrigeration System," p. 129).
7. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 133).
8. Connect three-phase electric power to the compressor.
9. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 136).
10. Perform a controller pretrip test to verify system operation.



1	Scroll Compressor
2	Suction Service Valve
3	Discharge Service Valve

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. 130).*
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. 129). 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. 133).
8. Replace the condenser coil support brackets, condenser fan shroud and condenser fan grille.
9. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 136).

Filter Drier/In-line Filter Replacement

Removal

1. Recover the refrigerant charge from the unit.
2. Place the new filter drier near the unit for immediate installation.
3. "Crack" both the inlet and outlet nuts on the filter drier. Use two wrenches on flare fittings to prevent line damage.

4. Separate the filter drier line mountings.
5. Remove the filter bracket clamping nuts and bolts.
6. Remove the old filter drier from the unit.

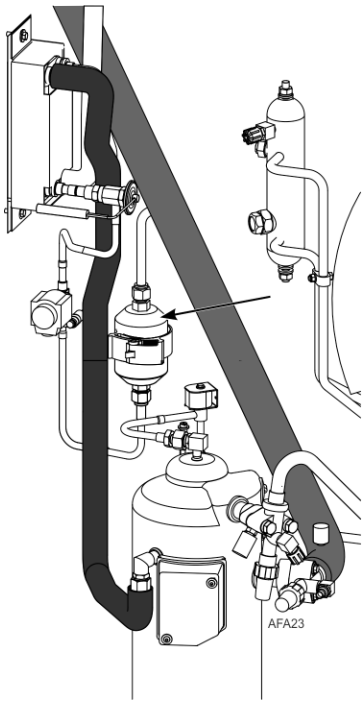
Installation

1. Remove the sealing caps from the new filter drier.
2. Apply clean compressor oil to filter drier threads.
3. Install new filter drier in unit. Finger tighten mounting nuts.

   Note: *To prevent incorrect installation of the dehydrator, the inlet and outlet fittings are different sizes.*
4. Reinstall clamping brackets, nut, and bolts. Tighten the bolts.
5. Tighten filter drier inlet and outlet nuts.

   Note: *Always hold the body of the dehydrator (or liquid filter) near the flange fittings. This will prevent twisting the tubing when the nuts are being loosened or tightened.*
6. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 129). Repair leaks if required.
7. Recover the refrigerant used for the leak test if no leaks were found.
8. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 133).
9. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 136).
10. Perform a controller pretrip test to verify system operation.

Figure 40. Filter Drier

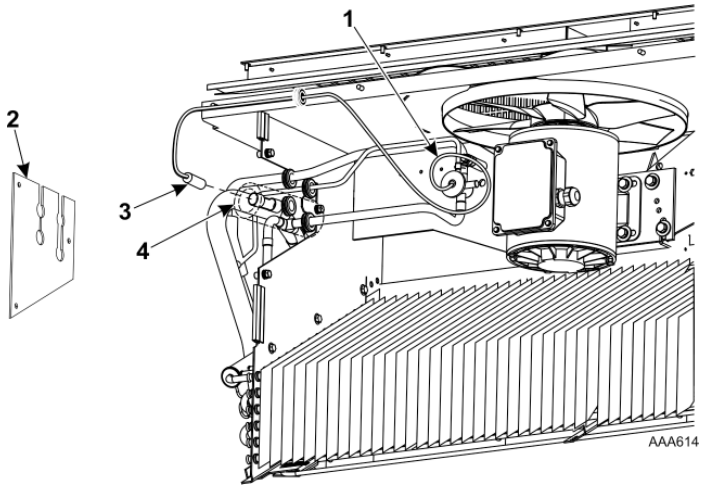


Evaporator Expansion Valve (TXV) Replacement

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. 129). Repair leak if required.
12. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 133).
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-404A/R-452A (Refer to "Charging System with Refrigerant," p. 136).
17. Perform a controller pretrip test to verify system operation.



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

Economizer Expansion Valve Replacement

Removal

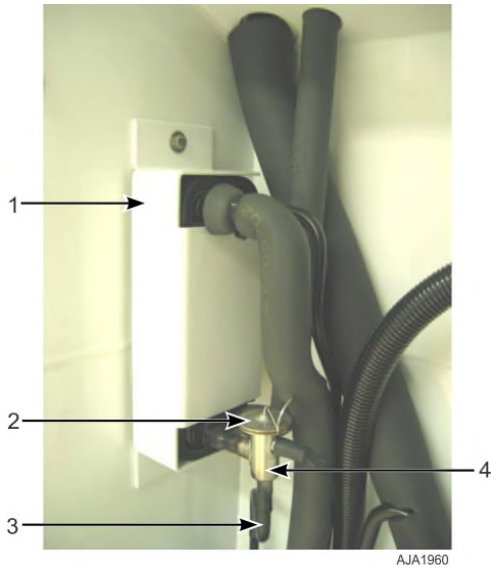
Remove the economizer expansion valve as follows:

1. Some units have a receive tank outlet valve, if the unit does perform a low side pump down and isolate the low side by closing the compressor service valves. If the unit does not have an outlet valve recover the refrigerant charge from the unit (Refer to "Recovering Refrigerant from System," p. 133).
2. On the feeler bulb carefully remove the outer insulation, to be reused. Remove cork tape from around element.
3. Unclamp feeler bulb from the suction line in the condenser section.
4. Clean element bulb tube holder and tube.
5. Heat and unsolder the inlet and outlet lines from economizer expansion valve.
6. Remove the old economizer expansion valve from unit and discard.

Installation

Install the economizer expansion valve as follows:

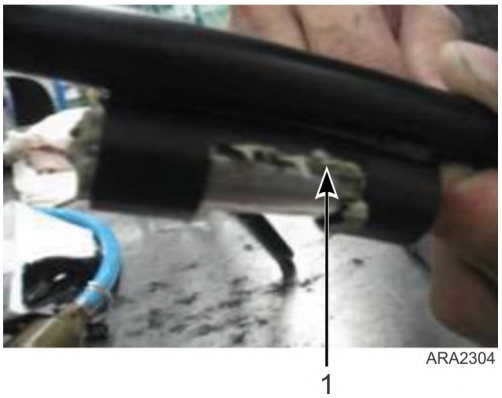
1. Clean the inlet and outlet lines for soldering.
2. Place new economizer expansion valve in position.

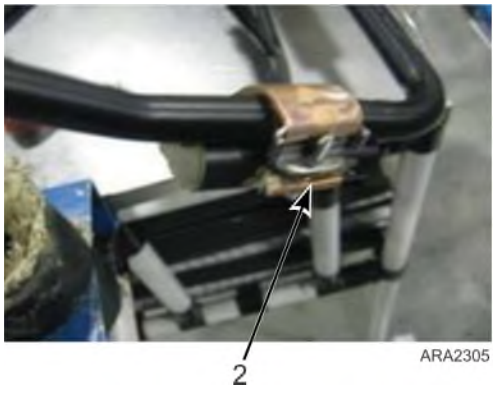


1	Economizer Heat Exchanger
2	Economizer Expansion Valve
3	Vapor Injection Line
4	Feeler Bulb Line

3. Solder inlet and outlet line connections to economizer expansion valve and clean solder connections with baking soda. Apply black paint to area to prevent corrosion.

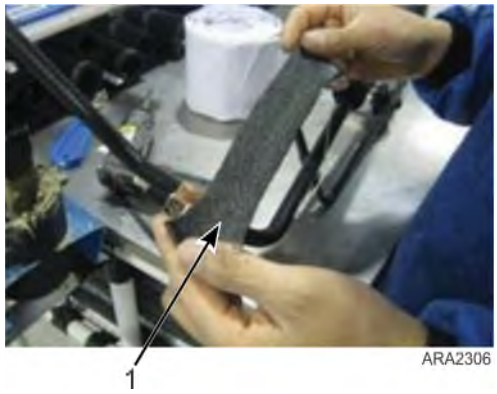
   Note: *Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (Refer to "Using Pressurized Nitrogen," p. 130).*
4. Pressurize the refrigeration system or the low side and check for leaks (Refer to "Leak Testing Refrigeration System," p. 129).
5. If no leaks are found, recover the refrigerant used for the leak test (Refer to "Recovering Refrigerant from System," p. 133).
6. Evacuate the system or the low side (Refer to "Evacuation and Cleanup of Refrigeration System," p. 133).
7. Locate feeler bulb in former position. The feeler bulb must make good contact or operation will be faulty. Apply heat transfer paste to element bulb holder and install bulb. Install clamp and tighten until bulb will not shift. See photos below.





