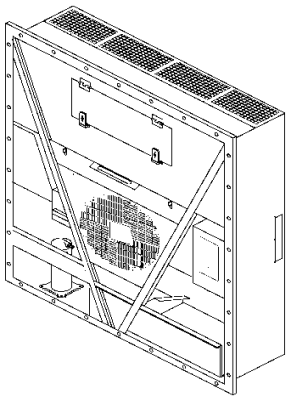
MAGNUM+

TK 60275-4-MM (Rev. 0, 09/08)



Printed in Ireland

The maintenance information in this manual covers unit models:	
	Base Unit
MAGNUM+	098203

For further information, refer to:

Parts Manuals	
MAGNUM Parts List	TK 54356
Operation, Diagnosis and Refrigeration Maintenance Manuals	
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.

This manual is published strictly for informational purposes. The information so provided should not be considered as all-inclusive or covering all contingencies. Thermo King Corporation should be consulted if further information is required.

Sale of product shown in this manual is subject to Thermo King's terms and conditions. This includes, but not limited to, the Thermo King Limited Express Warranty. Such terms and conditions are available upon request. Thermo King's warranty will not apply to any equipment which has been "so repaired or altered outside the manufacturer's plants as, in the manufacturer's judgment, to effect its stability."

No warranties, express or implied, are made regarding the information, recommendations, and descriptions contained herein. This includes warranties of fitness for a particular purpose or merchantability, or warranties arising from course of dealing or usage of trade. The manufacturer is not responsible and will not be held liable in contract or in tort (including negligence) for any special, indirect or consequential damages. This includes injury or damage caused to vehicles, contents or persons, by reason of the installation of any Thermo King product or its mechanical failure.

Recover Refrigerant

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.

In addition, service personnel must be aware of Federal regulations concerning the use of refrigerants and the certification of technicians. For additional information on regulations and technician certification programs, contact your local Thermo King dealer.

R-404A

WARNING: Use only Polyol Ester-based refrigeration compressor oil in R-404A. See Thermo King Parts Manual for part number.

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

When servicing Thermo King R-404A unit, use only those service tools certified for and dedicated to R-404A refrigerant and Polyol Ester compressor oils. Residual non-HFX refrigerants or oils will contaminate R-404A systems.

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Safety Instructions

General Precautions

- Always wear goggles or safety glasses. Refrigerant liquid and battery acid can permanently damage the eyes.
- Never operate the unit with the discharge valve closed. Never close the compressor discharge valve with the unit in operation.
- Keep your hands, clothing and tools clear of the fans when the refrigeration unit is running. If it is necessary to run the refrigeration unit with covers removed, be very careful with tools or meters being used in the area.
- Check the condition of the gauge manifold hoses. Never let the hoses come in contact with a fan motor blade or any hot surface.
- Never apply heat to a sealed refrigeration system or container.
- Fluorocarbon refrigerants produce toxic gases in the presence of an open flame or electrical arc. The gases are severe respiratory irritants capable of causing death.
- Firmly tighten all mounting bolts. Check each bolt for correct length for their particular application.
- Use extreme caution when drilling holes in the unit. The holes may weaken structural components. Holes drilled into electrical wiring can cause fire or explosion. Holes drilled into the refrigeration system may release refrigerant.
- Use caution when working around exposed coil fins. The fins can cause painful lacerations.
- Use caution when working with a refrigerant or refrigeration system in any closed or confined area with a limited air supply (for example, a trailer, container or in the hold of a ship). Refrigerant tends to displace air and can cause oxygen depletion. This can result in suffocation and possible death.
- Use caution and follow the manufacturer's suggested practices when using ladders or scaffolds.

Refrigerant Oil Precautions

Observe the following precautions when working with or around refrigerant oil:

- Do not allow refrigerant oil to contact your eyes.
- Rubber gloves are recommended when handling Polyol Ester based refrigerant oil.
- Do not allow prolonged or repeated contact with skin or clothing.
- Immediately wash all exposed skin after handling refrigerant oil.

Use the following First Aid practices if needed.

Eyes: Immediately flush eyes with large amounts of water. Continue flushing for at least 15 minutes while holding the eyelids open. 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. Restore breathing if necessary. Stay with victim until arrival of emergency personnel.

Ingestion: Do not induce vomiting. Contact a local poison control center or physician immediately.

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.

Precautions

In general disconnect the units power cord before repairing or changing any electrical components.

Note that even though the controller is turned off, one of the phases is still live and represents

a potential danger of electrocution
Where turning of the unit is not possible (for example at voltage measuring or troubleshooting), follow safety precautions below.

- Turn the unit On/Off switch to Off before connecting or disconnecting the unit power plug. Never attempt to stop the unit by disconnecting the power plug.
- Be certain the unit power plug is clean and dry before connecting it to a power source.
- Use tools with insulated handles. Use tools that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.
- Do not make any rapid moves when working with high voltage circuits. Do not grab a falling tool or other object. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
- Treat all wires and connections as high voltage until ammeter and wiring diagram show otherwise.
- Never work alone on high voltage circuits on the refrigeration unit. Another person should always be standing by in the event of an accident to shut off the refrigeration unit and to aid a victim.
- Have electrically insulated gloves, cable cutters and safety glasses available in the immediate vicinity in the event of an accident.

First Aid

IMMEDIATE action must be initiated after a person has received an electrical shock. Obtain immediate medical assistance.

The source of shock must be immediately removed. Shut down the power or remove the victim from the source. If it is not possible to shut off the power, the wire should be cut with either an insulated instrument (e.g., a wooden handled axe or cable cutters with heavy insulated handles). A rescuer wearing electrically insulated gloves and safety glasses could also cut the wire. Do not look at the wire while it is being cut. The ensuing flash can cause burns and blindness.

Pull the victim off with a non-conductive material if the victim has to be removed from a live circuit. Use the victim's coat, a rope, wood, or loop your belt around the victim's leg or arm and pull the victim off. *Do not touch* the victim. You can receive a shock from current flowing through the victim's body.

Check immediately for the presence of a pulse and respiration after separating the victim from power source. If a pulse is not present, start CPR (Cardio Pulmonary Resuscitation) and call for emergency medical assistance. Respiration may also be restored by using mouth-to-mouth resuscitation.

Low Voltage

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 MP-3000a microprocessor 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.

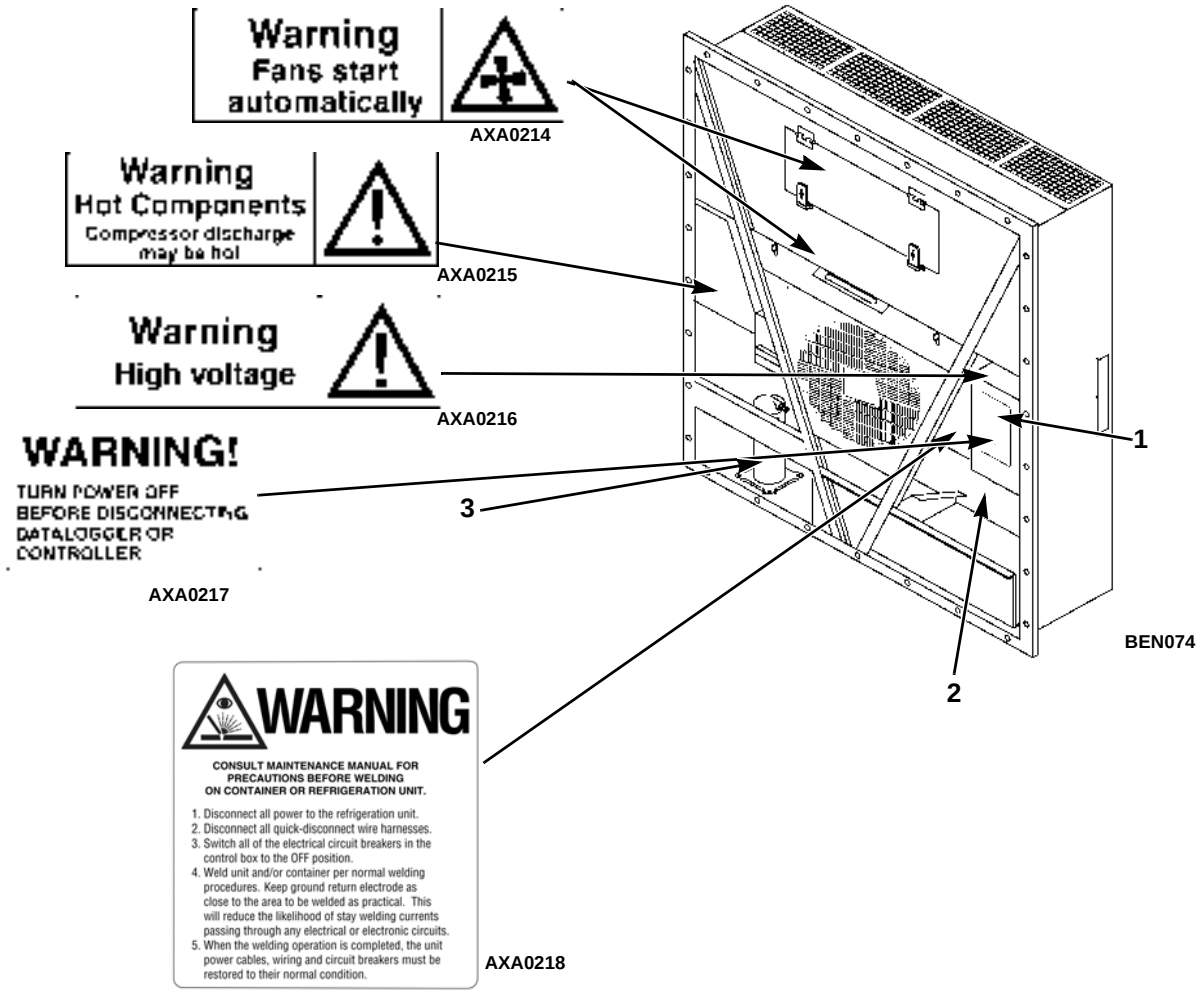
- Disconnect all power to the refrigeration unit.
- Disconnect all quick-disconnect wire harnesses from the back of the controller.
- Disconnect all wire harnesses from the Remote Monitor Modem (RMM).
- Switch all of the electrical circuit breakers in the control box to the Off position.
- Weld unit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

Removing Refrigerant Properly

Use a refrigerant recovery process that prevents or absolutely minimizes refrigerant escaping to the atmosphere. Fluorocarbon refrigerants are classified as safe refrigerants when proper tools and procedures are used. Certain precautions must be observed when handling them or servicing a unit in which they are used.

Fluorocarbon refrigerants evaporate rapidly, freezing anything they contact when exposed to the atmosphere in the liquid state. In the event of frost bite, attempt to protect the frozen area from further injury, warm the affected area rapidly, and maintain respiration.

- **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 lukewarm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection/injury. Get medical attention. Wash contaminated clothing before reuse.
- **Inhalation:** Move victim to fresh air and use CPR or mouth-to-mouth ventilation, if necessary. Stay with victim until arrival of emergency medical personnel.



1.	Controller Nameplate
2.	Unit Nameplate
3.	Compressor Nameplate

Nameplate and Warning Locations

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. See Figure .

Locating Serial Numbers

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

- **Electric Motor Nameplate:** Attached to the motor housing.
- **Compressor Nameplate:** On front of the compressor.
- **Unit Nameplate:** On unit frame in power cord storage compartment.
- **MP-4000 Controller Nameplate:** On back of controller.

Service Guide

A closely followed maintenance program will help to keep your Thermo King unit in top operating condition.

The following service guide 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 that clean evaporator coil after each trip.

Specifications

System Net Cooling Capacity— Full Cool

MAGNUM+ Model — Air Cooled Condensing*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power		
	Net Cooling Capacity		Power Consump
	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.

Evaporator Airflow Specifications

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+	5,250	4,515	17914	3,900	3,353	13,300

*System net heating capacity includes electric resistance rods and fan heat.

MAGNUM+

External Static Pressure (water column)	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 mm (0 in.)	6,560	3,860	3,170	1,865	5,480	3,225	2,710	1,595
10 mm (0.4 in.)	5,820	3,425	1,770	1,040	4,530	2,665	930	545
20 mm (0.8 in.)	5,000	2,940	—	—	3,750	2,205	—	—
30 mm (1.2 in.)	4,430	2,610	—	—	2,930	1,725	—	—
40 mm (1.6 in.)	3,520	2,070	—	—	1,870	1,100	—	—

Electrical System Specifications

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

Electrical System Specifications

Kilowatts	0.55 kW @ 460V, 60 Hz
Horsepower	0.75 hp @ 460V, 60 Hz
Number: All Models	1
Motor:	
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
Motor:	
RPM (Each): High Speed	3450 RPM @ 460V, 60 Hz
Low Speed	1725 RPM @ 460V, 60 Hz
Full Load Amps (Each): High Speed	1.6 amps @ 460V, 60 Hz
Low Speed	0.8 amps @ 460V, 60 Hz
Locked Rotor Amps: High Speed	10.5 amps @ 460V, 60 Hz
Low Speed	9.0 amps @ 460V, 60 Hz
Electrical Resistance Heater Rods:	
Type	460/380V, 60/50 Hz, 3 Phase
Number	6
Watts (Each)	680 Watts @ 460V, 60 Hz
Current Draw (Amps)	5 amps total @ 460V across each phase at heater contractor
Control Circuit Voltage:	29 Vac @ 60 Hz

Refrigeration System Specifications

Compressor:	
Model No.:	ZMD18KVE-TFD-277, Scroll
Refrigerant Charge:	
MAGNUM+	4.0 Kg (8.0 lb.) R-404A
Compressor Oil Capacity	1.77 liter (60 oz.)*
Compressor Oil Type:	Polyol Ester Based Type (required), (refer to Tool Catalog)**

*When the compressor is removed from the unit, oil level should be noted or the oil removed from the compressor should be measured so that the same amount of oil can be maintained in the replacement compressor.

***Do not* use or add standard synthetic or mineral oils to the refrigeration system. If Ester based oil becomes contaminated with moisture or with standard oils, dispose of properly — *Do Not Use!*

High Pressure Cutout Switch:	
Cutout	3240 ± 48 kPa, 32.4 ± 0.5 bar, 470 ± 7 psig
Cutin	2586 ± 262 kPa, 25.9 ± 2.6 bar, 375 ± 38 psig
Low Pressure Cutout Switch:	
Cutout	-17 to -37 kPa, -0.17 to -0.37 bar, 5 to 11 in. Hg vacuum
Cutin	28 to 48 kPa, 0.28 to 0.48 bar, 4 to 7 psig
High Pressure Relief Valve:	
Relief Temperature	99 C, 210 F

Refrigeration System Specifications (Continued)

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)	138 C (280 F)
Vapor Injection Valve De-energizes (Closes)	6 C (10.7 F) below energize temperature (132 C [123 F])
Compressor Shutdown (Auto Reset)	148 C (298 F)
Vapor Injection Valve (Compressor):	
Voltage	24 Vac
Current	0.85 amps
Cold Resistance	5.6 ohms
Compressor Digital Control Valve:	
Voltage	24 Vac
Current Draw	0.85 amps

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

Container Temp.	Operating Mode	Ambient Temp.	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.

MP-4000 Controller Specifications

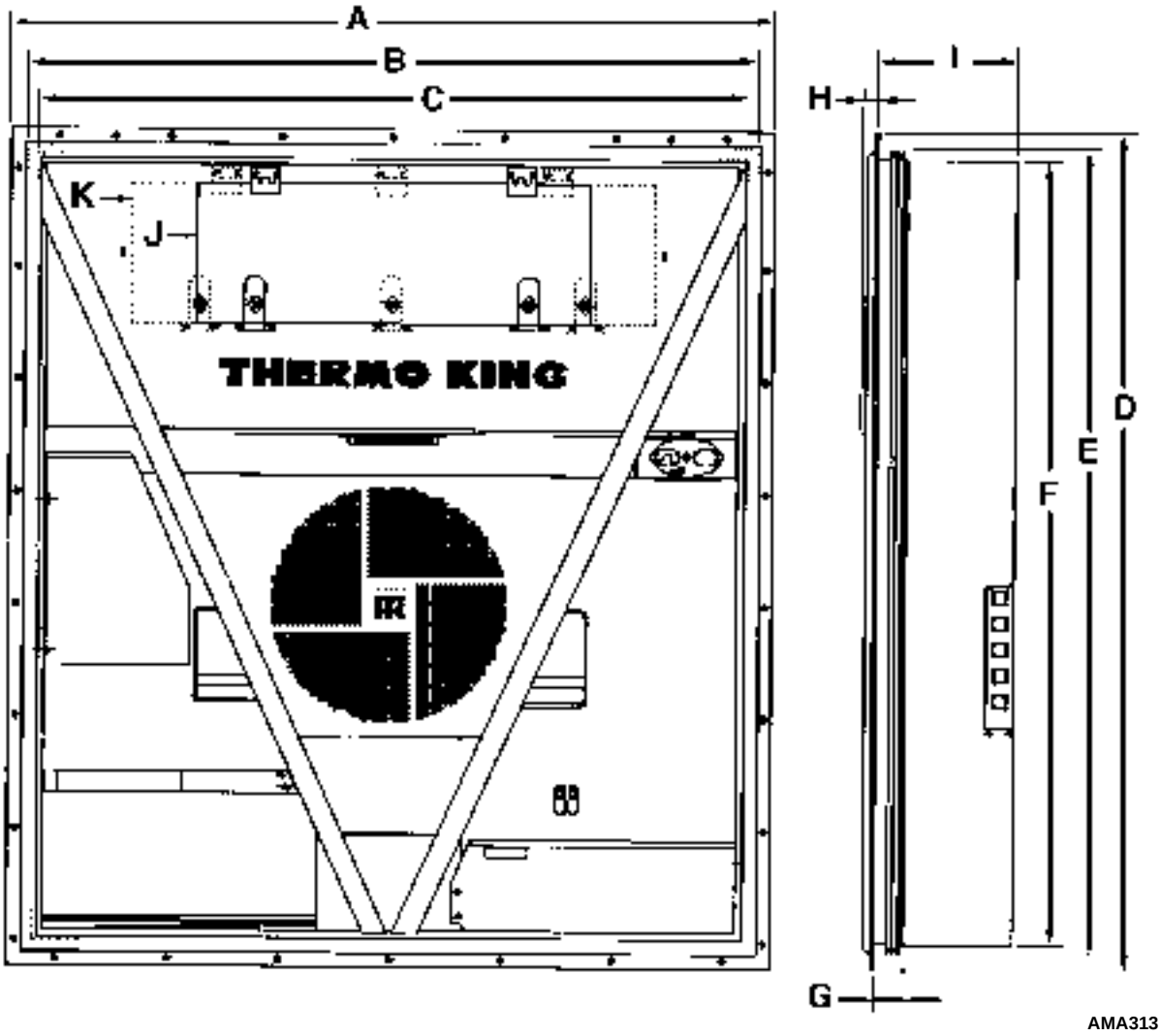
Temperature Controller:	
Type	MP-4000 is a controller module for the Thermo King Magnum+ Unit. Additional requirements can be met by means of expansion modules. The MP4000 is solely responsible for temperature regulation of the reefer container, but other monitoring equipment can be used in conjunction with the MP 4000 - 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	See 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 1 minute after the hour immediately following a defrost timer request for defrost initiation. For example, if the defrost timer requests a defrost cycle at 7:35, the defrost cycle will start at 8:01. Datalogger will record a Defrost event for each interval in which a Defrost cycle is pending or active (i.e. both the 8:00 and 9:00 data logs).
Demand Defrost	Demand defrost function initiates defrost when: • 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 8 hours of compressor operation. Defrost interval increases 2 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

MP-4000 Controller Specifications (Continued)

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

Fresh Air Exchange Venting System (Adjustable):	
MAGNUM+	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
Evaporator Fan Blade Specifications:	
MAGNUM+:	
Diameter	355 mm (14.0 in.)
Pitch	25°
Number of Fans	2
Weight (net):	
MAGNUM+ Base Unit	380 Kg (875 lb.)
Water-cooled Condenser-Receiver Option	13.6 Kg (30 lb.)



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+	420.0 mm (16.54 in.) from back of flange
J = MANGUM+	Evaporator Access Door

Figure 1: Physical Specifications

Unit Description, Features & Options

Introduction

This chapter will briefly describe the following items:

- General Unit Description.
- Standard Component Descriptions.
- Optional Component Descriptions.

General Description

MAGNUM 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.

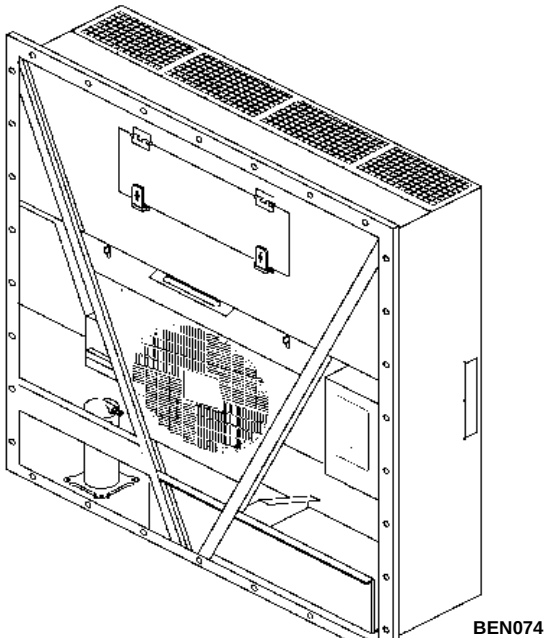


Figure 2: MAGNUM+ Unit

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

- Scroll Compressor
- Compressor Digital Control Valve
- Economizer Heat Exchange System
- Temperature Sensors
- Fresh Air Exchange System
- Receiver Tank Sight Glass
- Evaporator Fans
- Condenser Fan Control
- Suction/Discharge Pressure Sensor (Optional)
- Remote Monitoring Receptacle Option (4-pin) (optional)
- Remote Monitoring Modem (RMM) (Optional)
- USDA Cold Treatment Temperature Recording (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).

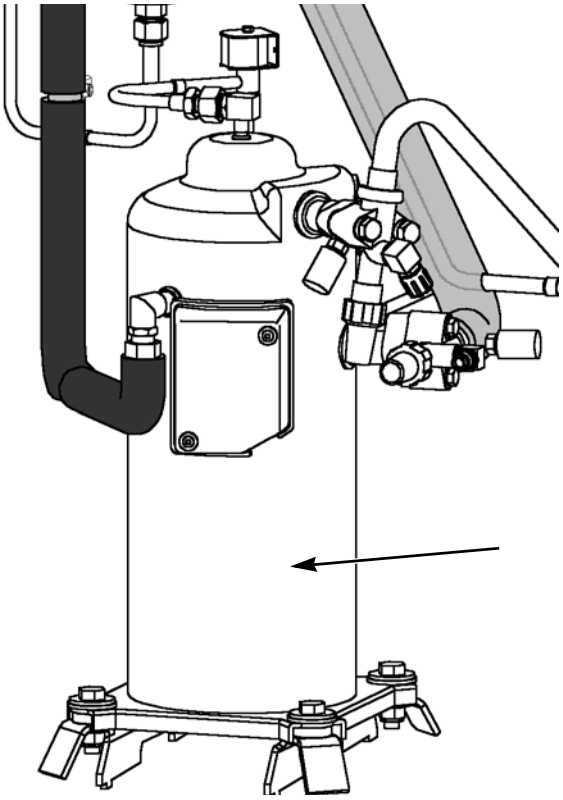
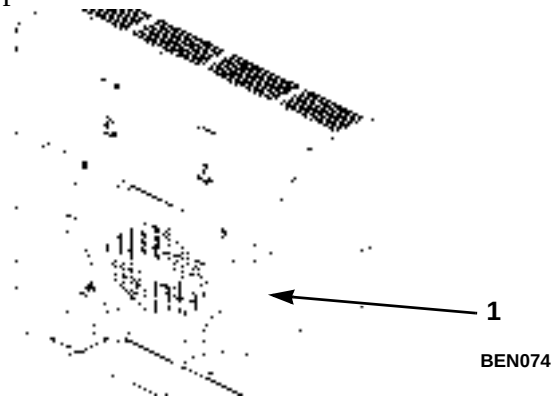


Figure 3: Scroll Compressor

MP-4000 Controller

The MP-4000 is an advanced microprocessor controller that has been specially developed for the control and monitoring of refrigeration units. See “Controller Description and Operating Chapter” for more detailed information.



1.	MP-4000 Controller

Figure 4: MP-4000 Controller

Compressor Digital Control Valve

The MP-4000 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. See the “General Theory of Operation Chapter” for more detailed information.

Figure 5: Compressor Digital Control Solenoid Valve

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. See the “General Theory of Operation Chapter” for more detailed information.

Figure 6: Economizer Heat Exchanger

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:

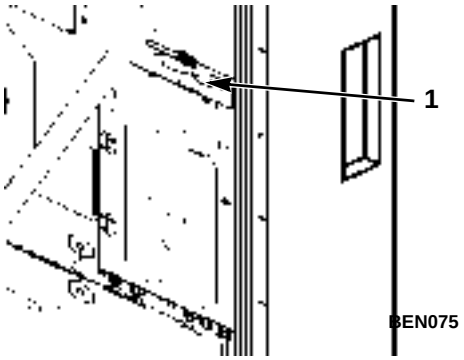
- Supply Air
- Return Air
- Evaporator Coil
- Condenser Coil
- Ambient Air

The compressor sensor is of Thermistor type and is located in the top cap of the compressor.

These sensors are field replaceable. Five sensor receptacles are provided; three USDA and one cargo temperature.

