



*Maintenance Manual*

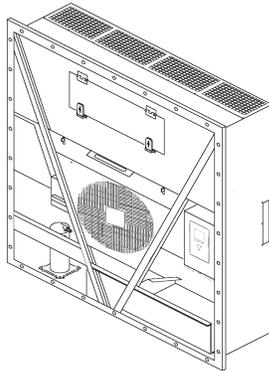
# MAGNUM +

TK 60275-4-MM (Rev. 3, 08/15)



# MAGNUM+

TK 60275-4-MM (Rev. 3, 08/15)



The maintenance information in this manual covers unit models:

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

For further information, refer to:

**Parts Manuals**

MAGNUM Parts List TK 54356

**Operation, Diagnosis and Refrigeration Maintenance Manuals**

Diagnosing Thermo King Container Refrigeration Systems TK 41166

Electrostatic Discharge (ESD) Training Guide TK 40282

Evacuation Station Operation and Field Application TK 40612

Tool Catalog TK 5955

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

**Revision History**

Rev. 3 – TK 60275-4-MM (Rev. 3, 08/15) Add information per Service and Software Bulletins since previous revision.

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.*

# Table of Contents

---

<b>Safety Instructions</b> .....	<b>9</b>
General Precautions .....	9
Refrigerant Oil Precautions .....	9
Electrical Precautions .....	10
Precautions .....	10
First Aid .....	10
Low Voltage .....	11
Electrostatic Discharge Precautions .....	11
Electrostatic Discharge and the Controller .....	11
Welding of Units or Containers .....	12
Removing Refrigerant Properly .....	12
Identifying Unit Safety and Warning Decals .....	14
Locating Serial Numbers .....	14
Component Serial Number Identification .....	14
<b>Service Guide</b> .....	<b>15</b>
Service Guide .....	15
<b>Specifications</b> .....	<b>16</b>
Evaporator Airflow Specifications .....	16
Electrical System Specifications .....	17
Refrigeration System Specifications .....	18
<b>Unit Description, Features &amp; Options</b> .....	<b>22</b>
Introduction .....	22
General Description .....	22
Scroll Compressor .....	23
MP-4000 Controller .....	24
Power Module Fuses .....	24
Compressor Digital Control Valve .....	25
Economizer Heat Exchange System .....	25
Temperature Sensors .....	25
Fresh Air Exchange System .....	26
Receiver Tank Sight Glass .....	26
Evaporator Fans .....	26
Condenser Fan Control .....	27
USDA Cold Treatment Temperature Recording (standard) .....	27
Unit Options .....	28
Electronic Chart Recorder (Optional) .....	29
Remote Monitoring Modem (RMM, RMM+) (Optional) .....	29
Suction and Discharge Pressure Sensors (Optional) .....	29
Water-Cooled Condenser/Receiver Tank (Optional) .....	29
Air Ventilation Logging (AVL - Optional) .....	30
Advanced Fresh Air Management (AFAM) System (Optional) .....	30
Advanced Fresh Air Management Plus (AFAM+) System (Optional) .....	31
<b>Controller Description</b> .....	<b>37</b>
Controller Description .....	37
Controller Back-up Battery .....	37
Controller Input and Output Signals .....	37
Standard Display .....	39
Idle Screen .....	39
Glossary of Mode Descriptions .....	41
Function Keys .....	42
Three Special Function Keys .....	43
MP-4000 Software .....	44
Software Version 2.3.4 100927 .....	44
Software Version 2.3.6 110301 .....	45
Software Version 2.3.7.0 110608 .....	46
Software Version 2.3.8.0 110628 .....	47
Software Version 2.4.0.0 111220 .....	48

Software Version 2.4.2.0 120313	48
Software Version 2.4.3.0 120628	49
Software Version 2.5.0.0 121121	50
Software Version 2.5.1.0 130213	51
Software Version 2.5.3.0 130424	51
Software Version 3.1.0.0 140612	52
Software Version 3.2.0.0 140822	53
<b>Operating Instructions</b>	<b>54</b>
Function Keys	54
Unit On/Off Key	55
Sequence Of Operation	55
Unit Start-up	55
Initiating a Manual Defrost	55
PTI	56
Viewing Alarms/Warnings	57
Display Alternate Fahrenheit (F) or Celsius (C) Temperatures	57
Changing Setpoint	57
Main Menu	57
Controller Back-up Battery	58
Controller Lockup Issue	58
Emergency Run Mode	59
Rotation Check	59
FULL COOL Mode	61
DEFROST Mode	62
High or Low Speed Fans Only	62
<b>Navigating the Controller Operating Menu</b>	<b>64</b>
Navigating the Controller Operating Menu	64
Icon Menu	65
Menu Scrolling Keys	66
Changing Screen Contrast	67
<b>Main Menu</b>	<b>68</b>
Main Menu	68
Data/Values Menu	68
MP4000	68
Data/Values	68
Setpoint/Control Menu	69
Cold Treatment (CT)	70
Multiple Temperature Set (MTS)	70
OPTISET	71
Temperature Setpoint	71
Controlling Mode	72
Pull Down Selection	72
Watercool	73
Humidity Control	73
Humidity Setpoint	74
AVL (Air Ventilation Logging)	74
Fresh Air Vent Man - AFAM Mode	75
Fresh Air Vent Man - AFAM+ Mode	75
AFAM Delay	76
AFAM Rate	76
AFAM+ CO2 Max	77
AFAM+ O2 Min	77
Smart PTI	78
Alarm List	78
Warning List	79
Configuration Menu	79
Unit Setting	80
Unit Configuration (Configuration Depends on Unit)	80
Options	81

## Table of Contents

---

Miscellaneous Settings	82
Datalogger Menu	82
States Menu	83
Special Function Keys - User Activated Commands	84
PTI Key	84
Defrost Key	87
PTI (Pretrip) Tests	88
Automated Tests	89
Function Test	89
Manual Function Test	90
Defrost	98
Alarms/Warnings Menu	99
Alarm Code States	99
Alarm/Warning List Menu	100
View the Alarm/Warning List Menu	100
Warning List Menu	101
Alarm List Menu	102
Configuration Menu	104
Viewing or Setting Functions	104
Set Date and Time	106
Datalogger Menu	107
Viewing the Datalogger Menu	107
Inspect Log	108
Trip Start	108
Set Log Time Interval	109
States Menu	110
Air Ventilation Logging (AVL)	112
<b>Starting the AFAM System</b>	<b>114</b>
Change the AFAM Delay	116
Change the AFAM Rate	116
Advanced Fresh Air Management Plus (AFAM+) System	117
Set AFAM+ System Values	117
Change the AFAM Delay	119
Change the CO <sub>2</sub> Minimum and Maximum Setting	119
Changing the AFAM+ Settings Using 'OPTISET'	121
Modify Optiset Product Settings	121
Testing AFAM+ / AFAM System	122
AFAM+ Option Alarm Codes (see manual for further descriptions)	122
Pulsating Vent Door	125
AFAM+ Door Closes Automatically	125
Pulsating AFAM+ Door	125
AFAM+ Enabled	125
<b>Operating Theory</b>	<b>126</b>
Chill Loads: (Setpoint at -9.9 C [14.1 F] and Above)	126
Frozen Loads: (Setpoint at -10 C [14 F] and Below)	126
Compressor Vapor Injection	126
High Temperature Protection	127
Power Limit Mode	127
Evaporator Fan Control	127
Condenser Fan Control	127
Probe Test	128
Dehumidify Mode	128
Continuous Temperature Control Operation	128
Frozen Loads (Controller Setpoint at -10 C [14 F] and Below):	131
Compressor Digital Control Valve	134
Economizer System	135
Data Recording and Downloading Data	135
Cold Treatment (CT)	136
Multiple Temperature Setpoint (MTS)	142

<b>Controller Maintenance</b> .....	<b>147</b>
Controller Door Open and Close Instructions .....	147
Flash Loading Controller Software .....	148
MP-4000 Test System Tool .....	151
Controller Replacement .....	152
<b>Electrical Maintenance</b> .....	<b>153</b>
Unit Protection Devices .....	153
Introduction .....	153
Main Circuit Breaker .....	153
Evaporator Overheat Protection .....	153
High Pressure Cutout Switch .....	153
High Pressure Cutout Manifold .....	155
High Pressure Cutout Switch Removal .....	155
High Pressure Cutout Switch Installation .....	156
Low Pressure Cutout Switch .....	157
Low Pressure Cutout Switch Removal .....	157
Low Pressure Cutout Switch Installation .....	158
Low Pressure Cutout Switch or Suction Transducer Configuration .....	158
Discharge and Low Pressure Sensors (Optional) .....	160
Discharge and Low Pressure Sensors Removal .....	160
Discharge and Low Pressure Sensor Installation .....	160
Condenser Fan and Evaporator Fan Rotation .....	160
Check Condenser Fan Rotation .....	160
Check Evaporator Fan Rotation .....	160
Reversing Power Phase on MAGNUM Units .....	161
Evaporator Heater Selection .....	161
Extended Capacity Heaters .....	162
Electric Heaters Malfunction .....	162
Compressor Discharge Gas Temperature Sensor .....	163
Compressor Discharge Temperature Sensor Replacement .....	163
Temperature Sensors .....	164
Installing Temperature Sensors .....	165
Testing the Sensors .....	165
Resistance Values for Temperature Sensors .....	167
<b>Refrigeration Maintenance</b> .....	<b>169</b>
Introduction .....	169
Use the Correct Tools .....	169
Use the Correct Vacuum Pump .....	169
Use Filters and Cartridges .....	169
Use the Correct Refrigerant Recovery Equipment .....	169
Detecting Leaks .....	169
Locating Special Service Fittings .....	169
Perform an Oil Acid Test .....	170
Isolate the Compressor .....	170
Working with a Gauge Manifold .....	171
Using a New Gauge Manifold Set .....	171
Gauge Manifold Valve Positions .....	171
Gauge Manifold Set Installation & Removal .....	174
Gauge Manifold Set Installation .....	174
Removing the Gauge Manifold Set .....	175
Checking Refrigerant Charge .....	175
Receiver Tank Sight Glass .....	176
Leak Testing the Refrigeration System .....	177
Using Pressurized Nitrogen .....	178
Safety Precautions .....	178
Purge High Side to Low Side .....	179
Maximum Gas Pressures .....	179
Recovering Refrigerant from the System .....	181
Evacuation and Cleanup of the Refrigeration System .....	182

## Table of Contents

---

Unit Preparation and Hookup .....	182
Unit Evacuation .....	183
Pressure Rise Test .....	184
Factors Affecting the Speed of System Evacuation .....	185
Heat Saves Time .....	185
Charging the System with Refrigerant .....	186
Unit Charging by weight (from an Evacuated Condition) .....	186
Compressor Replacement .....	187
Compressor Removal .....	187
Compressor Installation .....	187
Condenser Coil Replacement .....	189
Filter Drier/In-line Filter Replacement .....	190
Evaporator Expansion Valve (TXV) Replacement .....	192
Economizer Expansion Valve Replacement .....	193
Economizer Heat Exchanger Replacement .....	195
Economizer Heat Exchanger Removal .....	195
Economizer Heat Exchanger installation .....	196
Receiver Tank/ Water-Cooled Condenser Tank Replacement .....	197
Tank Removal .....	197
Tank Installation .....	197
Vapor Injection Valve Replacement .....	199
Compressor Digital Control Valve Replacement .....	200
<b>Servicing The Unit .....</b>	<b>202</b>
Taking Care of the Structure .....	202
Inspecting the Unit .....	202
Checking the Mounting Bolts .....	202
Cleaning the Condenser Coil .....	203
Cleaning the Evaporator Coil .....	203
Cleaning the Defrost Drains .....	203
Positioning the Condenser Fan Blade .....	203
Positioning the Evaporator Fan Blade .....	204
Servicing the Fresh Air System .....	205
Adjusting the Fresh Air Exchange System .....	205
<b>Diagnosis: Troubleshooting, Warnings and Alarm Codes .....</b>	<b>207</b>
Introduction .....	207
Controller Diagnostics .....	207
Warnings and Controller Actions .....	214
<b>Wiring and Schematic Diagrams Index .....</b>	<b>254</b>
Controller Menu Guide .....	260

# 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

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

**Note** that even though the controller is turned off, one of the phases is still live and represents a potential danger of electrocution

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

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

### First Aid

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

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

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

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

## Low Voltage

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

## Electrostatic Discharge Precautions

Precautions must be taken to prevent electrostatic discharge while servicing the MP-3000a microprocessor and related components. The risk of significant damage to the electronic components of the unit is possible if these precautionary measures are not followed. The primary risk potential results from the failure to wear adequate electrostatic discharge preventive equipment when handling and servicing the controller. The second cause results from electric welding on the unit and container chassis without taking precautionary steps.

## Electrostatic Discharge and the Controller

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

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

### Welding of Units or Containers

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

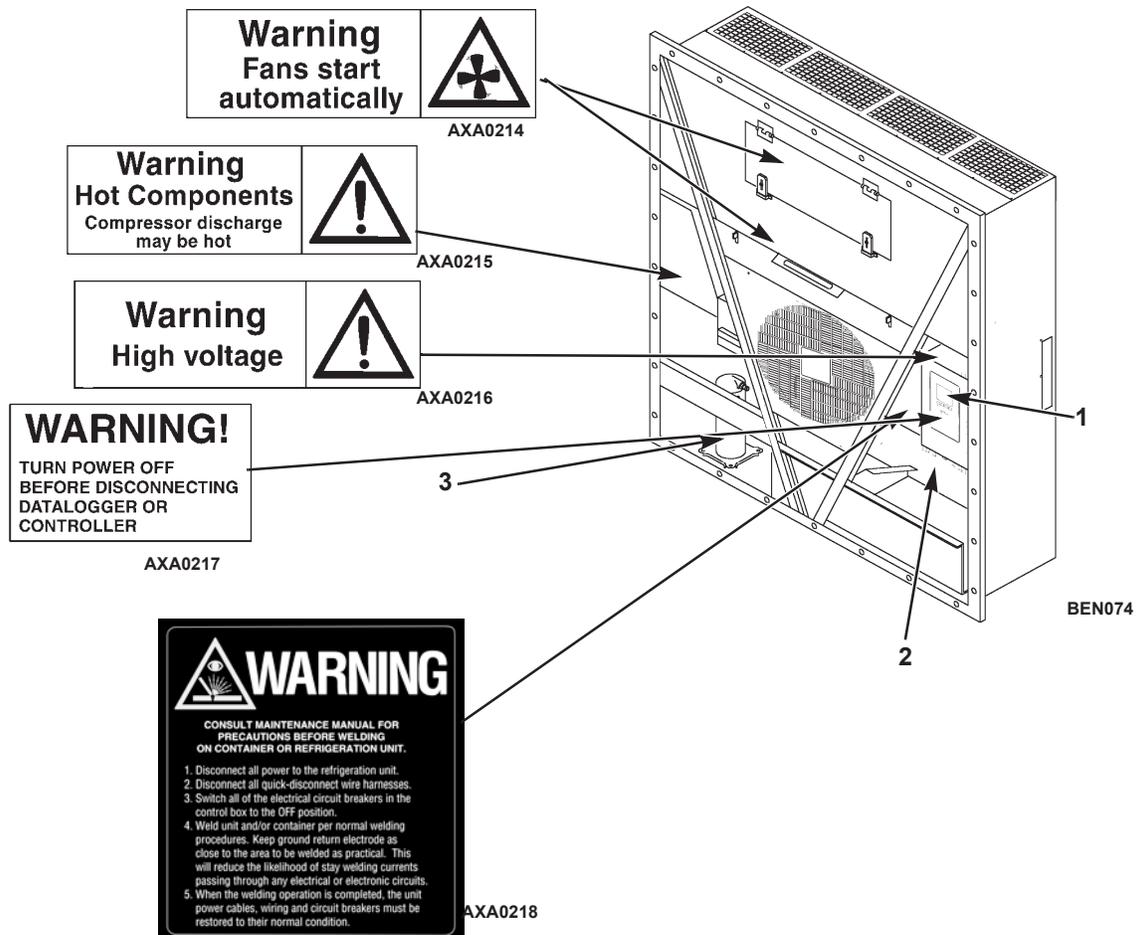
- Disconnect all power to the refrigeration unit.
- Disconnect all quick-disconnect wire harnesses from the back of the controller.
- Disconnect all wire harnesses from the Remote Monitor Modem (RMM).
- Switch all of the electrical circuit breakers in the control box to the Off position.
- Weld unit and/or container per normal welding procedures. Keep ground return electrode as close to the area to be welded as practical. This will reduce the likelihood of stray welding currents passing through any electrical or electronic circuits.
- The unit power cables, wiring and circuit breakers must be restored to their normal condition when the welding operation is completed.

### Removing Refrigerant Properly

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

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

- **Eyes:** For contact with liquid, immediately flush eyes with large amounts of water and get prompt medical attention.
- **Skin:** Flush area with large amounts of lukewarm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection/injury. Get medical attention. Wash contaminated clothing before reuse.
- **Inhalation:** Move victim to fresh air and use CPR or mouth-to-mouth ventilation, if necessary. Stay with victim until arrival of emergency medical personnel.



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

**Nameplate and Warning Locations**

## Identifying Unit Safety and Warning Decals

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

## Locating Serial Numbers

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

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

## Component Serial Number Identification

To better identify the different electronic components, our supplier has changed their serial number labeling on the MP-4000 controller and power module. The label will show part number, date, and sequence.

MP4000 Controller

New label shows controller ID ABS782800212245390

Part number	Date	2012 24 wk	Sequence
ABS7828002	1224		5390

ID in controller would show 1224-5390

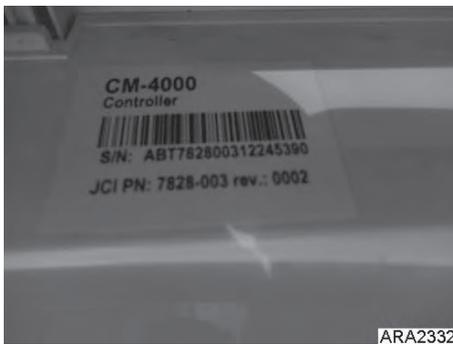


Figure 1: Label on Controller

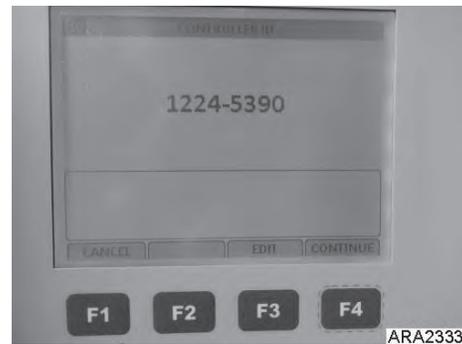


Figure 2: ID in Controller

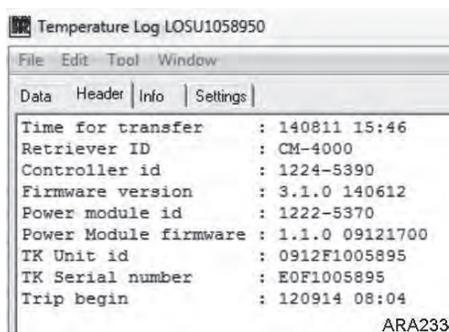


Figure 3: Controller ID Shown in Datalogger

# 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 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.

**NOTE:** *If a unit has been carrying cargo which contains a high level of sulphur or phosphorous (e.g. garlic, salted fish etc.), it is recommended that clean evaporator coil after each trip.*

# Specifications

## System Net Cooling Capacity— Full Cool

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

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power		
	Net Cooling Capacity		Power Consump
	60 Hz Capacity B/hr	60 Hz Capacity kW	60 Hz Power kW
21.1 C (70 F)	56,700	16.603	11.55
1.7 C (35 F)	40,945	11.990	11.03
-17.8 C (0 F)	24,785	7.258	7.57
-29 C (-20 F)	17,215	5,041	6.6
-35 C (-31 F)	14,000	4.104	6.03

\*System net cooling capacity with a 38 C (100 F) ambient air temperature and R-404A.

## Evaporator Airflow Specifications

### System Net Heating Capacity\*

	460/230V, 3 Phase, 60 Hz Power			380/190V, 3 Phase, 50 Hz Power		
	Heating Capacity			Heating Capacity		
	Watts	Kcal/hr	BTU/hr	Watts	Kcal/hr	BTU/hr
MAGNUM+ normal	5,250	4,515	17,914	3,900	3,353	13,300
MAGNUM+ extended	7,250	6,234	24,738	5,550	4,772	18,937

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

### MAGNUM+

External Static Pressure (water column)	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	High Speed		Low Speed		High Speed		Low Speed	
	m <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.)	6,560	3,860	3,170	1,865	5,480	3,225	2,710	1,595
10 mm (0.4 in.)	5,820	3,425	1,770	1,040	4,530	2,665	930	545
20 mm (0.8 in.)	5,000	2,940	—	—	3,750	2,205	—	—
30 mm (1.2 in.)	4,430	2,610	—	—	2,930	1,725	—	—
40 mm (1.6 in.)	3,520	2,070	—	—	1,870	1,100	—	—

## Electrical System Specifications

<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
<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:		
	Normal Capacity	6 (18 ga wire)
	Normal Capacity	3 (18 ga wire)
	Extended Capacity	3 (16 ga wire)
Watts (Each):		
	Normal Capacity	680 Watts @ 460V, 60 Hz
	Normal Capacity	1360 Watts @ 460V, 60 Hz
	Extended Capacity	2000 Watts @ 460V, 60 Hz
Current Draw (Amps):		
	Normal Capacity	5 amps total @ 460V across each phase at heater contractor
	Extended Capacity	4.5 amps total @ 460V across each phase at heater contractor
<b>Control Circuit Voltage:</b>		
		29 Vac @ 60 Hz

## Refrigeration System Specifications

<b>Compressor:</b>	
Model No.:	ZMD18KVE-TFD-277, Scroll
Refrigerant Charge: MAGNUM+	4.0 Kg (8.0 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
<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

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

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

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

\*\*Discharge pressure is determined by condenser fan cycling.

## MP-4000 Controller Specifications

Temperature Controller:	
Type	MP-4000 is a controller module for the Thermo King Magnum+ Unit. Additional requirements can be met by means of expansion modules. The MP4000 is solely responsible for temperature regulation of the reefer container, but other monitoring equipment can be used in conjunction with the MP 4000 - such as a chart recorder.
Setpoint Range	-40.0 to +30.0 C (-31.0 to +86.0 F)
Digital Temperature Display	-60.0 to +80.0 C (-76.0 to +176.0 F)
Controller Software (Original Equipment):	
Version	See controller identification decal
Defrost Initiation:	
Evaporator Coil Sensor	<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 4 C (41 F). Defrost cycle starts 1 minute after the hour immediately following a defrost timer request for defrost initiation. For example, if the defrost timer requests a defrost cycle at 7:35, the defrost cycle will start at 8:01. Datalogger will record a Defrost event for each interval in which a Defrost cycle is pending or active (i.e. both the 8:00 and 9:00 data logs).</li> </ul>

## MP-4000 Controller Specifications (Continued)

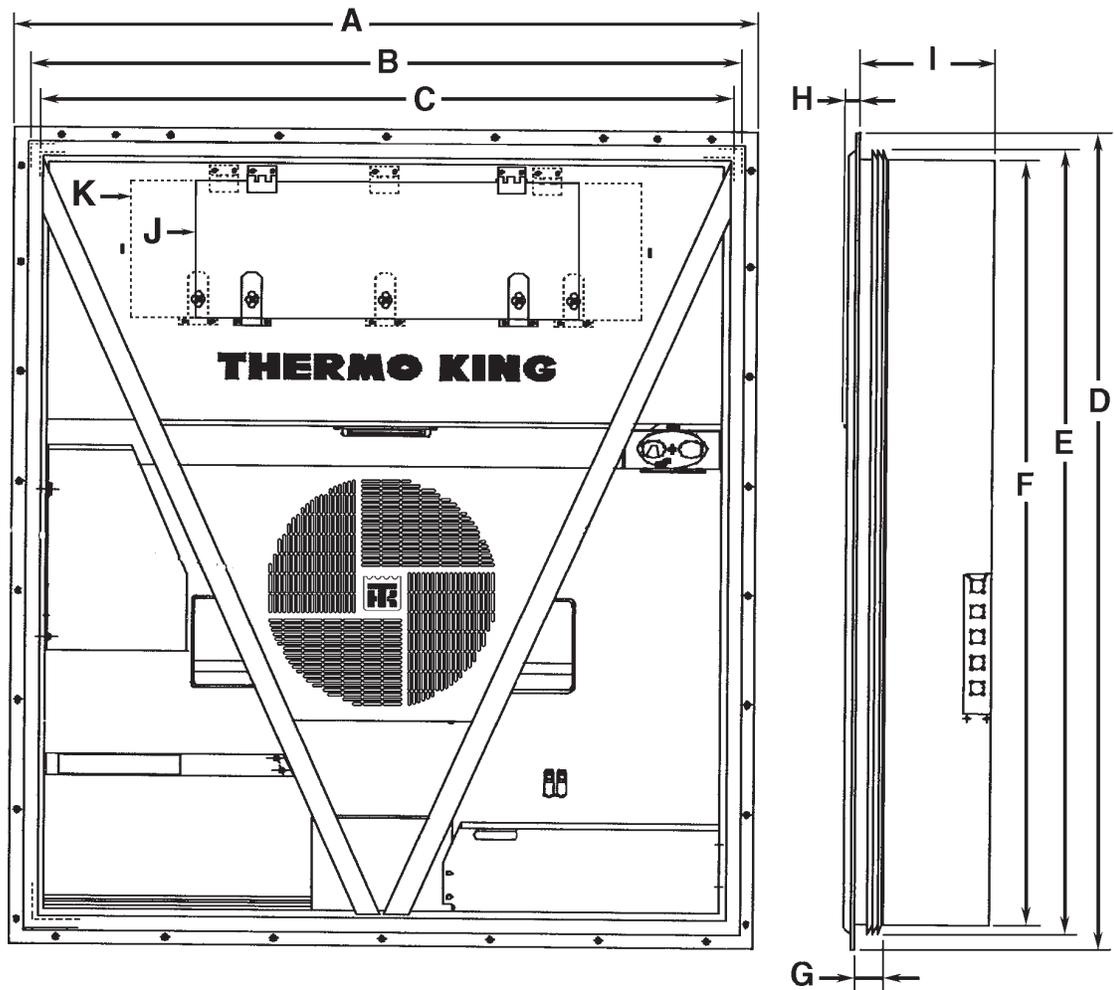
Demand Defrost	<p>Demand defrost function initiates defrost when:</p> <ul style="list-style-type: none"> <li>• Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large for 90 minutes</li> <li>• Temperature difference between the supply air sensors and return air sensor is too large</li> </ul>
<b>Defrost Timer:</b>	
Chilled mode	<p>Evaporator Coil Temperature must be below 5C (41 F) to activate the defrost compressor hour timer.</p> <p>There is an interval set for defrosting, however, the defrost timer is built intelligent - it detects whether or not there is ice building up on the coil. If there is no ice building up on the coil, it extends the defrost interval, and if there is Ice building up earlier on the coil it reduces the defrost interval. The maximum interval is 48 hours.</p>
Frozen mode	<p>Every 8 hours of compressor operation. Defrost interval increases 2 hours each timed defrost interval. Maximum time interval in Frozen mode is 24 hours.</p>
Reset to Base Time	<p>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.</p>
<b>Defrost Termination:</b>	
Defrost (Coil) Sensor	<p><b>Chilled mode:</b> Terminates defrost when coil sensor temperature rises to 18 C (65 F).</p> <p><b>Frozen mode:</b> Terminates defrost when coil sensor temperature rises to 18 C (65 F).</p>
Termination Timer	<p>Terminates defrost after 90 minutes at 60 HZ operation if coil sensor has not terminated defrost (120 minutes at 50 Hz operation)</p>
Power Off	<p>Turning Unit On/Off switch Off terminates defrost</p>
<b>Compressor Shutdown Protection (Auto Reset):</b>	
Stops Compressor	<p>148 C (298 F)</p>
Allows Compressor Start	<p>90 C (194 F)</p>
<b>Bulb Mode:</b>	
Evaporator Fan Speed Settings	<p><b>Flow High:</b> High speed only</p> <p><b>Flow Low:</b> Low speed only</p> <p><b>Flow Cycle:</b> Fans will cycle between low and high speed every 60 minutes</p>
Defrost Termination Temperature Setting	<p>4 to 30 C (40 to 86 F)</p>

## Physical Specifications

<b>Fresh Air Exchange Venting System (Adjustable):</b>	
MAGNUM+	<p>0 to 225 m<sup>3</sup>/hr (0 to 168 ft<sup>3</sup>/min.) @ 60 Hz</p> <p>0 to 185 m<sup>3</sup>/hr (0 to 139 ft<sup>3</sup>/min.) @ 50 Hz</p>
<b>Evaporator Fan Blade Specifications:</b>	
<b>MAGNUM+:</b>	
Diameter	<p>355 mm (14.0 in.)</p>
Pitch	<p>25°</p>
Number of Fans	<p>2</p>

## Physical Specifications (Continued)

<b>Weight (net):</b>	
MAGNUM+ Base Unit	380 Kg (875 lb.)
Water-cooled Condenser-Receiver Option	13.6 Kg (30 lb.)