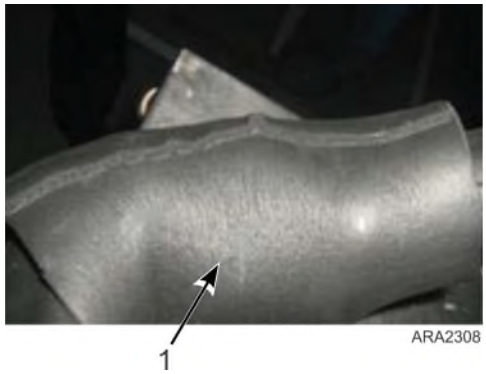
1	Apply heat transfer paste to bulb holder before installing TXV bulb.
2	Tighten clamp to verify bulb is secure.

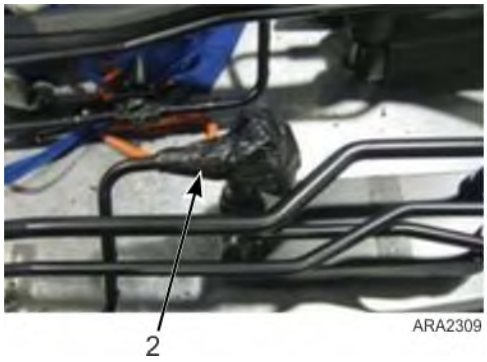
8. Apply cork tape around element making sure all air pockets are removed. See photos below.



1	Wrap feeler bulb with cork tape.
2	Verify bulb is fully covered.

9. Apply the insulation removed in step 2 of Removal above. See photo below.
10. Apply cork tape to the complete TXV valve. See photo below.





1	Apply insulation to feeler bulb (reuse insulation that was removed).
2	Seal TXV valve with cork tape including feeler bulb line.

11. If low side pump down was performed open compressor service valves. Otherwise, recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 136).
12. Start unit and perform a PTI to check performance.

Economizer Heat Exchanger Replacement

Removal

1. Recover the refrigerant charge from the unit (Refer to "Recovering Refrigerant from System," p. 133).
2. Unsolder the two liquid and two suction line connections.
3. Unbolt the economizer heat exchanger from the mounting bracket.
4. Lift the heat exchanger assembly from the unit.

Installation

1. Bolt the economizer heat exchanger to the mounting bracket in the condenser section.
2. Clean the two liquid and two suction lines for soldering.

Important: *Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (Refer to "Using Pressurized Nitrogen," p. 130).*

3. Solder the liquid and suction lines to the economizer heat exchanger.
4. Pressurize the low side and check for leaks (Refer to "Leak Testing Refrigeration System," p. 129).
5. If no leaks are found, recover the leak test gas (Refer to "Leak Testing Refrigeration System," p. 129).
6. Evacuate the low side (Refer to "Evacuation and Cleanup of Refrigeration System," p. 133).
7. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 136).
8. Perform a controller pretrip test to verify system operation.

Receiver Tank/ Water-Cooled Condenser Tank Replacement

Removal

1. Recover the refrigerant charge from the unit.
2. Unsolder the liquid inlet and liquid outlet valve line connections.
3. Loosen the mounting nuts and remove the tank.

Installation

1. Install a new tank in the unit and tighten the mounting bolts.
2. Solder the inlet line and outlet 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. 130).*
3. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 129).
4. If no leaks are found, recover the refrigerant used for the leak test.
5. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 133).
6. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 136).
7. Perform a controller pretrip test to verify system operation.

Figure 41. Receiver Tank

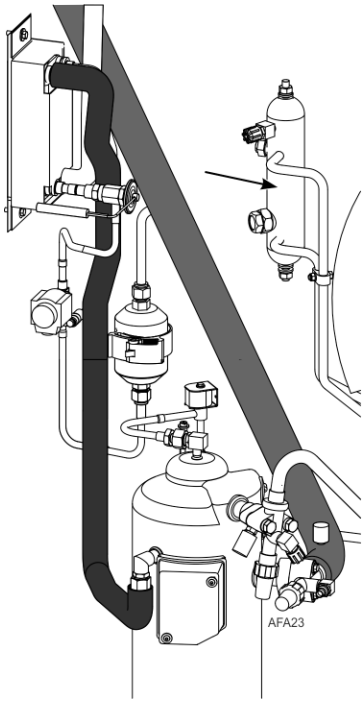
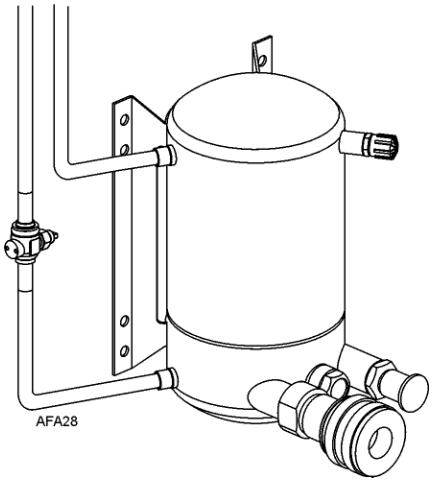


Figure 42. Water-Cooled Condenser Tank



Vapor Injection Valve Replacement

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

Removal

1. Recover the refrigerant charge from the unit.
2. Turn the Unit On/Off switch Off. Disconnect electrical connections to valve coil.
3. Unsolder liquid line connections to the valve.
4. Remove the valve from the unit.

Installation

1. Clean the tubes for soldering.

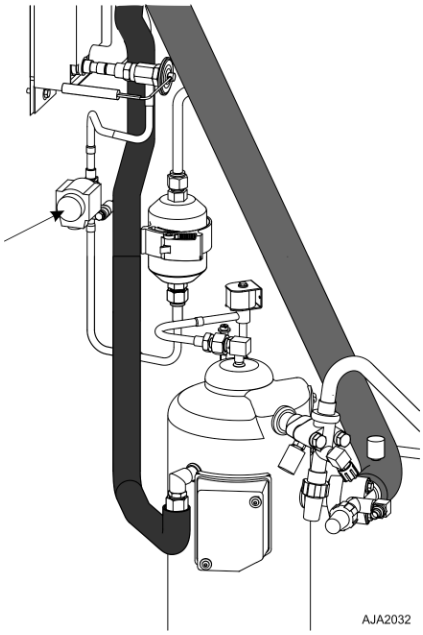
NOTICE

Equipment Damage!

Use a heat sink or wrap switch with wet rags to prevent damage to new switch.

2. Place the new valve in position and solder the liquid line connections.
3. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 129). Repair leak if required.
4. Recover the refrigerant used for the leak test if no leaks were found.
5. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 133).
6. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 136).
7. Perform a controller pretrip test to verify system operation.

Figure 43. Vapor Injection Valve



Compressor Digital Control Valve Replacement

Removal

1. Isolate the compressor and digital valve from the system.
   a. Front seat the discharge service valve by turning the valve fully clockwise.
   b. Front seat the suction service valve by turning the valve fully clockwise.
   c. Turn the digital service valve one quarter turn to the right.
2. Turn the Unit On/Off switch Off.
3. Disconnect electrical connections to valve coil.
4. Unsolder the liquid line connections to the valve.
5. Remove the valve from the unit.

