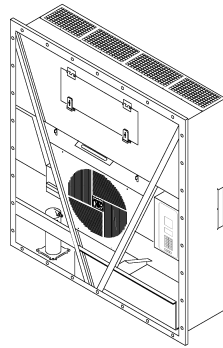


# MAGNUM

TK 51122-4-MM (Rev. 8, 04/16)



**The maintenance information in this manual covers unit models:**

	<b>Base Unit</b>
MAGNUM	098922
MAGNUM	098924
MAGNUM SL	098934
MAGNUM SL	098935
MAGNUM 20	098916

**For further information, refer to:**

**Parts Manuals**

MAGNUM Parts List	TK 51745
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**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.

**Revision History**

- Rev. 7 – TK 51122-4-MM (Rev. 7, 02/16) Add Controlling Mode (Optimized) information.  
Rev. 8 – TK 51122-4-MM (Rev. 8, 04/16) Clarify Optimized Controlling Mode on pages 32 and 106.

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.

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# 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

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## 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

- 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.

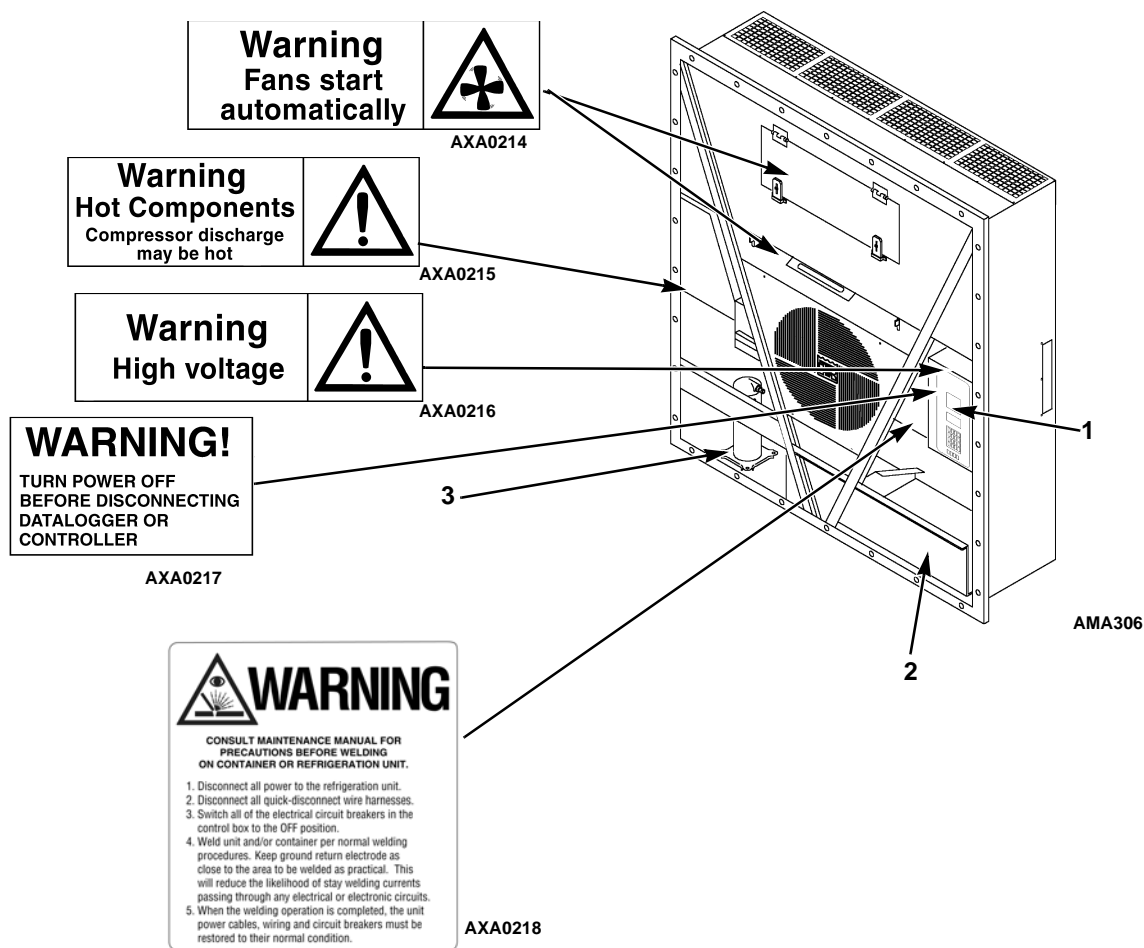
- Disconnect all power to the refrigeration unit.
- Disconnect all quick-disconnect wire harnesses from the back of the controller.
- Disconnect all wire harnesses from the Remote Monitor Modem (RMM).
- Switch all of the electrical circuit breakers in the control box to the Off position.
- Weld unit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

Figure 1: 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 above 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-3000a Controller Nameplate:** On back of controller.



# Service Guide

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## 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
			<b>Electrical</b>
•			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.
			<b>Refrigeration</b>
•	•	•	Check refrigerant charge.
•	•	•	Check compressor oil level.
	•	•	Check for proper discharge and suction pressures.
		•	Check filter drier/in-line filter for a restriction pressures.
			<b>Structural</b>
•	•	•	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.



# Specifications

## System Net Cooling Capacity— Full Cool

### MAGNUM, MAGNUM SL Models — Air Cooled Condensing\*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power			380/190V, 3 Phase, 50 Hz Power		
	Net Cooling Capacity		Power Consump	Net Cooling Capacity		Power Consump
	60 Hz Capacity B/hr	60 Hz Capacity kW	60 Hz Power kW	50 Hz Capacity B/hr	50 Hz Capacity kW	50 Hz Power kW
21.1 C (70 F)	54,000	15.813	11.8	46,000	13.470	9.2
1.7 C (35 F)	42,000	12.299	11.2	36,000	10.542	8.7
-17.8 C (0 F)	25,000	7.321	7.8	21,300	6.237	6.2
-28.9 C (-20 F)	17,300	5.066	6.9	14,400	4.217	5.4
-35 C (-31 F)	14,000	4.100	6.4	12,000	3.514	5.0

\*System net cooling capacity with a 37.8 C (100 F) ambient air temperature and R-404A.

### MAGNUM, MAGNUM SL Models — Water 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
2 C (35 F)	23,850	6.990	9.2
-18 C (0 F)	23,066	6.760	8.0
-29 C (-20 F)	17,333	5.080	6.5
-35 C (-31 F)	13,887	4.070	5.9

\*Unit capacity water cooled condenser at 37.8 C (100 F) water temperature at 60 HZ power @30 liter/min (8 Gal/min)

### MAGNUM, MAGNUM SL Models — Water 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
2 C (35 F)	35076	10.280	10.9
-18 C (0 F)	25113	7.360	6.9
-29 C (-20 F)	21598	6.330	7.5
-35 C (-31 F)	15115	4.430	5.2

\*Unit capacity water cooled condenser at 30 C (86 F) water temperature at 60 HZ power @30 liter/min (8 Gal/min)

### MAGNUM 20 Model — Air Cooled Condensing\*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power			380/190V, 3 Phase, 50 Hz Power		
	Net Cooling Capacity		Power Consump	Net Cooling Capacity		Power Consump
	60 Hz Capacity B/hr	60 Hz Capacity kW	60 Hz Power kW	50 Hz Capacity B/hr	50 Hz Capacity kW	50 Hz Power kW
21.1 C (70 F)	49,000	14.348	11.6	41,800	12.240	9.1
1.7 C (35 F)	31,800	11.157	10.8	32,800	9.605	8.4
-17.8 C (0 F)	22,700	6.647	7.2	19,100	5.593	5.7
-28.9 C (-20 F)	15,700	4.597	6.1	13,300	3.895	4.8
-35 C (-31 F)	12,700	3.719	5.5	11,400	3.338	4.3

\*System net cooling capacity with a 37.8 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	5,800	4,990	19,800	4,900	4,215	16,720

\*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	
	m³/hr	ft³/min	m³/hr	ft³/min	m³/hr	ft³/min	m³/hr	ft³/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	—	—

### MAGNUM SL

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	
	m³/hr	ft³/min	m³/hr	ft³/min	m³/hr	ft³/min	m³/hr	ft³/min
0 mm (0 in.)	5,658	3,330	2,773	1,632	4,715	2,775	2,311	1,360
10 mm (0.4 in.)	5,097	3,000	1,612	949	4,248	2,500	1,344	791
20 mm (0.8 in.)	4,417	2,600	510	300	3,682	2,167	425	250
30 mm (1.2 in.)	3,908	2,300	—	—	3,257	1,917	—	—
40 mm (1.6 in.)	3,228	1,900	—	—	2,690	1,583	—	—

**MAGNUM 20**

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 <sup>3</sup> /hr	ft <sup>3</sup> /min	m <sup>3</sup> /hr	ft <sup>3</sup> /min	m <sup>3</sup> /hr	ft <sup>3</sup> /min	m <sup>3</sup> /hr	ft <sup>3</sup> /min
0 mm (0 in.)	4,000	2,350	2,000	1,180	3,300	1,940	1,650	970
10 mm (0.4 in.)	3,500	2,060	1,450	850	2,600	1,530	900	530
20 mm (0.8 in.)	2,900	1,710	—	—	1,800	1,060	—	—
30 mm (1.2 in.)	2,200	1,300	—	—	1,100	650	—	—
40 mm (1.6 in.)	1,400	820	—	—	—	—	—	—

**Electrical System Specifications**

<b>Compressor Motor:</b>		
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
<b>Condenser Fan Motor:</b>		
Type		460/380V, 60/50 Hz, 3 Phase
Kilowatts		0.55 kW @ 460V, 60 Hz
Horsepower		0.75 hp @ 460V, 60 Hz
Number: All Models		1
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
<b>Evaporator Fan Motors:</b>		
Type		460/380V, 60/50 Hz, 3 Phase
Kilowatts		0.75 kW @ 460V, 60 Hz
Horsepower		1.0 hp @ 460V, 60 Hz
Number:		
CSR20SL		3
CSR40SL		2
CSR40		2

## Electrical System Specifications

<b>Motor:</b>	
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
<b>Electrical Resistance Heater Rods:</b>	
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
<b>Control Circuit Voltage:</b>	
	29 Vac @ 60 Hz
	24 Vac @ 50 Hz
<b>Evaporator Overheat Switch:</b>	
Opens	54 ± 3 C (130 ± 5 F)
Closes	32 ± 4.5 C (90 ± 8 F)

## Refrigeration System Specifications

<b>Compressor:</b>	
Model No.:	ZMD18KVE-TFD-277, Scroll
<b>Refrigerant Charge:</b>	
MAGNUM, MAGNUM SL, MAGNUM 20	4.0 Kg (8.0 lb.) R-404A
Water-Cooled Condenser-Receiver Tank (Option)	4.8 Kg (8.8 lb.) R-404A
<b>Compressor Oil Capacity</b>	1.77 liter (60 oz.)*
<b>Compressor Oil Type:</b>	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!*

<b>High Pressure Cutout Switch:</b>	
Cutout	3240 ± 48 kPa, 32.4 ± 0.5 bar, 470 ± 7 psig
Cutin	2586 ± 262 kPa, 25.9 ± 2.6 bar, 375 ± 38 psig
<b>Low Pressure Cutout Switch:</b>	
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
<b>High Pressure Relief Valve:</b>	
Relief Temperature	99 C, 210 F

## Refrigeration System Specifications (Continued)

<b>Vapor Injection Control:</b>	
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).
<b>Compressor Discharge Temperature Control:</b>	
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)
<b>Vapor Injection Valve (Compressor):</b>	
Voltage	24 Vac
Current	0.85 amps
Cold Resistance	5.6 ohms
<b>Compressor Digital Control Valve:</b>	
Voltage	24 Vac
Current Draw	0.85 amps
<b>Water Pressure Switch (Option):</b>	
Close	117 ± 21 kPa, 1.17 ± 0.20 bar, 17 ± 3 psig
Open	35 ± 21 kPa, 0.35 ± 0.20 bar, 5 ± 3 psig

## 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-3000a Controller Specifications

<b>Temperature Controller:</b>	
Type	MP-3000a microprocessor with thermostat, digital thermometer, programming keypad, mode indicators, LED display and LCD display for displaying unit operating and cargo information
Setpoint Range	-35.0 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)
<b>Controller Software (Original Equipment):</b>	
Version	See controller identification decal
<b>Defrost Initiation:</b>	
Evaporator Coil Sensor	<ul style="list-style-type: none"> <li>• <b>Manual Switch or Demand Defrost Initiation:</b> Coil must be below 18 C (65 F). Defrost cycle starts when technician or controller requests defrost initiation.</li> <li>• <b>Timed Defrost Initiation:</b> Coil must be below 10 C (50 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).</li> </ul>
Demand Defrost	<p>Demand defrost function initiates defrost when:</p> <ul style="list-style-type: none"> <li>• Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large for 90 minutes</li> <li>• Temperature difference between the left hand and right hand supply air sensors is too large and unit has operated for 90 minutes since last defrost</li> <li>• Temperature difference between the supply air sensors and return air sensor is too large</li> </ul>
<b>Defrost Timer:</b>	
Chilled mode	<ul style="list-style-type: none"> <li>• <b>Supply Temperature at 5.1 C (41.2 F) or Above:</b> Every 8 hours of compressor operation.</li> <li>• <b>Supply Temperature at 5.0 C (41.0 F) or Below:</b> Every 2.5 hours of compressor operation. Defrost interval increases 0.5 hours each timed defrost interval. Defrost synchronization creates step intervals of 3, 4, 4, 5, 5, 6, 6 and 7 hours. Maximum time interval in Chilled mode is 7 hours.</li> </ul>
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.
<b>Defrost Termination:</b>	
Defrost (Coil) Sensor	<p><b>Chilled mode:</b> Terminates defrost when coil sensor temperature rises to 30 C (86 F); or exceeds 18 C (65 F) for 35 minutes/45 minutes if voltage is less than 440 volts.</p> <p><b>Frozen mode:</b> Terminates defrost when coil sensor temperature rises to 30 C (86 F); or exceeds 8 C (46 F) for 35 minutes/45 minutes if voltage is less than 440 volts.</p>
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-3000a Controller Specifications (Continued)

<b>Compressor Shutdown Protection (Auto Reset):</b>	
Stops Compressor	148 C (298 F)
Allows Compressor Start	90 C (194 F)
<b>Bulb Mode:</b>	
Evaporator Fan Speed Settings	<b>Flow High:</b> High speed only <b>Flow Low:</b> Low speed only <b>Flow Cycle:</b> 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

<b>Fresh Air Exchange Venting System (Adjustable):</b>	
MAGNUM and MAGNUM SL	0 to 285 m³/hr (0 to 168 ft³/min.) @ 60 Hz 0 to 237 m³/hr (0 to 139 ft³/min.) @ 50 Hz
MAGNUM 20	0 to 160 m³/hr (0 to 96 ft³/min.) @ 60 Hz 0 to 134 m³/hr (0 to 79 ft³/min.) @ 50 Hz
<b>Evaporator Fan Blade Specifications:</b>	
<b>MAGNUM:</b>	
Diameter	355 mm (14.0 in.)
Pitch	25°
Number of Fans	2
<b>MAGNUM SL:</b>	
Diameter	312 mm (12.25 in.)
Pitch	30°
Number of Fans	2
<b>MAGNUM 20:</b>	
Diameter	270 mm (10.6 in.)
Pitch	25°
Number of Fans	3
<b>Weight (net):</b>	
MAGNUM 20 Base Unit	392Kg (865 lb.)
MAGNUM SL Base Unit	402 Kg (885 lb.)
MAGNUM Base Unit	422 Kg (930 lb.)
Full TRANSFRESH®Option	13 Kg (28 lb.)
Water-cooled Condenser-Receiver Option	13.6 Kg (30 lb.)
<b>Unit Dimensions: see Figure 2</b>	
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 = Unit Depth: MANGUM 20	335.0 mm (13.18 in.) from back of flange
MAGNUM SL	378.0 mm (14.88 in.) from back of flange
MAGNUM	420.0 mm (16.54 in.) from back of flange
J = MANGUM and MAGNUM SL	Evaporator Access Door
K = MAGNUM 20 and MAGNUM SL	Evaporator Access Door

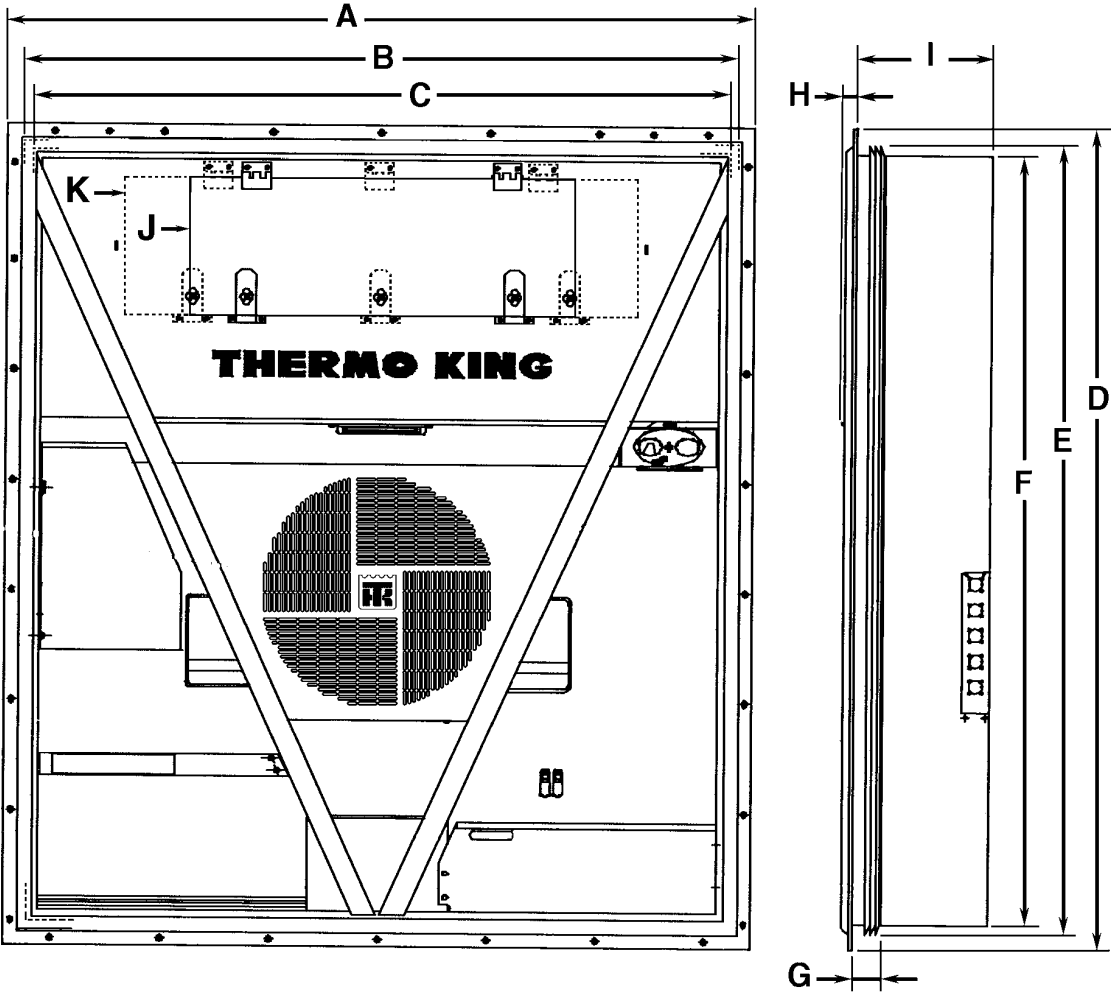


Figure 2: Physical Specifications

## 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.

# Unit Description, Features & Options

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## Introduction

This chapter will briefly describe the following items:

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

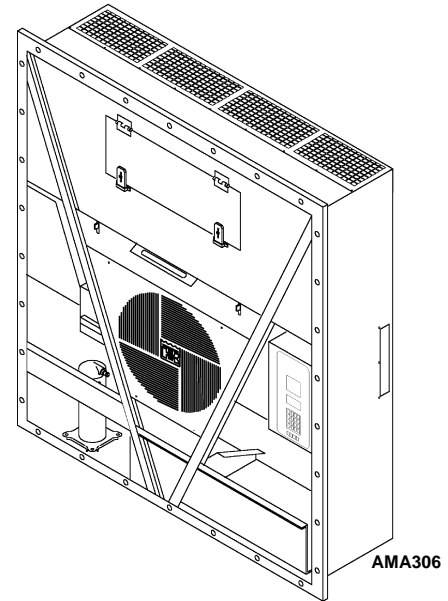
## General Description

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. MAGNUM SL and MAGNUM 20 units feature a slimline frame. Fork lift pockets are provided for installation and removal of the unit.

The frame and bulkhead panels are constructed of aluminum and are treated to resist corrosion. A hinged, removable evaporator compartment door provides easy service access. All 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 3: 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)
- Water-Cooled Condenser/Receiver Tank (Optional)
- Advanced Fresh Air Management (AFAM) and Advanced Fresh Air Management Plus (AFAM+) (Optional)
- Water Pressure Switch (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).

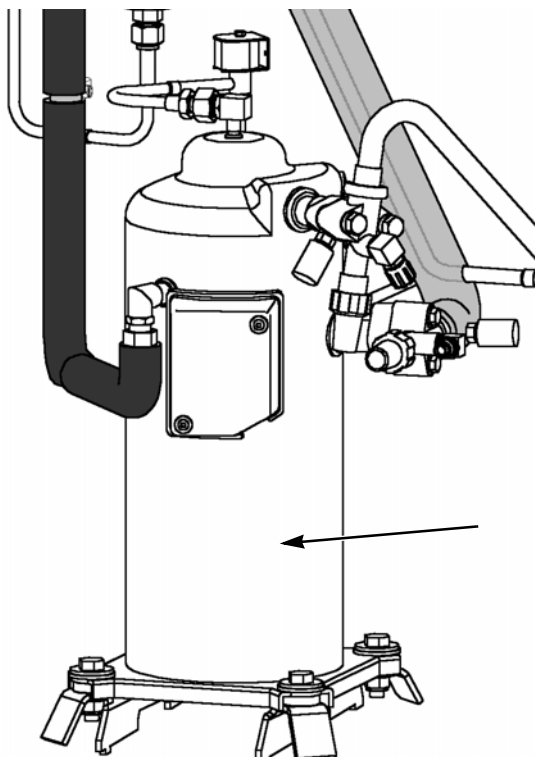
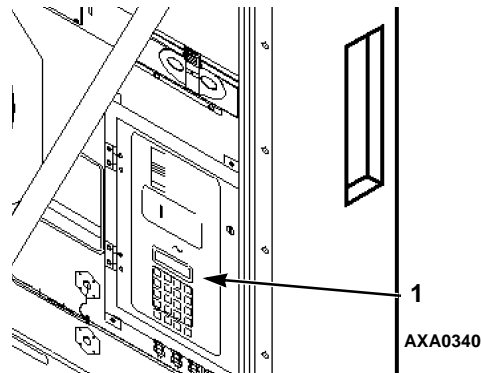


Figure 4: Scroll Compressor

## MP-3000a Controller

The MP-3000a 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-3000a Controller

Figure 5: MP-3000a Controller

## Compressor Digital Control Valve

The MP-3000a 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.

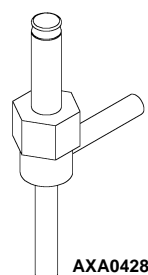


Figure 6: Compressor Digital Control Solenoid Valve

## 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.

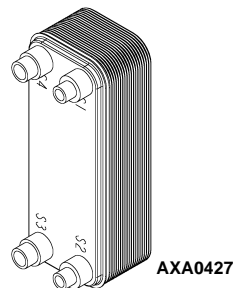


Figure 7: Economizer Heat Exchanger

## Temperature Sensors

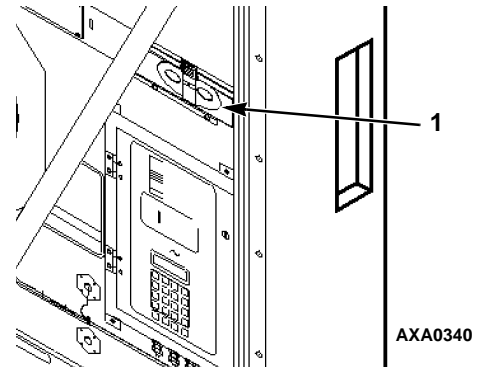
Each sensor element is connected to a cable and packaged in a sealed stainless steel tube. The temperature signal from the sensor is transmitted through the cable. Thermistor type temperature sensors are used to sense temperatures for the:

- Supply Air, Left Hand
- Supply Air, Right Hand
- Return Air
- Evaporator Coil
- Condenser Coil
- Compressor Top Cap
- Ambient Air

These sensors are field replaceable. Four 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 8: Fresh Air Exchange Vent

## Fresh Air Exchange Recorder (Optional)

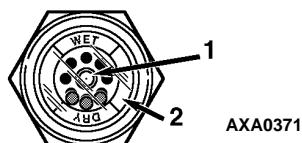
The Fresh Air Exchange Recorder detects vent disk movement. It automatically displays a value on the LCD display. This value is also logged in the datalogger. The entry records the time, date and vent opening position. It mounts on the fresh air vent door.



Figure 9: 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 10: 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 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, or the Controlling Mode setting if available.

**NOTE: If Economy Mode is on:**

- **Chill Loads:** Evaporator fans operate on low speed when container temperature is in-range.
- **Frozen Loads:** Evaporator fans stop during the Null mode; controller operates fans on low speed for 5 minutes every 45 minutes.

**NOTE: If the Controlling Mode is available and set to Optimized:**

- **Chill Loads:** Evaporator fans operate on high and low speed - depending on the need for cooling.
- **Frozen Loads:** Evaporator fans stop during the Null mode; controller operates fans on low speed for 5 minutes every 45 minutes.

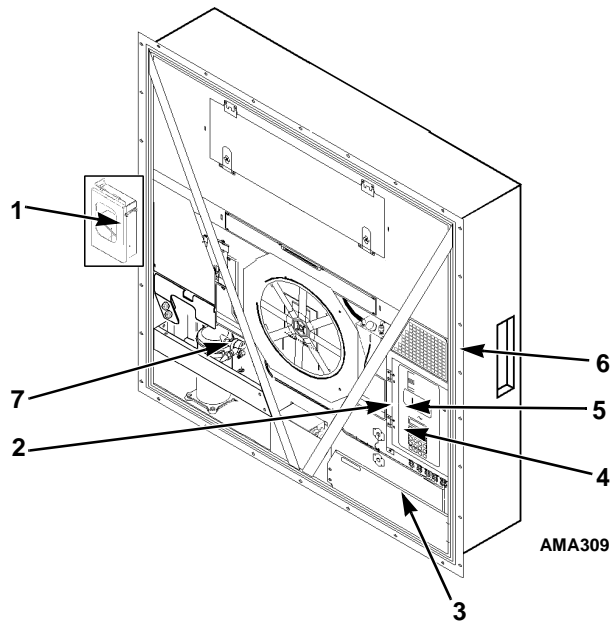
## Condenser Fan Control

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 11. These options are specified when placing the order. These options are briefly described on the following pages.



1.	Recording Thermometer (Optional)
2.	Remote Monitor Plug Option (4-Pin Connector on Side of Control Box) (Optional)
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.	Advanced Fresh Air Management (AFAM+) (Optional)
7.	Suction/Discharge Pressure Transducer (Optional)

**Figure 11: 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 Receptacle Option (4-Pin) (Optional)

An optional 4-pin remote monitor connector provides 24 Vac signals for bridge lights that monitor Cool (Compressor On), Defrost and In-range conditions.

## 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.

## USDA Cold Treatment Temperature Recording (Optional)

The MP-3000a 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.

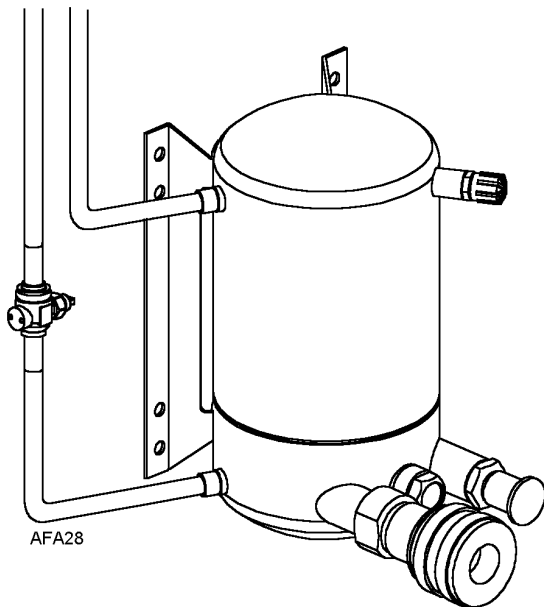


Figure 12: Water-Cooled Condenser/Receiver Tank

## 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 (Optional)

The Condenser Fan 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  $117 \pm 21$  kPa,  $1.17 \pm 0.21$  bar, ( $17 \pm 3$  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  $35 \pm 21$  kPa,  $0.35 \pm 0.21$  bar, ( $5 \pm 3$  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.).*

## Advanced Fresh Air Management (AFAM) and Advanced Fresh Air Management Plus (AFAM+) (Optional)

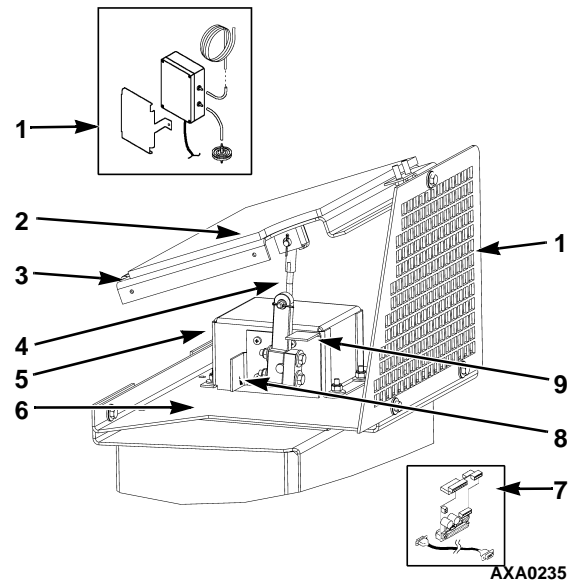
An advanced microprocessor controlled fresh air management system provides:

- programmable control of the air exchange rate
- programmable delayed vent opening
- automatic closure of the air exchange vent during low ambient conditions
- data logging of the air exchange rate and vent opening delay interval

The AFAM system includes a door control module, vent door and vent grille. The MP-3000a controller sends a communication signal to the door control module to position the vent door to the desired position. The controller can also be set to delay opening of the fresh air vent for up to 72 hours, in 1-hour increments. This allows faster product temperature pull-down.

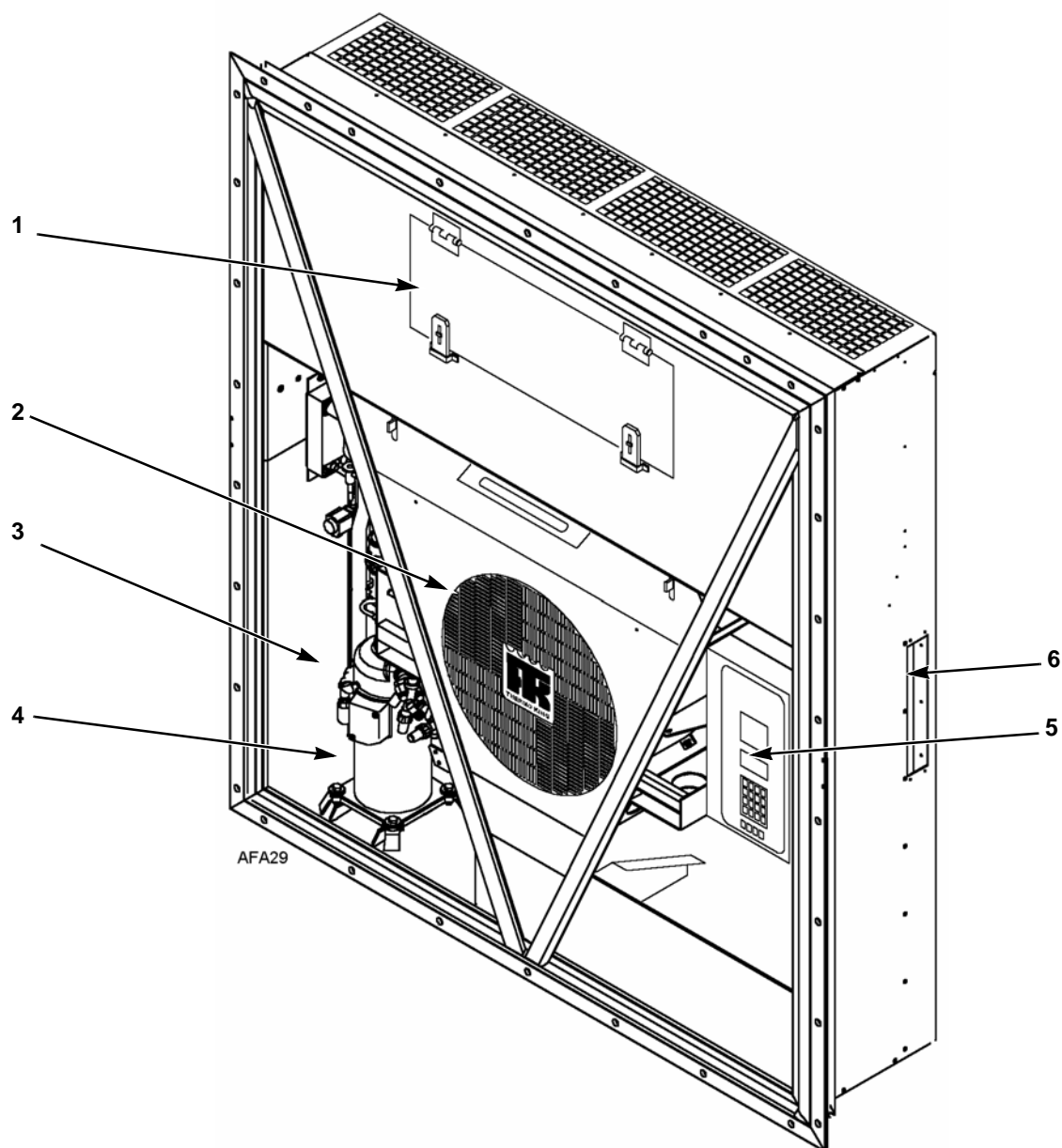
An advanced microprocessor controlled fresh air management system also provides programmable control of the CO<sub>2</sub> levels in the container, and data logging of the CO<sub>2</sub> gas level readings.

The AFAM+ system includes a gas sensor unit, sensor filter, vent loop, pressure relief valve assembly and single purge port. The controller can be set to maintain a maximum CO<sub>2</sub> level in the container between 0 and 25 percent.