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

Figure 7: Fresh Air Exchange Vent

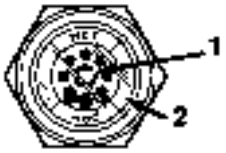
Fresh Air Exchange Recorder (Optional)

The Fresh Air Exchange Recorder detects vent disk movement. It 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 mounts on the fresh air vent door.

Figure 8: Fresh Air Exchange Recorder

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.

Figure 9: Receiver Tank Sight Glass

Evaporator Fans

MAGNUM 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:

- 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.

NOTE: If Non-Optimised mode is on:

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

NOTE: If optimised mode is on:

- ***Chill Loads: Evaporator fans operate on high and low speed - depending on the need for cooling.***

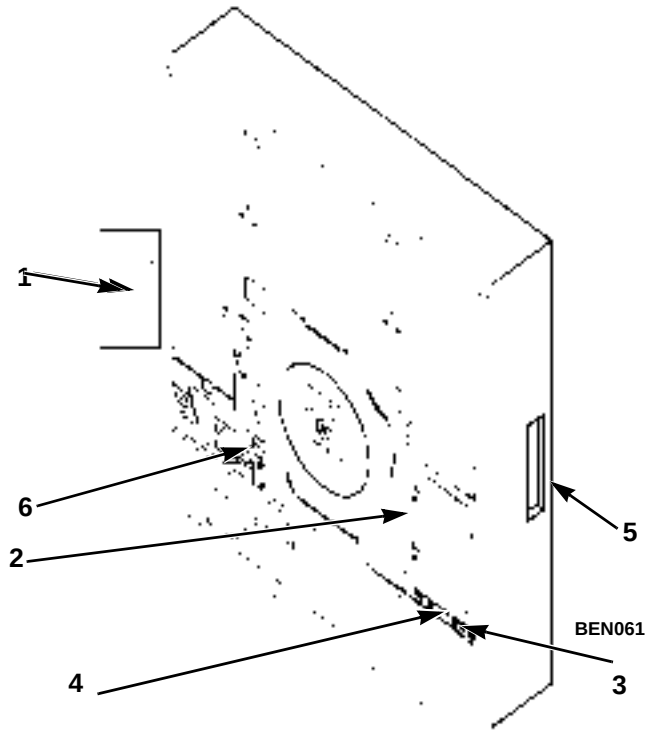
• Frozen Loads: Evaporator fans operate on low speed and stops when there is no need for cooling.

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.

Unit Options

This unit is available with several options that are listed in Figure 10. These options are specified when placing the order. These options are briefly described on the following pages.



1.	Recording Thermometer (Optional)
2.	Air Ventilation Logging (AVL)
3.	Water Pressure Switch (Optional)
4.	Remote Monitor Modem for Power Line Communications (REFCON control modem inside Control Box) (Optional)
5.	USDA Sensor Receptacle (Access from Inside Container) (Optional)
6.	Suction/Discharge Pressure Transducer (Optional)

Figure 10: Optional Components

Recording Thermometer (Optional)

The recording thermometer indicates and permanently records the temperature of the air returning to the evaporator section on a calibrated chart.

Several models of temperature recorders are available for mounting on the unit. Each temperature recorder is designed to withstand widely varying environments including low and high ambient temperatures, salt water, humidity, fungus, industrial pollutants, dynamic loading, rain, sand and dust.

Remote Monitoring Modem (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 (Optional)

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.

Air Ventilation Logging (AVL - Optional)

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 opening is detected in steps of 5m3/h, from 0 to 125. When opening is greater than 125m3/h the log will just state that the opening is greater than 125m3/h.

USDA Cold Treatment Temperature Recording (standard)

The MP-4000 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.

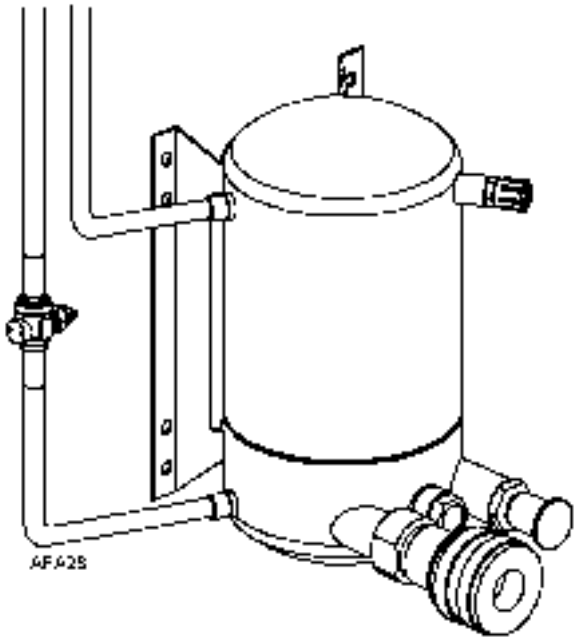


Figure 11: Water-Cooled Condenser/Receiver Tank

Water-Cooled Condenser/Receiver Tank (Optional)

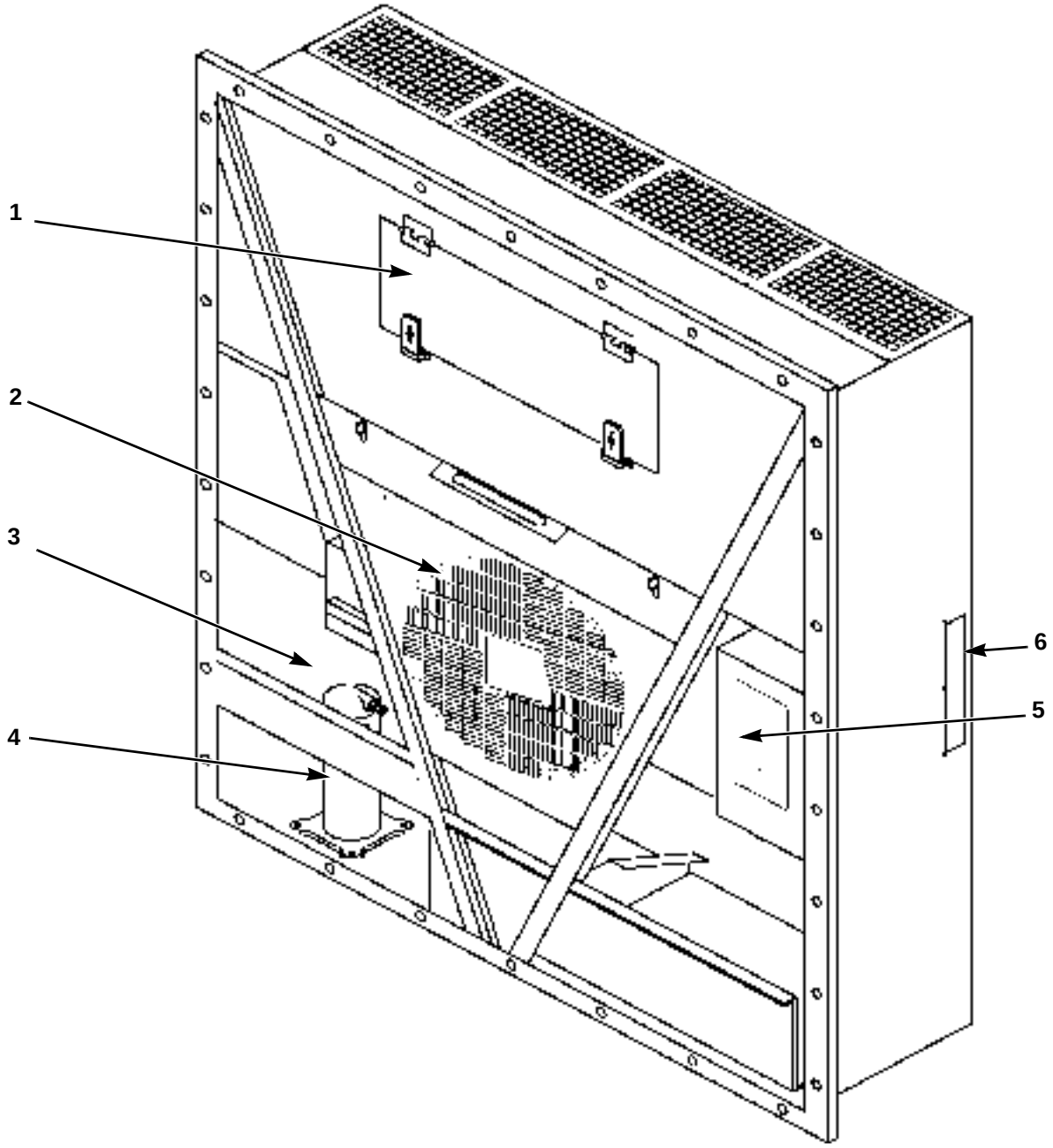
A water-cooled condenser/receiver provides the unit with above and below deck operating capabilities. Condenser fan control is provided in software or by a Condenser Fan Selection switch or a Water Pressure switch. Starting april 2005 we have added a shutoff valve on the outlet tube of the water-cooled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

Water Pressure Switch (Optional)

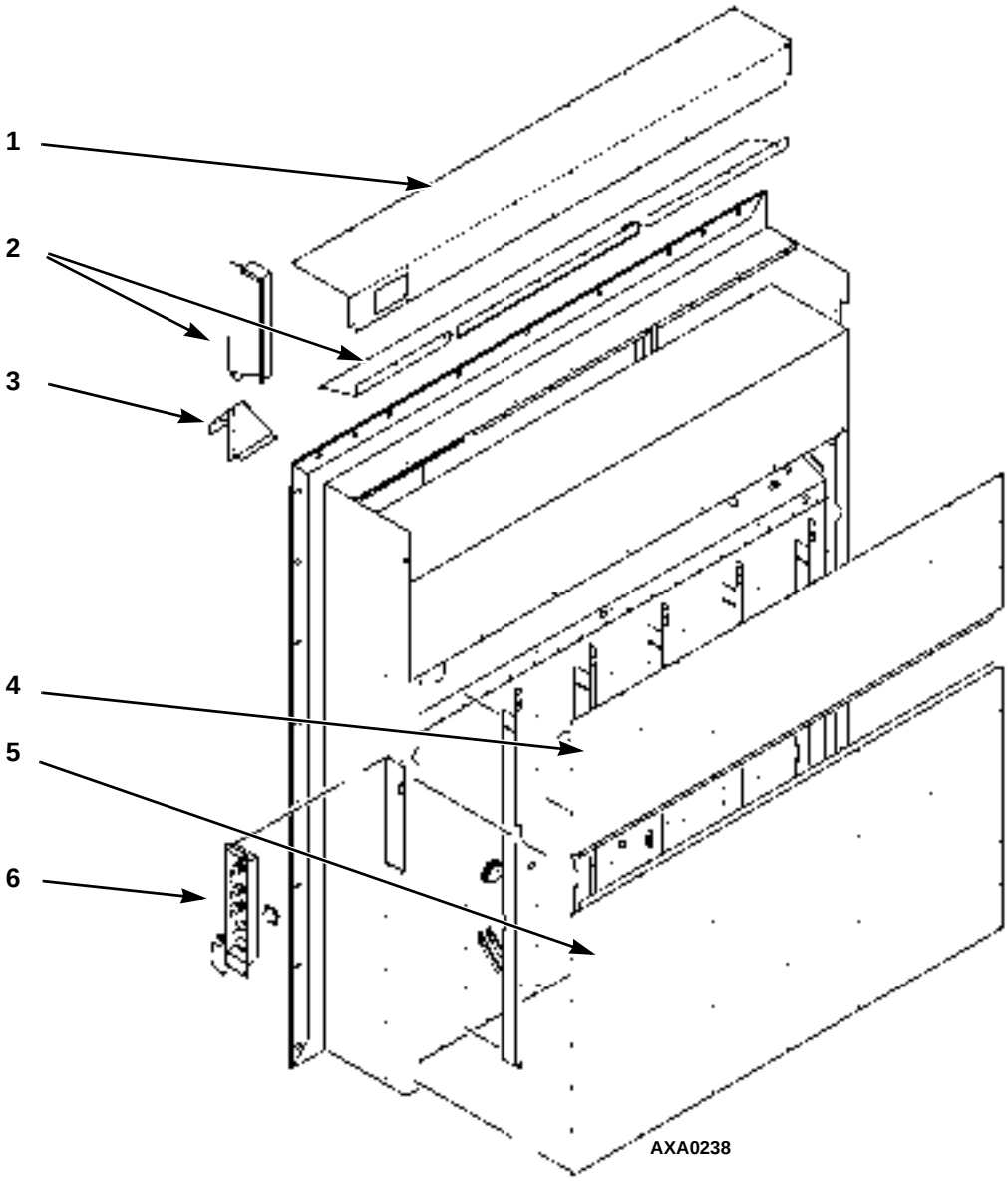
When water pressure greater than 117 ± 21 kPa, 1.17 ± 0.21 bar, (17 ±3 psig) is provided to the condenser-receiver tank, the water pressure switch closes. This causes the controller to stop condenser fan operation. When the water pressure decreases below 35 ± 21 kPa, 0.35 ± 0.21 bar, (5 ± 3 psig), the switch opens, causing the controller to place the unit on air-cooled condenser fan operation.

Water-cooled condenser requires a water flow of 19 to 38 l/min. (5 to 10 gal./min.).



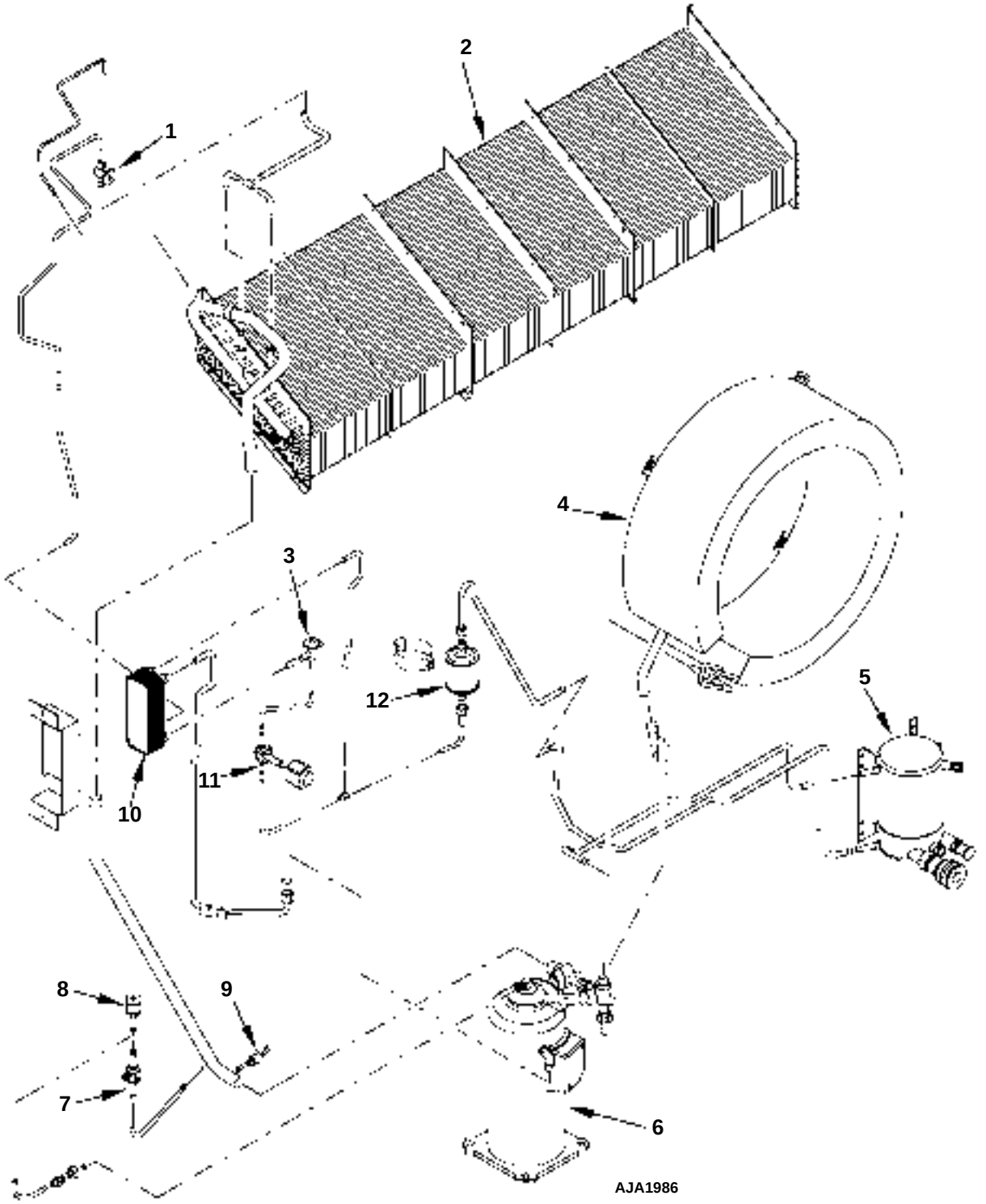
1.	Evaporator Access Door
2.	Condenser Fan
3.	Compressor Compartment
4.	Scroll Compressor
5.	Control Box
6.	Rear Download and USDA Receptacle Panel (Access from Inside Container)

Figure 12: Unit Front View



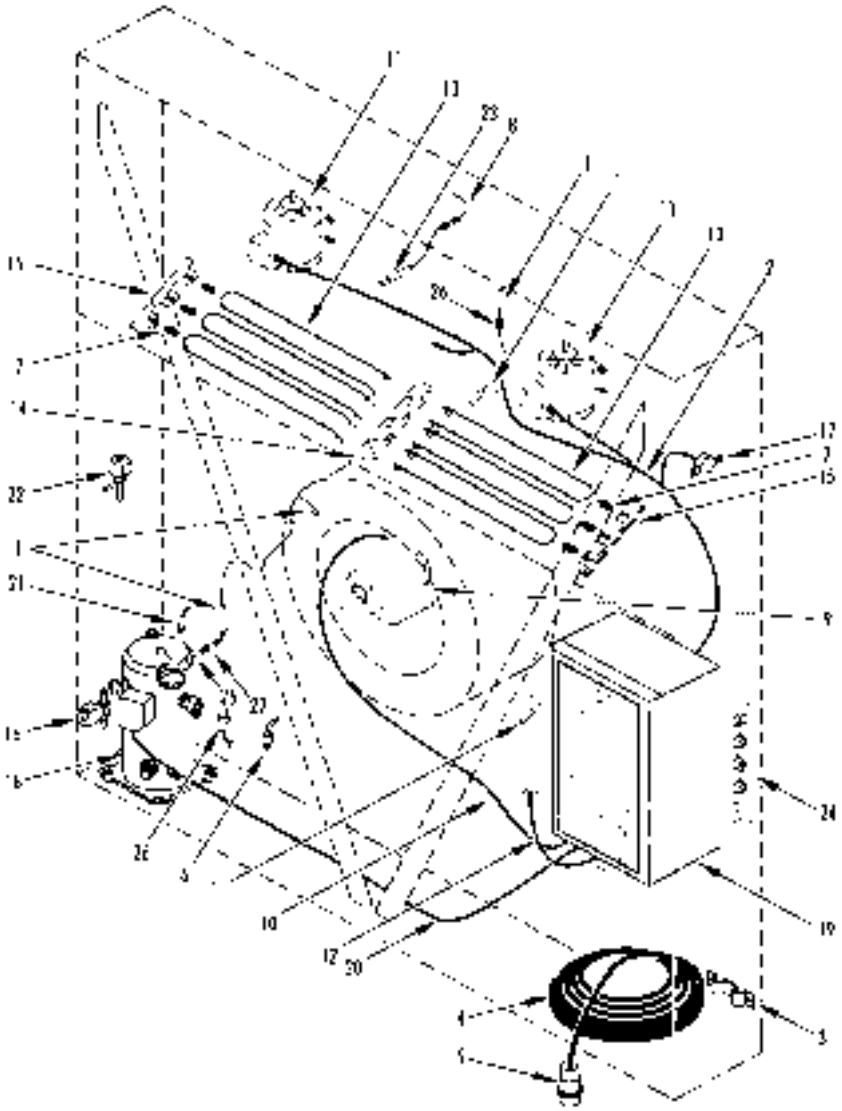
1.	Evaporator Grille
2.	Air Channels
3.	Fresh Air Inlet
4.	Top Rear Plate
5.	Bottom Rear Plate
6.	USDA Receptacle Panel: • Controller Communications and Data Download Port • USDA1/Spare 1 Sensor Connection • USDA2/Spare 2 Sensor Connection • USDA3/Spare 3 Sensor Connection • Cargo (Pulp) Sensor Connection

Figure 13: Unit Back View



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

Figure 14: Refrigeration System



1.	Sensor Kit	15.	Heater Bracket
2.	Evaporator Fans Harness	16.	Solenoid Valve
3.	Power Cable Bracket	17.	Thermostat, Defrost Termination
4.	Power Cable	18.	Scroll Compressor
5.	Power Plug	19.	Control Box
6.	LPCO Switch	20.	Compressor Cable
7.	Heater Spring	21.	HPCO Switch
8.	Humidity Sensor Harness	22.	Digital Valve
9.	Condenser Fan Harness	23.	Humidity Sensor
10.	Condenser Fan Motor	24.	USDA Receptacle Panel
11.	Evaporator Fan Motor	25.	Thermistor Kit
12.	Control Box Harness	26.	Suction Pressure Sensor
13.	Heater Leads	27.	Discharge Pressure Sensor
14.	Heater Bracket		

Figure 15: Electrical Components

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)

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.

Controller Description

Controller Description

The MP-4000 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
- 2 Status LED indicators
- Special Function keys. ON/OFF, PTI, Defrost

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 - 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.

Controller Input and Output Signals

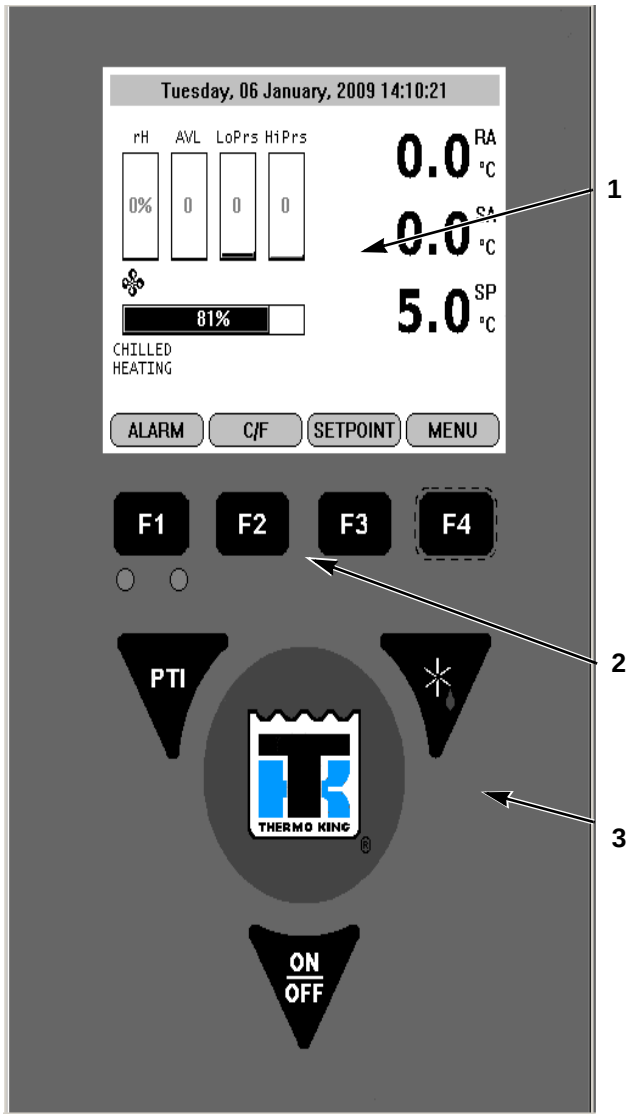
The MP-4000 microprocessor controls all unit functions to maintain the cargo at the proper temperature. The controller also monitors and records system faults and performs pretrip.

The MP-4000 controller uses advanced solid-state integrated circuits to monitor and control unit functions. The controller monitors inputs from:

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

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

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



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

Figure 16: MP-4000 Controller Display Panel

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 2 min of no key activity the display will return the Standard display

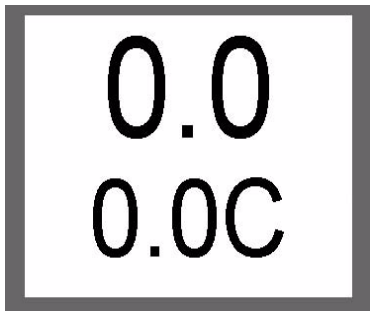


Figure 17: Standard Display

Unit Status Display

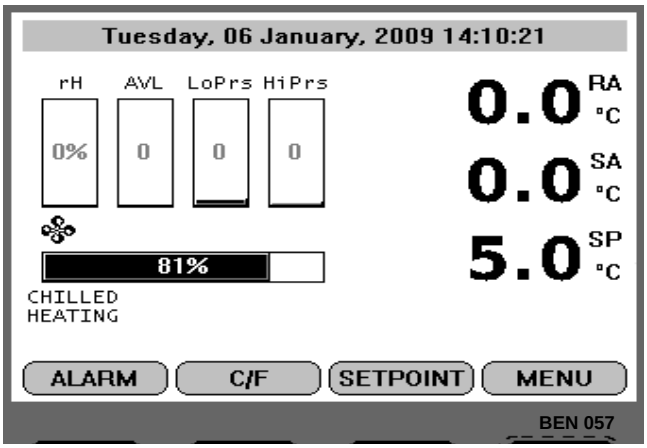


Figure 18: Unit Status Display

The Unit Status display will show.