Installation

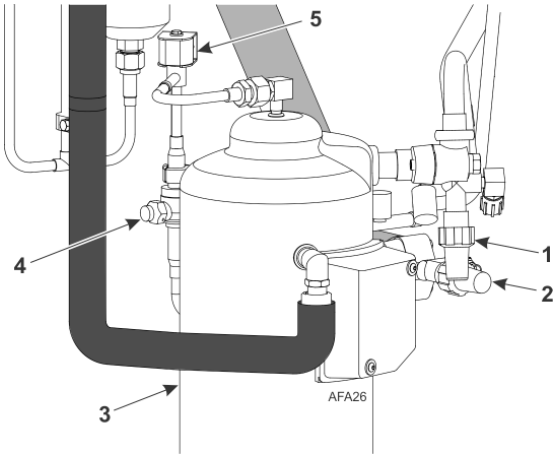
1. Clean the tubes for soldering.

NOTICE

Equipment Damage!

Use a heat sink or wrap switch with wet rags to prevent damage to new switch.

2. Place the new valve in position and solder the liquid line connections.
3. Perform a leak test (Refer to "Leak Testing Refrigeration System," p. 129). Repair leak if required.
4. Check the refrigerant charge (Refer to "Checking Refrigerant Charge," p. 128).
5. Reconnect the electrical wires to the valve.
6. Perform a controller pretrip test to verify system operation.



1	Discharge Service Valve
2	Suction Service Valve
3	Compressor
4	Digital Service Valve
5	Digital Control Valve

Servicing the Unit

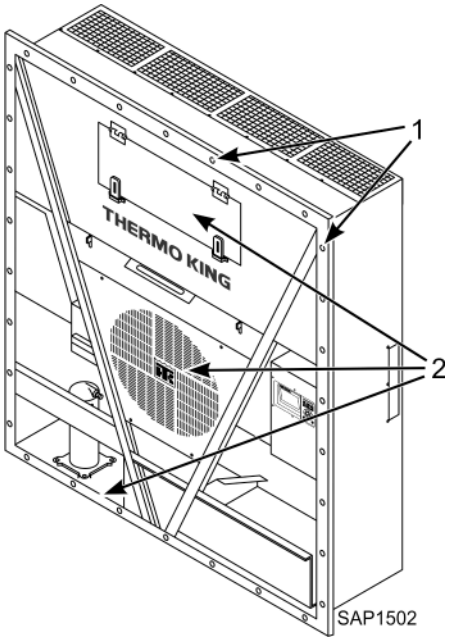
Taking Care of the Structure

Inspecting Unit

Inspect the unit during unit pretrip inspection and every 1,000 operating hours for loose or broken wires or hardware, compressor oil leaks, or other physical damage which can affect unit performance and require repair or replacement of parts.

Checking Mounting Bolts

Check and tighten all unit, compressor, and fan motor mounting bolts during pretrip inspections and every 1,000 operating hours. Unit mounting bolts should be tightened to a torque value of 204 N•m (150 ft-lb). Compressor and fan motor mounting bolts should be tightened to a torque value of 20 to 21 N•m (15 to 20 ft-lb).



1	Tighten Unit Mounting Bolts
2	Tighten Compressor, Condenser Fan, and Evaporator Fan Mounting Bolts

Cleaning the Condenser Coil

NOTICE

Equipment Damage!

Air pressure or water spray must not be high enough to damage coil fins.

Clean the condenser coil by blowing low pressure compressed air or a medium pressure warm water spray from the inside of the coil outward (opposite direction of normal airflow). Inspect coil and fins for damage and repair if necessary.

If a build up of salt or debris is present on the condenser coil, the coil should be cleaned using a mild alkaline cleaner with a pH of 9.5 to 10.5. For example, a 2-3 percent solution of SIMPLE GREEN® would make a suitable cleaning solution. Apply the solution using a pressure spray/wash type apparatus. Spray the condenser coil thoroughly from both the inside and outside of the coil. Always thoroughly rinse the coil with a fresh water spray.

Also inspect the directional airflow condenser grille for damage. This grille directs the condenser airflow out and away from the unit to increase the efficiency of the condenser coil by preventing the recirculation (short cycling) of warm air through the coil. Abnormally high head pressures may result if this special condenser grille is damaged or missing.

Cleaning the Evaporator Coil

NOTICE

Equipment Damage!

The air pressure should not be high enough to damage coil fins.

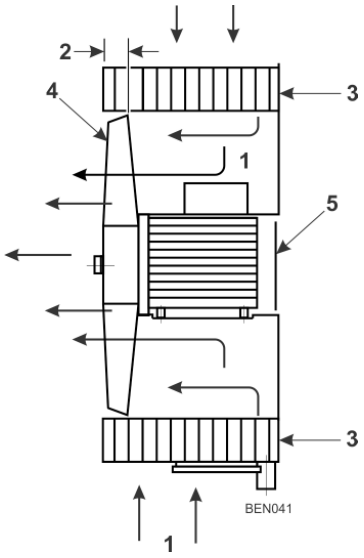
Clean the evaporator coil by blowing low pressure compressed air from the bottom side of the coil upward (opposite direction of normal airflow). Inspect coil and fins for damage and repair if necessary.

Cleaning the Defrost Drains

Clean the defrost drains every 1,000 operating hours to verify the lines remain open.

Positioning the Condenser Fan Blade

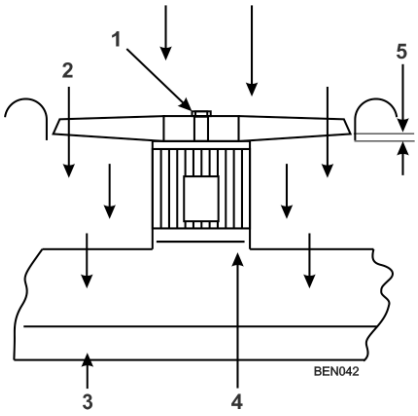
Place fan blade on motor shaft with hub located on the outside of the blade for proper airflow direction. When mounting the fan blade and hub assembly on the fanshaft, center the assembly in the orifice. Position the front of the fan blade 10 mm (0.4 in.) in from the outer edge of the fan orifice.



1	Airflow Direction
2	10 mm (0.4 in)
3	Condenser Coil
4	Condenser Fan Blade
5	Condenser Motor

Positioning the Evaporator Fan Blade

Place fan blade on motor shaft with hub located on the outside of the blade for proper airflow direction. When mounting the fan blade and hub assembly on the fanshaft, center the assembly in the orifice. Position the front (top) of the fan blade hub 13 mm (0.5 in.) in from the outer edge of the fan orifice.



1	Evaporator Fan Blade
2	Airflow Direction
3	Evaporator Coil
4	Evaporator Motor
5	13 mm (0.5 in)

Adjusting the Fresh Air Exchange System

The fresh air exchange system has an adjustable vent door for ventilation. The evaporator fans draw in outside air through an air intake and discharge an equal amount of container air through an air outlet.

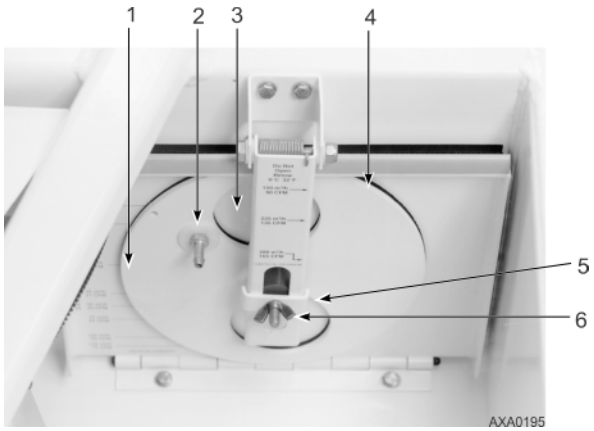
Note: *Set the disk or door position to the ventilation rate indicated on the shipping manifest.*

Disk Adjustment - Low Ventilation Rates

1. Loosen wing nut on handle bracket (See Figure below).
2. Rotate the disk to set the indicator at the air exchange rate shown on the ventilation scale on the door. For MAGNUM PLUS Models: 0-225m3/hr (0-154 ft³/min).
3. Tighten the wing nut.

Handle Adjustment - High Ventilation Rates

1. Loosen wing nut on handle assembly until handle bracket will rotate over handle.
2. Align handle bracket and wing nut over hole in handle assembly and push through handle.
3. Pull handle down to lower ventilation door. Insert edge of ventilation door in a notch on handle. Spring loaded handle holds ventilation door in position. Air exchange rate is shown on the handle scale.