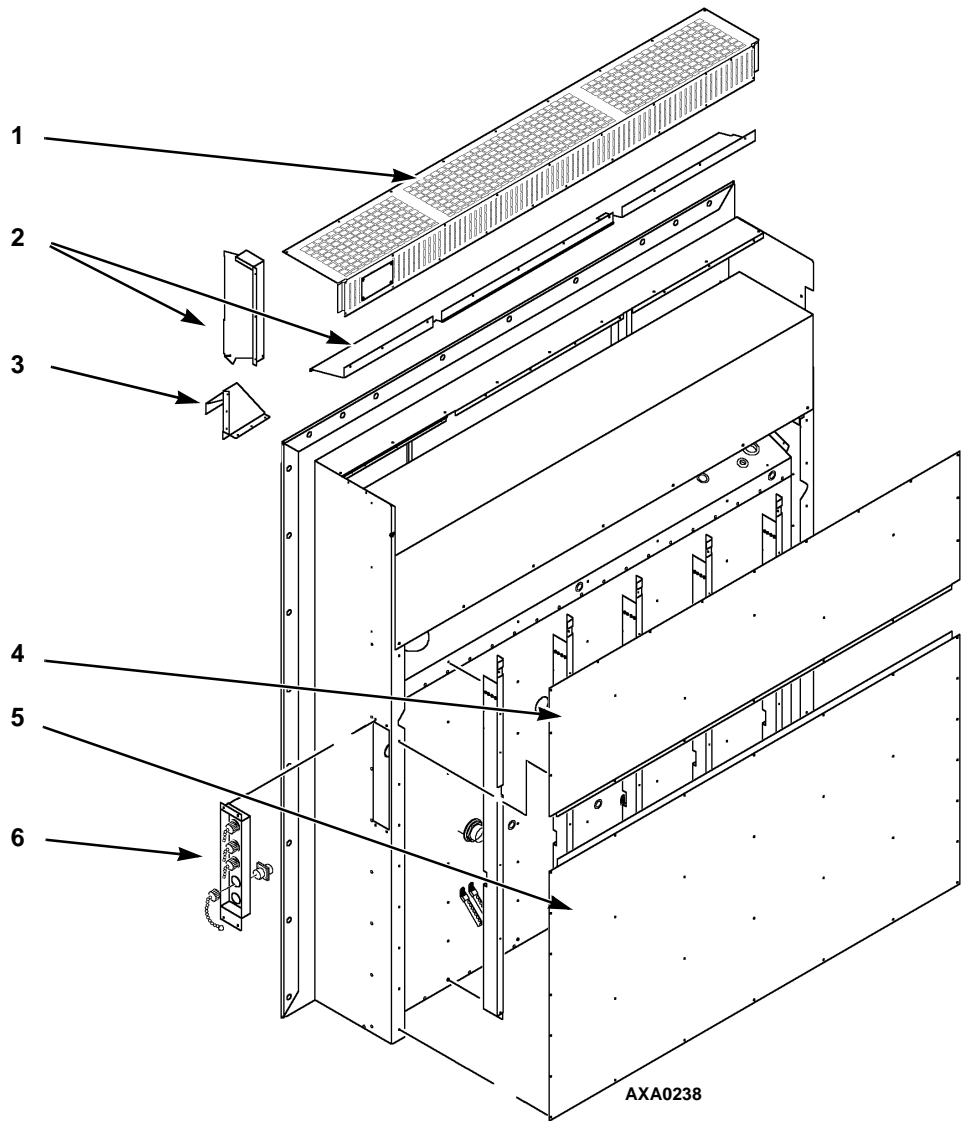
1.	Gas Sensor Assembly (Mounts in Evaporator)
2.	Gasket
3.	Vent Door Assembly
4.	Linkage Assembly
5.	Damper Motor Housing
6.	Damper Motor Assembly Mounting Bracket
7.	Interface Board and Cable (Mounts in Control Box)
8.	Stop Bracket, Vent Door Full Open
9.	Stop Bracket, Vent Door Closed
10.	Grille

**Figure 13: Advanced Fresh Air Management (AFAM+) Option**



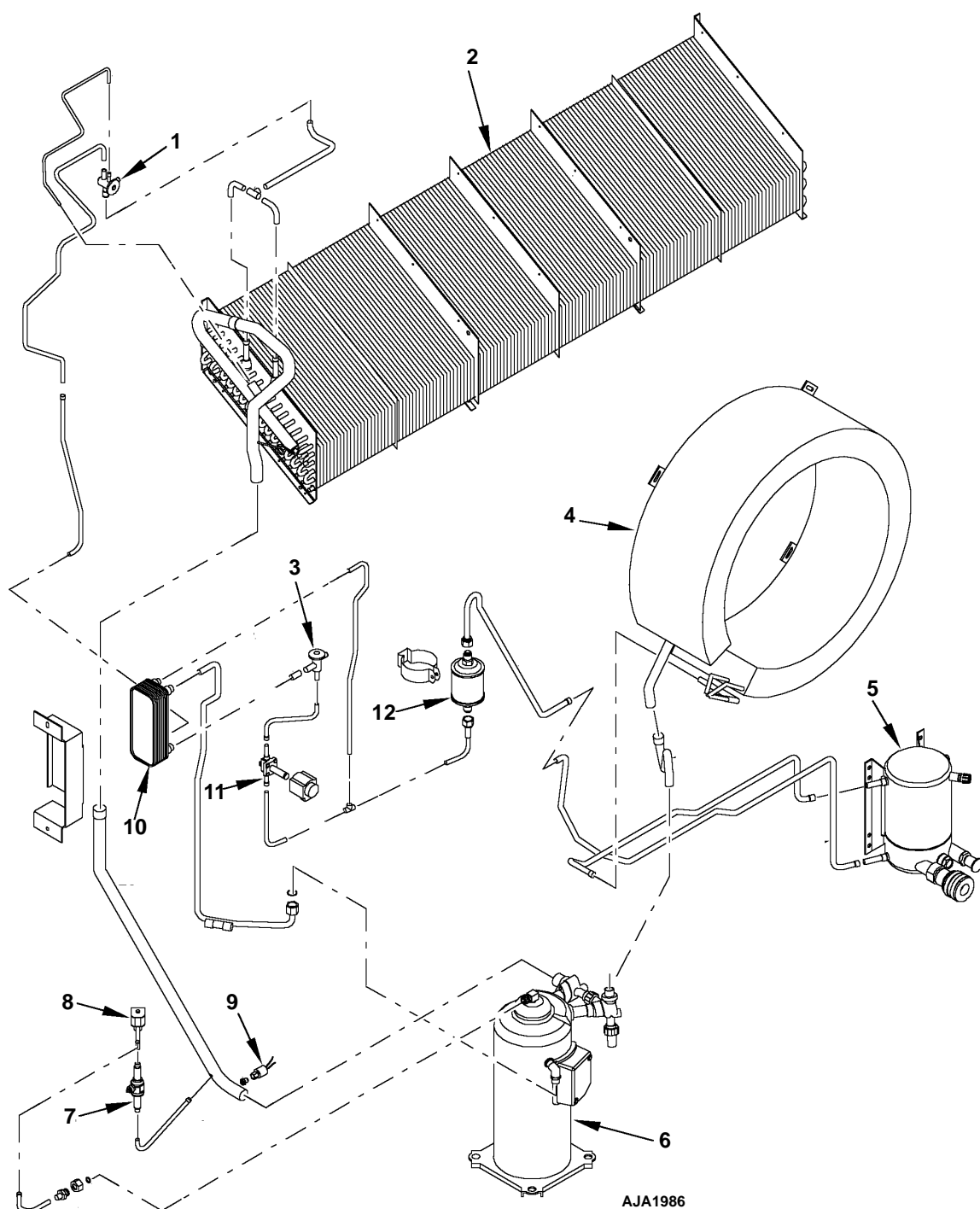
1.	Evaporator Access Door
2.	Condenser Fan
3.	Compressor Compartment
4.	Scroll Compressor
5.	Control Box
6.	Rear Download and USDA Receptacle Panel (Access from Inside Container)

**Figure 14: 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: <ul style="list-style-type: none"><li>• Controller Communications and Data Download Port</li><li>• USDA1/Spare 1 Sensor Connection</li><li>• USDA2/Spare 2 Sensor Connection</li><li>• USDA3/Spare 3 Sensor Connection</li><li>• Cargo (Pulp) Sensor Connection</li></ul>

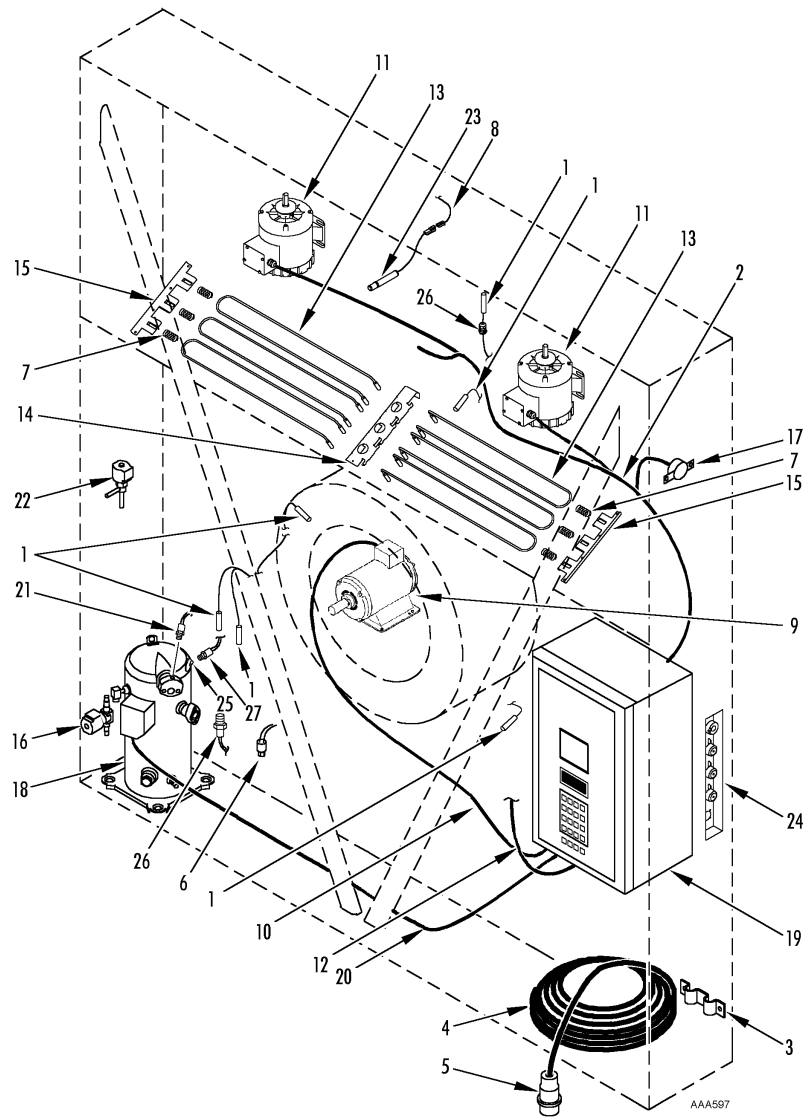
Figure 15: Unit Back View



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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 16: 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 17: Electrical Components





# Controller Description

## Controller Description

The MP-3000a 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 Status Display:** Displays the controlling sensor temperature (return or supply). Also has 8 status indicator LED's. See the next page for further information.

**Message Display:** Displays the controller menu, alarms and messages. See the next page for further information.

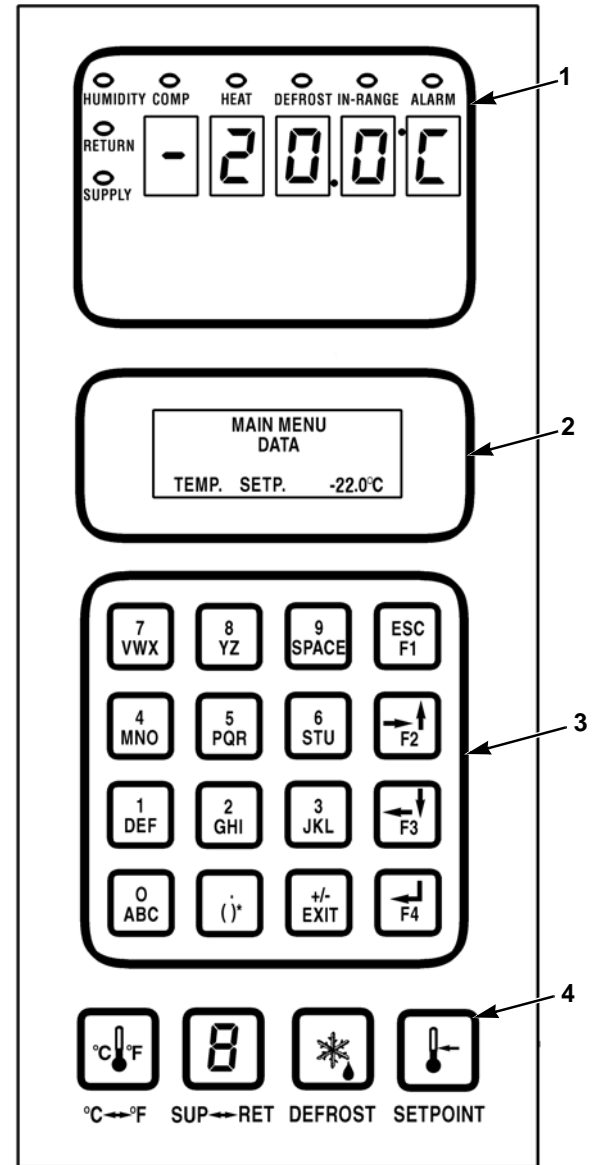
**Keypad:** Contain sixteen keys used to:

- Navigate/scroll the controller menu
- Enter/change text and numeric characters in the message display.

See the next page for further information.

**Special Function Keys:** Four special function keys are available to quickly move to a specific area of the controller menu. See the next page for further information.

Each of the above areas will be described in detail on the following pages.



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1.	Temperature Status Display
2.	Message Display
3.	Keypad
4.	Special Function Keys

Figure 18: MP-3000a Controller Display Panel

## Temperature Status Display

The Temperature Status Display consists of two areas: A 5 digit LED display that shows the sensor temperature in Fahrenheit or Celsius and 8 status indicator LED's.

### LED Display

The LED display shows controlling (return or supply) sensor temperature. The sensor temperature shown in LED display is indicated by status indicator lights. If a sensor is out of range the display shows "+Err" or "-Err". The  $\pm$  sign indicates whether the sensor temperature is out of range high or low. The LED display also shows the test stage of a pretrip (PTI) or function test.

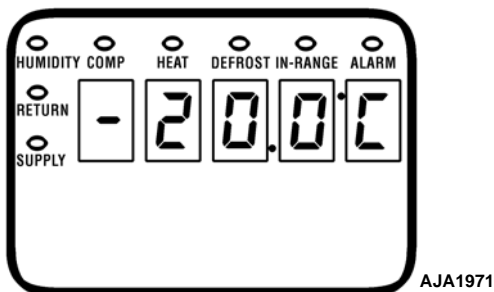


Figure 19: Temperature Status Display

### Status Indicator LEDs

Eight status indicator LEDs are located along the top of the Temperature Status Display and signal the following:

- Supply (Air Temperature)
- Return (Air Temperature)
- Humidity Mode (Humidification set to On in Setpoint menu)
- Compressor (Cooling On)
- Heat (On)
- Defrost
- In-range (Temperature)
- Alarm

The indicator LEDs stay on continuously to indicate sensor temperature display, unit operating mode or condition.

The Alarm LED flashes on and off continuously when a Check Alarm or Shutdown Alarm occurs.

## Message Display

The Message Display shows setpoint temperature during normal operation.

**NOTE:** *On units that have the Controlling Mode selection available, the Message Display switches between the setpoint temperature and the Controlling Mode (CTRL MODE OPTIMIZED or CTRL MODE NON-OPTIMIZED) about every four seconds.*

Alarms, messages and the controller menu also appear in the LCD display when special keys are pressed.

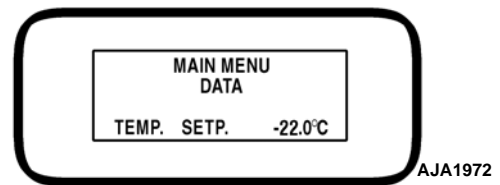


Figure 20: Message Display

## Four Special Function Keys

The following four keys are located at the bottom of your controller. These special function keys allow the operator to move quickly to a specific area of information.



Figure 21: Special Function Keys

- **C/F** key: Press to view alternate temperature scale Celsius or Fahrenheit in LED display.
- **DEFROST** key: Press to initiate defrost. Evaporator coil temperature must be below 10 C (50 F).
- **SUP/RET** key: Press to view alternate return/supply sensor temperature in LED display.
- **SETPOINT** key: Press to enter Setpoint menu. The first line of the Setpoint menu is the setpoint temperature. Press **F2** or **F3** key to scroll up or down through the menu list.

**NOTE:** Press the **5** key to increase the display time of the current LCD data screen by 5 minutes. Maximum display time is 30 minutes for data screens and 100 minutes for manual tests.

## Keypad

The keys are used to scroll through the Controller menu and enter text and numeric characters.

### Menu Scrolling Keys

Display menus: The MP-3000a controller contains an extensive display menu that can be navigated via the 4 menu scrolling keys on the keypad. The display menu is organized into eight main menus.

General text keys **F1**, **F2**, **F3** and **F4** also include directional arrows for entering and scrolling through the controller Main menu:

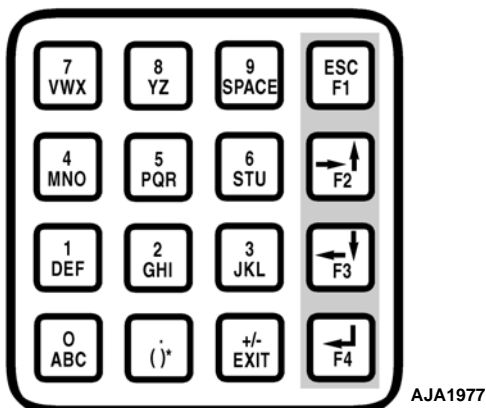


Figure 22: Menu Scrolling Keys on Keypad

- **F1** key: “ESC” indicates that pressing the **F1** key moves the cursor out of (exits) a menu list.
- **F2** key: Forward/Up Arrows indicate that pressing the **F2** key scrolls the cursor forward and/or upward through text boxes and menu lists.
- **F3** key: Backward/Down Arrows indicate that pressing the **F3** key scrolls the cursor backward and/or downward through text boxes and menu lists.
- **F4** key: Enter Arrow indicates that pressing the **F4** key moves the cursor into the next menu level or into a menu item text box.

- Setpoint Menu
- Alarm List Menu
- Data Menu
- REFCON Remote Monitoring (RMM) State
- Data logger Menu
- Miscellaneous Functions Menu
- Configuration Menu
- Commands Menu

**NOTE:** 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.

### Text Input

The keyboard supports both numerical and text input. Each key can have more than one meaning. Use the special text keys **F1**, **F2**, **F3** and **F4** to enter text in an information screen:

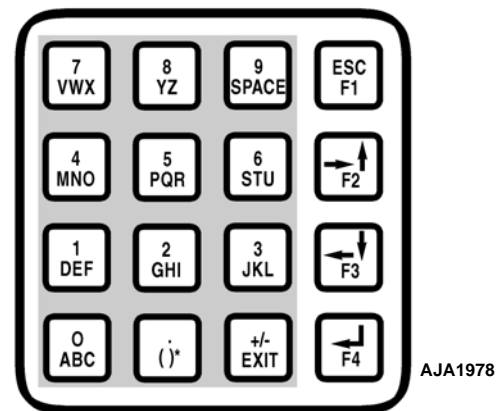


Figure 23: Text Keys on Keypad

**F1 key:** Press the **F1** key, then press another general purpose key to enter the number shown on the key.

**F2 key:** Press the **F2** key, then press another general purpose key to enter the first letter shown on the key.

**F3 key:** Press the **F3** key, then press another general purpose key to enter the second letter shown on the key.

**F4 key:** Press the **F4** key, then press another general purpose key to enter the third letter shown on the key.

**NOTE:** When the **F1**, **F2**, **F3** or **F4** key is pressed to enter a character in the display, the keypad remains on that “character level” until another “level” is selected by pressing the **F1**, **F2**, **F3** or **F4** key.

### Text Input Example

The following paragraph gives an example of how to enter text to an informational screen.

To enter “THERMO” in an information screen:

- Enter “T” by pressing the **F3** key, then pressing **STU** key.
- Enter “H” by pressing the **GHI** key.
- Enter “E” by pressing the **DEF** key.
- Enter “R” by pressing the **F4** key, then pressing the **PQR** key.
- Enter “M” by pressing the **F2** key, then pressing the **MNO** key.
- Enter “O” by pressing the **F4** key, then pressing the **MNO** key.

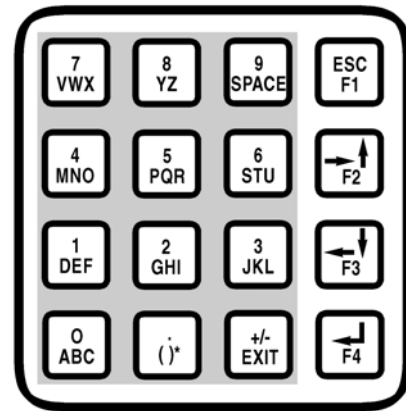


Figure 24: Text Keys

# Navigating the Controller Operating Menu

## Navigating the Controller Operating Menu

The MP-3000a contains an extensive operating menu. The menu is navigated via the controller keypad. The Main menu is divided into eight major areas:

- Setpoint
- Alarm List
- Data
- RMM State
- Datalogger
- Configuration
- Misc. Functions
- Commands

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 MP3000a Controller Menu. It is recommended to fold this menu out and leave it folded out until you become familiar with the controller menu.

## Menu Scrolling Keys

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



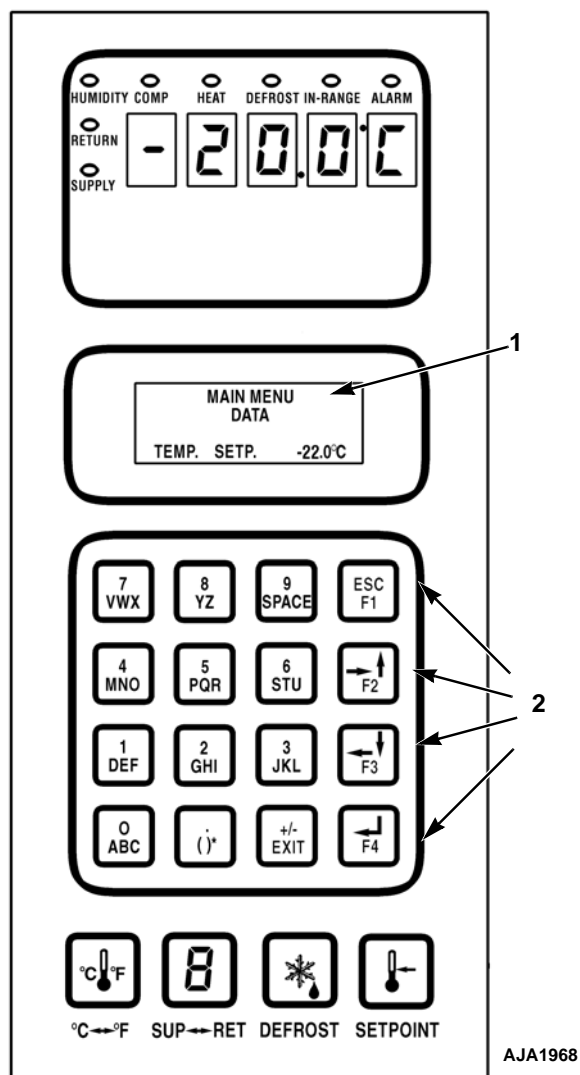
Press the **F1** key each time you want to exit a submenu shown in the message display.



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** key: Press the **F4** key to enter a new menu or submenu; to access a menu line to enter information; or to load a command or value.



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1.	Message Display
2.	Menu Scrolling Keys

Figure 25: MP-3000a Controller Display Panel

1. Display menus: The MP-3000a controller contains an extensive display menu that can be navigated via keypad. The display menu is organized into eight main menus:

***NOTE: 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.***

- Setpoint Menu: Menu screens in this group are used to enter the temperature setpoint and set the Economy mode. Setpoint menu option functions include: set Bulb mode or dehumidify operation and enter humidity setpoint, set AFAM, set AFAM delay, set AFAM rate, set O<sub>2</sub> Minimum, set CO<sub>2</sub> Maximum and OPTI-SET.
- Alarm List Menu: Menu screens in this group display a list of alarm code(s).
- Data Menu: Menu screens in this group are used to display unit operating information including sensor temperatures, voltage, current and frequency information.
- REFCON Remote Monitoring (RMM) State: Menu screen show current remote monitoring state (Offline, Zombie or On-line).
- Data logger Menu: Menu screens in this group display temperature log, event log, set log time and PTI log.
- Configuration Menu: Menu screens in this group display refrigerant type, in-range setting, container ID, contrast (screen), language, unit type, reefer type, AFAM option, evaporator type, condenser type, USDA type, AFAM units and other unit settings.
- Miscellaneous Functions Menu: Menu screens in this group display date/time, C/F, cargo data, program version and run time (hourmeters) information.
- Commands Menu: Menu screens in this group are used to activate pretrip (PTI) tests, function tests, manual function tests, and power management.

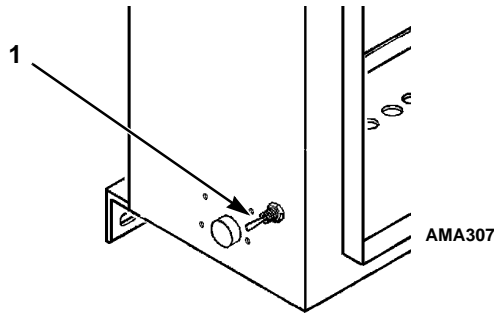
A complete listing of the controller operating menu is located on an 11' x 17' fold out in the Wiring and Diagram section in the back of the manual (see last page in book). It is designed to be folded out so you can continuously view it as you are learning how to navigate the MP3000a Controller Menu. It is recommended to fold this menu out and leave it folded out until you become familiar with the controller menu.

# Operating Instructions

## Unit On/Off Switch

The unit control box has a two position toggle switch to turn power On or Off to the unit.

- **On position.** Unit will operate on Cool or Heat depending on the controller setpoint temperature and the container air temperature.
- **Off position.** The unit will not operate.



1	Unit On/Off Switch
---	--------------------

Figure 26: Unit On/Off Switch

## Sequence Of Operation

### Unit Start-up

A 60 second sequence start of the required loads occurs during initial start-up of the controller. If cooling (or heating) is required, the unit operates in the Cool (or Heat) mode.

- When the Unit On/Off switch is turned On, the LED display turns on and then off.
- The setpoint appears briefly in the LED display.

**NOTE: When the setpoint appears in the LED display, both the Return and Supply LEDs are lit.**

- The LED then shows the controlling air sensor temperature.
- The controller energizes the heater relay for 5 seconds and senses the incoming power phase and selects the correct power phase to unit components.
- The evaporator fan motors start about 40 seconds after the unit is turned on.

- Evaporator fans operate on high speed at setpoints of -9.9 C (14.1 F) and above.
- Evaporator fans operate on low speed at setpoint temperatures of -10 C (14 F) and below.
- The compressor starts about 10 seconds later and the liquid line solenoid energizes (opens) if the controller calls for cooling.
- The condenser fan then starts if the condenser temperature requires condenser fan operation.
- If the controller calls for heating, the electric heaters are pulsed on and off to provide heat.
- The controller turns on the In-range LED when the controlling sensor temperature is within 1.5 C (2.7 F) of the setpoint.

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

## Controller Input and Output Signals

The MP-3000a 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 MPC-3000a 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 unload valve
- Vapor injection valve
- Dehumidify valve
- Electric heaters
- Phase selection



### Change the Setpoint

To change the controller setpoint, turn the **UNIT ON/OFF** switch **ON**. Complete the following steps:

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F4** key. An Enter Arrow appears in the menu line and the current setpoint disappears.
3. Enter (type) the new setpoint in the LCD display using the general purpose keypad. Press the **EXIT (±)** key first to enter a minus setpoint. The cursor moves to the right of the screen as each key entry is acknowledged and displayed.

**NOTE:** Always check that the setpoint entered in the LCD display is correct before proceeding.

4. Press and hold the **F4** key until the cursor stops flashing. The new setpoint is recorded in the controller and appears in the LCD display.

**NOTE:** The controller will default (return) to the previous setpoint if the setpoint is not entered within 30 seconds. Repeat steps 1 through 4 if this occurs.

**NOTE:** Humidity control, humidity setpoint and Economy mode can also be set from the Setpoint menu. See “Setpoint Menu” under “Menu Operating Instructions” in this chapter.



### Initiating a Manual Defrost

Turn the **UNIT ON/OFF** switch **ON**. Complete the following steps:

1. Press the **DEFROST** 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 as the Defrost and Heat LEDs turn on. LCD message display shows [DEFROST ACTIVATED].
  - If unit operating conditions do *not* allow defrost, the LCD message display shows [DEFROST NOT ACTIVATED].
2. The defrost cycle automatically terminates.

**NOTE:** A “timed” defrost of the evaporator coil can be performed if frost or ice can not be removed from the evaporator coil by an automatic defrost cycle:

- Activate [HEAT ON] in the Manual Function Test submenu.
- Press the **5** key six times. Heaters will be activated for 70 minutes. Unit then returns to normal operation.



### Display Alternate Controlling (Supply or Return) Air Sensor Temperature

The controller can show either the supply or return air temperature in the LED Display. Turn **UNIT ON/OFF** switch **ON**. Complete the following steps to display alternate controlling temperature:

1. Check the indicator LEDs to determine which sensor temperature (supply air or return air) currently appears in the right display. This is the controlling sensor.
2. To view the alternate (supply or return) air temperature, press and hold the **SUP/RET** key. The controller will show the alternate sensor temperature as long as the **SUP/RET** key is depressed.



- The display then returns to controlling sensor temperature when **SUP/RET** key is released.



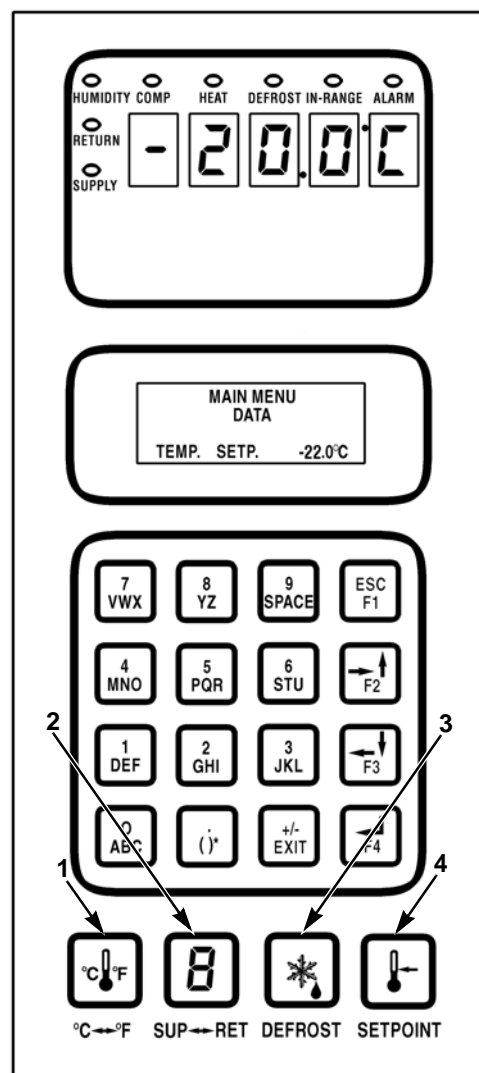
## Display Alternate Fahrenheit (F) or Celsius (C) Temperatures

The controller can display temperatures in Celsius or Fahrenheit. Turn the **UNIT ON/OFF** switch **ON** and complete the following steps to display in fahrenheit or celsius:

- Press and hold the **C/F** key. The controller will show both LED and LCD display temperatures in the alternate temperature scale (Fahrenheit or Celsius) as long as the **C/F** key is depressed.
- The display then returns to the original display when the **C/F** key is released.

To change the default temperature unit display, complete the following steps:

- Press and hold the **C/F** key.
- Press the **SETPOINT** key for 1 second.



1.	C/F Key
2.	Sup/Ret Key
3.	Defrost Key
4.	Setpoint Key

Figure 27: Special Function Keys

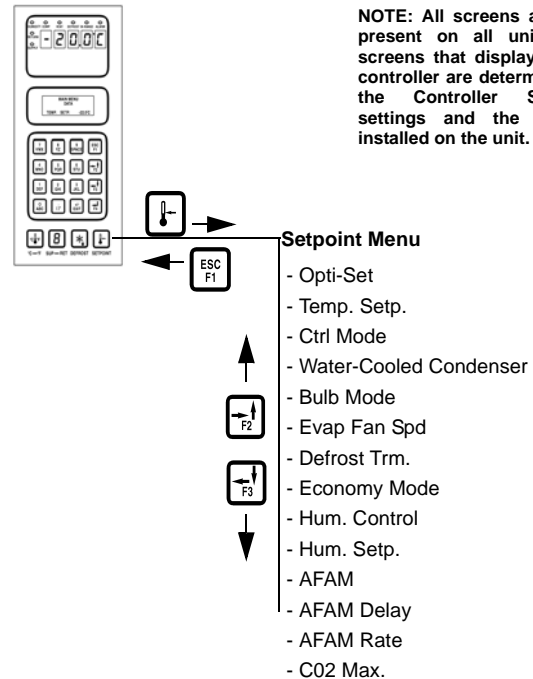
## Setpoint Menu

Pressing the **SETPOINT** key displays the following list of tasks and values that can be activated or set:

- Opti-Set (AFAM+ only)
- Setpoint Temperature
- Controlling Mode (if available)
- Water-Cooled Condenser
- Bulb Mode
- Evaporator Fan Speed
- Defrost Termination Temperature
- Economy Mode
- Humidity Control
- Humidity Setpoint
- AFAM (AFAM+ only)
- AFAM Delay (AFAM+ only)
- AFAM Rate (AFAM+ only)
- CO<sub>2</sub> Maximum (AFAM+ only)

**NOTE:** 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.

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



**Figure 28: Setpoint Menu**

## Change the Setpoint Temperature

See “Changing the Setpoint”.

## Change Controlling Mode

The Controlling Mode is only available for containers with specific IDs. If available, Optimized is the default setting. See “Evaporator Fan Control” on page 106 for more information.

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to “CTRL MODE” line.
3. Press the **F4** key to change the mode setting. An arrow appears in the menu line and the cursor moves to the end and flashes.
4. Press the **F2** or **F3** key to toggle between [OPTIMIZED], and [NON-OPTI].
  - [OPTIMIZED] means the evaporator fans operate on low and high speed as needed to maintain the setpoint and save energy.
  - [NON-OPTI] (Non-Optimized) means the evaporator fans operate continuously on high speed.

**NOTE: The Controlling Mode setting only affects operation in the Chilled Mode (setpoints of -9.9 C [14.1 F] and above). It does change operation in the Frozen Mode (setpoint at -10.0 C [14.0 F] or below).**

5. With the desired state in the menu line, press and hold the **F4** key until the cursor stops flashing. New mode setting appears in the display.

## Change Condenser Fan Mode

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to “WATER COOL. CON” line.
3. Press the **F4** key to change the mode setting. An arrow appears in the menu line and the cursor moves to the end and flashes.

4. Press the **F2** or **F3** key to toggle between [OFF], and [ON].
  - [OFF] means the condenser fan will be ON
  - [ON] means the condenser fan will be OFF
5. With the desired state in the menu line, press and hold the **F4** key until the cursor stops flashing. New mode setting appears in the display.

## Change the Bulb Mode Setting

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to “BULB MODE” line.
3. Press the **F4** key to change the mode setting. An Enter Arrow appears in the menu line and the current setting disappears.
4. Press the **F2** or **F3** key to toggle between [OFF], [FLOW CYCLE], [FLOW HIGH] and [FLOW LOW]. Stop on desired mode setting line.
  - [OFF]: Controller removes the [DEFROST TERM] setting from display. Humidity mode must be manually set to off to stop dehumidify operation.
  - [FLOW CYCLE]: Evaporator fans cycle between high and low speed every 60 minutes.
  - [FLOW HIGH]: Evaporator fans operate continuously on high speed.
  - [FLOW LOW]: Evaporator fans operate continuously on low speed.
5. Press and hold the **F4** key until the cursor stops flashing. The new mode setting appears in the display. When the Bulb mode is active:
  - The defrost termination temperature can be adjusted from 4 to 30 C (40 to 86 F). Lower defrost termination settings may result in less warming of the cargo during defrost.

- The Dehumidify mode is on. A humidity setpoint for dehumidify system operation must be entered.

6. Press the **F2** or **F3** key to scroll to the [DEFROST TERM] line.
7. Press the **F4** key to enter a new defrost termination temperature. An Enter Arrow appears in the menu line and the current temperature disappears.
8. Enter (type) the new termination temperature setpoint in the LCD display using the general purpose keypad. The cursor moves to the right of the screen as each key entry is displayed and acknowledged.

**NOTE:** *The defrost termination temperature setting during Bulb mode operation should be established by the shipper. Always check that the temperature entered in the LCD display is correct before proceeding.*

9. Press and hold the **F4** key until the cursor stops flashing. The new setpoint is recorded in the controller and appears in the LCD display.
10. Press the **F2** or **F3** key to scroll to the [HUM CONTROL] line.
11. Press the **F4** key to enter a new setpoint. An Enter Arrow appears in the menu line and the current setpoint disappears.
12. Enter (type) the new setpoint in the LCD display using the general purpose keypad. The cursor moves to the right of the screen as each key entry is acknowledged and displayed.

**NOTE:** *The humidity setpoint should be established by the shipper. Always check that the setpoint entered in the LCD display is correct before proceeding.*

13. Press and hold the **F4** key until the cursor stops flashing. The new setpoint is recorded in the controller and appears in the LCD display.
14. Press the **ESC** key to exit the Setpoint screen.

**NOTE:** *If the Bulb mode is active, the controller LCD display will show [BULB] and current humidity setpoint.*

## Change the Economy Mode Setting

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

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to [ECONOMY MODE] line.
3. Press the **F4** key to change the mode setting. Cursor moves to end of menu line and flashes.
4. Press the **F2** or **F3** key to toggle between “OFF” and “ON”.
5. With the desired state in the menu line, press and hold the **F4** key until cursor stops flashing. New mode setting appears in display.

**NOTE:** *On frozen loads, the Economy mode also modifies the temperature control algorithm to extend the Null mode. See [Economy Min.] and [Economy Max.] under [Configuration Menu] in this chapter to check the current settings or enter new settings.*

6. Press the **ESC** key to exit the Setpoint screen.

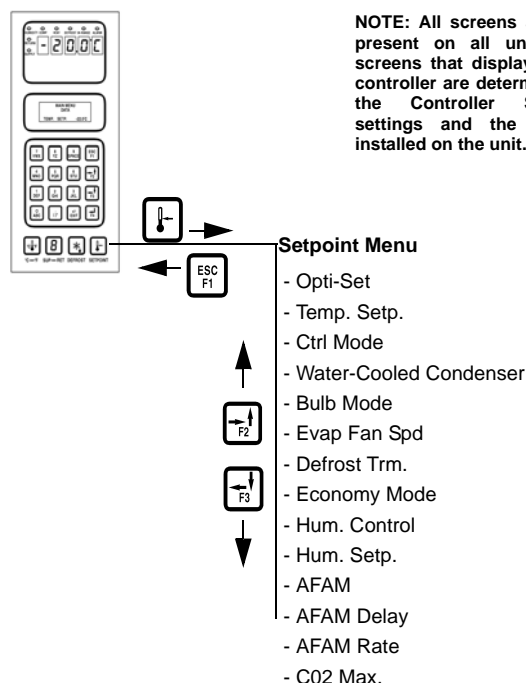


Figure 29: Setpoint Menu

## Change the Humidity Mode Setting

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to [HUM CONTROL] line.
3. Press the **F4** key to change the mode setting. Cursor moves to end of menu line and flashes.
4. Press the **F2** or **F3** key to toggle between [OFF] and [DEHUM].
5. Press and hold the **F4** key until cursor stops flashing. New mode setting appears in display.
6. Press the **ESC** key to exit the Setpoint screen.

## Change the Humidity Setpoint

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to [HUM SETP] line.
3. Press the **F4** key to enter a new setpoint. An Enter Arrow appears in the menu line and the current setpoint disappears.
4. Enter (type) the new setpoint in the LCD display using the general purpose keypad. The cursor moves to the right of the screen as each key entry is acknowledged and displayed.

**NOTE:** Always check that the setpoint entered in the LCD display is correct before proceeding.

Press and hold the **F4** key until the cursor stops flashing. The new setpoint is recorded in the controller and appears in the LCD display.