AMA313

<b>Unit Dimensions:</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 = MAGNUM+	420.0 mm (16.54 in.) from back of flange
J = MANGUM+	Evaporator Access Door

Figure 1: Physical Specifications

# 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.

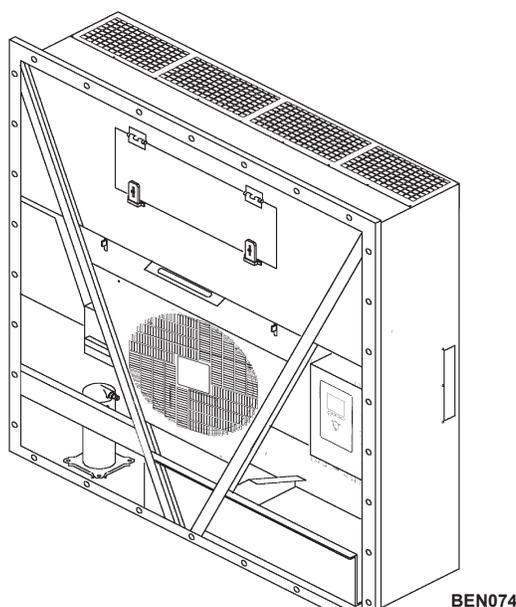
## General Description

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. Fork lift pockets are provided for installation and removal of the unit.

The frame and bulkhead panels are constructed of aluminum and are treated to resist corrosion. A removable evaporator compartment door provides service access. All components except the evaporator coil and electric heaters can be replaced from the front of the unit.

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

Each unit is equipped with 460-380V/3 Ph/60-50 Hz electric motors. An automatic phase correction system provides the proper electrical phase sequence for condenser fan, evaporator fan and compressor operation.



**Figure 2: MAGNUM+ Unit**

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

- Scroll Compressor
- Compressor Digital Control Valve
- Economizer Heat Exchange System
- Temperature Sensors

- Fresh Air Exchange System
- Receiver Tank Sight Glass
- Evaporator Fans
- Condenser Fan Control
- Suction/Discharge Pressure Sensor (Optional)
- Remote Monitoring Receptacle Option (4-pin) (optional)
- Remote Monitoring Modem (RMM, RMM+) (Optional)
- USDA Cold Treatment Temperature Recording (Optional)
- Advanced Fresh Air Management (AFAM) and Advanced Fresh Air Management Plus (AFAM+) (Optional)

## Scroll Compressor

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

### Digital Port

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

### Intermediate Suction Port

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

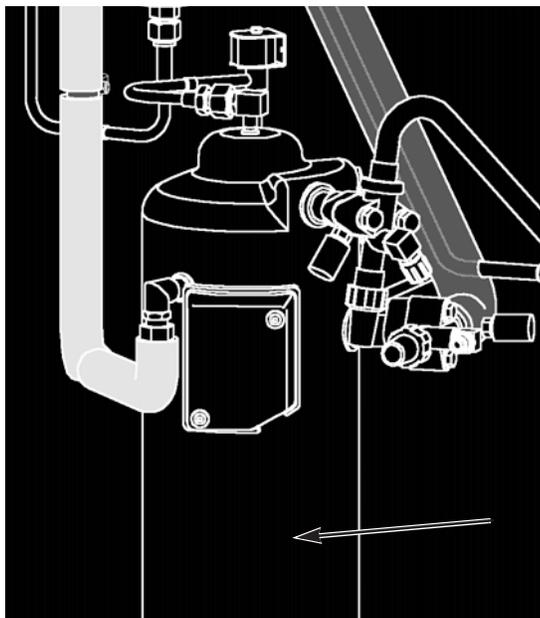


Figure 3: Scroll Compressor

## MP-4000 Controller

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

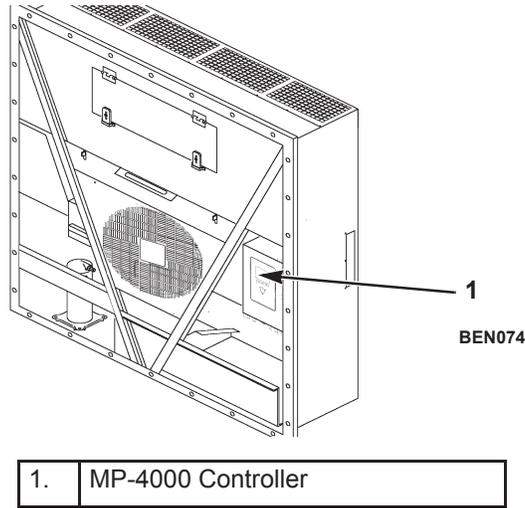


Figure 4: MP-4000 Controller

## Power Module Fuses

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

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

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

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



Figure 5: Power Module Fuses

## Compressor Digital Control Valve

The MP-4000 controller pulses the Compressor Digital Control solenoid valve between open and closed positions. This provides precise cooling capacity control. No pump down function or warm gas bypass control is used in conjunction with the Compressor Digital Control valve. See the “General Theory of Operation Chapter” for more detailed information.

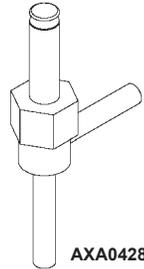


Figure 6: Compressor Digital Control Solenoid Valve

## 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.

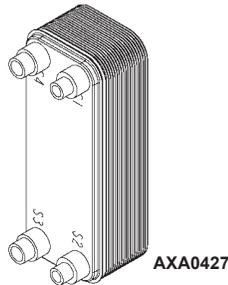


Figure 7: Economizer Heat Exchanger

## 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. PT.1000 type temperature sensors are used to sense temperatures for the:

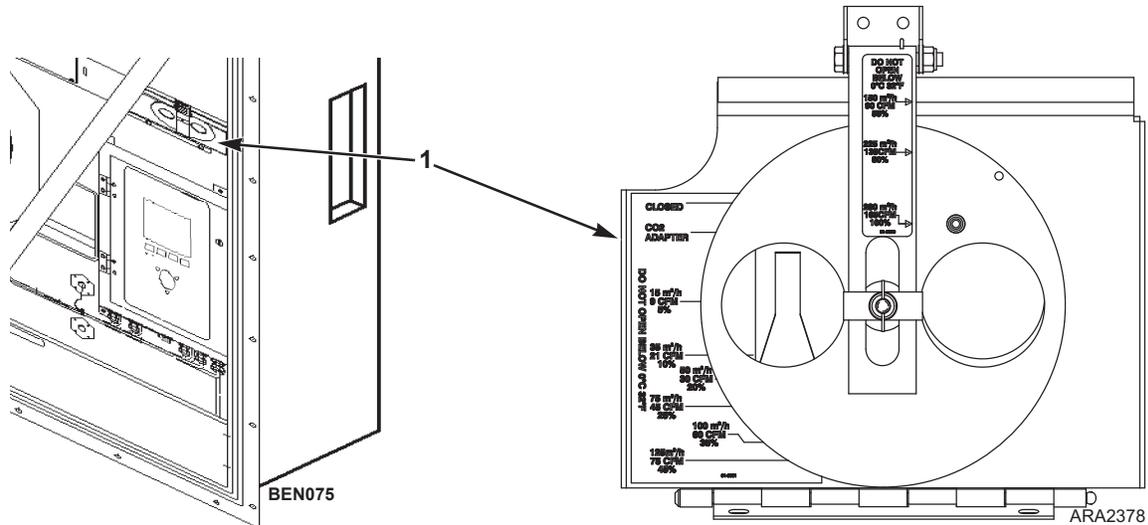
- Supply Air
- Return Air
- Evaporator Coil
- Condenser Coil
- Ambient Air

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

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

## Fresh Air Exchange System

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

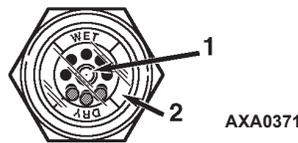


1.	Fresh Air Exchange Vent
----	-------------------------

Figure 8: Fresh Air Exchange Vent

## Receiver Tank Sight Glass

The receiver tank contains a sight glass which has three small balls that indicate the level of refrigerant in the tank for checking the refrigerant charge. A moisture indicator in the sight glass changes color to indicate the level of moisture in the system.



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

Figure 9: Receiver Tank Sight Glass

## Evaporator Fans

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

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

The evaporator fan low speed RPM is one-half the high speed RPM.

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

**NOTE: If Non-Optimized mode is on:**

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

**NOTE: If optimized mode is on:**

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

## Condenser Fan Control

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

## USDA Cold Treatment Temperature Recording (standard)

The MP-4000 controller includes provisions for the use of three or four USDA sensors. These sensors allow temperatures in various areas of the load to be monitored and recorded for United States Department of Agriculture use in monitoring Cold Treatment shipments.

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

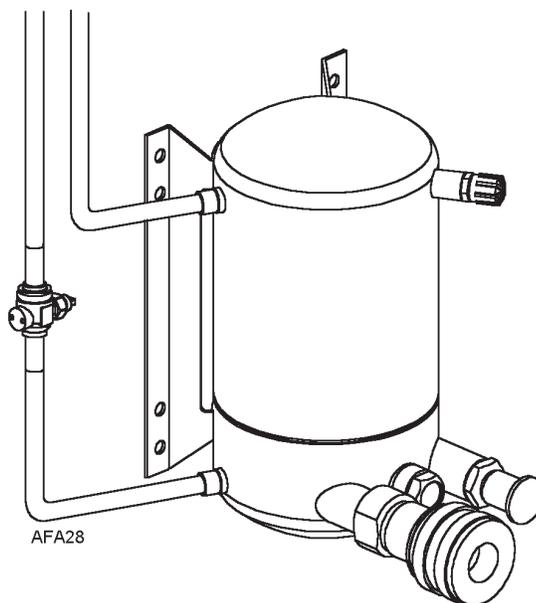
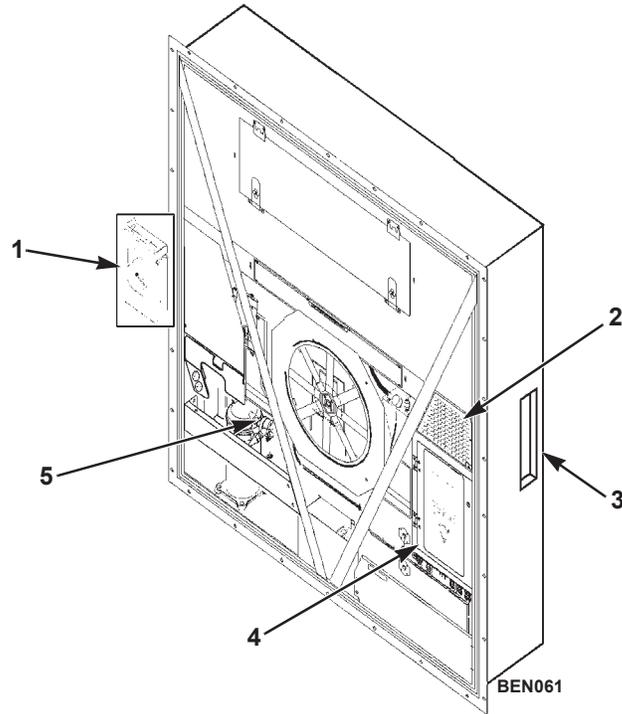


Figure 10: Water-Cooled Condenser/Receiver Tank

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

**Figure 11: Optional Components**

## Electronic Chart Recorder (Optional)

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

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

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

## Suction and Discharge Pressure Sensors (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.

## Water-Cooled Condenser/Receiver Tank (Optional)

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

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

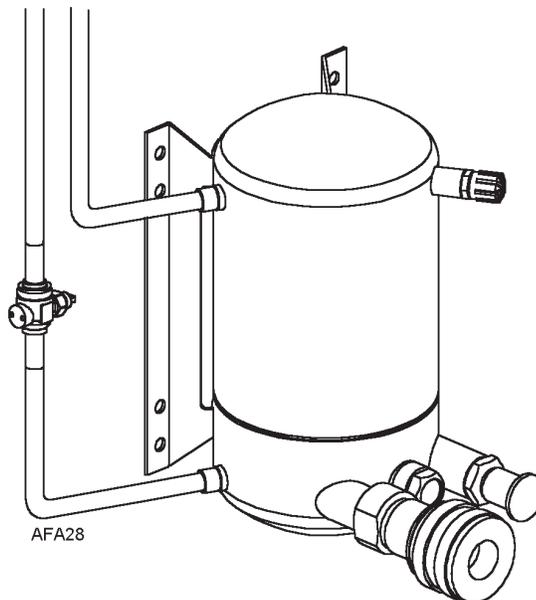


Figure 12: Water-Cooled Condenser/Receiver Tank

## Air Ventilation Logging (AVL - Optional)

AVL is used for detecting and logging the fresh air exchange position on the manual fresh air vent. The opening angle of the fresh air vent is converted to an output signal from approximately 2-5 volts. The disk opening is detected in steps of 0-125, 150, 175, 215 and 225 m<sup>3</sup>/hr. See “Air Ventilation Logging (AVL)” on page 112 for more information.

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

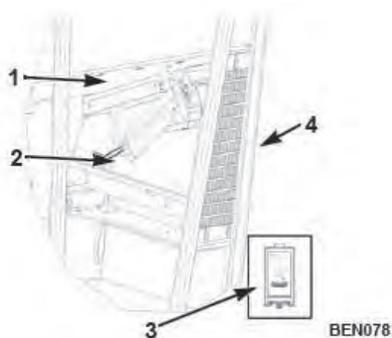
An advanced microprocessor controlled fresh air management system provides programmable control of air exchange rate, programmable delayed vent opening, automatic closure of air exchange vent during low ambient conditions, and data logging of air exchange rate and vent opening delay interval.

The AFAM system includes a door control module, vent door and vent grille. The MP-4000 controller sends a communication signal to the door control module to position vent door to desired position. The controller can also be set to delay opening of fresh air vent for up to 48 hours (in 1 hour increments). This allows faster product temperature pull-down.

See “Starting the AFAM System” on page 114 for more information.

### AFAM Operation

The system is pre-calibrated for air exchange rates of 0 to 225 m<sup>3</sup>/hr. (0 to 132 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 Module Board and Cable (mounts in Control Box)
4.	Grille

**Figure 13: 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.

## AFAM Vent Door Assembly

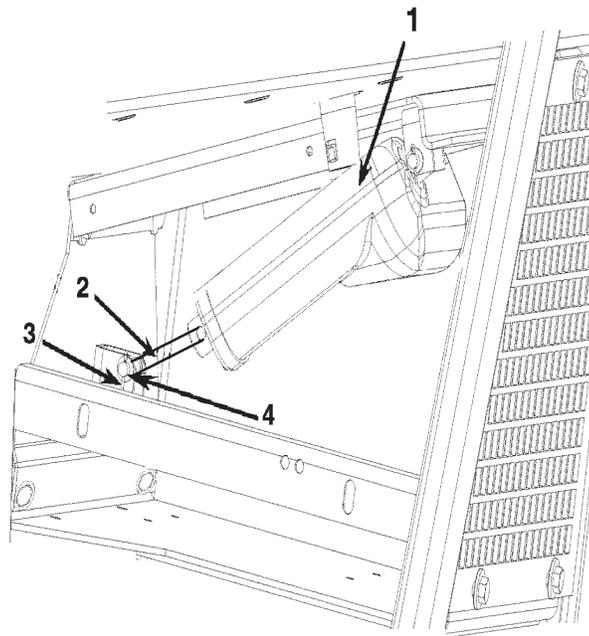
A microprocessor controlled vent door provides programmable control of the air exchange rate. The vent door is adjusted to the desired position by a vent door motor and linkage assembly, shown in Figure 14. The system is pre-calibrated for air exchange rates of 0 to 225 m<sup>3</sup>/hr. (0 to 132 ft<sup>3</sup>/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, AFAM). The Fresh Air Vent Man submenu should be set to AFAM to control the vent door to the fresh air exchange rate setting.

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

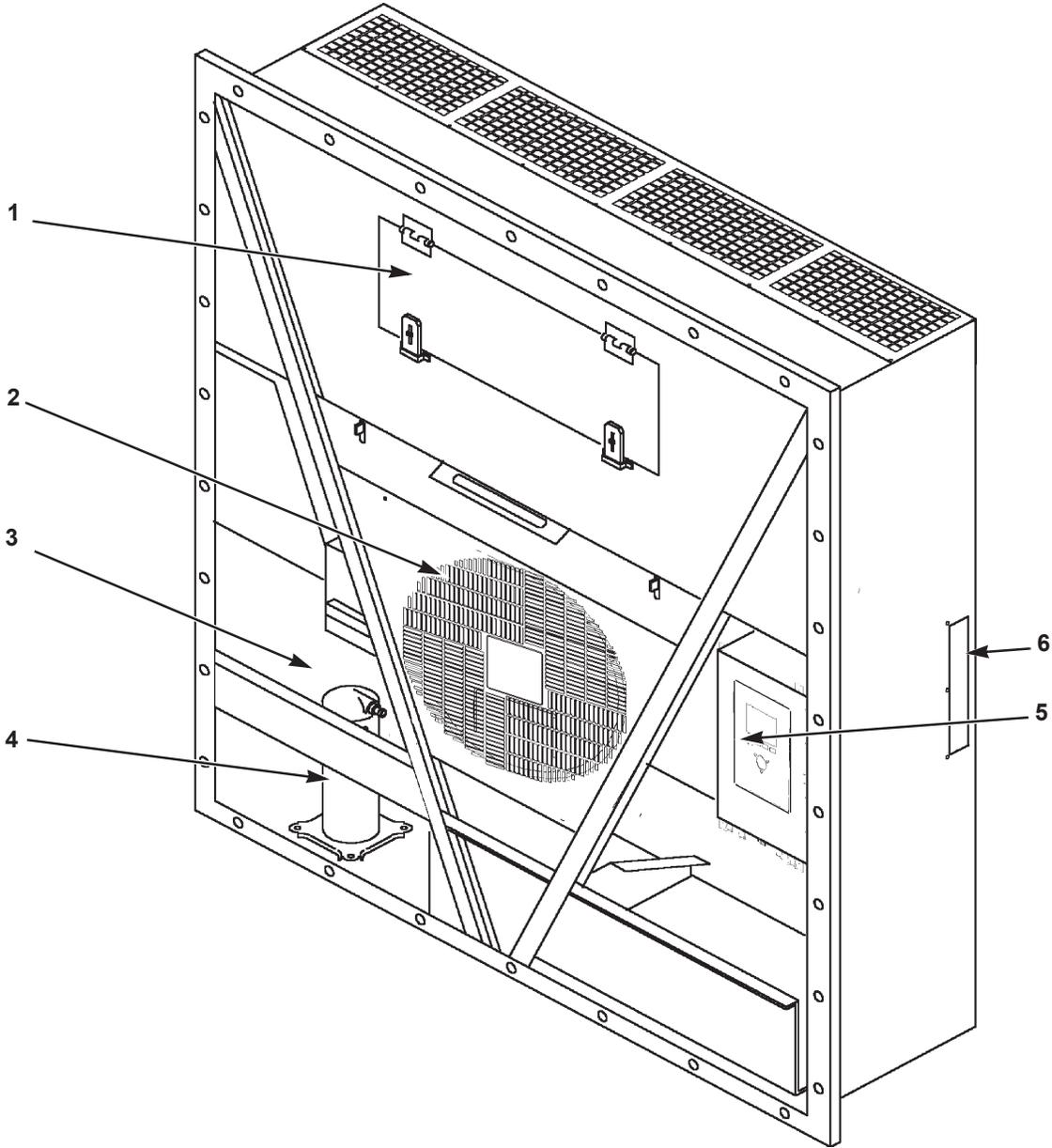


1.	Actuator
2.	Shaft
3.	Cotter Pins
4.	Pin clevis

Figure 14: Vent Door Adjustment

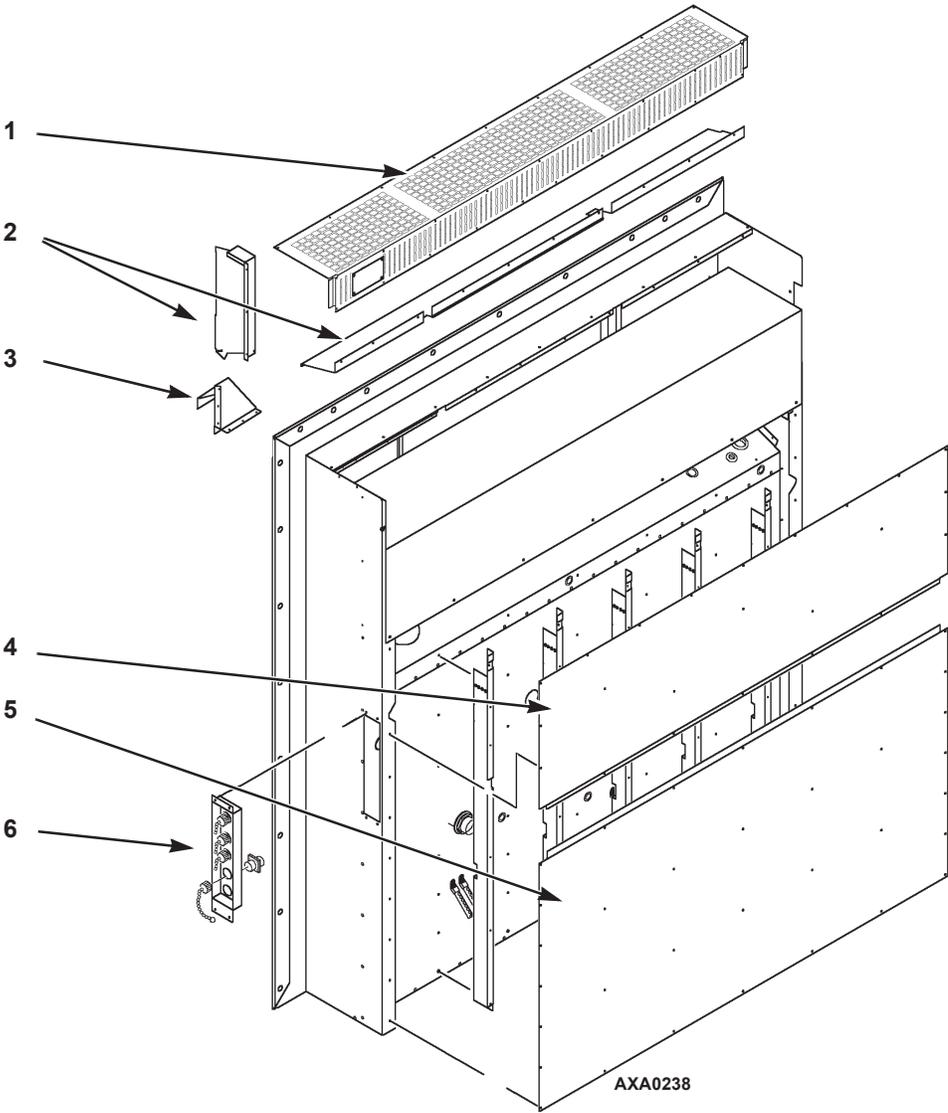
## Advanced Fresh Air Management Plus (AFAM+) System (Optional)

The Advanced Fresh Air Management Plus (AFAM+) System provides programmable control of the CO<sub>2</sub> level in the container. The controller can be set to control the CO<sub>2</sub> level in the container from 0 to 25 percent. See “Advanced Fresh Air Management Plus (AFAM+) System” on page 117 for more information.



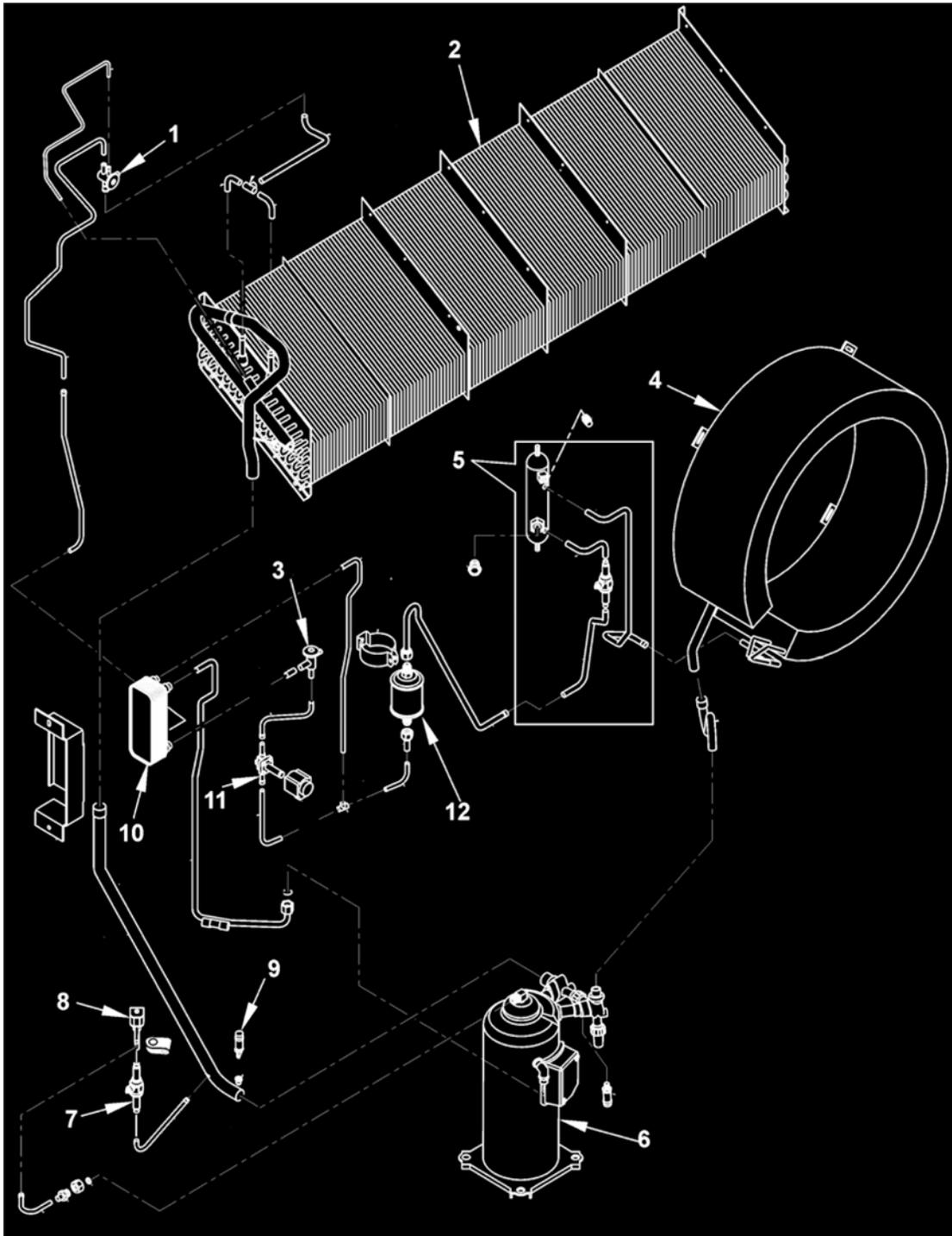
1.	Evaporator Access Door
2.	Condenser Fan
3.	Compressor Compartment
4.	Scroll Compressor
5.	Control Box
6.	Rear Download and USDA Receptacle Panel (Access from Inside Container)

Figure 15: Unit Front View



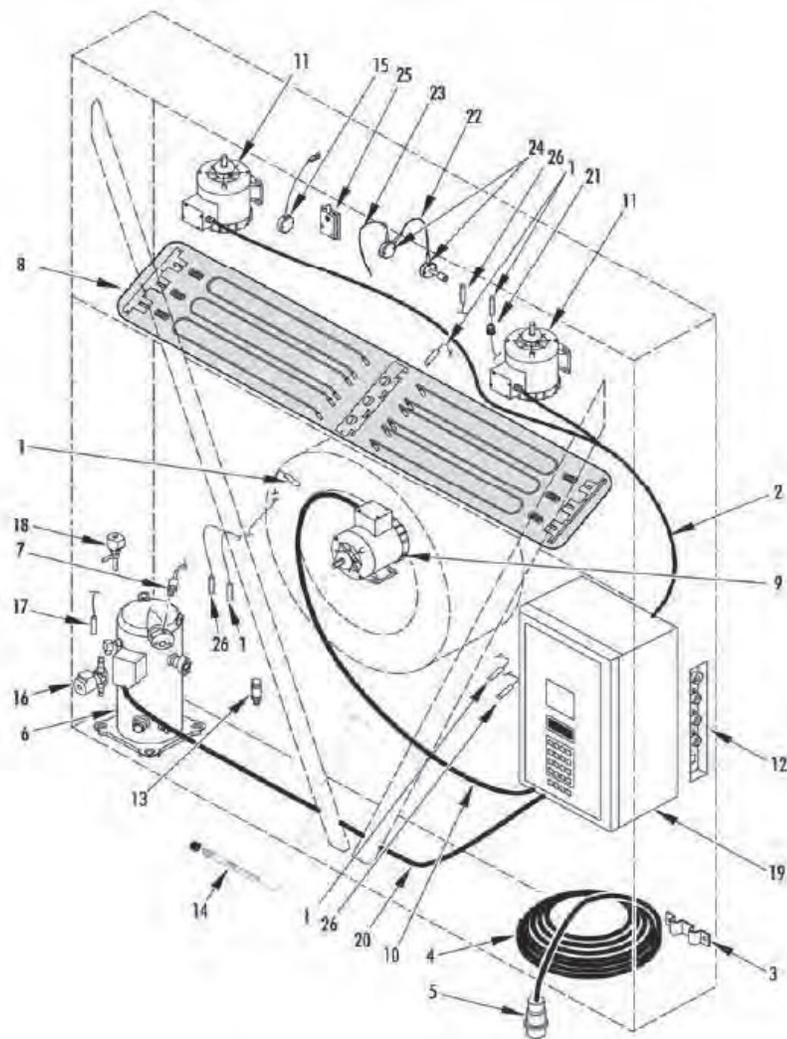
1.	Evaporator Grille
2.	Air Channels
3.	Fresh Air Inlet
4.	Top Rear Plate
5.	Bottom Rear Plate
6.	USDA Receptacle Panel: <ul style="list-style-type: none"><li>• Controller Communications and Data Download Port</li><li>• USDA1/Spare 1 Sensor Connection</li><li>• USDA2/Spare 2 Sensor Connection</li><li>• USDA3/Spare 3 Sensor Connection</li><li>• Cargo (Pulp) Sensor Connection</li></ul>

Figure 16: Unit Back View



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

Figure 17: Refrigeration System



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

Figure 18: Electrical Components

## Metric Hardware Torque Charts

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

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

\*HH = Hex Head, CL = Class.