1	Disk Scale: Low Ventilation Rates
2	Disk Assembly with Rate Indicator
3	CO2 Port
4	Ventilation Door
5	Handle Bracket
6	Wing Nut

Diagnostics

Introduction

This section includes the following:

- Controller Diagnostics
- Mechanical Diagnostics
- Refrigeration Diagnostics
- Status Messages and Controller Actions
- Alarm Codes and Corrective Actions

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 MAGNUM 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 2.5 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.
	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.	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.
	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).

Condition	Possible Cause	Remedy
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.	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	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.
	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).
	Unit in Cool with low condenser temperature.	Check indicator condenser temperature and discharge pressure. Condenser temperature may not require condenser fan operation (no remedy required; condenser fan also pulses on and off on a 30 second cycle to control condenser temperature).
	Water pressure switch closed (Water-cooled position) (Option).	If unit is on water cooled condenser operation, unit operation is normal. Otherwise water pressure switch must be Open for air-cooled condenser operation.
	Defective water pressure switch (option).	Replace defective switch.
	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.
	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
Load temperature too high - unit not cooling.	Compressor does not operate.	Refer to ("Mechanical Diagnostics," p. 151).
	Controller setpoint too high.	Adjust controller setpoint.
	Defective container insulation or poor fitting doors.	Repair container.
	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 Digital Control Valve defective.	Replace defective valve.
	Condenser coil dirty or airflow restricted.	Clean condenser coil, clear restriction, or repair or replace fan motor or condenser fan blade.
	No water flow to water-cooled condenser.	Restore water flow to water-cooled condenser-receiver tank.
	Defective water pressure switch (Option).	Replace switch.
	Expansion valve open too much.	Adjust or replace valve.
	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.	No remedy.
	Service gauge out of calibration.	Replace gauge.
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. 151).
	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.
	Defective service gauge.	Replace gauge.

Condition	Possible Cause	Remedy
Compressor loses oil.	Refrigerant leak.	Repair leak and recharge.
Compressor oil migrates to system.	Short cycling.	Refer to "Unit Short Cycles" ("Mechanical Diagnostics," p. 151).
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. 151).
	Compressor Digital Control valve stuck close or defective.	Replace valve.
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.	Check defrost circuit including controller and evaporator coil sensor.
	Evaporator fan does not operate.	Refer to "Evaporator Fan Motor Does Not Operate" ("Mechanical Diagnostics," p. 151).
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.	No remedy.
	Iced or dirty evaporator coil.	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
1	High Pressure Cut Out - Check Water Cooling • When: – If HPCO is detected and the configuration is set to water cooled condenser. • Indicates: – Poor cooling water supply.	• Controller auto clears message 10 minutes after compressor start-up. • Water cooled condensing may be wrongly selected.
6	High Pressure Cut Out - Check Condenser Probe • When: – Unit stops due to high pressure cutout and the condensing temperature regulation has not activated the condenser fan. • Indicates: – Wrong location of condenser probe.	• Controller auto clears message 10 minutes after compressor start-up. • Check location of condenser probe.
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.
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.

Status Message	Description	Controller Action/Corrective Action
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.
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.

Status Message	Description	Controller Action/Corrective Action
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.
27	System Low Pressure - Check Refrigerant Charge • When: – The message is related to the capacity surveillance system which observes the reefer machine capability to create a temperature drop between return air and supply air when expected to be running at high capacity. • Action: – If the expected delta temperature is not reached, the message is set and the evaporator fans stopped to prevent heating the cargo. • Indicates: – Lack of refrigerant.	• Check Refrigerant level. • Check for refrigerant flow through the system, look for restrictions.
28	Frozen Setpoint - Check Air Exchange • When: – If AVL door is open in frozen set point mode. • Indicates: – Air ventilation ought to be in position closed when running within frozen mode.	• Check air ventilation door position.
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.

Status Message	Description	Controller Action/Corrective Action
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.
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.

Status Message	Description	Controller Action/Corrective Action
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.
36	AVL Open - Check FAE and CA Settings • When: – If configuration is AVL, the setting is below 125CMH and the AVL sensor indicates full open / dismounted door, the message is set. • Indicates: – Wrongly dismounted air ventilation door.	• Check air exchange position vs setting.
37	CO2 Reading Stuck for greater than 24 Hours • When: – With AFAM+ option the CO2 level is constantly monitored. If the reading does not change / fluctuates minimum 0.1% within 24 hour the message is set. – • The message will clear itself 10 minutes after a change has been observed. •	• Check gas analyzer readings.
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.
42	CA Unit LPCO • CA Unit is having too frequent LPCOs.	
43	CA Unit HPCO • CA Unit is having too frequent HPCOs.	
44	CA Unit OBS • CA Unit needs attention.	
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.

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 Magnum+ 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 Magnum+ 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 -18 C (0 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 0 °C (32 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.
26	Vapor Injection Error • Occurs during pti, brief pti and function tests. • Power consumption does not increase when activating economizer valve. • Current consumption not correct for valve position.	• Enter Manual Function Test and start compressor and evaporator fans on high speed, with digital valve off, operate vapor injection valve and observe current consumption change. An increase in current consumption is expected. • Check vapor valve function. • Evaluate economizer Tx valve operation. ***Note:*** *This alarm can be activated in low ambient temperatures where condenser temperature may not be high.*
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 -0,27BarR and has not yet increased above +0,38BarR. • 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 2250 kPa, 22.5 bar, 326 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 2250 kPa, 22.5 bar, 326 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.*
57	FAE Device Error • Occurs during pretrip testing if the expected door endpoints can't be reached. • Occurs during normal operation. – If the AFAM+ module isn't detected. – During door position calibration the expected door endpoints feedback can't be reached. – During pulsing movement the expected door end points feedback can't be reached. • Indicates: – Stocked air vent. door motor. – Failing or missing AFAM+ module.	• Inspect AFAM+ module connection to the controller. • Using STATES MENU / EXPANSION MODULE to inspect the observed presence and readings of the AFAM+ module. If the module is not found use the tester to decide the problem. – From backside left bay is bay 1 – From backside right bay is bay 2 • Inspect wiring from AFAM+ motor to AFAM+ module. • Using MANUAL FUNCTION TEST move and Inspect air vent door movement. • Inspect air vent. • Replace AFAM+ motor.
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
60	Humidity Sensor Error • Occurs during Pre-Trip (PTI) test: – The last defrost must be more than 5 minutes away and Return Air Temperature must be above -1C to allow for the alarm to be set. – 4-20mA Humidity sensor type: Relative humidity reading is less than 15%. – Modbus sensor type: Modbus communication with the sensor is lost for 3 retries. • Occurs during: – The unit mode must be chilled, The humidity control set to ON, the last defrost must be more than 5 minutes away and Return Air Temperature must be above -10C to allow for the alarm to be set. – 4-20mA Humidity sensor type: Relative humidity reading is less than 15%. Error must be persistent for 60 minutes. – Modbus sensor type: Modbus communication with the sensor is lost for 11 retry equals approximately 5 minutes. • Indicates: – Sensor disconnected. – Wrong controller configuration, sensor might be disconnected or removed. – Defective sensor. • If the alarm occurs together with the 'Sensor System Overload" alarm 137, the sensor input might be short circuit.	• Check sensor connections. • Check controller configuration menu for correct humidity setting. • Replace sensor.
65	CO2 Too High • Occurs during Normal Run with AFAM+ DEMAND. • If the Co2 level has been within 0.6% of set point for at least one hour and then gets 1.6% above set point. • Indicates: – Need of ventilation with fresh air. • Stocked air vent door. • Air Vent. Motor defect.	• Using Manual Function Test - Check air vent door functionality. • Check wiring.
66	CO2 Too Low • Occurs during Normal Run with AFAM+ DEMAND. • If the Co2 level has been within 0.6% of set point for one hour and then gets 1.6% below set point. • Indicates: – Nor intended ventilation with fresh air. • Stocked air vent door. • Air Vent. Motor defect. • Container doors open.	• Using Manual Function Test - Check air vent door functionality. • Check wiring. • Check container doors.
68	Gas Analyzer Error • Occurs during Pre-Trip (PTI) test only. • With O2 ON, If Both O2 and CO2 sensor reading is not ready and valid within 10 minutes. • Occurs during normal run with AFAM+ DEMAND – If the sensor is capable of producing valid reading for 10 minutes. • Indicates: – Failing sensor, not capable of heating up or create conditions for valid reading.	• Redo AFAM+ PTI. • Replace sensor.