Looking at the display from top to bottom

- Date and Time / Alarm Warning
- rH Relative Humidity sensor
- AVL Door Position
- 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 Descript unit operation
- F1 – f4 Key Functions ALARM C/F SETPOINT MENU

Glossary of Symbols

 - Alarm

 - Pretrip - Component Being Tested

 - Heating

 - Evaporator Fan High Speed

 - Dehumidification

 - Defrost

 - Condenser Fan On

 - Compressor On Unloaded

 - Compressor On loaded without Vapour Injection

 - Compressor On loaded with Vapour Injection

 - Evaporator Fan Low Speed

Glossary of 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 algoritim 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.

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.

Function keys will change based on what menu is active in the display

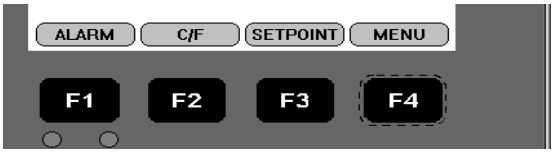


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Figure 19: Function Keys

- F1 ALARM key: Press to view an explaination 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

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

Three Special Function Keys

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

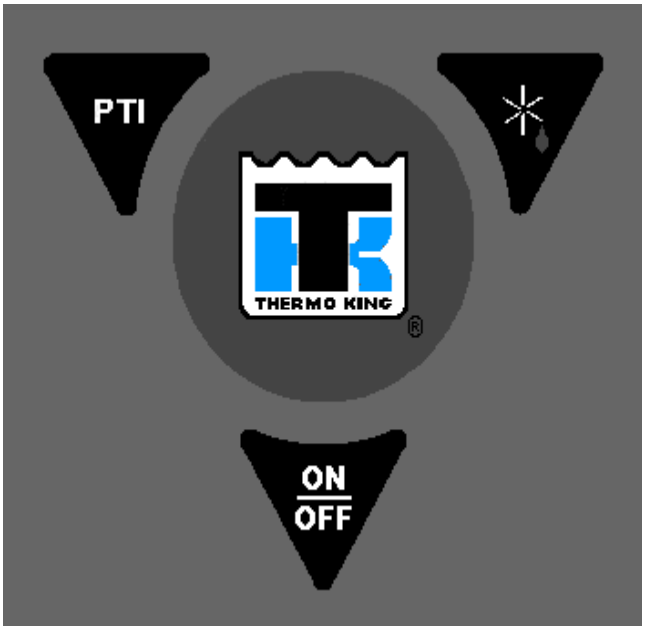
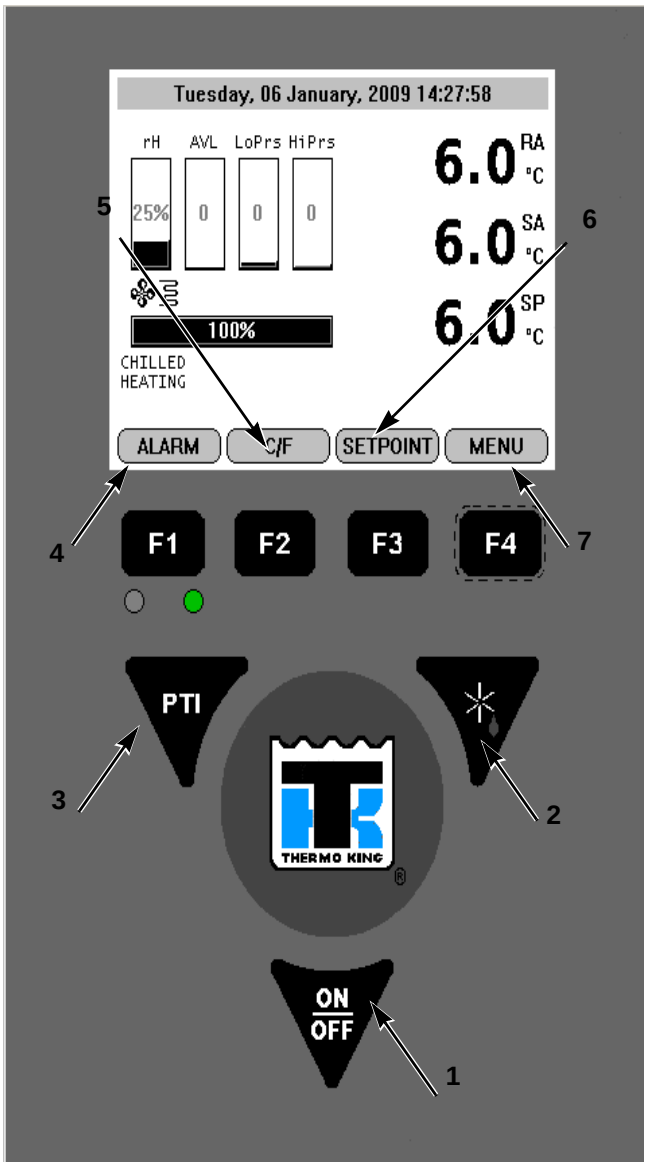


Figure 20: Special Function Keys

PTI	Pre-Trip Inspecion
*	Defrost
ON/OFF	Unit On/OFF Control

Operating Instructions

Function Keys



1.	ON/OFF Key
2.	Defrost Key
3.	PTI - Pre-trip Inspection
4.	Alarm Key
5.	C/F Key
6.	Setpoint Key
7.	Menu Key

Figure 21: Function Keys

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

Connect unit to 460 Volt shore power or genset.

Turn circuit breaker on at post to apply power to unit.

- Display will show Johnson Controls
- Test Memory Passed
- Start Application
- Display will go blank with just status bar
- Display Thermo King Logo Please Wait. Loading…..
- Screen go blank

Press and Hold ON/OFF key for 2 seconds

- Display shows RA, SA, SP
- PM 4000 Setup
- Power Module Init
- Power Module Phase test - Shows heater icon
- Power module Ready
- Stop Plant

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

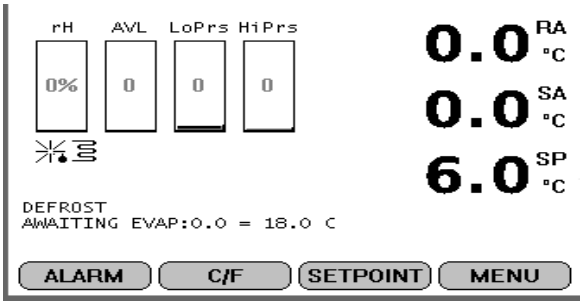
NOTE: Random time delays during the initial unit start-up minimize peak current draw.

Initiating a Manual Defrost

Turn the **UNIT ON**. Allow Unit to start and stabilise.

Complete the following steps:

1. 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.



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

PTI

Turn the **UNIT ON**. Allow Unit to start and stabilise.

Complete the following steps:

1. Press the **PTI** Special Function key.

During testing the screen is divided into 3 sections.

Section 1:

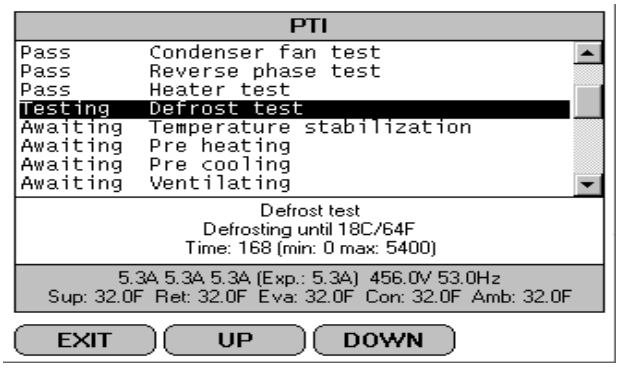
Showing the list of test to be performed and there state.
List of possible states:
Awaiting: the test has not yet been performed.
Testing: the test is ongoing.
Pass: the test has been tested, with the result Pass.
Fail: the test has been tested, with the result Fail.
Skipped: the test is skipped, based 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.



2. Press the **F2/F3** keys to scroll between each of the tests.
3. 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 MP-4000 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/Warnings

To view the alarms that are present, turn the **UNIT ON**.Allow Unit to start and stabilise.

Complete the following steps:

1. Press the **F1/ALARM 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: See a full List of Alarm and Warning codes on p. 72 of this manual.

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

To view the alarms that are present, turn the **UNIT ON**.Allow Unit to start and stabilise.

Complete the following step:

The controller can display temperatures in Celsius or Fahrenheit. Press the **F2** function key display will change to C or F

Changing Setpoint

To change the controller setpoint, turn the **UNIT ON**.Allow Unit to start and stabilise.

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: Humidity control, humidity setpoint and Non-Optimised mode can also be set from the Setpoint menu. See "Setpoint Menu" under "Menu Operating Instructions" in this chapter.

Main Menu

To view the alarms that are present, turn the **UNIT ON**.Allow Unit to start and stabilise.

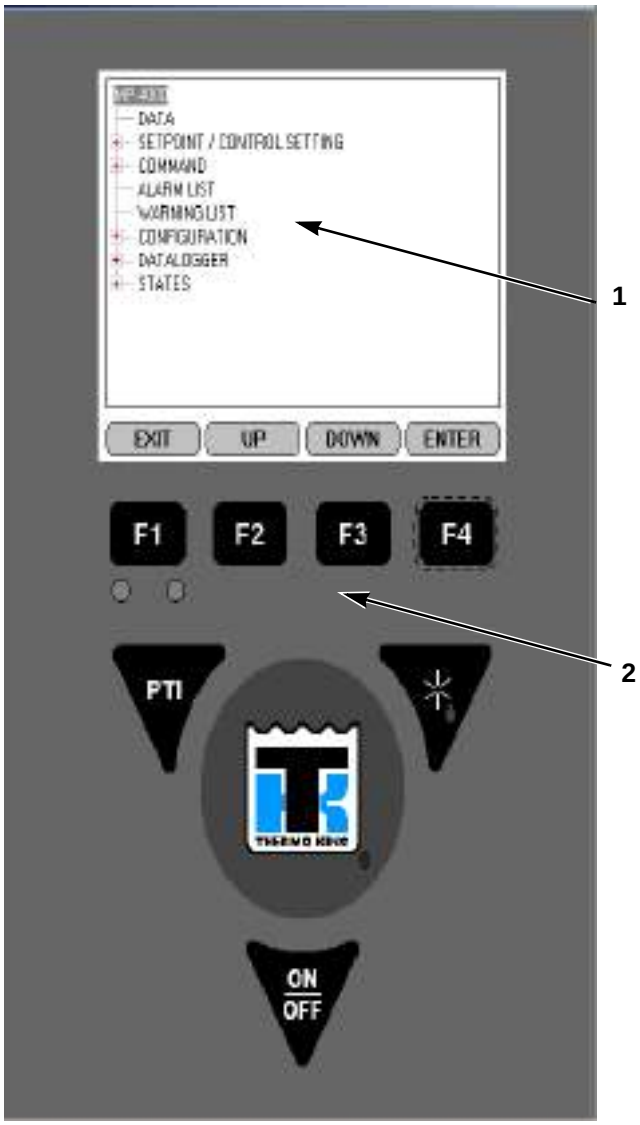
To enter the main menu Press **F4.** See next Section on Navigating the Controller Menu p. 51 for this operation

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 - 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.

Navigating the Controller Operating Menu



1.	Message Display
2.	Menu Scrolling Keys

Figure 22: MP-4000 Controller Display Panel

Menu Scrolling Keys

Moving through these eight 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 F3 **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.

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

The MP-4000 contains an extensive operating menu. The menu is navigated via the controller keypad. The Main menu is divided into eight major areas that can be navigated via keypad.

- Data Menu - Menu screens in this group are used to display unit operating information including sensor temperatures, voltage, current and frequency information.
- Setpoint Menu - Menu screens in this group are used to enter the temperature setpoint and set between Optimised/Non-Optimised mode. Setpoint menu option functions include: set Humidity Control operation and enter humidity setpoint,
- Commands Menu - Menu screens in this group are used to activate pretrip (PTI or brief PTI) tests, function tests, manual function tests, and power management.
- Alarm List Menu - Display a list of alarm code(s) present.
- Warnings List Menu - Display a list of warning code(s) present.
- Configuration Menu - Menu screens in this group display a)Unit setting - in-range setting, container ID, b) - contrast (screen), language, unit type, reefer type, evaporator type, condenser type, USDA type, and other unit settings, c)miscellaneous settings - Unit ID’s, Date/Time

- Data logger Menu - Menu screens in this group display Inspect log, set log interval, calibrate probes.
- States Menu - Gives information on the following: PTI, Input/Output, RMM, Defrost.

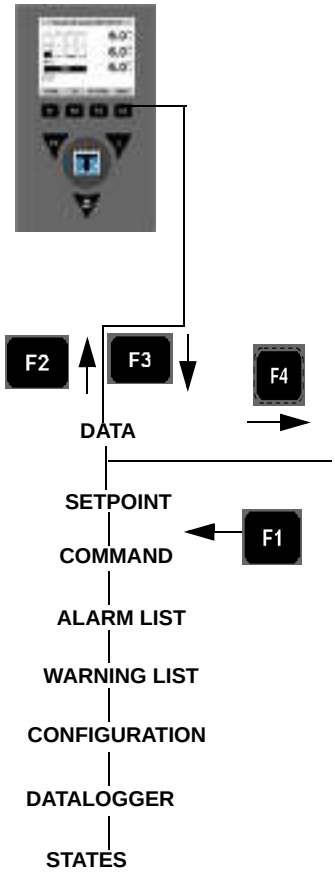
A complete listing of the controller operating menu is located on an 11’ x 17’ fold out in the Wiring and Diagram section in the back of the manual (see last page in book). It is designed to be folded out so you can continuously view it as you are learning how to navigate the MP-4000 Controller Menu. It is recommended to fold this menu out and leave it folded out until you become familiar with the controller menu.

Main Menu

Data Menu

The Data menu displays general unit operating information including sensor temperatures, unit electrical data, etc. A complete listing of the controller operating menu is located on an 11” x 17” foldout on the last page of the book.

NOTE: Information can ONLY be displayed using the Data menu. Items can NOT be changed. The screens that 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.



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

- Supply
- Return
- Evaporator
- Condensor
- Compressor
- Ambient
- Humidity
- USDA 1
- USDA 2
- USDA 3
- Cargo
- Voltage
- Current
- Curr. Ph. 1
- Curr. Ph. 2
- Curr. Ph. 3
- Frequency
- Modulation
- Fresh Air E:
- AVL Position
- Radiator
- Suct. Press
- Disch. Press
- Bat. Voltage
- Bat. c. Current
- Bat. Temp.
- Board Temp
- CO2
- O2
- pt1000 Spare

Figure 23: Data Menu

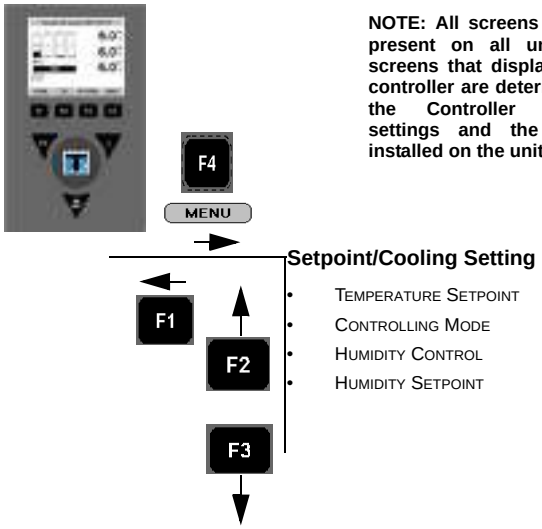
Viewing the Data Menu

With the **UNIT ON** and the Display showing the unit status display:

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the Data.
2. Press the **F4 ENTER KEY** to enter the data submenu.
3. Press the **F3** key to scroll the cursor down through the menu list (or **F2** to see previous).
4. Press the **F1** key to exit the submenu.

Supply : View display on or off value (factory default = off). Controller automatically activates when supply sensor is installed for more than 1 minute. Setting this value is not necessary.

Setpoint Menu



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

Figure 24: Setpoint Menu

The screens that 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.

Temperature Setpoint

To change the controller setpoint, turn the **UNIT ON**. Allow Unit to start and stabilise.

Complete the following steps:

1. Press the **MENU** key. Press the **F3** key to scroll down to the Temperature/Setpoint Menu. Press the **F4 ENTER KEY** to expand this menu.
2. Press the **F2/F3 UP/DOWN** keys to move the Setpoint Up or down - depending on your required Temperature.
3. Press and hold the **F4 ENTER KEY** until you are returned to the sub menu. 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.

Controlling Modes

Optimised: The default Mode for the new Magnum+ for temperature and fan control.

Non-Optimised: The default Mode for the original Magnum for temperature and fan control.

Change the Optimised/Non-Optimised Mode Setting

NOTE: Enter Setpoint temperature before turning on the Non-Optimised mode. The controller automatically turns the Non-Optimised mode off when the setpoint is changed.

1. Press the **F4 SETPOINT** key at the main screen. The Setpoint Change menu appears.
2. Press the **F2/F3 UP/DOWN** keys to scroll between Non-Optimised and Optimised Mode.
3. Press and hold the **F4 ENTER KEY** until you are returned to the main Screen. The new mode is recorded in the controller.

   NOTE: On frozen loads, the Non-Optimised mode also modifies the temperature control algorithm to extend the Null mode. See [In Range Temperature Limit] under [Configuration Menu] in this chapter to check the current settings or enter new settings.

Change the Humidity Control Setting

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the Humidity Setting Menu. Press the **F4 ENTER KEY** to expand this menu.
2. Press the **F2 OR F3 UP/DOWN** key to scroll between “OFF” and “ON”.
3. Press and hold the **F4 ENTER KEY** until the main menu screen appears again.

Change the Humidity Setpoint

1. Now press the **F3** key to scroll to the [Humidity Setpoint] line.
2. Press the **F2 OR F3 UP/DOWN** key to increase or decrease the the percentage Humidity Control required.

   NOTE: The humidity setpoint should be established by the shipper. Always check that the setpoint entered in the Display is correct before proceeding.
3. Press and hold the **F4 ENTER KEY** until the menu screen appears again. The new setpoint is recorded in the controller and appears in the display.
4. Press the **F1 EXIT** key to exit the Setpoint screen.

Commands Menu

The Commands menu displays a list of tasks that can be activated. The following commands are available:

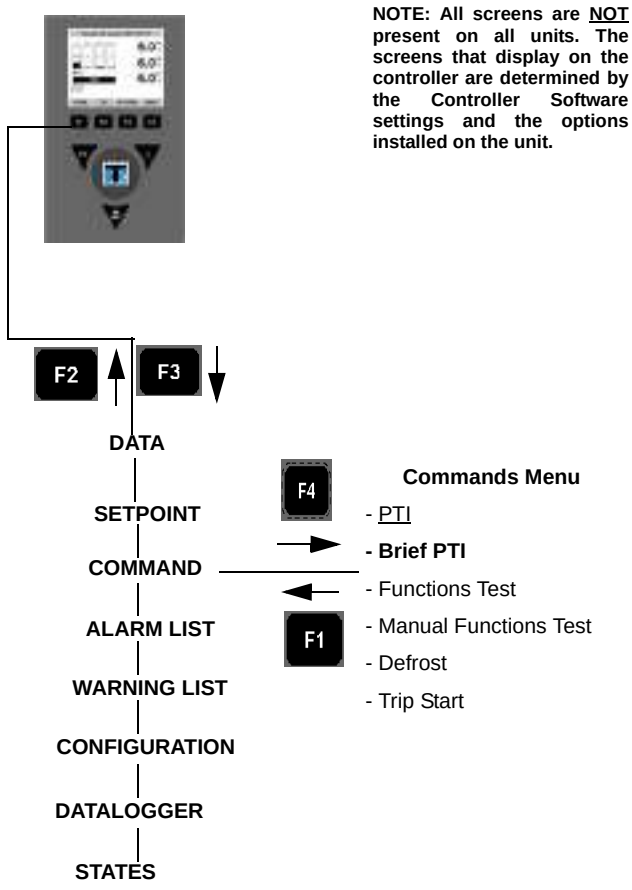


Figure 25: Commands Menu

View the Commands Menu

With the **UNIT TURNED ON** Having allowed Unit to start and stabilise. Display showing unit status display (setpoint):

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the Commands Menu.
2. Press the **F4** ENTER key to expand this menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll to desired command.
4. Press the **F4 ENTER KEY** to activate command selected.

PTI, Brief PTI, Function Test Display

This Screen shows the different states of the PTI, Brief PTI and Function Tests

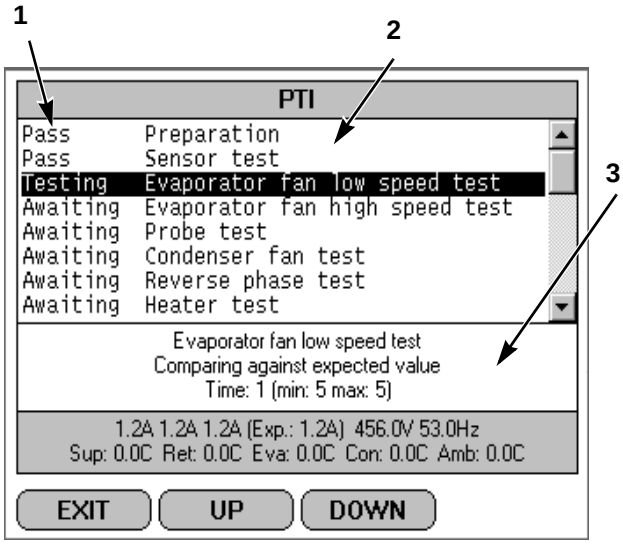


Figure 26: PTI Menu

The Screen is divided into three sections:

Section 1:

Shows the list of test to be performed and there state.

List of possible states:

1. Awaiting: the test has not yet been performed.
2. Testing: the test is ongoing.
3. Pass: the test has been tested, with the result Pass.
4. Fail: the test has been tested, with the result Fail.
5. 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.

PTI (Pretrip) Test

CAUTION: The Full PTI test 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 MP-4000 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, contactors, 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.

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.

With the **UNIT TURNED ON** Allow Unit to start and stabilise and the Display showing the unit status display (setpoint):

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the Commands Menu.
2. Press the **F4 ENTER KEY** to access the Commands menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll to "PTI ".
4. Press the **F4 ENTER KEY** to start the PTI test. Display shows PTI test currently being performed. PTI test ends automatically. Press any key on the controller to return the unit to normal operation.

See Figure 30 for the Magnum PTI Test Procedure. Detailed PTI test results are stored in the MP-4000 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.

Brief PTI (Pretrip) Test

CAUTION: The Brief PTI test 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.

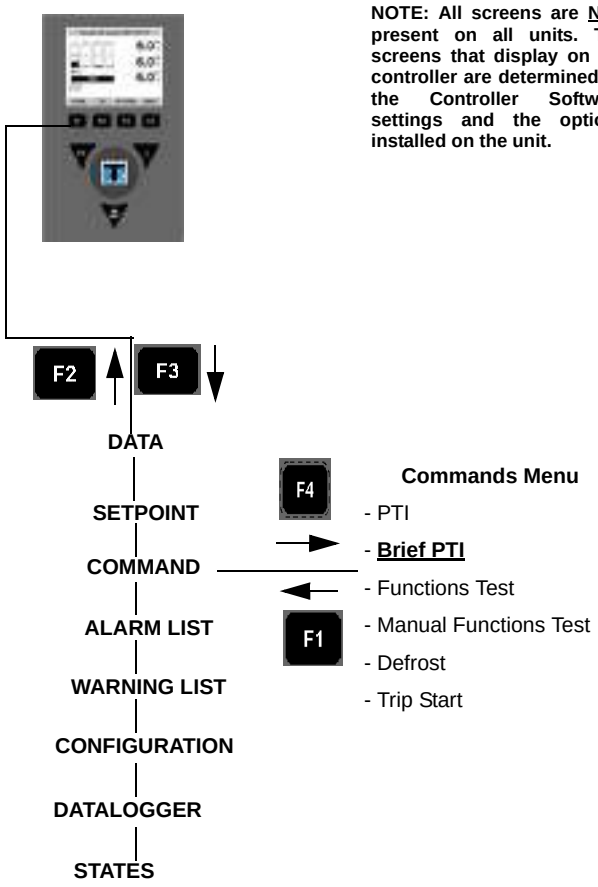


Figure 27: Brief PTI

The MP-4000 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, contactors, 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.

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

With the **UNIT TURNED ON** Allow Unit to start and stabilise and the Display showing the unit status display (setpoint):

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the Commands Menu.
2. Press the **F4 ENTER KEY** to access the Commands menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll to [Brief PTI].
4. Press the **F4 ENTER KEY** to start the Brief PTI test. Display shows PTI test currently being performed. PTI test ends automatically. Press any key on the controller to return the unit to normal operation.

See Figure 30 for the Magnum PTI Test Procedure. Detailed PTI test results are stored in the MP-4000 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.

Function Test

The MP-4000 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.