# Controller Description

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## Controller Description

The MP-4000 is an advanced microprocessor controller. It has been specially developed for the control and monitoring of refrigeration units. The controller contains the following basic features:

**Temperature/Message Status Display:** •Temperature area. Displays Return air sensor, Supply air sensor, and Setpoint

- Message area. Displays Alarms, Message and Controller menu

**Keypad:**

- F1 – F4 Function keys navigate within the Status Display
- 2 Status LED indicators
- Special Function keys. ON/OFF, PTI, Defrost

## Controller Back-up Battery

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

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

## Controller Input and Output Signals

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

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

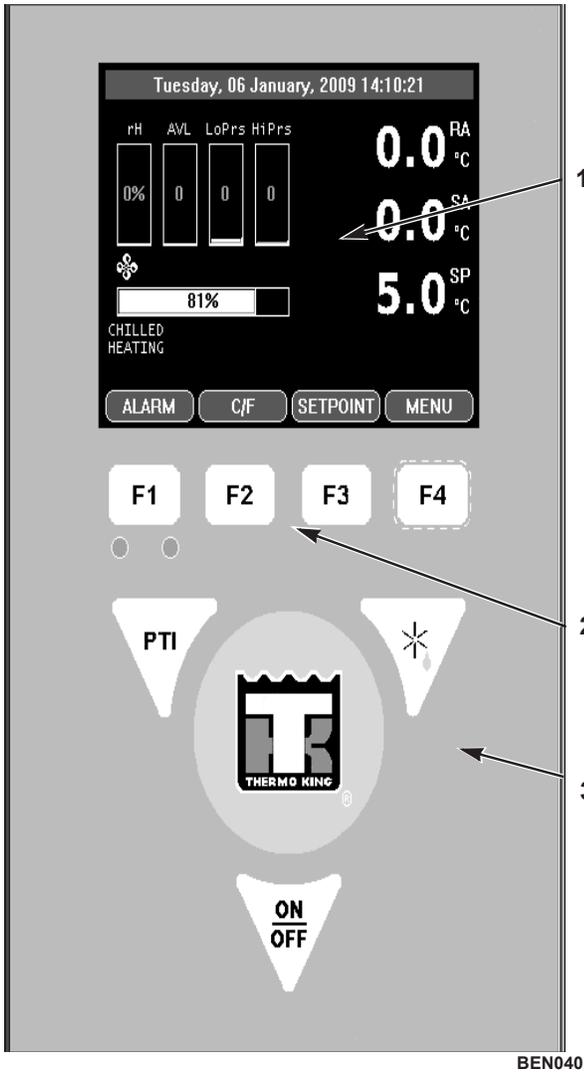
- Return Air Sensor
- Supply Air Sensor
- Evaporator Coil Sensor
- Condenser Coil Sensor
- Ambient Sensor
- Humidity Sensor
- USDA (Spare) Sensors 1, 2 and 3
- Compressor Discharge Line Temperature Sensor
- High Pressure Cutout Switch/Discharge Pressure Sensor
- Low Pressure Cutout Switch/Suction Pressure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

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

- Compressor operation
- Condenser fan operation

**Controller Description**

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



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

**Figure 19: MP-4000 Controller Display Panel**

## Standard Display

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

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

Once a key is pressed the Standard display will change to the Unit Status Display. After 2 min of no key activity the display will return the Standard display.



Figure 20: Standard Display

## Idle Screen

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



The happy face => everything is OK



The Disgruntled face => we do have a warning



The unhappy face => we do have an alarm

## Checkmark Symbol



The checkmark symbol indication that a Smart PTI has recently been running and no problems was found.

The checkmark will only be shown in the normal operation state. This symbol will appear at the left hand corner of the idle screen display.

Unit Status Display

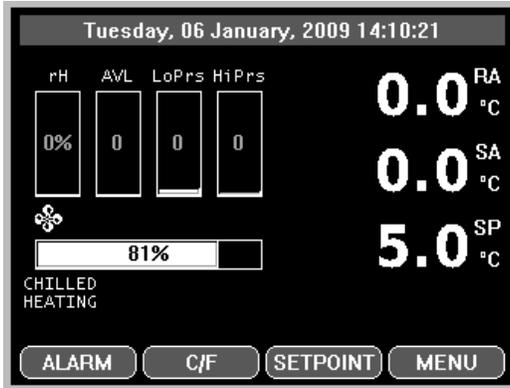


Figure 21: Unit Status Display

The Unit Status display will show.

Looking at the display from top to bottom

- Date and Time / Alarm Warning
- rH Relative Humidity sensor
- AVL Door Position/AFAM+
- LoPrs Low Pressure Transducer
- HiPrs High Pressure Transducer
- RA Return air sensor
- SA Supply air sensor
- SP Setpoint
- Mode Icons Compressor ON, Heater ON, Evap Fan ON
- Capacity Bar Graph Percentage of mode (100% is full on)
- Mode Description unit operation
- F1 – F4 Key Functions ALARM C/F SETPOINT MENU

Glossary of Symbols

	- Alarm
	- Pretrip Inspection / Test in Progress
	- Heating
	- Evaporator Fan High Speed
	- Evaporator Fan Low Speed
	- Condenser Fan On
	- Watercooled
	- Dehumidification
	- Defrost

### Glossary of Symbols (Continued)

	- Compressor On Unloaded
	- Compressor On loaded without Vapour Injection
	- Compressor On loaded with Vapour Injection
	- SmartPTI has recently been running and no problems found
	- Controlling mode optimized
	- Controlling mode economy
	- Bluetooth
	- Cell Phone
	- GPS Signal
	- RMM
	- Battery Full (Datalogger Battery)
	- Battery Charging (Datalogger Battery)
	- Battery state not known. Temperature too low or high, charger suspended. (Datalogger Battery)
	- Battery Error (Datalogger Battery)

## Glossary of Mode Descriptions

### Chilled/Cooling

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

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

### Chilled/Heating

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

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

### Frozen/cooling down

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

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

### Defrost

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

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

### PTI

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

## Function Keys

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

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



Figure 22: Function Keys

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

### Indicator LEDs

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

<b>Green Led</b>	Flashing	Temperature approaching in-range
	Solid	Temperature In-Range
<b>Red Led</b>	Flashing	Alarm present and has not been acknowledged
	Solid	Alarm present and has been acknowledged

### Three Special Function Keys

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

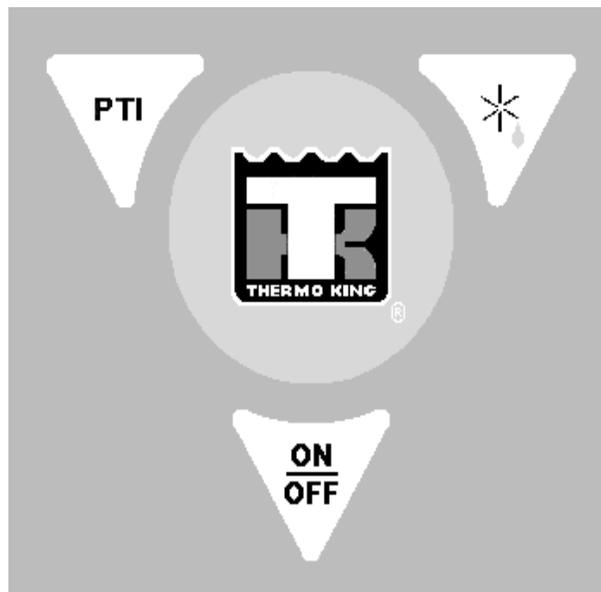


Figure 23: Special Function Keys

<b>PTI</b>	Pre-Trip Inspection
<b>*</b>	Defrost
<b>ON OFF</b>	Unit On/OFF Control

## MP-4000 Software

The various software versions are listed below.

### Software Version 2.3.4 100927

Release Date	New Features
September 2010	<p><b>Unit Running No Display</b> If PTI key is pressed before unit is up and running, unit could run with no display. Added time delay to key function.</p> <p><b>OOCL Unit Features Added for MAGNUM SL 211</b> Unit runs non optimized mode OOCL Defrost termination OOCL PTI rules</p> <p><b>RMM+ Added for TAL</b> TAL prefixes allowed for the RMM+ option</p> <p><b>Shorter Logging Intervals Default OFF</b> 1 min and 5 min logging, after 24 hrs default back to 1 hour logging 15 min logging after 30 days default back to 1 hour logging 30 min logging will not default back</p> <p><b>Index for Event with RMM+</b> Added index to events for RMM+</p>

## Software Version 2.3.6 110301

Release Date	New Features
April 2011	<p><b>Cold Treatment Feature</b> Cold Treatment (CT) has been added for all prefixes except OOLU.</p> <p><b>Multi Temperature Settings</b> Multi Temperature settings has been add for all prefixes (including OOLU).</p> <p><b>Chilled PTI Chilled</b> PTI test only has been added as a selection under the COMMANDS menu. Test will end after MAINTAINING 0C (32F) TEST is completed.</p> <p><b>Cold Ambient Battery Issue</b> Heater remains OFF for the first 10 min of unit operation. Once energized will monitor voltage, if decreased will de-energized heater for 30 min, repeat.</p> <p><b>Warning Message 39 Battery Error added</b> After battery heater is energized and controller does not see temperature rise, will active Warning 39 Battery Error before Alarm 123 Datalogger Battery Error.</p> <p><b>PTI Pull Times Logged</b> During PTI tests, FULL and CHILL, the pull down or Approaching times are logged. Need Logview version 5.9.8 or higher to view.</p> <p><b>Warning 38 HIGH VOLTAGE ON LINE</b> High voltage max limit has been increased from &gt;505 VAC to &gt;515VAC.</p> <p><b>Power Limit Mode Based on Condenser Temperature</b> If condenser temperature is &gt;64 C unit will enter power limit mode.</p> <p><b>AFAM Door Closes HLX</b> Units with prefix HLX. The AFAM door will close when Power OFF key is pressed.</p> <p><b>MTS and CT Disabled after PTI</b> After a PTI is completed or unit OFF for &gt;5 days, MTS and CT will be disabled.</p> <p><b>RMM Enables for UACU Units</b> MP4000 has the RMM built in. RMM features enables for prefixes UACU473411 to UACU473710 (300 units).</p> <p><b>Discharge Pressure now in Data Menu</b> Discharge pressure can now be viewed in the DATA MENU, if no transducer it will be calculated using Condenser and Ambient temperatures.</p> <p><b>Mode Flags Added</b> Mode flags for MTS, CT, Ca, and Capacity Limitation added to the Temperature log.</p> <p><b>Defrost Termination Temperature and Interval Hours Limited</b> When USDA is ON, user can adjust defrost termination temperature from +4C to +18C or Interval time from 3 hours to 12 hours. OOCL request, all users</p> <p><b>Trip Start All Temperature Logged</b> When a Trip Start is activated all temperature sensors and RH is logged. Needed for Logview function.</p> <p><b>AFAM PTI Added</b> AFAM PTI added to COMMAND menu.</p> <p><b>Gas Sensor to be OFF when not Selected</b> To save the life of the gas sensor if AFAM+ is not selected sensor will be not be power ON/</p> <p><b>Backlight ON</b> Display backlight will be on all the time.</p> <p><b>Event Log Available in display</b> Can now view the Event Log on the display. 100 logs back</p> <p><b>Display timer</b> Main display idle for 5 min, Display goes to scroll every 3 sec Set point to Controlling Sensor Temperature. Additional 5 min goes to scroll every 3 sec Smiley Face to Controlling Sensor Temperature</p>

**Software Version 2.3.7.0 110608**

Release Date	New Features
June 10, 2011	<p><b>MTS and CT Feature Selectable</b>                      MTS and CT must be selected through the CONFIGURATION/OPTIONS menu, "MTS FEATURE ON/OFF" oCT FEATURE ON/OFF". CT is not allowed with OOCL prefix.</p> <p><b>MTS Feature Selects Present Set Point</b>                      MTS feature will now select the present set point as first set point and not the last MTS set point.</p> <p><b>USDA Trip Defaults OFF</b>                      When all the USDA sensors are removed from unit, the USDA feature will default to OFF.</p> <p><b>Dehumidify Improvement</b>                      Unit running dehumidify the evaporator fans will change momentarily from low to high every hour, to blow water off coil</p> <p><b>Battery Heater Disabled</b>                      If battery sensor errors battery heater will be disabled.</p> <p><b>Compressor Temperature Reading</b>                      Compressor sensor reading returns to the data menu.</p> <p><b>Heating Element Type</b>                      Heating element type has been added to CONFIGURATION/UNIT CONFIG menu. Units with 3 heaters show "EXTENDED CAPACITY" unit with 6 heaters show "NORMAL CAPACITY".</p> <p><b>C to F or F to C Display Change</b>                      Press the C/F key to change the display from C to F or F to C, if another key is pressed or display returns to main display, display will return to original C or F.                      To permanently change the display from C to F or F to C, press and hold the C/F key. Message will appear ARE YOU SURE? Select YES or NO to change.                      Permanent display change not allowed with OOCL or HL prefix</p> <p><b>Viewing Event or Temperature Logs in Display</b>                      Now can select under DATALOGGER/INSPECT LOGS. INSPECT EVENT LOGS, INSPECT TEMPERATURE LOGS, INSPECT SMART LOGS (Event/Temp logs together) on main power or battery power.</p>

**Software Version 2.3.8.0 110628**

Release Date	New Features
June 29, 2011	<p><b>Padlock Option</b></p> <p>The Keypad Lock feature has been added for all customers. In PADLOCK state no user intervention is allowed. Option is found in CONFIGURATION/UNIT SETTING/PADLOCK OPTION. Default is OFF. Select PADLOCK OPTION and select ON, press hold the F4 key to lock. PADLOCK will default OFF after 3 days power OFF or after software flashload. To unlock press any key and display will show UNIT LOCKED Please enter right key to unlock unit.</p> <div><p><b>UNIT LOCKED</b></p><p><b>This unit TKMU1234566 is locked Please enter righth key To unlock unit</b></p><p><b>20</b></p><p><b>Use UP and DOWN To change key press ACCEPT to unlock.</b></p><p><b>EXIT</b></p><p><b>DOWN</b></p><p><b>UP</b></p><p><b>ACCEPT</b></p></div>

## Software Version 2.4.0.0 111220

Release Date	New Features
January 2012	<p><b>MP4000 Test System Tool</b> Introduce field tester system tool (8232-010) functionality.</p> <p><b>Alarm 127 GENERAL UNIT ERROR</b> Introduced Alarm 127 GENERAL UNIT ERROR shut down alarm. If controller is missing needed information to run alarm will be set and unit will shut down. Possible errors could be low voltage, no probe information (plug out), setpoint information or other vital information to run. Correct error and acknowledge alarm.</p> <p><b>Alarm 52 PROBE ERROR</b> Have reintroduce Alarm 52 PROBE ERROR. Sensor evaluation during the PTI test and/or Probe Test. During the probe test if the test cannot determine which sensor is wrong, alarm 52 PROBE ERROR will be set. SA, RT, EC sensor difference &gt;1.5C</p> <p><b>Alarm 120 SUCTION PRESSURE SENSOR ERROR</b></p> <p><b>Alarm 31 LOW PRES CUTOUT</b> Alarms were being set on power ON and OFF. Power ON pressure reading based on ambient were outside sensor range. Power OFF voltage deteriorating and sensor reading inaccurate. Introduced transducer surveillance.</p> <p><b>Evaporator Fan Speed Option</b> For prefixes NFLU and SONS with frozen setpoint, evaporator fans will run high speed until -9.9C then switch to low speed fans</p> <p><b>MTS Defaulted OFF on Power OFF</b> MTS setting would default OFF after a power OFF. Controller will retain setting until power OFF period 5 days or pass PTI is passed.</p> <p><b>COLD Treatment for HL</b> CT mode for HL will run in non optimized high or low speed evaporator fans all the time.</p> <p><b>Humidity Controller</b> If humidity sensor is defective or removed, humidity controller is disabled.</p> <p><b>AFAM+, AFAM Disable in Frozen Mode</b> AFAM functionality and CO2/O2 setting disabled in frozen mode.</p> <p><b>AFAM Introduced</b> Introduced AFAM option and HL special features  AFAM door closes after ON/OFF key is press OFF  5 day period OFF, for HL remains ON  After pass PTI will default OFF  Setpoint to 10C only after pass PTI</p> <p><b>RMM+ Controller Clock Update</b> Controller and server date and time must match. If they do not match the controller date and time will be updated to the server GMT time and date.</p> <p><b>RMM Built in Option</b> Added prefixes TEMU905600 through 908379 for RMM option.</p> <p><b>RMM+ Graphics</b> Introduced graphics to show connection state for the RMM+ option. Icons will appear above the RA temp in the main menu. Cell tower and satellite icon.</p>

## Software Version 2.4.2.0 120313

Release Date	New Features
April 2012	<p><b>RMM Built in Option</b> Added prefixes TEMU911630 through 9912129 and ACLU596901 through 597000 for RMM option.</p>

## Software Version 2.4.3.0 120628

Release Date	New Features
June 2012	<p><b>RMM Built in Option</b>  Added prefixes FOR RMM option  TEMU915380 through 915579  GCNU880256 through 880455  CGNU800050 through 800099</p> <p><b>Optimize (OPT)</b>  Icons indicating controlling mode OPT have been added to the state/Icon line of the standard display.</p>  <p><b>Cooling Capacity Surveillance</b>  Unit with CMC* and CHDU prefix only. If controller detects that the unit has no capacity, controller will shut off compressor, condenser fan, and evaporator fan and Message 27 SYSTEM LOW PRESSURE – CHECK REFR CHARGE.</p> <p><b>AFAM PTI Selectable</b>  If unit has AFAM option, PTI for AFAM will be selectable. Before it showed AFAM+. If unit has AFAM+ option, PTI for AFAM+ will be selectable.</p> <p><b>Humidity Control Fan Change</b>  Unit with Dehumidify Control ON and operational. After Defrost ends evap fans will run in High speed for 5 sec to remove additional water from coil.</p> <p><b>Humidity and AFAM+ PTI</b>  If Return temperature is &lt;5C Humidity and AFAM+ will not run. Unit will preheat until Return is &gt;5C then run PTI.</p> <p><b>AFAM+ Auto Configuration</b>  If AFAM+ is selected user must select it to be OFF or AFAM. Auto detect of this option has been removed.</p> <p><b>HL AFAM</b>  HLXU prefixes only. If AFAM is set for Units and the value is &lt;26CMH. Door will not go to a set position, door will pulse open and closed to equal the CMH needed.</p> <p><b>PTI Aborted Event</b>  If PTI is aborted by unplug or switch off. Event will show in the log to indicate test is ended before its time.</p> <p><b>Setpoint Range +35C to -40C</b>  Prefix CRSU only. Setpoint range +35C to -40C is allowed.</p> <p><b>SmartPTI Event</b>  Before SmartPTI would show in the event logger even if option was not selected ON. SmartPTI option must be selected for it to show in the logger</p> <p><b>SmartPTI Thumbs Up</b>  SmartPTI thumbs up will now show has a Icon in the standard display on the Icon line next to the compressor Icon.</p>

## Software Version 2.5.0.0 121121

Release Date	New Features
November 2012	<p><b>RMM Built in Option</b>                      Added prefixes FOR RMM option.                      TEMU908680 through 909879                      TEMU917080 through 917379</p> <p><b>Display Contrast Improvement</b>                      Have improved temperature compensation on adjusting display contrast.</p> <p><b>Gas Sensor ON/OFF Handling</b>                      Change to help extend sensor life. After unit startup heater and LED in gas sensor will be active for 5 minutes. If AFAM+ option is not active gas sensor function will be turned OFF. If AFAM+ option is active sensor will remain ON.</p> <p><b>Humidity Operation</b>                      In the past dehumidification was allowed once cargo temperature was in range. Now Dehumidification is allowed during pull down.</p> <p><b>Setpoint Change on Battery</b>                      Reports of setpoint change on battery not being saved. Improved power ON start up sequence. Improved power OFF shutdown sequence. After 25 second Display timer times out SHUTTING DOWN will be shown on displayed, keypad function will be deactivated.</p> <p><b>Frozen Optimized Mode</b>                      First time pull down low limit has been changed from 4 below to 2 below setpoint.</p> <p><b>Modbus Handling Changed</b>                      When option were added to the Modbus (AFAM+, RMM+,...) system would ask once and if option was busy system would not detect or give error message. Now system ask several times to add devices and confirm sensor errors before setting alarms.</p>

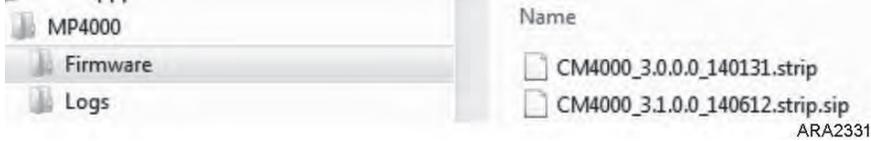
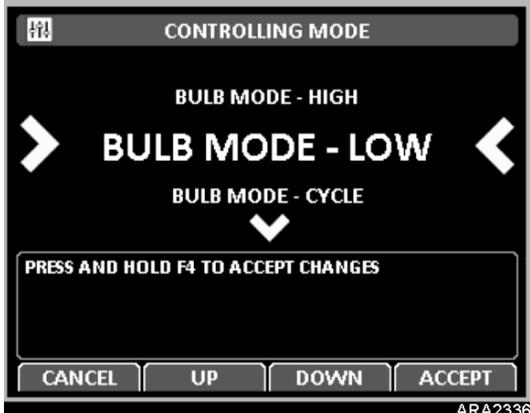
## Software Version 2.5.1.0 130213

Release Date	New Features
February 2013	<p><b>Alarm 137 Sensor System Overload</b> Introduced Alarm 137 Sensor System Overload. If a short occurs on one of the analog inputs, humidity sensor, compressor sensor, transducers, it causes an overload to the converter circuit and the controller will display invalid readings. The controlling PT1000 sensors input are not affected. Check analog circuit if alarm occurs.</p> <p><b>Alarm 140 Evaporator Section Too Hot</b> Introduced Alarm 140 Evaporator Section Too Hot. If SA, RA, EC sensor readings are &gt;60C alarm is set. Check heater circuit.</p> <p><b>Alarm 98 Compressor Temperature Sensor Short Circuit</b> If ambient is &lt;10C compressor sensor could have resistance value low enough to indicate OPEN. Sensor is not looked at if ambient is &lt;10C.</p> <p><b>Phase Check</b> If heaters are not functioning on start up the controller will use fans to determine correct phase.</p> <p><b>Setpoint of +45</b> Setpoint allowed for prefix TLTS. Range -40 to +45.</p> <p><b>RMM Option</b> Added prefixes for RMM option WHLU7800011 to WHLU7802502</p> <p><b>SmartPTI Thumbs Up changed</b> Have changed the SmartPTI thumbs up icon to a check mark.</p> 

## Software Version 2.5.3.0 130424

Release Date	New Features
May 2013	<p><b>Cold Storage Defrost Feature</b> Allowed on units with prefixes TCLU, CCCU, BCHU. Feature is selected by choosing "DEFROST SEQUENCE". Intervals can be selected between 2/3/4/6/8/12 hrs. Defrost termination temperature must be select under "DEFROST TERMINATION TEMPERATURE". Defrost internal are controlled by wall clock. The standard timed defrost, surveillance activated defrost (Auto), and de-hum activation defrost are disabled.</p> <p><b>SmartPTI Feature</b> Trail period extended to 1 year for prefix HLXU and TCLU120103-120602 Enabled for prefix TCLU119XXX Enabled for prefix YMLU527667 and YMLU527364, include RMM</p> <p><b>O2 Sensor Calibration AFAM+ PTI</b> OOLU prefix only. O2 sensor calibration feature has been added back to the AFAM+ PTI. 17% - 25% reset to 20.8%. If below or above set alarm 69 GAS ANALYSER CALIBRATION.</p>

## Software Version 3.1.0.0 140612

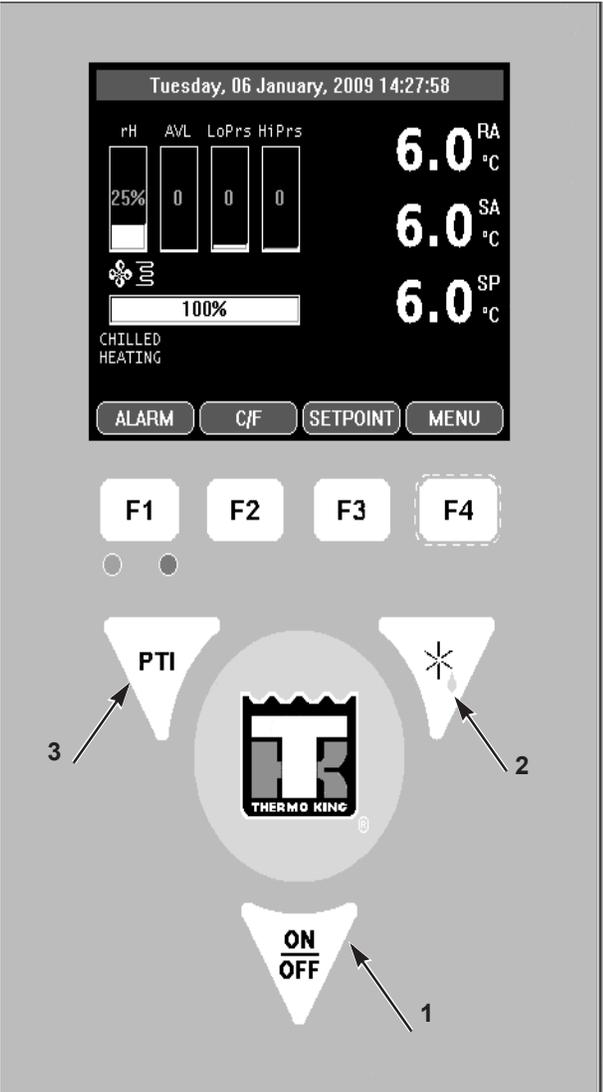
Release Date	New Features
June 2014	<p><b>Software File Format SIP</b></p> <p>In version 3.0.0.0 we introduced the SIP file format for adding options like RMM to the unit. Version 3.1.0.0 120612 is released in this SIP format.            CM4000_3.1.0.0.120612.srip.sip            In order to load version 3.1.0.0 software the MP4000 controller needs to have 3.0.0.0 software installed first.            Load to SD Card file contains both 3.0.0.0 and 3.1.0.0 software.</p>  <p>If controller has 3.0.0.0 software installed, insert SD card to load 3.1.0.0            If controller has 2.5.4.0 or older software, insert SD to load 3.0.0.0 software. Then reinsert SD card to load 3.1.0.0 software.</p> <p><b>Alarm 60 Humidity Sensor</b></p> <p>Alarm 60 Humidity sensor error occurred during PTI mode. During the PTI will only look at sensor in Chill mode, If sensor is open circuit or failed communication.</p> <p><b>Alarm 68 CO2/O2 Sensor Error</b></p> <p>Need to allow CO2/O2 sensor to warm up for 20 minutes before testing. Have move test to the end of the PTI.</p> <p><b>Bulb Mode</b></p> <p>Bulb mode has been added to the available Controlling modes.            Bulb mode HIGH Evap fan HIGH            Bulb Mode LOW Evap fan Low            Bulb mode Cycle Evap fan CYCLE – Low and High.</p> 

## Software Version 3.2.0.0 140822

Release Date	New Features
August 2014	<p><b>RMM Option</b> Container prefixes have been added for the RMM option. SUDU118000 – 118999, SUDU806000 – 807699, SUDU808000 – 808799</p> <p><b>SMART PTI Option</b> Container prefixes have been added for the SMART PTI option. BCHU140X, BCHU150X, BCHU240X, BCHU250X, DCHU251X, BCHU267X, BCHU596X</p> <p><b>Humidity Sensor Alarm 60</b> Criteria for humidity sensor surveillance have been improved. If unit has an Alarm 60, software 3.2.0.0 should be upgraded first before replacing any humidity sensors. PTI – Return air temp must be &gt; -1C, last defrost must be 5 min past Normal run – Chill mode, Humidity control ON, Return air temp must be &gt;-10C, last defrost must be 5 min past.</p> <p><b>PTI HPCO Test</b> PTI detection of a failing HPCO switch has been improved.</p>

# Operating Instructions

## Function Keys



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

Figure 24: Function Keys

## Unit On/Off Key



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

## Sequence Of Operation

### Unit Start-up

Connect unit to 460 Volt shore power or genset.