Code	Description	Corrective Action
69	Gas Analyzer Calibration Error • Occurs during AFAM+ PTI test. – After ventilation if the CO2 reading is below 0% or above 2%. • Occurs during normal run with AFAM+ DEMAND – With O2 ON, if (CO2+O2) is not within 10% to 30%. – With O2 OFF, if CO2 is above 25%. • Indicates: – Sensor lost the calibration. – Failing sensor.	• Redo the test. • Replace sensor.
70	O2 Sensor Error • Occurs during Pre-Trip (PTI) test only. • If the sensor reading is not ready and valid within 10 minutes. • Indicates: – Failing sensor, not capable of heating up or create conditions for valid reading.	• Redo the test. • Replace sensor.
71	CO2 Sensor Error • Occurs during Pre-Trip (PTI) test only. • If the sensor reading is not ready and valid within 10 minutes. • Indicates: – Failing sensor, not capable of heating up or create conditions for valid reading.	• Redo the test. • Replace sensor.

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.*

Code	Description	Corrective Action
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 • 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).
119	Digital Valve Error • Occurs during Pre-Trip (PTI) test if: – Compressor Current consumption is not correct for valve position. • Occurs during normal run. – If unit operation indicates problem with the modulation of the compressor cooling capacity. – The compressor startup is tested for power consumption change based on activating modulation for the compressor. – The change from un-loaded to loaded must increase the power draw more than 0,6A. • With this alarm NOT ACKNOWLEDGED, the unit will offset the regulation temperature set point +1,5C (up), to compensate for low temperature peaks.	• Using Manual Function Test, without compressor and fans active check the function of the valve by observing the sound or feel of the valve while activating/deactivating. • Using Manual Function Test, with compressor and fans active check the function of the valve. – The current consumption during NOT energized valve must be higher than during energized position. – With Condenser coil temperature above 35C the expected increase is min 0,9A and below 35C expected limit is 1,5A.
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.	• 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 7 to be 0.5 – 4.5 VDC. • Replace sensor.

Code	Description	Corrective Action
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.	• 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.
122	O2 Sensor Calibration Error • Occurs during AFAM+ PTI test. • Occurs only if the setting O2 SENSOR USAGE is ON. • After ventilation if the O2 reading is below 17% or above 25%. • Indicates: – Sensor lost the calibration. – Failing sensor.	• Open doors and ventilate container. • Redo the test. • Recalibrate sensor. • Replace the 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.
124	Cold Treatment Restart • Occurs during Normal Run and only with cold Treatment active. • Only active with the surveillance active (OOCL option) • Indicates: – Cold treatment period is restarted due to temperatures. – Problem with cooling process – Too long duration of power off.	• Unit will automatically restart the treatment period.
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.

Code	Description	Corrective Action
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.
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.

Code	Description	Corrective Action
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.
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.
138	AVL Sensor Error • Occurs if the sensor is detected to be out of range, open or short circuit. • Indicates: – Sensor failure.	• Using DATA menu evaluate sensor readings. • Check wiring to be correct and connected. • Check J1 plug is plugged and connected to controller. • Check voltage at J1 pin 1 to be 0.5 – 4.5 VDC. • Check supply voltage at J1 pin 3 (GND) to pin 2 to be approximately 12.6VDC. • Replace sensor.
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.

Code	Description	Corrective Action
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.
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.

Diagrams

Diagram Index

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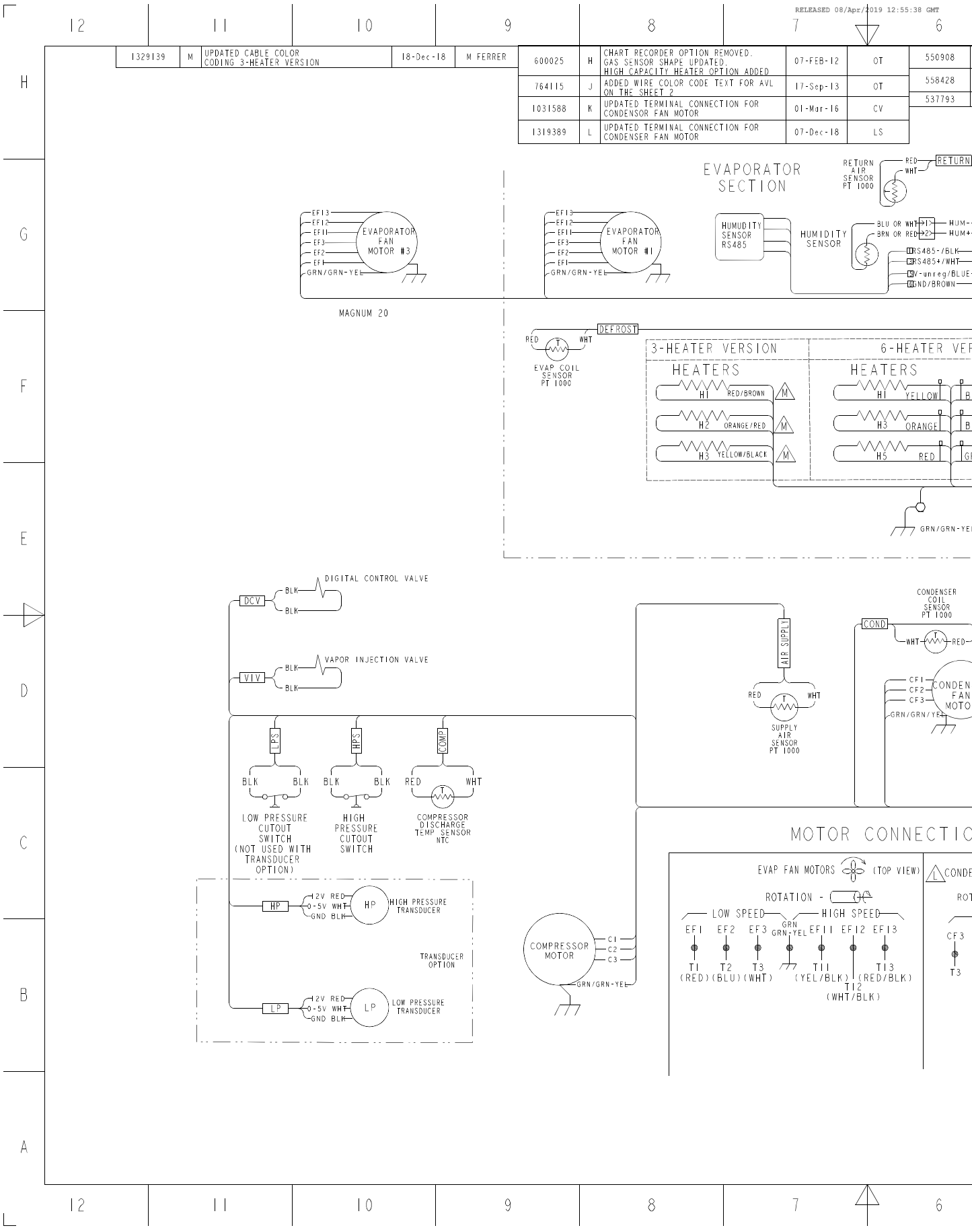
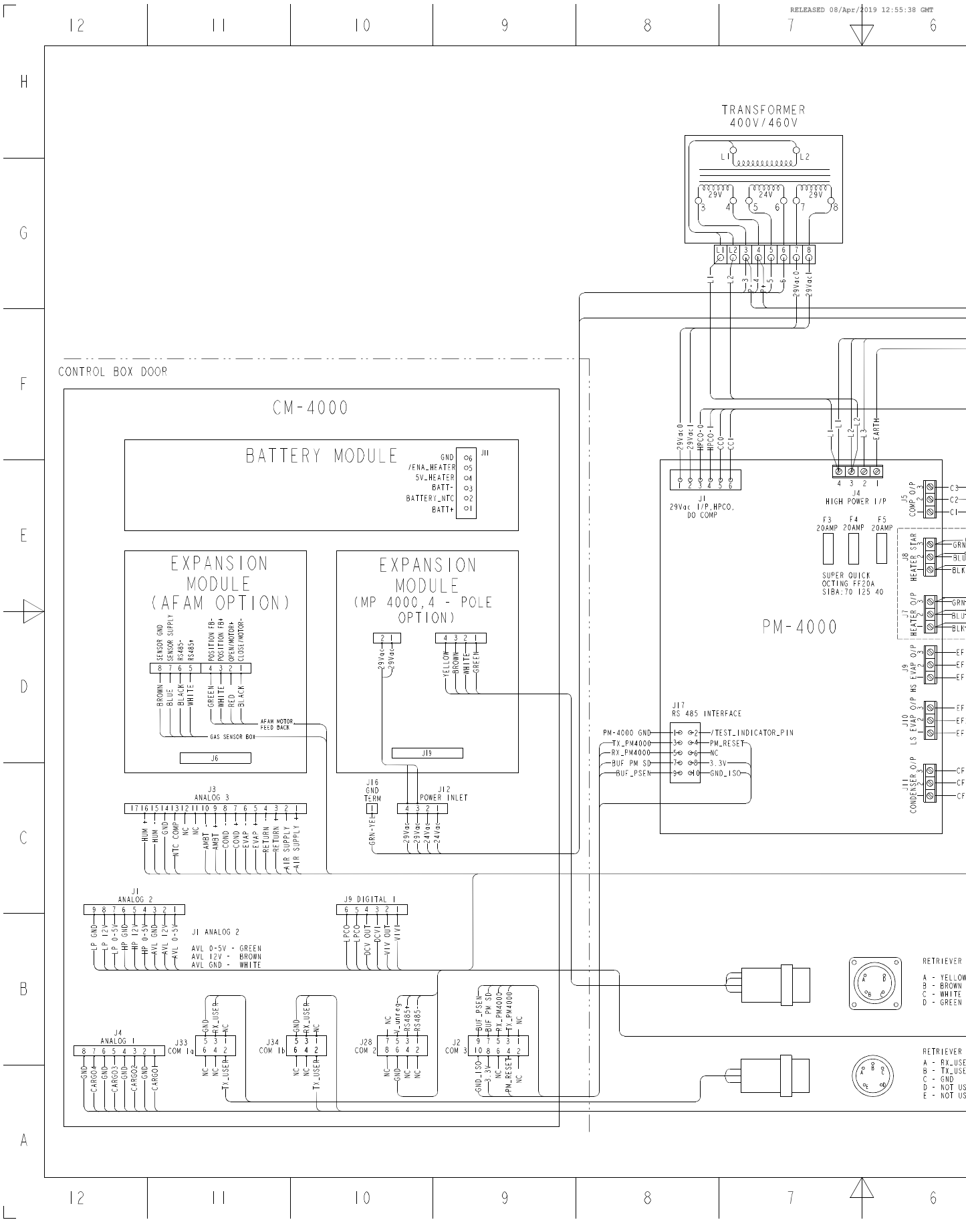
TK 52234	MAGNUM PLUS Refrigeration System Components	Figure 47, p. 189 to Figure 48, p. 191
	MP4000 Menu Flow Diagram	Figure 49, p. 193