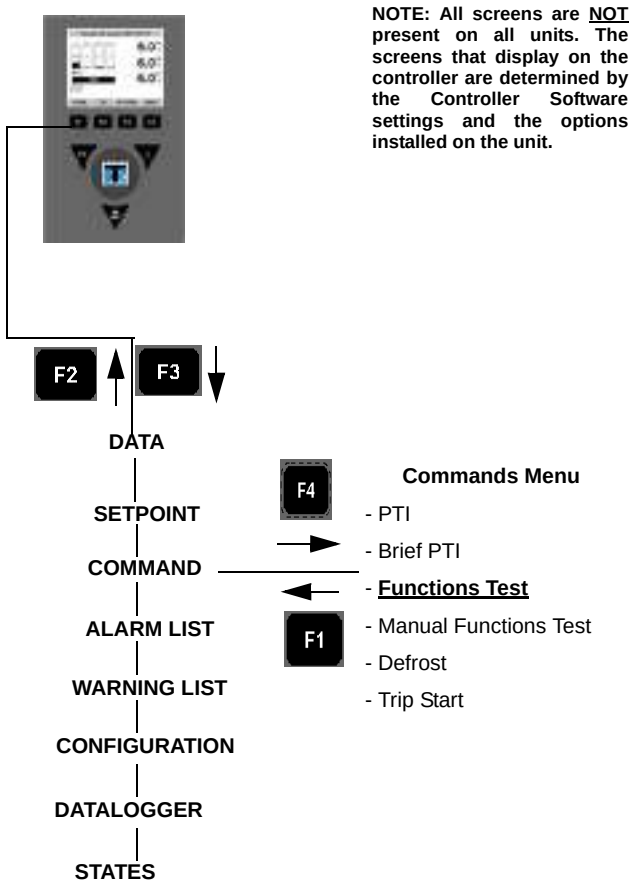


Figure 28: Function Test

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 Unit to start and stabilise and the Display showing the unit status display (setpoint):

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the Commands Menu.
2. Press the **F4 ENTER KEY** to access the Commands menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll to [FUNCTION TEST].

4. Press the **F4 ENTER KEY** to start the Function test. Display shows functional test currently being performed. Function test ends automatically. Unit automatically returns to normal operation.

See Figure 30 for the full Function Test Procedure. 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.

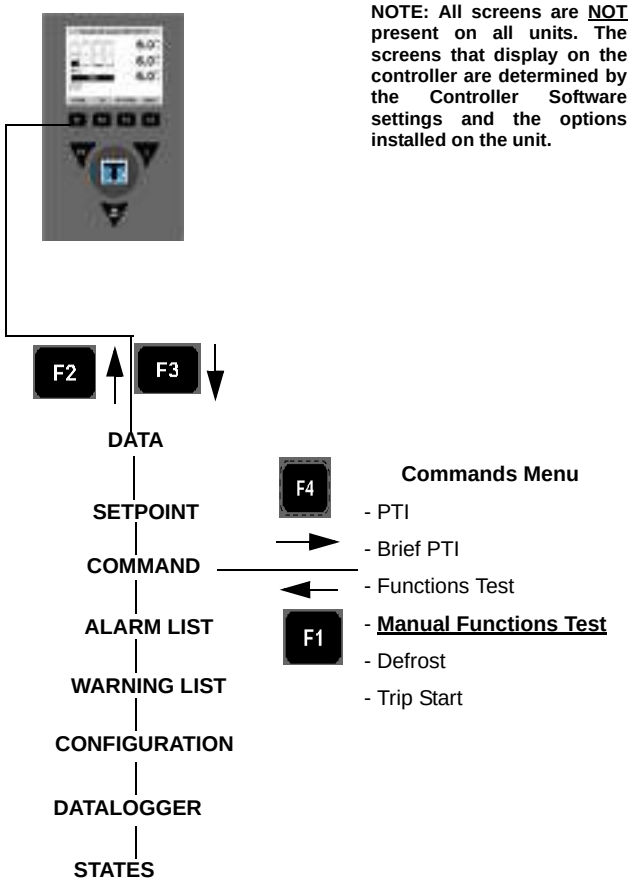


Figure 29: Manual Function Test

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 Unit to start and stabilise and the Display showing the unit status display (setpoint):

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the Commands Menu.
2. Press the **F4 ENTER KEY** to access the Commands menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll to [MANUAL FUNCTION TEST].

4. Press the **F4 ENTER KEY** to enter the Manual Function Test: [CONDENSER OFF] appears in the Display.

To test a unit component:

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 ENTER 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 ENTER 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 ENTER KEY** to turn the component on.
3. Press the **F3** key to scroll to select next component. Press the**F4 ENTER KEY** to turn 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 ENTER 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.

Figure 30: 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 PTI log.	12, 13	5 seconds	X	X	X

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
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 PTI log.	16, 17	5 seconds	X	X	X
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. Heater amperes are recorded in 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	-

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
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 5degC or above. With electric heaters turned on and evaporator fan on high speed, the test will end when return air temperature is at 5degC 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

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

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
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 degC / 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	-	-

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
MAINTAINING 0C TEST	With the unit running chilled – Non-Optimised, maintaining 0 degC / 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
PULLDOWN TO -18 C TEST	With the unit running frozen, approaching -18 degC / 0F. Probe readings and time are recorded in the pti log when started and when ended. When return air temperature is at -18 degC / 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

Display*	LED Display	Description	Possible Alarms	Duration (Time)

RUNNING PTI 0°C / 32°F 00:00:00 0.0C 10.0C 10.0C	Supply temp.	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.	None	120 minutes maximum
RUNNING PTI DEFROST 00:00:00 -18.0C 10.0C 10.0C	Return temp.	Unit operates in normal mode with -18C (0F) setpoint and defrost activated. Defrost terminates when evaporator temperature increases to 18C (65F).	20	30 minutes
RUNNING PTI -18°C / 0°F 00:00:00 -18.0C 10.0C 10.0C	Return temp.	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.	22, 60	90 minutes maximum
PTI PASS – PRESS KEY	Return temp.	Unit will remain OFF until any key is pressed. If alarms occurred during PTI, Display shows “PTI FAIL – PRESS KEY”.	None	180 minutes maximum
*** Readings may vary depending on voltage and temperature**				

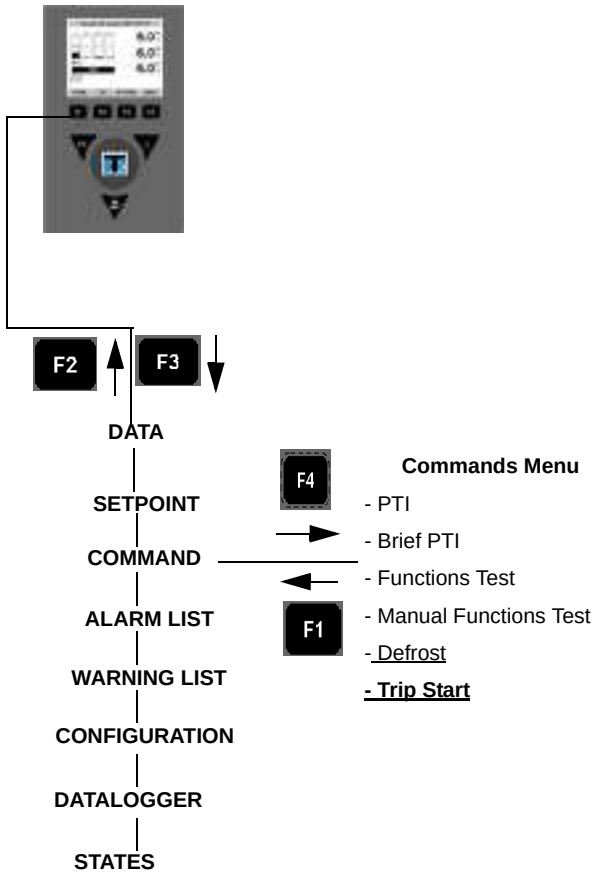


Figure 31: Commands Menu

Defrost

With the unit turned on, allow unit to start and stabilise and the Display showing the unit status display :

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the Commands Menu.
2. Press the **F4 ENTER KEY** to expand this menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll through submenu until [Defrost] appears in display.
4. Press the **F4 ENTER 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.

Trip Start

With the **UNIT TURNED ON Allow Unit to start and stabilise** and the Display showing the unit status display :

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the Commands Menu.
2. Press the **F4 ENTER KEY** to expand this menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll through submenu until [TRIP START] appears in display.
4. Press the **F4 ENTER KEY** to enter Tripstart function. The date and time of the last trip start appears in the screen.

5. Press the **F4 ENTER KEY** again to enter a new start of trip date and time in the log.

   NOTE: When a PTI test is completed, the controller automatically enters a Tripstart in the log.

6. Press the **F1** key to exit the Commands menu

Alarms/Warnings Menu

There are two types of alerts:

Warnings: Warning indicates corrective action should be taken before a problem becomes severe. When a Warning occurs the controller will try to determine if the component or input is good or bad.

The Warning description will be displayed across the top of status display and the Red LED will not be turned on. If the controls determine the component or input is bad the Warning will become an Alarm.

Alarms: Alarm indicates corrective action should be taken. Red LED flashes and unit may stop or continue to base 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.

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 1 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 1 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 Warning 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/Warning list.

A complete listing of the controller operating menu is located on an 11” x 17” fold out on the last page of this manual.

Alarm/Warning List Menu

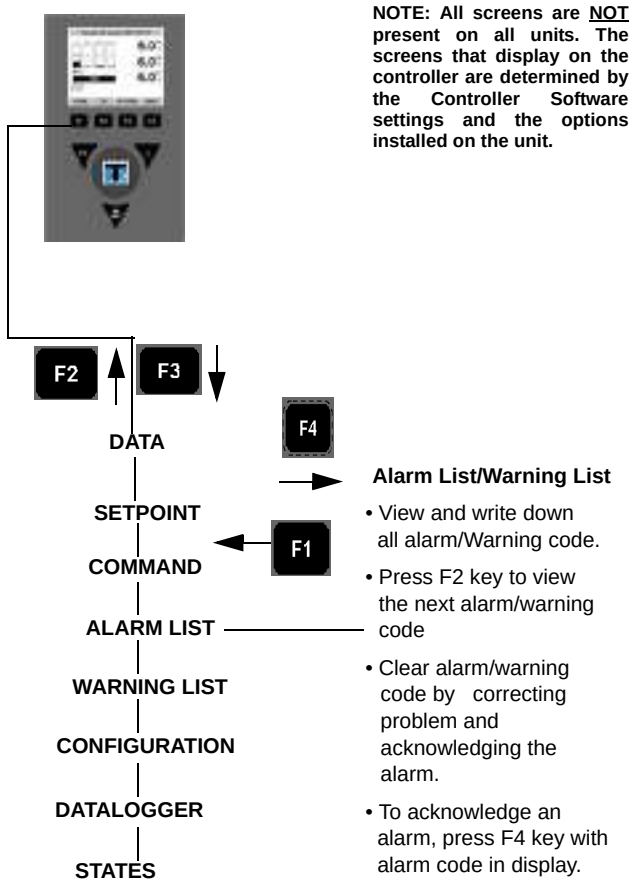


Figure 32: Alarms Menu

View the Alarm/Warning List Menu

The Alarm/Warning list 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.

With the unit turned on, allow unit to start and stabilise and the Display showing the unit status display (setpoint):

1. Press the **F1** key to directly enter Alarms/Warning menu. The first alarm code number, alarm state and alarm description appears in 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 List menu.

5. To acknowledge an alarm/warning, press **F4 ACCEPT 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

NOTE: See detailed Alarm/Warning Code list complete with corrective actions in the Diagnosing and Troubleshooting Section in the back of the manual.

Warning List Menu

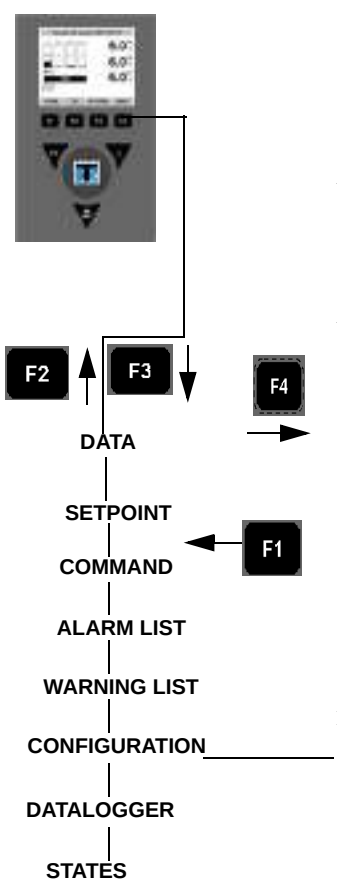
Warning Code	Action
1	Power Error, Check 20A Fuses
2	High Pressure Cutout, Check Water Cooling
3	Probe Test, Please Wait
7	High Pressure Cutout, Check Condenser Probe
9	High Pressure Cutout, Check Condenser Fan
11	Scroll Compressor, High Temperature
12	Scroll Compressor, Low Pressure
21	Total Current Too High
22	Total Current Too Low (Check Alon switch)
23	Supply Air Temperature Too High
24	Supply Air Temperature Too Low
25	Return Air Temperature Too High
26	Evaporator Coil Temperature Too High
27	Evaporator Coil Temperature Too Low

Alarm List Menu

Alarm Code	Action
00	Supply Air Sensor Open Circuit
01	Check Supply Air Sensor Short Circuit
02	Check Return Air Sensor Open Circuit
03	Check Return Air Sensor Short Circuit
04	Check Evaporator Coil Open Circuit
05	Check Evaporator Coil Sensor Short Circuit
06	Check Compressor Current Too High
07	Check Compressor Current Too Low
10	Check Heater Current Too High
11	Check Heater Current Too Low
12	Check Evaporator Fan High Speed Current Too High
13	Check Evaporator Fan High Speed Current Too Low
14	Check Evaporator Fan Low Speed Current Too High
15	Check Evaporator Fan Low Speed Current Too Low
16	Check Condenser Fan Current Too High
17	Check Condenser Fan Current Too Low
18	Log Power Supply Phase Error
19	Check Temperature Too Far from Setpoint
20	Check Defrost Time Too Long
22	Check Capacity Test 1 Error
26	Vapor Injection Valve Error
31	Low Pressure Cutout Error
32	Check Condenser Air Sensor Open Circuit
33	Check Condenser Air Sensor Short Circuit
34	Check Ambient Air Sensor Open Circuit
35	Check Ambient Air Sensor Short Circuit
43	Check Return Air Temperature
51	Check for Low Voltage
52	Check Probe Error
53	Check High Pressure Cutout Switch Off Error
54	Check High Pressure Cutout Switch On Error
56	Shutdown Compressor Temperature Too High
58	Check Phase Sensor Error
59	Check Delta Current Error
60	Check Humidity Sensor Error
98	Log Compressor Sensor Short Circuit
119	Digital Valve Error
120	Check Suction Pressure Sensor
121	Check Discharge Pressure Sensor
122	Re-calibrate O_2 Sensor
123	Check Datalogger Battery
124	Check Power Module Sensor
128	Check Supply Air Temperature Probe
129	Check Return Air Temperature Probe
130	Check Evaporator Coil Temperature Probe
131	Ambient Condition Temperature Probe Error

Configuration Menu

The Configuration menu displays a list of functions that identifies unit operating features and current settings. The following functions are available:



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

Unit Setting

- Container ID,
- In-range temperature limit,

Unit Configuration

- 20 FT. Unit
- AFAM Otpion
- Humidity Option
- Suction Pressure Option
- Discharge Pressure Option
- AVL Option
- USDA Option
- Auto Configuration

Miscellaneous Settings

- Date/Time,
- Contrast,
- Version,
- Controller ID,
- Power Module ID,
- Unit Serial ID,
- Unit ID

Figure 33: Configuration Menu

When a spare parts controller is installed and powered up for the first time, an automatic configuration feature detects the unit options installed on a unit. After the initial unit power up, the controller turns the Auto Configuration feature off. See “Replacing the Controller” in this chapter for more information.

A complete listing of the controller operating menu is located on an 11” x 17” fold out on the last page in this manual.

Viewing or Setting Functions

With the **UNIT TURNED ON** Allow Unit to start and stabilise and the display showing the unit status display:

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the CONFIGURATION Menu.
2. Press the **F4 ENTER KEY** to expand this menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll cursor to view or reset the desired function:

Container ID: Sets the container identification number. Enter up to 11 characters (numbers or letters).

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).

20 FT Option: This tells the controller that this is the option chosen.

AFAM Option: This turns on the AVL option.scroll between none and AVL.

Humidity Option: When humidity sensor is mounted you can change the setting here.

Suction Pressure Option: .When suction pressure sensor is mounted you can change the setting here.

Discharge Pressure Option: When discharge sensor is mounted/changed you can change the setting here.

AVL Option: Again if AVL sensor is mounted you can change the setting here.

USDA Option: When USDA sensor is mounted you can change the setting here.

Auto Configuration: View display on or off value (factory default = off). Set value to on to automatically configure unit to installed components.

Unit Serial ID

Is the TK serial number of the unit itself. This is a ten digit alpha / numeric entry found under the UNIT Serial Number on the Serial Plate on the unit.

Unit ID: A 12 digit alpha / numeric unit serial number (old system).

Power Module ID: An 8 digit alpha / numeric power module number - found on the power module.

Date Time: Sets the controller time and date.

Version: Displays the current software version loaded in the controller: Controller (CTRL), EPROM and program serial numbers (SER NO).

NOTE: MAGNUM units without a container number beginning with MAE, MSF or MWC must be set for USDA temperature sensing. See "USDA Type" above.

4. To set a new Configuration screen value:
   a. Press the **F4 ENTER KEY** with cursor in the desired menu line.
   b. Press the **F2 OR F3 UP/DOWN UP/DOWN** keys to scroll the value to the desired setting.
   c. Press the **F4 ENTER 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.

Set Date and Time

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the CONFIGURATION Menu.
2. Press the **F4 ENTER KEY** to access the CONFIGURATION menu. Press the **F3** key to scroll down to the Miscellaneous Settings Menu.
3. Press **F3** to scroll to the Date/Time Menu and
4. Press the **F4 ENTER KEY** to access the Date Time screen. Date Time screen appears.
5. Press the **F4 ENTER KEY** [EDIT] to edit.
6. 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.
7. Once you have scrolled the cursor through all the time and date digits, you get an option to Press the **F4 ENTER KEY** to save. Press and hold **F4** until the main menu appears.
8. Press the **F1** key to exit the Date Time screen

Datalogger Menu

The Datalogger menu contains a list of functions that display unit operating information recorded in the MP-4000 datalogger. The following functions are available:

Inspect Log: Displays results of last PTI, Event and Temperature test including component volt and amps data and sensor temperatures. Test values are recorded at the start and end of the Chilled and Frozen mode test.

Calibrate Probe (Optional): Sets a temperature offset in the controller memory to calibrate each USDA sensor to the controller.

Set Log Time Interval: Sets the data log interval (1 minute or 1/2, 1, 2 or 4 hours).

A complete listing of the controller operating menu is located on an 11" x 17" fold out on the last page of the book.

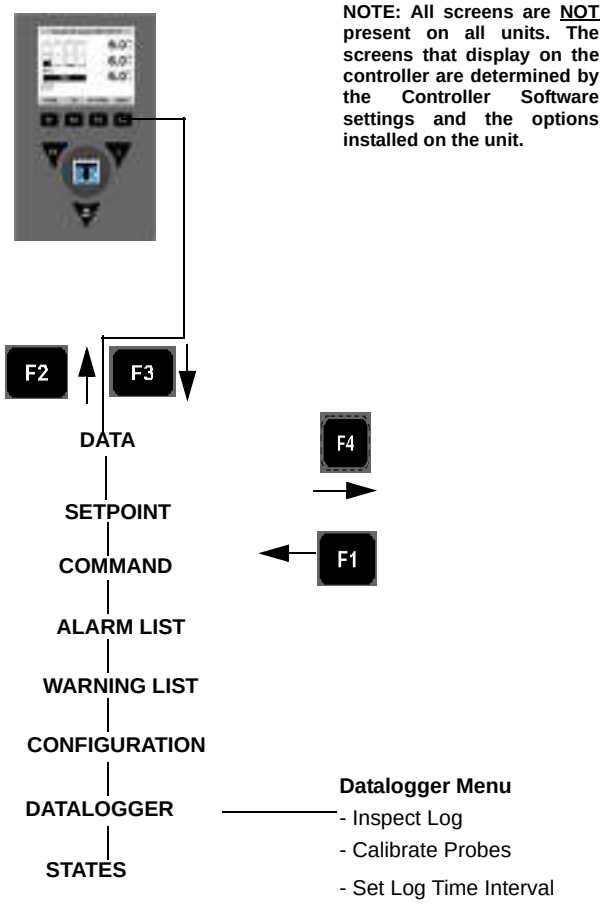


Figure 34: Datalogger Menu

Viewing the Datalogger Menu

With the **UNIT TURNED ON** Allow Unit to start and stabilise and the Display showing the unit status display (setpoint):

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the DATALOGGER Menu.
2. Press the **F4 ENTER** to access the Datalogger menu.
3. Press **F2 OR F3 UP/DOWN** key to scroll to the desired function:
   - [INSPECT LOG]
   - [CALIBRATE PROBE] (Optional)
   - [SET LOG TIME INTERVAL]
4. Press **F4 ENTER** to access the function selected.

Inspect Log

With the **UNIT TURNED ON** Allow Unit to start and stabilise and the Display showing the unit status display (setpoint):

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the DATALOGGER Menu.
2. Press the **F4 ENTER KEY** to access the Datalogger menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll through submenu TO [INSPECT LOG]
4. Press the **F4 ENTER KEY** to enter Inspect Log. Display shows the Log Time and the most recent event.
5. To scroll through test results in the log, press the **F3** key.

Event Examples

- Controller alarm status (alarms set/cleared)
- Main power On/Off status (humidity On/Off, temperature setpoint, and main power Hz)
- 12 Vdc battery discharge test (battery voltage, total unit and compressor hours if main power on) — this event logged at once a day
- Change temperature setpoint (new/old setpoint)
- Change RH setpoint (new/old RH setpoint)
- Change RH status (On/Off)
- Event log retrieval
- Temperature log retrieval
- Trip start
- New container ID
- PTI start (Unit configuration)
- PTI part 1 end (Temperature differences for tests 1, 2, 3 and heat test
- PTI end
- Defrost start (logged with demand or manual defrost only)
- Defrost end (start time)

6. Press the **F1** key to exit the log.

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 5 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 3 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 5 minutes.

2. Press the **F4 MENU** key. Press the **F3** key to scroll down to the DATALOGGER Menu.

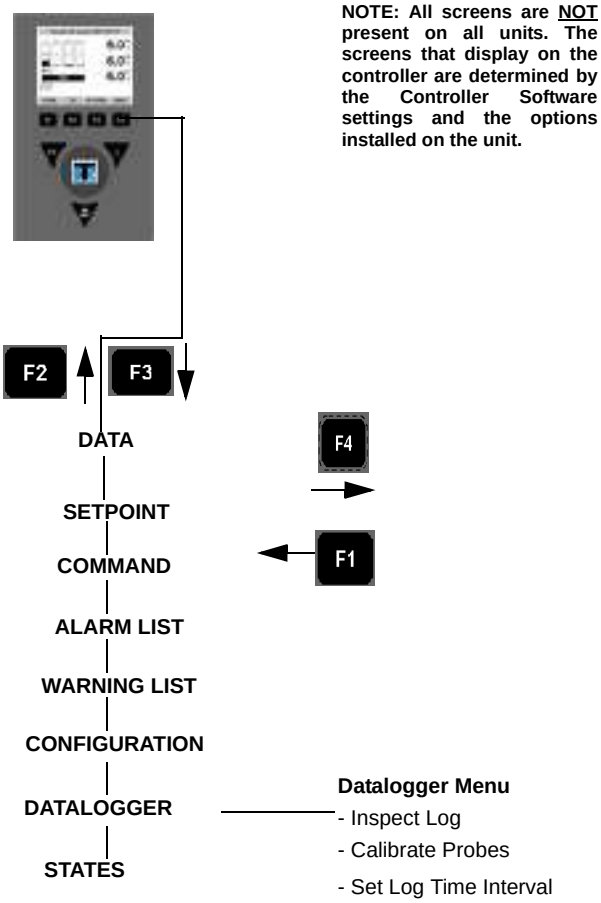


Figure 35: Datalogger Menu

3. Press the **F4 ENTER KEY** to access the Datalogger menu.
4. Press the **F2 OR F3 UP/DOWN** key to scroll through submenu to [CALIBRATE PROBE]
5. 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.

6. Press the **F3** key to release the current actual temperature offsets from the controller memory. Observe the sensor temperatures in the [CORR] row.
7. 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 5 minutes. The controller display will show the new offsets in the [RESULT] row.
8. Press the **F1** key to exit the Calibrate menu.

Set Log Time Interval

With the **UNIT TURNED ON** Allow Unit to start and stabilise and the Display showing the unit status display (setpoint):

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the DATALOGGER Menu.
2. Press the **F4 ENTER KEY** to access the Datalogger menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll through submenu to [SET LOG TIME INTERVAL]
4. Press the **F4 ENTER KEY** to enter Temp Log. Display shows the current Log Time interval.
5. Press the **F4 ENTER KEY** again with cursor in [LOG TIME] menu line to enter a new log interval. [ARROW] appears in menu line.
6. Press the **F2 OR F3 UP/DOWN** key to increase or decrease the Log Interval.

   *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.
7. When the correct Log Time appears in the menu line, press and hold the **F4 ENTER KEY** until cursor stops flashing. The new Log Time appears in the display.
8. Press the **F1** key to exit.