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

- Display will show date and software revision

Press and Hold ON/OFF key for 2 seconds

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

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

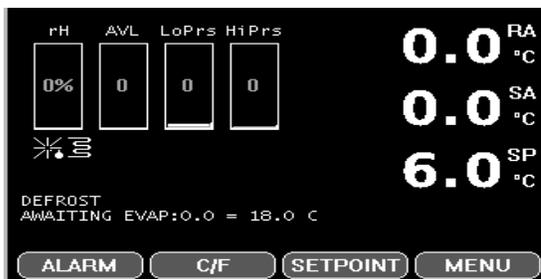
**NOTE:** Random time delays during the initial unit start-up minimize peak current draw.

### Initiating a Manual Defrost



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

Complete the following steps:



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

- If the unit operating conditions allow a manual defrost (e.g. evaporator coil temperature is less than 18 C [56 F]), the unit enters Defrost.

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



## PTI

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

Complete the following steps:

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



During testing the screen is divided into 3 sections.

### Section 1:

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

List of possible states:

Awaiting: the test has not yet been performed.

Testing: the test is ongoing.

Pass: the test has been tested, with the result Pass.

Fail: the test has been tested, with the result Fail.

Skipped: the test is skipped, based on conditions.

### Section 2:

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

### Section 3:

This section displays actual readings and the expected power consumption.



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

**NOTE:** Detailed PTI test results are stored in the MP-4000 Datalogger for later viewing. Any alarm codes recorded during the test can be viewed through the controller's Alarm List menu at the end of the test.



## Viewing Alarms/Warnings

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

Complete the following steps:

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

**NOTE:** See a full List of Alarm and Warning codes on p. 72 of this manual.



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

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

Complete the following step:

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

To change the display to C or F permanently,

press and hold the F2 C/F key, then confirm "ARE YOU SURE YES or NO. Some customers do not allow the display to be change permanently.



## Changing Setpoint

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

Complete the following steps:

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

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

**NOTE:** Watercool, Humidity Control, Humidity Setpoint, Defrost Terminate Temp, Defrost Internal, and USDA Trip can be set from the Setpoint menu. See "Setpoint Menu" under "Menu Operating Instructions" in this chapter.



## Main Menu

To view the main menu, turn the **UNIT ON**. Allow Unit to start and stabilize.

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

## Lock Padlock

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



Figure 25: Lock Padlock

## Controller Back-up Battery

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

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

## Controller Lockup Issue

There have been reports of MP4000 controllers with 2.5.4.0 software, not restarting while changing power sources without turning unit off. If a controller is found with no display and unit not running, follow this procedure.

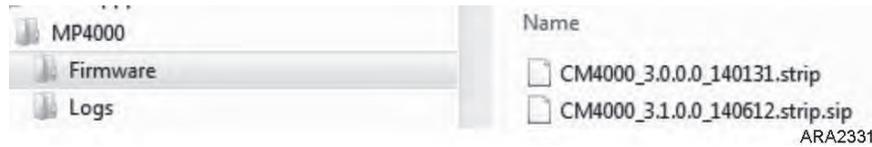
1. Unplug the unit or turn OFF the main circuit breaker in the control box.
2. Disconnect the battery found on the back side of the controller.
3. Wait 30 seconds then plug in the battery.
4. Plug in unit or turn the main CB back ON.
5. Turn unit ON by pressing the ON key.
6. Controller will now restart.

Install the latest MP4000 software (3.1.0.0 or later) in the controller before releasing unit. If unit has 2.5.4.0 software or older than you need to install 3.0.0.0 software before you can load 3.1.0.0.

The latest software can be found on the Thermoking.com web site under iService/Global Marine Solution Info Central/Software Updates/MP4000/CM4000 Load to SD Card.zip. Be sure to download the zip file to your computer to unzip it, DO NOT unzip from the web site.

In order to load version 3.1.0.0 or later software the MP4000 controller needs to have 3.0.0.0 software installed first.

Load to SD Card file contains both 3.0.0.0 and 3.1.0.0 or later software.



**Figure 26: Load Software to SD Card**

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

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

## Emergency Run Mode

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

### Rotation Check

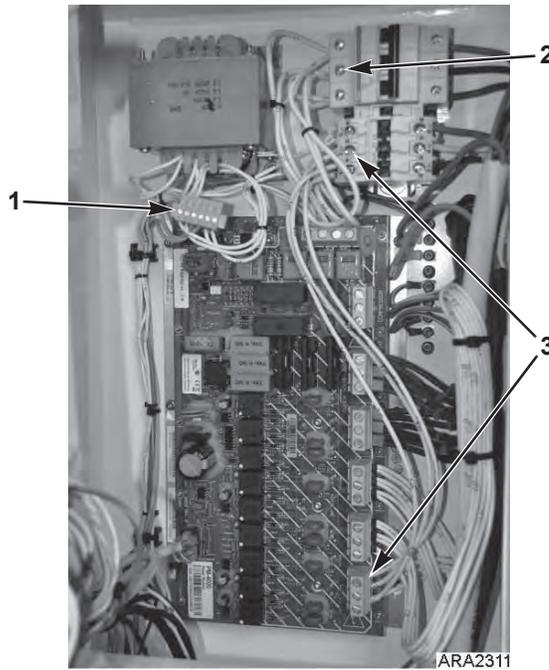
1. Unplug unit and turn OFF the main circuit breaker (CB) located in the controller box.
2. Remove the compressor wires CP1, CP2, and CP3 from J5 on the PM and connect them to the output side (left side) of the main CB. Figure 28 on page 60.
3. Make up 3 16 GA (2 mm) jumper wires 16” long (400 mm), mark them CF1, CF2, CF3. Connect the wires from J11 terminal on the PM and connect the other end to the input (left side) of the compressor contactor. Be sure to maintain the wiring 1-1, 2-2, 3-3. See Figure 28 on page 60.



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

**Figure 27: Make Jumper Wires**

4. Located J1 connector top left side of PM, disconnect J1 connector from PM. See Figure 28 on page 60.



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

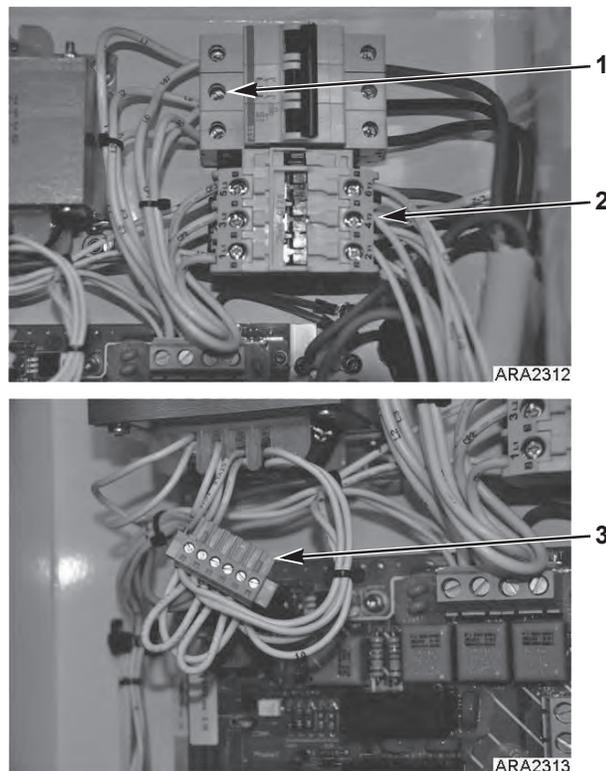
**Figure 28: Rotation Check**

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

## FULL COOL Mode

1. Unplug unit and turn off the CB located in the controller box.
2. Remove the Condenser Motor wires CF1, CF2, and CF3 from the input side of the compressor contactor, installed during the Rotation Check. Re-tighten input wires.
3. Remove the Low Speed Evaporator wires EF1, EF2, and EF3 from J10 on the PM.
4. Connect the CF and EF wires to the output side (right side) of the compressor contactor. Be sure to maintain wiring 1-1 2-2 3-3. See Figure 28 on page 60.
5. Locate J1 connector top left side of PM. Disconnect J1 connector from the PM. Install 3 18 GA 3” long jumper wires on the J1 connector. Leave J1 disconnected during cool mode. See Figure 28 on page 60.
  - a. Pin 1 (wire 29VAC 0) to pin 6 (wire CC1).
  - b. Pin 2 (wire 29VAC 1) to pin 3 (wire HPCO-0).
  - c. Pin 4 (wire HPCO-1) to pin 5 (wire CC0).
6. Plug unit into, turn main CB ON and OFF to maintain box temperature. If compressor runs backward but the fans run correct, swap the Red and White wires on the output side of the compressor contactor.

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

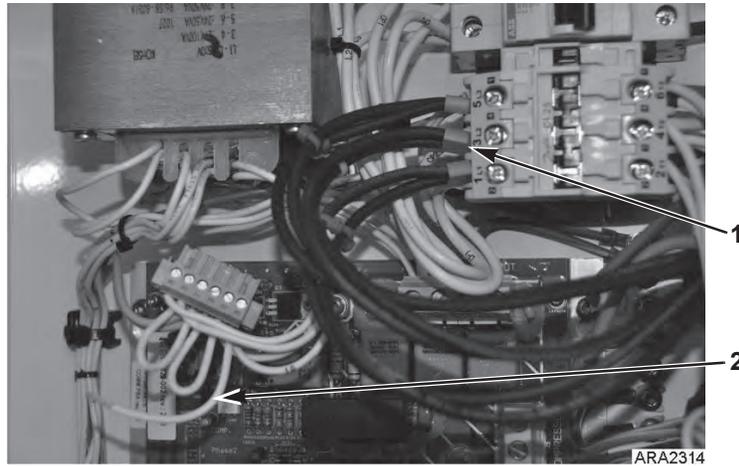


1.	CP Wires Connected to Output Side of Main CB
2.	CF and EF Wires Connected to Output of Compressor Contactor
3.	J1 Connector Disconnect from PM

Figure 29: FULL COOL Mode

## DEFROST Mode

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



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

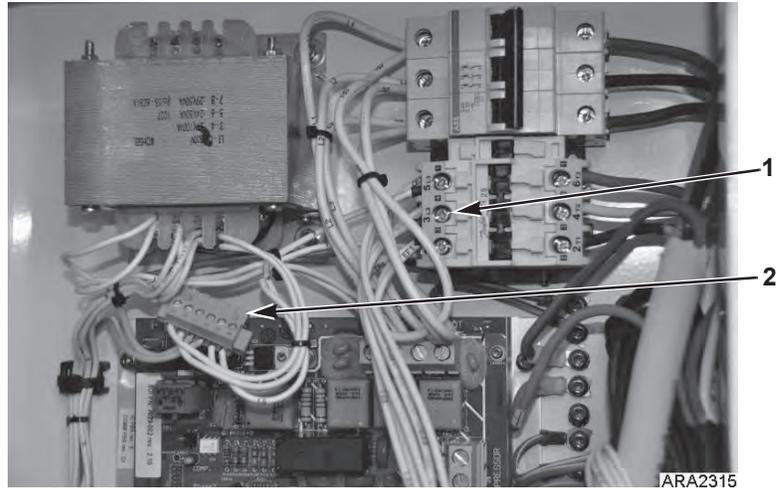
**Figure 30: FULL COOL Mode**

3. Disconnect the black heater wires (not Brown wire) from J7 on the PM and connect them to the input side (left side) of the compressor contactor.
  4. Plug unit in and turn main CB ON to defrost coil and OFF once no water is going from drains.
- IMPORTANT: DO NOT LEAVE THE HEATERS ON FOR MORE THAN 1 HOUR. When running a unit in Defrost mode DO NOT leave unit unattended.**
5. To return to the FULL COOL mode. Turn main CB OFF and unplug unit Remove the heater wires from the compressor contactor and re-tighten the input wires. Reinstall the jumper wire on J1 connector pin 1 to pin 6.

## High or Low Speed Fans Only

1. Unplug unit and turn main CB OFF located in the control box.
2. Locate J1 connector disconnected in the FULL Cool mode. Disconnect the jumper wire from pin 1 to pin 6.
3. Disconnect EF1, EF2, EF3 for low speed from J10 or EF11, EF12, EF13 for High speed from J9
4. Depending on what speed connect the EF to the output side of the compressor contactor (left side).
5. Plug unit in and turn main CB ON and OFF to maintain box temperature.

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

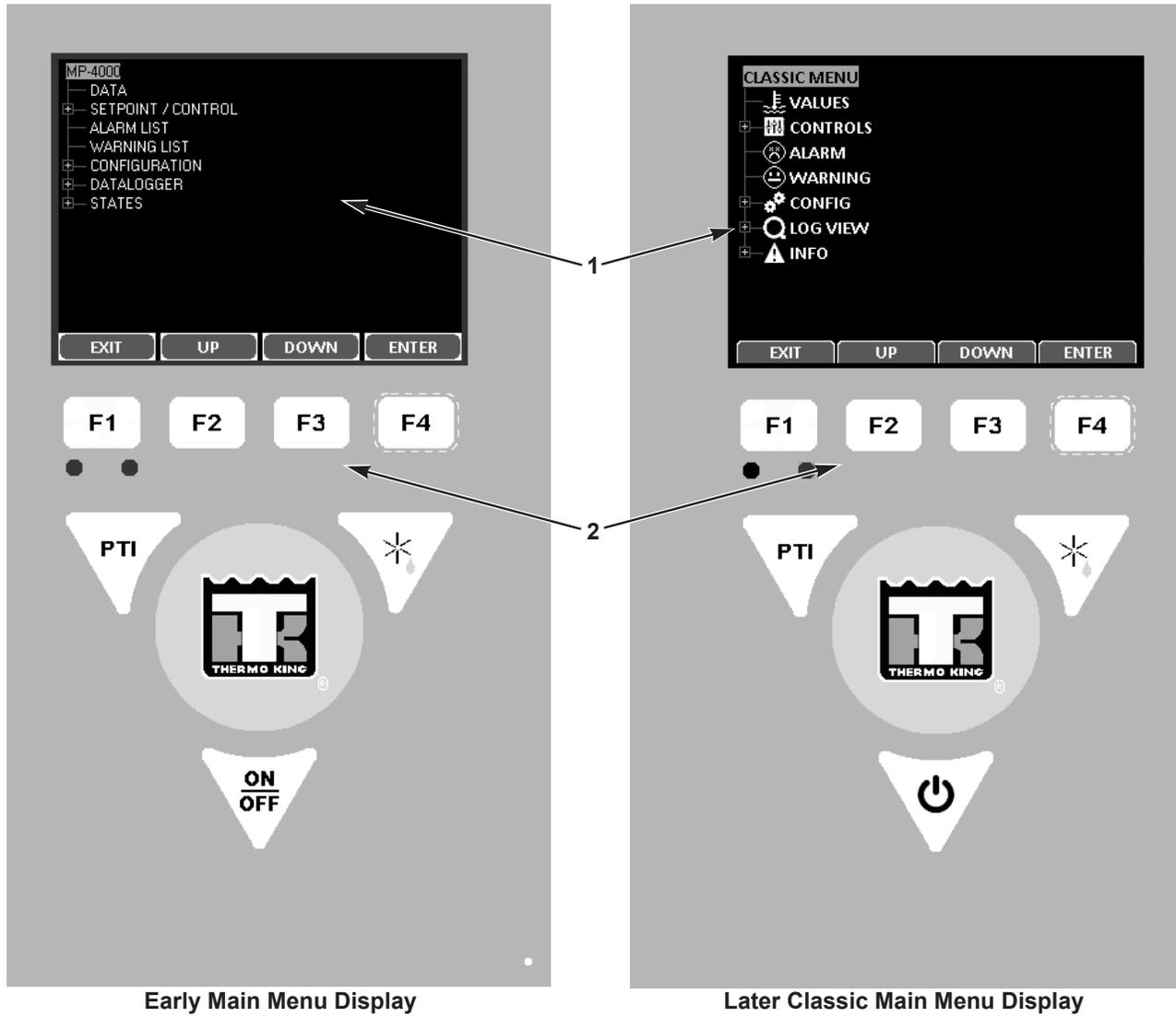


1.	EF Wire Connected to Input Side of Compressor Contactor
2.	J1 Connector Disconnected from PM

**Figure 31: High or Low Speed Evap Fans Only Mode**

# Navigating the Controller Operating Menu

## Navigating the Controller Operating Menu



1.	Message Display
2.	Menu Scrolling Keys

Figure 32: MP-4000 Controller Display Panel

## Icon Menu

The later Classic Menu can be changed to an Icon Menu as follows:

1. Press the **F4 ENTER KEY** to display the Classic Menu.



Figure 33: Classic Menu

2. Press the **F2 OR F3 UP/DOWN** key to scroll to the Configuration selection and press the **F4 ENTER KEY**. The Configuration Menu will appear.

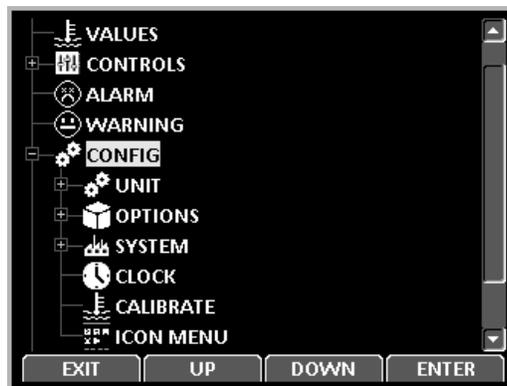


Figure 34: Configuration Menu

3. Press the **F2 OR F3 UP/DOWN** key to scroll to the Icon Menu selection and press the **F4 ENTER KEY**. The Icon Menu will appear as shown below.

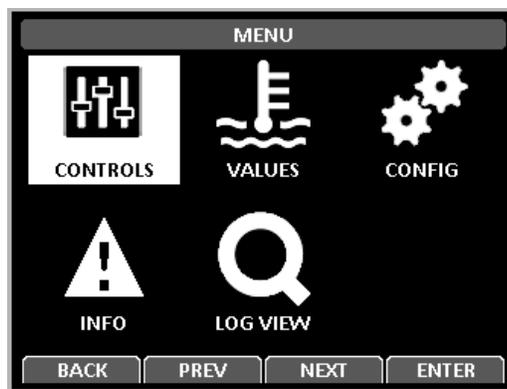


Figure 35: Icon Menu

Change back to the Classic Menu as follows:

1. Press the **F4 ENTER KEY** to display the Icon Menu.

2. Press the **F2 OR F3 UP/DOWN** key to scroll to the Config selection.

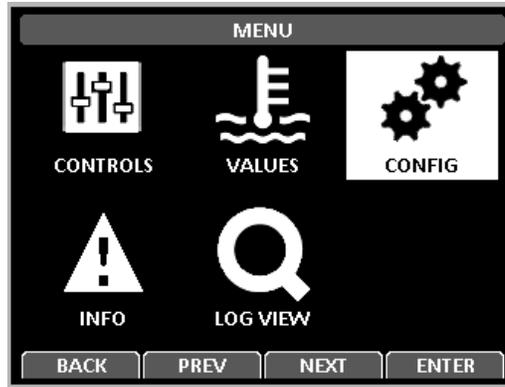


Figure 36: Select Configuration

3. Press the **F4 ENTER KEY**. The Configuration Menu will appear.

4. Press the **F2 OR F3 UP/DOWN** key to scroll to the Classic Menu selection.

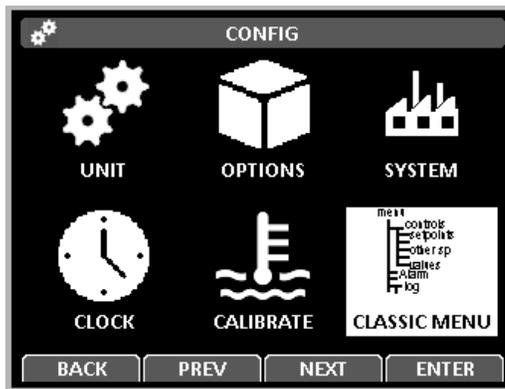


Figure 37: Select Configuration

5. Press the **F4 ENTER KEY**. The Classic Menu will appear.

## Menu Scrolling Keys

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

- F1** **EXIT** - Press the **F1** key each time you want to exit a submenu shown in the message display.
- F2** **UP/ DOWN**- Press the **F2** or **F3** key each time you want to scroll up or down in a menu or submenu shown in the Message Display; or scroll forward or backward in a menu line.
- F3**
- F4** **ENTER** - Press the **F4** key to enter a new menu or submenu.

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

- Data/Values Menu - Menu screens in this group are used to display unit operating information including sensor temperatures, voltage, current, frequency information and any input to the controller.

- Setpoint/Control Menu – Menu screens in this group are used to enter allowable setpoints. Setpoint menu include: set Cold treatment (CT), Multiple Temp Set (MTS), Optiset, Temperature Setpoint, Controlling Mode, Watercool, Humidity Control, Humidity Setpoint, AVL Open Value, Defrost Terminate Temp (USDA), Defrost Interval (USDA), Special 24-48H Defrost, USDA Trip, AFAM Mode, AFAM Delay, AFAM Rate, CO2 Max, and O2 Min.
- Alarm List Menu - Display a list of alarm code(s) present.
- Warning List Menu - Display a list of warning code(s) present.
- Configuration Menu - Menu screens in this group are used to change the functionality of the unit operation. Include: set Unit Setting, Unit Configuration, Sensor, Options, and Miscellaneous Settings.
- Datalogger/Log View Menu - Menu screens in this group display log information or log function. Includes: Inspect Log, set Trip Start, and Set Log Interval.
- States/Info Menu - Menu screens in this group give information on the following, Cold treatment (CT) state, Multiple Temperature Setpoint (MTS) state, PTI, Input – Output, RMM, RMM+, Defrost, Water Cooled Condenser, Runtime Counter, Expansion Module 1, Expansion module 2, Miscellaneous Feature, External Bus Devices.

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

## Changing Screen Contrast

Change the screen contrast temporarily as follows:

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



Figure 38: Contrast Screen

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

# Main Menu

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## Main Menu

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

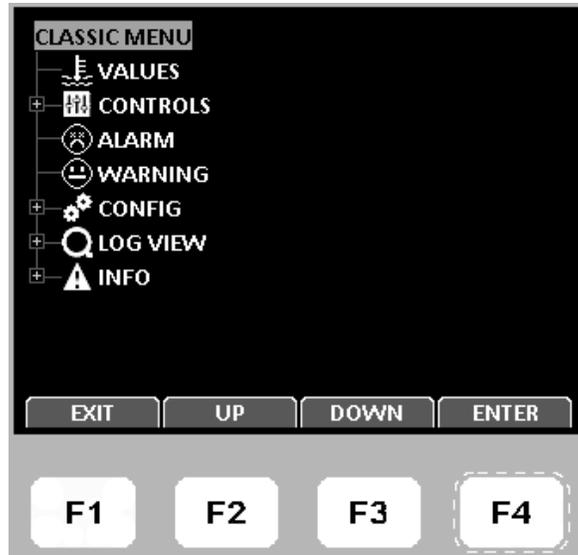


Figure 39: Main Menu

## Data/Values Menu

The Data/Values 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.

### MP4000

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

### Data/Values

The Data/Values menu display general unit operating information including sensors temperatures, unit electrical data, etc.

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

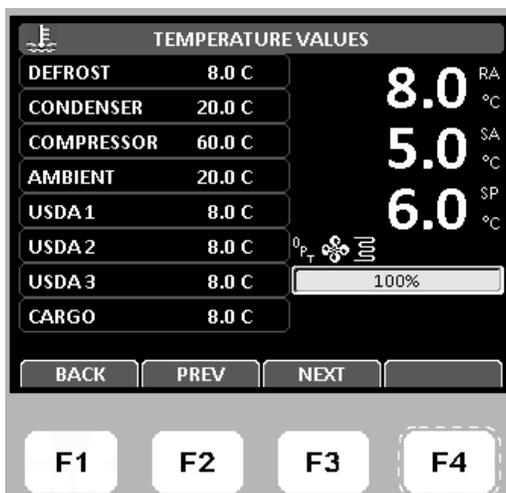


Figure 40: Data/Values Menu

## Setpoint/Control Menu

**NOTE:** When a submenu is highlighted, pressing the ENTER F4 key again will open a view show how the unit is currently set up. In order to see some of these different selections you need to turn the option on and then enter the Setpoint/Control Menu again.

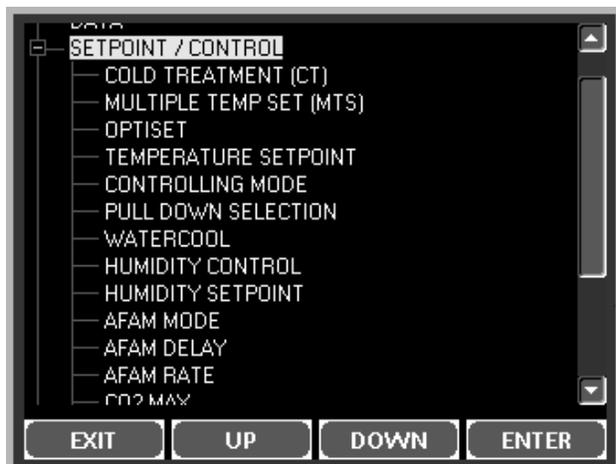


Figure 41: Setpoint/Control Menu

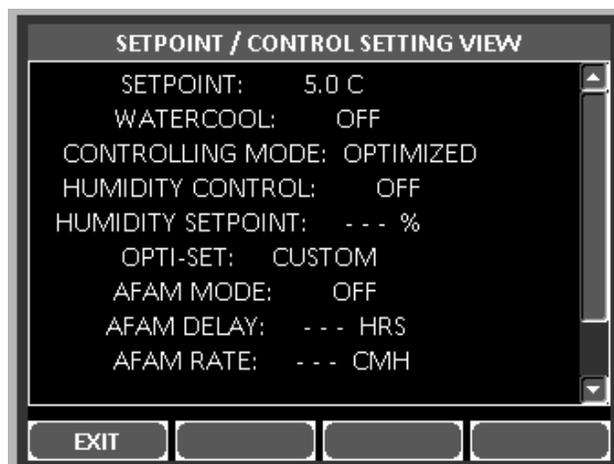


Figure 42: Setpoint/Control Setting View

## Cold Treatment (CT)

This feature is designed to maintain a temperature below the actual set point for a period of time, (per USDA specifications) and then increase the temperature to the final set point. For a complete description see CT “Cold Treatment (CT)” on page 136 under the Operating Theory section of this manual. CT FEATURE must be selected ON under the CONFIGURATION/OPTIONS/CT FEATURE for COLD TREATMENT to be active or visible.

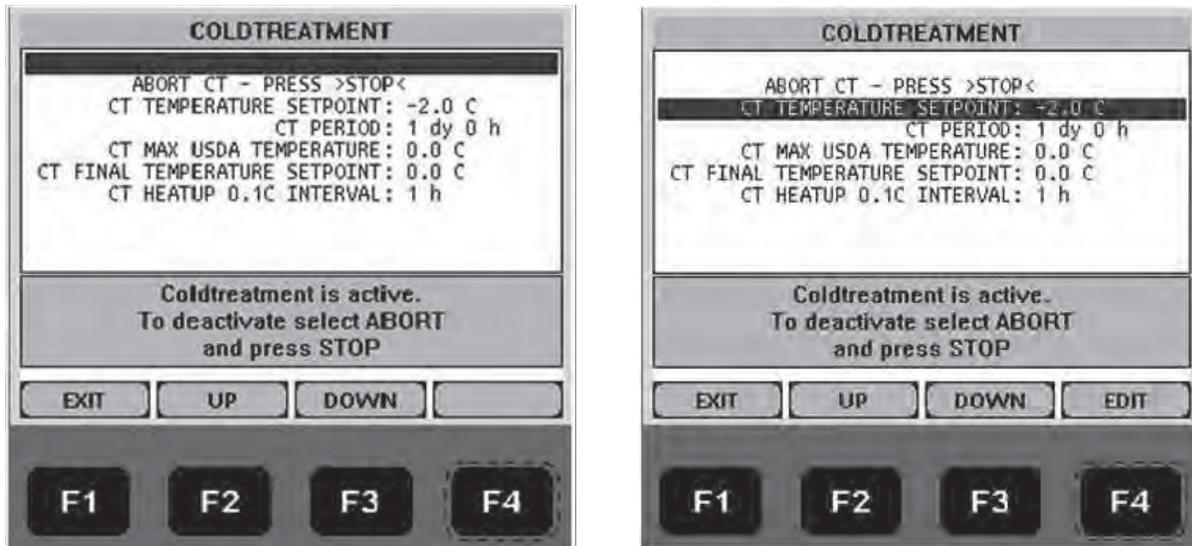


Figure 43: Cold Treatment

## Multiple Temperature Set (MTS)

This feature is designed to maintain up to 9 different set points with 8 timed periods in between the 9 set points. MTS FEATURE must be selected ON under the CONFIGURATION/OPTIONS/MTS FEATURE for MULTIPLE TEMP SET to be active or visible. See complete description of MTS under Operating Theory section of this manual

- sets of temperature set points
- sets of timing periods in between the 9 set points.