Figure 44. 1


RELEASED 08/Apr/2019 12:55:38 GMT
1329139 M UPDATED CABLE COLOR CODING 3-HEATER VERSION 18-Dec-18 M FERRER
600025 H CHART RECORDER OPTION REMOVED. GAS SENSOR SHAPE UPDATED. HIGH CAPACITY HEATER OPTION ADDED 07-FEB-12 OT 550908
764115 J ADDED WIRE COLOR CODE TEXT FOR AVL ON THE SHEET 2 17-Sep-13 OT 558428
1031588 K UPDATED TERMINAL CONNECTION FOR CONDENSOR FAN MOTOR 01-Mar-16 CV 537793
1319389 L UPDATED TERMINAL CONNECTION FOR CONDENSER FAN MOTOR 07-Dec-18 LS
EVAPORATOR SECTION
RETURN AIR SENSOR PT 1000
RETURN
EVAPORATOR FAN MOTOR #3
EVAPORATOR FAN MOTOR #1
HUMIDITY SENSOR RS485
HUMIDITY SENSOR
MAGNUM 20
DEFROST
EVAP COIL SENSOR PT 1000
3-HEATER VERSION
6-HEATER VER
HEATERS
H1 RED/BROWN
H2 ORANGE/RED
H3 YELLOW/BLACK
H1 YELLOW
H3 ORANGE
H5 RED
GRN/GRN-YEL
DIGITAL CONTROL VALVE
DCV
VAPOR INJECTION VALVE
VIV
LPS
HPS
COMP
LOW PRESSURE CUTOUT SWITCH (NOT USED WITH TRANSDUCER OPTION)
HIGH PRESSURE CUTOUT SWITCH
COMPRESSOR DISCHARGE TEMP SENSOR NTC
HP
HIGH PRESSURE TRANSDUCER
TRANSDUCER OPTION
LP
LOW PRESSURE TRANSDUCER
COMPRESSOR MOTOR
AIR SUPPLY
SUPPLY AIR SENSOR PT 1000
CONDENSER COIL SENSOR PT 1000
COND
MOTOR CONNECTIO
EVAP FAN MOTORS (TOP VIEW)
ROTATION -
LOW SPEED
HIGH SPEED
T1 (RED) T2 (BLU) T3 (WHT) T11 (YEL/BLK) T12 (WHT/BLK) T13 (RED/BLK)

BLANK PA

Figure 45. 1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TRANSFORMER
400V/460V
CONTROL BOX DOOR
CM-4000
BATTERY MODULE
GND
/ENA_HEATER
5V_HEATER
BATT-
BATTERY_NTC
BATT+
J11
EXPANSION MODULE (AFAM OPTION)
SENSOR GND
SENSOR SUPPLY
RS485-
RS485+
POSITION FB-
POSITION FB+
OPEN/MOTOR+
CLOSE/MOTOR-
BROWN
BLUE
BLACK
WHITE
GREEN
WHITE
RED
BLACK
AFAM MOTOR FEED BACK
GAS SENSOR BOX
J6
EXPANSION MODULE (MP 4000,4 - POLE OPTION)
29Vac
YELLOW
BROWN
WHITE
GREEN
J19
J3
ANALOG 3
HUM
HUM
GND
NTC COMP
NC
NC
AMBT
AMBT
COND
COND
EVAP
EVAP
RETURN
RETURN
AIR SUPPLY
AIR SUPPLY
J16
GND TERM
GRN-YEL
J12
POWER INLET
29Vac
29Vac
24Vac
24Vac
J1
ANALOG 2
LP GND
LP 12V
LP 0-5V
HP GND
HP 12V
HP 0-5V
AVL GND
AVL 12V
AVL 0-5V
J1 ANALOG 2
AVL 0-5V - GREEN
AVL 12V - BROWN
AVL GND - WHITE
J9 DIGITAL I
LPCO
LPCO
OCV OUT
OCV I
VIV OUT
VIV I
J4
ANALOG I
GND
CARGO4
GND
CARGO3
GND
CARGO2
GND
CARGO1
J33
COM 1a
GND
RX-USER
NC
NC
TX-USER
J34
COM 1b
GND
RX-USER
NC
NC
TX-USER
J28
COM 2
NC
V_unregd
RS485+
RS485-
NC
GND
NC
NC
J2
COM 3
BUF_PSEN
BUF PM SD
RX_PM4000
TX_PM4000
NC
GND_ISO
3.3V
NC
PM_RESET
NC
PM-4000
J1
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29Vac I
HPCO-0
HPCO-I
CCO
CCI
J4
HIGH POWER I/P
L1
L2
L3
EARTH
F3 20AMP
F4 20AMP
F5 20AMP
SUPER QUICK OCTING FF20A SIBA:70 125 40
J5
COMP O/P
C3
C2
C1
J8
HEATER STAR
GRN
BLU
BLK
J7
HEATER O/P
GRN
BLU
BLK
J9
EVAP O/P HS
EF
EF
EF
J10
LS EVAP O/P
EF
EF
EF
J11
CONDENSER O/P
CF
CF
CF
J17
RS 485 INTERFACE
PM-4000 GND
TX_PM4000
RX_PM4000
BUF PM SD
BUF_PSEN
/TEST_INDICATOR_PIN
PM_RESET
NC
3.3V
GND_ISO
RETRIEVER
A - YELLOW
B - BROWN
C - WHITE
D - GREEN
RETRIEVER
A - RX_USE
B - TX_USE
C - GND
D - NOT US
E - NOT US