States Menu

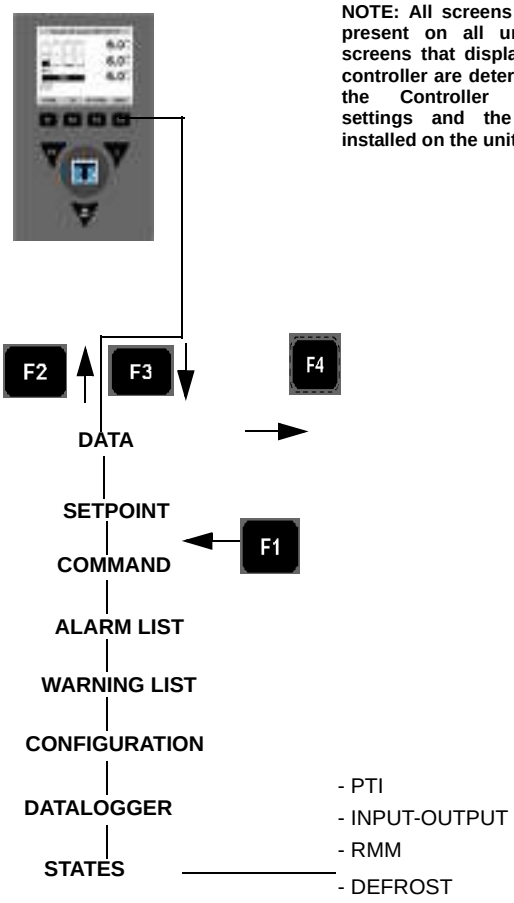


Figure 36: States Menu Screen Flow Diagram

PTI

Shows Information on the following:

- Last passed PTI
- Last passes Brief PTI
- Number of passed PTI's and Brief PTI's

Input - Output

Show's Digital Input Information:

- Phase Diirection
- HPCO
- LPCO

Output Information

- Economizer Valve
- Digital Valve
- Heater
- Evaporator Fan High
- Evaporator Fan Low
- Condenser Fan
- Compressor

RMM State

The RMM (Remote Monitoring Modem) State menu displays the current communications status with a REFCON system:

Offline: No communication between the controller RMM and a REFCON system.

Zombie: The controller has detected a REFCON system master module and is waiting for communication.

On-line: The controller RMM is logged-in on a REFCON system.

A complete listing of the controller operating menu is located on an 11" x 17" fold out on the last page of this manual.

Viewing the RMM State Screen

With the **UNIT TURNED ON** Allow Unit to start and stabilise and the display showing the unit status display :

1. Press the **F4 MENU KEY** to enter the Main menu.
2. Press the **F2 OR F3 UP/DOWN** key to scroll through Main menu until you reach [States]
3. Press the **F4 ENTER KEY** to access the STATES Menu
4. Press the **F2 OR F3 UP/DOWN** key to scroll through Main menu until you reach [RMM]
5. Press the **F4 ENTER KEY** to view the RMM states Menu.
6. Press the **ESC** key to exit the RMM State screen.

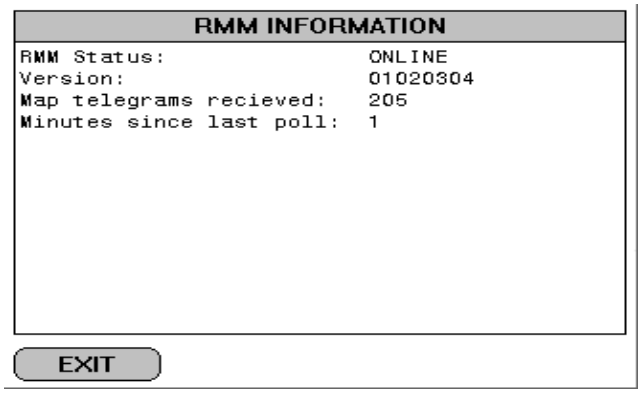


Figure 37: RMM States

Defrost

Show’s the following:

Compressor Defrost Timer [hours]

Timer Defrost timer Limit [hours]

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 Optimised Mode is set to ON, the evaporator fans operate on low and high speed.

When the Non-Optimised 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 Optimised mode is set to On, the evaporator fans operate on low speed on and off.

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.

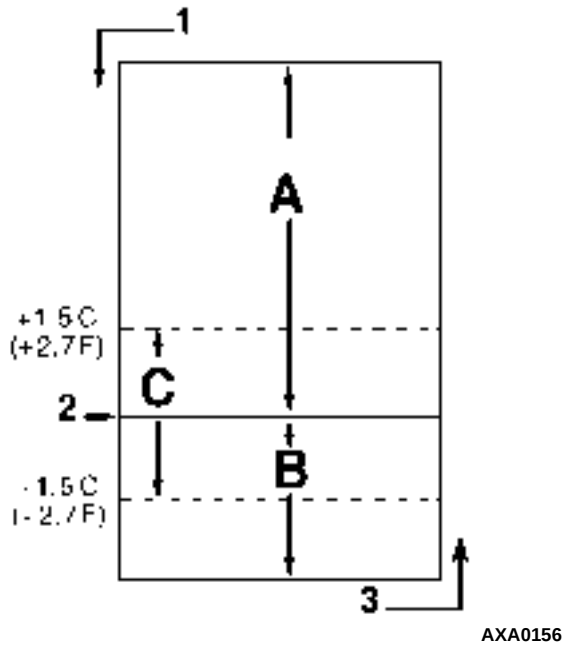
Continuous Temperature Control Operation

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 (see “General Theory of Operation” in this chapter 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:

- 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).



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

Figure 38: Chill Load Control Sequence (Setpoints at -9.9 C [14.1 F] and Above)

MAGNUM+ 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]
		•		•[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 2 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.

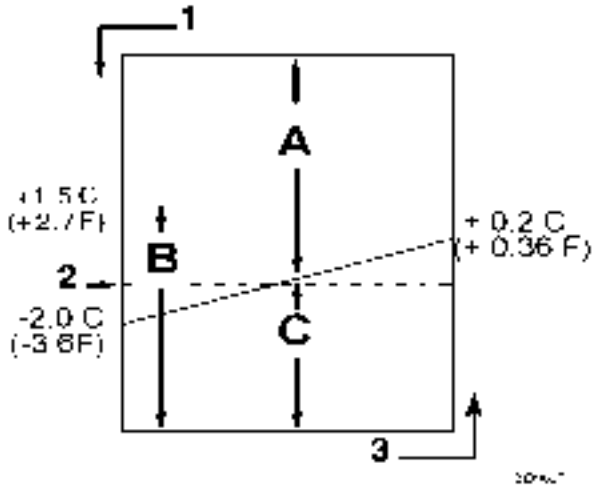
Defrost mode: Heaters are on until evaporator coil temperature increases to terminate defrost.

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.

At setpoints of -10 C (14 F) and below, 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

Figure 39: Frozen Load Control Sequence (Setpoints at -10 C [14 F] and Below)

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 MP-4000 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.

AXA0428

Figure 40: Compressor Digital Control Solenoid 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

An economizer heat exchange system replaces the conventional heat exchanger. The economizer system subcools the liquid refrigerant before it reaches the evaporator expansion valve. Subcooling liquid refrigerant increases the cooling efficiency and capacity of the evaporator.

AXA0427

Figure 41: Economizer Heat Exchanger

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 MP-4000 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.

Controller Maintenance

Flash Loading Controller Software

Controller software must be flash loaded when software has been revised. To flash load software complete the following steps:

1. Load the New Software on an SD card.
2. Open the controller door.
3. On the side of the controller there is an SD slot.
4. Put the SD card into the slot. The controller will automatically upload the software (if it is a newer version than the one already in use) and restart the unit.
5. Remember to ensure you still have the correct settings.
6. The SD card can be removed when the unit has re-started.

Controller Replacement

1. Turn the **UNIT ON/OFF** switch **OFF**.
2. Turn the unit 460/380V main circuit breaker off.
3. Disconnect the unit power cord from the power supply.

WARNING: 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.

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 ensure they are fully seated.
9. Review the Configuration Menu instructions in the operating section. Reset information as required.
10. Review the Misc. Functions Menu instructions in the operating section. Reset information as required.

NOTE: Be sure to enter the container ID before releasing the unit for service. The container ID is required to identify the data downloaded from the controller datalogger.

NOTE: 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.

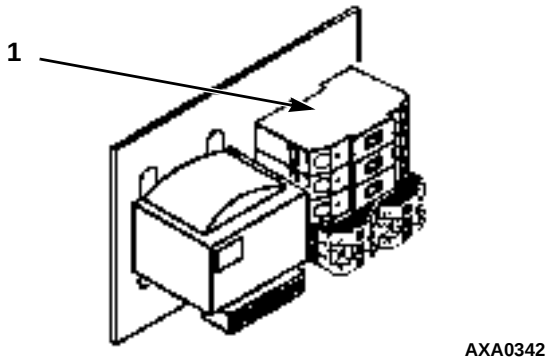
Unit Protection Devices

Introduction

The unit has numerous protection devices. They are described in detail on the following pages.

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

Figure 42: Main Circuit Breaker

Evaporator Overheat Protection

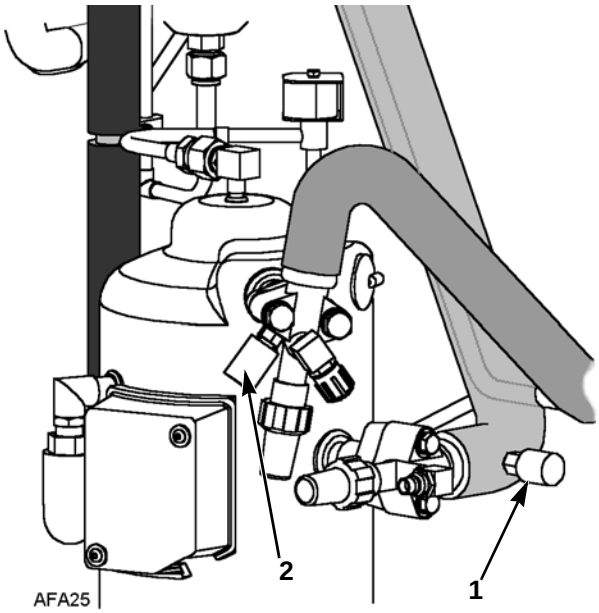
The Heater are protected from overheating surveillance from the supply, return and evaporator sensor.

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 3 seconds.
- After 1 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

Figure 43: Low and High Pressure Cutout Switches

- 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 5 minutes, the controller also turns on the Alarm indicator and records Alarm 37 (Total Power Consumption Too Low).

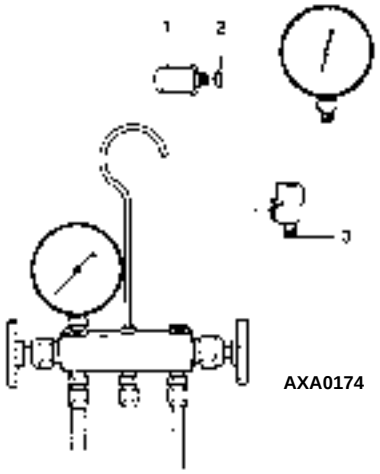
High Pressure Cutout Switch:

- Opens: 3243 ± 7 kPa, 32.43 ± 0.48 bar, 470 ± 7 psig.
- Closes: 2586kPa, 25.9 bar, 375 psig.

To test the switch, rework a gauge manifold per “High Pressure Cutout Manifold” illustration.

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.



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

Figure 44: High Pressure Cutout Manifold

3. Raise the discharge pressure of 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. Be sure to remove the cardboard installed in step 3.

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

High Pressure Cutout Switch Removal

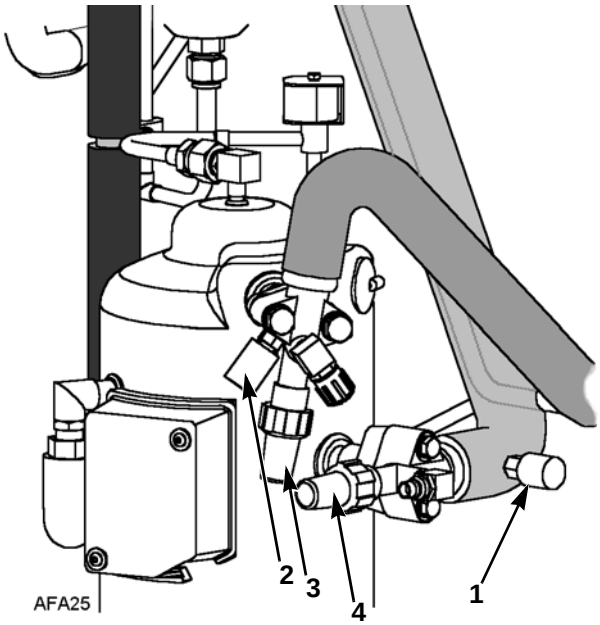
Remove the high pressure cutout switch by performing the following steps:

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. (see “Recovering Refrigerant from the System).
3. Disconnect the high pressure cutout switch wires from the control box.
4. Remove the high pressure cutout switch from the compressor flange.

High Pressure Cutout Switch Installation

Install the high pressure cutout switch by performing the following steps:

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 (see “Evacuation and Cleanup of the Refrigeration System”).



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

Figure 45: Low and High Pressure Cutout Switches

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

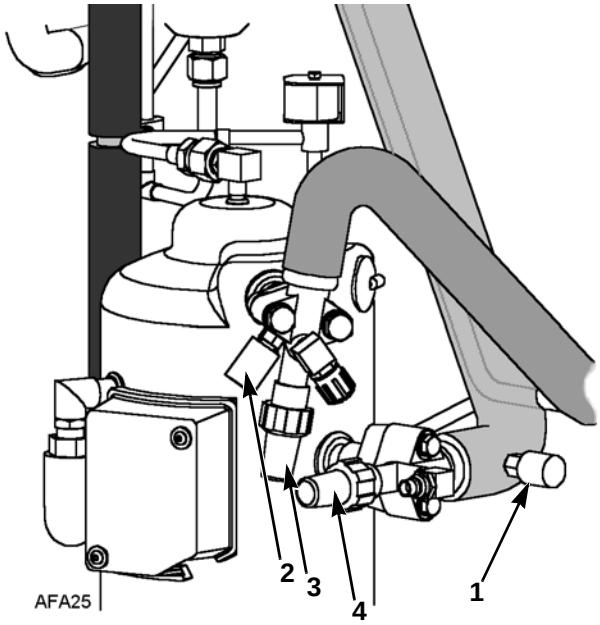
A low pressure cutout switch is located on the compressor suction line. If the suction pressure becomes too low, the switch opens to stop the compressor:

- 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.

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.

Low Pressure Cutout Switch Removal



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

Figure 46: Low and High Pressure Cutout Switches

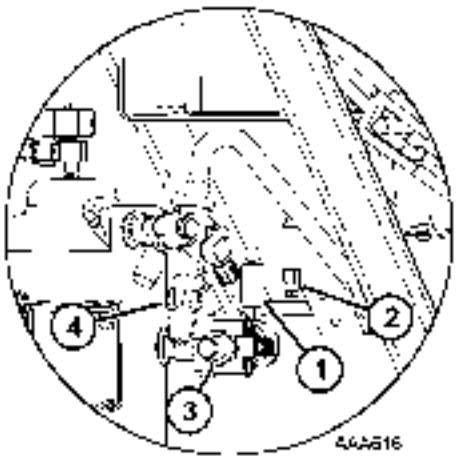
Remove the low pressure cutout switch by performing the following steps:

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.

Low Pressure Cutout Switch Installation

Install the low pressure cutout switch by performing the following steps:

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 Pressure Sensor
2.	Discharge Pressure Sensor
3.	Suction Service Valve
4.	Discharge Service Valve

Figure 47: Pressure Sensor Location

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 (see “Configuration Menu” in the Operating Instruction chapter in this manual).

Discharge and Low Pressure Sensors Removal

Remove the discharge or suction sensor by performing the following steps:

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.

Discharge and Low Pressure Sensor Installation

Install the discharge and low pressure sensor by performing the following steps:

1. Apply Locktite to fitting threads (Red 277).
2. Install sensor on fitting.
3. Route wire harness to control box and connect per 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, see 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 fans rotate backwards on one or both speeds, see 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 complete the following steps:

1. Turn the unit 460/380V main circuit breaker off.
2. Disconnect unit power cord from power supply.

WARNING: 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.

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 stabilise.
6. Check condenser airflow again to confirm correct fan rotation.

Electric Heaters Malfunction

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 3 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.

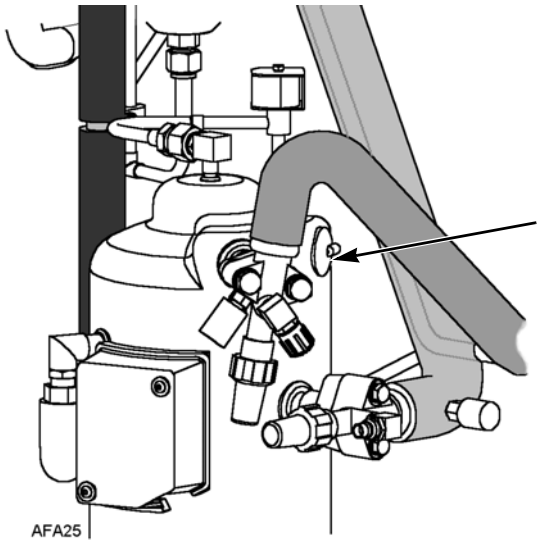


Figure 48: Compressor Discharge Temperature Sensor

Compressor Discharge Gas 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).

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.

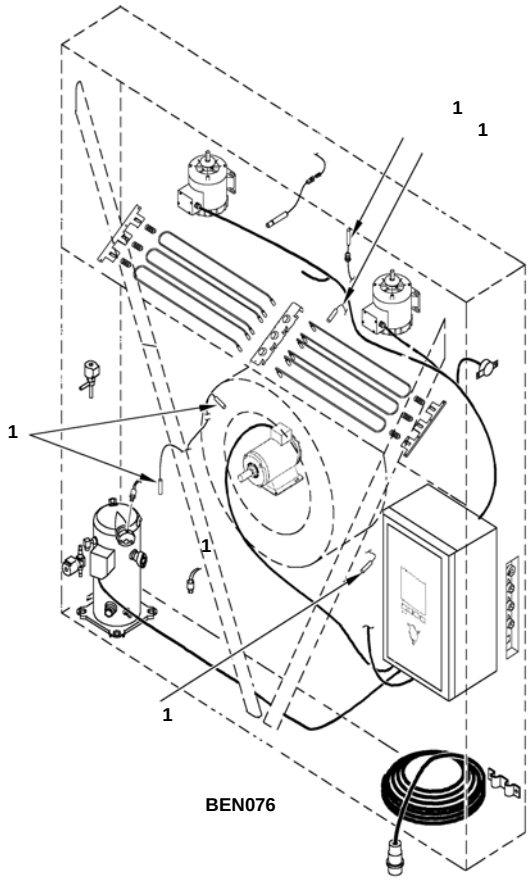


Figure 49: Temperature Sensors

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:

- Supply Air
- Return Air
- Evaporator Coil
- Condenser Coil
- Compressor Discharge Temperature Sensor
- Ambient Air

Installing Temperature Sensors

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. See “Compressor Discharge Temperature Sensor Replacement” in the chapter for Refrigeration System Diagnosis and Service.

Testing the Sensors

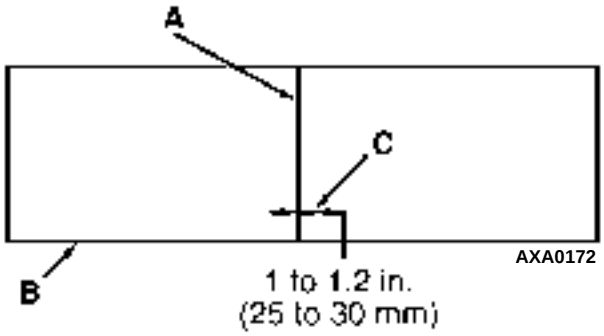
The controller constantly monitors the left hand and right hand supply sensors, return sensor and defrost (evaporator coil) sensor to determine when to initiate a demand defrost. If a demand defrost is requested and defrost has occurred within the last 90 minutes, the controller initiates a probe test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

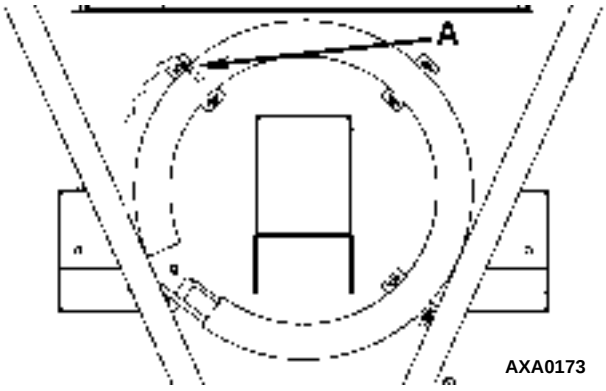
Sensor errors recorded during a probe test are cleared when the next Defrost is initiated or Unit On/Off switch is turned Off.

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



A.	Coil Support Bracket
B.	Unit Front
C.	Insert Sensor at least 75 mm into coil between Tube Rows 2 and 3.

Figure 50: MAGNUM+ Evaporator Coil (Defrost) Sensor Location



A.	Insert Sensor into condenser coil between Tube Rows 1 and 2

Figure 51: Condenser Coil Sensor Location

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.

1. Resistance Values for Supply, Return, Evaporator Coil, Condenser Coil and Ambient Air Sensors

Figure 52: Resistance Values for temperature sensors

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

2. Resistance Values for Compressor Discharge Sensors

Temp. F	Temp. C	Ohms	Temp. F	Temp . 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: All regulated refrigeration service procedures must be performed by an EPA certified technician, using approved equipment and complying with all Federal, State and Local laws.

Use the Correct Tools

CAUTION: Use only those service tools certified for and dedicated to R-404A refrigerant and Polyol Ester based compressor oils (i.e., vacuum pump, refrigerant recovery equipment, gauge hoses, and gauge manifold set). Residual non-HFC refrigerants or non-Ester based oils will contaminate HFC systems.

Use the Correct Vacuum Pump

A two-stage (refer to Tool Catalog), 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 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.

Use 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 systems.

Use the Correct Refrigerant Recovery Equipment

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

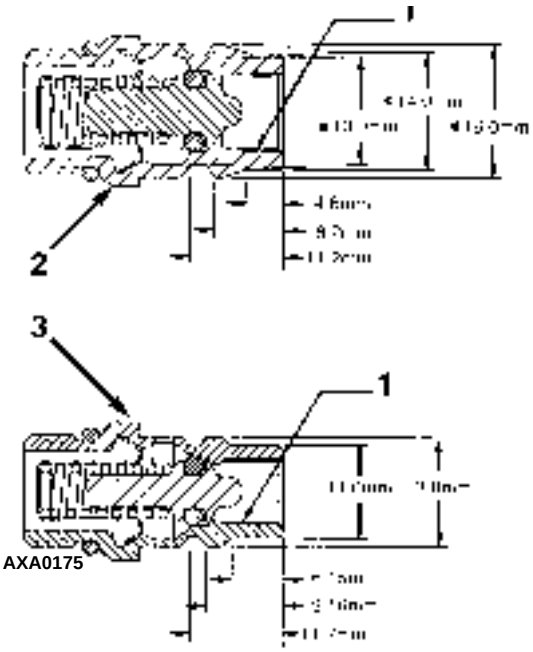
Detecting Leaks

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

Locating 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

Figure 53: Service Fittings Specifications

Perform an 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.

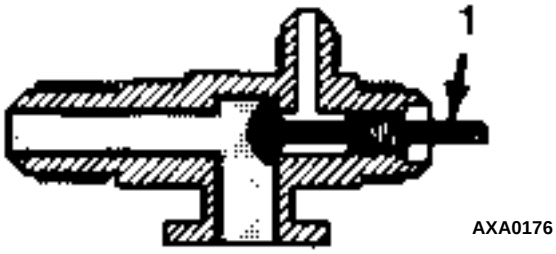
Isolate the Compressor

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.

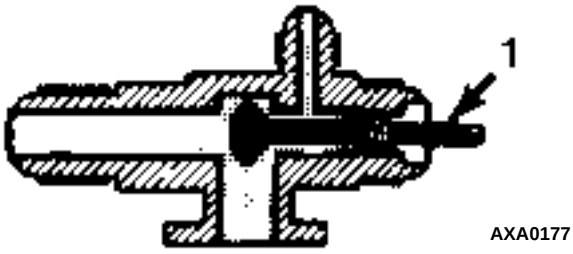
- Back Seated: Normal operation position.
- Open to Service Port: Position for servicing.
- Front Seated: To check or remove compressor.

WARNING: Do not start unit with discharge valve in Front Seated position.



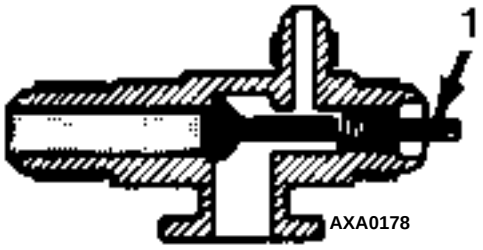
1.	Full Counterclockwise

Figure 54: Service Valve Back Seated



1.	1/2 Turn in

Figure 55: Service Valve Open to Port



1.	Full Clockwise

Figure 56: Service Valve Front Seated

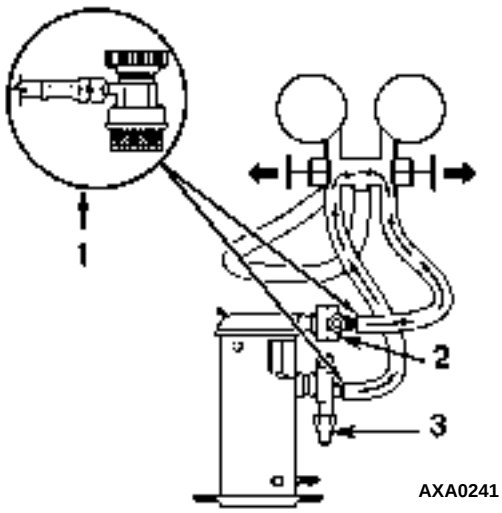
Working with a Gauge Manifold

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-404refrigerant.