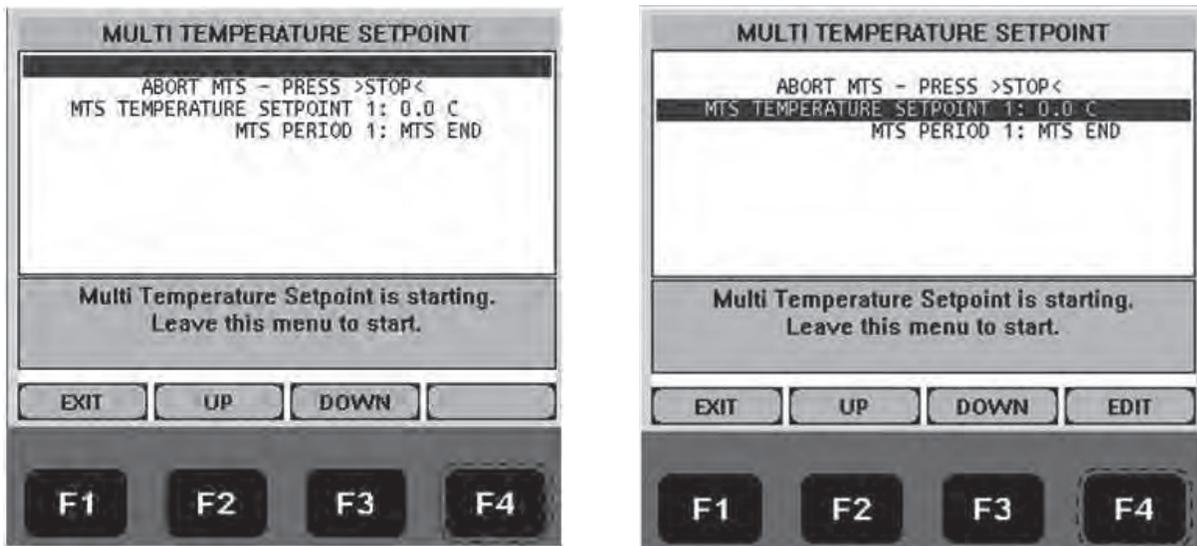


Figure 44: Multiple Temperature Set

## OPTISET

Allows all the AFAM variable to be set by selecting a specify commodity. Refer to “Changing the AFAM+ Settings Using ‘OPTISET’” on page 121 and AFAM+ Setting Guide TK51318. AFAM must be selected under the CONFIGURATION/OPTIONS/AFAM MODULE for OPTISET to be active or visible



Figure 45: Optiset Display

## Temperature Setpoint

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

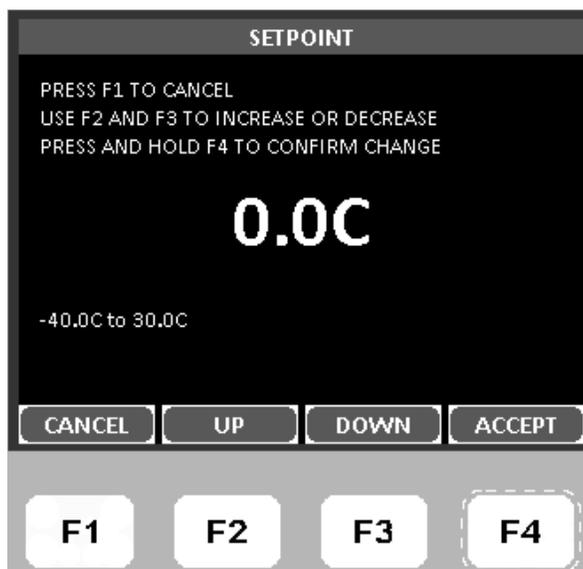


Figure 46: Temperature Setpoint

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

## Controlling Mode

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

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

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

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

**Dry Cargo:** This mode is intended for dry, not alive and/or evolving cargo. It is only allowed with setpoints at and above 15C/59F. Changing the setpoint below that will cause the controlling mode to change to a predefined default mode. The standard default is to Optimized.

With a special customer configuration the default reflects the selected setpoint. For setpoints below 15C/59F the default is Optimized. For setpoints at and above 15C/59F the default is Dry Cargo.

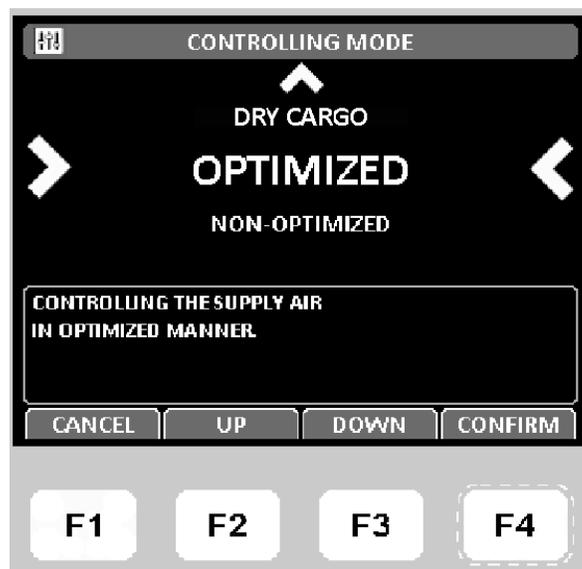


Figure 47: Controlling Mode

## Pull Down Selection

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

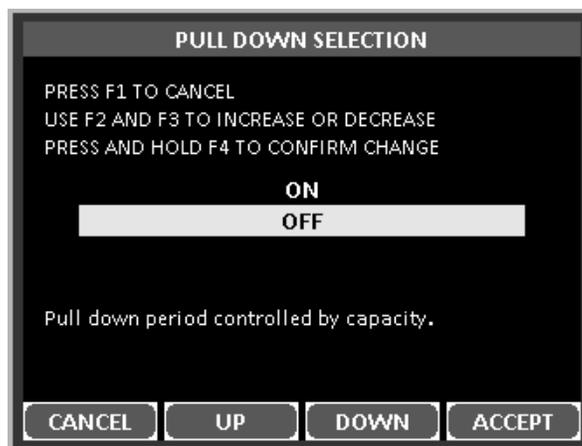


Figure 48: Pull Down Selection

## Watercool

Watercool is turned ON when the unit is equipped with the optional water cooled condenser.

When Watercool is turned OFF the condenser fan runs as required.

When Watercool is turned ON the condenser fan does not run unless no cooling water is available, then the unit will trip off on HPCO and the condenser fan will run as required.

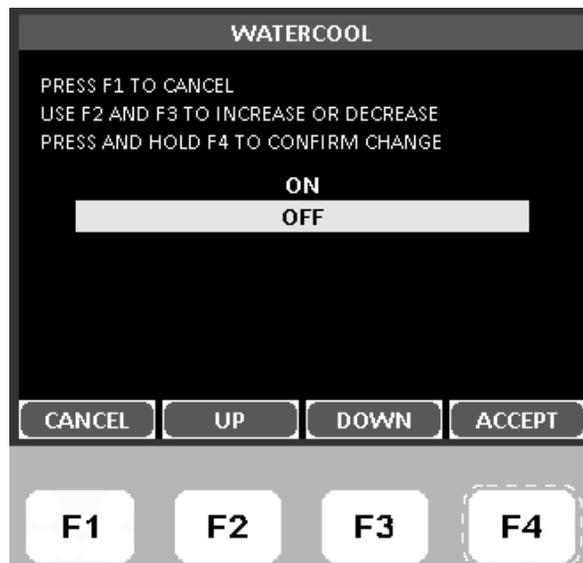


Figure 49: Watercool

## Humidity Control

During Chill mode operation, a dehumidification function is available to reduce the relative humidity in the container to the desired humidity setpoint.

HUMIDITY SENSOR mounted must be selected under the CONFIGURATION/OPTIONS/HUMIDITY SENSOR for HUMIDITY CONTROL to be active or visible. See complete description of HUMIDITY CONTROL under Operating Theory section of this manual



Figure 50: Humidity Control

## Humidity Setpoint

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

HUMIDITY SENSOR mounted must be selected under the CONFIGURATION/OPTIONS/HUMIDITY SENSOR for HUMIDITY SETPOINT to be active or visible. See complete description of HUMIDITY CONTROL under Operating Theory section of his manual.

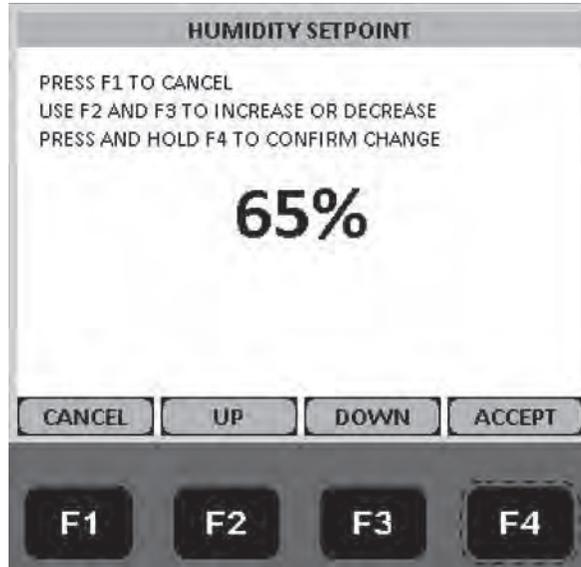


Figure 51: Humidity Setpoint

## AVL (Air Ventilation Logging)

The Fresh Air Exchange Recorder (AVL) detects vent disk movement and automatically displays a value in the LCD display for values of 0 to 125 m<sup>3</sup>/h. For settings greater than 125 m<sup>3</sup>/h the technician must set the AVL Open Value to match the notched setting on the Fresh Air Exchange Vent.

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

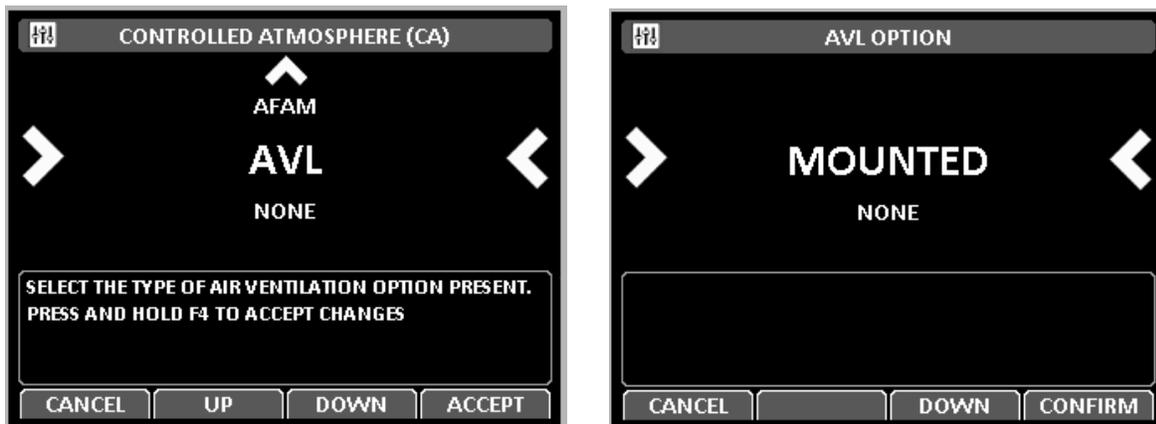


Figure 52: Enabling AVL

## Fresh Air Vent Man - AFAM Mode

Can be set to OFF or AFAM.

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

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

See “Starting the AFAM System” on page 114 for more information about setting up AFAM.

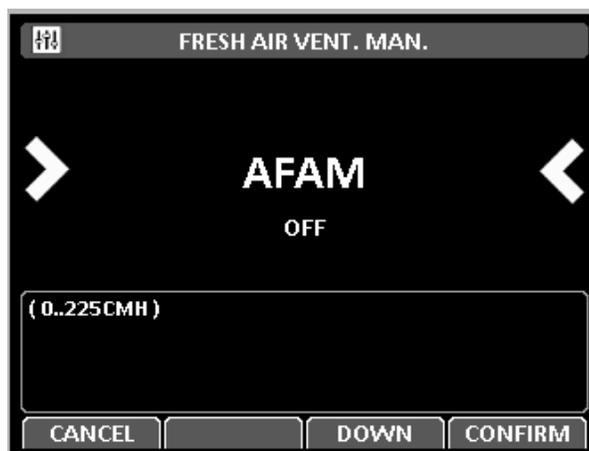


Figure 53: AFAM Mode

## Fresh Air Vent Man - AFAM+ Mode

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

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

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

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

See “Advanced Fresh Air Management Plus (AFAM+) System” on page 117 for more information about setting up AFAM+.



Figure 54: AFAM+ Mode

## AFAM Delay

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

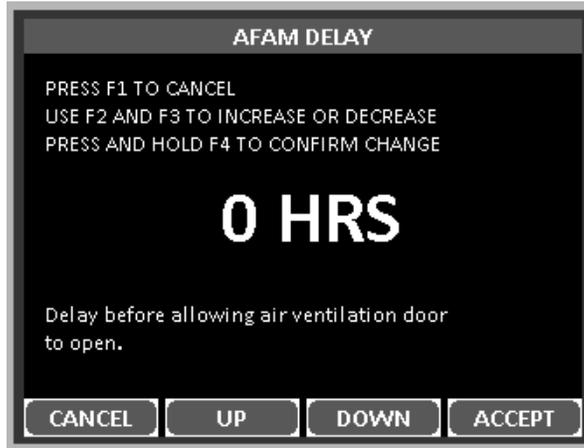


Figure 55: AFAM Delay

## AFAM Rate

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

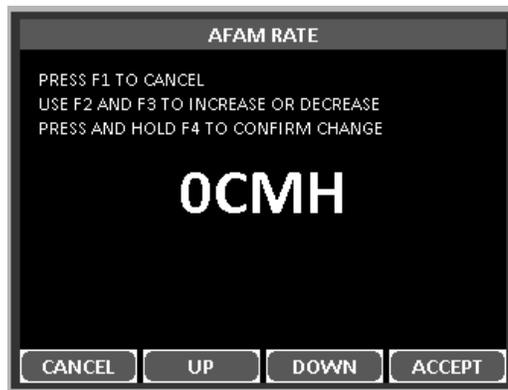


Figure 56: AFAM Rate

## AFAM+ CO2 Max

Used to set the highest level of Carbon Dioxide allowed in the container. The AFAM+ door will open or close to maintain this level. Active only when AFAM+ is enabled. Selectable from 0% to 25%. See “Advanced Fresh Air Management Plus (AFAM+) System” on page 117 for more information.

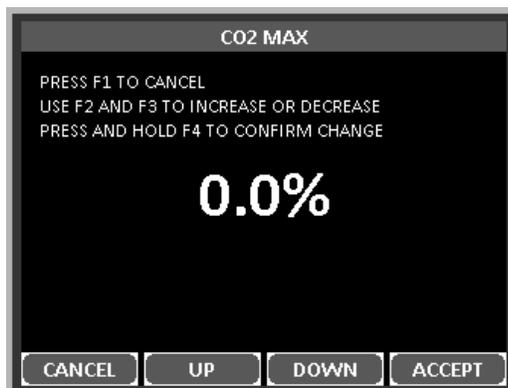


Figure 57: CO2 Max

## AFAM+ O2 Min

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

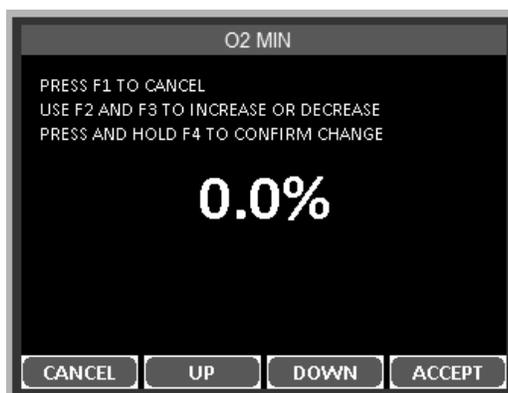


Figure 58: O2 Min

## Smart PTI

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

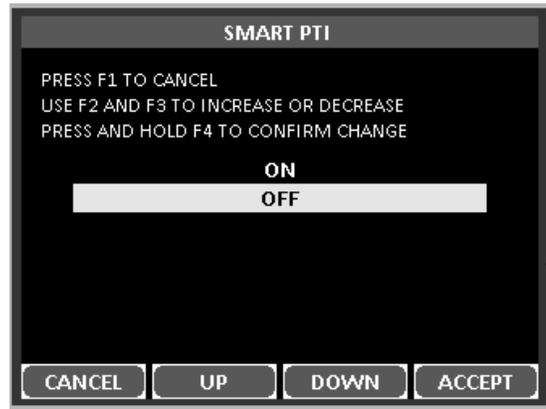


Figure 59: Smart PTI

## Alarm List

Display show either NO ALARMS or the newest ALARM. See to “Alarms/Warnings Menu” on page 99 for more information.

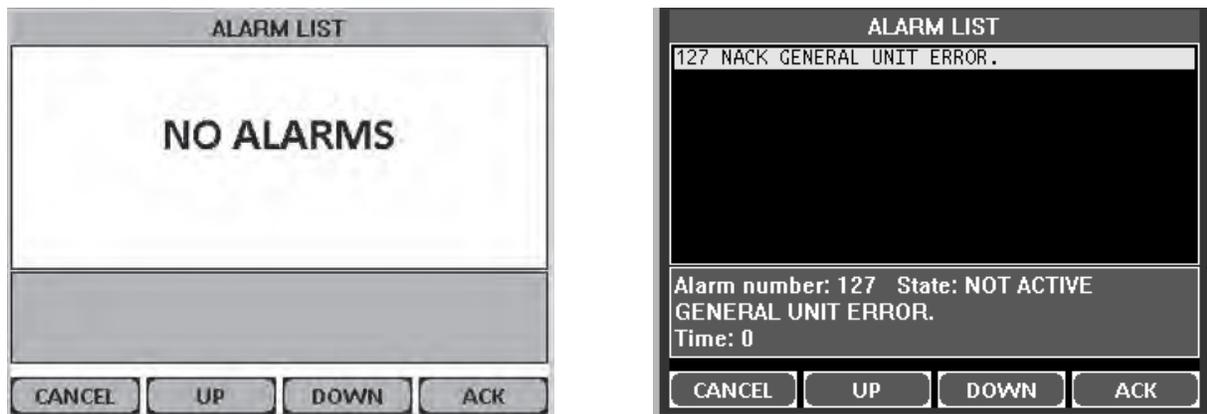


Figure 60: No Alarms or Newest Alarm

## Warning List

Display show either NO MESSAGES or the newest MESSAGE. See to “Alarms/Warnings Menu” on page 99 for more information.



Figure 61: No Warnings or Newest Warning

## Configuration Menu

The Configuration menu is used to select unit configuration settings. A complete listing of the controller Configuration menu is located on an 11” x 17” foldout on the last page of the book.



Figure 62: Configuration Menu

## Unit Setting

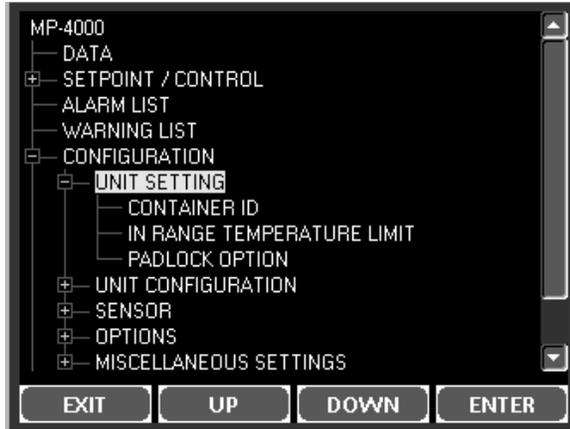


Figure 63: Unit Setting

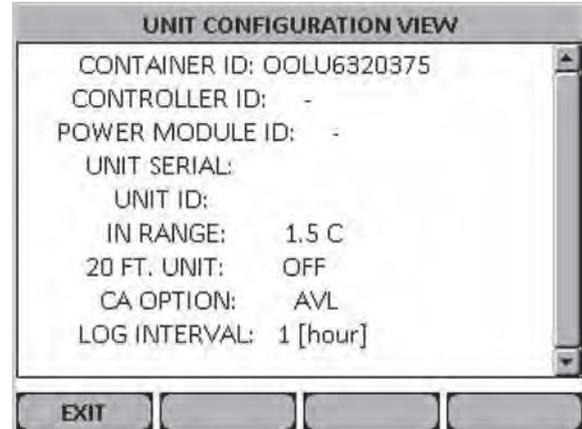
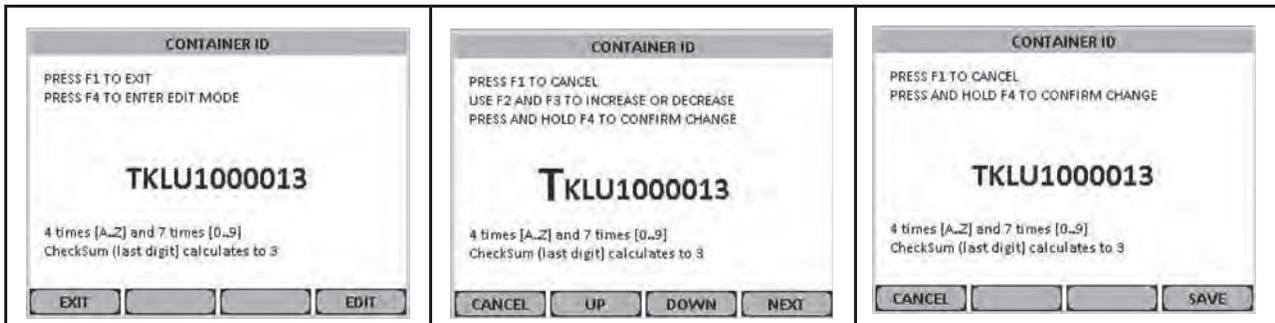


Figure 64: Unit Configuration View

Container ID : Use to EDIT container ID stored in controller:



In Range Temperature Limit: Select range between 0C and 5C

Padlock Option : Select ON/OFF

## Unit Configuration (Configuration Depends on Unit)

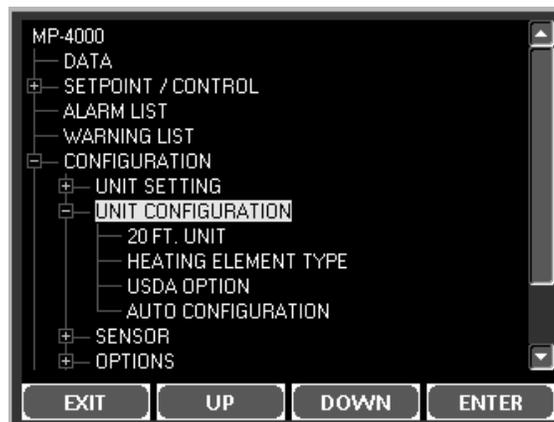


Figure 65: Unit Configuration

20 FT. Unit: Select ON/OFF

Heater Element Type: Select from Extended Capacity and Normal Capacity

USDA Option: Select from None or Sensor Mounted.

Auto Configuration: Select ON/OFF

## Options

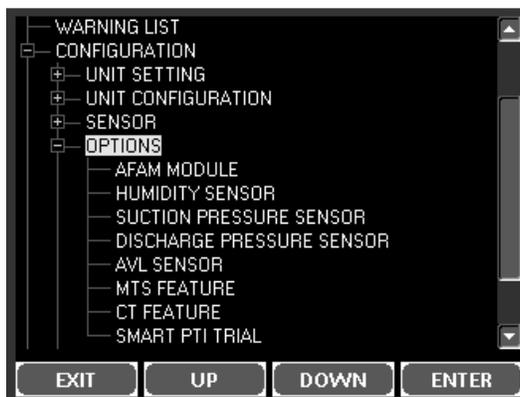


Figure 66: Options

This Menu is used to:

1. Turn ON/OFF a Module/Feature.
2. Select a particular Option within a module.
3. Tell the Controller when a Sensor is mounted.

Here is the list of Modules, Features and Options under this menu (See Setpoint/Controlling section previously in this chapter for more details on each option):

**AFAM Module:** Select from None, AVL, AFAM, and AFAM+. Selecting AFAM+ also turns Optiset ON.

**Humidity Sensor:** Select from None, Sensor Mounted and Sensor Mounted (RS-485)

**Suction Pressure Sensor:** Select from None or Sensor Mounted.

**Discharge Pressure Sensor :** Select from None or Sensor Mounted.

**AVL Sensor :** Select from None or Sensor Mounted.

**MTS Feature:** Select ON/OFF.

**CT Feature:** Select ON/OFF.

**Smart PYI Trial:** Select ON/OFF.

## Miscellaneous Settings

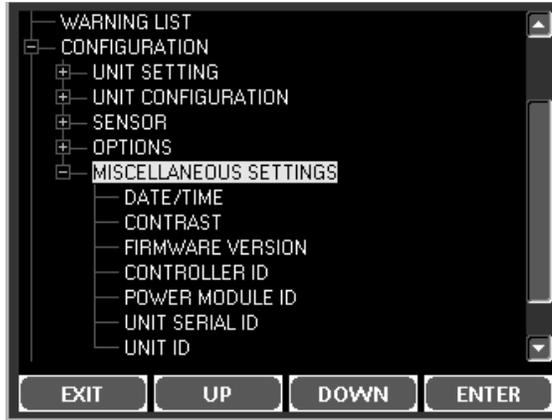


Figure 67: Miscellaneous Settings

**DATE/TIME** . Displays Current Date and Time - you can also edit.

**Contrast** . To adjust Screen Display contrast.

**Firmware Version**. Displays Controller Software/Application Revision, Bootloader Revision, Power Module Revision, Serial Number, and Option File Revision.

**Controller ID** . View and Edit Controller ID.

**Power Module ID** . View and Edit Power Module ID.

**Unit Serial ID** . View and Edit Unit Serial Number ID.

**Unit ID** : View and Edit Unit ID.

## Datalogger Menu

This menu gives an allows the user to inspect logs, perform a Trip Start, and set the log time interval.



Figure 68: Datalogger Menu

**Inspect Log:**

**Inspect Event Log:**

**Inspect Temperature Log:**

**Inspect Smart Log :**

**Trip Start:** See to “Trip Start” on page 108 for more information.

**Set Log Time Interval:**

## States Menu

This menu gives an overview of all the tests that are running and also Information on any Special features selected.

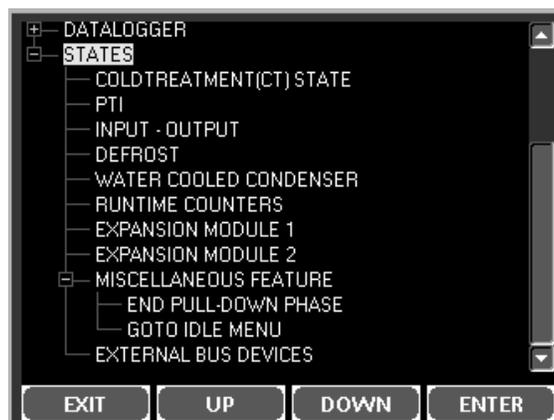


Figure 69: States Menu

**Cold Treatment (CT) State:**

**Multiple Temperature Setpoint (MTS) State :**

**PTI:**

**Input - Output:**

**RMM:**

**RMM+ :**

**Defrost:**

**Water Cooled Condenser:**

**Runtime Counters:**

**Expansion Module 1:**

**Expansion Module 2:**

**Miscellaneous Feature:**

**End Pulldown Phase:**

**Go to Idle Menu:**

**External Bus Devices:**

## Special Function Keys - User Activated Commands

Pressing the PTI or DEFROST key will open up for selecting a user activated functionality. Pressing PTI key or DEFROST key alone WILL NOT ACTIVATE THE FUNCTION.

### PTI Key

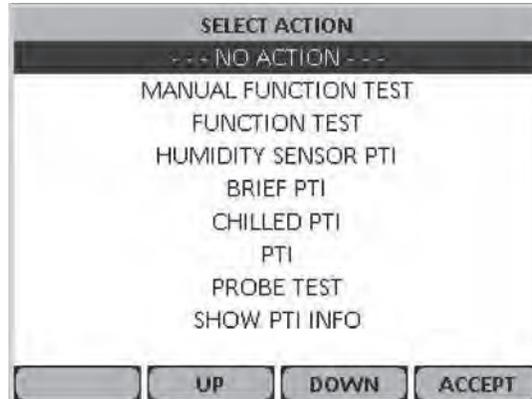


Figure 70: PTI Menu Screen

### No Action

### Manual Function Test

See "Manual Function Test" on page 90 for more information.

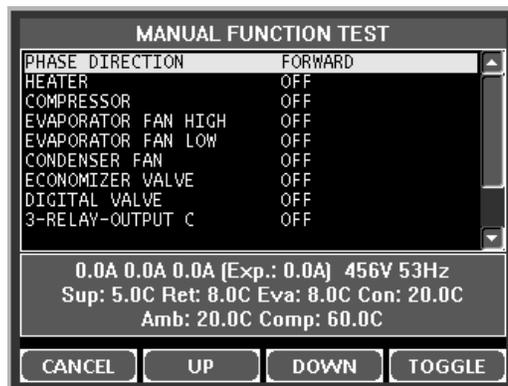


Figure 71: Manual Function Test Screen

## Function Test

See “Automated Tests” on page 89 and “Function Test” on page 89 for more information.