5. Press the **ESC** key to exit the Setpoint screen.

## Changing the Advanced Fresh Air Management (AFAM) or Advanced Fresh Air Management Plus (AFAM+) Setting

For AFAM or AFAM+ operating instructions, see AFAM+ instructions in the Operating Section.



**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.

### Setpoint Menu

- Opti-Set
- Temp. Setp.
- Ctrl Mode
- Water-Cooled Condenser
- Bulb Mode
- Evap Fan Spd
- Defrost Trm.
- Economy Mode
- Hum. Control
- Hum. Setp.
- AFAM
- AFAM Delay
- AFAM Rate
- C02 Max.

**Figure 30: Setpoint Menu**

## Alarms Menu

The Alarm List menu displays alarm codes. Alarm 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 Alarm LED is on or flashing on and off, enter the alarm list to view the alarm.

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 Types

There are two types of alarms:

**Shutdown Alarm (Level 1):** Alarm LED flashes and unit stops. 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. Alarm code 56 (compressor temperature too high) is a shutdown alarm.

**Check Alarm (Level 2):** Alarm LED flashes until alarm is acknowledged. Check alarms indicate corrective action should be taken before a problem becomes severe.

## Alarm Code States

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

**Not Active:** An alarm condition has occurred but no longer exists in the unit. Not Active means the condition was corrected and did not recur for 1 hour; or the Unit On/Off switch was turned Off and then On.

When a Not Active alarm code is acknowledged (**F4** key pressed while alarm code appears in LCD display): The Alarm LED will turn off and the alarm code disappears from the alarm list.

**Active:** An alarm condition has occurred and continues to exist in the unit; or the alarm condition occurred within the past 1 hour but does not currently exist in the unit.

If the alarm condition no longer exists in the unit and the alarm code is acknowledged: The Alarm LED will turn off and the alarm code disappears from the alarm list.

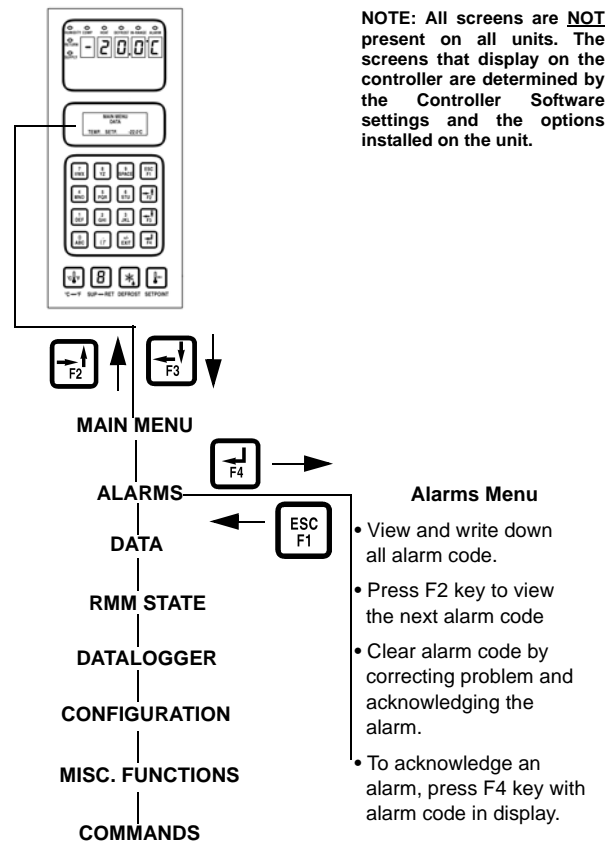


Figure 31: Alarms Menu

**Acknowledge:** An alarm code has been viewed and acknowledged in the alarm list. The Alarm LED remains on but does not flash.

If the alarm condition is corrected: The Alarm LED will turn off and the alarm code disappears from the alarm list.

## View the Alarm List Menu

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** key to directly enter Alarms menu. The first alarm code number, alarm state and alarm description appears in LCD display.

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

2. Write down the first alarm code. Then press the **F2** key to view next alarm code when more than one alarm code has been recorded.

3. Repeat above step until all alarm codes have been recorded. Press the **F3** key to scroll backward to return to a previous alarm 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, press **F4** while alarm 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 LCD Standard Display

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

## Alarm List

Alarm Code	Type	Description
00	Check	Supply Air Sensor Open Circuit
01	Check	Check Supply Air Sensor Short Circuit
02	Check	Check Return Air Sensor Open Circuit
03	Check	Check Return Air Sensor Short Circuit
04	Check	Check Evaporator Coil Open Circuit
05	Check	Check Evaporator Coil Sensor Short Circuit
06	Check	Check Compressor Current Too High
07	Check	Check Compressor Current Too Low
10	Check	Check Heater Current Too High
11	Check	Check Heater Current Too Low
12	Check	Check Evaporator Fan High Speed Current Too High
13	Check	Check Evaporator Fan High Speed Current Too Low
14	Check	Check Evaporator Fan Low Speed Current Too High
15	Check	Check Evaporator Fan Low Speed Current Too Low
16	Check	Check Condenser Fan Current Too High
17	Check	Check Condenser Fan Current Too Low
18	Check	Log Power Supply Phase Error
19	Check	Check Temperature Too Far from Setpoint
20	Check	Check Defrost Time Too Long
22	Check	Check Capacity Test 1 Error
25	Check	Check Evaporator Temperature Test Error
26	Check	Vapor Injection Valve Error
27	Check	Check Heat Capacity Test Error
31	Check	Low Pressure Cutout Error
32	Check	Check Condenser Air Sensor Open Circuit
33	Check	Check Condenser Air Sensor Short Circuit
34	Check	Check Ambient Air Sensor Open Circuit
35	Check	Check Ambient Air Sensor Short Circuit
43	Check	Check Return Air Temperature

## Alarm List (Continued)

Alarm Code	Type	Description
52	Check	Check Probe Error
53	Check	Check High Pressure Cutout Switch Off Error
54	Check	Check High Pressure Cutout Switch On Error
56	<b>Shutdown</b>	Shutdown Compressor Temperature Too High
57	Check	AFAM Device Error
58	Check	Check Phase Sensor Error
59	Check	Check Delta Current Error
60	Check	Check Humidity Sensor Error
68	Check	AFAM Gas Analyzer Error
69	Check	Gas Analyzer Calibration Error
97	Check	Log Compressor Sensor Open Circuit
98	Check	Log Compressor Sensor Short Circuit
115	Check	Probe Error Return & Evaporator
116	Check	Probe Error Return & Supply
117	Check	Probe Error Supply RH & LH
118	Check	High Refrigerant Level
119	Check	Digital Valve Error
120	Check	Suction Pressure Sensor Error
121	Check	Discharge Pressure Sensor Error
122	Check	CO2 Sensor Calibration Error

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



## 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.**

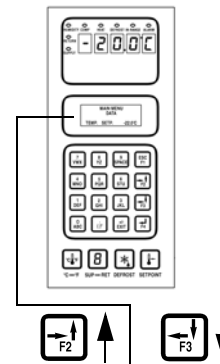
### Viewing the Data Menu

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F4** key to directly enter the Data menu. Menu items appear in LCD display.
2. Press the **F3** key to scroll the cursor down through the menu list. The Data menu displays the following functions:
  - Supply Air Temperature, Left Hand
  - Supply Air Temperature, Right Hand
  - Return Air Temperature
  - Evaporator Coil (Defrost) Temperature
  - Condenser Coil Temperature
  - Suction Pressure
  - Discharge Pressure
  - Cool Capacity
  - Ambient Temperature
  - High Pressure
  - High Pressure Temperature (Compressor Discharge Line Temperature)
  - Relative Humidity
  - Battery Voltage
  - Voltage Average (380/460V Power Supply)
  - Voltage 1 (Main Power Supply) (P1-P2)
  - Voltage 2 (Main Power Supply) (P2-P3)
  - Voltage 3 (Main Power Supply) (P3-P1)
  - Frequency (Main Power Supply)

- Current Phase 1 (Main Power Supply)
- Current Phase 2 (Main Power Supply)
- Current Phase 3 (Main Power Supply)
- CO<sub>2</sub>
- Fresh Air Exchange Rate

**NOTE: Press the 5 key to lock a Data screen in the LCD display for 5 minutes. Press any key to unlock the display. Controller returns to previous menu level or LCD Standard Display after 30 seconds.**



**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.**

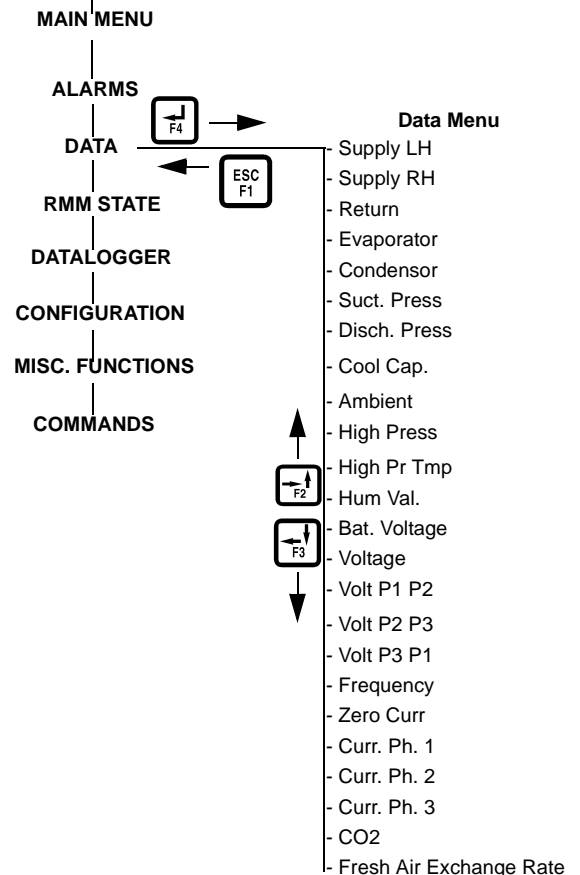


Figure 32: Data Menu

## RMM State Menu

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 ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the Main menu.
2. Press the **F2** or **F3** key to scroll through Main menu until [RMM STATE] appears in LCD display.
3. Press the **F4** key to access the RMM State screen. The screen will show: [OFFLINE], [ZOMBIE] or [ON-LINE].
4. Press the **ESC** key to exit the RMM State screen.

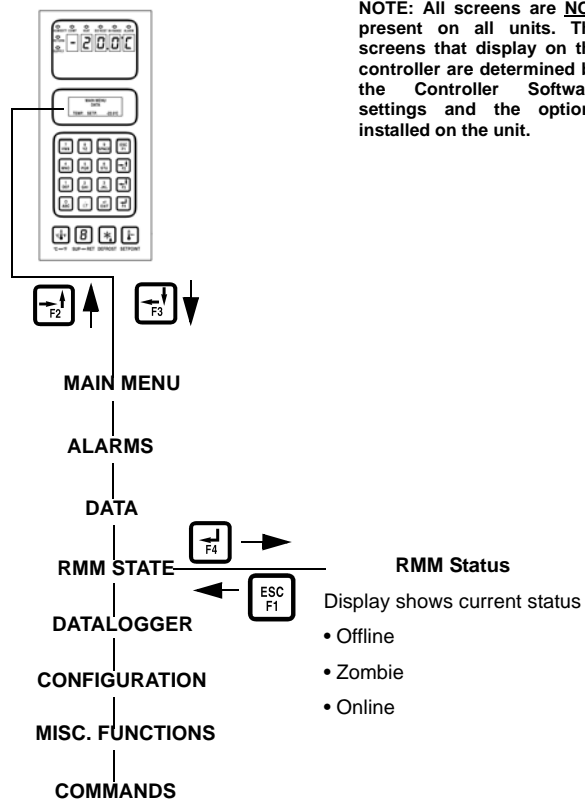


Figure 33: RMM Menu Screen Flow Diagram

## Datalogger Menu

The Datalogger menu contains a list of functions that display unit operating information recorded in the MP-3000a datalogger. The following functions are available:

**Inspect Temperature Log:** Displays temperature logs by time and date for the Setpoint, Supply (Controlling Temp), Return, USDA1, USDA2, USDA3 and ambient sensors, humidity sensor, and event flags.

**PTI State:** Displays days since last PTI Test.

**Inspect PTI Log:** Displays results of last PTI 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 USDA Probe (Optional):** Sets a temperature offset in the controller memory to calibrate each USDA sensor to the controller.

**Activate Tripstart:** Sets the date and time of the trip start.

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

**Inspect Event Log:** Displays important event logs by time and date for events such as unit alarms, power On/Off, setpoint change, clock reset, trip start, defrost, etc.

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

### Viewing the Datalogger Menu

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the Main menu.
2. Press the **F2** or **F3** key to scroll through Main menu until [DATALOGGER] appears in LCD display.
3. Press the **F4** key to access the Datalogger menu. The first function appears in the LCD display: [INSPECT TEMP LOG].

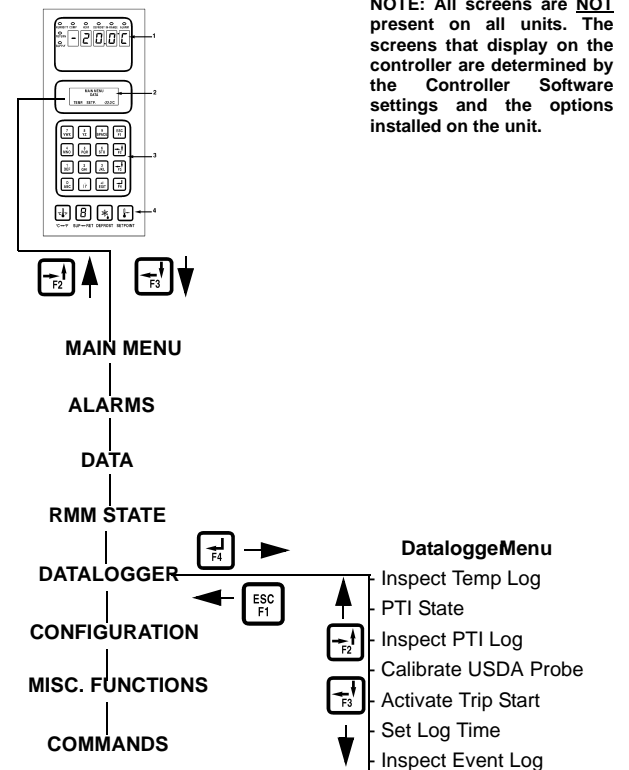


Figure 34: Datalogger Menu

4. Press **F2** or **F3** key to scroll to the desired function:
  - [INSPECT TEMP LOG]
  - [PTI STATE]
  - [INSPECT PTI LOG]
  - [CALIBRATE USDA PROBE] (Optional)
  - [ACTIVATE TRIPSTART]
  - [SET LOG TIME]
  - [INSPECT EVENT LOG]
5. Press **F4** key to access the function selected.

### Inspect Temp Log

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the menu list.
2. Press the **F2** or **F3** key to scroll through Main menu until [DATALOGGER] appears in LCD display.

3. Press the **F4** key to access the Datalogger menu. [INSPECT TEMP LOG] appears in the LCD display.
4. Press the **F4** key to enter Temp Log. LCD display shows the Log Time and the Setpoint, Supply and Return temperatures of the most recent log in the first screen.
5. Press the **F3** key to scroll through previous logs of the sensor temperatures currently in the display. All temperature logs recorded in the datalogger memory may be viewed on the LCD display.
6. Press the **F4** key again to view additional sensor log and event flag screens. LCD display shows USDA1, USDA2, USDA3, Relative Humidity (rH), Ambient, sensor readings, and flags etc.
7. Press the **F3** key to scroll through previous logs of the sensor temperatures currently in the display.

### Event Flags for Temperature Log

T = Tripstart Activated

P = Primary Power Off

D = Defrost in Last Interval

O = Temperature Not In-range

h = Humidity Control Active

E = Evaporator High Temperature

H = High Refrigeration Pressure

d = Defrost terminated on time limit

e = Economy mode activated

s = Reefer unit stopped (after PTI)

w = Water-cooled operation (water pressure switch is closed)

A = Alarm in last interval

R = Condenser Temperature Limited

L = Power Consumption Limited

F = PTI Activity

V = AFAM Door Open

B = Bulb Mode

W = Warning in Last Interval

C = CO<sub>2</sub> Active

**NOTE:** *All event flags that occurred during a log interval are displayed.*

8. Press the **ESC** key to exit the Temp Log.

### Inspect Event Log

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the Main menu.
2. Press the **F2** or **F3** key to scroll through Main menu until [DATALOGGER] appears in LCD display.
3. Press the **F4** key to access the Datalogger menu. [INSPECT TEMP LOG] appears in the LCD display.
4. Press the **F2** or **F3** key to scroll through submenu until [INSPECT EVENT LOG] appears in LCD display.
5. Press the **F4** key to enter PTI log. LCD display shows the Start Time and PTI test results of the most recent PTI log.
  - To scroll through additional test results in the log, press the **F3** key.

### PTI Examples

- PTI stores volt and amps of all power consuming components
  - PTI stores temperatures logged at both the start and end of Chilled mode and Frozen mode capacity tests
6. Press the **ESC** key to exit the Event log.

### Calibrate USDA 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 **F2** or **F3** key to enter Main menu.
3. Press the **F2** or **F3** key to scroll through menu list until [DATALOGGER] appears in LCD display.

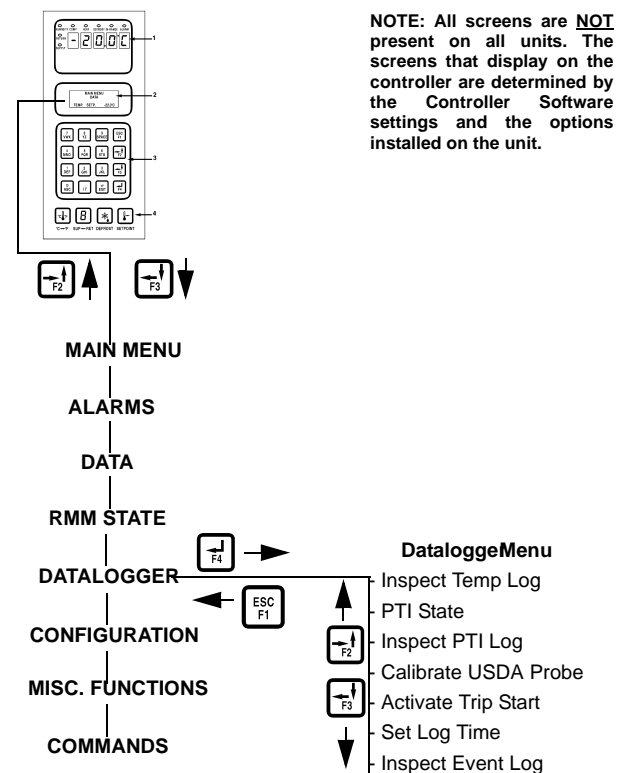


Figure 35: Datalogger Menu

4. Press the **F4** key to access the Datalogger menu. [INSPECT TEMP LOG] appears in LCD display.
5. Press the **F2** or **F3** key to scroll through submenu until [CALIBRATE USDA PROBE] appears in LCD display.
6. Press the **F4** key to enter Calibrate function. The display shows [ACTUAL] and [NEW 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.*

7. Press the **F3** key to release the current actual temperature offsets from the controller memory. Observe the sensor temperatures in the [NEW CORR] row.
8. Press the **F4** 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 [ACTUAL] row.
9. Press the **ESC** key to exit the Calibrate menu.

## Set Trip Start

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the Main menu.
2. Press the **F2** or **F3** key to scroll through menu list until [DATALOGGER] appears in LCD display.
3. Press the **F4** key to access the Datalogger menu. [INSPECT TEMP LOG] appears in the LCD display.
4. Press the **F2** or **F3** key to scroll through submenu until [ACTIVATE TRIPSTART] appears in LCD display.
5. Press the **F4** key to enter Tripstart function. The date and time of the last trip start appears in the screen.
6. Press the **F4** 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.*

7. Press the **ESC** key to exit the Datalogger menu.

## Set Log Time

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the Main menu.
2. Press the **F2** or **F3** key to scroll through the menu list until [DATALOGGER] appears in LCD display.
3. Press the **F4** key to access the Datalogger menu. [INSPECT TEMP LOG] appears in the LCD display.
4. Press the **F2** or **F3** key to scroll through submenu until [SET LOG TIME] appears in LCD display.
5. Press the **F4** key to enter Temp Log. LCD display shows the current Log Time interval.
6. Press the **F4** key again with cursor in [LOG TIME] menu line to enter a new log interval. [ARROW] appears in menu line.
7. Press the **F2** or **F3** key to scroll through a list of log time intervals:
  - [1 MINUTE]\*
  - [1/2 HOUR]
  - [1 HOUR]
  - [2 HOUR]
  - [4 HOUR]
8. When the correct Log Time appears in the menu line, press and hold the **F4** key until cursor stops flashing. The new Log Time appears in the display.
9. Press the **ESC** key to exit the Temp Log.

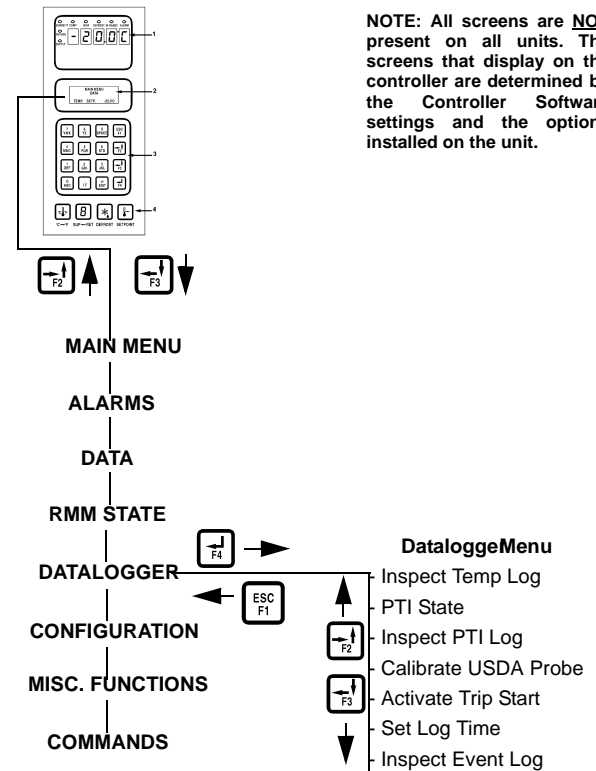


Figure 36: Datalogger Menu

\*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.

## Inspect Event Log

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter Main menu.
2. Press the **F2** or **F3** key to scroll through Main menu until [DATALOGGER] appears in LCD display.
3. Press the **F4** key to access the Datalogger menu. [INSPECT TEMP LOG] appears in the LCD display.
4. Press the **F2** or **F3** key to scroll through submenu until [INSPECT EVENT LOG] appears in LCD display.
5. Press the **F4** key to enter Event Log. LCD display shows the Log Time and the most recent event.
  - To scroll through previous event log screens, press the **F3** key. All event logs recorded in the datalogger memory may be viewed on the LCD display.

## 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 **ESC** key to exit the Event Log.



## Configuration Menu

The Configuration menu displays a list of functions that identifies unit operating features and current settings. The following functions are available: Container ID, Control Type, In-range, Controller Type, Contrast, Language, Economy Max, Economy Min., Reefer Type, Supply LH, AFAM Options, Evaporator Fans, AFAM Setup, Auto Configuration and Serial Number.

**NOTE:** 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

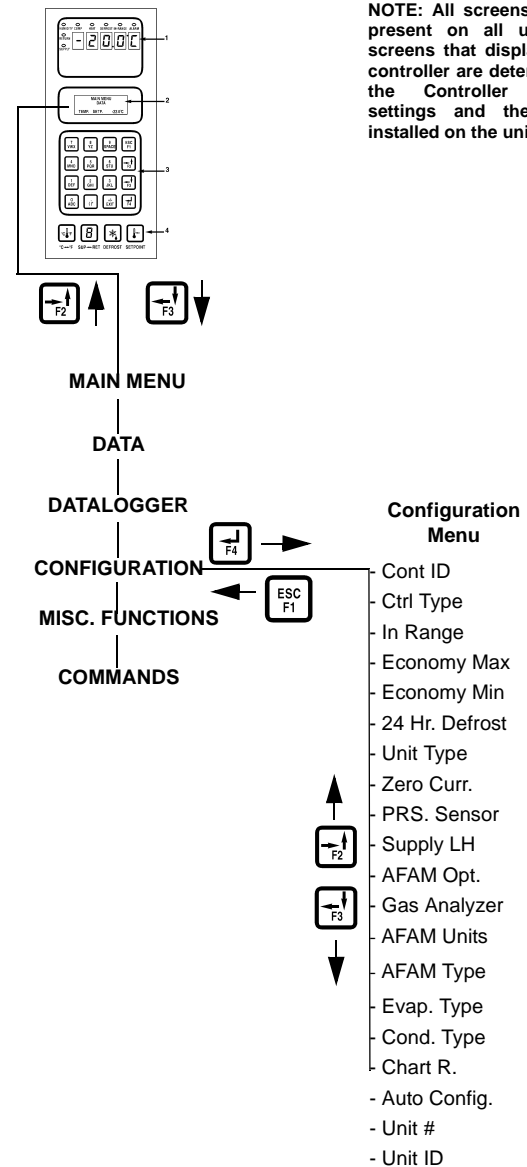
With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the Main menu.
2. Press the **F2** or **F3** key to scroll through Main menu until [CONFIGURATIONS] appears in LCD display.
3. Press the **F4** key to access the Configurations screen. Configurations screen appears with cursor in the [CONTAINER-ID] menu line.
4. Press the **F2** or **F3** 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).

**Control Type:** Unit type based on serial plate.

**In-Range:** 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).



**Figure 37: Configuration Menu**

**Economy Max:** Sets the Economy mode maximum temperature limit (factory default = 0.2 C). Enter a value from 0 to 5.0 C (0 to 8.9 F).

**Economy Min:** Sets the Economy mode minimum temperature limit (factory default = 2.0 C). Enter a value from 0 to 5.0 C (0 to 8.9 F).

**24 Hr Defrost:** Sets the defrost interval to 24 hrs if the return temperature is within 5 degree C from Set point. Next defrosts will be 30-36-42-48-48-48.

**Unit Type:** View display value (factory default = NO HUM). Controller automatically activates when a humidity sensor is installed for more than 1 minute. Setting this value is not necessary.

**Pressure Sensor:** Sets the pressure sensor to NONE, LOW, HIGH, HIGH+LOW.

**Zero Current:** Displays zero current On or Off.

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

**AFAM Option:** Sets the Advanced Fresh Air Management System to None, AFAM, AFAM+ or Log.FAE (factory default = None). Controller automatically activates when an AFAM system vent door and/or AFAM+ gas sensor is installed for more than one minute. Setting this value is not necessary.

**Gas Analyzer:** Select type of gas sensor.

**AFAM Units:** Displays whether the fresh air exchange rate will be displayed in cubic meters per hour or cubic feet per min.

**AFAM Type:** Selects the type of AFAM motor. **NONE** = No AFAM. **FEEDBACK** = potentiometer motor. **TIMING CUR** current measuring motor. (factory default = TIMING CUR).

**Evaporator Type:** Sets the evaporator fan value to 3 fan or 2 fan.

**Condenser Type:** Sets the condenser fan value to 1/2 HP, 3/4 HP or 2 HP. Must be manually set.

**Chart R (Electronic Chart Recorder):** Must be manually set to -20 +80 F 31 day, -30 +25 C 31 day, -25 + 25 C 31 day or Not Present.

**Auto Configuration:** View display on or off value (factory default = off). Set value to on to automatically configure unit to installed components. See “Automatic Configuration of Spare Parts Controller” in this chapter for additional information.

**Unit #:** 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 container number.

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

5. To set a new Configuration screen value:
  - a. Press the **F4** key with cursor in the desired menu line. The Password screen appears.
  - b. Press the **F2** key, **A** key (password is “A”), **F4** key and then the **EXIT** key. An Enter Arrow appears in the hourmeter line.
  - c. Use the general purpose keypad to enter the desired value; or press the **F3** key to toggle the value to the desired setting.
  - d. Press the **F4** key and release when the entry is complete. Press the **EXIT** key. The new value appears in the menu line.
6. Repeat steps 4 and 5 to reset additional configuration values.
7. Press the **ESC** key to exit the Configurations screen.

## Misc. Functions Menu

The Misc. Functions menu displays a list of functions that identifies and determines how the controller records and displays operating information. The following functions are available:

- **Date Time:** Sets the controller time and date.
- **Status:** Displays status messages. See the complete list of all status messages and the corrective action listed in the Diagnosing and Troubleshooting Section in the back of the manual.
- **Run Time:** Displays and sets operating hours for the unit and components.
- **Program Version:** Displays the current software version loaded in the controller: Controller (CTRL), EPROM and program serial numbers (SER NO).

**NOTE: The Controller Label on the side of the control box shows the controller serial number and the EPROM version.**

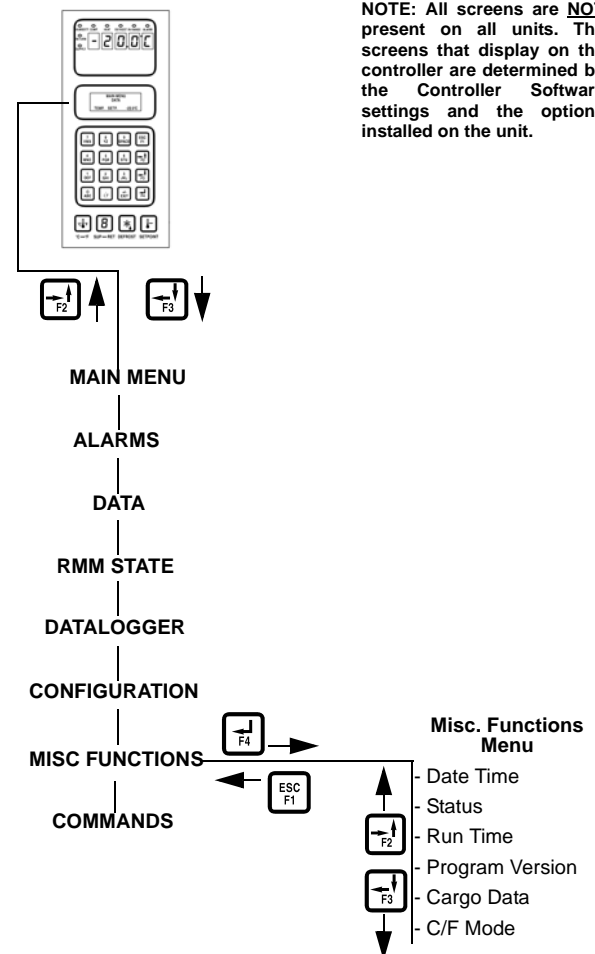
- **Cargo Data:** Sets important trip information about the container and the load in the controller.
- **C/F Mode:** Sets the temperature value (Celsius or Fahrenheit) the controller uses to record and display temperature (including historical data).

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

### View Misc. Functions Menu

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the menu list. Press **F2** or **F3** key to scroll through Main menu until [MISC. FUNCTIONS] appears in LCD display.
2. Press the **F4** key to access the Misc. Functions menu. The first command in the submenu appears in the LCD display: Date Time.



**Figure 38: Misc. Functions Menu**

3. Press the **F2** or **F3** key to scroll to the desired function:
  - [DATE TIME]
  - [STATUS]
  - [RUN TIME]
  - [PROGRAM VERSION]
  - [CARGO DATA]
  - [C/F MODE]
4. Press the **F4** key to access the function selected.

## Set Date and Time

1. Press the **F2** or **F3** key to enter the menu list. Press the **F2** or **F3** key to scroll to [MISC. FUNCTIONS].
2. Press the **F4** key to access the Misc. Functions menu. [DATE TIME] appears in the LCD display.
3. Press the **F4** key to access the Date Time screen. Date Time screen appears with cursor in the Time menu line. Display shows time in "HH.MM.SS" where H = hour, M = minute and S = second.
4. Press the **F4** key with cursor in [TIME] menu line to enter a new time. An Enter Arrow appears in the menu line and the previous time disappears.
5. Enter new time in [HH.MM.SS] format. Decimal points must be included in the entry between the hour, minute and second.

**NOTE:** To scroll backward in the [TIME] or [DATE] menu line, press and hold the **F4** key, then press the **F3** key. Press the **F1** key to return keyboard to "numerical" entry before typing again.

6. Press the **F4** key. Then press the **EXIT** key to enter time in controller memory. Cursor stops blinking and new time appears in display.
7. Press the **F3** key to move cursor to Date menu line to enter a new date. Display shows date in and date in "YY.MM.DD" where Y = year, M = month and D = day.
8. Press the **F4** key with cursor in "DATE" menu line. An Enter Arrow appears in the menu line and the previous date disappears.
9. Enter new date in [YY.MM.DD] where Y = year, M = month and D = day. Decimal points must be included in the entry between the year, month and day.
10. Press the **F4** key. Then press the **EXIT** key to enter date in controller memory. Cursor stops blinking and new date appears in the display.
11. Press the **ESC** key to exit the Date Time screen.

## View or Set Run Time

1. Press the **F2** or **F3** key to enter the menu list. Press the **F2** or **F3** key to scroll to "MISC. FUNCTIONS".
2. Press the **F4** key to access the Misc. Functions menu. "Date Time" appears in the LCD display. Press the **F2** or **F3** key to scroll to "RUN TIME".
3. Press the **F4** key to access the Run Time screen. The Run Time screen appears with cursor in "HEAT" menu line.
4. Press the **F2** or **F3** key to scroll cursor up or down through cargo data list:
  - [HEAT]
  - [COMPRESSOR]
  - [EVAPORATOR HIGH]
  - [EVAPORATOR LOW]
  - [CONDENSER]
  - [TOTAL]
5. To reset an hourmeter or set hours on a replacement controller:
  - a. Press the **F4** key with cursor in the desired menu line. The Password screen appears.
  - b. Press the **F2** key, **A** key (password is "A"), **F4** key and then the **EXIT** key. An Enter Arrow appears in the hourmeter line.
  - c. Enter the desired run time setting (up to 5 characters).
  - d. Press and hold the **F4** key until the cursor stops flashing. The new run time appears in the menu line.
6. Repeat step 5 to reset additional hourmeters.
7. Press the **ESC** key to exit the Run Time screen.

## Set Cargo Data

1. Press the **F2** or **F3** key to enter the menu list. Press the **F2** or **F3** key to scroll to [MISC. FUNCTIONS].
2. Press the **F4** key to access the Misc. Functions menu. [DATE TIME] appears in the LCD display. Press the **F2** or **F3** key to scroll to [CARGO DATA].
3. Press the **F4** key to access the Cargo Data screen. Cargo Data screen appears with cursor in [LOC. BRT] menu line.
4. Press the **F2** or **F3** key to scroll cursor up or down through cargo data list:
  - [LOC. BRT]
  - [CONTENTS]
  - [DATE] (Loading Date)
  - [VOYAGE]
  - [SHIP]
  - [LD PORT] (Loading Port)
  - [DIS PORT] (Discharge Port)
  - [COMMENTS]
5. To enter text in a cargo data line, press the **F4** key with cursor in the desired menu line. An Enter Arrow appears and the cursor flashes in the selected line. Enter (type) the desired text. When entering information:
  - Enter up to 10 characters of text/numbers for each menu item.
  - Press and hold the **F4** key to scroll backwards in the text box, then the press the **F3** key.
  - Press the **F4** key and then the **SPACE** key to delete text from a previous entry,.
  - Press the **F4** key to start entry over or quickly return to the beginning of the text box, then the **EXIT** key and then the **F4** key again.
- When the **F1**, **F2**, **F3** or **F4** key is pressed to enter a character in the display, the keypad remains on that “character level” until another “level” is selected by pressing the **F1**, **F2**, **F3** or **F4** key.
6. When the desired text entry is complete, press the **F4** key. Then press the **EXIT** key. The cursor stops flashing and the new text appears in the menu line.
7. Repeat step 5 until all information has been entered in the Cargo Data screen.
8. Press **ESC** key to exit the Cargo Data screen.

## Change the Temperature Display Value (C/F)

1. Press the **F2** or **F3** key to enter the menu list. Press the **F2** or **F3** key to scroll to [MISC. FUNCTIONS].
2. Press the **F4** key to access the Misc. Functions menu. [DATE TIME] appears in the LCD display. Press the **F2** or **F3** key to scroll to [C/F MODE].
3. Press the **F4** key to access the C/F Mode screen. C/F Mode screen appears with cursor in the [TEMPERATURE VALUE] menu line. Display shows [C/F MODE C] where C = Celsius and F = Fahrenheit.
4. Press the **F4** key to change the temperature value. Cursor moves to end of menu line and flashes.
5. Press the **F2** or **F3** key to toggle temperature value in the menu line between [C] and [F].
6. With the desired temperature value in the menu line, press and hold the **F4** key until cursor stops flashing. Cursor stops blinking and new temperature value appears in display.
7. Press the **ESC** key to exit the C/F Mode screen.


## Commands Menu

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

**PTI (Full PreTrip) Test:** Controller automatically completes a test of individual components, checks unit refrigeration capacity, heating capacity and temperature control. The test takes approximately 2-2 1/2 hours to complete. See “PTI (Full Pretrip) Test” on page 75.

**Power Management:** Sets power limit and power limit activation (“On”) time.

**Function Test:** Controller automatically tests the operation of individual unit components. This is not a performance test of the complete system. See “Function Test” in this chapter for test details.

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

**Manual Function Test:** Controller tests individual components selected by the technician for diagnosis. LCD display will show expected and actual current of the component being tested.