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LEGEND		
CODE	DESCRIPTION	LOC
AVL	AIR VENT LOGGIN	6D
BAT	BATTERY	4C
CBI	CKT BREAKER - MAIN	3B
CCI	COMPRESSOR CONTACTOR	4A
CFM	CONDENSER FAN MOTOR	7A
COMP	COMPRESSOR MOTOR	4A
DCV	DIGITAL CONTROL VALVE	6D
EFM 1,2 &3	EVAPORATOR FAN MOTORS	6A, 7A
F3	FUSE - 20 AMP	5B
F4	FUSE - 20 AMP	5B
F5	FUSE - 20 AMP	5B
HP	HIGH PRESSURE TRANSDUCER	6D
HPS	LOW PRESSURE CUT OFF SWITCH	4B
K1	RELAY - PHASE SELECT #1	4B
K2	RELAY - PHASE SELECT #2	4B
LP	LOW PRESSURE TRANSDUCER	6D
LPS	LOW PRESSURE CUT OFF SWITCH	7D
MP	MICRO PROCESSOR	6B, 7B
S1	SOL. STATE RELAY - EVAP HEATERS	6B
S2	SOL. STATE RELAY - EFM1	6B
S3	SOL. STATE RELAY - EFM2	7B
S4	SOL. STATE RELAY - CFM	7B
TFO	TRANSFRESH OPTION	3C
T1	TRANSFORMER	3B
VIV	VAPOR INJECTION VALVE	7D