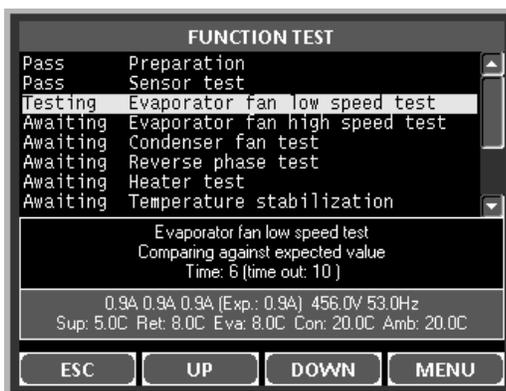


Figure 72: Function Test Screen

## AFAM+ PTI

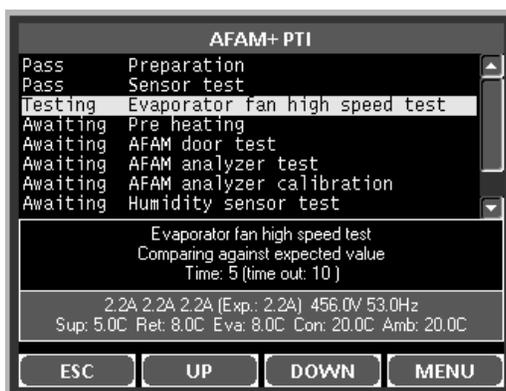


Figure 73: AFAM+ PTI Test Screen

## Humidity Sensor PTI

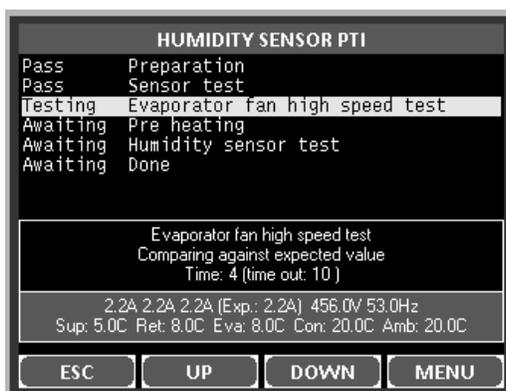


Figure 74: Humidity Sensor PTI Test Screen

### Brief PTI

See “Automated Tests” on page 89 for more information.

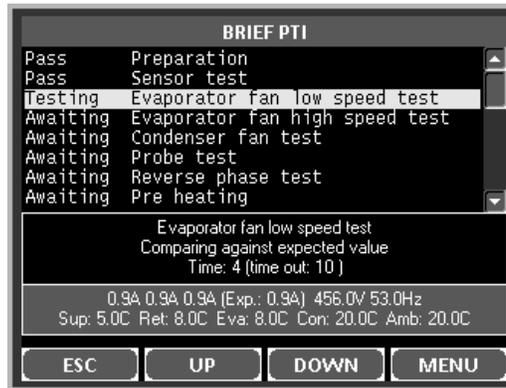


Figure 75: Brief PTI Test Screen

### Chilled PTI

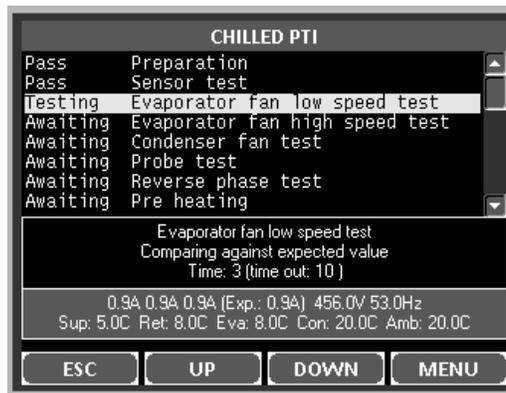


Figure 76: Chilled PTI Test Screen

### PTI

See “PTI (Pretrip) Tests” on page 88 for more information.

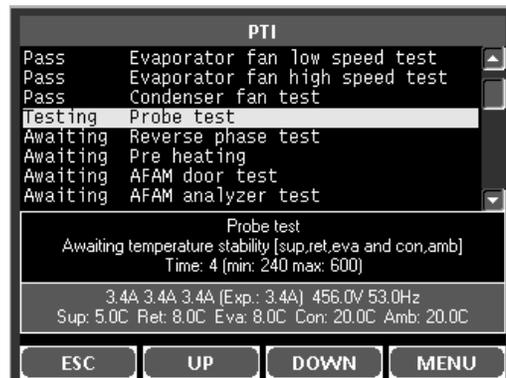


Figure 77: PTI Test Screen

## Probe Test

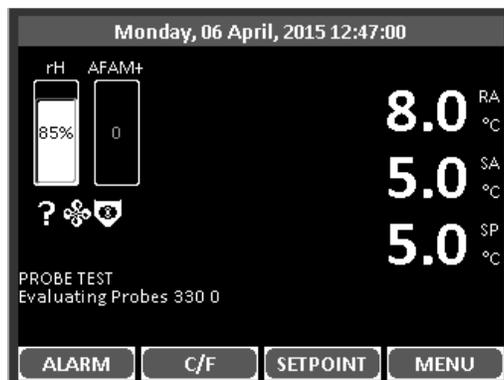


Figure 78: Probe Test Screen

## Show PTI Info

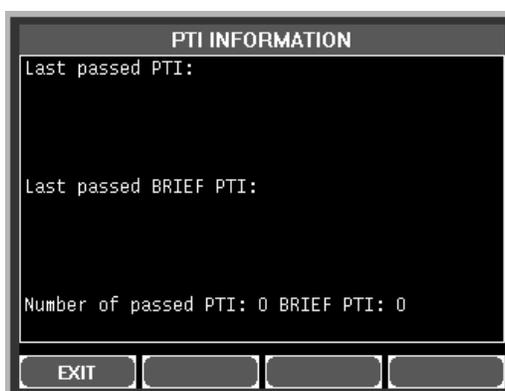


Figure 79: PTI Information Screen

## Defrost Key

See “Defrost” on page 98 for more information.



Figure 80: Defrost Menu Screen

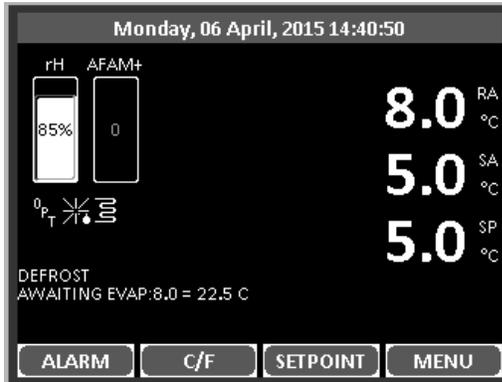


Figure 81: Defrost Screen



Figure 82: Defrost Information Screen

## PTI (Pretrip) Tests



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

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

The MP-4000 controller contains special PTI pretrip tests that automatically checks unit refrigeration capacity, heating capacity, temperature control, and individual components including the controller display, contactors, fans, protection devices and sensors. The test includes measurement of component power consumption and compares test results to expected values.

The Full PTI test takes up to 2 to 2.5 hours to complete, depending on the container and ambient temperature.

The Brief PTI 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 Full PTI test. The controller will automatically clear all existing alarms before beginning the Full PTI test.*

With the Unit turned On, Allow Unit to start and stabilize and the Display to show the unit status display (setpoint):

1. Press the **PTI KEY** to open the PTI Menu.
2. Press the **F2 OR F3 UP/DOWN KEY** to scroll to “PTI” (or another desired test).
3. Press the **F4 ENTER KEY** to start the selected test. Display shows test currently being performed. the PTI test ends automatically. Press any key on the controller to return the unit to normal operation.

Detailed PTI test results are stored in the MP-4000 Datalogger for later viewing. Any alarm codes recorded during the test can be viewed through the controller’s Alarm List menu at the end of the test.

## Automated Tests

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

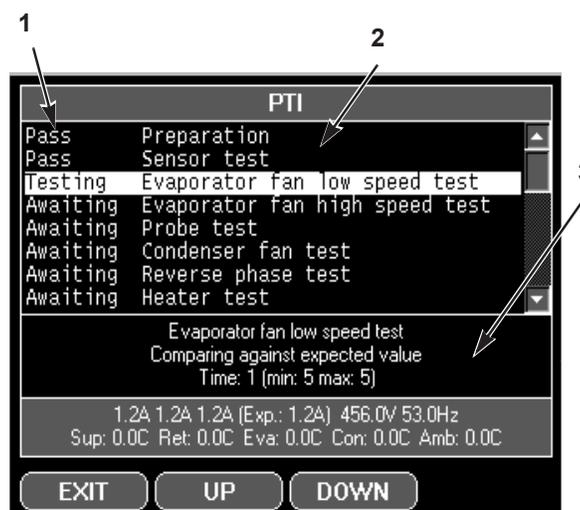


Figure 83: PTI Menu

The Screen is divided into three sections:

### Section 1:

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

List of possible states:

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

### Section 2:

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

### Section 3:

This section displays actual readings and the expected power consumption.

## Function Test

The MP-4000 controller contains a special function test that automatically tests individual components including the controller display, sensors, condenser fan, evaporator fan, compressors, etc. The test includes measurement of component power consumption and compares test results to expected values.

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

With the Unit turned On, Allow Unit to start and stabilize and the Display to show the unit status display (setpoint):

1. Press the **PTI KEY** to open the PTI Menu.
2. Press the **F2 OR F3 UP/DOWN KEY** to scroll to “Function Test”.

3. Press the **F4 ENTER KEY** to start the Function Test. Display shows test currently being performed. The Function test ends automatically. Press any key on the controller to return the unit to normal operation.

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

### Manual Function Test

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

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

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

With the Unit turned On, Allow Unit to start and stabilize and the Display to show the unit status display (setpoint):

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

#### To test a unit component:

1. Press the **F2 OR F3 UP/DOWN** key to scroll to desired component test:
  - [PHASE DIRECTION]
  - [HEATER]
  - [COMPRESSOR]
  - [EVAPORATOR FAN HIGH]
  - [EVAPORATOR FAN LOW]
  - [CONDENSER FAN]
  - [ECONOMIZER VALVE]
  - [DIGITAL VALVE]
2. Press the **F4 ENTER KEY** to start the component test. Display will change the component state from off to on.
3. Verify component performance: Display will show expected current and actual current on phase 1, 2 and 3.
4. Press the **F4 ENTER KEY** again to stop test. Display will change component state from on to off.

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

1. Press the **F2 OR F3 UP/DOWN** key to scroll to the first component.
2. Press the **F4 ENTER KEY** to turn the component on.
3. Press the **F3** key to scroll to select next component. Press the **F4 ENTER KEY** to turn component on.

4. Repeat step 3 until all required components are on. For example, to operate unit in Full Cool mode, start the following components:
  - Condenser Fan
  - Compressor
  - Capacity 100 percent
  - Evaporator High or Low
5. Observe current draw and system performance to verify component(s) performance.
6. Press the **F4 ENTER KEY** again to turn off components individually. Or press the **F1** key to exit Manual Function Test menu and turn *all* components off.

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

**Figure 84: PTI, Brief PTI, Function Tests**

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
PTI START Activated 0.1A 0.0A 0.1A	Event Log for PTI begins. Awaits phase selection, and surveillance to start up. All alarms are turned off. Alarm list is cleared. All relays are turned off and air vent are closed.	18	1 to 100 seconds	X	X	X
SENSOR TEST Activated 0.1A 0.0A 0.1A	Testing sensor interface, All sensors must have values within their measuring range.	00, 01, 02, 03, 04, 05, 32, 33, 34, 35, 60, 97, 98, 120, 121, 123	Instant	X	X	X
EVAP FAN LOW SPEED TEST SUP RET EVA 5.1C 5.0C 5.1C 1.1A 1.0A 1.1A	With evaporator fan on low speed, amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency: • MAGNUM+ / MAGNUM+ 40'SL: 1.0 Amps approx. at 50 Hz, 1.0 Amps approx. at 60 Hz • MAGNUM+ 20'SL: 1.5 Amps approx. at 50 Hz, 1.5 Amps approx. at 60 Hz Amperes are recorded in the PTI log.	14, 15	5 seconds	X	X	X

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
EVAP FAN HIGH SPEED TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	With evaporator fan on high speed, amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency. If the minimum phase amp draw is less than 70% of the maximal amp draw both alarm is set. • MAGNUM / MAGNUM 40'SL: 2.1 Amps approx. at 50 Hz, 2.5 Amps approx. at 60 Hz • MAGNUM 20'SL: 2.7 Amps approx. at 50 Hz, 3.2 Amps approx. at 60 Hz Amperes are recorded in PTI log.	12, 13	5 seconds	X	X	X
COND FAN TEST SUP RET EVA 5.2C 5.0C 5.1C 1.3A 1.2A 1.3A	With condenser fan on, amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency. If the phase amp draw differs more than 1,0 Amp both alarm is set. • MAGNUM+ Expected Power Consumption: 1.2 Amps approx. at 50 Hz, 1.5 Amps approx. at 60 Hz Amperes are recorded in PTI log.	16, 17	5 seconds	X	X	X
PROBE TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	Evaporator fans operate on high speed for maximum 3 minutes. Then probe test runs until temperature difference between sensors stops increasing. Maximum temperature difference allowed: • Return/Evaporator: 1.5C (34.7F); return air sensor temperature must be 0.5C (32.9F) above evaporator sensor temperature. • Return/Supply: 0.8C (33.0F); return air sensor temperature must be 0.5C (32.9F) above supply air temperature. • LH Supply/RH Supply (if equipped): 0.5C (32.9F).	115, 116, 117	1 minute minimum to 13 minutes maximum	X	X	X
REVERSE PHASE TEST SUP RET EVA 1.3C 1.0C 1.3C 1.3A 1.2A 1.3A	With condenser fan on, reverse phase selector relay is energized. Condenser fan and compressor reverse current is measured.	58	30 seconds	X	X	X

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
HEATER TEST SUP RET EVA 1.3C 1.0C 1.3C 5.2A 5.1A 5.2A	Electric heaters are turned on. Amp draw is measured to the expected amp draw, in respect to voltage and frequency • 4.4 Amps approx. at 400V; • 5.1 Amps approx. at 460V. Heater amperes are recorded in PTI log.	10, 11	5 seconds	X	X	X
DEFROST TEST SUP RET EVA 5.0C 12.0C 15.0C 5.2A 5.1A 5.2A	If evaporator temperature is below +10C, heater remains on until evaporator temperature is above +18C. Defrosting until Eva. > 18C/64F	20	0-90 Minutes at voltage above 440V  0-120 Minutes at voltage below 440V	X	X	-
TEMPERATURE STABILISATION	With evaporator fan on high speed awaiting the supply, return and evaporator temperatures to stabilize. Delta SUP-RET and Delta RET-EVA must be stable, within 7 seconds. Awaiting temperature stability	None	20 to 180 seconds	X	X	-
PRE HEAT TEST SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	Test is skipped if return air temperature is at 5degC or above. With electric heaters turned on and evaporator fan on high speed, the test will end when return air temperature is at 5degC or above. Heating until 5C/41F	None	Instant to 2 hours	X	X	-
PRE COOL TEST SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	If the return air temperature is below 15C (68F) the test is skipped. Unit operates in cool until the return sensor is less than +15C (59F) or 1 hour Cooling until 15C/59F	None	Instant to 2 hours	X	X	-
VENTILATING	If heater or compressor has been running in the preceding test, the unit is ventilated with evaporator fan on high speed. Ventilating	None	60 seconds	X	X	X

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
COMPRESSOR TEST AMB CON EVA 8.0C 15.0C 5.0C 9.1A 9.0A 9.1A	Compressor loaded, and condenser fan activated for 10 sec. Followed by compressor run alone for 7 sec before the amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency. Amperes are recorded in the PTI log. Evaluating power consumption	6, 7	18 seconds	X	X	X
COMPRESSOR DIGITAL TEST AMB CON EVA 8.0C 25.0C 2.0C 9.1A 9.0A 9.1A	Compressor running loaded, evaporator fan at high speed, and condenser fan maintaining 30-35degC for 15 sec. Next the compressor is unloaded and running for 10 sec Amp draw difference is measured and expected to be at least 0,9 Amp (Con > 35C) or 1,5 Amp (Con < 35C).	119	25 to 35 seconds	X	X	X
COMPRESSOR ECONOMIZER TEST AMB CON EVA 8.0C 45.0C 1.0C 9.1A 9.0A 9.1A	With compressor on (loaded), condenser and evaporator fans at high speed are turned on for 30 seconds. If condenser fan temperature is below 30C (86F) then the test is aborted. Vapor injection valve is turned on. Amp draw difference is measured and verified to be minimum 0.4 amps. Evaluating Power Consumption Increase.	26	Max 90 seconds	X	X	X

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
HIGH PRESSURE CUTOUT TEST	<p>Running with compressor fully loaded and with evaporator fan at high speed, awaiting high pressure cut out. The test is ended if the condenser coil probe reads temperature above 70°C and the HPCO does not occur. The time observing is depending on the startup temperature and will be increased as long as the condenser temperature is increasing.</p> <p>After the HPCO the compressor signal is removed and the condenser fan is activated to lower the pressure in the condenser. When the temperature gets below 40°C the compressor is also activated. The test will then look for when the HPCO gets back to normal in maximal 60 seconds.</p> <p><b>Awaiting HPCO - Compressor stop</b></p>	53, 54	Max. 200 seconds	X	X	-
CAPACITY TEST	<p>With compressor fully loaded condenser fan on and evaporator fan at high speed running for the time period. At the end of the test is the cooling capability evaluated.</p> <p><b>Evaluating cooling capability</b></p>	22	180 seconds for 40' and 240 seconds for 20' unit.	-	X	-
APPROACHING 0 TEST	<p>Probe readings and time are recorded in the pti log when started. When supply air temperature is at 0 deg C / 32F the test is ended. If the test is not ended within the time limit the alarm is set.</p> <p><b>Approaching 0C/32F</b></p>	23	Max. 2 hours	X	-	-

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
MAINTAINING 0C TEST	With the unit running chilled – Non-Optimized, maintaining 0 deg C / 32F. After 30 minutes the probe readings and time are recorded in the pti log. <b>Maintaining 0C/32F</b>	None	30 Minutes	X	X	-
DEFROST TEST	Test is skipped and Fail if either of alarm 4,5,130 is present. Test is skipped if evaporator temperature is at 5degC or above. With electric heaters turned on, the test will pass when evaporator temperature reach 18degC or above. <b>Defrosting until Eva. &gt; 18C/64F</b>	4, 5, 20, 130	0 to 90 minutes at voltage above 440V 0 to 120 minutes at voltages below 440V.	X	X	X
PULLDOWN TO -18 C TEST	With the unit running frozen, approaching -18 deg C / 0F. Probe readings and time are recorded in the pti log when started and when ended. When return air temperature is at -18 deg C / 0F the test is ended. If the test is not ended within the time limit the alarm is set. <b>Approaching -18C/0F</b>	22	Max. 3 hours	X	X	-
PTI END	“PTI End” are recorded in PTI log and a Trip Start is automatically activated. All alarms are cleared and must be acknowledged by the user. Unit awaits an <b>ACCEPT</b> of the just ended test before returning to normal operation. <b>PASSED - PASSED - PASSED FAILED - FAILED - FAILED</b>	26	Max 90 seconds	X	X	X

Display*	LED Display	Description	Possible Alarms	Duration (Time)
RUNNING PTI 0°C / 32°F 00:00:00 0.0C 10.0C 10.0C	Supply temp.	Unit operates in normal mode with 0C (32F) setpoint for 30 minutes after previous test is completed. At the end of 30 minutes, "Chill End" temperatures are recorded in PTI log. Sensor values for supply, return and evaporator sensors are recorded in the event log.	None	120 minutes maximum
RUNNING PTI DEFROST 00:00:00 -18.0C 10.0C 10.0C	Return temp.	Unit operates in normal mode with -18C (0F) setpoint and defrost activated. Defrost terminates when evaporator temperature increases to 18C (65F).	20	30 minutes
RUNNING PTI -18°C / 0°F 00:00:00 -18.0C 10.0C 10.0C	Return temp.	Unit operates in normal mode with -18C (0F) setpoint. When return air temperature decreases to setpoint, "Frozen Arrival" temperatures are recorded in PTI log.  "PTI End" are recorded in PTI log and a Trip Start is automatically activated.	22, 60	90 minutes maximum
PTI PASS – PRESS KEY	Return temp.	Unit will remain OFF until any key is pressed.  If alarms occurred during PTI, Display shows "PTI FAIL – PRESS KEY".	None	180 minutes maximum
<b>* Readings may vary depending on voltage and temperature</b>				

## Defrost

With the Unit turned On, Allow Unit to start and stabilize and the Display to show the unit status display (setpoint):

1. Press the **DEFROST (\*) KEY** to open the Defrost Menu.
2. Press the **F2 OR F3 UP/DOWN KEY** to scroll to “Start Defrost”.

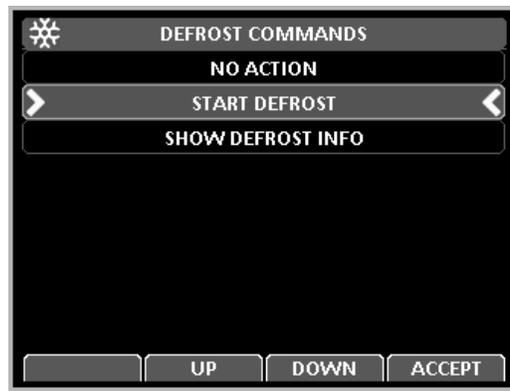


Figure 85: Defrost Menu

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

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

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

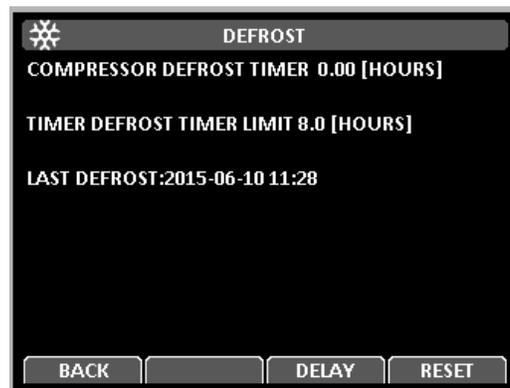


Figure 86: Defrost Info Screen

## Alarms/Warnings Menu

There are two types of alerts:

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

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

**Alarms:** Alarm indicates corrective action should be taken. Red LED flashes and unit may stop or continue to run based on the alarm. Alarm 56 (Compressor Temperature too high) is a Shutdown alarm.

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

### Alarm Code States

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

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

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

**Acknowledge:** A code condition has been viewed and acknowledged in the Alarm or Warning list. If the Alarm code condition still exists in the unit the Red LED will stay on and not flash. If the code condition is corrected the Red LED will turn off and the code condition will disappear from the Alarm/Warning list.

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

## Alarm/Warning List Menu

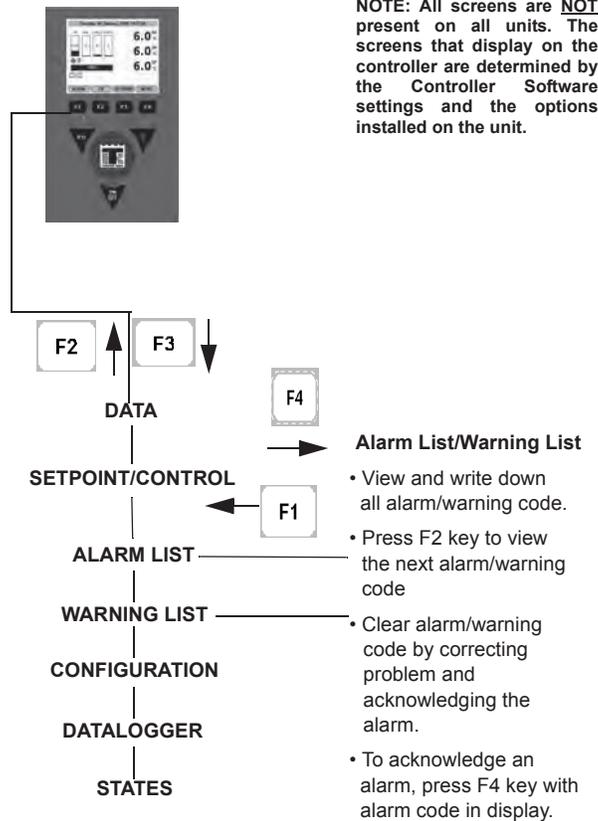


Figure 87: Alarms Menu

### View the Alarm/Warning List Menu

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

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

1. Press the **F1** key to directly enter Alarms/Warning menu. The first alarm code number, alarm state and alarm description appears in Display.
- NOTE: Alarm codes are displayed in sequential order, not in order of occurrence.*
2. Write down the first code. Then press the **F2 or F3 Up/Down** key to view next alarm code when more than one code has been recorded.
  3. Repeat above step until all alarm codes have been recorded. Press the **F2** key to scroll backward to return to a previous code.
  4. To clear all alarm codes from the current display list and turn off the Alarm LED, all problems must be corrected and the alarm code “acknowledged” in the Alarm List menu.
  5. To acknowledge an alarm/warning, press **F4 ACCEPT KEY** while code appears on screen. The alarm state will change from Active or Not Active to Acknowledge. If no key is pressed for 30 seconds, the controller returns to previous menu level or Unit status display

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

## Warning List Menu

Warning Code	Action
1	High Pressure Cut Out, Check Water Cooling
6	High Pressure Cut Out, Check Condenser Probe
8	High Pressure Cut Out, Please Wait
13	Evaporator High Temperature - Check Heater System
20	Low Voltage On Line - Unit Stopped
21	Current Too High - Check Compressor and Fans
22	Current Too Low - Check Compressor and Fans
23	Supply Temperature Too High - Check Sensors
24	Supply Temperature Too Low - Check Evaporator Coil
25	Evaporator Temperature Too High - Check Evaporator Sensor
26	Evaporator Temperature Too Low - Check Evaporator Sensor
27	System Low Pressure - Check Refrigerant Charge
28	Frozen Setpoint - Check Air Exchange
30	High Pressure Cut Out - Please Wait
31	HPCO (High Pressure Cut Out) Timer Hold - Please Wait
32	Low Pressure Cut Out - Please Wait
33	LPCO (Low Pressure Cut Out) Timer Hold - Please Wait
34	Compressor Too High Temperature Timer - Please Wait
35	Compressor High Temperature
36	AVL Open - Check FAE and CA Settings
37	CO2 Reading Stuck for >24 Hours
38	High Voltage On Line
39	Battery Charger/Heater - Check Battery
40	12V Sensor PSU Problem
41	Power Module Heat Exchanger High Temperature – Please Wait
42	CA Unit LPCO
43	CA Unit HPCO
44	CA Unit OBS
45	45 Wall Clock Failure
46	Battery Needs Charging

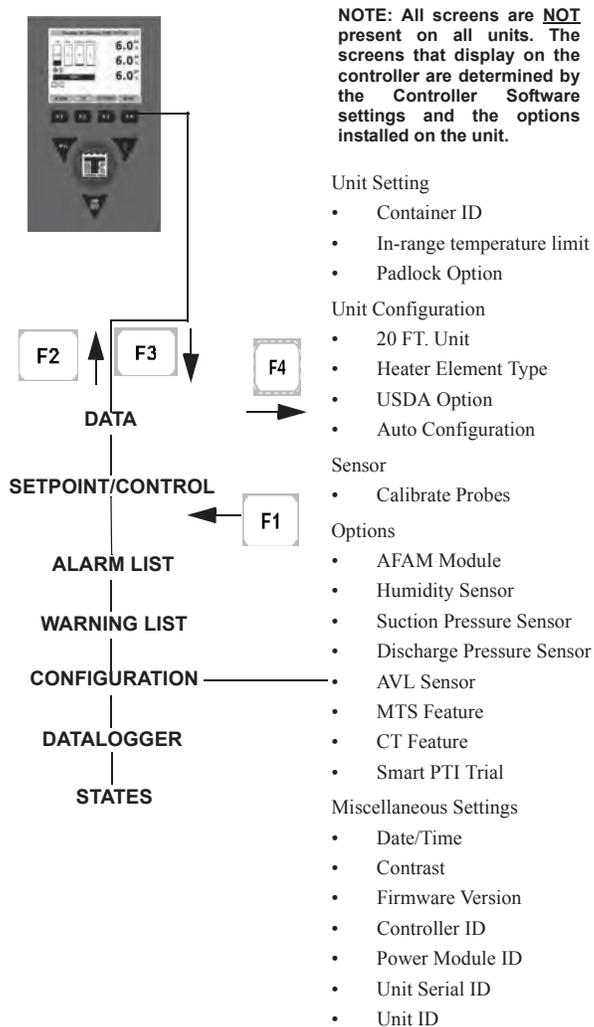
**Alarm List Menu**

<b>Alarm Code</b>	<b>Action</b>
00	Supply Air Sensor Open Circuit
01	Supply Air Sensor Short Circuit
02	Return Air Sensor Open Circuit
03	Return Air Sensor Short Circuit
04	Evaporator Coil Sensor Open Circuit
05	Evaporator Coil Sensor Short Circuit
06	Compressor Current Too High
07	Compressor Current Too Low
10	Heater Current Too High
11	Heater Current Too Low
12	Evaporator Fan High Current Too High
13	Evaporator Fan High Current Too Low
14	Evaporator Fan Low Current Too High
15	Evaporator Fan Low Current Too Low
16	Condenser Fan Current Too High
17	Condenser Fan Current Too low
18	Power Supply Phase Error
19	Temperature Too Far From Setpoint
20	Defrost Time Too Long
22	Capacity Test 1 Error
23	Capacity Test 2 Error
26	Vapor Injection Error
31	Low Pressure Cut Out
32	Condenser Temperature Sensor Open Circuit
33	Condenser Temperature Sensor Short Circuit
34	Ambient Air Sensor Open Circuit
35	Ambient Air Sensor Short Circuit
43	Return Air Temperature - Too High
44	Return Air Temperature - Too Low
51	Power Line Voltage Too Low
52	Probe Error
53	High Pressure Switch Off Error
54	High Pressure Switch On Error
56	Compressor Temperature Too High
57	FAE Device Error
58	Phase Sensor Error
59	Delta Current Error
60	Humidity Sensor Error
65	CO2 Too High
66	CO2 Too Low
68	Gas Analyzer Error
69	Gas Analyzer Calibration Error
70	O2 Sensor Error
71	CO2 Sensor Error
97	Compressor Sensor Open Circuit

Alarm Code	Action
98	Compressor Sensor Short Circuit
119	Digital Valve Error
120	Suction Pressure Sensor Error
121	Discharge Pressure Sensor Error
122	O2 Sensor Calibration Error
123	Datalogger Battery Error
124	Cold Treatment Restart
127	Alarm General Unit Error
128	Supply Air Temperature Probe Error
129	Return Air Temperature Probe Error
130	Evaporator Coil Temperature Probe Error
131	Ambient Condenser Temperature Probe Error
132	Power Module Sensor Error
133	Power Module Network Error
134	Controller Error
135	Power Module Error
136	Transducer Circuit Error
137	Sensor System Overload
138	AVL Sensor Error
139	Internal File Handling Error
140	Evaporator Section Too Hot
141	Power Module Heat Exchanger Too Hot
157	Data Logger Battery Failure

## Configuration Menu

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



**Figure 88: Configuration Menu**

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

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

### Viewing or Setting Functions

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

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

## Unit Setting

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

**In-Range Temperature limit:** Sets the temperature value for the controller's In-range LED and datalogger functions (factory default = 1.5 C [2.7 F]). Enter a value from 0.5 to 5.0 C (0.9 to 8.9 F).