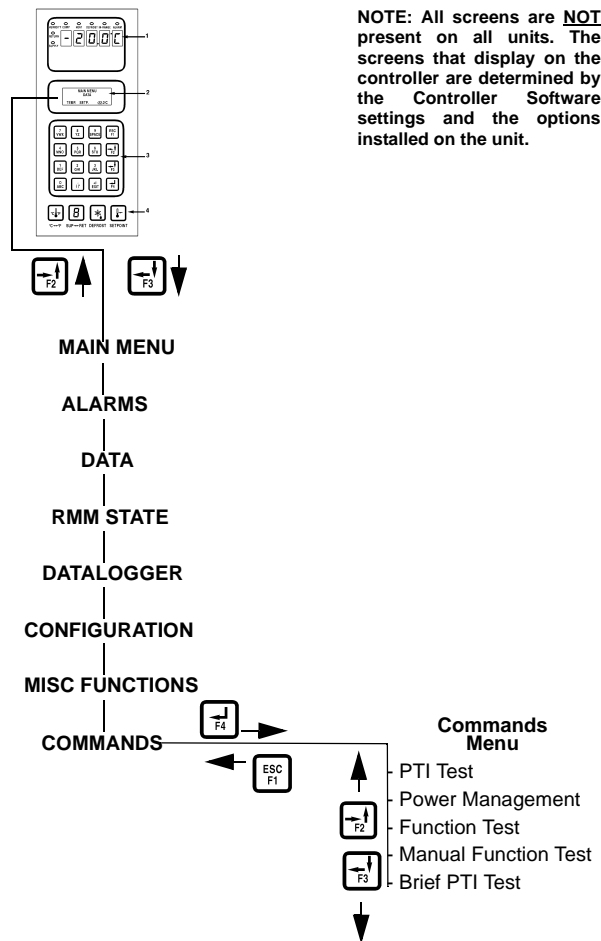
**Brief PTI (Brief Pretrip Test):** Controller automatically completes a test of individual components, checks unit refrigeration capacity, heating capacity and temperature control. The Test takes approximately 20-25 minutes to complete. See “Brief PTI (Pretrip) Test” on page 71. Also refer to Full PTI Test above.

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

### View the Commands Menu

With the **UNIT ON/OFF** switch **ON** and LCD display showing standard display (setpoint):

1. Press the **F2** or **F3** key to enter the Main menu.
2. Press the **F2** or **F3** key to scroll through Main menu until [COMMANDS] appears in LCD display.
3. Press the **F4** key to access Commands menu. The first command in submenu appears in LCD display.



**Figure 39: Commands Menu**

4. Press the **F2** or **F3** key to scroll to desired command:
  - [PTI] [(Pretrip) TEST]
  - [POWER MANAGEMENT]
  - [FUNCTION TEST]
  - [MANUAL FUNCTION TEST]
  - [BRIEF PTI TEST]

Press the **F4** key to activate command selected.

## 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.

The MP-3000a 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 ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the menu list. Repeatedly press the **F2** or **F3** key to scroll through Main menu until [COMMANDS] appears in LCD display.
2. Press the **F4** key to access the Commands menu. The first command in the submenu appears in the LCD display.
3. Press the **F2** or **F3** key to scroll to [Brief PTI TEST].
4. Press the **F4** key to start the Brief PTI test. LCD display shows PTI test currently being performed. PTI test ends automatically. Press any key on the controller to return the unit to normal operation.

See the following [MAGNUM Brief Pretrip (PTI) Test Procedure] for a detailed description of the PTI Test. Detailed PTI test results are stored in the MP-3000a 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.

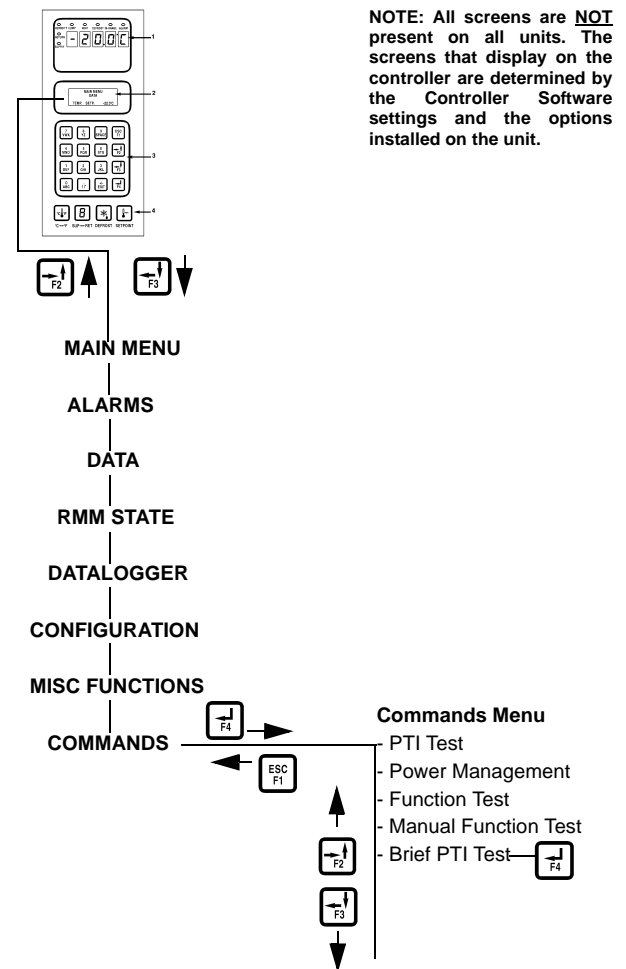


Figure 40: Brief PTI Test

**MAGNUM Brief PTI Test**

<b>LCD Display*</b>	<b>Description</b>	<b>Possible Alarms</b>	<b>Duration (Time)</b>
PTI START Activated 0.1A 0.0A 0.1A	Event Log for PTI begins. All alarms are turned off. Alarm list is cleared. All relays are turned off and air vent are closed.	None	2 seconds
SENSOR TEST Activated 0.1A 0.0A 0.1A	All sensors must have values within their measuring range.	00, 01, 02, 03, 04, 05, 32, 33, 34, 35, 97, 98, 99	5 seconds
EVAP FAN LOW TEST SUP RET EVA 5.1C 5.0C 5.1C 1.1A 1.0A 1.1A	Condenser fan and compressor are turned off. With evaporator fan on low speed, amp draw is measured and compared to voltage and frequency: <ul style="list-style-type: none"> <li>• MAGNUM and MAGNUM SL: 1.0 Amps approx. at 50 Hz, 1.0 Amps approx. at 60 Hz</li> <li>• MAGNUM 20: 1.5 Amps approx. at 50 Hz, 1.5 Amps approx. at 60 Hz</li> </ul> Amperes are recorded in the PTI log.	14, 15	10 seconds
EVAP FAN HIGH TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	Condenser fan and compressor are turned off. With evaporator fan on high speed, amp draw is measured and compared to voltage and frequency: <ul style="list-style-type: none"> <li>• MAGNUM: 2.1 Amps approx. at 50 Hz, 2.5 Amps approx. at 60 Hz</li> <li>• MAGNUM SL and MAGNUM 20: 2.7 Amps approx. at 50 Hz, 3.2 Amps approx. at 60 Hz</li> </ul> Amperes are recorded in PTI log.	12, 13	10 seconds
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: <ul style="list-style-type: none"> <li>• Return/Evaporator: 1.5C (34.7F); return air sensor temperature must be 0.5C (32.9F) above evaporator sensor temperature.</li> <li>• Return/Supply: 0.8C (33.0F); return air sensor temperature must be 0.5C (32.9F) above supply air temperature.</li> <li>• LH Supply/RH Supply (if equipped): 0.5C (32.9F).</li> </ul>	115, 116, 117	1 minute minimum to 13 minutes maximum
AFAM+ TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	Air vent is opened and verified that the motor is operating. Evaporator fan is started and operating until CO2 value is below 0.5 percent or 20 minutes.	57, 68, 69	10 seconds minimum to 20 minutes maximum
<b>* Readings may vary depending on voltage and temperature</b>			



## MAGNUM Brief PTI Test

LCD Display*	Description	Possible Alarms	Duration (Time)
COND FAN TEST SUP RET EVA 5.2C 5.0C 5.1C 1.3A 1.2A 1.3A	Condenser fan is turned on. Amp draw is measured and compared to voltage and frequency: 1.5 Amps at 60 Hz, 1.2 Amps at 50 Hz. Condenser fan amperes are recorded in PTI log.	16, 17	10 seconds
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
HEAT ELEMENT 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 and compared to voltage: • 4.4 Amps approx. at 400V; • 5.1 Amps approx. at 460V. Heater amperes are recorded in PTI log.	10, 11	10 seconds
PRE COOL/HEAT TEST SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	If the return air temperature is above +20C (68F), unit operates in cool until the return sensor is less then +15C (59F) or 1 hour. If the return air temperature is below +5C (41F), unit operates in heat until return temperature is above +5C (41F) or 2 hours.	None	30 to 60 seconds  1 or 2 hours maximum
COMPRESSOR TEST AMB CON EVA 8.0C 15.0C 5.0C 9.1A 9.0A 9.1A	With compressor and condenser fan on, compressor is operating at 100 percent capacity. Amp draw is measured and compared to voltage. Compressor amperes are recorded in PTI log.	6, 7	20 seconds
DIGITAL VALVE TEST AMB CON EVA 8.0C 25.0C 2.0C 9.1A 9.0A 9.1A	With compressor on - if condenser temperature is above +30C (86F) condenser fan is turned on. Digital valve is turned on then off. Amp draw difference is measured and verified to be minimum 1.4 amps.	119	20 seconds
VAPOUR INJ. TEST AMB CON EVA 8.0C 25.0C 2.0C 9.1A 9.0A 9.1A	With compressor on, condenser and evaporator fans 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.	26	50 seconds
COMP HI PRESS TEST AMB CON EVA 8.0C 45.0C 1.0C 9.1A 9.0A 9.1A	With compressor on, evaporator fan operates on high speed until high-pressure cutout occurs or condenser temperature is above +70C (158F). Condenser fan starts and operates until compressor starts.	53, 54	10 to 60 second  Plus 30 seconds
CAPACITY 1 TEST SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	With condenser fan on, compressor on, and evaporator fans on high speed, cool capacity is set to 100 percent capacity. Vapor injection valve is turned on. A difference of approx. 4.5C (40.1F) is required between return and supply air temperatures, depending on return air and condenser coil temperatures.	22	3 minutes
* Readings may vary depending on voltage and temperature			

**MAGNUM Brief PTI Test**

<b>LCD Display*</b>	<b>Description</b>	<b>Possible Alarms</b>	<b>Duration (Time)</b>
PTI PART 1 END SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	"PTI Part 1 end" is recorded in PTI log.	None	5 seconds
PTI PASS – PRESS KEY	Unit will remain OFF until any key is pressed. If alarms occurred during PTI, LCD display shows "PTI FAIL – PRESS KEY".	None	
<b>* Readings may vary depending on voltage and temperature</b>			

## PTI (Full Pretrip) Test



**CAUTION:** The Full PTI test should only be performed on an empty container!

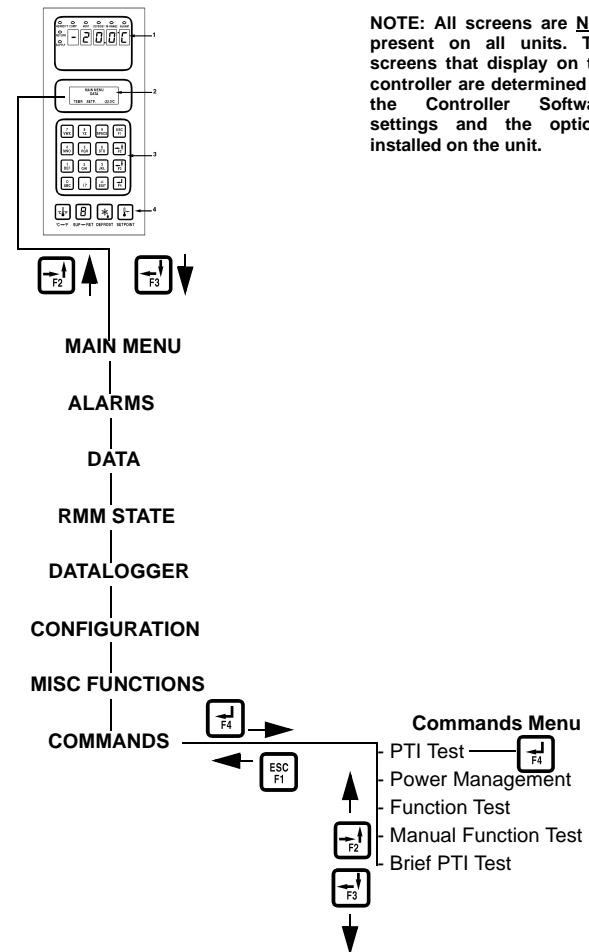
**NOTE:** Units equipped with a water-cooled condenser must be set to operate on air-cooled condensing to perform a complete system capacity test.

The MP-3000a 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 ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the menu list.
2. Repeatedly press the **F2** or **F3** key to scroll through Main menu until [COMMANDS] appears in LCD display.
3. Press the **F4** key to access the Commands menu. The first command in the submenu appears in the LCD display.
4. Press the **F2** or **F3** key to scroll to "PTI TEST".
5. Press the **F4** key to start the PTI test. LCD display shows PTI test currently being performed. PTI test ends automatically. Press any key on the controller to return the unit to normal operation.



**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 41: Full PTI Test**

See the following pages for the “MAGNUM PTI (Full Pretrip) Test Procedure” for a detailed description of the PTI Test. Detailed PTI test results are stored in the MP-3000a 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.

### MAGNUM PTI Full Pretrip Test

LCD Display*	Description	Possible Alarms	Duration (Time)
PTI START Activated 0.1A 0.0A 0.1A	Event Log for PTI begins. All alarms are turned off. Alarm list is cleared. All relays are turned off and air vent are closed.	None	2 seconds
SENSOR TEST Activated 0.1A 0.0A 0.1A	All sensors must have values within their measuring range.	00, 01, 02, 03, 04, 05, 32, 33, 34, 35, 97, 98, 99	5 seconds
EVAP FAN LOW TEST SUP RET EVA 5.1C 5.0C 5.1C 1.1A 1.0A 1.1A	Condenser fan and compressor are turned off. With evaporator fan on low speed, amp draw is measured and compared to voltage and frequency: <ul style="list-style-type: none"> <li>• MAGNUM and MAGNUM SL: 1.0 Amps approx. at 50 Hz, 1.0 Amps approx. at 60 Hz</li> <li>• MAGNUM 20: 1.5 Amps approx. at 50 Hz, 1.5 Amps approx. at 60 Hz</li> </ul> Amperes are recorded in the PTI log.	14, 15	10 seconds
EVAP FAN HIGH TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	Condenser fan and compressor are turned off. With evaporator fan on high speed, amp draw is measured and compared to voltage and frequency: <ul style="list-style-type: none"> <li>• MAGNUM: 2.1 Amps approx. at 50 Hz, 2.5 Amps approx. at 60 Hz</li> <li>• MAGNUM SL and MAGNUM 20: 2.7 Amps approx. at 50 Hz, 3.2 Amps approx. at 60 Hz</li> </ul> Amperes are recorded in PTI log.	12, 13	10 seconds
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: <ul style="list-style-type: none"> <li>• Return/Evaporator: 1.5C (34.7F); return air sensor temperature must be 0.5C (32.9F) above evaporator sensor temperature.</li> <li>• Return/Supply: 0.8C (33.0F); return air sensor temperature must be 0.5C (32.9F) above supply air temperature.</li> <li>• LH Supply/RH Supply (if equipped): 0.5C (32.9F).</li> </ul>	115, 116, 117	1 minute minimum to 13 minutes maximum
AFAM+ TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	Air vent is opened and verified that the motor is operating. Evaporator fan is started and operating until CO2 value is below 0.5 percent or 20 minutes.	57, 68, 69	10 seconds minimum to 20 minutes maximum
* Readings may vary depending on voltage and temperature			

## MAGNUM PTI Full Pretrip Test

LCD Display*	Description	Possible Alarms	Duration (Time)
COND FAN TEST SUP RET EVA 5.2C 5.0C 5.1C 1.3A 1.2A 1.3A	Condenser fan is turned on. Amp draw is measured and compared to voltage and frequency: 1.5 Amps at 60 Hz, 1.2 Amps at 50 Hz. Condenser fan amperes are recorded in PTI log.	16, 17	10 seconds
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
HEAT ELEMENT 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 and compared to voltage: • 4.4 Amps approx. at 400V; • 5.1 Amps approx. at 460V. Heater amperes are recorded in PTI log.	10, 11	10 seconds
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.	20	1 hour maximum
PRE COOL/HEAT TEST SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	If the return air temperature is above +20C (68F), unit operates in cool until the return sensor is less than +15C (59F) or 1 hour. If the return air temperature is below +5C (41F), unit operates in heat until return temperature is above +5C (41F) or 2 hours.	None	30 to 60 seconds 1 or 2 hours maximum
COMPRESSOR TEST AMB CON EVA 8.0C 15.0C 5.0C 9.1A 9.0A 9.1A	With compressor and condenser fan on, compressor is operating at 100 percent capacity. Amp draw is measured and compared to voltage. Compressor amperes are recorded in PTI log. Suction pressure sensor must read a decreasing signal at min 0.15 bars (2.175 psi). Discharge pressure sensor must read an increasing signal of min 0.15 bars (2.175 psi).	6, 7	20 seconds
DIGITAL VALVE TEST AMB CON EVA 8.0C 25.0C 2.0C 9.1A 9.0A 9.1A	With compressor on - if condenser temperature is above +30C (86F) condenser fan is turned on. Digital valve is turned on then off. Amp draw difference is measured and verified to be minimum 1.4 amps.	119	20 seconds
VAPOUR INJ. TEST AMB CON EVA 8.0C 25.0C 2.0C 9.1A 9.0A 9.1A	With compressor on, condenser and evaporator fans 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.	26	50 seconds
COMP HI PRESS TEST AMB CON EVA 8.0C 45.0C 1.0C 9.1A 9.0A 9.1A	With compressor on, evaporator fan operates on high speed until high-pressure cutout occurs or condenser temperature is above +70C (158F). Condenser fan starts and operates until compressor starts.	53, 54	10 to 60 second Plus 30 seconds
* Readings may vary depending on voltage and temperature			

**MAGNUM PTI Full Pretrip Test**

LCD Display*	Description	Possible Alarms	Duration (Time)
PRE COOL/HEAT TEST SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	If the return air temperature is above +20C (68F), unit operates in cool until the return sensor is less then +15C (59F) or 1 hour.  If the return air temperature is below +5C (41F), unit operates in heat until return temperature is above +5C (41F) or 2 hours.	None	30 to 60 seconds  1 or 2 hours maximum
PTI PART 1 END SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	"PTI Part 1 end" is recorded in PTI log.	None	5 seconds

LCD 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 LH, supply RH, 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, LCD display shows "PTI FAIL – PRESS KEY".	None	180 minutes maximum
* Readings may vary depending on voltage and temperature				

## Function Test

The MP-3000a controller contains a special function test that automatically tests individual components including the controller display, sensors, condenser fan, evaporator fan, compressors, etc. The test includes measurement of component power consumption and compares test results to expected values.

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

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the menu list. Repeatedly press **F2** key to scroll through Main menu until [COMMANDS] appears in LCD display.
2. Press the **F4** key to access the Commands menu. The first command in the submenu appears in the LCD display.
3. Press the **F2** or **F3** key to scroll to [FUNCTION TEST].
4. Press the **F4** key to start the Function test. LCD display shows functional test currently being performed. Function test ends automatically. Unit automatically returns to normal operation.

See “MAGNUM Function Test Procedure” in the following table for a detailed description of the Function Test. Any alarm codes recorded during the test can be viewed through the controller’s Alarm List menu at the end of the test.

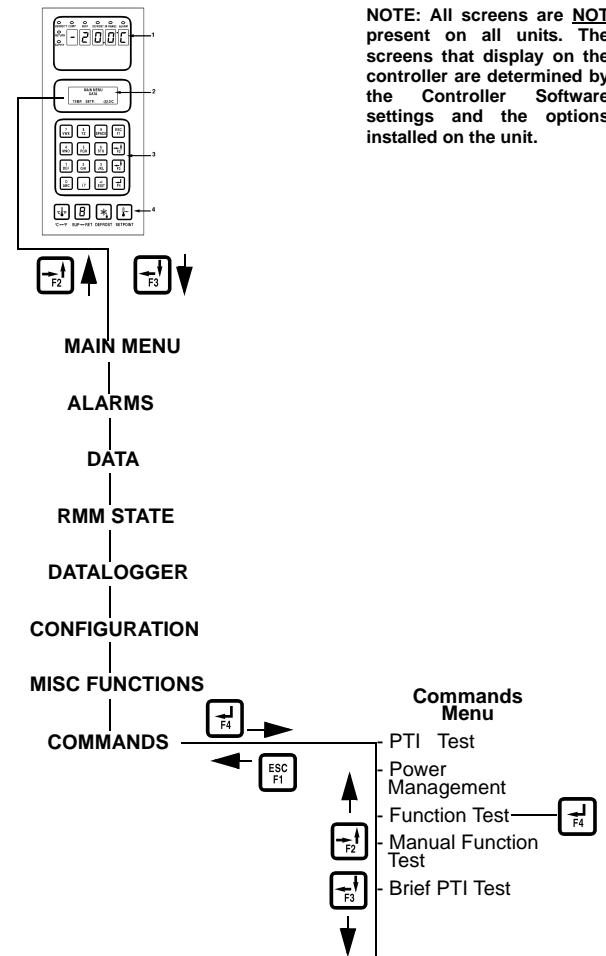


Figure 42: Function Test

### MAGNUM Function Test

LCD Display*	Description	Possible Alarms	Duration (Time)
PTI START Activated 0.1A 0.0A 0.1A	Event Log for PTI begins. All alarms are turned off. Alarm list is cleared. All relays are turned off and air vent are closed.	None	2 seconds
SENSOR TEST Activated 0.1A 0.0A 0.1A	All sensors must have values within their measuring range.	00, 01, 02, 03, 04, 05, 32, 33, 34, 35, 97, 98, 99	5 seconds
EVAP FAN LOW TEST SUP RET EVA 5.1C 5.0C 5.1C 1.1A 1.0A 1.1A	Condenser fan and compressor are turned off. With evaporator fan on low speed, amp draw is measured and compared to voltage and frequency: <ul style="list-style-type: none"> <li>• MAGNUM and MAGNUM SL: 1.0 Amps approx. at 50 Hz, 1.0 Amps approx. at 60 Hz</li> <li>• MAGNUM 20: 1.5 Amps approx. at 50 Hz, 1.5 Amps approx. at 60 Hz</li> </ul> Amperes are recorded in the PTI log.	14, 15	10 seconds
EVAP FAN HIGH TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	Condenser fan and compressor are turned off. With evaporator fan on high speed, amp draw is measured and compared to voltage and frequency: <ul style="list-style-type: none"> <li>• MAGNUM: 2.1 Amps approx. at 50 Hz, 2.5 Amps approx. at 60 Hz</li> <li>• MAGNUM SL and MAGNUM 20: 2.7 Amps approx. at 50 Hz, 3.2 Amps approx. at 60 Hz</li> </ul> Amperes are recorded in PTI log.	12, 13	10 seconds
AFAM+ TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	Air vent is opened and verified that the motor is operating. Evaporator fan is started and operating until CO2 value is below 0.5 percent or 20 minutes.	57, 68, 69	10 seconds minimum to 20 minutes maximum
COND FAN TEST SUP RET EVA 5.2C 5.0C 5.1C 1.3A 1.2A 1.3A	Condenser fan is turned on. Amp draw is measured and compared to voltage and frequency: 1.5 Amps at 60 Hz, 1.2 Amps at 50 Hz. Condenser fan amperes are recorded in PTI log.	16, 17	10 seconds
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
* Readings may vary depending on voltage and temperature			



## MAGNUM Function Test

LCD Display*	Description	Possible Alarms	Duration (Time)
HEAT ELEMENT 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 and compared to voltage: • 4.4 Amps approx. at 400V; • 5.1 Amps approx. at 460V. Heater amperes are recorded in PTI log.	10, 11	10 seconds
COMPRESSOR TEST AMB CON EVA 8.0C 15.0C 5.0C 9.1A 9.0A 9.1A	With compressor and condenser fan on, compressor is operating at 100 percent capacity. Amp draw is measured and compared to voltage. Compressor amperes are recorded in PTI log. Suction pressure sensor must read a decreasing signal at min 0.15 bars (2.175 psi). Discharge pressure sensor must read an increasing signal of min 0.15 bars (2.175 psi).	6, 7	20 seconds
DIGITAL VALVE TEST AMB CON EVA 8.0C 25.0C 2.0C 9.1A 9.0A 9.1A	With compressor on - if condenser temperature is above +30C (86F) condenser fan is turned on. Digital valve is turned on then off. Amp draw difference is measured and verified to be minimum 1.4 amps.	119	20 seconds
VAPOUR INJ. TEST AMB CON EVA 8.0C 25.0C 2.0C 9.1A 9.0A 9.1A	With compressor on, condenser and evaporator fans are turned on for 30 seconds. If condenser fan temperature is below 30C then the test is aborted. Vapor injection valve is turned on. Amp draw difference is measured and verified to be minimum 0.4 amps.	26	50 seconds
* Readings may vary depending on voltage and temperature			

## Manual Function Test

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

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

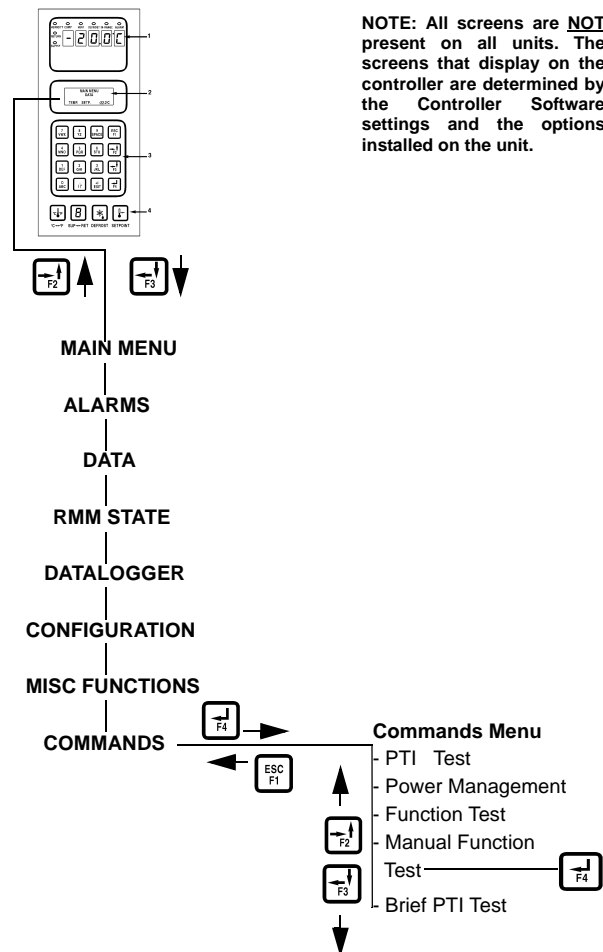
Complete the following steps to enter the Manual Function Test menu.

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the menu list. Repeatedly press the **F2** key to scroll through Main menu until [COMMANDS] appears in LCD display.
2. Press the **F4** key to access the Commands menu. The first command in the submenu appears in the LCD display.
3. Press the **F2** or **F3** key to scroll to [MANUAL FUNCTION TEST].
4. Press the **F4** key to enter the Manual Function Test: [CONDENSER OFF] appears in the LCD display.

### To test a unit component:

1. Press the **F2** or **F3** key to scroll to desired component test:
  - [CONDENSER]
  - [SENSOR CHECK LOW]
  - [SENSOR CHECK]
  - [HEAT]
  - [AFAM CLOSE]
  - [AFAM OPEN]
  - [EVAP LOW.]
  - [EVAP HIGH]
  - [VAPOR INJECTION VALVE]
  - [DIGITAL CONTROL VALVE]
  - [COMPRESSOR]



**Figure 43: Manual Function Test**

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

**NOTE: Controller returns unit to normal operation if no keys are pressed for 10 minutes. Pressing the 5 key extends test time by 10 minutes each time it is pressed (maximum time = 100 minutes). Pressing any other key resets test time to 10 minutes.**

### System Test (test multiple components at the same time):

1. Press the **F2** or **F3** key to scroll to the first component.

2. Press the **F4** key to turn the component on.
3. Press the **F3** key to scroll to select next component. Press the **F4** key to turn component on.
4. Repeat step 3 until all required components are on. For example, to operate unit in Full Cool mode, start the following components:
  - Condenser Fan
  - Compressor
  - Capacity 100 percent
  - Evaporator High or Low
5. Observe current draw and system performance to verify component(s) performance.
6. Press the **F4** key again to turn off components individually. Or press the **ESC** key to exit Manual Function Test menu and turn *all* components off.

Press the **ESC** key to exit the Manual Function Test submenu.

**NOTE:** *Controller returns unit to normal operation if no keys are pressed for 10 minutes. Pressing the 5 key extends test time by 10 minutes each time it is pressed (maximum time = 100 minutes). Pressing any other key resets test time to 10 minutes.*

## Power Management

Selecting a Power Limit from the Power Limit screen turns on the power reduction control algorithm that reduces total unit electric power consumption based on the Power Limit and Power Time settings.

Complete the following steps to **enter** the Power Management Menu.

With the **UNIT ON/OFF** switch **ON** and the LCD display showing the standard display (setpoint):

1. Press the **F2** or **F3** key to enter the menu list. Repeatedly press the **F2** key to scroll through Main menu until [COMMANDS] appears in LCD display.
2. Press the **F4** key to access the Commands menu. The first command in the submenu (Defrost) appears in the LCD display.
3. Press the **F2** or **F3** key to scroll to [POWER MANAGEMENT].
4. Press the **F4** key to enter Power Management submenu. LCD display shows the current Power Limit setting and Power Time setting.

### To activate or change the power limit:

1. Press the **F4** key with cursor in the [POWER LIMIT] menu line. Cursor moves to end of menu line and flashes.
2. Press the **F2** or **F3** key to scroll to the desired power limit setting: [OFF], [13 amps], [15 amps] or [17 amps].
3. With the desired power limit in the menu line, press and hold the **F4** key until cursor stops flashing. Cursor stops flashing and new value appears in display.

### To change the length of time power limit is active (On):

1. Press the **F2** key to scroll to Power Time menu line (standard setting = 48 hours).
2. Press the **F4** key with cursor in the [POWER TIME] menu line. An Enter Arrow appears in the menu line and the previous time disappears.
3. Enter new active period in hours.
4. Press and hold the **F4** key until cursor stops flashing. Cursor stops flashing and new value appears in display.

Press the **ESC** key to exit the Power Management submenu.

## Manual Emergency Mode Operation

In the event of an emergency situation where a failure of the controller occurs, a manual emergency mode function can be used to operate the unit. However, the unit must be manually cycled on and off using the unit 460/380V main circuit breaker. This is because manual control disconnects both the controller and **UNIT ON/OFF** switch from the main relay board. Manual control offers a selection of six operating positions:

**Position 1:** Not Use:

**Position 2:** Cool: Continuous cooling with condenser fan in operation, compressor in operation, vapor injection in operation, and evaporator fan high in operation.

**Position 3:** Not Used

**Position 4:** Not Used

**Position 5: Defrost:** Heaters are activated (evaporator fans off).

**Position 6: Evaporator Fan:** Evaporator fans operate at high speed to introduce fan motor heat only into the container (no electric heater operation).



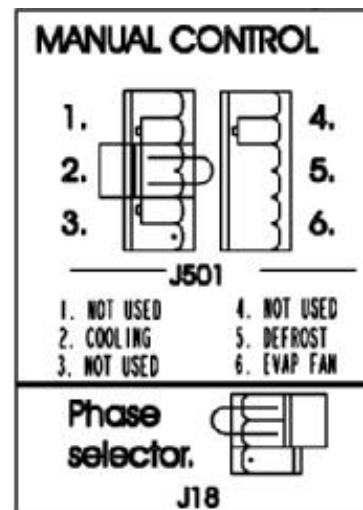
**CAUTION:** The unit must be cycled on and off manually to maintain the desired temperature. Use the 460/380V main circuit breaker to start and stop the unit. Monitor container temperature with an external thermometer.

To select Manual Control:

1. Turn the **UNIT ON/OFF** switch to **OFF**.
2. Turn the unit 460/380V main circuit breaker off. Then 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 relay board 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.



AJA1843

**Figure 44: Manual Emergency Control Connections**

3. Disconnect cable No. 2 from the controller and main relay board (see electrical schematic). The main relay board will now control the unit based on the manual control setting.

**NOTE:** *MUST check 2-pin plug location on J501 connections of main relay board to ensure correct unit operation.*

4. If necessary, remove 2-pin plug from J501 (see decal on main relay board) and relocate based on the unit operating mode required.
5. Connect the unit power cord to the proper power supply.
6. Start the unit by turning the unit 460/380V main circuit breaker on.

**NOTE:** *On MAGNUM units, both the 460/380V main circuit breaker and the Unit On/Off switch must be used to cycle the unit on and off. The Unit On/Off switch must be On to operate the scroll compressor.*

7. Check for correct rotation of condenser fan. Condenser air should be blowing out from the center of the grille. If the fan is running backwards, power supply phase must be changed.

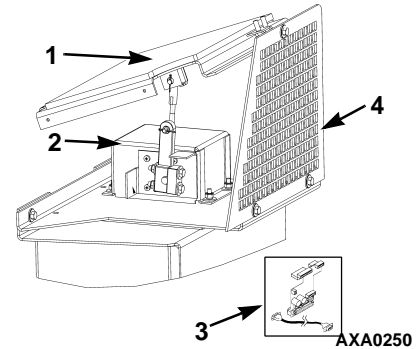
## Advanced Fresh Air Management (AFAM) System (Optional)

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

The AFAM system includes a door control module, vent door and vent grille. The MP-3000a controller sends a communication signal to the door control module to position vent door to desired position. The controller can also be set to delay opening of fresh air vent for up to 72 hours (in 1 hour increments). This allows faster product temperature pull-down.

## AFAM Operation

The system is pre-calibrated for air exchange rates of 0 to 280 m<sup>3</sup>/hr. (0 to 165 ft<sup>3</sup>/min.). The actual door position is based on the air exchange setting and the power supply frequency.



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

**Figure 45: AFAM System**

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

# Vent Door Assembly

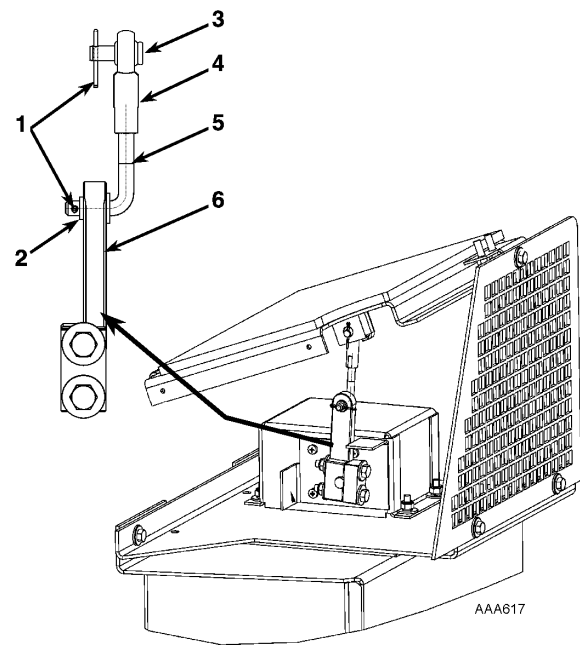
A microprocessor controlled vent door provides programmable control of the air exchange rate. The vent door is adjusted to the desired position by a vent door motor and linkage assembly, shown in Figure 46. The system is pre-calibrated for air exchange rates of 0 to 280 m³/hr. (0 to 165 ft³/min.). The use of the AFAM system should be established by the shipper.

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

The default setting for AFAM in the Setpoint menu is the last value set (Off, Units, Demand, or Manual). The AFAM submenu should be set to Units to control the vent door to the fresh air exchange rate setting.

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

Alarm Code	Alarm Type	Description
57	Check	AFAM Control Module or Motor Error: Indicates a frozen or stuck vent door or a problem with the control module or its wiring or the motor current draw is not with limits.



1.	Cotter Pins
2.	Shoulder Washer
3.	Pin
4.	Rod End
5.	L-Rod
6.	Vent Motor Linkage

Figure 46: Vent Door Linkage Adjustment

## Starting the AFAM System

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to [AFAM] line.
3. Press the **F4** key to change the mode setting. Cursor moves to end of menu line and flashes.



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

4. Press the **F2** key to toggle between [OFF], [UNITS] and [MANUAL].
  - [OFF]: Vent door closes and/or remains closed. AFAM Delay and AFAM Rate settings become blank (“----”).
  - [UNITS]: Controller uses enter AFAM DELAY and AFAM RATE time to adjust FAE door to user setting. CO2 setting goes blank.
  - [MANUAL]: Allows the operator to manually move the door to the desired opening. CO2 and AFAM DELAY settings go blank.
5. Press and hold the **F4** key with the desired state in the menu line until cursor stops flashing. New mode setting appears in display.
6. Press the **ESC** key to exit the Setpoint screen.