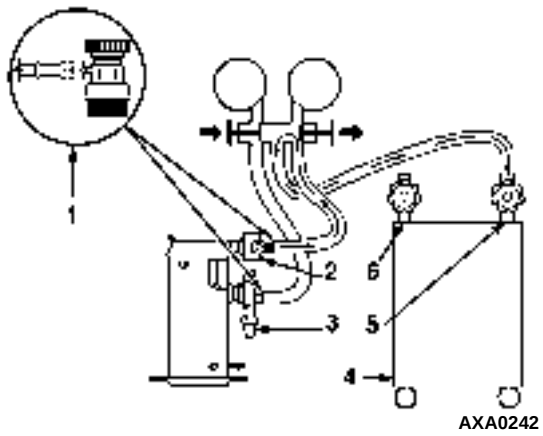
Gauge Manifold Valve Positions

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



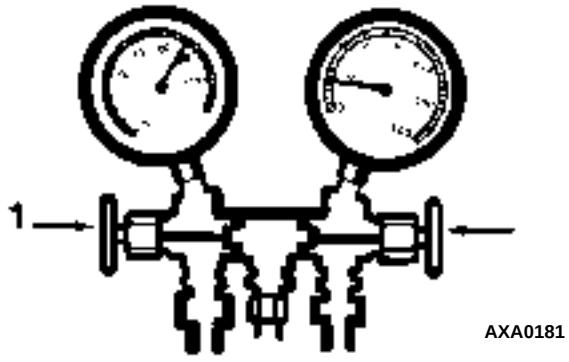
1.	Quick Disconnect Access Valve
2.	Discharge Service Valve (DSV)
3.	Suction Service Valve (SSV)

Figure 57: Balancing the Pressure



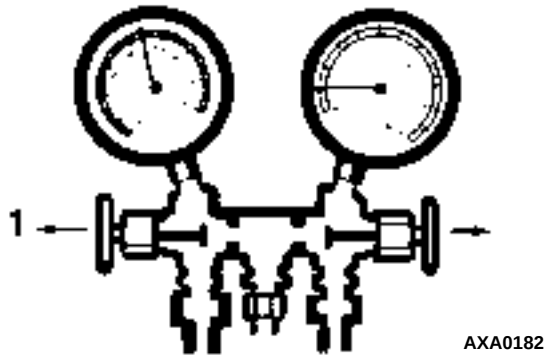
1.	Quick Disconnect Access Valve
2.	Discharge Service Valve (DSV)
3.	Suction Service Valve (SSV)
4.	Reclaimer
5.	In
6.	Out

Figure 58: Removing Refrigerant



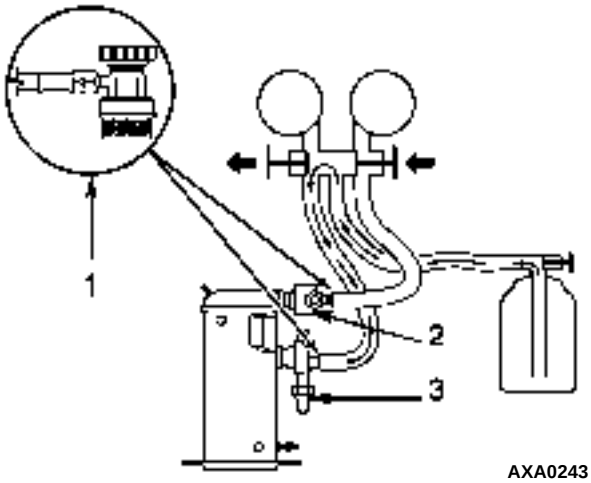
1.	Close Hand Valves

Figure 59: Gauge Manifold Closed to Center Port



1.	Open Hand Valves

Figure 60: Gauge Manifold Open to Center Port



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

Figure 61: Charging the System

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

NOTE: Carefully check to ensure that access connections are functioning properly when any of these devices are used.

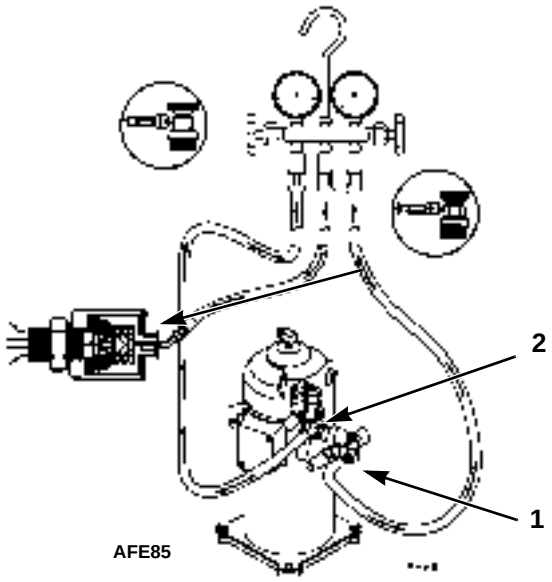
Gauge Manifold Set Installation

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.



1.	Suction Connection
2.	Discharge Connection

Figure 62: Purging Gauge Manifold

Removing the Gauge Manifold Set

NOTE: THE SYSTEM SHOULD BE RUNNING to ensure 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.

   CAUTION: Rubber gloves are recommended when handling Ester based compressor oil.

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 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 charge level is correct.
2. If the ball is not floating in the sight glass, the unit may be low on R-404A charge. Adjust the controller setpoint to operate the unit on cool. Operate the unit on cool for 5 minutes. If the ball floats in the receiver tank sight glass, the R-404A charge level is correct.

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

3. If the ball in the receiver tank sight glass does not float after operating the unit on cool for 5 minutes, the unit is low on R-404A charge. With the unit operating on cool, add liquid R-404A charge. With the unit operating in cool, add liquid R-404A 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 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).

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

Figure 63: Receiver Tank Sight Glass

Leak Testing the 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 (see “Gauge Manifold Set Attachment and Purging” 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. See “Using Pressurized Nitrogen” in this chapter.
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.

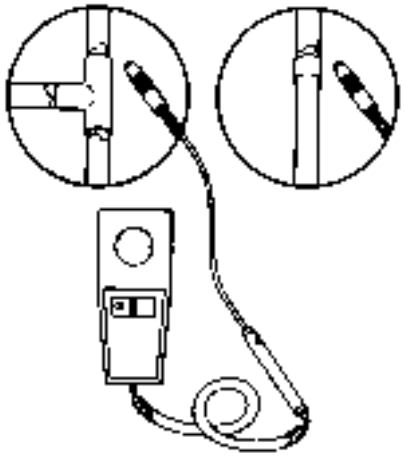
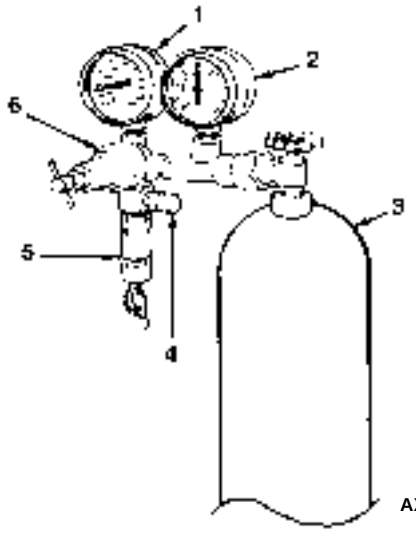


Figure 64: Test for Refrigerant Leaks

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.



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

Figure 65: Typical Pressurized Gas Bottle with Pressure Regulator and Gauges

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: 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 (N_2). The proper equipment and application of equipment is of greatest importance.

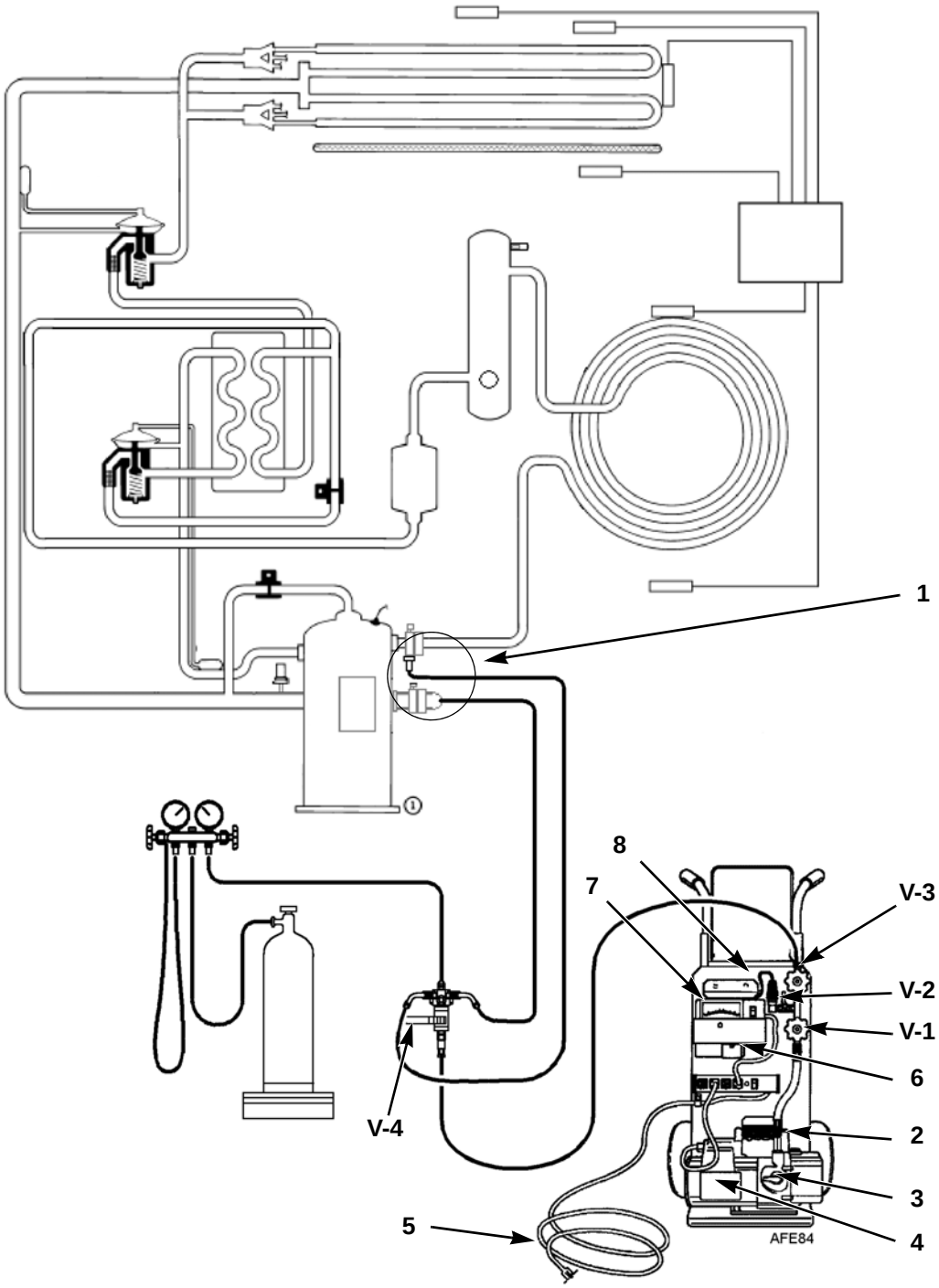
Purge High Side to Low Side

1. Attach gauge manifold set (see “Gauge Manifold Set Attachment and Purging” 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.



1.	Special, self-sealing quick disconnect couplers are required for R-404A units.
2.	Gas Ballast Valve
3.	Iso Valve
4.	Two-stage Vacuum Pump
5.	To 220/190 VAC Power
6.	Calibration Standard
7.	Micron Meter
8.	Sensor

Figure 66: Evacuation Station and Unit Hook-up

Recovering Refrigerant from the System

CAUTION: Use only refrigerant recovery equipment approved for and dedicated to R-404A 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 the 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: 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 Figure 66 on page 103. 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.

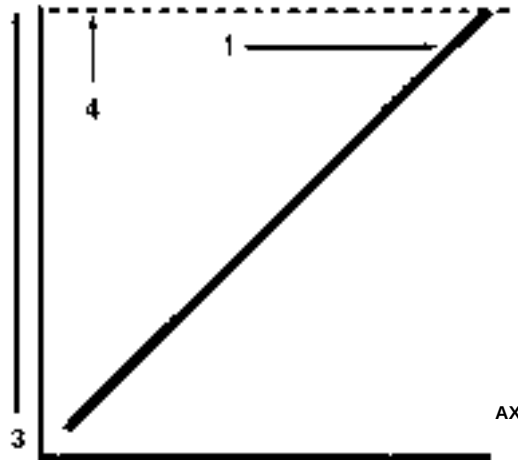
NOTE: The presence of refrigerant in the compressor oil may prevent a low vacuum reading from being achieved. Compressor oil can continue to outgas for long periods of time.

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 5 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 5 minutes, the unit is ready to charge. See “Charging the System with Refrigerant”.

Pressure Rise Test

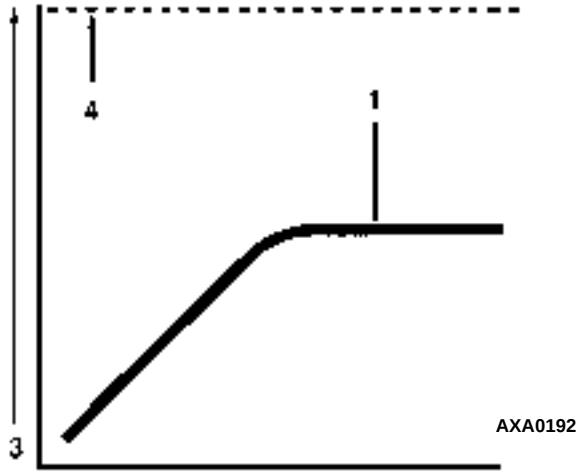
Evacuate the system and close valve V1. With valves V3 and V4 open, the pump is isolated and the system is held under a vacuum. If the micron meter rises, one of the following conditions exist:

- 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 (see “Pressure Rise Test Evaluation” in this chapter).
- 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. See Figure 68 “Pressure Rise Levels Off After Evacuation Indicates Moisture in System”.



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

Figure 67: Constant Pressure Rise After Evacuation Indicates System Leak



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

Figure 68: Pressure Rise Levels Off After Evacuation Indicates Moisture in System

Factors Affecting the 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

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.

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

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 the 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 (see “Evacuation Station and Unit Hookup” in this chapter).
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

Remove the Evacuation Station by performing the following steps:

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

Compressor Removal

Remove the compressor by performing the following steps:

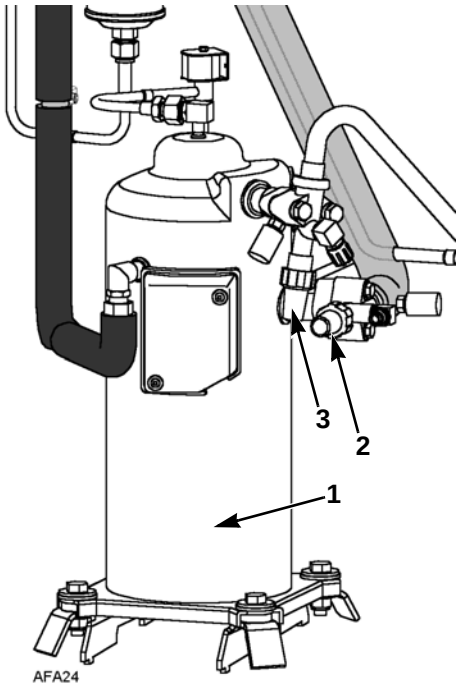
1. Remove the compressor compartment bracket.
2. Isolate the compressor from the system.
   a. Front seat the discharge service valve by turning the valve fully clockwise.
   b. Front seat the suction service valve by turning the valve fully clockwise.
   c. Turn the digital service valve one quarter turn to the right.

   See “Isolate the Compressor” on page 96. for additional information.
3. Recover the refrigerant charge from the compressor. (see “Recovering Refrigerant from the System” on page 104).
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.

Compressor Installation

Install the compressor by performing the following steps:

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.



1.	Scroll Compressor
2.	Suction Service Valve
3.	Discharge Service Valve

Figure 69: Scroll Compressor

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 (see “Refrigerant Leak Test Procedure” in this chapter).
6. If no leaks are found, recover the refrigerant used for the leak test (see “Leak Test Procedures” in this chapter).
7. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
8. Connect three-phase electric power to the compressor.
9. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
10. Perform a controller pretrip test to verify system operation.

Condenser Coil Replacement

Condenser Coil Removal

Remove the condenser coil by performing the following steps:

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.

Condenser Coil Installation

Install condenser coil by performing the following steps:

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.

   NOTE: It's strongly recommended that dry nitrogen be used to purge the system during any solder operations (see "Using Pressurized Nitrogen" in this chapter).
4. Perform a controller pretrip test to verify system operation. Check compressor oil level.
5. Pressurize the system and test for leaks (see "Refrigerant Leak Test Procedure" in this chapter). Repair leak if required.
6. Recover the leak test gas if no leaks were found.
7. Evacuate the system (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
8. Replace the condenser coil support brackets, condenser fan shroud and condenser fan grille.
9. Recharge the unit with R-404A (see "Charging the System with Refrigerant" in this chapter).

Filter Drier/In-line Filter Replacement

Filter Drier/In-line Filter Removal

Remove the filter drier/in-line filter by performing the following steps:

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.

Filter Drier/In-line Filter Installation

Install the filter drier/in-line filter by performing the following steps:

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 (see "Refrigerant Leak Test Procedure" in this chapter). Repair leaks if required.
7. Recover the refrigerant used for the leak test if no leaks were found.
8. Evacuate the system (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
9. Recharge the unit with R-404A (see "Charging the System with Refrigerant" in this chapter).
10. Perform a controller pretrip test to verify system operation.

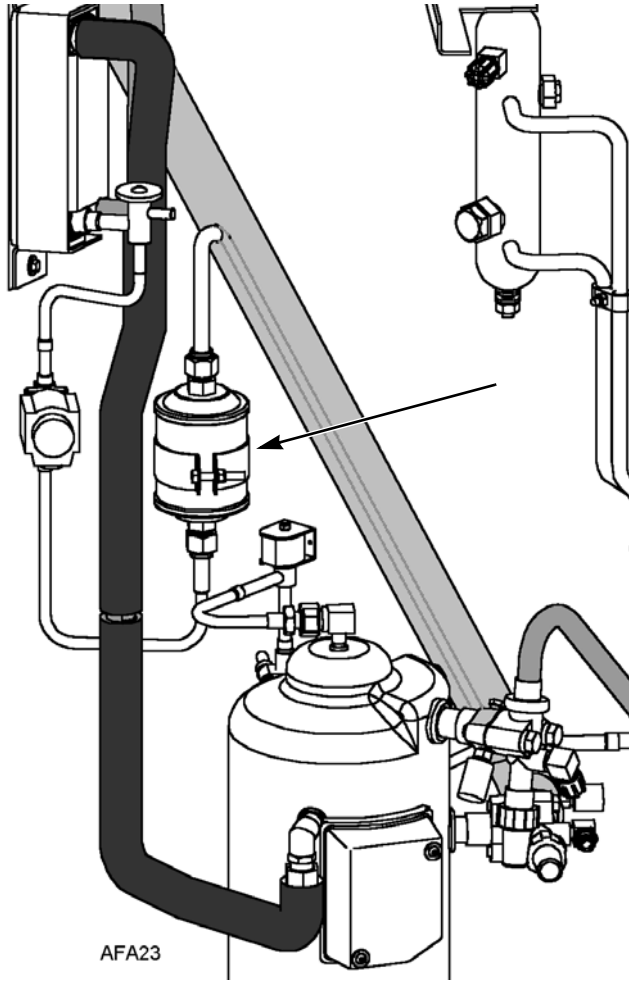
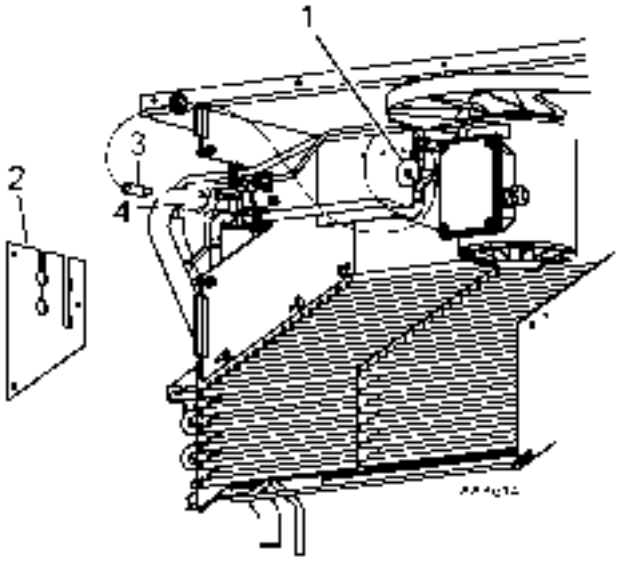


Figure 70: Filter Drier

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.



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

Figure 71: TXV Valve and Element Location

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 (see “Refrigeration Leak Test Procedure” in this chapter). Repair leak if required.
12. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
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 R404A (see “Charging the System with Refrigerant” in this chapter).
17. Perform a controller pretrip test to verify system operation.

Economizer Expansion Valve Replacement

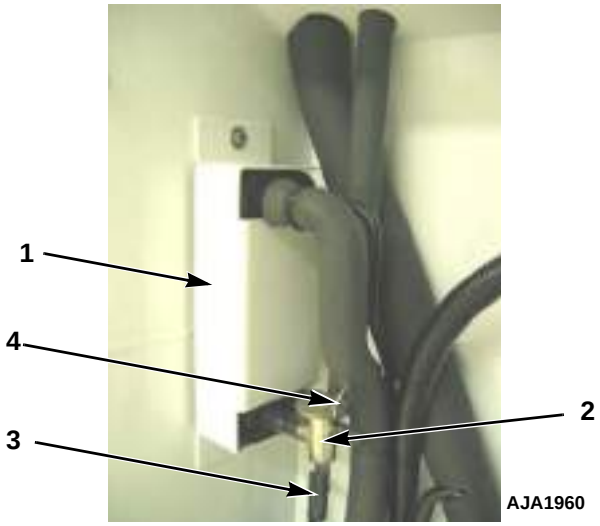
Economizer Expansion Valve Removal

Remove the economizer expansion valve by performing the following steps:

1. Recover the refrigerant charge from the unit (see “Recovering Refrigerant from the System” on page 104).
2. Unclamp feeler bulb from the suction line in the condenser section.
3. Heat and unsolder the inlet and outlet lines from economizer expansion valve.unit.
4. Remove economizer expansion valve from unit.

Economizer Expansion Valve Installation

1. Install the economizer expansion valve by performing the following steps:
2. Clean the inlet and outlet lines for soldering.
3. Place new economizer expansion valve in position.



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

Figure 72: Economizer Expansion Valve and Heat Exchanger

4. Solder inlet and outlet line connections to economizer expansion valve.

NOTE: Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (see “Using Pressurized Nitrogen” in this chapter).

5. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
6. If no leaks are found, recover the refrigerant used for the leak test (see “Recovering Refrigerant from the System” on page 104).
7. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
8. Locate feeler bulb in former position. The feeler bulb must make good contact or operation will be faulty. Cover with insulating tape.
9. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
10. Perform a controller pretrip test to verify system operation and correct feeler bulb installation.

Economizer Heat Exchanger Replacement

Economizer Heat Exchanger Removal

Remove the economizer heat exchanger by performing the following steps:

1. Recover the refrigerant charge from the unit (see “Recovering Refrigerant” in this chapter).
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.

Economizer Heat Exchanger installation

Install the heat exchanger by performing the following steps:

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.
3. Solder the liquid and suction lines to the economizer heat exchanger.
4. Pressurize the low side and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
5. If no leaks are found, recover the leak test gas (see “Refrigerant Leak Test Procedure” in this chapter).
6. Evacuate the low side (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
7. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
8. Perform a controller pretrip test to verify system operation.

NOTE: Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (see “Using Pressurized Nitrogen” in this chapter).

Receiver Tank/ Water-Cooled Condenser Tank Replacement

Tank Removal

Remove the old tank by performing the following steps:

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.

Tank Installation

Install the new tank by performing the following steps:

1. Install a new tank in the unit and tighten the mounting bolts.
2. Solder the inlet line and outlet line connections.

   NOTE: It is strongly recommended that dry nitrogen be used to purge the system during any solder operations (see “Using Pressurized Nitrogen” in this chapter).
3. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
4. If no leaks are found, recover the refrigerant used for the leak test.
5. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
6. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
7. Perform a controller pretrip test to verify system operation.