**Padlock Option :** Select ON/OFF.

## Unit Configuration (Configuration Depends on Unit)

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

**Heater Element Type:** Select from Extended Capacity and Normal Capacity

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

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

## Sensor

**Calibrate Probes:** Used to calibrate sensor probes.

## Options

**AFAM Module:** This turns on the AVL option. Select from None, AVL, AFAM, and AFAM+. Selecting AFAM+ also turns Optiset ON.

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

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

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

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

**MTS Feature:** Select ON/OFF.

**CT Feature:** Select ON/OFF.

**Smart PYI Trial:** Select ON/OFF.

## Miscellaneous Settings

**DATE/TIME .** Sets the controller time and date.

**Contrast .** Used to adjust Screen Display contrast.

**Firmware Version.** Displays Controller Software/Application Revision, Bootloader Revision, Power Module Revision, Serial Number, and Option File Revision.

**Controller ID .** View and Edit Controller ID.

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

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

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

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

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

- c. Press the **F4 ENTER KEY** and release when the entry is complete. Press the **F1** key. The new value appears in the menu line.
5. Repeat steps 3 and 4 to reset additional configuration values.
6. Press the **F1** key to exit the Configurations screen.

### Set Date and Time

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

## Datalogger Menu

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

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

**Trip Start:** Sets a temperature offset in the controller memory to calibrate each USDA sensor to the controller.

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

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

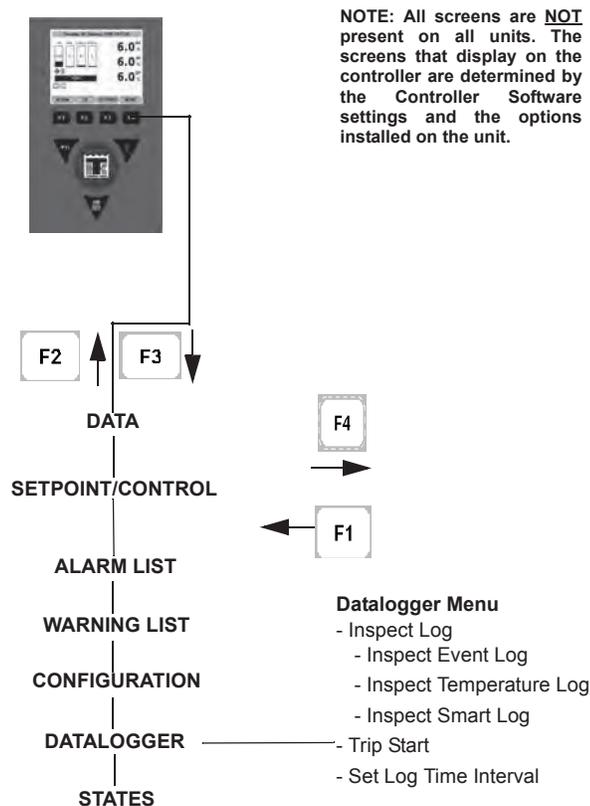


Figure 89: Datalogger Menu

### Viewing the Datalogger Menu

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

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the DATALOGGER Menu.
2. Press the **F4 ENTER** to access the Datalogger menu.
3. Press **F2 OR F3 UP/DOWN** key to scroll to the desired function:
  - [INSPECT LOG]
  - [TRIP START]

- [SET LOG TIME INTERVAL]

4. Press **F4 ENTER** to access the function selected.

### Inspect Log

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

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

### Event Examples

- Controller alarm status (alarms set/cleared)
  - Main power On/Off status (humidity On/Off, temperature setpoint, and main power Hz)
  - 12 Vdc battery discharge test (battery voltage, total unit and compressor hours if main power on) — this event logged at once a day
  - Change temperature setpoint (new/old setpoint)
  - Change RH setpoint (new/old RH setpoint)
  - Change RH status (On/Off)
  - Event log retrieval
  - Temperature log retrieval
  - Trip start
  - New container ID
  - PTI start (Unit configuration)
  - PTI part 1 end (Temperature differences for tests 1, 2, 3 and heat test)
  - PTI end
  - Defrost start (logged with demand or manual defrost only)
  - Defrost end (start time)
8. Press the **F1** key to exit the log.

### Trip Start

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

1. Press the **F4 MENU** key. Press the **F3** key to scroll down to the Datalogger Menu.

2. Press the **F4 ENTER KEY** to expand this menu.
3. Press the **F2 OR F3 UP/DOWN** key to scroll through submenu until [TRIP START] appears in display.
4. Press the **F4 ENTER KEY** to enter Trip Start function. The date and time of the last trip start appears in the screen.
5. Press the **F4 ENTER KEY** again to enter a new start of trip date and time in the log.  
*NOTE: When a PTI test is completed, the controller automatically enters a Trip Start in the log.*
6. Press the **F1** key to exit the Commands menu.

## Set Log Time Interval

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

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

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

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

## States Menu

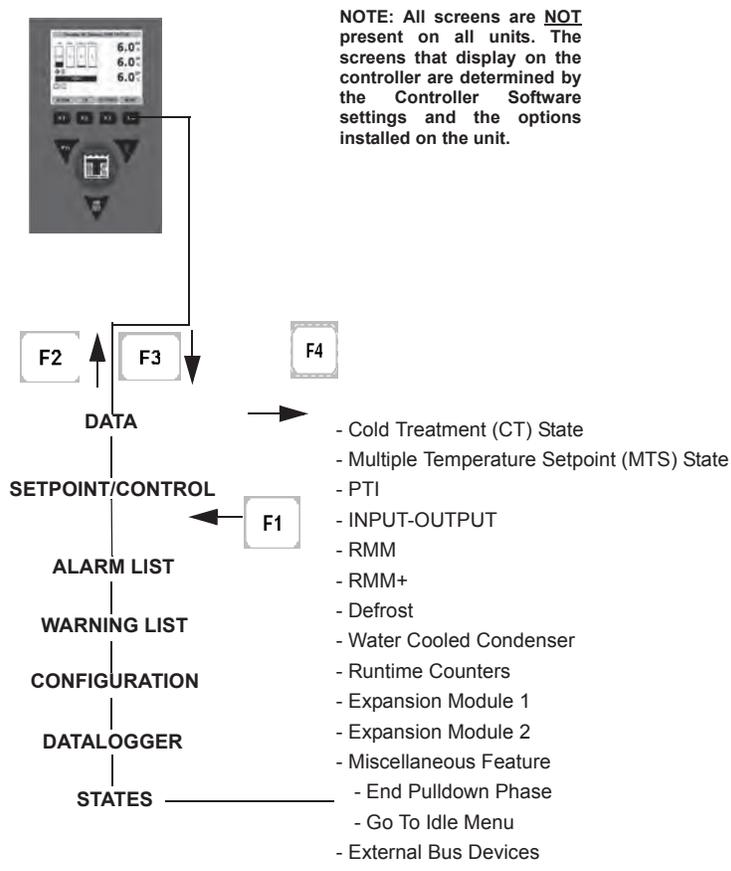


Figure 90: States Menu Screen Flow Diagram

### Cold Treatment (CT) State

Shows information on the Cold Treatment (CT) State if used.

### Multiple Temperature Setpoint (MTS) State

Shows information on the Cold Treatment (CT) State if used.

### PTI

Shows Information on the following:

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

### Input - Output

Shows Digital Input Information:

- Phase Direction
- HPCO
- LPCO

## Output Information

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

## RMM and RMM+ States

The RMM (Remote Monitoring Modem) State and RMM+ State menus display the current communications status with a REFCON system:

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

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

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

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

## Viewing the RMM State Screen

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

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

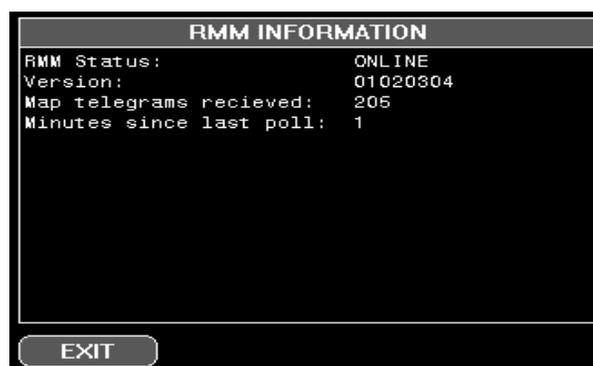


Figure 91: RMM States

### Defrost

Shows the following:

Compressor Defrost Timer [hours]

Timer Defrost timer Limit [hours]

### Water Cooled Condenser

Shows information on the Water Cooled Condenser State if used.

### Runtime Counters

Shows information on the Runtime Counters for the compressor, heating elements, evaporator fan, condenser fan, and main power.

### Expansion Module 1

Shows information on the Expansion Module 1 if used.

### Expansion Module 2

Shows information on the Expansion Module 1 if used.

### Miscellaneous Feature

Used to do the following:

End Pulldown Phase

Go To Idle Menu

### External Bus Devices

Shows information on the External Bus Devices if used.

## Air Ventilation Logging (AVL)

The Air Ventilation Logging option detects vent disk movement and automatically displays a value on the Display. This value is also logged in the datalogger. The entry records the time, date and vent opening position. It 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 **F1** key until the Display returns to the unit status display (setpoint):
2. Press the **F4** key to enter the Main menu.
3. Press the **F2 OR F3** key to scroll through Main menu until reach CONFIGURATION
4. Press the **F4** key to access the Configuration screen.
5. Press the **F3** key to scroll to Options. Press the F4 key to Expand this menu. Press F3 key until you reach AFAM Module/Controlled Atmosphere (CA) option.

6. Press the **F2 OR F3** key until it highlights AVL. Press and hold the **F4** key until the display returns to the AFAM Module/Controlled Atmosphere (CA) selection. The unit is now configured to log the vent door motion.
7. Press the **F1** key to exit the Options screen, and again to exit the Configuration screen.

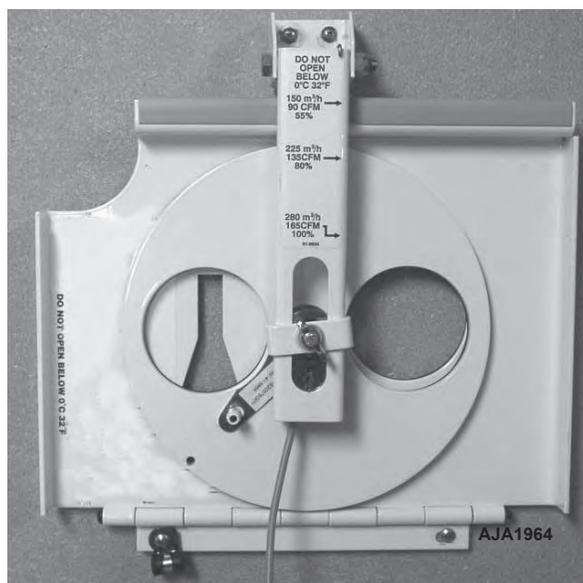


Figure 92: AVL

## Operating Instructions

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

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

## Starting the AFAM System

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

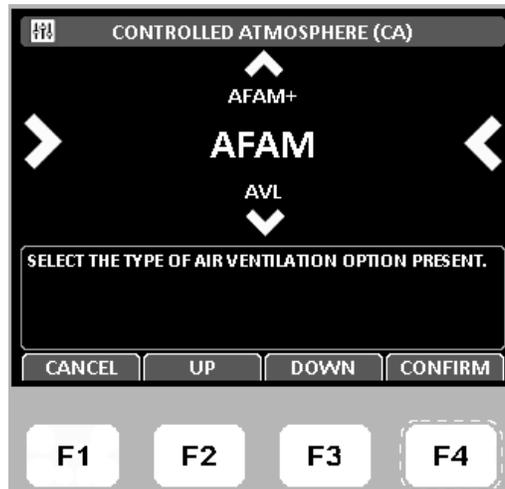


Figure 93: Controlled Atmosphere (CA) Menu

5. Press the **F1** key several times to return to the standard display.
6. Press the **MENU F4** key to enter the main menu. Press the **F2** or **F3** key to scroll to **Setpoint/Control** Menu and Press **F4** to expand the menu.
7. Press the **F2** or **F3** key to scroll to [Fresh Air Vent Man] line.
8. Press the **F4** key to enter the Fresh Air Vent Man menu.



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

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

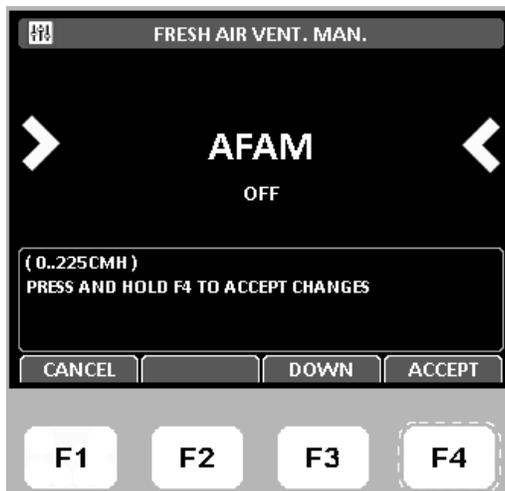


Figure 94: Fresh Air Vent Man Menu

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

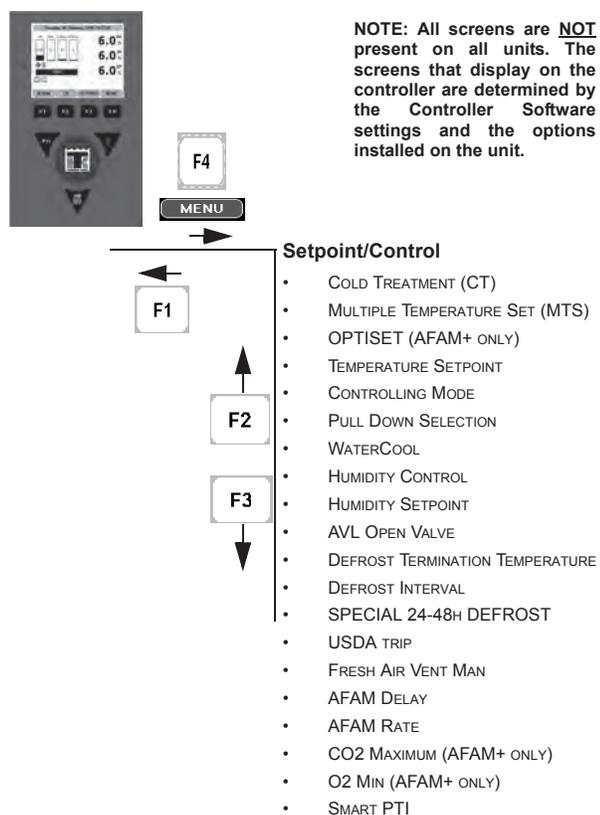
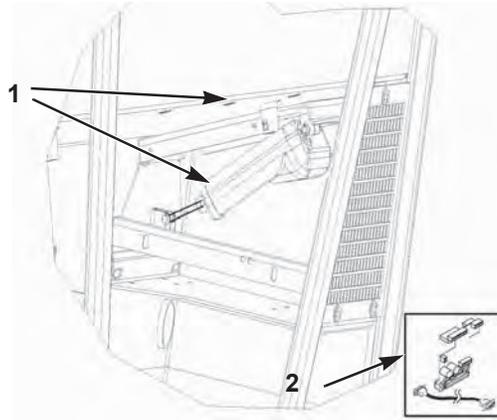


Figure 95: Setpoint/Control Menu

## 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.	Vent Door Assembly and Damper Motor
2.	Interface Board and Cable (Mounts in Control Box)

**Figure 96: 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 **MENU F4** key to enter the main menu. Press the **F2** or **F3** key to scroll to **Setpoint/Control** Menu and Press **F4** to expand the menu.
2. Press the **F2** or **F3** key to scroll to [AFAM DELAY] line.
3. Press the **F4** key to enter the AFAM DELAY menu. The current setting (“0”) appears in the display.
4. Press the **F2 OR F3** key to increase or decrease the time delay.



**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 you are returned to the main menu. The new time delay is recorded in the controller and appears in the Display.
6. Press the **F1** key to exit the 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 **MENU F4** key to enter the main menu. Press the **F2** or **F3** key to scroll to **Setpoint/Control** Menu and Press **F4** to expand the menu.

2. Press the **F2** or **F3** key to scroll to [AFAM RATE] line. Press **F4** to enter menu. The current rate and units (e.g. “0 CFM”) appears in the display.
3. Press the **F2** OR **F3** key to increase or decrease the AFAM Rate.

Units	Rate Setting
CFM	0 to 132 Cubic Feet Per Minute
M3H	0 to 225 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.*

4. Press and hold the **F4** key until you are returned to the main menu. The new rate is recorded in the controller and appears in the Display.

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

An advanced microprocessor controlled fresh air management system that provides:

- programmable control of the 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 Module/Controlled Atmosphere (CA) 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/Control menu. If a replacement controller or new software is installed, a controller auto configuration will detect the AFAM+ option when the AFAM door control module and gas sensor are connected to the controller.

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

The default setting for AFAM in the Setpoint menu is the last value set (Off, AFAM, or AFAM+).

Controlled Atmosphere (CA) and Fresh Air Vent Man must be set to AFAM+ to control the vent door to the CO<sub>2</sub> gas level.

1. Press the **MENU F4** key to enter the main menu. Press the **F2** or **F3** key to scroll to **Config** Menu and press **F4** to expand the menu.
2. Press the **F2** or **F3** key to scroll to **Options** Menu and press **F4** to expand the menu.
3. Press the **F2** or **F3** key to scroll to **Controlled Atmosphere (CA)** Menu and press **F4** to enter the menu.

4. Press the **F2** or **F3** key to select **AFAM+** and Press and hold **F4** to accept the selection.

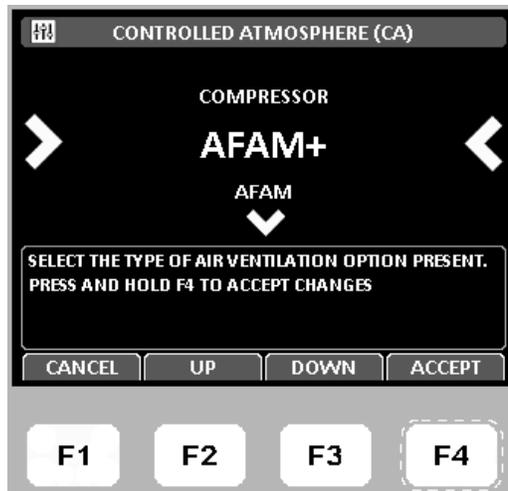


Figure 97: Controlled Atmosphere (CA) Menu

5. Press the **F1** key several times to return to the standard display.
6. Press the **MENU F4** key to enter the main menu. Press the **F2** or **F3** key to scroll to **Setpoint/Control** Menu and Press **F4** to expand the menu.
7. Press the **F2** or **F3** key to scroll to [Fresh Air Vent Man] line.
8. Press the **F4** key to enter the Fresh Air Vent Man menu.



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

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

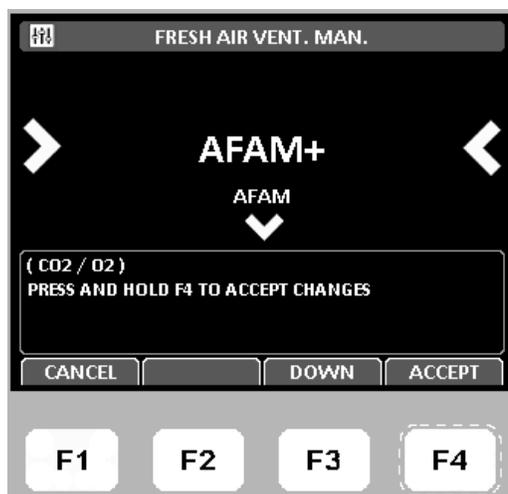


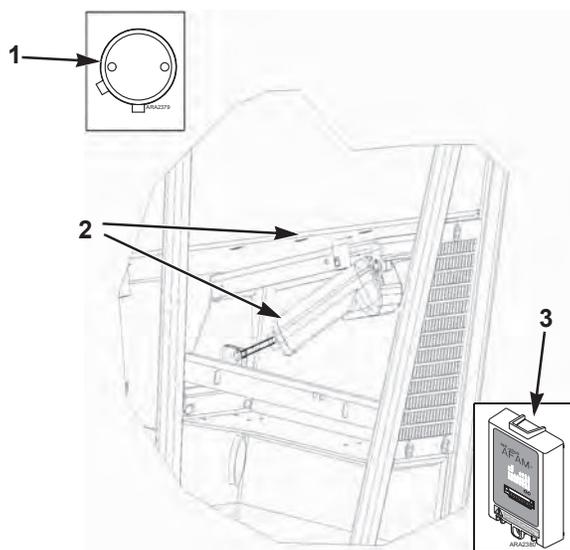
Figure 98: Fresh Air Vent Man Menu

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

## Change the AFAM Delay

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

The AFAM delay setting keeps the fresh air vent closed for a preset time when the unit starts. This allows faster product temperature pull-down. The AFAM delay can be set from 1 to 72 hours in 1-hour increments. See “Change the AFAM Delay” on page 116 for the procedure to set the delay.



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

**Figure 99: 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.*



**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.*

## 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 **MENU F4** key to enter the main menu. Press the **F2** or **F3** key to scroll to **Setpoint/Control Menu** and Press **F4** to expand the menu.

2. Press the **F2** or **F3** key to scroll to “CO<sub>2</sub> MAX” line.
3. Press the **F4** key to enter the CO<sub>2</sub> MAX menu. The current rate and units (e.g. “2.5 percent”) appears in the display.
4. To change the rate, press the **F2** OR **F3** key to increase or decrease the CO2 Max setting.

 **WARNING:** *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 you are returned to the main menu. The new rate is recorded in the controller and appears in the Display.

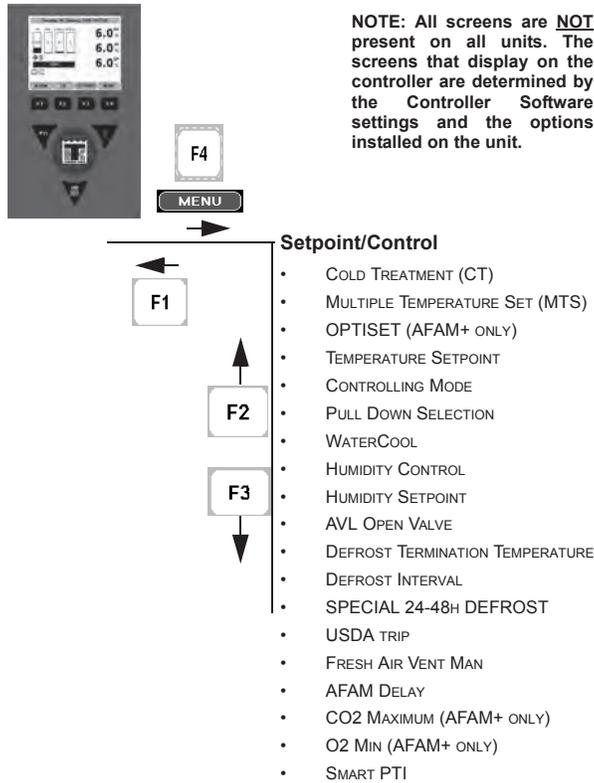


Figure 100: Setpoint/Control Menu

## Changing the AFAM+ Settings Using 'OPTISET'

1. Press the **MENU F4** key to enter the main menu. Press the **F2** or **F3** key to scroll to **Setpoint/Control** Menu and Press **F4** to expand the menu.
2. Press the **F2** or **F3** key to scroll to **Optiset** Menu.
3. Press **F4** key. The following screen will appear:

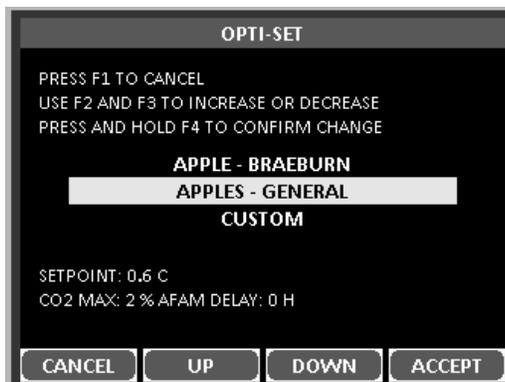


Figure 101: Optiset Menu

4. Use **F2 / F3** keys to scroll to desired product.
5. Press and hold **F4** key to auto enter product settings.
6. 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

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

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

- Evaporator Fan Speed
- Defrost Termination Temperature
- Humidity Control
- Humidity Setpoint
- AFAM DELAY
- O2 Minimum (if applicable)
- CO2 Maximum

**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 the **F2 OR F3** key to increase or decrease the O2 Min supplied by the shipper.
6. Press and hold the **F4** key until you are returned to the main menu. The new rate is recorded in the datalogger and appears on the Display.
7. Press **F2 or F3** key to scroll to 'CO2 MAX'.
8. Press **F4** key to enter the setting mode.
9. Enter the CO2 setting supplied by the shipper.
10. Press and hold the **F4** key until you are returned to the main menu. The new rate is recorded in the datalogger and appears on the Display.

### Testing AFAM+ / AFAM System

The system consists of the following main parts:

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

### AFAM+ Option Alarm Codes (see manual for further descriptions)

- Code 122 – O2 Sensor Calibration Error (PTI Only) (if equipped)
- Code 124 - Power module sensor Error

### 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 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 (and the unit Schematic and Wiring Diagrams) to verify the connections, supply voltages and communication wiring to the two components. Also verify that the AFAM+ Expansion Module is firmly attached to the back of the controller.

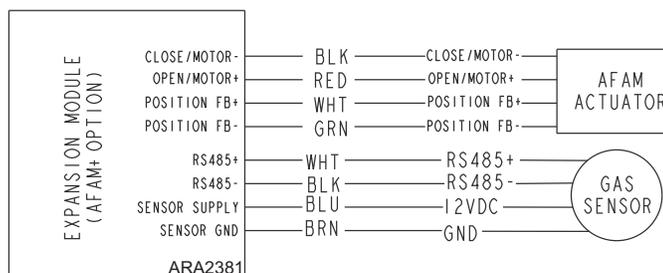


Figure 102: AFAM+ Schematic Diagram

## Alarm Codes and Actions / Data Menu Display

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

Alarms	Possible Cause	Corrective Action(s)
Code 122 O2 Sensor Calibration Error (if equipped) (PTI Only)	<ol style="list-style-type: none"> <li>1. Stale atmosphere / Filter or inlet / outlet tubes restricted (SEE NOTE BELOW)</li> <li>2. O2 sensor reading &lt; 17% or &gt; 25%</li> </ol>	<ol style="list-style-type: none"> <li>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</li> <li>2. If O2 reading is still out of calibration range after purge procedure noted above is performed, replace analyzer</li> </ol>

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.***

## Pulsating Vent Door

### AFAM+ Door Closes Automatically

On units equipped with the AFAM option, a harness from J\_B12 to the on/off switch, and a container prefix of HLXU. If the AFAM door is open it will close automatically if the on/off switch is turned off. Unit and controller will shut off and the AFAM door will be power close.