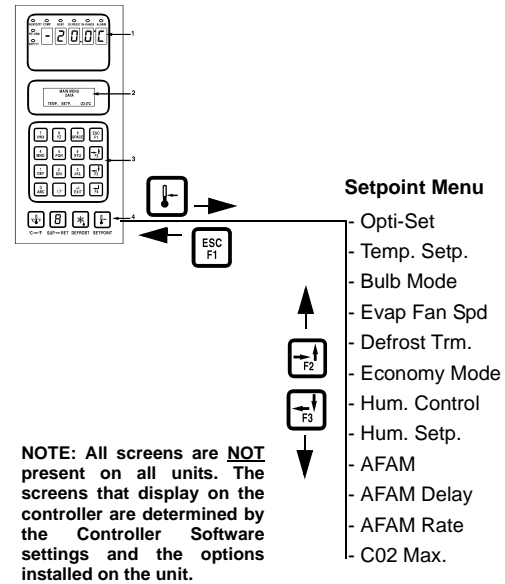
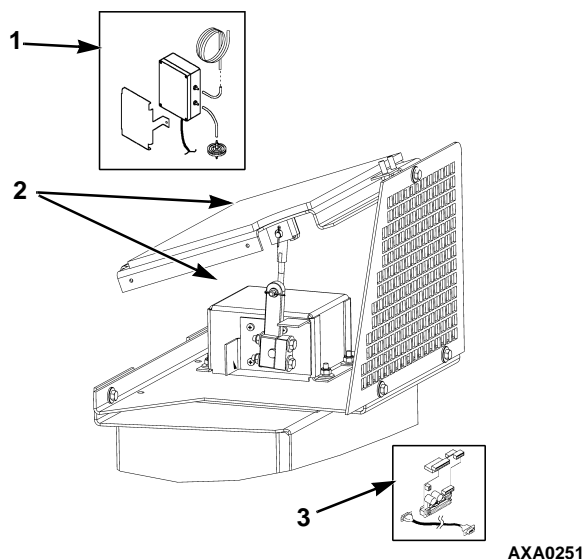


Figure 47: Setpoint Menu

## Change the AFAM Delay

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

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



1.	Gas Sensor Assembly (Mounts in Evaporator)
2.	Vent Door Assembly and Damper Motor
3.	Interface Board and Cable (Mounts in Control Box)

**Figure 48: AFAM+ System**

**NOTE:** During unit startup, the AFAM delay prevents the AFAM door from opening until the delay times out. The AFAM delay prevents the AFAM door from opening due to the AFAM Rate or CO<sub>2</sub> system settings.

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to [AFAM DELAY] line. The current setting ("0") appears in the display.
3. Press the **F4** key to enter a new time delay,. An Enter Arrow appears in the menu line and the current time delay disappears.
4. Enter (type) the new time delay in the LCD display using the general purpose keypad (1 to 72 hours). The cursor moves to the right of the screen as each key entry is acknowledged and displayed.

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

5. Press and hold the **F4** key until the cursor stops flashing. The new time delay is recorded in the controller and appears in the LCD display.
6. Press the **ESC** key to exit the Setpoint screen.

## Change the AFAM Rate

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

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

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to [AFAM RATE] line. The current rate and units (e.g. "0 CFM") appears in the display.
3. To change the rate, press the **F4** key. An Enter Arrow appears in the menu line and the current rate disappears.
4. Enter (type) the new rate in the LCD display using the general purpose keypad:

Units	Rate Setting
CFM	0 to 168 Cubic Feet Per Minute
M3H	0 to 280 Cubic Meters Per Hour
PERCENT	0 to 100 Percent

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

5. Press and hold the **F4** key until the cursor stops flashing. The new rate is recorded in the controller and appears in the LCD display.



## Advanced Fresh Air Management Plus (AFAM+) System

An advanced microprocessor controlled fresh air management system that provides:

- programmable control of the CO<sub>2</sub> level in the container
- data logging of the CO<sub>2</sub> gas level reading
- gas sensor unit
- sensor filter
- vent loop

The controller can be set to control the CO<sub>2</sub> level in the container from 0 to 25 percent.

### Set AFAM+ System Values

The AFAM option submenu in the Configuration menu is factory set to AFAM+. The controller then adds the AFAM, AFAM Delay, AFAM Rate, and CO<sub>2</sub> Max submenus to the Setpoint menu. If a replacement controller or new software is installed, a controller auto configuration will detect the AFAM+ option when the AFAM door control module and gas sensor are connected to the controller.

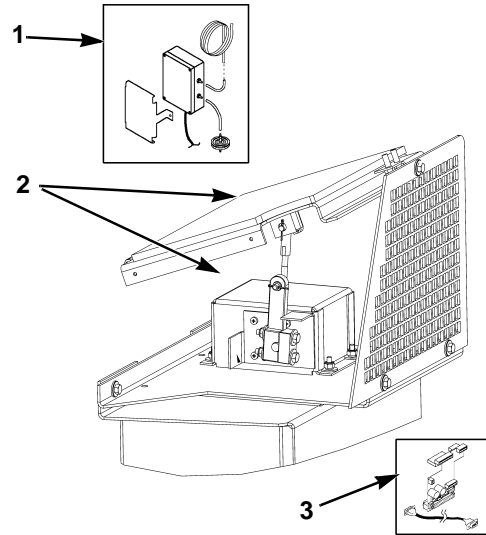
- **DEMAND:** This setting turns on the AFAM+ system to control the CO<sub>2</sub> gas level. The controller then adds CO<sub>2</sub> Max and AFAM Delay submenus to the Setpoint display.

The default setting for AFAM in the Setpoint menu is the last value set (Off, Units, Demand or manual). AFAM must be set to Demand to control the vent door to the CO<sub>2</sub> gas level.

### Change the AFAM Delay

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

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



AXA0251

1.	Gas Sensor Assembly (Mounts in Evaporator)
2.	Vent Door Assembly and Damper Motor
3.	Interface Board and Cable (Mounts in Control Box)

**Figure 49: AFAM+ System**

**NOTE:** During unit startup, the AFAM delay prevents the AFAM door from opening until the delay times out. The AFAM delay prevents the AFAM door from opening due to the AFAM Rate or CO<sub>2</sub> system settings.

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to [AFAM DELAY] line. The current setting ("0") appears in the display.
3. Press the **F4** key to enter a new time delay,. An Enter Arrow appears in the menu line and the current time delay disappears.
4. Enter (type) the new time delay in the LCD display using the general purpose keypad (1 to 72 hours). The cursor moves to the right of the screen as each key entry is acknowledged and displayed.



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

5. Press and hold the **F4** key until the cursor stops flashing. The new time delay is recorded in the controller and appears in the LCD display.
6. Press the **ESC** key to exit the Setpoint screen.

## Change the CO<sub>2</sub> Minimum and Maximum Setting

**NOTE:** *The minimum CO<sub>2</sub> rate should be established by the shipper.*

The CO<sub>2</sub> rate sets the desired CO<sub>2</sub> level in the container when a gas sensor unit is installed. The actual AFAM door position is based on the CO<sub>2</sub> level and AFAM delay.

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the [TEMP SETP] line.
2. Press the **F2** or **F3** key to scroll to “CO<sub>2</sub>” line. The current rate and units (e.g. “2.5 percent”) appears in the display.
3. To change the rate, press the **F4** key. An Enter Arrow appears in the menu line and the current rate disappears.
4. Enter (type) the new rate in the LCD display using the general purpose keypad:  
0 to 21 percent for Minimum  
0 to 25 percent for Maximum



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

5. Press and hold the **F4** key until the cursor stops flashing. The new rate is recorded in the controller and appears in the LCD display.

## OPTI-SET

Automated Fresh Air Exchange Management is designed for simple operation with the flexibility to handle a variety of commodities and situations.

OPTI-SET allows all of the following variables to be set by selecting a specific commodity. If OPTI-SET is turned ON, a list of all available commodities will appear. The commodity selected will appear in the setpoint menu. If a change is made to any of the below variables after selecting a commodity, OPTI-SET will go from ON to CUSTOM and the displayed commodity will go away.

- **TEMP. SETP.** - Temperature to be maintained in the container. This is settable from -30C (-22F) to 30C (86F).
- **AFAM** - Can be set to Manual, UNITS, DEMAND or OFF.
- **MANUAL** - Allows the operator to manually move the door to the desired opening based on the door position reference decal located on the frame of the unit, next to the FAE door.
- **AFAM Delay** - Hours the fresh air exchange door will remain closed before opening to desired exchange rate or opening due to gas sensor readings. This can be set from 1 to 72 hours. The unit will cancel the delay once the product has reached setpoint temperature.
- **AFAM Rate** - Desired air exchange rate. (Active only when AFAM is set to UNITS).
- **CO<sub>2</sub> Max** - Highest level of Carbon Dioxide allowed in the container. The AFAM door will open or close to maintain this level. (Active only when AFAM is set to DEMAND.) Settable from 0 - 25 percent.

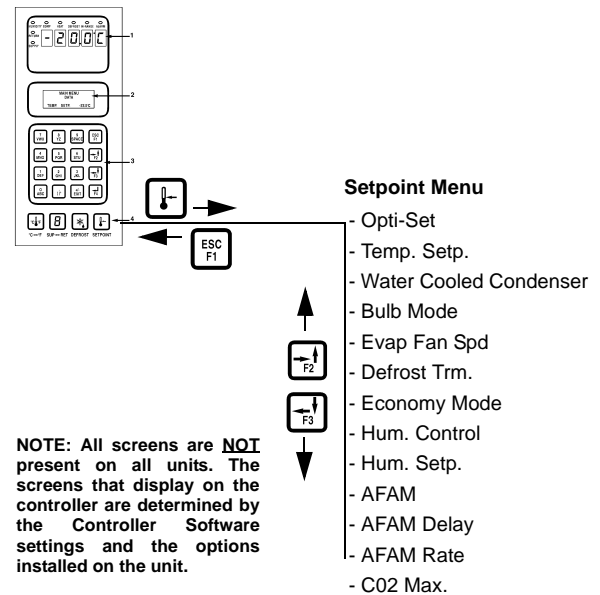


Figure 50: Setpoint Menu

## Setting the AFAM+ or AFAM System

1. Press **Setpoint** key. The setpoint menu appears with the cursor on the '**OPTISET**' line.
2. Press **F3** key and scroll to the '**AFAM**' line.
3. To change mode setting, press **F4** key. Cursor moves to the end of the command line and flashes.
4. Press **F2** key to toggle between '**OFF**', '**DEMAND**', '**UNITS**' or '**MANUAL**'
  - '**OFF**': Vent door closes and remains closed. AFAM DELAY and AFAM RATE and CO<sub>2</sub> / O<sub>2</sub> settings go blank.
  - '**UNITS**': Controller uses entered AFAM DELAY and AFAM RATE time to adjust FAE door to user setting. CO<sub>2</sub> / O<sub>2</sub> settings go blank
  - '**DEMAND**': Controller uses gas analyzer to control FAE opening based on user settings of CO<sub>2</sub> / O<sub>2</sub> and AFAM DELAY
  - '**MANUAL**': Allows the operator to manually move the door to the desired opening based on the door position reference decal located on the frame of the unit, next to the FAE door. CO<sub>2</sub> / O<sub>2</sub> and AFAM DELAY settings go blank

5. With the mode setting in the menu line, press and hold the **F4** key until the cursor stops flashing. The new mode setting will appear on the LCD display.
6. When settings are completed, press the **ESC** key to exit the setpoint menu.

### Changing the AFAM+ Settings Using 'OPTISET' (sets 'DEMAND' Mode)

1. Press **Setpoint** key. The setpoint menu appears with the cursor on the 'OPTISET' line.
2. Press **F4** key. The following screen will appear:

**OPTISET**  
**APPLES - GENERAL**  
**TO ACTIVATE PRESS F4**

3. Use **F2** / **F3** keys to scroll to desired product.
4. Press and hold **F4** key to auto enter product settings.
5. Display will show selected product.

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

### Modify Optiset Product Settings in 'DEMAND'

1. Press **Setpoint** key. The setpoint menu appears with the cursor on the 'OPTISET' line.
2. Press **F3** key and scroll to the setting to be modified. Settings that can be modified:

- Temperature Setpoint

***NOTE: Setpoint changes > 5° C (9° F) will force the CO2 setting to 1%, O2 setting to 20%, cancel the AFAM DELAY and switch OFF Bulb Mode, Economy Mode, Humidity Control and Humidity Setpoint.***

- Bulb Mode
  - Evaporator Fan Speed

- Defrost Termination Temperature
- Economy Mode
- Humidity Control
- Humidity Setpoint
- AFAM DELAY
- O2 Minimum (if applicable)
- CO2 Maximum

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

3. Example. Modifying the O2 and CO2 settings:
4. Press **F3** key to scroll to 'O2 MIN'.
5. Press **F4** key to enter the setting mode.
6. Enter the O2 setting supplied by the shipper.
7. Press and hold the **F4** key until the cursor stops flashing. The new rate is recorded in the datalogger and appears on the LCD display.
8. Press **F3** key to scroll to 'CO2 MAX'.
9. Press **F4** key to enter the setting mode.
10. Enter the CO2 setting supplied by the shipper.
11. Press and hold the **F4** key until the cursor stops flashing. The new rate is recorded in the datalogger and appears on the LCD display.

### Changing the AFAM Mode to 'DEMAND'

1. Press **Setpoint** key. The setpoint menu appears with the cursor on the 'OPTISET' line.
2. Press **F3** key and scroll to the 'AFAM' line.
3. Press **F4** key. Cursor moves to the end of the command line and flashes.
4. Press **F2** key to toggle to 'DEMAND'.
5. With 'DEMAND' in the menu line, press and hold the **F4** key until the cursor stops flashing.
6. Press **F3** key to scroll to 'CO2 MAX'.
7. Press **F4** key to enter the setting mode.
8. Enter the CO2 setting supplied by the shipper.

9. Press and hold the **F4** key until the cursor stops flashing. The new rate is recorded in the datalogger and appears on the LCD display.

**NOTE:** *If O2 setting is applicable, use above instructions to set O2 value.*

10. If 'AFAM DELAY' is required.
11. Press **F2** key to scroll to 'AFAM DELAY'.
12. Press **F4** key to enter setting mode.
13. Enter the delay time in hours supplied by the shipper.
14. Press and hold **F4** key until cursor stops flashing.
15. 'CUSTOM' will be displayed with the user entered settings.

### Changing the AFAM Mode to 'UNITS'

1. Press Setpoint key. The setpoint menu appears with the cursor on the 'OPTISET' line.
2. Press **F3** key and scroll to the 'AFAM' line.
3. Press **F4** key. Cursor moves to the end of the command line and flashes.
4. Press **F2** key to toggle to 'UNITS'.
5. With 'UNITS' in the menu line, press and hold the **F4** key until the cursor stops flashing.
6. If 'AFAM DELAY' is required.

**NOTE:** *If delay is required, 'AFAM DELAY' must be set before 'AFAM RATE'.*

7. Press **F2** key to scroll to 'AFAM DELAY'.
8. Press **F4** key to enter setting mode.
9. Enter the delay time in hours supplied by the shipper.
10. Press and hold **F4** key until cursor stops flashing.
11. Press **F3** key to scroll to 'AFAM RATE'.
12. Press **F4** key to enter the setting mode.
13. Enter fresh air exchange rate supplied by the shipper.

14. Press and hold the **F4** key until the cursor stops flashing. Door will calibrate to open position and the new rate is recorded in the datalogger and appears on the LCD display.

### Changing the AFAM Mode to 'MANUAL'

1. Press Setpoint key. The setpoint menu appears with the cursor on the 'OPTISET' line.
2. Press **F3** key and scroll to the 'AFAM' line.
3. Press **F4** key. Cursor moves to the end of the command line and flashes.
4. Press **F2** key to toggle to 'MANUAL'.
5. With 'MANUAL' in the menu line, press and hold the **F4** key until the cursor stops flashing.
6. Press **F3** key to scroll to 'AFAM RATE'.
7. Press **F4** key to enter the setting mode.
8. Enter fresh air exchange rate supplied by the shipper.
9. Press and hold the **F4** key until the cursor stops flashing. The new rate will be recorded in the datalogger. The following LCD screen will appear:

**MOVE DOOR TO DESIRED  
POSITION USING F2 / F3  
  
PRESS F4 TO ACCEPT**

10. Use **F3** key to open the door or **F2** key to close the door, move FAE door opening to required opening based on requirement from shipper using the door position reference decal located on the frame of the unit, next to the FAE door.
11. Press **F4** key to accept door position.

**NOTE:** *Failure to press the F4 key within 30 seconds will result in the vent door remaining Closed or at a previously set opening.*

**NOTE:** *When using 'MANUAL' mode, once the door position is entered, the door will remain open until it is physically changed or the unit power has been OFF for more than 120 hours.*

## Testing AFAM+ / AFAM System

The system consists of the following main parts:

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

### AFAM+ Option Alarm Codes (see manual for further descriptions) – Software versions 04100100 and above

- Code 57 – AFAM Control Module or Damper Motor Error
- Code 68 – AFAM Gas Analyzer Error
- Code 69 – Gas Analyzer Calibration
- Code 122 – O2 Sensor Calibration Error (PTI Only) (if equipped)

### How the system works:

The way the AFAM+ feature will operate depends on the AFAM mode selection in the setpoint menu. If selection is:

**‘OFF’:** Vent door is closed and remains closed. There will be no indication of CO2 or O2 in the ‘DATA’ menu. AFAM selection is automatically set to OFF for temperature setpoints below -10° C (14° F)

**‘UNITS’:** Controller uses AFAM DELAY and AFAM RATE to adjust FAE door to the user setting. The FAE door will open to the set AFAM RATE after the AFAM DELAY (if any) has expired. If there is an AFAM RATE set, and the FAE door is not open, verify that the opening is not being delayed by an AFAM DELAY setting before taking any action. The FAE door will close

automatically during any defrost cycle. It will re-open to the user setting once the defrost cycle has completed. There will be no indication of CO2 or O2 in the ‘DATA’ menu.

**‘DEMAND’:** Controller uses gas analyzer to control FAE door open / close based on user settings of CO2 and O2 (if equipped) and AFAM DELAY. The FAE door will not open until the container temperature is ‘In Range’ of setpoint regardless of the CO2 and O2 (if applicable) readings. If the door is closed, verify that the CO2 is not above CO2 setpoint and the O2 (if equipped) is not below O2 setpoint. The FAE door will open after the AFAM DELAY (if any) has expired. The FAE door will close automatically during any defrost cycle. The gas sensor readings are updated every 15 minutes. There will be active CO2 and O2 (if applicable) readings in the ‘DATA’ menu

**‘MANUAL’:** Allows the operator to manually move the door to the desired opening based on the door position reference decal located on the frame of the unit, next to the FAE door. There will be no indication of CO2 or O2 in the ‘DATA’ menu.

### How to verify System Operation

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

***NOTE: Upgrade the controller software to the latest released version. ‘Auto Config’ will be automatically be initiated upon successful completion of a software flashload.***

***NOTE: If only the AFAM option is found, then there is a communication problem with the gas analyzer.***

***NOTE: If only Gas Analyzer is found, there is a problem with the operation of the damper motor.***

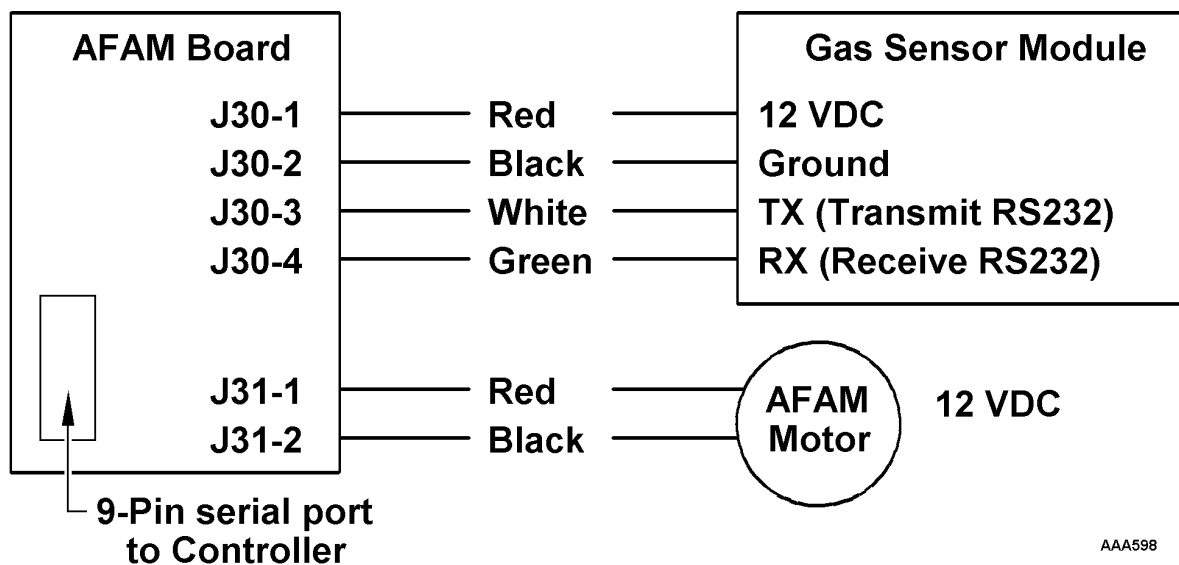
To select 'Auto Config' to ON:

1. Enter 'Configuration' menu.
2. Use F2 or F3 key to scroll to 'Auto Config' menu line.
3. Press F4. The password line appears.
4. Press the following keys in this order:
  - F2, then A, then F4, then EXIT
5. Use F2 or F3 key to scroll to ON.
6. Press and hold F4 key until entry is complete.

7. Press ESC key to begin the 'Auto Config' sequence.

Once the 'Auto Config' is complete, and the AFAM+ system has been found and configured into controller memory, enter the desired settings.

If the damper motor or the gas analyzer is not found during the 'Auto Config', use the diagram below to verify the connections, supply voltages and communication wiring to the two components. Also verify that the 9-pin serial cable is connected from the AFAM board to the controller.



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## Alarm Codes and Actions / Data Menu Display

There are three (3) possible alarm codes that can be generated if the AFAM+ system is not working properly. There is one (1) additional PTI alarm that could be generated on a unit equipped / utilizing an O2 sensor.

Alarms	Possible Cause	Corrective Action(s)
Code 57 AFAM Control Module or Motor Error	<ol style="list-style-type: none"> <li>1. Vent door is frozen or stuck</li> <li>2. Door linkage adjustment</li> <li>3. Incorrect wiring</li> <li>4. Defective motor</li> <li>5. Defective control module</li> </ol>	<ol style="list-style-type: none"> <li>1. Visually inspect door for ice or obstruction</li> <li>2. Check for proper linkage adjustment</li> <li>3. Check wiring connections</li> <li>4. Using Manual Function Test – AFAM Open or AFAM Close, test to cycle the door open and closed. If motor does not move the door, use independent 12 VDC (battery) supply to cycle the motor. If motor does not move with independent supply, motor is defective</li> <li>5. If motor cycles using independent 12 VDC supply, the control module is faulty</li> </ol>
Code 68 AFAM Gas Analyzer Error	<ol style="list-style-type: none"> <li>1. Analyzer disconnected</li> <li>2. Incorrect wiring</li> <li>3. Wrong configuration</li> <li>4. Cable plugged into download port during sampling interval</li> <li>5. Defective analyzer</li> </ol>	<ol style="list-style-type: none"> <li>1. Verify analyzer harness is correctly connected to control module, to gas analyzer and 9-pin cable is connected to control module and controller</li> <li>2. Verify wiring is correct</li> <li>3. In Configuration menu, check that AFAM+ configuration is set properly</li> <li>4. Both the controller download port and gas analyzer are connected to the same serial port on the controller and only one can communicate at a time. If cable is plugged into the download port, the analyzer is disabled and will not sample. Remove download cable from serial port</li> <li>5. Replace analyzer</li> </ol>



Alarms	Possible Cause	Corrective Action(s)
Code 69 Gas Analyzer Calibration (Normal)	1. Stale atmosphere / Filter or inlet / outlet tubes restricted (SEE NOTE BELOW)  2. CO2 or O2 sensor faulty	1. Open evaporator access door or fully open vent door and allow unit to operate on high speed fan for 20 to 30 minutes to purge any old, stale air trapped in the analyzer module  2. Replace analyzer
Code 69 Gas Analyzer Calibration (During PTI)	1. Stale atmosphere / Filter or inlet / outlet tubes restricted (SEE NOTE BELOW)	1. Open evaporator access door or fully open vent door and allow unit to operate on high speed fan for 20 to 30 minutes to purge any old, stale air trapped in the analyzer module before performing PTI
	2. CO2 or O2 sensor faulty	2. Replace analyzer
Code 122 O2 Sensor Calibration Error (if equipped) (PTI Only)	1. Stale atmosphere / Filter or inlet / outlet tubes restricted (SEE NOTE BELOW)  2. O2 sensor reading < 17% or > 25%	1. Open evaporator access door or fully open vent door and allow unit to operate on high speed fan for 20 to 30 minutes to purge any old, stale air trapped in the analyzer module before performing PTI  2. If O2 reading is still out of calibration range after purge procedure noted above is performed, replace analyzer

Data Menu	Display Indication	Corrective Action(s)
CO2%	Open or Short	If no alarm has been generated, the system most likely has not communicated with or is verifying communications with the analyzer. Follow action for 'Stale Atmosphere' steps noted above. If fault exists, an alarm will be generated.
O2%	Open or Short	If no alarm has been generated, the system most likely has not communicated with or is verifying communications with the analyzer. Follow action for 'Stale Atmosphere' steps noted above. If fault exists, an alarm will be generated.

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

## Vent Door Calibration and Linkage Adjustment

### Vent Door Calibration

The positioning of the vent door is controlled based on a timing algorithm in the controller. The time it takes for the damper motor to move the vent door, travel from the fully closed to the fully open position, is recorded by the controller and used to determine the open position when the 'UNITS' mode selection is set. This is the calibration of the vent door assembly. If the vent door linkage is out of adjustment or misaligned, it may affect the correct calibration of the vent door and the vent door may not open to the desired position.

See 'Linkage Adjustment' in next section.

The auto calibration of the vent door is dependent on the AFAM mode selection entered in the setpoint menu. If selection is:

- 'OFF' – No vent door calibration will occur
- 'UNITS' – Vent door will calibrate every time the unit power is cycled
- 'DEMAND' – Vent door will not calibrate until the gas level setpoint has been reached
- 'MANUAL' – No vent door calibration will occur

Additionally, the vent door will re-calibrate at every defrost cycle to ensure vent door is not frozen in its position.

### Linkage / Door Adjustment

The linkage adjustment is very important as the container may be used sometimes for a non-AFAM+ load. In this event, the vent door must be able to open to the setting desired by the shipper. If the linkage is out of adjustment or misaligned, the timing algorithm recorded by the controller may be incorrect and the vent door may not open correctly, not open to the desired position or not open at all.

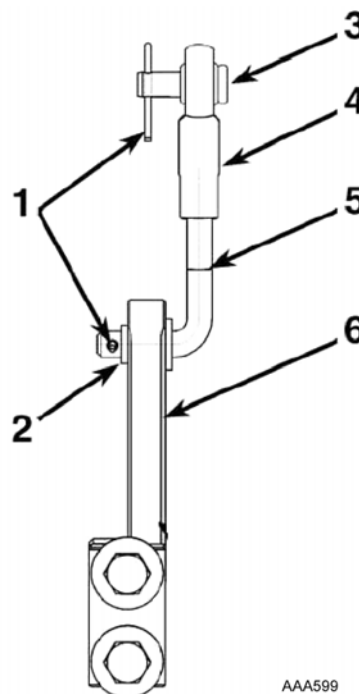
Correct adjustment of the linkage and the door is based by the following criteria: (see Figure 51).

- Alignment between the L-Rod and motor linkage at 90 degrees

- L-Rod movement in shoulder washer free
- Ball joint movement in rod end free
- Door can be adjusted as required by loosening the bolts on the back wall. Adjustment can be made vertically and horizontally. If adjustment is done on the door, ensure the door is level (vertical) when the bolts are re-tightened

Correct closure of the door adjustment is based on the following criteria: (see Figure 51).

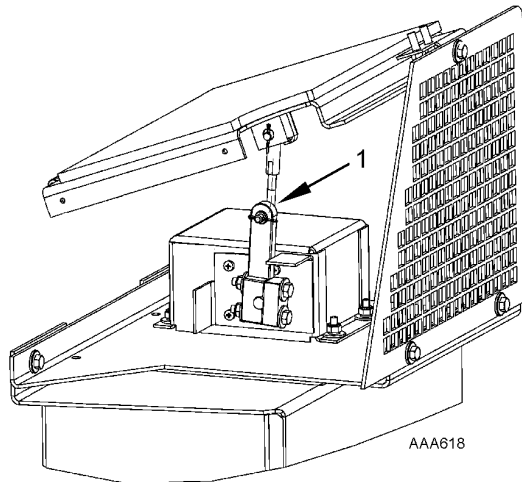
- Vent door must be able to travel freely to the bottom stop. The closing position at the top should be when the vent door gasket seals on the vent inlet and outlet tubes. The motor linkage arm should not reach the top stop. The top stop is to prevent the vent door linkage from going over center. Keep a small positive angle towards the unit back wall
- The rod end and L-Rod are threaded to lengthen or shorten the door adjustment as required.



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1.	Cotter Pins
2.	Shoulder Washer
3.	Pin
4.	Rod End
5.	L-Rod
6.	Vent Motor Linkage

**Figure 51: Linkage and Door Adjustment**



- |    |   |
|----|---|
| 1. | With the door fully sealed on the gasket, linkage should not touch the top stop and the linkage angle should be towards the unit back wall. |
|----|---|

**Figure 52: AFAM+ Door Adjustment**

## Fresh Air Exchange Recorder (Optional)

The Fresh Air Exchange Recorder detects vent disk movement and automatically displays a value on the LCD 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.

### Configuration Instructions

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

1. Press the **ESC** key until the LCD display returns to the standard display (setpoint):
2. Press the **F3** key to enter the Main menu.
3. Press the **F2** or **F3** key to scroll through Main menu until CONFIGURATIONS appears in LCD display.
4. Press the **F4** key to access the Configurations screen.
5. Press the **F3** key to scroll cursor to the AFAM OPTION line.
6. Press the **F4** key. The password line appears.
7. Press the **F2** key and then the **A** Key (password is "A"). Press the **F4** key and then the **EXIT** key to enter the password.
8. Press the **F3** key until it highlights LOGFAE on the AFAM option line. Press and hold the **F4** key until the cursor stops blinking. The line will read AFAM OPT. LOGFAE. The unit is now configured to log the vent door motion.
9. Press the **ESC** key to exit the Configurations screen.



Figure 53: Fresh Air Exchange Recorder

### Operating Instructions

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

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

## Electronic Chart Recorder for MP3000a Controllers

An Electronic Temperature Chart Recorder is available for use in the MP-3000a controlled units. The recorder connects to the controller through a RS-485 port on the side of the controller. The recorder uses the sensors in the unit for its data/chart plotting. The charts that are used are any 31-day type charts currently used or available in the industry.

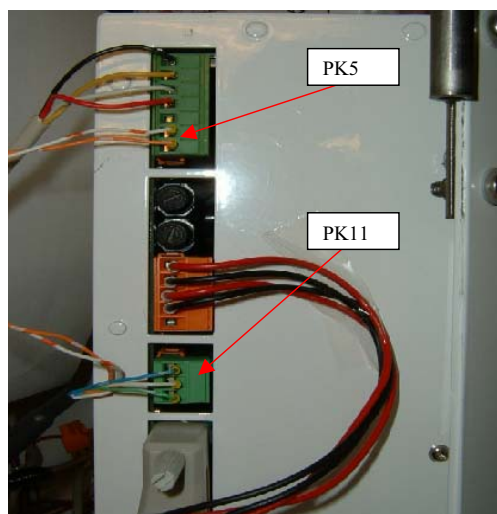
### Recorder Installation

Recorder fits in TK enclosure only. If OEM Partlow box is installed, it must be replaced with TK design box.

1. Turn unit **OFF** and remove from main power.
2. Remove OEM recorder from enclosure.
3. Route recorder cable through sensor harness grommet in bottom of control box.

**NOTE:** *Cable end with connector is controller end. Loose wire end goes to recorder.*

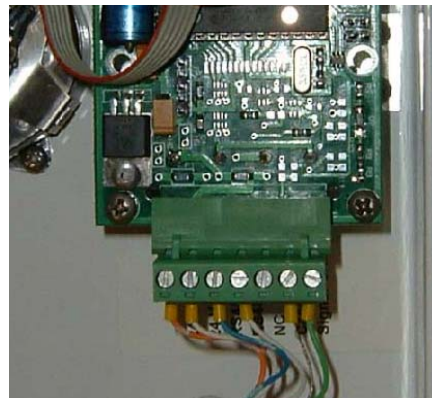
4. Plug the RS-485 plug into controller.
5. Connect power wires to battery connector on controller.



1.	PK11-1: RS485 (+) - blue
2.	PK11-2: RS485 (-) - white
3.	PK11-3: Signal GND - green
4.	PK5-6: (24Vac) - orange
5.	PK5-7: (24Vac) - orange/white

**Figure 54: Power Wire Connections**

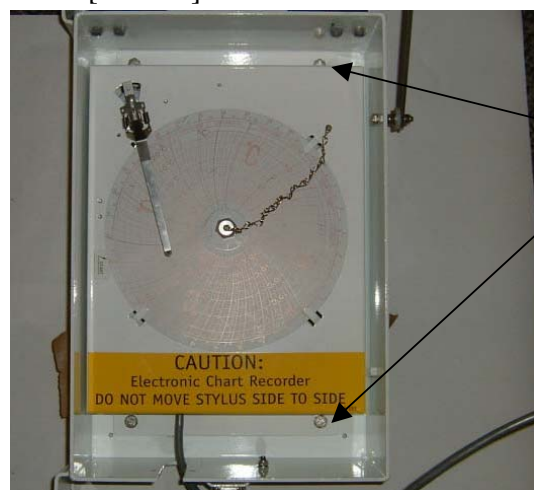
6. Route recorder cable, loose wire end, through grommet in bottom of recorder enclosure and Timmerman clamp on recorder. Ensure exposed length is enough to reach recorder connections.
7. Connect cable to recorder as shown below.



1.	Pin 1: Signal GND - green
2.	Pin 2: Case ground - bare
3.	Pin 3: NC
4.	Pin 4: RS485 (-) - white
5.	Pin 5: RS485 (+) - blue
6.	Pin 6: (24Vac) - orange/white
7.	Pin 7: (24Vac) - orange

**Figure 55: Chart Recorder Terminals**

8. Mount recorder into enclosure using bolts provided (or existing ones removed).
9. Mechanical installation is complete. Proceed to [SETUP] section.



**Figure 56: Electronic Chart Recorder Mounting Bolts**

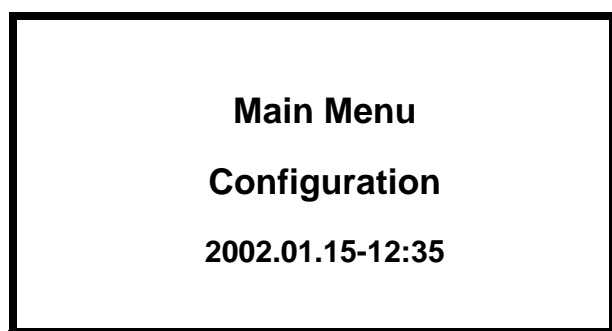
## Recorder Setup

Once the recorder is installed, it needs to be added to the unit configuration. Connect unit to main power and turn ON.

**NOTE:** *Software version 01122300 or above is required to add the electronic recorder.*

**Flashload software as necessary**

1. Press the **UP** or **DOWN** key to enter menu area.
2. Scroll up or down to [CONFIGURATION] menu. Press **F4** to enter menu.



3. Scroll up or down to find [CHART R NOT PRESENT] (below is only an example of where item is located).

<b>COND TYPE</b>	<b>1/2HP FAN</b>
<b>USDA TYPE</b>	<b>3 PT100</b>
<b>CHART R.</b>	<b>NOT PRESENT</b>
<b>AUTO CONFIG</b>	<b>OFF</b>

4. Press the **F4** to select [CHART R. NOT PRESENT].

5. Enter password. Password is A

**NOTE:** *To enter password: Press **F2** key, press **A** key, press **F4** key, press **EXIT** key.*

6. Scroll up or down to select chart type being used. Press and hold **F4** for 5 seconds.

### Chart Types Available

- +25/ -25 C 31-day
- +25 / -30 C 31-day
- +80 / -20 F 31-day
- +20 / -40 C 31-day

7. Controller will now enter [AUTO CONFIG] test as unit configuration has been changed.
8. Setup is complete upon completion of [AUTO CONFIG] test.

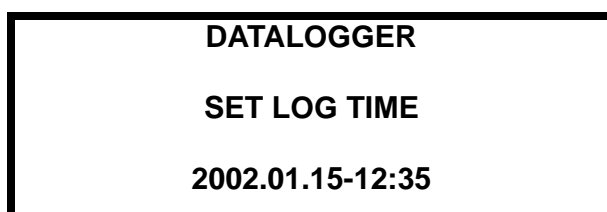
## Using Special Features

An operator can create a new chart from any date range of data recorded in the datalogger. This is extremely valuable if:

- The original chart is missing
- The original chart has been damaged

### Procedure for Redraw Chart

1. Install new temperature chart in recorder
2. Press the **UP** or **DOWN** key to enter menu area
3. Scroll up or down to [DATALOGGER] menu. Press the **F4** to enter menu
4. Scroll up or down to [SET LOG TIME]



5. Press the **F4** key and the following menu will appear.

<b>LOG CHART</b>	<b>1 HOUR</b>
<b>CHART RECORD</b>	<b>RET</b>
<b>CHART STATE</b>	<b>ONLINE</b>
<b>CHART CDM</b>	<b>ONLINE</b>
<b>REDRAW FROM</b>	<b>02.01.15</b>
<b>REDRAW TO</b>	<b>02.01.15</b>

6. Scroll up or down to place cursor on [REDRAW FROM] line. Press the **F4**.
7. Date information will now be blank. Select date to start record. After entering, press the **F4** and EXIT.

**NOTE:** *Date format: YY.MM.DD*

8. Scroll down to place cursor on [REDRAW TO] line. Press the **F4**.

9. Date information will now be blank. Select date to end record. After entering, press the **F4** and EXIT.

***NOTE: Date format: YY.MM.DD.***

***NOTE: Do not exceed 31 days. This is the limit of the chart.***

10. Scroll up to place cursor on [CHART CMD]. Press the **F4**.
11. Use up or down to scroll to [REDRAW]. Press the **F4**.
12. Chart will now begin to plot requested date range.
13. Remove chart when complete.
14. Install new chart.