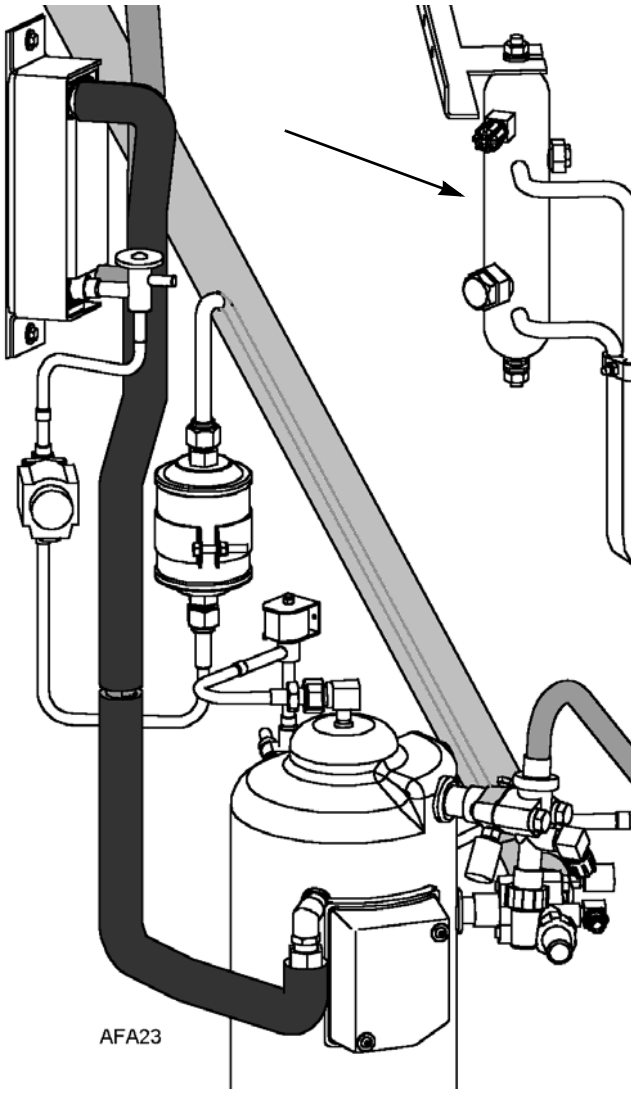


Figure 73: Receiver Tank

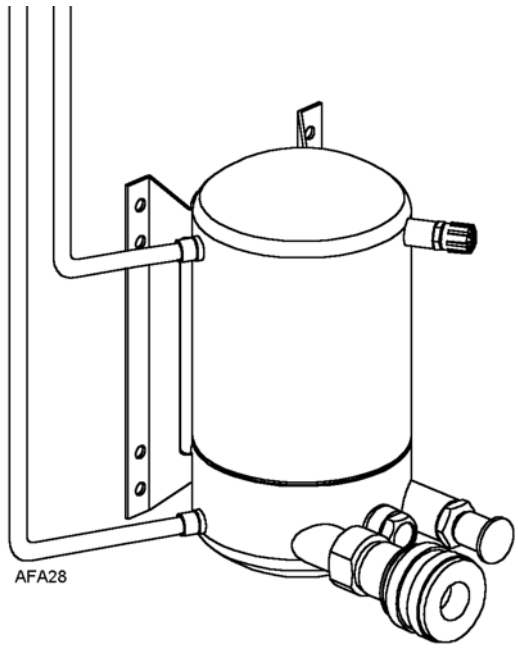


Figure 74: Water-Cooled Condenser Tank

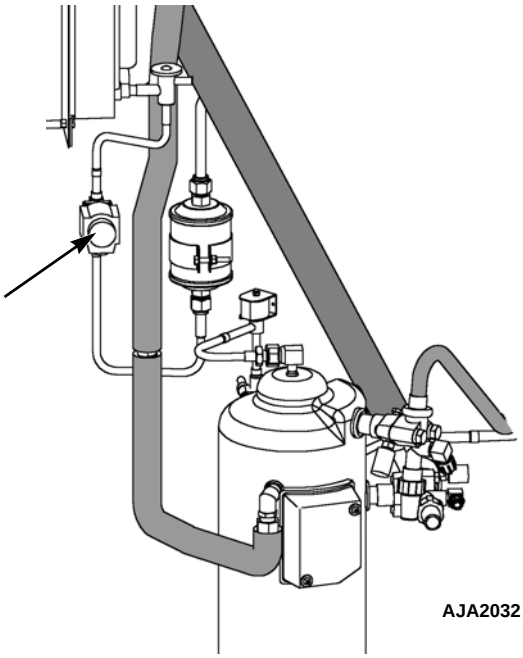


Figure 75: Vapor Injection Valve

Vapor Injection Valve Replacement

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

Valve Removal

To remove the vapor injection valve, perform the following steps:

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.

Valve Installation

To install the vapor injection valve, perform the following steps:

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

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

3. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter). Repair leak if required.
4. Recover the refrigerant used for the leak test if no leaks were found.
5. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
6. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
7. Perform a controller pretrip test to verify system operation.

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

Compressor Digital Control Valve Replacement

Digital Control Valve Removal

To remove the compressor digital control valve, perform the following steps:

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.

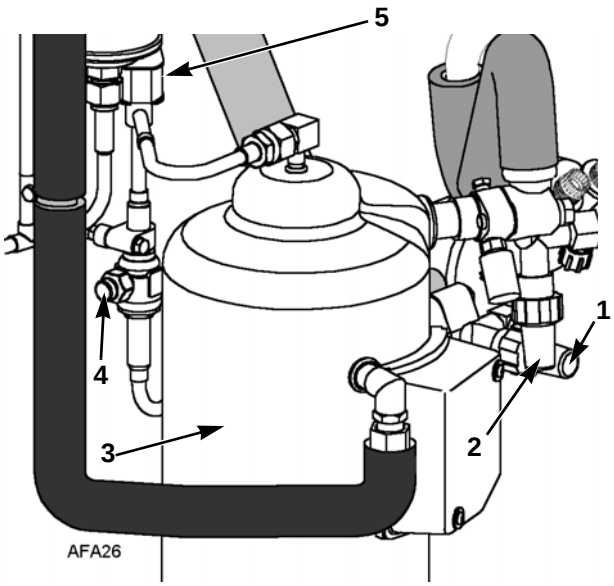
Digital Control Valve Installation

To install the compressor digital control valve, perform the following steps:

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

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

3. Perform a leak test (see Leak Testing the Refrigeration). Repair leak if required.
4. Check the refrigerant charge (see Checking the Refrigerant Charge).
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

Figure 76: Digital Control Valve

Servicing The Unit

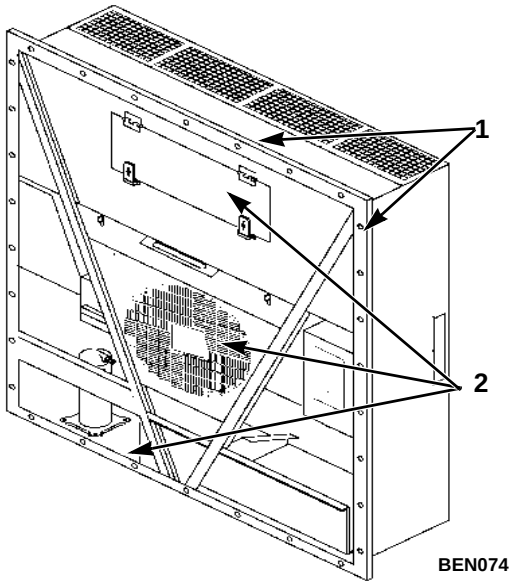
Taking Care of the Structure

Inspecting the 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 the 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

Figure 77: Mounting Bolts

Cleaning the Condenser Coil

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.

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

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

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.

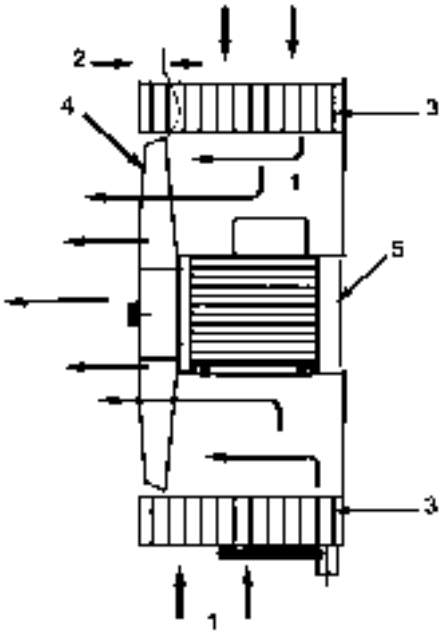
CAUTION: Air pressure must not be high enough to damage coil fins

Cleaning the Defrost Drains

Clean the defrost drains every 1,000 operating hours to be sure 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.

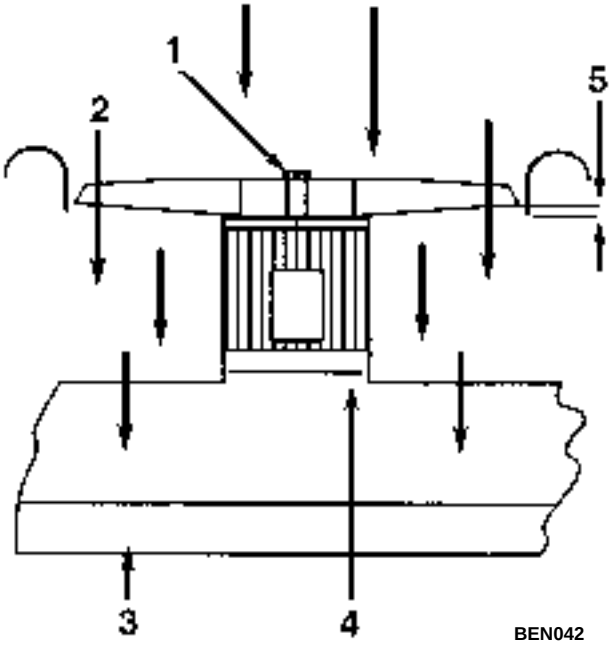


1.	Airflow Direction
2.	10 mm (0.4 in.)
3.	Condenser Coil
4.	Condenser Fan Blade
5.	Condenser Motor

Figure 78: Condenser Fan Blade Placement

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.)

Figure 79: Evaporator Fan Blade Placement

Servicing the Fresh Air System

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

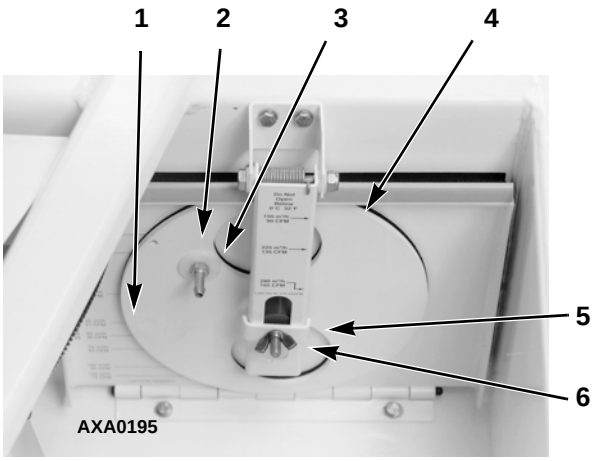
To make a disk adjustment perform the following steps:

1. Loosen wing nut on handle assembly, Figure 80
2. Rotate the disk to set the Indicator at the air exchange rate shown on the ventilation scale on the door:
   - MAGNUM+ Models: 0-225m3/hr (0-154 ft3/min)
3. Tighten the wing nut.

Handle Adjustment: High Ventilation Rates

To make a handle adjustment, perform the following steps:

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.	CO_2 Port
4.	Ventilation Door
5.	Handle Bracket
6.	Wing Nut

Figure 80: Air Exchange System

Diagnosis: Troubleshooting, Warnings and Alarm Codes

Introduction

This chapter includes the following:

- Introduction to Controller Diagnostics
- Troubleshooting charts
- Warnings chart
- Alarm Codes chart

The charts will help you identify and fix unit problems.

Controller Diagnostics

The MP4000 can be a very helpful diagnostic tool.

The following menu areas of the MP4000 controller menu will help you diagnose problems occurring with the Magnum unit.

Alarms/Warnings Menu: The Alarm/Warning list 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 MP-4000 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 MP-4000 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 MP-4000 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: 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. Refer to the Manual Functions Test Menu in the Operating Instructions Section.

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

Troubleshooting Mechanical Problems

Condition	Possible Cause	Remedy
Compressor does not operate—no amperage draw	Controller on; unit start sequence still timing	Wait up to 2 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

Condition	Possible Cause	Remedy
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

Troubleshooting Refrigeration Problems

Condition	Possible Cause	Remedy
Load temperature too high—unit not cooling	Compressor does not operate	See “Mechanical Diagnosis”
	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

Condition	Possible Cause	Remedy
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	See “Condenser Fan Motor Does Not Operate” under “Mechanical Diagnosis”
	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
Compressor loses oil	Refrigerant leak	Repair leak and recharge
Compressor oil migrates to system	Short cycling	See "Unit Short Cycles" under “Mechanical Diagnosis”
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	See “Unit Short Cycles” under “Mechanical Diagnosis”
	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	See “Evaporator Fan Motor Does Not Operate” under “Mechanical Diagnosis”
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

Condition	Possible Cause	Remedy
Low suction pressure ***NOTE: This unit has a capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is on 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

Warnings and Controller Actions

The controller displays Warnings (In the 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.

Warnings and Controller Actions

Warning No.	Warning Message	Controller Action/Corrective Action
1	**Power Error, Check 20A Fuses** **Indicates:** • One or more phases are missing • Compressor is able to draw amps on all phases while heater lacks amps on one or more phases.	• Controller activates Alarm 18 • Controller will try to restart unit after 60 minutes.
2	**High Pressure Cutout, Check Water Cooling** **Indicates:** • Unit stops due to high pressure cutout and water pressure switch is open.	• Controller clears message on compressor start-up. • No alarm is set until Controller determines that unit current draw is too low or supply air temperature is too high.
3	**Probe Test, Please Wait** **Indicates:** • Incorrect temperature difference between Supply or Return Air Sensor for 10 minutes with evaporator fan amps OK.	• Controller automatically activates probe test to check for a defective sensor. Message clears when test is complete. • Controller displays new message if test indicates a sensor is defective.
7	**High Pressure Cutout, Check Condenser Probe** **Indicates:** • Units stops due to high pressure cutout, water pressure switch is closed and condenser temperature is low.	• Controller clears message on compressor start-up. • No alarm is set until Controller determines that unit current draw is too low or supply air temperature is too high.
9	**High Pressure Cutout, Check Condenser Fan** **Indicates:** • Unit stops due to high pressure cutout, water pressure switch is closed and condenser temperature is high.	• Controller clears message on compressor start-up. • No alarm is set until Controller determines that unit current draw is too low or supply air temperature is too high
11	**Scroll Compressor, High Temperature** **Indicates:** • Compressor stops because discharge temperature is above 148 C (300 F). Message remains in display until discharge temperature decreases to normal.	• Controller clears message after compressor start-up.

Warnings and Controller Actions (Continued)

Warning No.	Warning Message	Controller Action/Corrective Action
12	**Scroll Compressor, Low Pressure** **Indicates:** • Low pressure cutout switch is open. • Possible causes include low refrigerant charge, defective low pressure cutout switch or open circuit, block TXV or suction line restriction etc.	• Controller activates Alarm Code 31 after 5 minutes. • Controller clears message after compressor start-up.

21	**Total Current Too High**
	• When the unit or component current draw is 25 percent above expected amps for 4 minutes.
	• Indicates:
	  • Digital Control valve malfunction
	  • Compressor, evaporator fan 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.

22	**Total Current Too Low**
	• Compressor Start-up: Unit or component current draw is 50 percent below expected amps for 4 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 Air Temperature Too High**
	• During Chill or Frozen Mode: Supply air temperature is too high compared to return air temperature under operating conditions.
	• 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
		• Last defrost > 90 minutes, perform defrost
		• Controller perform Probe test
		• If sensor is still high generates Alarm 128.

Warnings and Controller Actions (Continued)

Warning No.	Warning Message	Controller Action/Corrective Action

24	**Supply Air Temperature Too Low**
	• During Chill or Frozen Mode: Supply air temperature is too low compared to return air temperature under operating conditions.
	• Indicates:
	  • Ice or frost on evaporator coil
	  • Low heating capacity
	  • Incorrect evaporator fan operation
	  • Incorrect connection or location of supply or return air sensors
		• Last defrost > 90 minutes, perform defrost
		• Controller perform Probe test
		• If sensor is still low generates Alarm 128

25	**Return Air Temperature Too High**
	• During Defrost: Return air temperature increases above 40 C (104 F).
	• Indicates:
	  • Defective return or evaporator coil sensor
	  • Return and evaporator coil sensor connections are reversed
		• Last defrost > 90 minutes, perform defrost
		• Controller perform Probe test
		• If sensor is still high generates Alarm 129

26	**Evaporator Coil Temperature Too High**
	• During Chill or Frozen Mode: Evaporator coil temperature is too high compared to return air temperature under operating conditions.
	• Indicates:
	  • Low refrigerant charge.
	  • Defective evaporator coil or return air sensor
	  • Incorrect connection or location of evaporator coil or return air sensor
		• Last defrost > 90 minutes, perform defrost
		• Controller perform Probe test
		• If sensor is still high generates Alarm 130

27	**Evaporator Coil Temperature Too Low**
	• During Chill or Frozen Mode: Evaporator coil temperature is too low compared to return air temperature under actual operating conditions.
	• Controller initiates defrost if no recent defrost.
	• Indicates:
	  • Airflow is blocked in the container
	  • Evaporator fans do not operate
	  • Fresh air exchange vent open too much on frozen load
	  • Defective evaporator coil or return air sensor
		• Last defrost > 90 minutes, perform defrost
		• Controller perform Probe test
		• If sensor is still low generates Alarm 130

Alarm Codes, Descriptions and Corrective Actions

NOTE: Sensors used with the MP-4000 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.

Alarm Codes, Descriptions and Corrective Actions

Code	Description	Corrective Action

00	**Supply Air Sensor Open Circuit**
	• When the sensor circuit resistance is higher than 100,000 ohms.
	• Indicates:
	  • Open circuit to left or right hand sensor
	  • Defective or wrong sensor
	  • Defective controller
		• Check sensor resistance, must be approx 1,000 ohms at 25 C (77 F).(See “Resistance Values for temperature sensors” on page 94.)
		• Check for damaged sensor wires.
		• Check sensor connections at controller.

01	**Supply Air Sensor Short Circuit**
	• When the sensor circuit resistance is lower than 200 ohms.
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor Defective power module
	  • Defective or wrong sensor
	  • Defective controller
		• Check sensor resistance, must be approx 1,000 ohms at 25 C (77 F).(See “Resistance Values for temperature sensors” on page 94.)
		• Check for damaged sensor wires.
		• Check sensor connections at controller.

02	**Return Air Sensor Open Circuit**
	• When the sensor circuit resistance is higher than 100,000 ohms.
	• Indicates:
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective power module
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance, must be approx 1,000 ohms at 25 C (77 F).(See “Resistance Values for temperature sensors” on page 94.)
		• Check for damaged sensor wires.
		• Check sensor connections at controller.

03	**Return Air Sensor Short Circuit**
	• When the sensor circuit resistance is lower than
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective power module
	  • Defective controller
		• Check sensor resistance, must be approx 1,000 ohms at 25 C (77 F).(See “Resistance Values for temperature sensors” on page 94.)
		• Check for damaged sensor wires.
		• Check sensor connections at controller.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

04	**Evaporator Coil Sensor Open Circuit**
	• When the sensor circuit resistance is higher than 100,000 ohms.
	• Indicates:
	  • Open circuit to sensor Defective or wrong sensor
	  • Defective power module
	  • Defective controller
	  • Low evaporator coil temperature
		• Check sensor resistance, must be approx 1,000 ohms at 25 C (77 F).(See “Resistance Values for temperature sensors” on page 94.)
		• Check for damaged sensor wires.
		• Check sensor connections at controller.

05	**Evaporator Coil Sensor Short Circuit**
	• When the sensor circuit resistance is lower than 200 ohms.
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective power module
	  • Defective controller
		• Check sensor resistance, must be approx 1,000 ohms at 25 C (77 F).(See “Resistance Values for temperature sensors” on page 94.).
		• Check for damaged sensor wires.
		• Check sensor connections at controller.

06*	**Compressor Current Too High**
	• Occurs during pretrip (PTI) or function test only.
	• Compressor power consumption is 25 percent expected current draw (above approximately 13 amps); or compressor phase current level difference of 10 percent or more, depending on ambient temperature.
	• Indicates:
	  • Defective Digital Control valve
	  • Defective compressor
	  • Defective volt or amp meter on power module
	  • Inaccurate ambient, condenser or evaporator temperature measurement
	  • Out of range power supply
	  • Excessive condenser pressure due to air or wrong refrigerant in system, or refrigerant over charge
		• Check evaporator, condenser and ambient sensor temperatures for correct value (± 5 C [± 9 F]) by viewing Data menu.
		• Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor 100 percent, condenser fan and evaporator fan (high and low).
		• Check volt and ampere meter.
		• Check power supply volts.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

07*	**Compressor Current Too Low**
	• Occurs during pretrip (PTI) or function test only.
	• Compressor power consumption is 25 percent below expected current draw (below approximately 9 amps).
	• Indicates:
	  • Defective or open high pressure cutout switch.
	  • Defective compressor relay
	  • Defective volt or amp meter on power module
	  • Low refrigerant charge
	  • Defective compressor
		• Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor 25 percent, condenser fan and evaporator fan (high and low).
		• Check discharge and suction pressure gauge readings. Evaluate readings based on current cargo and ambient temperatures.
		• Check volt and ampere meter.
		• Check power supply volts.

*If both Alarms 06 and 07 are activated, the alarms are caused by a large difference in measured amps. Enter Function Test and start condenser fan, compressor, compressor 100 percent and evaporator fans on high speed. Check the amps measurements. If necessary, check the resistance of the motor windings.		

10*	**Heater Current Too High**
	• Occurs during pretrip (PTI) or function test only.
	• Heater power consumption is 25 percent above expected current draw (above approximately 4.4 amps and 5.1 amps, depending on voltage).
	• Indicates:
	  • Incorrect heaters or heater connections
	  • Defective volt or amp meter on power module
	  • Defective heater element
		• Enter Manual Function Test and turn heaters on. Check current draw on each phase. Current draw should be about 4.4 amps on each phase at 400V (5.1 amps at 460V).
		• Check heater resistance. Resistance should be about 99 ohms on each leg.

11*	**Heater Current Too Low**
	• Occurs during pretrip (PTI) or function test only.
	• Heater power consumption is 25 percent pretrip below the expected current draw (below approximately 3.2 amps and 3.8 amps, depending on voltage).
	• Indicates:
	  • Defective heater element.
	  • Defective wire connection
	  • Incorrect heaters or heater connections
		• Enter Manual Function Test and turn heaters on. Make sure the heat relay energizes. Check current draw on each phase. Current draw should be 4.4 on each phase at 400V (5.1 amps at 460V).
		• Check heater resistance. Resistance should be about 99 ohms on each leg.
		• Check volt and ampere meter.

*If both alarms 10 and 11 are activated, the alarms are caused by a large difference in measured amps. Enter Manual Function Test menu and start HEAT. Check the amps measurements. If necessary, check the resistance. Resistance should be about 99 ohms on each leg.		

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

12**	**Evaporator Fan High Speed Current Too High**
	• Occurs during pretrip (PTI) or function test only.
	• When the evaporator fan power consumption is 25 percent above expected current draw (above 2.0 to 3.0 amps, depending on voltage)
	• 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.
		• Check volt and ampere meter.

**If both alarms 12 and 13; or 14 and 15 are activated, the alarms are caused by a large difference in measured amps. Enter Manual Function Test menu and operate evaporator fans on low and high speed. Check the evaporator fan amps measurement. If necessary, check the resistance in the motors: High speed between EF11 and EF12, EF12 and EF13, and EF11 and EF13; Low speed between EF1 and EF2, EF2 and EF3, and EF1 and EF3. Resistance readings should be equal: High speed about 6 Ohms, total of 2 motors; Low speed about 20 Ohms, total of 2 motors.

13**	**Evaporator Fan High Speed Current Too Low**
	• Occurs during pretrip (PTI), function test or probe test.
	• When the evaporator fan power consumption is 25 percent below expected current draw (below 1.6 to 2.4 amps, depending on voltage).
	• Indicates:
	  • Defective or open fan motor internal over temperature protection switch
	  • Defective volt or amp meter on power module
	  • Incorrect motor or motor connections
		• 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.
		• Check fan motor volts and amps.
		• Check volt and ampere meter.

14**	**Evaporator Fan Low Speed Current Too High**
	• Occurs during pretrip (PTI) or function test only.
	• Evaporator fan power consumption is 25 percent above expected current draw (above 1.0 to 2.0 amps, depending on voltage).
	• Indicates:
	  • Defective or stuck evaporator fan motor
	  • Incorrect motor or motor connections
	  • Motor high and low speed connection are interchanged
	  • 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.
		• Check volt and ampere meter.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

15**	**Evaporator Fan Low Speed Current Too Low**
	• Occurs during pretrip (PTI) or function test only.
	• When the evaporator fan power consumption is 25 percent below expected current draw (below 0.6 to 1.2 amps, depending on voltage).
	• Indicates:
	  • Defective or open fan motor internal over temperature protection switch
	  • Defective volt or amp meter on power module
	  • Incorrect motor or motor connections
		• 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.
		• Check fan motor volts and amps.
		• Check volt and ampere meter.

**If both alarms 12 and 13; or 14 and 15 are activated, the alarms are caused by a large difference in measured amps. Enter Manual Function Test menu and operate evaporator fans on low and high speed. Check the evaporator fan amps measurement. If necessary, check the resistance in the motors: High speed between EF11 and EF12, EF12 and EF13, and EF11 and EF13; Low speed between EF1 and EF2, EF2 and EF3, and EF1 and EF3. Resistance readings should be equal: High speed about 6 Ohms, total of 2 motors; Low speed about 20 Ohms, total of 2 motors.		

16*	**Condenser Fan Current Too High**
	• Occurs during pretrip (PTI) or function test only.
	• When the condenser fan power consumption is 25 percent above expected current draw (above 1.5 to 1.9 amps, depending on voltage).
	• Indicates:
	  • Defective or stuck condenser fan motor
	  • Defective volt or amp meter on power module
	  • Incorrect motor or motor connections
		• Enter Manual Function Test and start condenser fan. Make sure the fan starts. Check fan motor volts and amps.
		• Check power supply volts and amps.
		• Check volt and ampere meter.