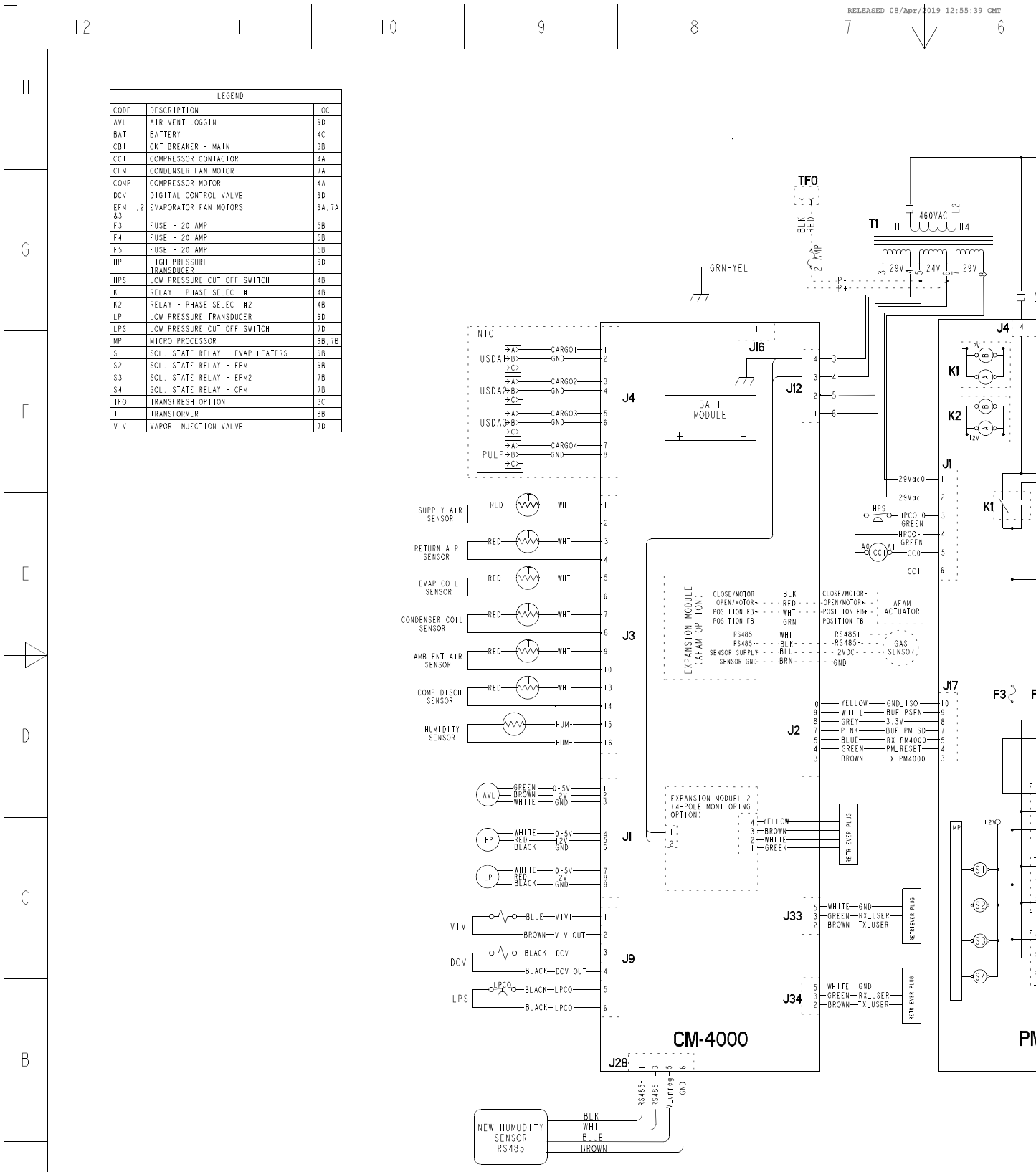

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Figure 47. MAGNUM PLUS

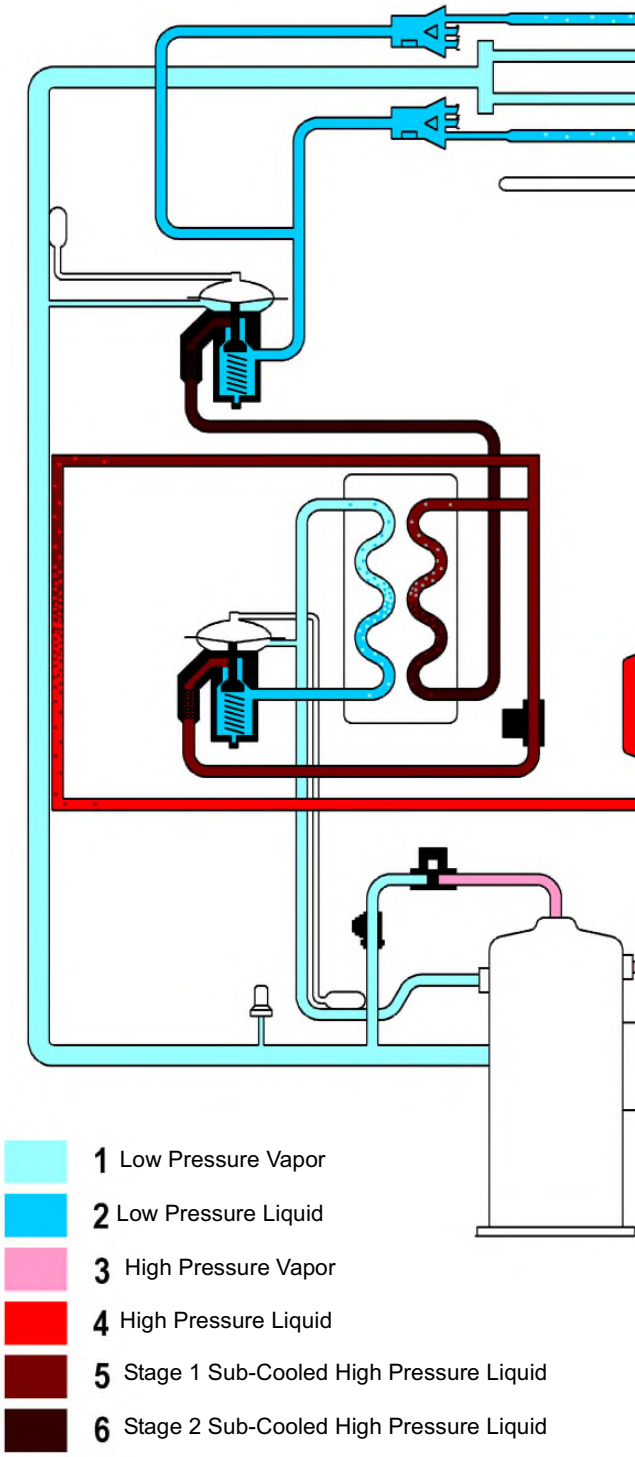

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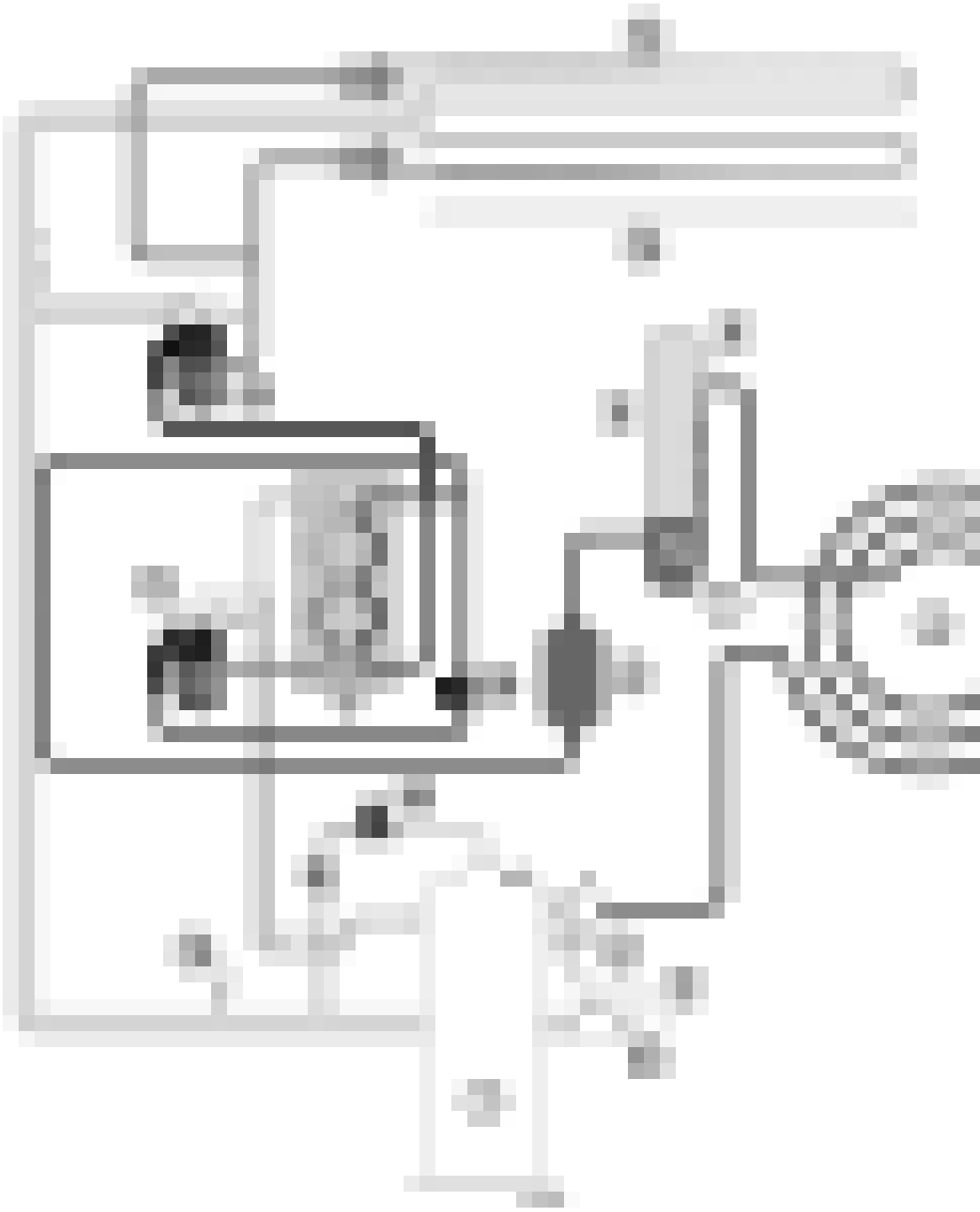
Figure 48. MAG



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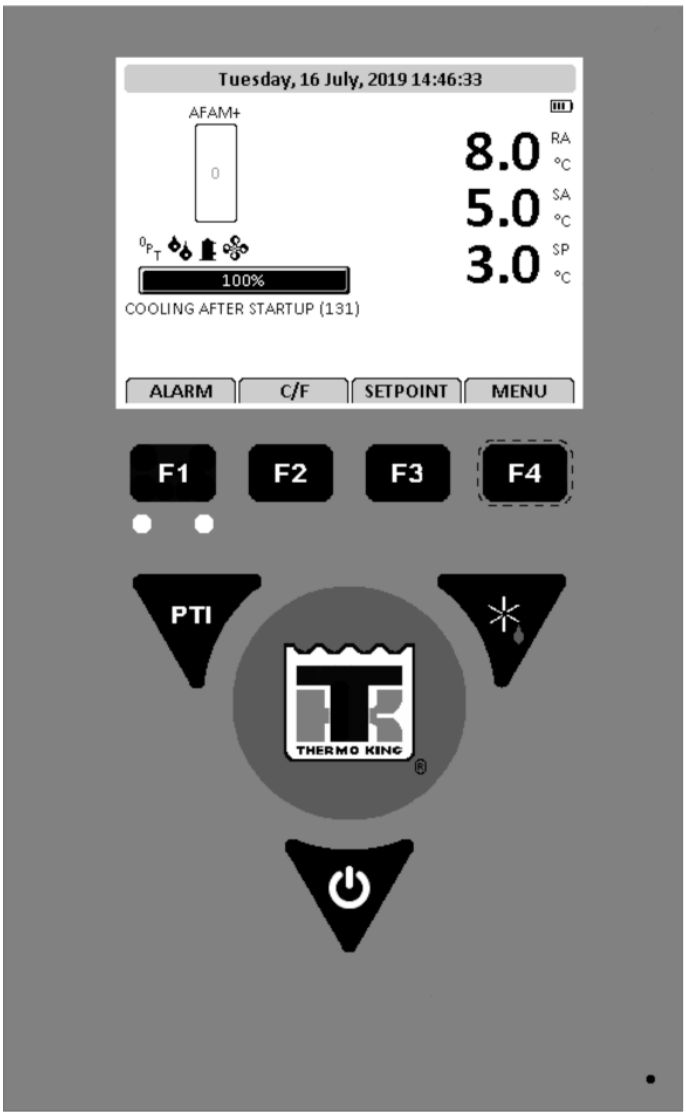
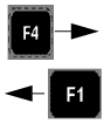


NOTE: All screens are NOT present on all units. The screen that display on the controller are determined by the Controller Software setting and the options installed on the unit.

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:

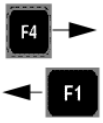
- Press F4 key.

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.

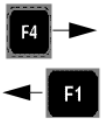
To Exit a Menu or Text Line:

- 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.



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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Supersedes TK 60275-4-MM-EN (August 2015)