# Operating Theory

---

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

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

The Digital Control valve engages and disengages the compressor to control capacity. The valve opens and closes in response to a controller voltage signal based on a control temperature differential. The controller uses the setpoint temperature, supply air sensor temperature (left and/or right hand sensors) 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 accuracy and protection against frost damage is provided by using two separate sensors (left hand and right hand) to determine the supply temperature used to calculate the control temperature differential:

- At setpoints below -1 C (30 F), the controller uses the lowest supply air sensor temperature.
- At setpoints above 0 C (32 F), the controller uses the average temperature of the left hand and right hand supply air sensors.
- At setpoints between -1 C and 0 C (30 F and 32 F), the controller uses a sliding temperature scale from the lowest supply air sensor temperature to the average temperature of the left hand and right hand supply air sensors.

If one supply air sensor fails, the controller uses the temperature of the other supply air sensor for temperature control. If both 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 Data Menu

The percent displayed in the Data menu 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 Data menu 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 Economy mode setting.

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

When the Economy mode is set to Off, the evaporator fans operate continuously on high speed.

If Controlling Mode is available and set to OPTIMIZED, the evaporator fans operate on low and high speed as needed to maintain the setpoint and save energy. Typically, the evaporator fans run in high speed during the initial pull-down to setpoint, but the evaporator fans may run in low speed at times during pull-down as determined by the controller. Once the setpoint has been reached, the evaporator fans usually run in low speed as long as the temperature is near the setpoint. If the controller determines it is necessary, the

evaporator fans may shift back to high speed temporarily to bring the temperature back to setpoint or increase air circulation.

If Controlling Mode is available and set to NON-OPTI (Non-Optimized), the evaporator fans operate continuously on high speed.

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

When the Economy mode is set to Off, the evaporator fans operate on low speed. Low speed RPM is one-half the high speed RPM. If Controlling Mode is available and set to OPTIMIZED, operation will be the same as in Economy mode for frozen cargo.

### Economy Mode Operation

The Economy mode reduces unit power consumption by reducing evaporator fan operation on both chill and frozen loads. The use of the Economy mode should be established by the shipper and the type of cargo. The Economy mode option is turned on from Setpoint menu of the controller.

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

- **Chill Loads (Setpoints of -9.9 C [14.1 F] and Above):** When the temperature is In-range, the controller shifts the evaporator fans to low speed.

**NOTE: On Chill loads, container air temperatures may vary 1 C to 3 C (1.8 F to 5.4 F) above setpoint in high ambient temperatures.**

- **Frozen Loads (Setpoints of -10 C [14 F] and Below):** When the unit is in the Null mode, the controller stops the evaporator fans. A null state timer automatically re-starts the evaporator fans on low speed for 5 minutes every 45 minutes.

The Economy mode also modifies the temperature control algorithm on frozen loads to extend the Null mode. The unit continues on Cool operation until return air temperature reaches ECMIN temperature. Default ECMIN setting is 2.0 C (3.6 F) below setpoint. ECMIN temperature is

adjustable from 0 to 5 C (0 to 8.9 F) below setpoint through the Configuration menu of the controller.

The unit remains in Null until the return air temperature increases to EMAX temperature at the expiration of a 45 minute Null state time sequence. Default EMAX setting is 0.2 C (0.4 F) above setpoint. EMAX setting is adjustable from 0 to 5 C (0 to 8.9 F) above setpoint through the Configuration menu of the controller.

**NOTE: On Frozen loads, supply and return air temperatures may vary considerably during Economy mode operation due to long periods of no air circulation.**

## 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.

## Probe Test

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 last 90 minutes, the controller initiates a probe test to check for a defective sensor.

During a Probe test, the LCD 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 LCD display shows "RUNNING WITH HIGH SUPPLY DIFFERENCE" message.

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.**

## Bulb Mode

The Bulb mode allows the shipper to control the evaporator fan speed and defrost termination temperature during Dehumidification. The Bulb mode screen setting determines the evaporator fan speed: Flow Cycle, Flow High or Flow Low.

Setting a Bulb mode fan speed automatically activates the defrost termination temperature setting and the Dehumidify mode (controller sets Humidity control to DEHUM). The use of the Bulb mode should be established by the shipper.

**NOTE: If the Bulb mode is set to On, the controller LCD display will show "BULB" and current humidity setpoint.**

## 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.

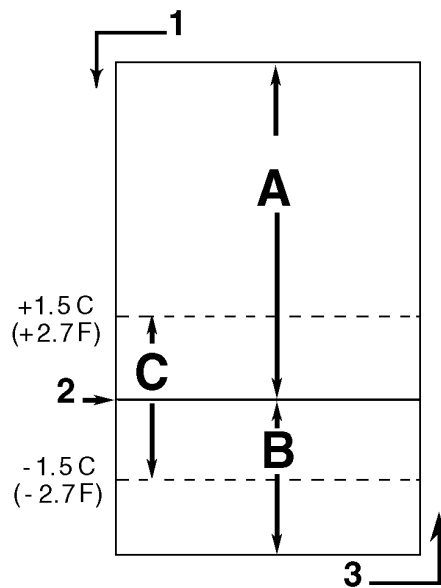
## Continuous Temperature Control Operation

### 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 57: 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
• <sup>1</sup>	•					Evaporator Fans High Speed <sup>1</sup>
• <sup>1</sup>			•	• <sup>1</sup>		Evaporator Fans Low Speed <sup>1</sup>
		•		• <sup>1</sup>	•	Evaporator Fans Off <sup>1</sup>
•	•					Proportional-integral Derivative (Supply Air) Control
			•	•		Return Air Sensor Control
		•			•	Evaporator Coil Sensor Control
•			•			Compressor On
•			•			Compressor Vapor Injection On (valve energized) <sup>2</sup>
•			•			Condenser Fan On <sup>3</sup>
•			• <sup>4</sup>			Digital Control Valve Modulating (energized) <sup>4</sup>
• <sup>5</sup>	•	•			•	Electric Heaters Pulsing or On (energized) <sup>5</sup>

<sup>1</sup>Setpoint temperature and Economy/Optimized mode setting determine the evaporator fan speed:

**Normal Operation (Economy/Optimized mode off):** Chill Loads — High speed fans; Frozen Loads — Low speed fans.

**Economy/Optimized mode set to On:** Chill Loads — Fans switch from high speed to low speed when temperature is in-range. Frozen Loads — Low speed fans during cooling; fans are off during Null mode but operate on low speed for 5 minutes every 45 minutes.

<sup>2</sup>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).

<sup>3</sup>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.

**NOTE: Condenser fan does not operate when the water pressure switch (option) is open.**

<sup>4</sup>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.

<sup>5</sup>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 LED 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 on the In-range LED when the supply air sensor temperature is within 1.5 C (2.7 F) of setpoint.
- Supply air sensor control algorithm increases temperature control accuracy and protection against frost damage (see “Chill Loads” under “General Theory of Operation” in this chapter).
- Controller turns on the Heat LED whenever the heaters are pulsed on and off.

### Heat

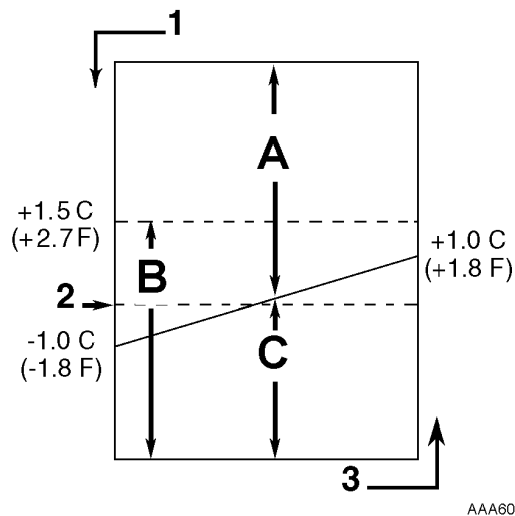
- If the supply air temperature is too low and the Control Temperature Differential is below the setpoint, the controller stops the compressor and pulses the electric heaters on and off on a 60 second duty cycle to provide heat. The controller pulses the electric heaters on and off until the supply air temperature increases to setpoint.

### 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; or when Economy mode is on and the unit is in Null mode).
- Controller LED display shows the return air sensor temperature.
- Controller LCD 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).



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

**Figure 58: Frozen Load Control Sequence  
(Setpoints at -10 C [14 F] and Below)**

### Cool

- After initial start-up and pull-down to 1.0 C (1.8 F) below setpoint, the controller calls for the Cool mode whenever:
  - Return air temperature increases more than 1.0 C (1.8 F) above setpoint.
  - Return air temperature is above setpoint and the compressor has been off for 30 minutes.
- Controller turns on the Compressor LED 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 1.0 C (1.8 F) below setpoint.

- The controller stops the compressor and condenser fan.
- The evaporator fans continue to operate (except when Economy mode is on).
- Compressor remains off for a minimum of 5 minutes.

### 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 10 C (50 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 left hand and right hand supply air sensors is too large and unit has operated for more than 90 minutes since last defrost.
  - 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 initial time interval is:
  - 8 hours of compressor operation at supply air temperatures of 5.1 C (41.2 F) or above.
  - 2.5 hours of compressor operation at supply air temperatures of 5.0 C (41.0 F) or below. One-half (0.5) hour is added to

the time interval each timed defrost interval. Defrost synchronization creates step intervals of 3, 4, 4, 5, 5, 6, 6 and 7 hours. Maximum time interval is 7 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 LCD 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 LED, Heat LED and energizes the heater contactor, turning on the electric heaters.

### The controller terminates the Defrost mode when:

- Evaporator temperature:
  - Chill mode: Evaporator coil sensor temperature reaches 30 C (86 F); or exceeds 18 C (65 F) for 35 minutes/45 minutes if voltage is less than 440 volts.
  - Frozen mode: Evaporator coil sensor temperature reaches 18 C (65 F); or exceeds 8 C (46 F) for 35 minutes/45 minutes if voltage is less than 440 volts.
- 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.

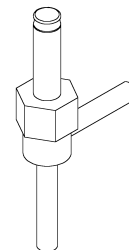
### When the defrost mode is terminated:

- The Heat and Defrost LEDs turn off and the heater contactor 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-3000a 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.



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**Figure 59: 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

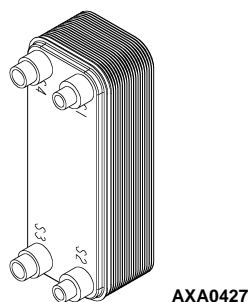


(compressor pumping time) in the duty cycle equals the cooling capacity percent required to meet the current load demand.

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.



**Figure 60: 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-3000a 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 LCD 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 11.4 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 handheld data retriever, LOGMAN PC used on a

laptop PC or a REFCON power line remote monitoring system. LOGMAN 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

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## Flash Loading Controller Software

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

1. Turn the **UNIT ON/OFF** switch **OFF**.
2. Plug cable from a portable computer with controller software into the data retrieval connector on the control box.
3. Press and hold the **7** key and **F1** key at the same time. LCD display will show [FLASHLOAD].
4. Press one of the special functions keys to activate controller LCD display on battery power; or turn the **UNIT ON/OFF** switch **ON**.

**NOTE:** *Controller will start in Emergency mode and LCD display will show “EMERGENCY MODE” if the communications cable is defective or not connected to the download port. Secure cable connection to proceed with flash loading of software.*

5. Start flash load program on portable computer.
6. Flash loading of new software is complete when [FLASH LOADING] clears from the LCD display.
7. The controller then checks the new software and loads the new control program into memory.

**NOTE:** *If the flash load procedure is interrupted or fails on a MP3000a, the controller will stay in the flash mode until correctly flash loaded.*

**NOTE:** *If the flash load procedure is interrupted or fails on a MP3000, the controller will continue to use the previous control program.*

**NOTE:** *Installing new software does not change any configuration settings or the setpoint setting, or erase the data log currently stored in the controller.*

## 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 relay board 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. Disconnect battery power connection from the controller (top plug on the controller).
5. Disconnect the communication cables from the controller and remote monitoring modem.
6. Remove the screws that secure the remote monitoring modem to the controller.
7. Remove the screws that secure the controller to the inside of the control box door.
8. Remove the controller from the door.
9. Install the replacement controller in the door using the existing hardware.
10. Connect the keyboard cable to the controller.
11. Install the remote monitoring modem on the back of the controller.
12. Connect the communication cables to the remote monitoring modem and controller.

13. Recheck all connector plugs to ensure they are fully seated.
14. Review the Configuration Menu instructions in the operating section. Reset information as required.
15. 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 via a laptop computer or a REFCON remote communications system.***

***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.***

***NOTE: If a controller from another unit has been installed, see “Automatic Configuration of Spare Parts Controller” in this chapter to set configuration correctly.***

## Automatic Configuration of Spare Parts Controller

An automatic configuration feature detects the unit options installed on a unit when a spare parts controller is installed. When the controller is powered up for the first time, the controller turns the Auto Configuration feature on. After the initial unit power up, the controller turns the Auto Configuration feature off.

The Auto Configuration feature detects the following options and sets the correct value in Configuration menu:

- Unit Type
- AFAM+
- Number of Supply Air Sensors (1 or 2):  
Controller detects left hand and right supply air sensors.
- Humidity sensors
- Horsepower and Condenser Fan (1/2 hp or 3/4 hp).
- Number of Evaporator Fans (2 or 3)
- Chart Recorder
- Fresh Air Exchange Recorder
- Discharge or Suction Pressure Sensors

# Electrical Maintenance

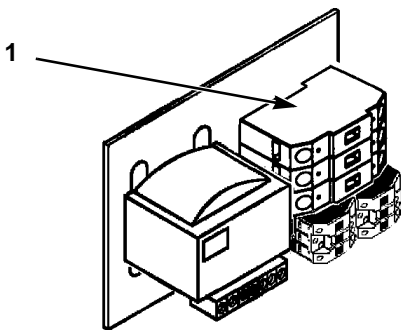
## Unit Protection Devices

### 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.



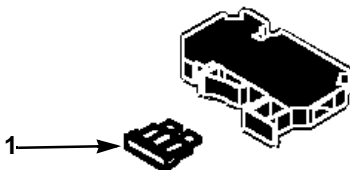
AXA0342

1.	Main Circuit Breaker
----	----------------------

Figure 61: Main Circuit Breaker

### Control System Fuse

A 7.5 ampere automotive blade type fuse protects the 29 Vac control circuit. This fuse is located inside the control box (right side) on the terminal block rail.



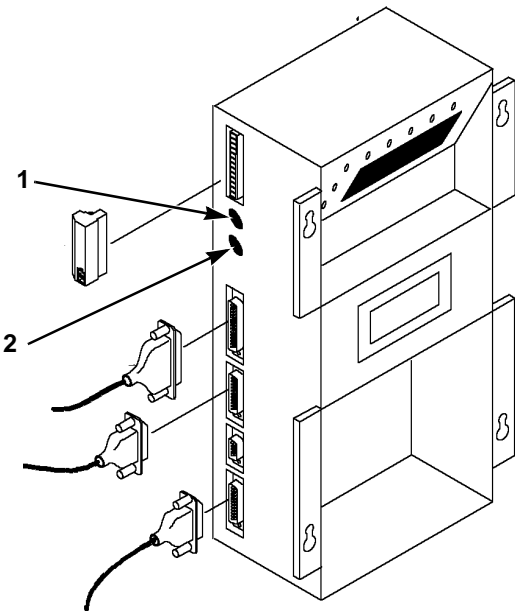
AMA312

1.	Control System 7.5 Amp Fuse (ATO)
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Figure 62: Control System Fuse

### Control Circuit Fuses

Two control circuit fuses are located on the controller. They protect the unit circuits and components. No fuses are present on newer controllers.



AMA308

1.	28 Vac Control Circuit Fuse, 2 ampere
2.	28 Vac Control Circuit Fuse, 2 ampere

Figure 63: Control Circuit Fuses

### Evaporator Overheat Switch

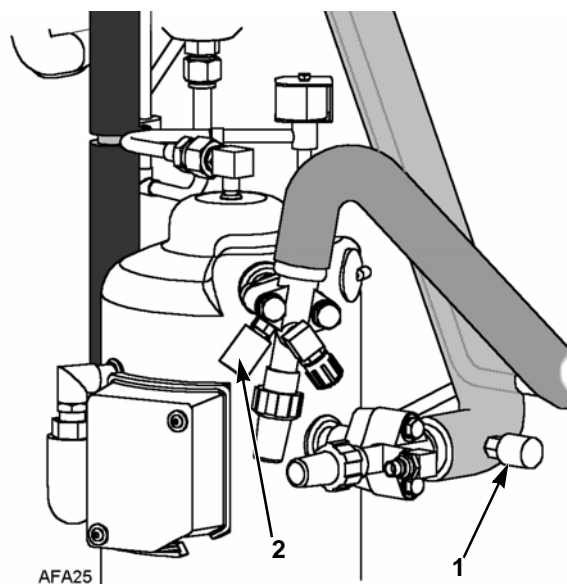
A temperature switch near the evaporator coil opens to de-energize the heater contactor if the evaporator temperature reaches  $54 \pm 3$  C ( $130 \pm 5$  F). The switch closes (resets) when the evaporator temperature decreases to  $38 \pm 4.5$  C ( $100 \pm 8$  F).

Newer units do not have this overheat switch. The coil sensor is used for overheat protection.

## 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 LCD 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 64: 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 LED and records Alarm 37 (Total Power Consumption Too Low).

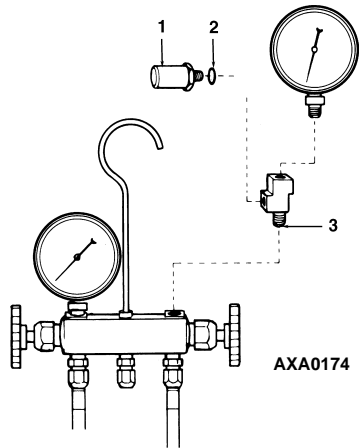
High Pressure Cutout Switch:

- Opens:  $3243 \pm 7$  kPa,  $32.43 \pm 0.48$  bar,  $470 \pm 7$  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 65: 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

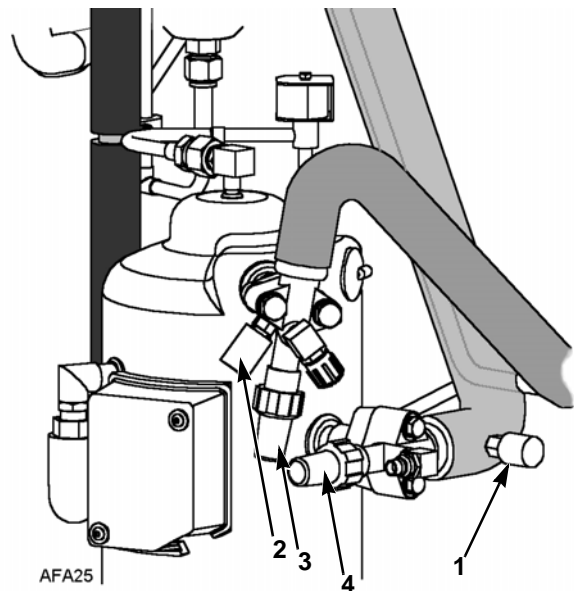
Remove the high pressure cutout switch by performing the following steps:

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 Loctite 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 66: 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.

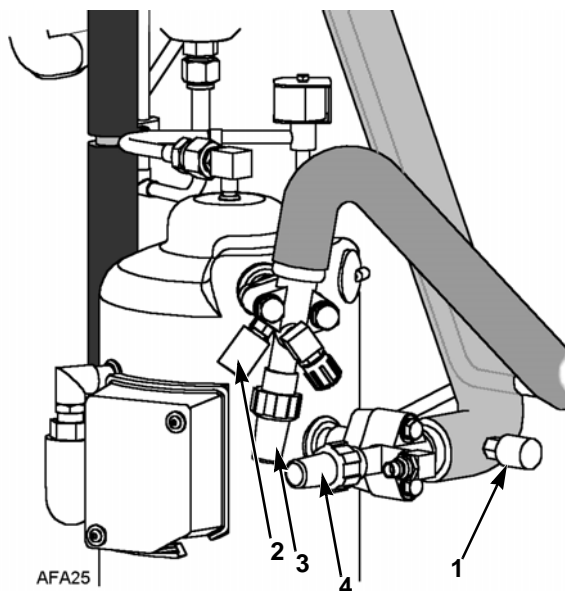
## Low Pressure Cutout Switch Removal

**NOTE:** Units built before December 2003 do not have a Schrader valve in fitting and will require the refrigerant charge to be recovered from the unit.

### On units built before December 2003:

1. Recover the refrigerant charge from the unit. (see "Recovering Refrigerant from the System").
2. Disconnect the low pressure cutout switch wires from the control box.
3. Remove the low pressure cutout switch from the suction line.

If the unit is equipped with a low pressure sensor, the LPCO is not used.



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

Figure 67: Low and High Pressure Cutout Switches

### On units built after December 2003:

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 schrader valve which will prevent refrigerant leakage.

## Low Pressure Cutout Switch Installation

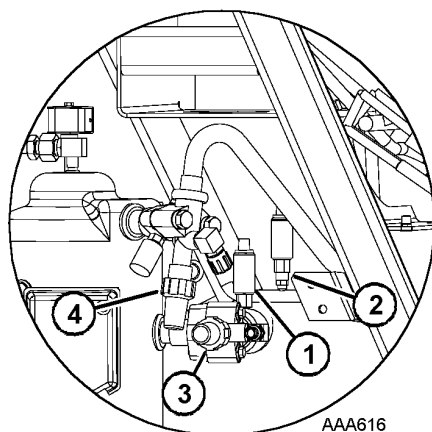
Install the low pressure cutout switch by performing the following steps:

### On units built before December 2003:

1. Install low pressure cutout switch in the suction line.
2. Route wires into the control box and connect to proper terminals.
3. Pressurize the low side with refrigerant and check for leaks. If no leaks are found, recover the leak test gas (see “Recovering Refrigerant from the System”).
4. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System”).
5. Recharge the unit with R-404A (see “Refrigerant Charge”).
6. Perform a controller pretrip test to verify system operation.

### On units built after December 2003:

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 68: 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 Loctite 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:

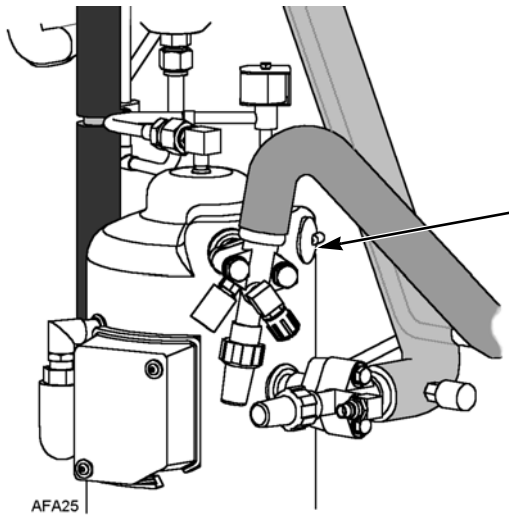
1. Turn the unit 460/380V main circuit breaker off.
2. Disconnect unit power cord from power supply.
-  **WARNING:** *The unit will automatically start and operate if 460/380V power is present at the main relay board when the controller is disconnected. To prevent personal injury from rotating machinery 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 On/Off switch On.
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 69: 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.

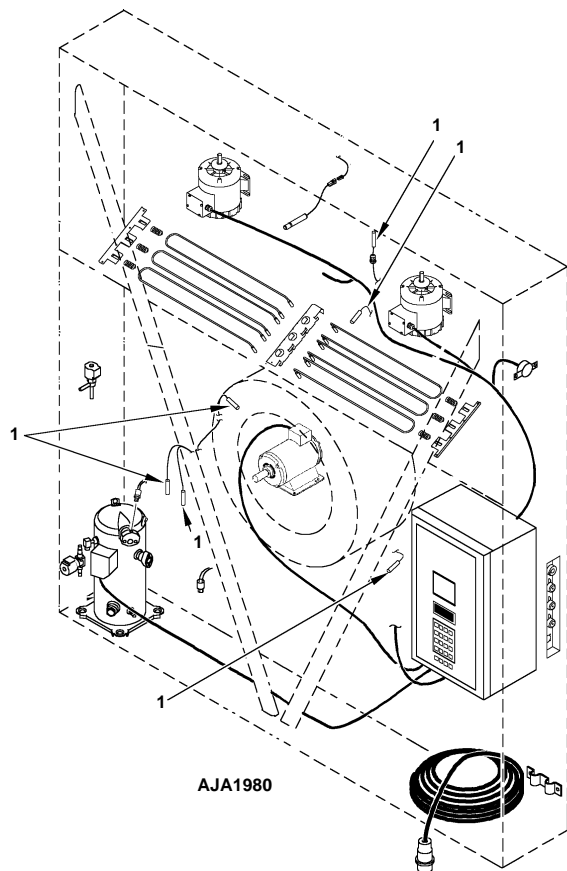
When the discharge gas temperature decreases to 132 C (270 F), the vapor injection will be turned off unless it is required to be on for other reasons.

The controller immediately stops unit operation if the discharge gas temperature increases to 148 C (298 F). The controller activates the Alarm LED 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 relay board.
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 relay board.



**Figure 70: 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, Left Hand
- Supply Air, Right Hand
- 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.
- Left hand supply sensor installs in the sensor tube on the left side of the RH sensor tube.
- Right hand supply sensor installed in the sensor tube on the right side of the LH sensor tube.
- 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

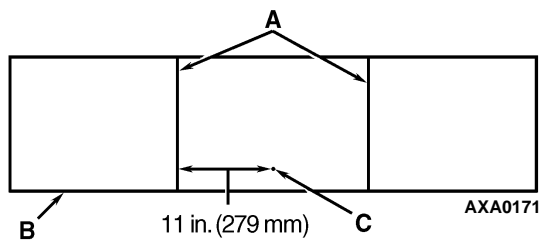
The controller constantly monitors the left hand and right hand supply sensors, return sensor and defrost (evaporator coil) sensor to determine when to initiate a demand defrost. If a demand defrost is requested and defrost has occurred within the last 90 minutes, the controller initiates a probe test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

During a Probe test, the LCD 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 LCD display shows [RUNNING WITH HIGH SUPPLY DIFFERENCE] message.

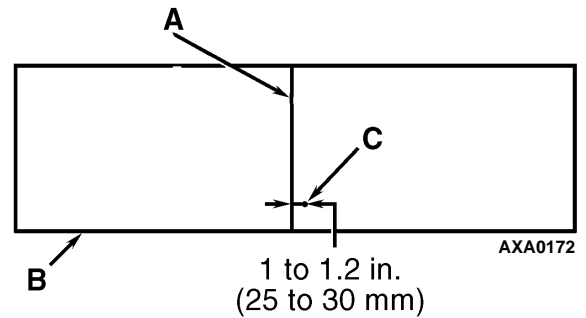
Sensor errors recorded during a probe test are cleared when the next Defrost is initiated or Unit On/Off switch is turned Off.

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



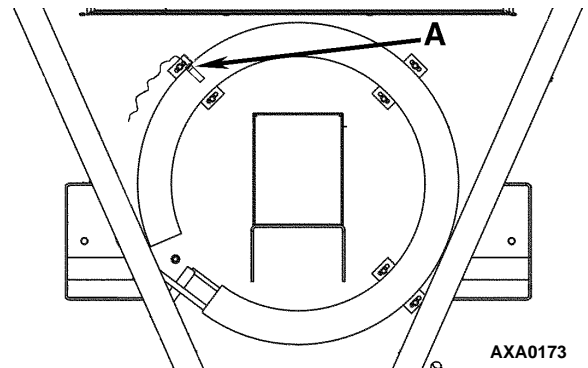
A.	Coil Support Brackets
B.	Unit Front
C.	Insert Sensor at least 75 mm into coil between Tube Rows 2 and 3.

**Figure 71: MAGNUM 20 Evaporator Coil (Defrost) Sensor Location**



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

**Figure 72: MAGNUM and MAGNUM SL Evaporator Coil (Defrost) Sensor Location**



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

**Figure 73: 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.

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

Temp. F	Temp. C	Ohms	Temp. F	Temp. C	Ohms
-40	-40	42,618	53.6	12	3,360
-31	-35	32,198	57.2	14	3,094
-22	-30	24,532	60.8	16	2,852
-13	-25	18,850	64.4	18	2,632
-4	-20	14,618	68	20	2,431
5	-15	11,383	71.6	22	2,347
10.4	-12	9,838	75.2	24	2,079
14	-10	8,941	78.8	26	1,925
17.6	-8	8,132	82.4	28	1,785
21.2	-6	7,406	86	30	1,657
24.8	-4	6,752	89.6	32	1,539
28.4	-2	6,164	93.2	34	1,430
32	0	5,634	96.8	36	1,330
35.6	2	5,155	100.4	38	1,239
39.2	4	4,721	104	40	1,154
42.8	6	4,329	107.6	42	1,076
46.4	8	3,907	111.2	44	1,004
50	10	3,652	113	45	970

**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.

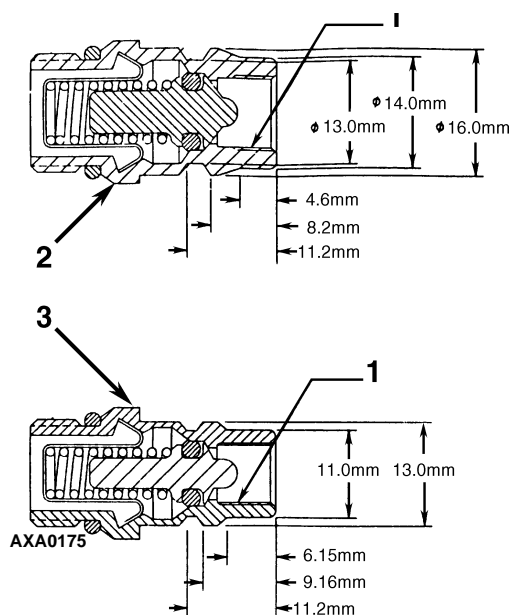
## Detecting Leaks

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 74: 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

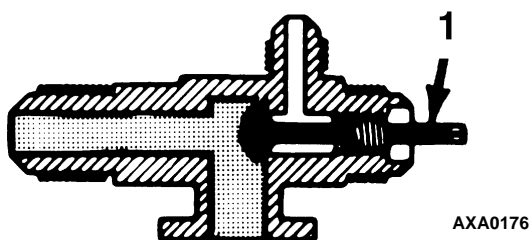
The discharge suction and digital ball service valves isolate the compressor from the high and low sides of the refrigeration system. compressor isolation is needed for system diagnosis, service and repair.

**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.

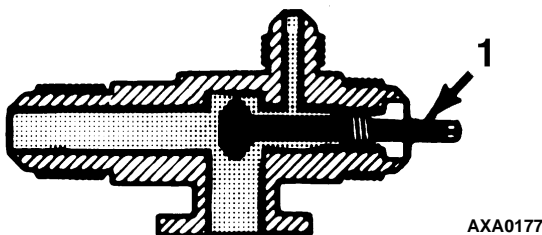


**WARNING:** Do not start unit with discharge valve in Front Seated position.



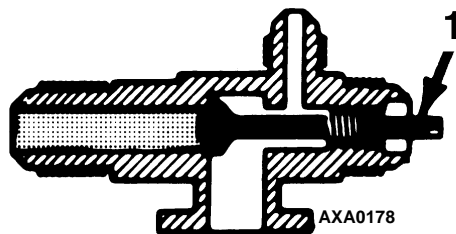
1. Full Counterclockwise

Figure 75: Service Valve Back Seated



1. 1/2 Turn in

Figure 76: Service Valve Open to Port



1. Full Clockwise

Figure 77: Service Valve Front Seated

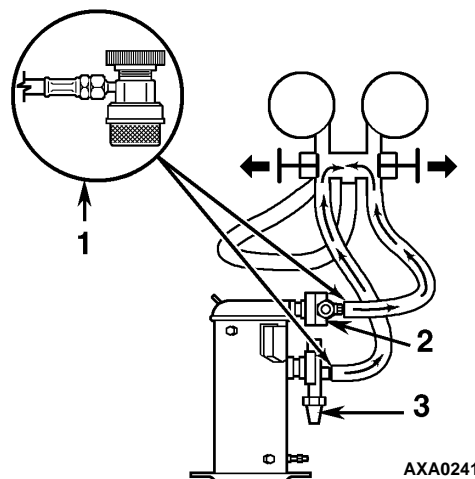
## Working with a Gauge Manifold

### 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.

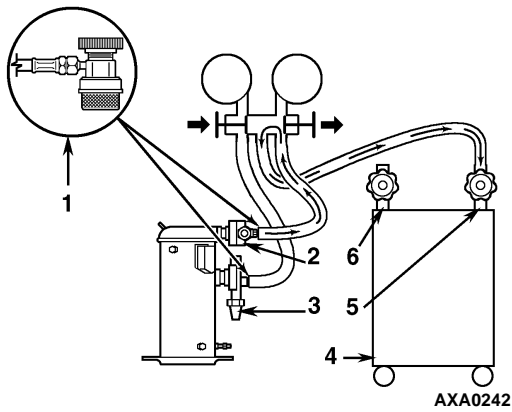
### Gauge Manifold Valve Positions

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



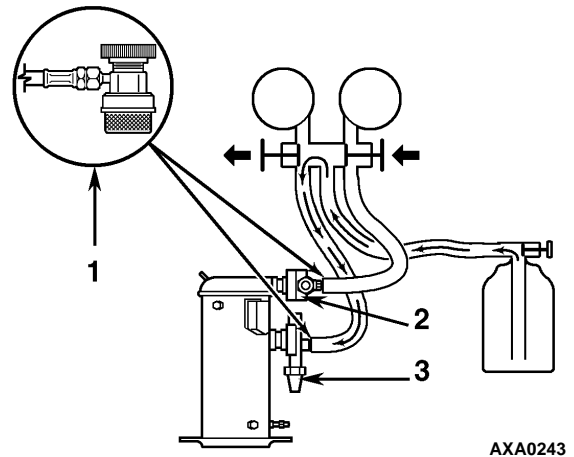
1.	Quick Disconnect Access Valve
2.	Discharge Service Valve (DSV)
3.	Suction Service Valve (SSV)

Figure 78: 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 79: Removing Refrigerant



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

Figure 82: 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.

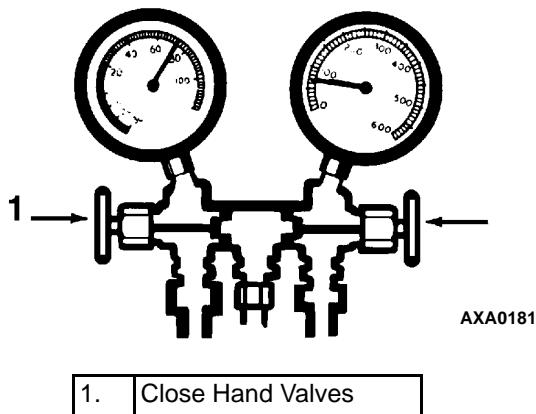


Figure 80: Gauge Manifold Closed to Center Port

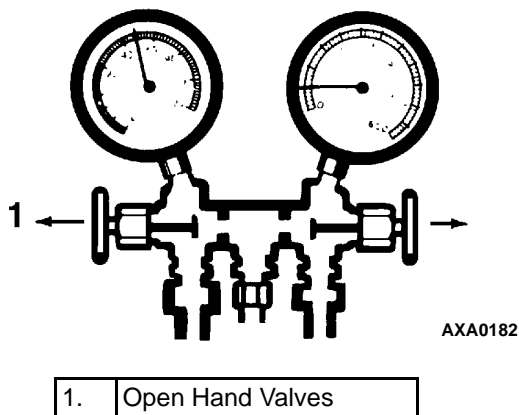


Figure 81: Gauge Manifold Open to Center Port

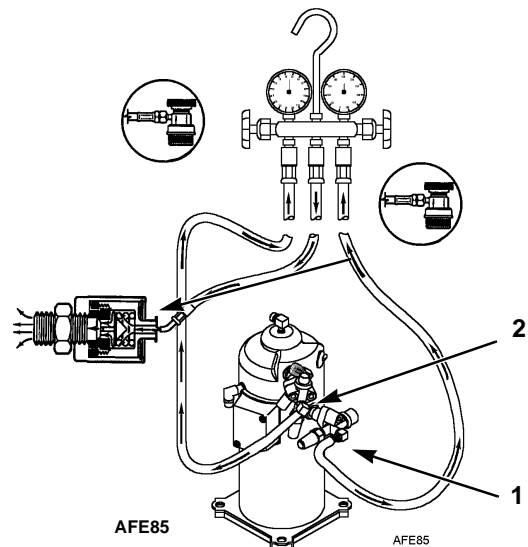
## Gauge Manifold Set Installation

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 83: 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.



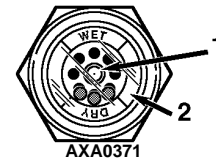
**CAUTION:** When adjusting the controller setpoint to check refrigerant charge, be sure to return controller to the setpoint indicated on the shipping manifest.

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 84: 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.

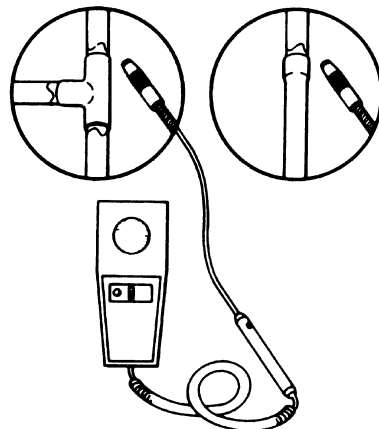
**NOTE: Due to environmental concerns and personal safety, the use of a Halide torch is no longer recommended.**

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.

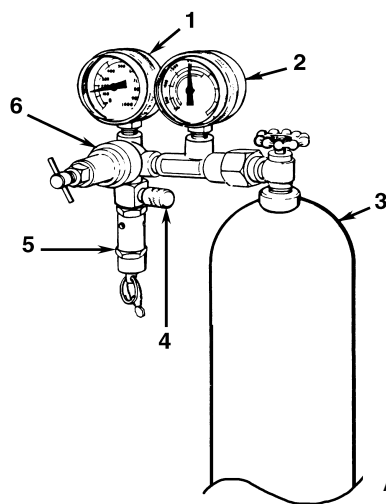


AXA0186

Figure 85: 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.



AXA0194

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

Figure 86: 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.