17*	**Condenser Fan Current Too Low**
	• Occurs during pretrip (PTI) or function test only.
	• Condenser fan power consumption is 25 percent below expected current draw (below 0.5 to 0.7 amps, depending on voltage).
	• Indicates:
	  • Defective condenser fan motor relay
	  • 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.
		• Check power supply volts and amps.
		• Check volt and ampere meter.

18	**Power Supply Phase Error**
	• One or more frequency inputs are missing for more than 20 seconds.
	• Indicates:
	  • One phase on power line is missing
	  • Defective fuse on power module
	  • Defective digital inputs on power module
	  • Defective controller
		• Enter Data menu and view voltage reading on each phase.
		• Check all fuses on power module.
		• Replace power module.
		• Check voltage reading on each phase.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
*If both alarms 16 and 17 are activated, the alarms are caused by a large difference in measured amps. Enter Manual Function Test menu and start the condenser fan. Check the condenser fan amps measurement. If necessary, check the resistance in the motor between CF1 and CF2, CF2 and CF3, and CF1 and CF3. Resistance readings should be equal (approximately 25 Ohms).		

19	**Temperature Too Far From Setpoint**
	• 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)
		• Press **SUP/RET** key 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 (39 F - 43 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 Time Too Long**
	• Heat signal has been on for more than 90 minutes on 60 Hz power during Defrost (120 minutes on 50 Hz power).
	• 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. Then select Sensor Checks test and operate fans 2 to 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 low 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.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
26	**Vapor Injection Valve Error** • Occurs during pti, brief pti and function tests • Current consumption not correct for valve position	• Check vapor valve function
31	**Low Pressure Cutout Error** • Occurs during pretrip (PTI) test only. • Indicates: • Low refrigerant charge • Refrigeration system restriction at filter drier or expansion valve • Defective low pressure cutout switch	• 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 down stream 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. • Continuity check low pressure cutout switch wiring using a high quality multimeter. Replace switch.
32	**Condenser Temperature Sensor Open Circuit** • When the sensor circuit resistance is higher than 100,000 ohms. • Indicates: • Open circuit to sensor • Defective or wrong sensor • Defective power module • Defective controller	• Check sensor resistance, must be 1,000 ohms at 25 C (77 F). • Check for damaged sensor wires. • Check sensor connections at controller.
33	**Condenser Temperature Sensor Short Circuit** • Sensor circuit resistance is lower than 200 ohms. • Indicates: • Open circuit to sensor • Defective or wrong sensor • Defective power module • Defective controller	• Check sensor resistance, must be 1,000 ohms at 25 C (77 F). • Check for damaged sensor wires. • Check sensor connections at controller.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

34	**Ambient Air Sensor Open Circuit**
	• Occurs during pretrip (PTI) test only
	• Sensor circuit resistance is higher than 100,000 ohms.
	• Indicates:
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective power module
	  • Defective controller
		• Check sensor resistance, must be 1,000 ohms at 25 C (77 F).
		• Check for damaged sensor wires.
		• Check sensor connections at controller.

35	**Ambient Air Sensor Short Circuit**
	• Occurs during pretrip (PTI) test only.
	• Sensor circuit resistance is lower than 200 ohms.
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective power module
	  • Defective controller
		• Check sensor resistance, must be 1,000 ohms at 25 C (77 F).
		• Check for damaged sensor wires.
		• Check sensor connections at controller.

43	**Return Air temperature Too High** • During defrost: Return air temperature increases above 40 C (104 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.
51	**Low Supply Voltage** • Alarm occurs if line voltage is below 350 volts for 30 minutes • If the main power supply voltage to the unit, while running, drops below 340 VAC, the unit will stop running until the voltage increases above 350 VAC. If the main power supply voltage, on initial unit start up, is below 350 VAC, the unit will not start. If the voltage remains below 350 VAC for 30 minutes, Alarm 51 (Low Voltage) will occur.	• Check line voltage of power source. Refer to the electrical specifications in the Specifications Section for correct power source requirements.
52	**Probe Error** • Occurs during pretrip (PTI) test or probe test failed in Chilled mode. • Temperature difference between return air and evaporator coil sensors is too high (1.5 C [2.7 F] difference maximum)	• Check sensor connections. Check sensor resistance of each sensor. Resistance must be 1,000 ohms at 25 C (77 F).

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

53	**High Pressure Cutout 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 Cutout 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 5 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)

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 or valve plate
	  • Defective liquid injection system
	  • Wrong or defective sensor
		• Operate unit on Cool and check discharge and suction pressure gauge readings.
		• Enter Manual Function Test menu and test (operate) Injection Valve to determine if valve opens (energizes).
		• Check compressor discharge sensor resistance. Resistance must be 100,000 ohms at 25 C (77 F).
		• Check discharge line temperature with a separate electronic thermometer and compare to “HIGH PR TEMP” shown in the Data menu of controller.
		NOTE: Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.

58	**Phase Sensor Error**
	• Occurs during pretrip (PTI) or function test only.
	• During Phase Sensor Test, amperage difference between correct and wrong condenser fan rotation is more than 0.2 amps.
	• Indicates:
	  • Defective phase relay
	  • Defective power module
		• Start a Function Test. During step F1.05, check whether the phase relays on power module receive a signal (LED energizes). Verify that the relays respond and shift to reverse phase.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
59	**Delta Current Error** • 100 percent ampere difference between current phases. • Indicates: • Open connection on one phase of power supply to a motor or heater element	• Enter Manual Function Test menu and test (operate) each 3-phase component to locate defective connection.

60	**Humidity Sensor Error**
	• Occurs during pretrip (PTI) test only.
	• Relative humidity reading is less than 20 percent.
	• Indicates:
	  • Sensor disconnected
	  • Wrong controller software configuration
	  • Defective sensor
		• Check sensor connections.
		• Check controller configuration for correct humidity setting.
		• Replace sensor.

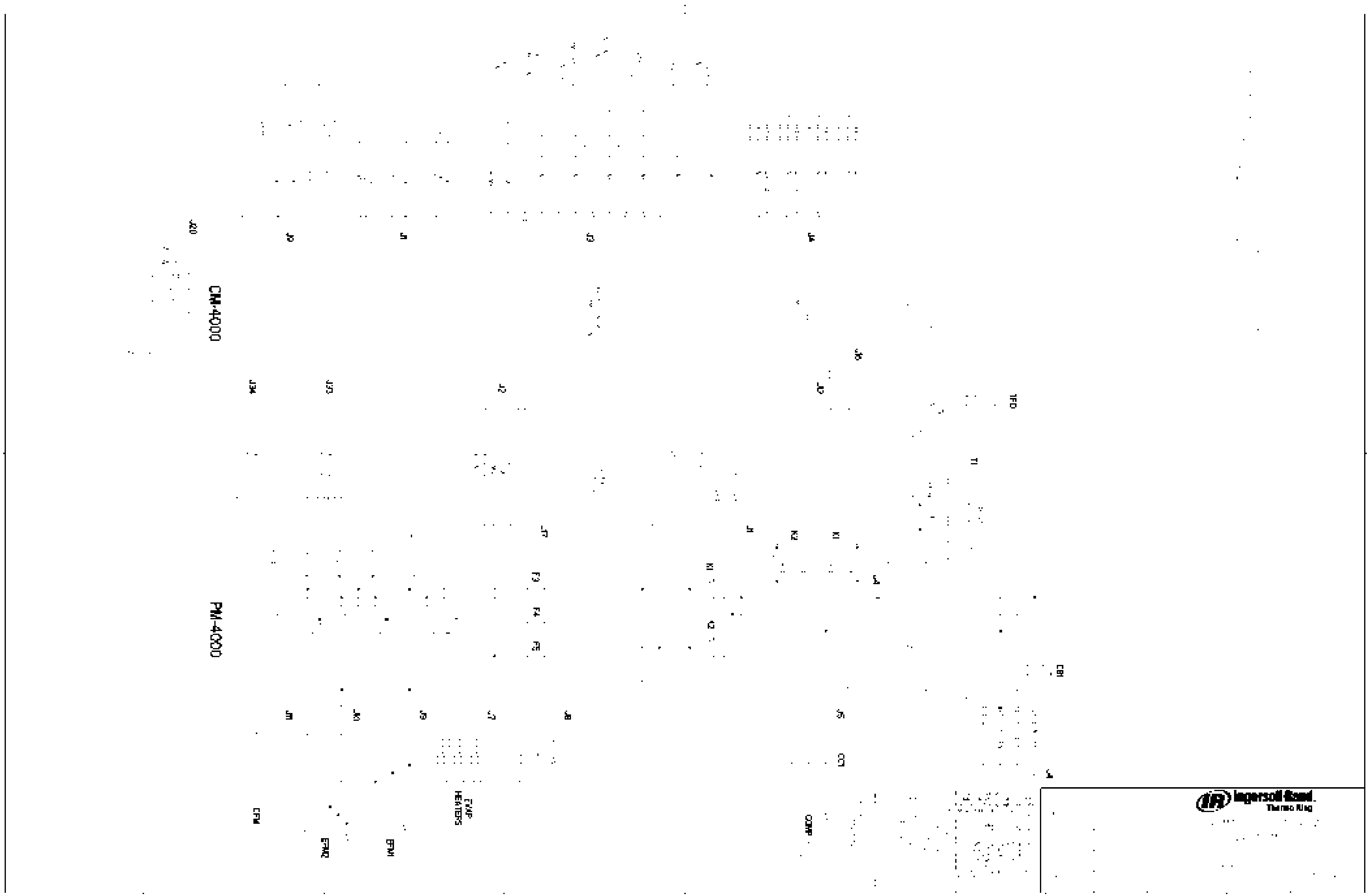
98	**Compressor Sensor Short Circuit**
	• Sensor circuit resistance lower than 200 ohms.
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective power module
	  • Defective controller
		• Check sensor resistance, must be 1,000 ohms at 25 C (77 F).
		• Check for damaged sensor wires.
		• Check sensor connections at controller.

119	**Digital Control Valve Error** • Current consumption not correct for valve position	• Check Digital Valve function
120	**Suction Pressure Sensor** • Indicate a problem exists with this sensor or its wiring. The sensor is reading out of the range, or appears to be open or shorted **PTI Test** • Reading did not decease by 0.15 bar (2.175 psi) between compressor on and off	• Check wiring to be correct and connected • Check J1 plug is plugged into MRB • Check voltage at J1 pin7 to be 0.5 – 4.5 volts
121	**Discharge Pressure Sensor** • Indicate a problem exists with this sensor or its wiring. The sensor is reading out of the range, or appears to be open or shorted **PTI Test** • Reading did not increase by 0.15 bar (2.175 psi) between compressor on and off	• Check wiring at J1 to be correct and connected • Check J1plug is plugged into MRB • Check voltage at J1 pin4 to be 0.5 – 4.5 volts
122	**CO2 Sensor Calibration Error** • Occurs during pretrip (PTI) test only • Sensor reading is less < 17% or > 25%	Replace CO2 sensor
123	**Controller Battery Error** • Controller detects the battery is not able to recharge.	• Check battery, and connections. • If no physical problem is observed replace battery.

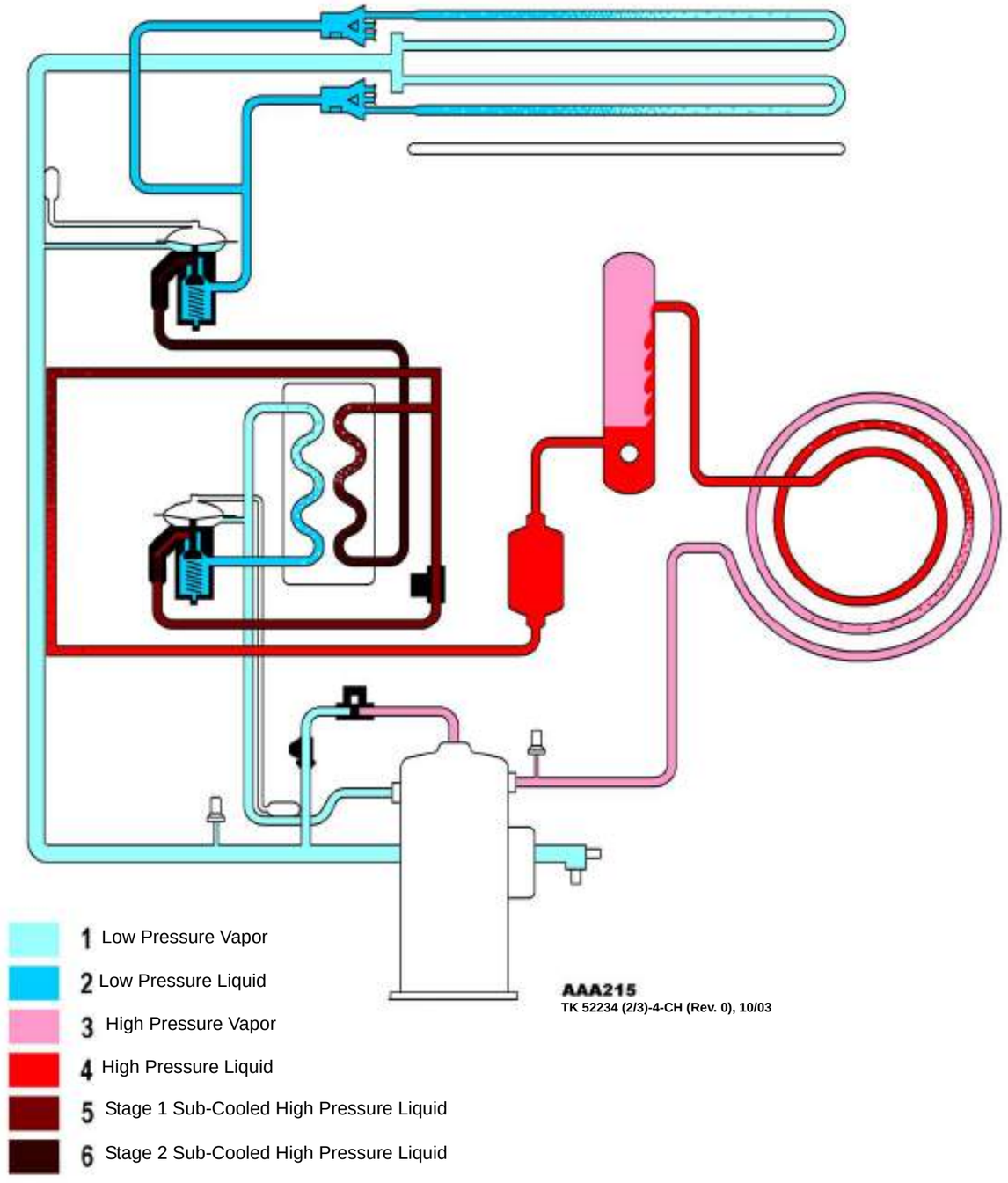
Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
124	**Check Power Module Sensor** • Voltage, frequency and current sensor located at the power module, has detected a problem.	• Replace power module.
128	**Check Supply Air Temperature Probe** • Probe Test detects sensor problem.	• Check discharge and suction pressure gauge readings and refrigerant charge. • Check for sensor or evaporator fan alarm codes. • Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan motor rotation and operation. • Check supply and return sensor connections and locations.
129	**Check Return Air Temperature Probe** • Probe Test detects sensor problem.	• Check for sensor alarm codes. • Check supply and return sensor connections and locations.
130	**Check Evaporator Coil Temperature Probe** • Probe Test detects sensor problem.	• Check for sensor or evaporator fan alarm codes. • Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan rotation and operation. • Inspect return air grille and cargo load. Remove any debris or cargo from blocking return air grille. • At setpoints below 5 C (41 F), maximum air vent setting is not allowed.. • Check discharge and suction pressure gauge readings and check refrigerant charge. • Check evaporator coil and return air sensor connections and locations.
131	**Check AMB - Condenser Temperature Probe Error** • Probetest detects inconsistency between ambient and condensor sensor.	• Check for sensor alarm codes. • Check supply and return sensor connections and locations.

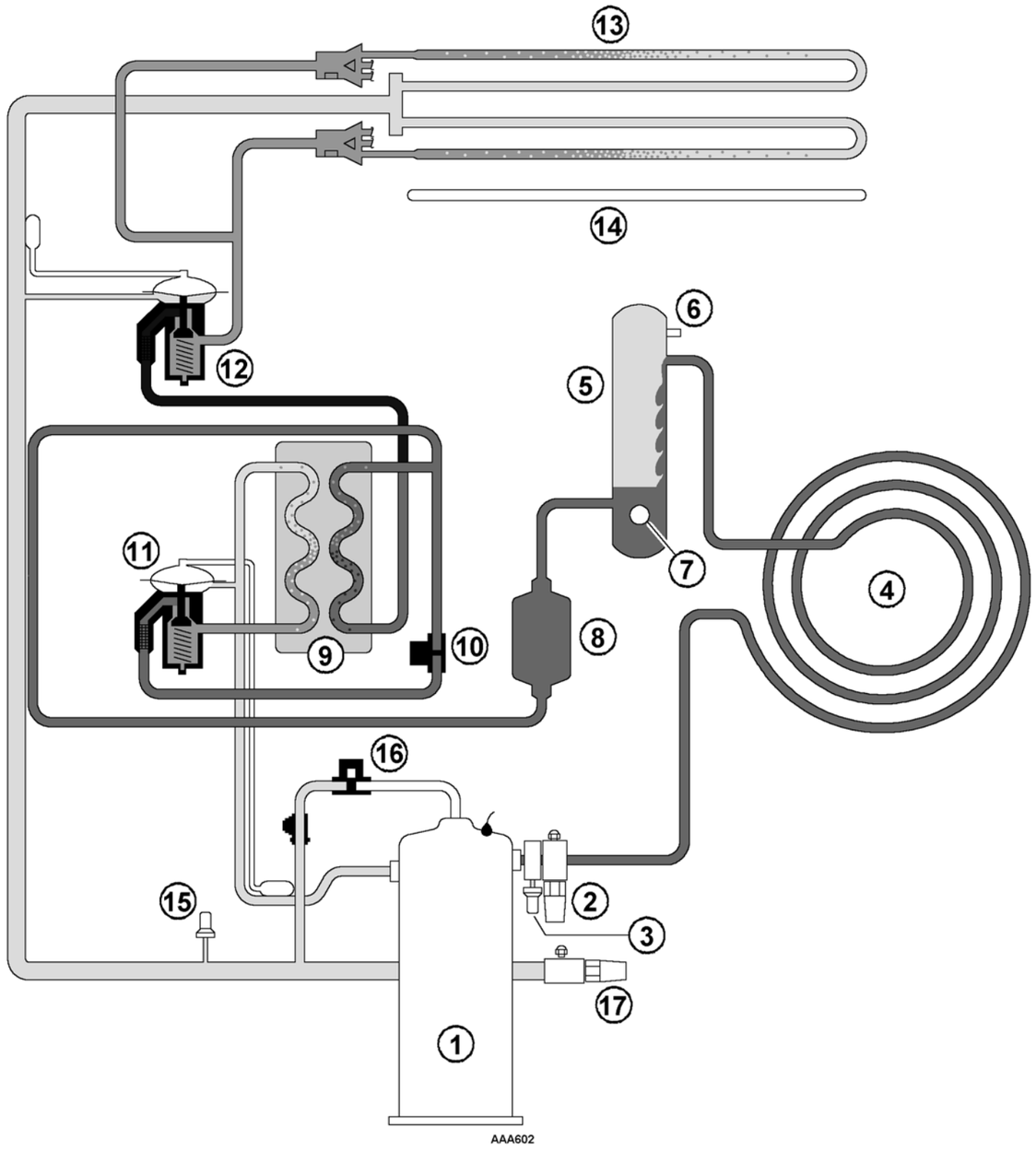
Wiring and Schematic Diagrams Index



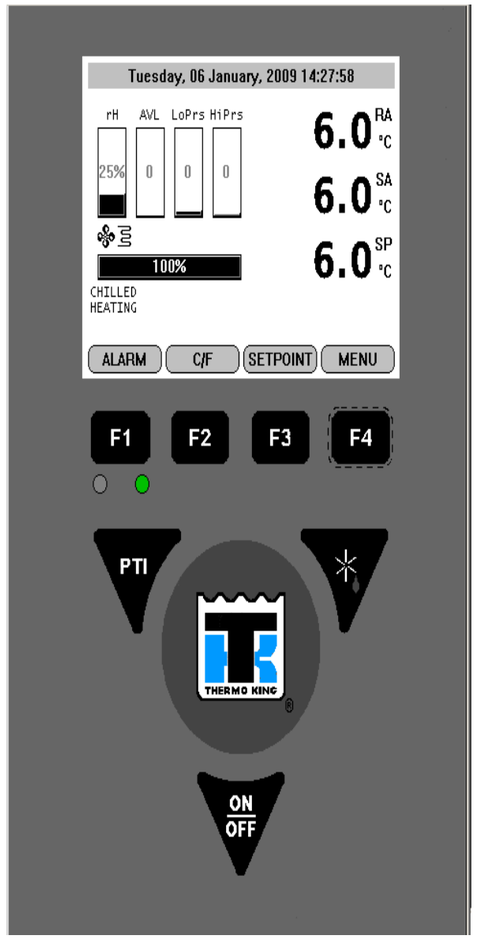
Magnum+ Refrigeration System Components



MAGNUM+ Components



1.	Scroll Compressor
2.	Discharge Service Valve
3.	High Pressure Switch
4.	Condenser Coil
5.	Receiver Tank
6.	Pressure Relief
7.	Sight Glass
8.	Drier / Oil Filter
9.	Economizer Heat Exchanger
10.	Vapor Injection Valve
11.	Economizer TXV
12.	Evaporator TXV
13.	Evaporator Coil
14.	Heater
15.	Low Pressure Switch
16.	Digital Control Valve
17.	Suction Service Valve



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.

CONTROLLER MENU GUIDE

- **F1** Alarms Menu
- **F2** C TO F
- **F3** SETPOINT
- **F4** MENU

MAIN MENU

DATA

- Supply LH
- Supply RH
- Return
- Evaporator
- Condensor
- Compressor
- Ambient
- Humidity
- USDA 1, 2, 3
- Cargo
- Voltage
- Current
- Curr. Ph. 1
- Curr. Ph. 2
- Curr. Ph. 3
- Frequency
- Modulation
- AVL Position
- Radiator
- Suct. Press
- Disch. Press
- Curr. Ph. 3
- CO2
- Fresh Air Ex
- Battery Voltage
- Battery c. current
- Bat, Temp
- CO2
- O2
- pt 1000 spare

SETPOINT

Setpoint Menu

- Opti-Set
- Temp. Setp.
- Watercool
- Controlling mode
- Hum. Control
- Hum. Setpoint
- Defrost Trm. Temp
- Defrost Interval
- Bulb Mode
- USDA Trip
- AFAM Mode
- AFAM Delay
- AFAM Rate
- C02 Max.
- 02 Min.

Enter a Temperature or Humidity Setpoint

- Press F4 key to select this menu.
- Press F2 or F3 key to increase or decrease setting
- Press and hold F4 key until you are returned to the main screen

Activate Humidity Contol

- Press F4 key.
- Press F2 key to scroll setting between OFF and ON.
- Press and hold F4 key until you are returned to the main screen

COMMAND

To Activate a Command

- Press F4 to start a:
- Brief PTI (Pretrip) Test
- PTI (Pretrip) Test
- Function Test
- Manual Function Test
- Trip Start

Commands Manual Function Test Submenu

- First Component Test appears in display:
- Press F2 or F3 key to scroll to the desired component:
- Sensor Test
- Evap Fan Low
- Evap Fan High
- Cond Fan Test
- Probe Test
- Reverse Phase Test
- Heater Test
- Defrost test
- Temperature Stabilisation
- Pre Heat Test
- Pre Cool Test
- Compressor Test
- Compressor Digital Test
- Compressor Econ Test
- Pressure Sensor Test
- HPCO Test
- Capacity Test
- Approaching 0 Test
- Maintaining 0 Test
- Defrost Test
- Pulldown to -18 C Test

- Press F4 key to start and stop test (scroll component display between ON and OFF).
- More than one component can be turned ON at a time to perform a functional test of the unit.

ALARM LIST

Alarms Menu

- View and write down all alarm code.
- Press F2 key to view the next alarm code
- Clear alarm code by correcting problem and acknowledging the alarm.
- To acknowledge an alarm, press F4 key with alarm code in display.

CONFIGURATION

Configuration Menu

- Unit Setting
- Unit Configuration
- Miscellaneous Settings
- Container ID
- In Range Temperature Limit
- Date/Time
- Contrast
- Version
- Controller ID
- Power Module ID
- Unit Serial ID
- 20 ft Unit
- AFAM Option
- AFAM+
- Pulsating
- Variable
- AFAM
- Humidity Option
- Suction Pressure Option
- Discharge Pressure Option
- AVLOption
- USDA Option

Set Time/Date

- Press F4 key to select this menu.
- Press F4 key again to edit.
- Press F2 or F3 key to increase or decrease a digit
- Press F4 to move to the next digit.
- Press and hold F4 key to saveuntil you are returned to the main screen

To Select an option in the Unit Configuration Menu

- Press F4 key to select Option.
- Press F2 key to scroll setting between settings.
- Press and hold F4 key until you are returned to the main screen

DATALOGGER

Datalogger Menu

- Inspect Log
- Calibrate Probes
- Set Log Time Interval

Datalogger Submenu

- Inspect log: Press F4 key to view next screen. Press F2 or F3 key to scroll through all logs.
- Calibrate Probes: Press F3 key to Release. Press F4 key to Calibrate.
- Set Log Time Interval: Press F3 key to scroll through log interval list. Press and hold F4 key until cursor stops flashing.

STATES

States Menu

- PTI
- Input - Output
- RMM
- Defrost

RMM Status

- RMM StatusDisplay shows current status:
  - Offline
  - Zombie
  - Online
- Version
- Map Telegrams Received
- Minutes since last Poll