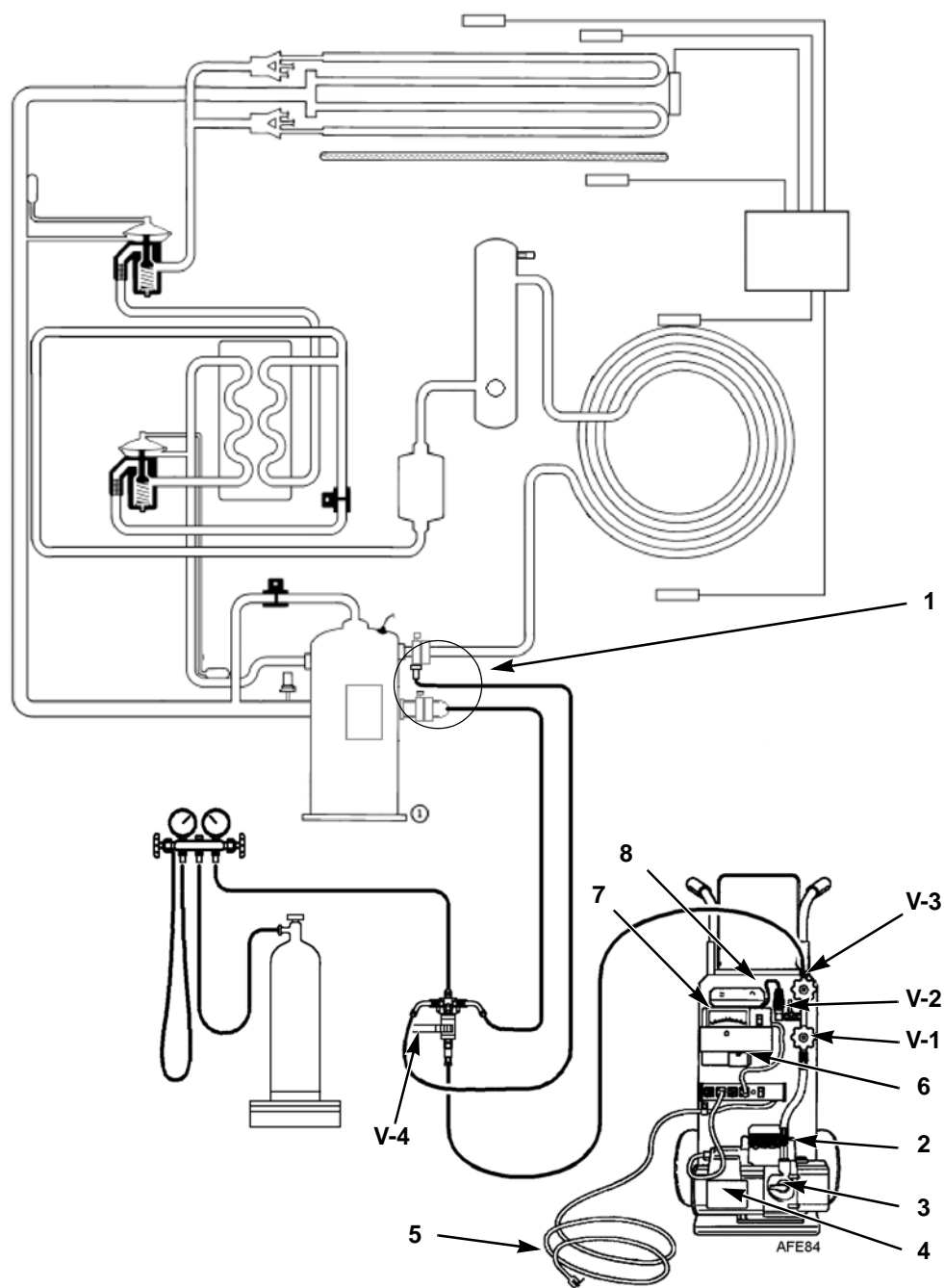
## Purge High Side to Low Side

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 87: 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 87 on page 136. 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.
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”.

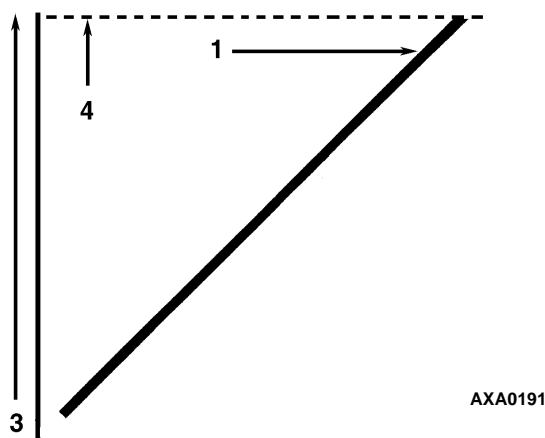
When the meter has stabilized, the value indicated on the micron meter is the equilibrium pressure. This reading must be 2000 microns or less.

***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.***

## Pressure Rise Test

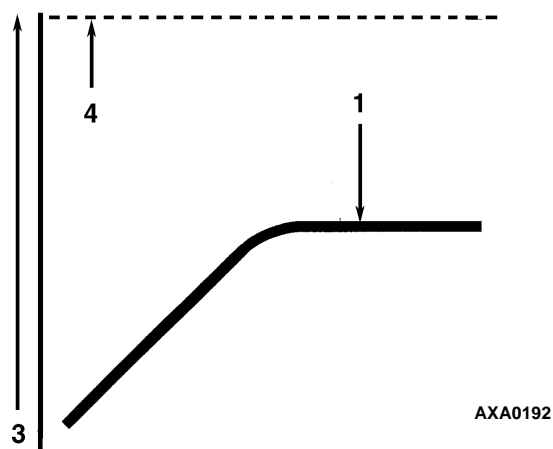
Evacuate the system and close valve V1. With valves V3 and V4 open, the pump is isolated and the system is held under a vacuum. If the micron meter rises, one of the following conditions exist:

- **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 89 “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 88: 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 89: 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.

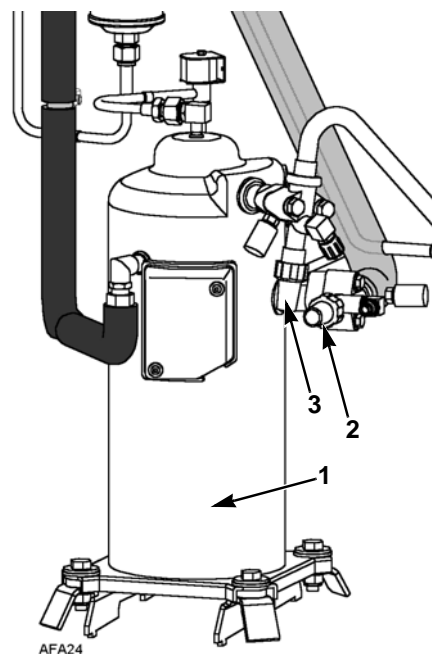
See “Isolate the Compressor” on page 130. for additional information.

3. Recover the refrigerant charge from the compressor. (see “Recovering Refrigerant from the System” on page 137).
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 90: 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.

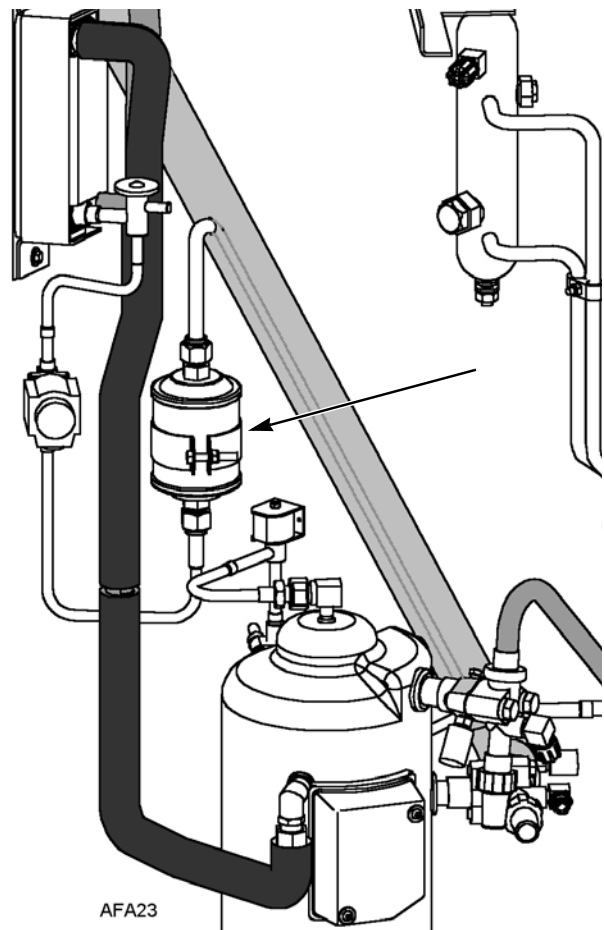


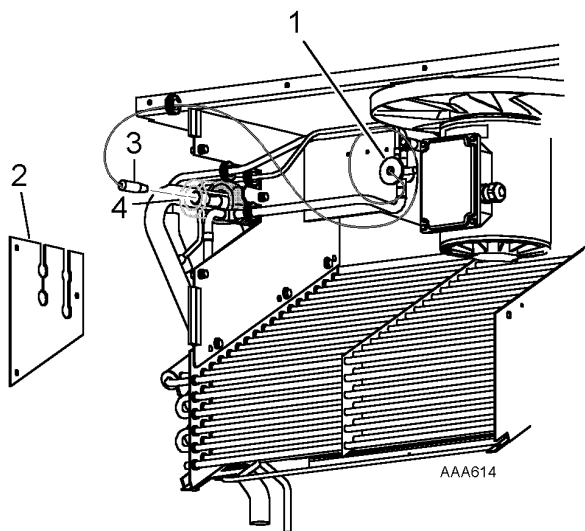
Figure 91: Filter Drier



## 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 92: TXV Valve and Element Location**

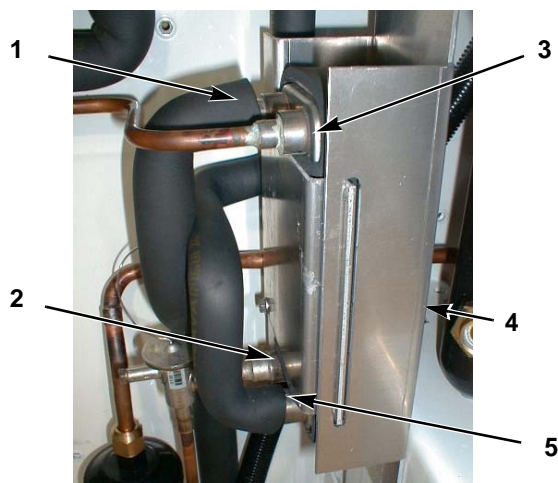
7. Cut the one ty band off the insulation around the element. Peel back the insulation to expose the clamp holding the element. Loosen the clamp and remove the element from the tube.
8. Unsolder the three tubes to the TXV and remove the valve from the unit.
9. Prepare the tubes in the unit and on the 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 137).
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.

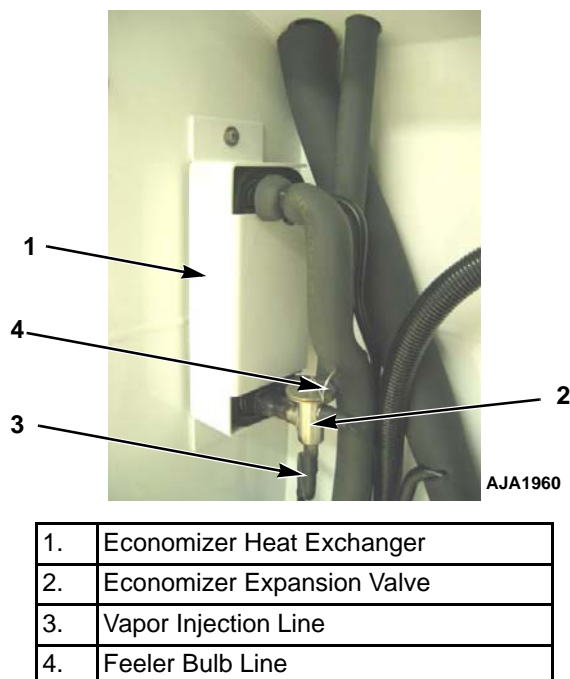


1.	Liquid Line
2.	Liquid Line
3.	Suction Line
4.	Unbolt Heat Exchanger Behind Bracket
5.	Suction Line

**Figure 93: Economizer Heat Exchanger (Before January 2003)**

### 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.



**Figure 94: Economizer Expansion Valve and Heat Exchanger (After January 2003)**

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 137).
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.

**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).*

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.

## 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.

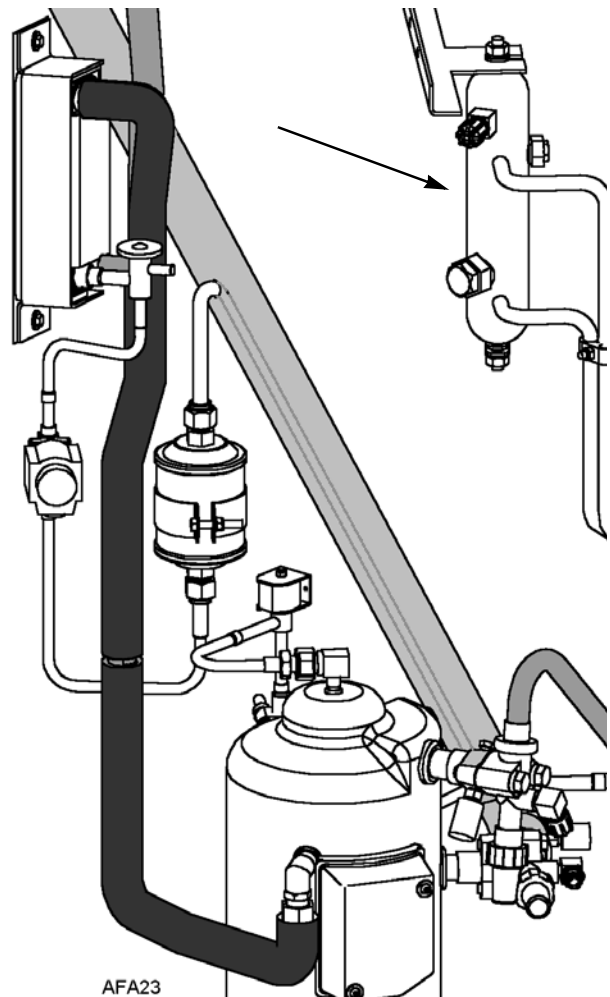


Figure 95: Receiver Tank

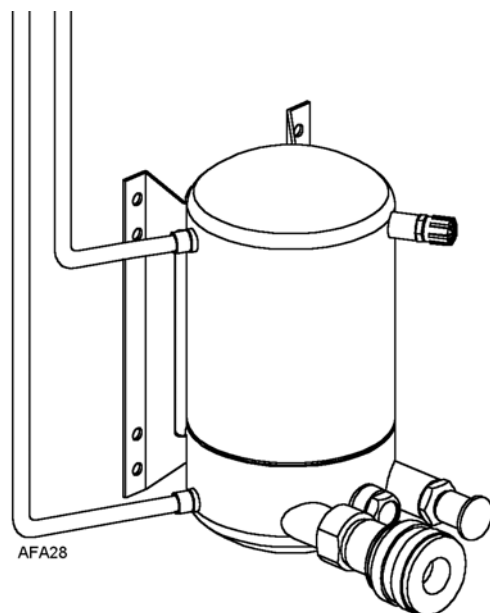


Figure 96: Water-Cooled Condenser Tank

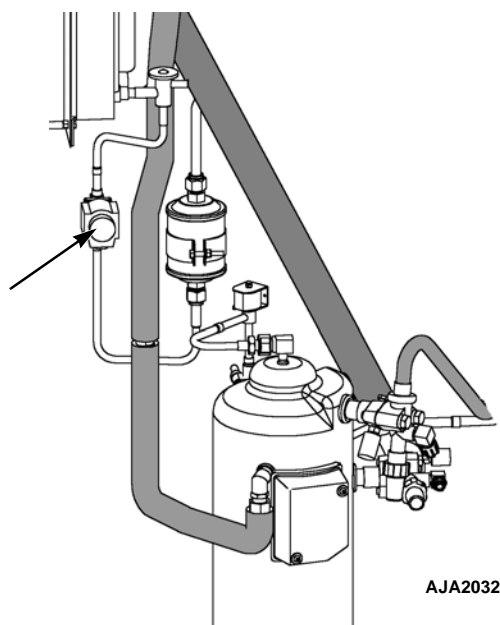


Figure 97: Vapor Injection Valve

## 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.

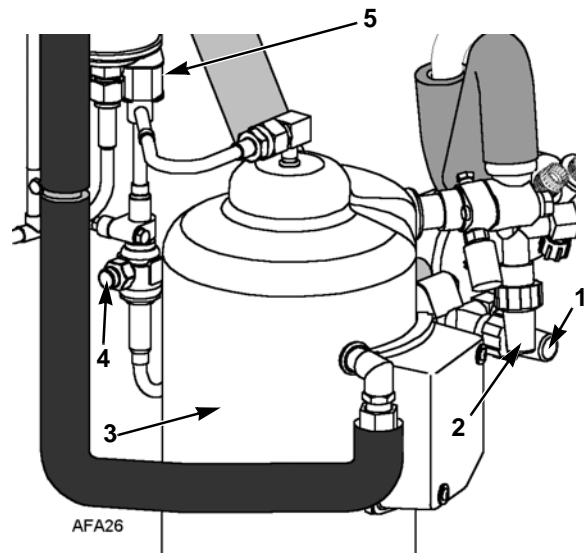
**NOTE:** In most cases, only the coil requires replacement. No other repair is possible on solenoid valves.

## 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.



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

**Figure 98: Digital Control Valve**

### 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.

# Servicing The Unit

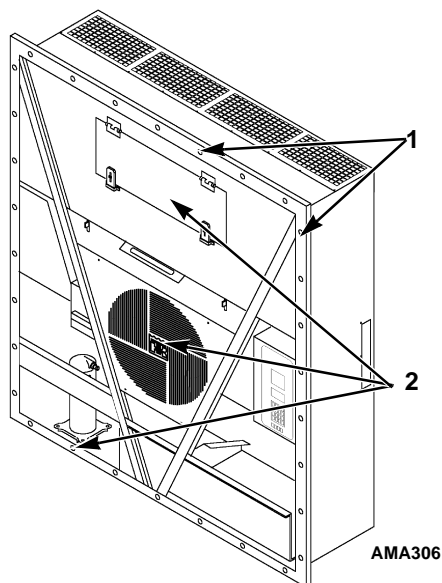
## Taking Care of the Structure

### 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 99: 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.



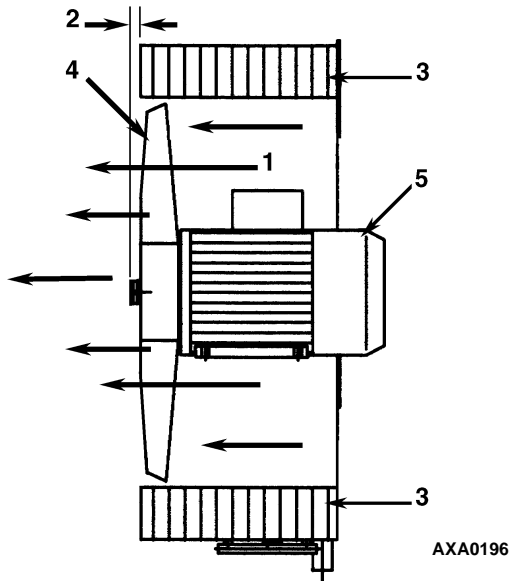
**CAUTION:** Air pressure must not be high enough to damage coil fins

## 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.

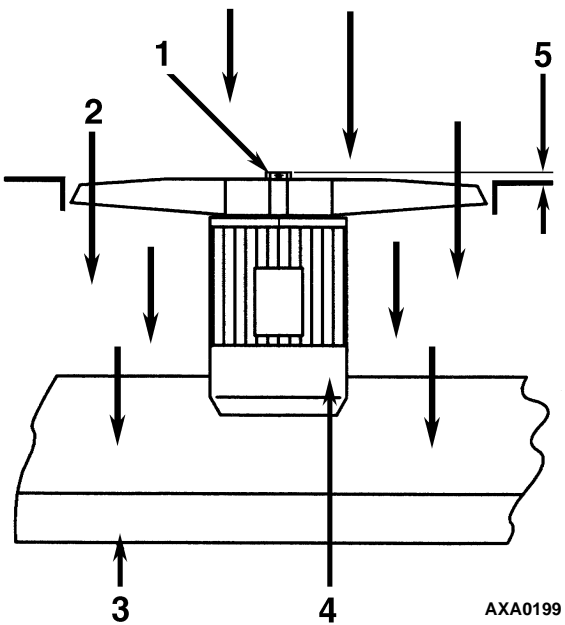


1.	Airflow Direction
2.	10 mm (0.4 in.)
3.	Condenser Coil
4.	Condenser Fan Blade
5.	Condenser Motor

Figure 100: 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 101: 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, see Figure 102 on page 153.
- 2. Rotate the disk to set the Indicator at the air exchange rate shown on the ventilation scale on the door:



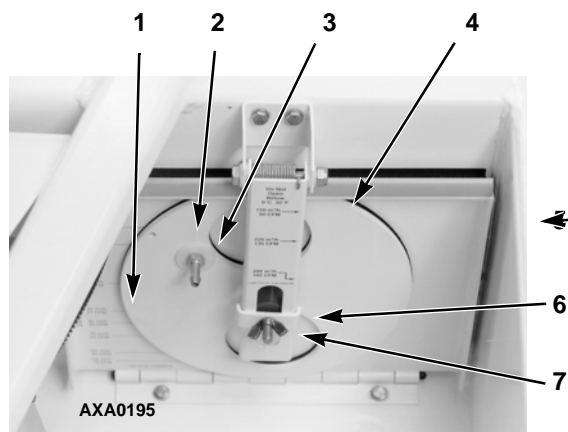
- MAGNUM 20 Model: 0 to 160 m<sup>3</sup>/hr. (0 and 96 ft<sup>3</sup>/min.).
- MAGNUM SL and MAGNUM Models: 0 to 125 m<sup>3</sup>/hr. (0 and 75 ft<sup>3</sup>/min.).

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:
  - MAGNUM SL and MAGNUM Models: 150, 225 and 280 m<sup>3</sup>/hr. (90, 135 and 165 ft<sup>3</sup>/min.).



1.	Disk Scale: Low Ventilation Rates
2.	Disk Assembly with Rate Indicator
3.	CO <sub>2</sub> Port
4.	Ventilation Door
5.	Handle Assembly with Scale: High Ventilation Rates (MAGNUM SL & MAGNUM Models Only)
6.	Handle Bracket
7.	Wing Nut

**Figure 102: Air Exchange System**



# Diagnosis: Troubleshooting, Status Messages, Alarm Codes

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## Introduction

This chapter includes the following:

- Introduction to Controller Diagnostics
- Troubleshooting charts
- Status Messages chart
- Alarm Codes chart

The charts will help you identify and fix unit problems.

## Controller Diagnostics

The MP3000a can be a very helpful diagnostic tool.

The following menu areas of the MP3000a controller menu will help you diagnose problems occurring with the Magnum unit.

**Alarms Menu:** The Alarm List menu displays alarm codes. Alarm 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. Refer to the Alarms Menu in the Operating Instructions Section.

**Brief PTI Test:** The MP-3000a 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. Refer to the Brief PTI Test in the Operating Instructions Section.

**Full PTI Test:** The MP-3000a 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. Refer to the Full PTI Test Menu in the Operating Instructions Section.

**Functions Test:** The MP-3000a 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
<b>Compressor does not operate—no amperage draw</b>	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 contactor, motor terminals, motor
	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 main relay board 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.
<b>Compressor does not operate—excessive amperage draw or intermittent cycling on overload</b>	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)

<b>Condition</b>	<b>Possible Cause</b>	<b>Remedy</b>
<b>Compressor contactor burned out</b>	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
<b>Unit short cycles</b>	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)
<b>Noisy compressor</b>	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
<b>Condenser fan motor does not operate</b>	Unit in Heat or Defrost	Check indicator lights. If unit is in Heat or Defrost, unit operation is normal (no remedy required)
	Unit in Cool with Low condenser temperature	Check indicator lights 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
	Defective condenser fan contactor	Replace defective contactor
	No condenser fan output signal from controller	Diagnose and replace condenser fan relay, main relay board or controller

Condition	Possible Cause	Remedy
<b>Evaporator fan motor(s) does not operate</b>	Unit on defrost	Check operating mode indicator LEDs
	Unit in Economy mode (Frozen Load; Null mode <i>only</i> )	Check setpoint, indicator lights and Configuration menu of MP-3000a controller to verify that Economy mode is set to On
	Loose line connection	Tighten connections
	Open motor internal thermal overload protector	Check for seized bearings or defective thermal overload protector. Repair or replace as necessary
	Defective motor	Replace motor
	Defective low or high speed evaporator fan contactor	Replace defective contactor
	No low or high speed evaporator fan output signal from controller output module	Diagnose and replace output module or controller

## Troubleshooting Refrigeration Problems

Condition	Possible Cause	Remedy
<b>Load temperature too high—unit not cooling</b>	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
<b>Head pressure too low</b>  <i>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).</i>	Shortage of refrigerant	Repair leak and recharge
	Low ambient air temperature	No remedy
	Service gauge out of calibration	Replace gauge

<b>Condition</b>	<b>Possible Cause</b>	<b>Remedy</b>
<b>Head pressure too high</b>	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
<b>Compressor loses oil</b>	Refrigerant leak	Repair leak and recharge
<b>Compressor oil migrates to system</b>	Short cycling	See "Unit Short Cycles" under "Mechanical Diagnosis"
<b>Rapid cycling between Cool, Null and Heat modes</b>	Air short cycling through evaporator	Check and correct cargo load
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Short cycling	See "Unit Short Cycles" under "Mechanical Diagnosis"
	Compressor Digital Control valve stuck close or defective	Replace valve
<b>Hot liquid line</b>	Shortage of refrigerant	Repair or recharge
	Expansion valve open too wide	Adjust or replace expansion valve
<b>Frosted liquid line</b>	Liquid line restricted	Remove restriction
	Restricted filter drier	Replace filter drier
<b>Frosted or sweating suction line</b>	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"
<b>Unit in vacuum—frost on expansion valve only</b>	Ice plugging expansion valve screen or orifice	Apply hot wet cloth to expansion valve. Moisture indicated by increase in suction pressure. Replace filter drier
<b>High suction pressure</b>	Overcharge of refrigerant	Purge system
	Expansion valve open too much	Adjust or replace valve
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Service gauge out of calibration	Adjust or replace service gauge



Condition	Possible Cause	Remedy
<b>Low suction pressure</b> <i>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).</i>	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 main relay board	Diagnose main relay board and controller. Replace defective component
	Service gauge out of calibration	Adjust or replace gauge

## Status Messages and Controller Actions

The controller displays status messages (In the Miscellaneous Function Menu under Status) on the LCD display for several general faults. More

than one status message may appear at a time. Press the **F2** or **F3** key to scroll through message displays.

### Status Messages and Controller Actions

Message No.	Status Message	Controller Action
1	<b>Power Error, Check 20A Fuses</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>One or more phases are missing</li> <li>Compressor is able to draw amps on all phases while heater lacks amps on one or more phases.</li> </ul>	<ul style="list-style-type: none"> <li>Controller activates Alarm 18</li> <li>Controller will try to restart unit after 60 minutes.</li> </ul>
2	<b>High Pressure Cutout, Check Water Cooling</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Unit stops due to high pressure cutout and water pressure switch is open.</li> </ul>	<ul style="list-style-type: none"> <li>Controller clears message on compressor start-up.</li> <li>No alarm is set until Controller determines that unit current draw is too low (Alarm Code 37) or supply air temperature is too high (Alarm Code 41).</li> </ul>
3	<b>Probe Test, Please Wait</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Incorrect temperature difference between Supply-LH, Supply-RH, or Return Air Sensor for 10 minutes with evaporator fan amps OK.</li> </ul>	<ul style="list-style-type: none"> <li>Controller automatically activates probe test to check for a defective sensor. Message clears when test is complete.</li> <li>Controller displays new message if test indicates a sensor is defective.</li> </ul>
4	<b>Supply-Right Hand Problem, Sensor Disabled</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Controller disables sensor due to open or short circuit or sensor failed a Probe Test.</li> </ul>	<ul style="list-style-type: none"> <li>Controller activates Alarm Code 52</li> <li>Controller activates Alarm Code 00 or 01, depending on type of sensor failure.</li> <li>Controller clears message during Defrost mode and when Unit On/Off switch is turned Off.</li> <li>Controller uses left hand supply sensor to control unit if right hand sensor is defective.</li> <li>Controller uses return sensor plus an offset to control unit if both supply sensors are defective.</li> </ul>
5	<b>Supply-Left Hand Problem, Sensor Disabled</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Controller disables sensor due to open or short circuit or sensor failed a Probe Test.</li> </ul>	<ul style="list-style-type: none"> <li>Controller activates Alarm Code 52</li> <li>Controller activates Alarm Code 00 or 01, depending on type of sensor failure.</li> <li>Controller clears message during Defrost mode and when Unit On/Off switch is turned Off.</li> <li>Controller uses right hand supply sensor to control unit if left hand sensor is defective.</li> <li>Controller uses return sensor plus an offset to control unit if both supply sensors are defective.</li> </ul>
7	<b>High Pressure Cutout, Check Condenser Probe</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Units stops due to high pressure cutout, water pressure switch is closed and condenser temperature is low.</li> </ul>	<ul style="list-style-type: none"> <li>Controller clears message on compressor start-up.</li> <li>No alarm is set until Controller determines that unit current draw is too low (Alarm Code 37) or supply air temperature is too high (Alarm Code 41).</li> </ul>

## Status Messages and Controller Actions (Continued)

Message No.	Status Message	Controller Action
8	<b>Running with High Supply Difference</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Temperature difference between the left hand and right hand Supply sensors is too large; even after Probe Test indicates no sensor errors.</li> <li>Possible causes include air leak around sensor cable, low refrigerant charge, defective expansion valve, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Controller clears message during defrost and when Unit On/Off switch is turned Off.</li> </ul>
9	<b>High Pressure Cutout, Check Condenser Fan</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Unit stops due to high pressure cutout, water pressure switch is closed and condenser temperature is high.</li> </ul>	<ul style="list-style-type: none"> <li>Controller clears message on compressor start-up.</li> <li>No alarm is set until Controller determines that unit current draw is too low (Alarm Code 37) or supply air temperature is too high (Alarm Code 41).</li> </ul>
10	<b>Condenser Probe Found, Please Change Type</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Controller is set for CRR40 DF and start-up is initiated on a KVQ/CRR40, MAGNUM or CSR40 unit. Correct by turning Unit On/Off switch Off. Then set Controller Software switch to correct position.</li> </ul>	<ul style="list-style-type: none"> <li>None. On CRR40 DF units, condenser sensor input must be left open.</li> </ul>
11	<b>Scroll Compressor, High Temperature</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Compressor stops because discharge temperature is above 148 C (300 F). Message remains in display until discharge temperature decreases to normal.</li> </ul>	<ul style="list-style-type: none"> <li>Controller clears message after compressor start-up.</li> </ul>
12	<b>Scroll Compressor, Low Pressure</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Low pressure cutout switch is open.</li> <li>Possible causes include stepper motor valve will not open, warm gas bypass valve will not open, low refrigerant charge, defective low pressure cutout switch, open circuit, block TXV or suction line restriction etc.</li> </ul>	<ul style="list-style-type: none"> <li>Controller activates Alarm Code 31 after 5 minutes.</li> <li>Controller clears message after compressor start-up.</li> </ul>
14	<b>Evaporator High Temperature Switch Open</b> <b>Indicates:</b> <ul style="list-style-type: none"> <li>Controller disables electric heaters due to open high temperature switch circuit.</li> <li>Possible causes include evaporator temperature over 54 C (130 F), defective heater, defective evaporator overheat switch, open circuit, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Controller clears message on compressor start-up.</li> <li>No alarm is set until Controller determines that heater current draw is too high (Alarm Code 10), unit current draw is too high (Alarm Code 36), or defrost time is too long (Alarm Code 20).</li> </ul>

## Status Messages and Controller Actions (Continued)

Message No.	Status Message	Controller Action
21	<b>Total Current Too High (Check Alarm)</b> <ul style="list-style-type: none"> <li>When the unit or component current draw is 25 percent above expected amps for 4 minutes.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Digital Control valve malfunction</li> <li>Compressor, evaporator fan motor, condenser fan motor or heater current too high</li> <li>Defective volt or amp meter on relay board</li> <li>Power supply voltage too low</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Enter Manual Function Test menu and test (operate) each component. Check volts and amps to determine which component has high amp draw.</li> <li>Check power supply volts.</li> <li>Check volt and ampere meter.</li> </ul>
22	<b>Total Current Too Low (Check Alarm)</b> <ul style="list-style-type: none"> <li>Compressor Start-up: Unit or component current draw is 50 percent below expected amps for 4 minutes.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective or open fuse CB 7A</li> <li>Defective or open high pressure cutout switch</li> <li>Defective evaporator high temperature protection switch</li> <li>Defective or open motor internal high temperature protection switch</li> <li>Unit on water-cooled condensing with no water flow</li> <li>Defective condenser coil sensor or sensor location</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check LCD display for High Pressure Cutout message.</li> <li>Enter Manual Function Test menu and test (operate) each component. Check volts and amps to determine which component has low amp draw.</li> <li>Check volt and ampere meter.</li> </ul>
23	<b>Supply Air Temperature Too High (Check Alarm)</b> <ul style="list-style-type: none"> <li>During Chill or Frozen Mode: Supply air temperature is too high compared to return air temperature under operating conditions.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Low refrigerant charge</li> <li>Incorrect connection or location of supply or return air sensor</li> <li>Air leakage at supply air sensor cable</li> <li>Ice or frost on evaporator coil</li> <li>Incorrect evaporator fan operation</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check discharge and suction pressure gauge readings and refrigerant charge.</li> <li>Check for sensor or evaporator fan alarm codes.</li> <li>Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan motor rotation and operation.</li> <li>Check supply and return sensor connections and locations.</li> </ul>

## Status Messages and Controller Actions (Continued)

Message No.	Status Message	Controller Action
24	<b>Supply Air Temperature Too Low (Check Alarm)</b> <ul style="list-style-type: none"> <li>During Chill or Frozen Mode: Supply air temperature is too low compared to return air temperature under operating conditions.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Ice or frost on evaporator coil</li> <li>Low heating capacity</li> <li>Incorrect evaporator fan operation</li> <li>Incorrect connection or location of supply or return air sensors</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check for sensor or evaporator fan alarm codes.</li> <li>Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan motor rotation and operation.</li> <li>Check supply and return sensor connections and locations.</li> </ul>
25	<b>Return Air Temperature Too High (Check Alarm)</b> <ul style="list-style-type: none"> <li>During Defrost: Return air temperature increases above 40 C (104 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective return or evaporator coil sensor</li> <li>Return and evaporator coil sensor connections are reversed</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check for sensor alarm codes.</li> <li>Check supply and return sensor connections and locations.</li> </ul>
26	<b>Evaporator Coil Temperature Too High (Check Alarm)</b> <ul style="list-style-type: none"> <li>During Chill or Frozen Mode: Evaporator coil temperature is too high compared to return air temperature under operating conditions.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Low refrigerant charge.</li> <li>Defective evaporator coil or return air sensor</li> <li>Incorrect connection or location of evaporator coil or return air sensor</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check for sensor alarm codes.</li> <li>Check discharge and suction pressure gauge readings and check refrigerant charge.</li> <li>Check evaporator coil and return air sensor connections and locations.</li> </ul>
27	<b>Evaporator Coil Temperature Too Low (Check Alarm)</b> <ul style="list-style-type: none"> <li>During Chill or Frozen Mode: Evaporator coil temperature is too low compared to return air temperature under actual operating conditions.</li> <li>Controller initiates defrost if no recent defrost.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Airflow is blocked in the container</li> <li>Evaporator fans do not operate</li> <li>Fresh air exchange vent open too much on frozen load</li> <li>Defective evaporator coil or return air sensor</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check for sensor or evaporator fan alarm codes.</li> <li>Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan rotation and operation.</li> <li>Inspect return air grille and cargo load. Remove any debris or cargo from blocking return air grille.</li> <li>At setpoints below 5 C (41 F), maximum air vent setting is not allowed.</li> <li>Check evaporator coil and return air sensor connections and locations.</li> </ul>

## Alarm Codes, Descriptions and Corrective Actions

**NOTE:** Sensors used with the MP-3000a 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	<b>Supply Air Sensor Open Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is higher than 100,000 ohms.</li> <li>• When the temperature is below -70 C (-94 F).</li> <li>• Indicates: <ul style="list-style-type: none"> <li>• Open circuit to left or right hand sensor</li> <li>• Defective or wrong sensor</li> <li>• Defective relay board</li> <li>• Defective cable No. 1 or cable No. 3</li> <li>• Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Identify defective sensor (left hand or right hand) by viewing Data menu.</li> <li>• Check sensor resistance between pins 1 and 2 on plug J15 and between pins 7 and 8 on plug J14. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>• Check cable No. 1 and cable No. 3 between the controller and relay board.</li> <li>• Check evaporator airflow.</li> </ul>
01	<b>Supply Air Sensor Short Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is lower than 200 ohms.</li> <li>• When the temperature is above 80 C (176 F).</li> <li>• Indicates: <ul style="list-style-type: none"> <li>• Short circuit to left or right hand sensor Defective or wrong sensor Defective relay board</li> <li>• Defective cable No. 1 or cable No. 3</li> <li>• Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Identify defective sensor (left hand or right hand) by viewing Data menu.</li> <li>• Check sensor resistance between pins 1 and 2 on plug J15 and between pins 7 and 8 on plug J14. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>• Check cable No. 1 and cable No. 3 between the controller and relay board.</li> </ul>
02	<b>Return Air Sensor Open Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is higher than 100,000 ohms.</li> <li>• When the temperature is below -70 C (-94 F).</li> <li>• Indicates: <ul style="list-style-type: none"> <li>• Open circuit to sensor</li> <li>• Defective or wrong sensor</li> <li>• Defective relay board</li> <li>• Defective cable No. 1</li> <li>• Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check sensor resistance between pins 3 and 4 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>• Check cable No. 1 between controller and relay board.</li> </ul>

**Alarm Codes, Descriptions and Corrective Actions (Continued)**

<b>Code</b>	<b>Description</b>	<b>Corrective Action</b>
<b>03</b>	<b>Return Air Sensor Short Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>When the sensor circuit resistance is lower than 200 ohms.</li> <li>When the temperature is above 80 C (176 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Short circuit to sensor</li> <li>Defective or wrong sensor</li> <li>Defective relay board</li> <li>Defective cable No. 1</li> <li>Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor resistance between pins 3 and 4 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>Check cable No. 1 between controller and relay board.</li> </ul>
<b>04</b>	<b>Evaporator Coil Sensor Open Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>When the sensor circuit resistance is higher than 100,000 ohms.</li> <li>When the temperature is below -70 C (-94 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Open circuit to sensor Defective or wrong sensor</li> <li>Defective relay board</li> <li>Defective cable No. 1</li> <li>Defective controller</li> <li>Low evaporator coil temperature</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor resistance between pins 5 and 6 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>Check cable No. 1 between controller and relay board.</li> <li>Check evaporator airflow.</li> </ul>
<b>05</b>	<b>Evaporator Coil Sensor Short Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>When the sensor circuit resistance is lower than 200 ohms.</li> <li>When the temperature is above 80 C (176 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Short circuit to sensor</li> <li>Defective or wrong sensor</li> <li>Defective relay board</li> <li>Defective cable No. 1</li> <li>Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor resistance between pins 5 and 6 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>Check cable No. 1 between controller and relay board.</li> </ul>

## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
06*	<b>Compressor Current Too High (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>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.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective Digital Control valve</li> <li>Defective compressor</li> <li>Defective volt or amp meter on relay board</li> <li>Inaccurate ambient, condenser or evaporator temperature measurement</li> <li>Out of range power supply</li> <li>Excessive condenser pressure due to air or wrong refrigerant in system, or refrigerant over charge</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check evaporator, condenser and ambient sensor temperatures for correct value (<math>\pm 5\text{ C}</math> [<math>\pm 9\text{ F}</math>]) by viewing Data menu.</li> <li>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).</li> <li>Check volt and ampere meter.</li> <li>Check power supply volts.</li> </ul>
07*	<b>Compressor Current Too Low (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>Compressor power consumption is 25 percent below expected current draw (below approximately 9 amps).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective or open fuse CB 7A, high pressure cutout switch or connection in plug J19 between pins 7 &amp; 8</li> <li>No signal on plug J11 on pin 8</li> <li>Defective compressor relay</li> <li>Defective volt or amp meter on relay board</li> <li>Low refrigerant charge</li> <li>Defective compressor</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>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). If relay does <i>not</i> energize and the LED above the compressor relay is <i>not on</i>, check for a defective cable No. 2, main relay board or controller.</li> <li>Check discharge and suction pressure gauge readings. Evaluate readings based on current cargo and ambient temperatures.</li> <li>Check volt and ampere meter.</li> <li>Check power supply volts.</li> </ul>

\*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.



## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
10*	<b>Heater Current Too High (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>Heater power consumption is 25 percent above expected current draw (above approximately 4.4 amps and 5.1 amps, depending on voltage).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Incorrect heaters or heater connections</li> <li>Defective volt or amp meter on relay board</li> <li>Defective heater element</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>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).</li> <li>Check heater resistance between H1 and H2, H2 and H3, and H1 and H3. Resistance should be about 99 ohms on each leg.</li> </ul>
11*	<b>Heater Current Too Low (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>Heater power consumption is 25 percent pretrip below the expected current draw (below approximately 3.2 amps and 3.8 amps, depending on voltage).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective high evaporator temperature switch</li> <li>Defective heater element or heat relay</li> <li>Defective wire connection</li> <li>Incorrect heaters or heater connections</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>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).</li> <li>If heat relay fails to energize, check evaporator high temperature switch. Switch should be closed at temperatures below 54 C (130 F); there should be continuity between pins 5 and 6 in plug J19.</li> <li>Check cable No. 2 between controller and relay board.</li> <li>Check heater resistance between H1 and H2, H2 and H3, and H1 and H3. Resistance should be about 99 ohms on each leg.</li> <li>Check volt and ampere meter.</li> </ul>

\*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 between H1 and H2, H2 and H3, and H1 and H3. Resistance should be about 99 ohms on each leg.

12**	<b>Evaporator Fan High Speed Current Too High (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>When the evaporator fan power consumption is 25 percent above expected current draw (above 2.0 to 3.0 amps, depending on voltage)</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective or stuck evaporator fan motor</li> <li>Incorrect motor or motor connections</li> <li>Defective volt or amp meter on relay board</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Open evaporator door and make sure all fans rotate freely.</li> <li>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.</li> <li>Check volt and ampere meter.</li> </ul>
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\*\*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.

## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
13**	<b>Evaporator Fan High Speed Current Too Low (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI), function test or probe test.</li> <li>When the evaporator fan power consumption is 25 percent below expected current draw (below 1.6 to 2.4 amps, depending on voltage).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective evaporator fan motor relay</li> <li>Defective or open fan motor internal over temperature protection switch</li> <li>Defective volt or amp meter on relay board</li> <li>Incorrect motor or motor connections</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Open evaporator door and make sure all fans rotate freely.</li> <li>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.</li> <li>Check fan motor volts and amps.</li> <li>Check volt and ampere meter.</li> </ul>
14**	<b>Evaporator Fan Low Speed Current Too High (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>Evaporator fan power consumption is 25 percent above expected current draw (above 1.0 to 2.0 amps, depending on voltage).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective or stuck evaporator fan motor</li> <li>Incorrect motor or motor connections</li> <li>Motor high and low speed connection are interchanged</li> <li>Defective volt or amp meter on relay board</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Open evaporator door and make sure all fans rotate freely.</li> <li>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.</li> <li>Check volt and ampere meter.</li> </ul>
15**	<b>Evaporator Fan Low Speed Current Too Low (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>When the evaporator fan power consumption is 25 percent below expected current draw (below 0.6 to 1.2 amps, depending on voltage).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective evaporator fan motor relay</li> <li>Defective or open fan motor internal over temperature protection switch</li> <li>Defective volt or amp meter on relay board</li> <li>Incorrect motor or motor connections</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Open evaporator door and make sure all fans rotate freely.</li> <li>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.</li> <li>Check fan motor volts and amps.</li> <li>Check volt and ampere meter.</li> </ul>

\*\*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.

## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
16*	<b>Condenser Fan Current Too High (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>When the condenser fan power consumption is 25 percent above expected current draw (above 1.5 to 1.9 amps, depending on voltage).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective or stuck condenser fan motor</li> <li>Defective volt or amp meter on relay board</li> <li>Incorrect motor or motor connections</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Enter Manual Function Test and start condenser fan. Make sure the fan starts. Check fan motor volts and amps.</li> <li>Check power supply volts and amps.</li> <li>Check volt and ampere meter.</li> </ul>
17*	<b>Condenser Fan Current Too Low (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>Condenser fan power consumption is 25 percent below expected current draw (below 0.5 to 0.7 amps, depending on voltage).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective condenser fan motor relay</li> <li>Defective or open fan motor internal over temperature protection switch</li> <li>Defective volt or amp meter on relay board</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Enter Manual Function Test and start condenser fan. Make sure the fan starts. Check fan motor volts and amps.</li> <li>Check power supply volts and amps.</li> <li>Check volt and ampere meter.</li> </ul>
18	<b>Power Supply Phase Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>One or more frequency inputs are missing for more than 20 seconds.</li> <li>Indicates: <ul style="list-style-type: none"> <li>One phase on power line is missing</li> <li>Defective fuse on relay board</li> <li>Defective digital inputs on relay board</li> <li>Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Enter Data menu and view voltage reading on each phase.</li> <li>Check all fuses. Check cable No. 1 on relay board.</li> <li>Check cable No. 1 between controller and relay board.</li> <li>Replace relay board. Check voltage reading on each phase.</li> </ul>

\*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).

## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
19	<b>Temperature Too Far From Setpoint (Check Alarm)</b> <ul style="list-style-type: none"> <li>After 75 minutes of operation, supply or return air temperature is not in-range and does not approach setpoint within preset pull-down rate.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Ice or frost on evaporator coil</li> <li>Low refrigerant charge</li> <li>Air exchange vent open too much</li> <li>Container air leakage (doors open)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Press <b>SUP/RET</b> key to check supply and return air sensor temperatures. Compare temperatures to evaluate unit cooling capacity and performance.</li> <li>Temperature difference should be 4 C to 6 C (39 F - 43 F).</li> <li>Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary.</li> <li>Check refrigerant charge</li> </ul> <p><b>NOTE: This alarm can be activated if the supply or return air temperature varies, even if the mean temperature does approach setpoint.</b></p>
20	<b>Defrost Time Too Long (Check Alarm)</b> <ul style="list-style-type: none"> <li>Heat signal has been on for more than 90 minutes on 60 Hz power during Defrost (120 minutes on 50 Hz power).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Low power supply voltage</li> <li>Defective heater elements</li> <li>Defective evaporator high temperature protection switch</li> <li>Defective heat relay</li> <li>Evaporator fans running during defrost</li> <li>Evaporator sensor placed wrong</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Initiate a manual defrost and check amperage draw and evaporator coil temperature. Evaluate defrost performance.</li> <li>Open evaporator door and check location of evaporator coil sensor.</li> </ul> <p><b>NOTE: This alarm can be activated at low voltage and very low box temperature conditions, even under normal operating conditions.</b></p>

## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
22	<b>Capacity Test 1 Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only.</li> <li>Difference between supply and return air temperature is too small with high speed evaporator fans (less than approximately 4.5 C [8 F]).</li> <li>When the return air temperature does not reach -18 C (0 F) within preset time.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Incorrect location of supply or return air sensor</li> <li>Air leakage at supply sensor cable</li> <li>Defective supply or return air sensor</li> <li>Interchanged sensor connections</li> <li>Incorrect evaporator fan rotation or high speed operation</li> <li>Incorrect refrigeration system operation</li> <li>Container/side panels defective, damaged or leaking</li> <li>Economizer circuit defective</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>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).</li> </ul> <p><b>NOTE: This sensor check does not detect air leakage around the sensor cables.</b></p> <ul style="list-style-type: none"> <li>Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on low speed.</li> <li>Check the sensor connections.</li> <li>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.</li> </ul> <p><b>NOTE: This alarm can be activated in ambient temperatures below -10 C (14 F), even under normal conditions.</b></p>
25	<b>Evaporator Temperature Test Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only.</li> <li>Evaporator coil temperature is too high with no evaporator fans running (above about -15 C [+5 F]).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Evaporator coil sensor is not in contact with evaporator coil</li> <li>Return and evaporator coil sensor connections are interchanged</li> <li>Expansion valve does not open enough or opens too much</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check evaporator coil sensor location.</li> <li>Check evaporator coil sensor and return air sensor connections.</li> <li>Check expansion valve superheat setting.</li> </ul>
26	<b>Vapor Injection Valve Error</b> <ul style="list-style-type: none"> <li>Occurs during function test only</li> <li>Current consumption not correct for valve position</li> </ul>	<ul style="list-style-type: none"> <li>Check vapor valve function</li> </ul>

## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
27	<b>Heat Capacity Test Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only.</li> <li>Difference between supply and return air temperature is too small with high speed evaporator fans (less than 0.4 C [0.7 F]).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Incorrect location of supply or return air sensor</li> <li>Air leakage at supply, return or evaporator coil sensor cable</li> <li>Defective supply or return air sensor</li> <li>Interchanged sensor connections</li> <li>Defective heater elements</li> <li>Incorrect evaporator fan rotation or high speed operation</li> <li>Container/side panels defective, damaged or leaking</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>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).</li> </ul> <p><b>NOTE: This sensor check does not detect air leakage around the sensor cables.</b></p> <ul style="list-style-type: none"> <li>Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on high speed.</li> <li>Check the sensor connections.</li> </ul>
28	<b>Scroll Compressor, Low Pressure Indicates:</b> <ul style="list-style-type: none"> <li>Low pressure has occur from suction transducer sensor</li> <li>Possible causes include low refrigerant charge, defective pressure transducer, blocked TXV or suction line restriction etc.</li> </ul>	<ul style="list-style-type: none"> <li>Controller activates Alarm Code 31 after 5 min</li> <li>Controller clears message after compressor start-up</li> </ul>
31	<b>Low Pressure Cutout Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Low refrigerant charge</li> <li>Refrigeration system restriction at filter drier or expansion valve</li> <li>Defective low pressure cutout switch</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check discharge and suction pressure gauge readings: <ul style="list-style-type: none"> <li>If refrigerant pressures are low, check for a restriction and leak check the refrigeration system.</li> <li>If refrigerant pressures are high, check for a high refrigerant charge (see below).</li> </ul> </li> <li>Check for a restriction: <ul style="list-style-type: none"> <li>Check for frost on down stream side of the filter drier.</li> <li>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.</li> </ul> </li> <li>Continuity check low pressure cutout switch wiring using a high quality multimeter. Replace switch.</li> </ul>

**Alarm Codes, Descriptions and Corrective Actions (Continued)**

<b>Code</b>	<b>Description</b>	<b>Corrective Action</b>
<b>32</b>	<b>Condenser Temperature Sensor Open Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>When the sensor circuit resistance is higher than 100,000 ohms.</li> <li>When the temperature is below -70 C (-94 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Open circuit to sensor</li> <li>Defective or wrong sensor</li> <li>Defective relay board</li> <li>Defective cable No. 1</li> <li>Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor resistance between pins 7 and 8 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>Check cable No. 1 between controller and relay board.</li> </ul>
<b>33</b>	<b>Condenser Temperature Sensor Short Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>Sensor circuit resistance is lower than 200 ohms.</li> <li>Temperature is above 80 C (176 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Short circuit to sensor</li> <li>Defective or wrong sensor</li> <li>Defective relay board</li> <li>Defective cable No. 1</li> <li>Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor resistance between pins 7 and 8 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>Check cable No. 1 between controller and relay board.</li> </ul>
<b>34</b>	<b>Ambient Air Sensor Open Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only</li> <li>Sensor circuit resistance is higher than 100,000 ohms.</li> <li>Temperature is below -70 C (-94 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Open circuit to sensor</li> <li>Defective or wrong sensor</li> <li>Defective relay board</li> <li>Defective cable No. 1</li> <li>Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor resistance between pins 13 and 14 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>Check cable No. 1 between controller and relay board.</li> </ul>

## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
35	<b>Ambient Air Sensor Short Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only.</li> <li>Sensor circuit resistance is lower than 200 ohms.</li> <li>Temperature is above 80 C (176 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Short circuit to sensor</li> <li>Defective or wrong sensor</li> <li>Defective relay board</li> <li>Defective cable No. 1</li> <li>Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor resistance between pins 13 and 14 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>Check cable No. 1 between controller and relay board.</li> </ul>
43	<b>Return Air temperature Too High (Check Alarm)</b> <ul style="list-style-type: none"> <li>During defrost: Return air temperature increases above 40 C (104 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective return or evaporator coil sensor.</li> </ul> </li> <li>Return and evaporator coil sensor connections are reversed.</li> </ul>	<ul style="list-style-type: none"> <li>Check for sensor alarm codes.</li> <li>Check supply and return sensor connections and locations.</li> </ul>
51	<b>Low Supply Voltage (Check Alarm)</b> <ul style="list-style-type: none"> <li>Alarm occurs if line voltage is below 350 volts for 30 minutes <ul style="list-style-type: none"> <li>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.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check line voltage of power source. Refer to the electrical specifications in the Specifications Section for correct power source requirements.</li> </ul>
53	<b>High Pressure Cutout Switch Off Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only.</li> <li>Compressor does not stop during high pressure cutout switch test.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Faulty compressor contactor or control circuit</li> <li>Low refrigerant charge</li> <li>Defective high pressure cutout switch</li> <li>Strong winds causing cooling of condenser coil in low ambient conditions</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check discharge and suction pressure gauge readings and check refrigerant charge.</li> <li>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).</li> </ul>



## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
54	<b>High Pressure Cutout Switch On Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only.</li> <li>Compressor does not start within normal time during high pressure cutout switch test.</li> <li>Indicates: <ul style="list-style-type: none"> <li>High pressure cutout switch did not respond to pressure change within 5 seconds</li> <li>Air in refrigeration system</li> <li>Defective high pressure cutout switch</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check discharge and suction pressure gauge readings.</li> <li>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)</li> </ul>
56	<b>Compressor Temperature Too High (Shutdown Alarm)</b> <ul style="list-style-type: none"> <li>Compressor discharge line temperature is above 148 C (298 F). Compressor stopped until discharge line temperature decreases to normal.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Air in refrigeration system</li> <li>Low refrigerant charge</li> <li>Defective compressor or valve plate</li> <li>Defective liquid injection system</li> <li>Wrong or defective sensor</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Operate unit on Cool and check discharge and suction pressure gauge readings.</li> <li>Enter Manual Function Test menu and test (operate) Injection Valve to determine if valve opens (energizes).</li> <li>Check compressor discharge sensor resistance. Resistance must be 100,000 ohms at 25 C (77 F).</li> <li>Check discharge line temperature with a separate electronic thermometer and compare to "HIGH PR TEMP" shown in the Data menu of controller.</li> </ul> <p><b>NOTE: Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.</b></p>
57	<b>AFAM Control Module or Motor Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Controller is unable to adjust vent door to desired position.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Frozen or stuck vent door</li> <li>Defective linkage</li> <li>Defective control module</li> <li>Open circuit to control module or motor</li> <li>Defective motor</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Visually inspect the vent door and linkage for ice or obstruction. Check for proper linkage adjustment.</li> <li>Check wiring connections to the AFAM circuit board for continuity using a high quality multimeter.</li> <li>Check motor winding for continuity using a high quality multimeter.</li> </ul>

## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
58	<b>Phase Sensor Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>During Phase Sensor Test, amperage difference between correct and wrong condenser fan rotation is more than 0.2 amps.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Defective phase relay</li> <li>Defective relay board</li> <li>Defective relay board cable No. 2</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Start a Function Test. During step F1.05, check whether the phase relays on relay board receive a signal (LED energizes). Verify that the relays respond and shift to reverse phase.</li> </ul>
59	<b>Delta Current Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>100 percent ampere difference between current phases.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Open connection on one phase of power supply to a motor or heater element</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Enter Manual Function Test menu and test (operate) each 3-phase component to locate defective connection.</li> </ul>
60	<b>Humidity Sensor Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only.</li> <li>Relative humidity reading is less than 20 percent.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Sensor disconnected</li> <li>Wrong controller software configuration</li> <li>Defective sensor</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor connections.</li> <li>Check controller configuration for correct humidity setting.</li> <li>Replace sensor.</li> </ul>
68	<b>AFAM Gas Analyzer Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Gas analyzer circuit resistance is too high or too low.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Sensor disconnected</li> <li>Wrong controller software configuration</li> <li>Short circuit to sensor</li> <li>Defective sensor</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor connections.</li> <li>Check controller configuration for correct AFAM setting.</li> <li>Replace sensor.</li> </ul>
69	<b>Gas Analyzer Calibration (Check Alarm)</b> <ul style="list-style-type: none"> <li>Indicates possible CO<sub>2</sub> failure.</li> </ul>	<ul style="list-style-type: none"> <li>Check sensor connections.</li> <li>Check controller configuration for correct AFAM setting.</li> <li>Replace sensor.</li> </ul>

## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
97	<b>Compressor Sensor Open Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>When the sensor circuit resistance is higher than 10,000,000 ohms.</li> <li>Temperature is below -30 C (-22 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Open circuit to sensor</li> <li>Defective or wrong sensor</li> <li>Defective relay board</li> <li>Defective cable No. 1</li> <li>Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor resistance between pins 9 and 10 on plug J15. Resistance must be 100,000 ohms at 25 C (77 F).</li> <li>Check cable No. 1 between controller and relay board.</li> </ul> <p><b>NOTE: Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.</b></p>
98	<b>Compressor Sensor Short Circuit (Check Alarm)</b> <ul style="list-style-type: none"> <li>Sensor circuit resistance lower than 200 ohms.</li> <li>Temperature above 180 C (356 F).</li> <li>Indicates: <ul style="list-style-type: none"> <li>Short circuit to sensor</li> <li>Defective or wrong sensor</li> <li>Defective relay board</li> <li>Defective cable No. 1</li> <li>Defective controller</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor resistance between pins 9 and 10 on plug J15. Resistance must be 100,000 ohms at 25 C (77 F).</li> <li>Check cable No. 1 between controller and relay board.</li> </ul>
115	<b>Probe Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test or probe test failed in Chilled mode.</li> <li>Temperature difference between return air and evaporator coil sensors is too high (1.5 C [2.7 F] difference maximum)</li> </ul>	<ul style="list-style-type: none"> <li>Check sensor connections. Check sensor resistance of each sensor. Resistance must be 2,000 ohms at 25 C (77 F).</li> </ul>
116	<b>Probe Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test or probe test failed in Chilled mode.</li> <li>Temperature difference between return air and supply air sensors is too high (0.8 C [1.5 F] difference maximum)</li> </ul>	<ul style="list-style-type: none"> <li>Check sensor connections. Check sensor resistance of each sensor. Resistance must be 2,000 ohms at 25 C (77 F).</li> </ul>
117	<b>Probe Error (Check Alarm)</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test or probe test failed in Chilled mode.</li> <li>Temperature difference between LH supply and RH supply sensors is too high (0.5 C [1.0 F] difference maximum)</li> </ul>	<ul style="list-style-type: none"> <li>Check sensor connections. Check sensor resistance of each sensor. Resistance must be 2,000 ohms at 25 C (77 F).</li> <li>Check left hand and right hand supply air sensor locations.</li> </ul>
119	<b>Digital Control Valve Error</b> <ul style="list-style-type: none"> <li>Current consumption not correct for valve position</li> </ul>	<ul style="list-style-type: none"> <li>Check Digital Valve function</li> </ul>

## Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action
120	<b>Suction Pressure Sensor</b> <ul style="list-style-type: none"> <li>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</li> </ul> <b>PTI Test</b> <ul style="list-style-type: none"> <li>Reading did not decrease by 0.15 bar (2.175 psi) between compressor on and off</li> </ul>	<p>Check wiring at J14 and J15 to be correct and connected</p> <p>Check J14 and J15 plugs are plugged into MRB</p> <p>Check voltage at J15 pin12 to be 0.5 – 4.5 volts</p> <p>Check cable No 1 and cable No. 3 between the controller and MRB</p>
121	<b>Discharge Pressure Sensor</b> <ul style="list-style-type: none"> <li>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</li> </ul> <b>PTI Test</b> <ul style="list-style-type: none"> <li>Reading did not increase by 0.15 bar (2.175 psi) between compressor on and off</li> </ul>	<p>Check wiring at J14 and J15 to be correct and connected</p> <p>Check J14 and J15 plugs are plugged into MRB</p> <p>Check voltage at J14 pin11 to be 0.5 – 4.5 volts</p> <p>Check cable No 1 and cable No. 3 between the controller and MRB</p>
122	<b>CO2 Sensor Calibration Error</b> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only</li> <li>Sensor reading is less &lt; 17% or &gt; 25%</li> </ul>	<p>Replace CO2 sensor</p>

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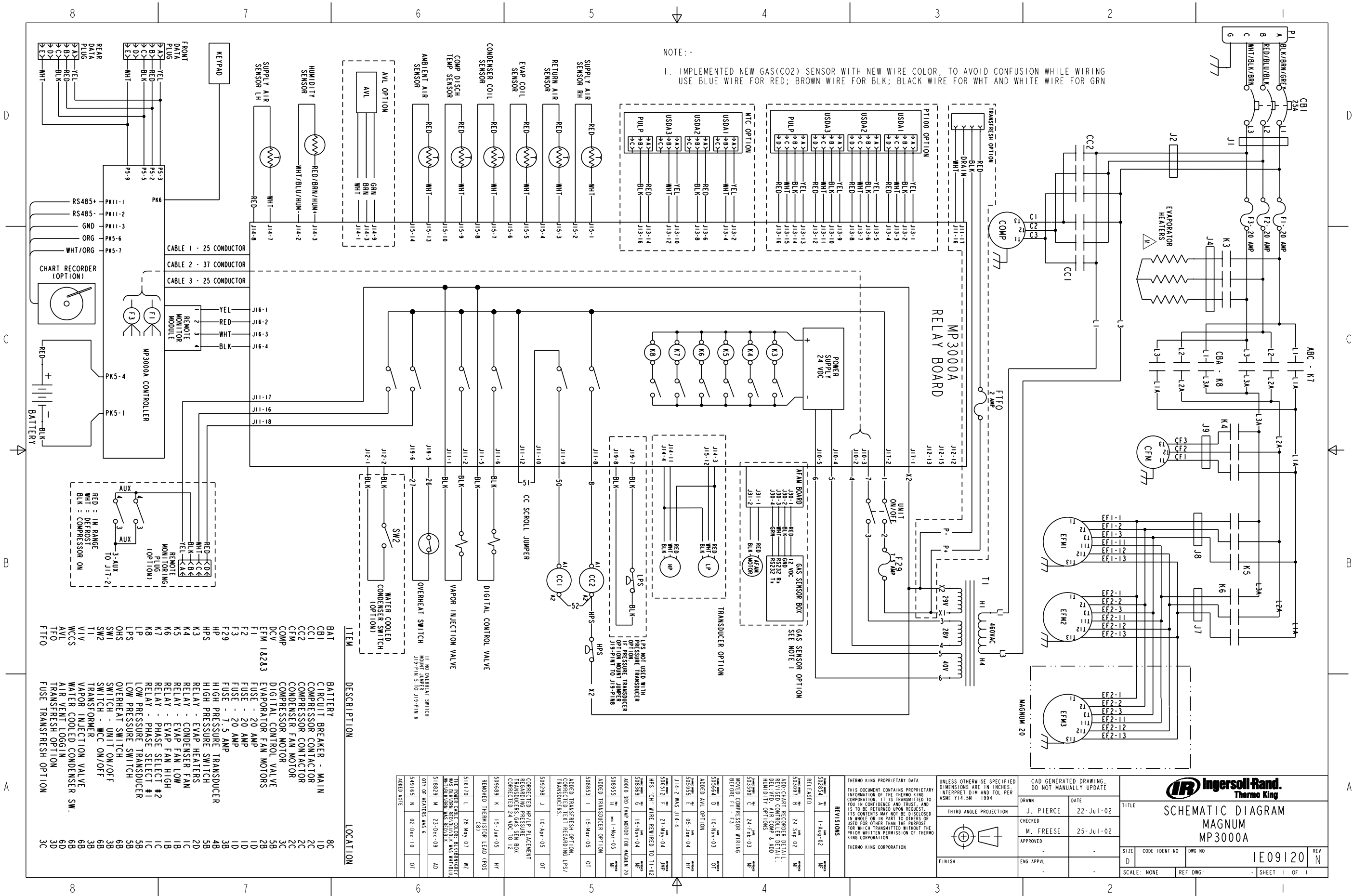
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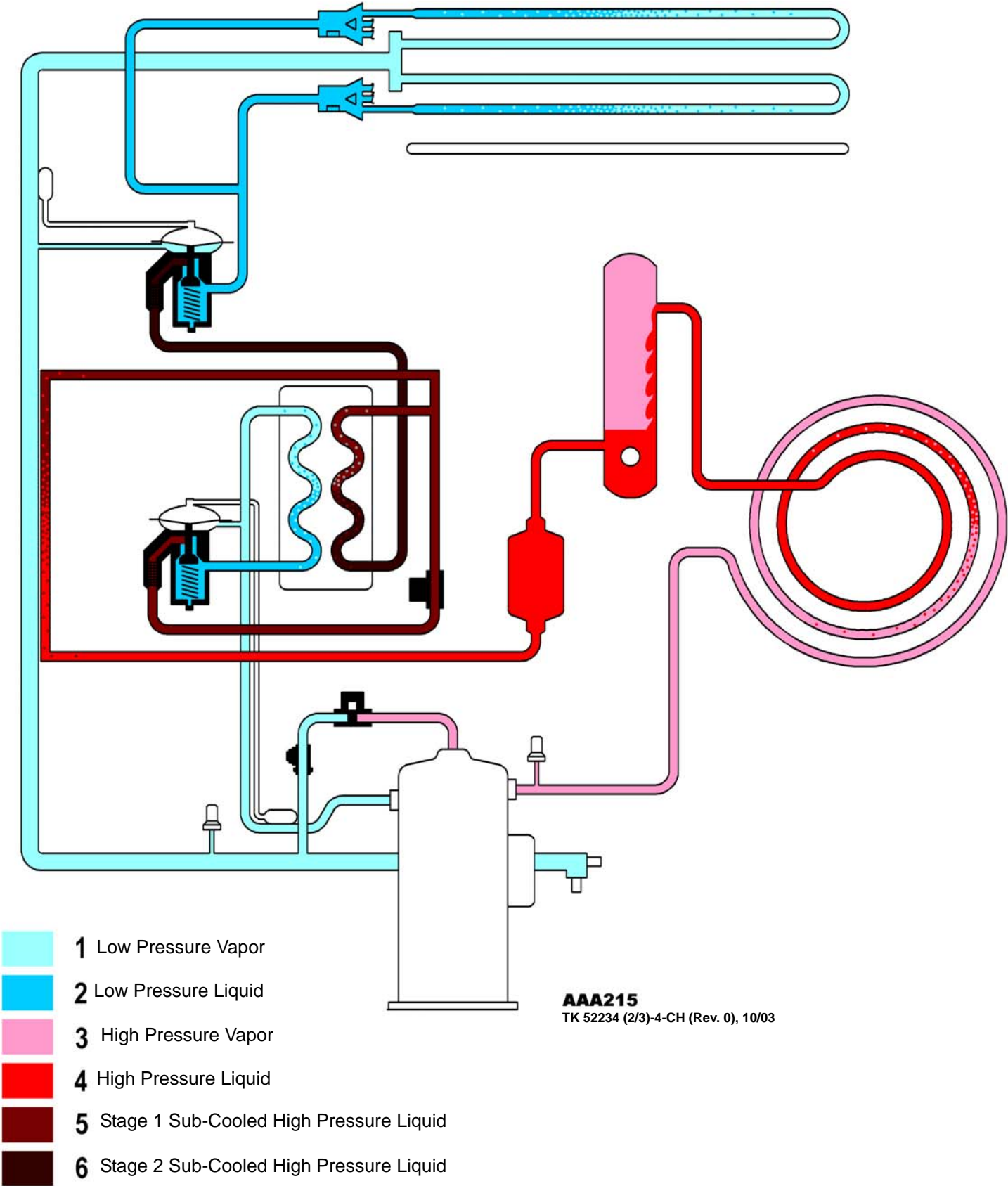


Wiring Schematic

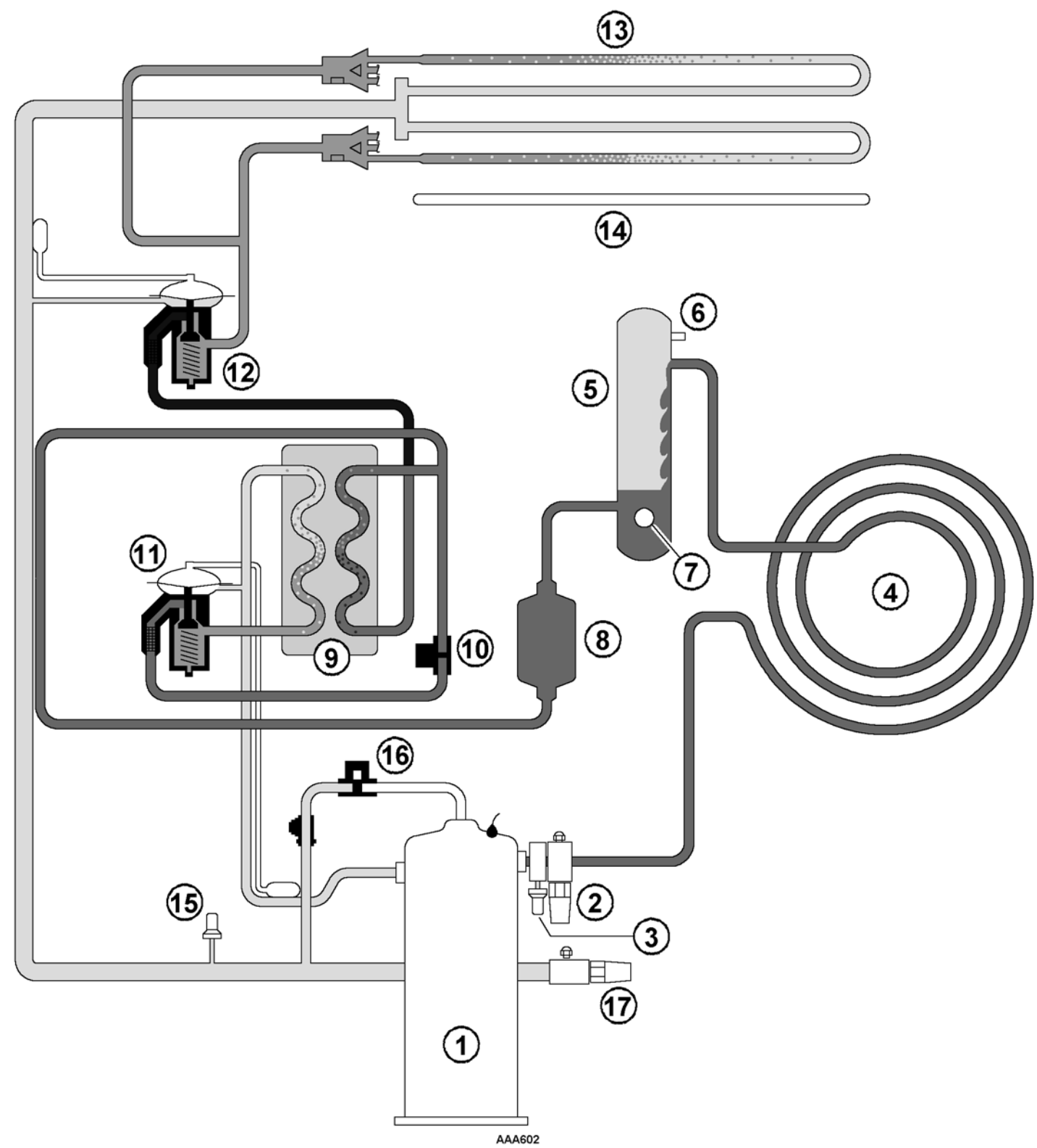




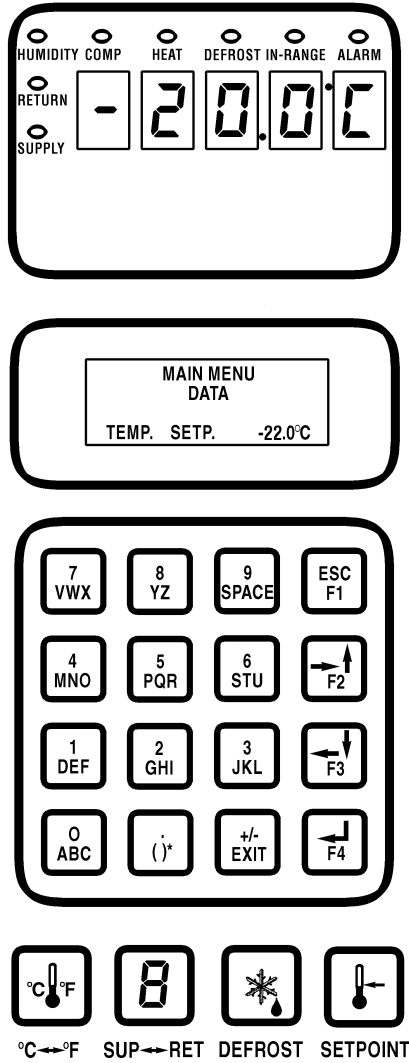








1.	Scroll Compressor
2.	Discharge Service Valve
3.	High Pressure Switch
4.	Condenser Coil
5.	Receiver Tank
6.	Pressure Relief
7.	Sight Glass
8.	Drier / Oil Filter
9.	Economizer Heat Exchanger
10.	Vapor Injection Valve
11.	Economizer TXV
12.	Evaporator TXV
13.	Evaporator Coil
14.	Heater
15.	Low Pressure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

**Text Input:** Use F1, F2, F3 and F4 keys to enter text in information screens:

- To enter a number: Press the F1 key and the desired number key.
- To enter 1st letter on a key: Press the F2 key, the desired letter key.
- To enter 2nd letter on a key: Press the F3 key, the desired letter key.
- To enter 3rd letter on a key: Press the F4 key, the desired letter key.

**NOTE:** When a function key (F1, F3, F3 or F4) is pressed to enter text, the keypad remains on that “character level: until another function key is pressed.

**To Enter a Controller Menu or Use Special Function Key:**

- Press F4 key to directly enter the Data menu.
- Press F2 key to directly enter the Alarms menu.
- Press F3 key to directly enter the Main menu.
- Press SETPOINT key to enter Setpoint menu.
- Press C/F Key to view alternate temperature scale in LED display.
- Press SUP/RET key to view alternate sensor temperature in LED display.
- Press DEFROST key to initiate a manual defrost. Evaporator coil temperature must be below 10 C (50 F).

**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 (ESC) key.

**Special Function Keys:**

- Press C/F key to view alternate temperature scale in LED display.
- Press DEFROST key to initiate a manual defrost. Evaporator coil temperature must be below 10C.
- Press SUP/RET key to view alternate return/supply-sensor temperature in LED display.

**To Lock a LCD Data Screen Display:**

- Each time the “5” key is pressed, the display time of the current LCD screen increases by 5 mi nutes. Maximum display time is 30 minutes for data screens and 100 minutes for manual tests. Press F1 (ESC) key to exit display.