### Pulsating AFAM+ Door

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

#### AFAM+ set to “AFAM” and the AFAM Rate set to 75 CMH

In the past if you wanted 75 CMH, the door would open to the 75 CMH position and stay.

Now the door will remain closed and then opens fully for 5 min every 15 min to achieve the same 75 CMH

When door is closed the display will read “PULSATING AFAM XXX SEC TO DOOR OPEN”

When door is open the display will read “PULSATING AFAM DOOR OPEN”

When the AFAM door opens it remains open for min of 30 sec.

### AFAM+ Enabled

In the past once the CO2 level reached the maximum setpoint, the door would start to ramp open. Once the CO2 level decrease the door would start to ramp closed.

Now once the CO2 level reaches the maximum setpoint, the door opens fully for calculated period of time. The door will when close for calculated period time. If the CO2 level remains above the maximum setpoint, the calculated period of time the door is open will be increase and the period of time close will decrease.

When door is closed the display will read

“PULSATING AFAM XXX SEC TO DOOR OPEN”

When door is open the display will read “PULSATING AFAM DOOR OPEN”

When the AFAM door opens it remains open for min of 30 sec.

**PULSATING AFAM  
XXX SEC TO DOOR OPEN**

**PULSATING AFAM  
DOOR OPEN**

# Operating Theory

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

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

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

## **Supply Air Sensor Control**

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

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

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

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

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

## **Cooling Capacity Display in main screen**

The percent displayed in the main screen indicates the cool capacity that is currently provided. For example, when controller display shows 70 percent, this means the Digital Control valve is operating to reduce system cooling capacity from 100 percent to 70 percent (a 30 percent reduction).

## **Power Limit Management**

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

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

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

## **Compressor Vapor Injection**

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

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

## High Temperature Protection

If the discharge gas temperature rises above 148 C (298 F), the unit stops immediately. The controller turns on the Alarm LED and records Alarm Code 56 (Compressor Temperature Too High). The controller will restart the unit when the sensor temperature is below 90 C (194 F).

## Power Limit Mode

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

## Evaporator Fan Control

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

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

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

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

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

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

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

## Condenser Fan Control

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

To do this the condenser fan pulses.

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

### Probe Test

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

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

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

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

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

### Dehumidify Mode

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

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

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

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

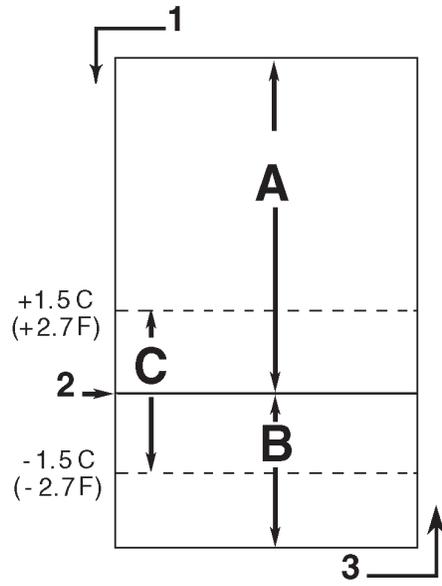
## Continuous Temperature Control Operation

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

The controller regulates the compressor, Digital Control valve and electric heaters based on a Control Temperature Differential (see “General Theory of Operation” in this chapter for more detail). This means the unit operating mode can *not* be predicted based *only* on the setpoint and supply air temperature.

At setpoints of -9.9 C (14.1 F) and above, the controller operates the unit on:

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



AXA0156

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

**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			Unit Function
Cool w/Mod	Heat	Defrost	Cool	Null	Defrost	
• <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 controlling mode setting determine the evaporator fan speed:

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

<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.

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

### Heat

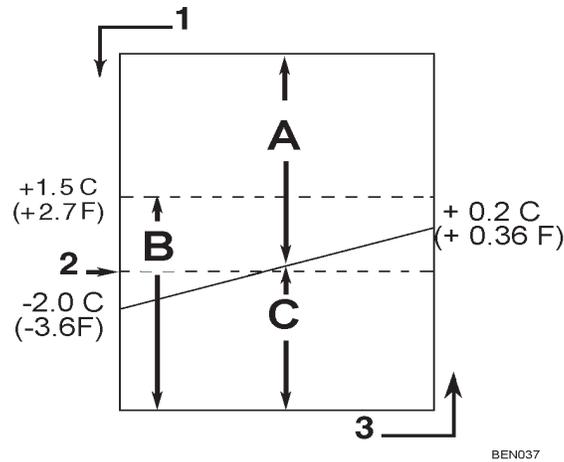
- If the supply air temperature is too low and the Control Temperature Differential is below the setpoint, the controller stops the compressor. The fans (low speed) are kept on to determine if fan heat is sufficient to increase temperature to setpoint. If not, switch to high speed. If not sufficient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

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

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

At setpoints of -10 C (14 F) and below, the controller operates the unit on:

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



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

Figure 103: Frozen Load Control Sequence (Setpoints at -10 C [14 F] and Below)

**Cool**

- After initial start-up and pull-down to 2.0 C (3.6 F) below setpoint, the controller calls for the Cool mode whenever:
  - Return air temperature increases more than 0.2 C (0.36 F) above setpoint.
  - Return air temperature is above setpoint and the compressor has been off for 30 minutes.
- Controller turns on the Compressor indicator when the compressor is operating.
- Compressor must operate for a minimum of 5 minutes after startup.
- After initial pull-down to setpoint, controller keeps the In-range LED on as long as the return air temperature remains less than 1.5 C (2.7 F) above setpoint.

**Null**

- The controller calls for Null when the return air temperature decreases more than 2.0 C (3.6 F) below setpoint.
- The controller stops the compressor and condenser fan and evaporator fan.

## Defrost

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

- Demand Defrost function initiates Defrost immediately when:
  - Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large.
  - Temperature difference between the supply sensors and return air sensor is too large.
- Manual Defrost may be initiated immediately by pressing the **DEFROST** key or by REFCON Remote Monitoring Modem (RMM).
- A Timed Defrost always starts at 1 minute past the hour immediately following a defrost timer request for defrost. For example, if the defrost timer requests a defrost cycle at 7:35, the defrost cycle will start at 8:01. The datalogger will record a Defrost event for each log interval in which a Defrost cycle is pending or active (i.e. both the 8:00 and 9:00 data logs on 1 hour logging interval).
- On Chill Loads (setpoints at -9.9 C [14.1 F] and above), the conditions for this are:
  - Evaporator Coil Temperature must be below 4 C (41 F) to activate the defrost compressor hour timer.
  - There is an interval set for defrosting, however, the defrost timer is built intelligent - it detects whether or not there is ice building up on the coil.
  - If there is no ice building up on the coil, it extends the defrost interval, and if there is Ice building up earlier on the coil it reduces the defrost interval. The maximum interval is 48 hours.
- On Frozen Loads, the initial time interval is 8 hours. Two (2) hours are added to the time interval each timed defrost interval. Maximum accumulated time interval is 24 hours.
- Defrost timer resets if the unit is off more than 12 hours, setpoint is changed more than 5 C (8.9 F) or PTI (pretrip) test occurs.

***NOTE: If unit operating conditions do not allow the unit to enter a defrost cycle, “Defrost Not Activated” appears on VGA display when the DEFROST key is pressed.***

### When the Defrost mode is initiated:

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

### The controller terminates the Defrost mode when:

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

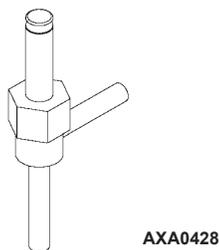
### When the defrost mode is terminated:

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

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

## Compressor Digital Control Valve

The MP-4000 controller pulses the Compressor Digital Control solenoid valve between open and closed positions. This provides precise cooling capacity control. No pump down function or warm gas bypass control is used in conjunction with the Compressor Digital Control valve.



**Figure 104: Compressor Digital Control Solenoid Valve**

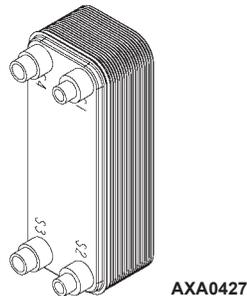
The Compressor Digital Control valve is normally closed. The normally closed position provides full cooling capacity. When the controller energizes, it opens the Compressor Digital Control valve. Refrigerant gas flows from the digital port of the compressor back to the suction line. This disengages the 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 105: Economizer Heat Exchanger**

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

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

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

## Data Recording and Downloading Data

The MP-4000 data logger can record sensor temperatures as well as loss of power, alarms, sensor failure, setpoint change and unit shutdown events. All data logs include the time and date; setpoint temperature; supply, return, ambient, USDA1, USDA2, USDA3 and cargo sensor temperatures; and humidity sensor. All temperature logs can be viewed from the controller's VGA message display.

Data logging intervals are selectable for 30 minutes, 1, 2 or 4 hours.

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

If the unit power supply is disconnected, the data logger will continue to register 120 temperature logs (except humidity sensor) when battery voltage is above 4.2 volts. These will be maintained until the unit is re-connected to power, and the battery automatically recharged.

Trip data can be retrieved (but not erased) from the data-logger memory using a LOGMAN II handheld data retriever, LOGMAN II PC used on a laptop PC or a REFCON power line remote monitoring system. LOGMAN II data transfer rate based on a 1 hour log interval is about 15 seconds per month of event logs and about 70 seconds per month of temperature logs. For example, downloading 90 days of data logs would take about 95 seconds for event logs only and about 210 seconds for temperature logs only.

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

## Cold Treatment (CT)

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

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

### Controller Settings

**CT Temperature Setpoint** - Setpoint temperature used during the CT period.

**CT Period** - Number of days and/or hours accepted by the USDA max limit, to pass the CT period.

**CT MAX USDA Temperature** - Maximum allowed USDA sensor temperature during the CT period.

**CT Final Temperature Setpoint** - Final setpoint temperature after the CT passes.

**CT Heatup** - Delay interval between each 0.1 C increase (normally 1 hour).

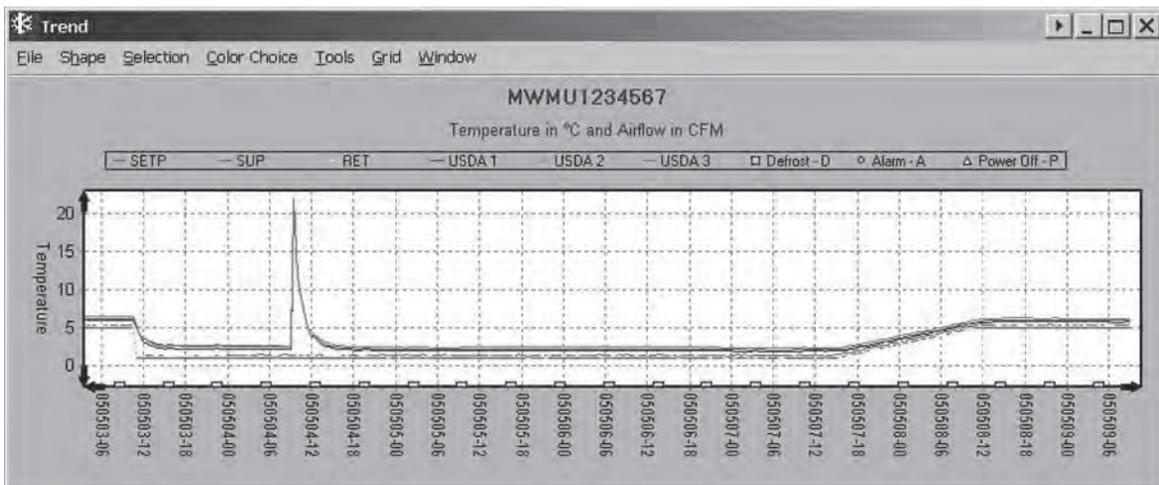
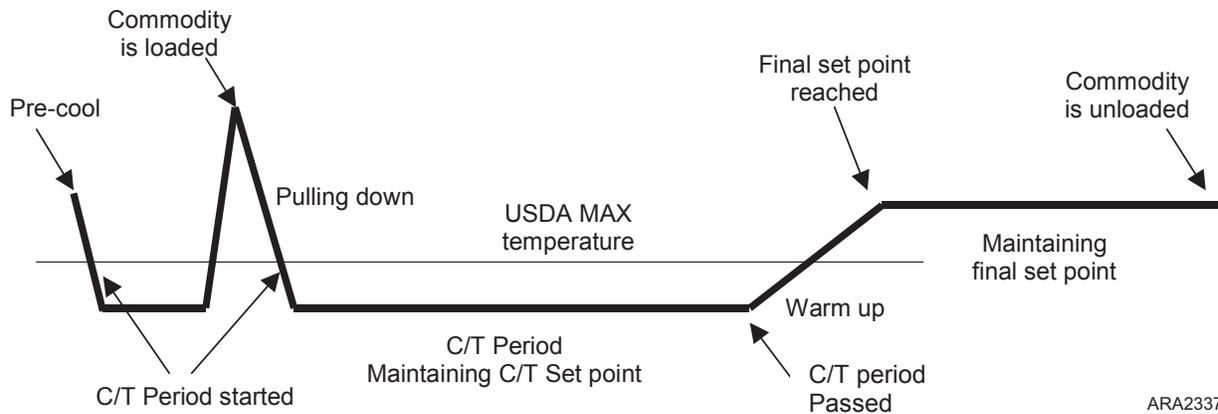


Figure 106: Example of CT Log



ARA2337

Figure 107: Details of CT Log

### Trip Action and Unit Mode

- Container is prepared with CT settings and transported to be loaded. If the unit is running the container will pre-cooled.
- If unit is equipped with the USDA sensors, once all the sensor temperature readings decrease to or below the USDA Max the CT period will start.
- Cargo is loaded and USDA sensors are placed in the cargo per the USDA specification.
- USDA sensor readings will increase to cargo temperature and a running CT period will be canceled. Pull down of the cargo temperature begins
- Once all the USDA sensor temperature readings decrease to or below the USDA Max the real CT period will start.
- If any of the USDA sensor temperature readings go above the USDA Max, the CT period will be canceled and the above action will repeat.
- When the specified number of days has finished the controlling setpoint is increase, 0.1 C per hour, until the final setpoint is reached.

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

2005/04/27 11:33 KBD Cold Treatment Activity - Option made possible - not yet activated.

2005/04/27 11:33 KBD Cold Treatment Activity - C/t set point 0.0C.

2005/04/27 11:33 KBD Cold Treatment Activity - Period/Days 3days.

2005/04/27 11:34 KBD Cold Treatment Activity - USDA max 3.0C.

2005/04/27 11:34 KBD Cold Treatment Activity - Final set point 5.0C.

2005/04/27 11:39 KBD Cold Treatment Activity - DE-ACTIVATED/STOPPED before time.

2005/05/03 10:30 KBD Cold Treatment Activity - ACTIVATED.

2005/05/03 10:30 AUTO Cold Treatment Activity - Initiated. C/t SP:1.0C - USDA max:3.0C - Period:3days - Final SP:5.0C.

2005/05/03 13:32 AUTO Cold Treatment Activity - Period started. C/t SP:1.0C - USDA max:3.0C - Period:3days.

2005/05/04 14:31 AUTO Cold Treatment Activity - Period started. C/t SP:1.0C - USDA max:3.0C - Period:3days.

2005/05/07 15:00 AUTO Cold Treatment Activity - Period passed OK.

2005/05/08 10:30 AUTO Cold Treatment Activity - Ended. Final SP:5.0C.

## Unit Requirements

To activate CT the unit must have:

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

## Activating Cold Treatment

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

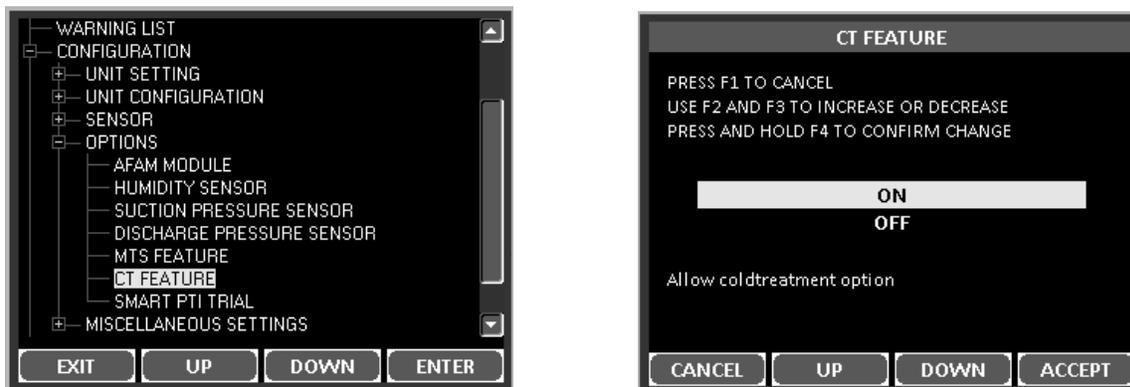


Figure 108: Turn CT Feature On

## Calibrate Probe (Optional)

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

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

## Ice Bath Preparation

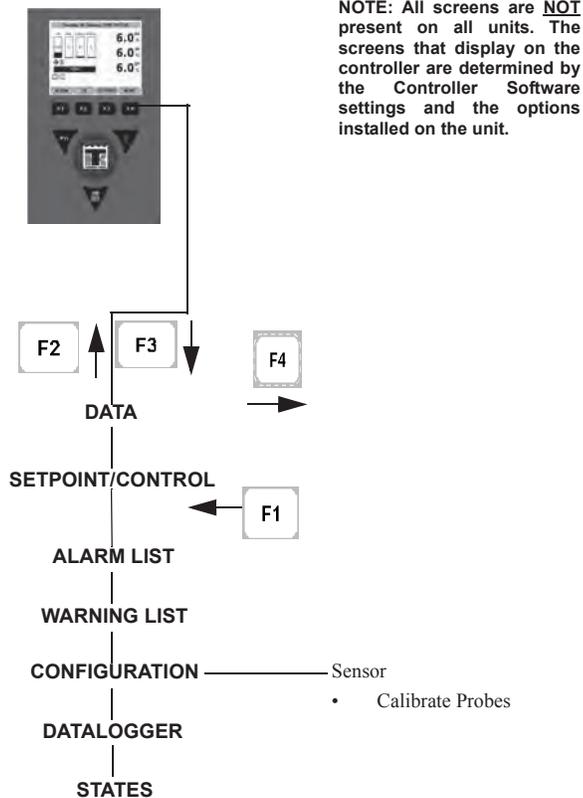
1. The ice bath should consists of an insulated container full of ice made from distilled water with enough distilled water added to cover the top of the ice during the test. A properly filled ice bath should be completely filled with ice all the way to the bottom of the container.
2. Stir the ice bath briskly for one minute before proceeding.
3. Insert the USDA sensors in the ice bath. Wait 5 minutes to allow the sensor temperatures to stabilize at 0 C (32 F).
4. Stir the ice bath frequently. As an option, test and verify ice bath temperature with a meter or measuring device meeting your accuracy requirements. Stirring 10 seconds every 3 minutes during the test procedure is adequate.

## Calibrating the USDA Sensors

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

**NOTE:** The sensors must be completely immersed in the ice bath without contacting the walls of ice bath container for 5 minutes.

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



**Figure 109: Configuration > Sensor Menu**

3. Press the **F4 ENTER KEY** to access the CONFIGURATION menu.
4. Press the **F2 OR F3 UP/DOWN** key to scroll to scroll down to the SENSOR Menu.
5. Press the **F4 ENTER** key to access the SENSOR Menu.



**Figure 110: Sensor Menu**

6. Press the **F3** key to scroll down to CALIBRATE PROBES.
7. Press the **F4 enter** key to enter Calibrate function. The display shows [RAW] and [CORR] temperature off-sets for each sensor in two rows.

CALIBRATE PROBES				
Sensor	Raw	Corr.	Pass	Result
USDA 1	8.0	0.0	NO	8.0
USDA 2	8.0	0.0	NO	8.0
USDA 3	8.0	0.0	NO	8.0
Cargo	8.0	0.0	NO	8.0

Raw reading must be within  
-0.3 to +0.3C to pass calibration

EXIT      RELEASE      CALIBRATE

Figure 111: Calibrate Probes

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

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

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

8. Press the **F3** key to release the current actual temperature offsets from the controller memory. Observe the sensor temperatures in the [CORR] row.
9. Press the **F4 ENTER KEY** to accept the new temperature offsets when all sensor offsets read between + 0.3 C (+0.5 F) and - 0.3 C (-0.5) and have been stable for 5 minutes. The controller display will show the new offsets in the [RESULT] row.
10. Press the **F1** key to exit the Calibrate menu.

### Starting Cold Treatment

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

**NOTE: Once Cold Treatment has been started, it must be stopped to change any of the settings.**

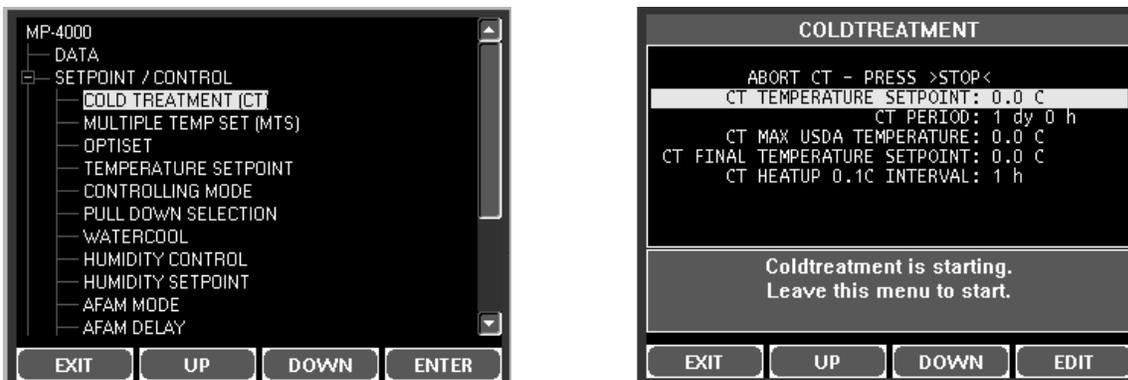


Figure 112: Starting CT

3. Select EXIT. The Standard Display will appear showing “CT In Progress”. CT is activated and the trip begins.

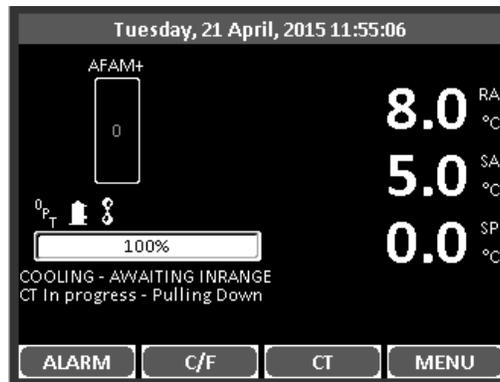


Figure 113: Standard Display Showing CT In Process

### Stopping Cold Treatment

1. Press the CT Key.
2. Scroll down to ABORT CT - PRESS >STOP< and press STOP.

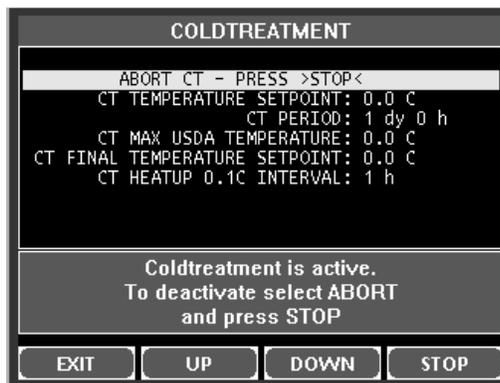


Figure 114: Stopping CT

3. The Standard Display will appear and “CT In Progress” will disappear from the display.

### Passed Cold Treatment – must be acknowledged

To ensure the user observe the passed display, Acknowledge CT will be displayed until it is acknowledged by pressing the CT Key and then pressing the ACK Key.

### Surveillance during cold treatment

During the CT period all USDA sensors can fail and the CT period will continue.

The fail state will be shown in the temperature log.

If all 3 probes fail the period will continue based on time only.

### RMM / Refcon:

The RMM at no time during the CT is able to change any of the CT settings

The RMM interface will show the final temperature as setpoint through out the trip, even when the period is running and another setpoint is used.

### Economy mode:

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

**Associated tools**

LogView must be updated to Version 5.8.2.0 to report the cold treatment events

**Various actions:**

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

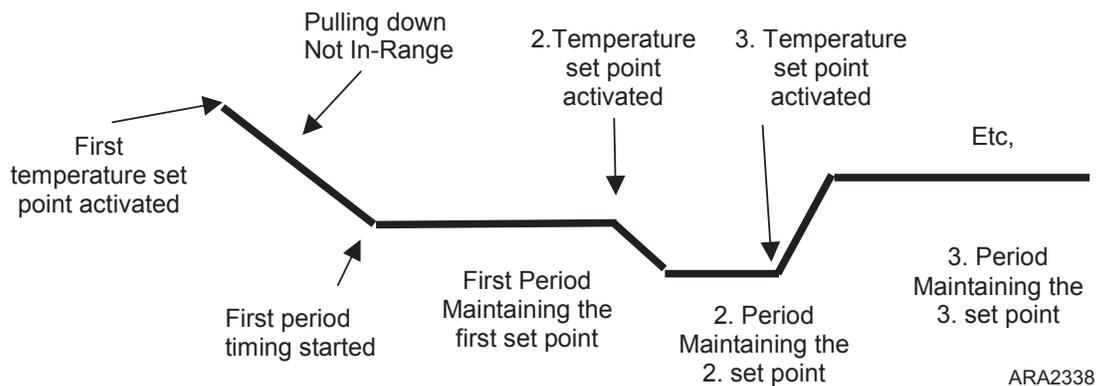
**Multiple Temperature Setpoint (MTS)**

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

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

The fix point list for the temperature scheme programming allows for up to 9 different sets of temperatures and periods.

- 9 sets of temperature setpoints
- 8 sets of timing in between the 9 setpoints.



**Figure 115: Example of MTS Log**

**Trip Actions and States:**

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

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

2005/04/27 11:33 KBD Multi Temperature Setting Activity - Option made possible - not yet activated.

2005/04/27 11:33 KBD Multi Temperature Setting – X. set point 0.0C.

2005/04/27 11:33 KBD Multi Temperature Setting – X. Period/Days 7days.

### Activating Multiple Temperature Setpoint

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

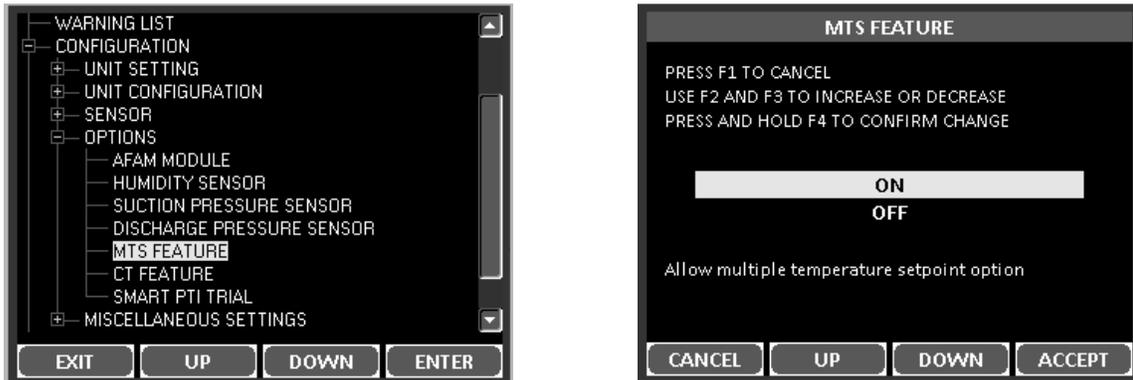


Figure 116: Turn MTS Feature On

### Starting and Setting Multiple Temperature Setpoint

- Go to the Setpoint/Control and enter Multiple Temp Set (MTS).
- The display will show the Multiple Temperature Setpoint setting list, scroll up and down to edit and enter the settings per the load specifications.



Figure 117: Starting and Setting MTS

3. Select MTS Temperature Setpoint 1 and press EDIT. The following screen will appear. Press UP and/or DOWN to change the setpoint to the desired setting and Press and hold ACCEPT to enter that setpoint.

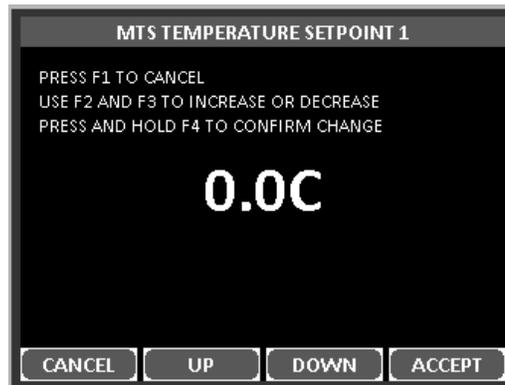


Figure 118: Setting MTS Temperature Setpoint 1

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



Figure 119: Setting MTS Period 1

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

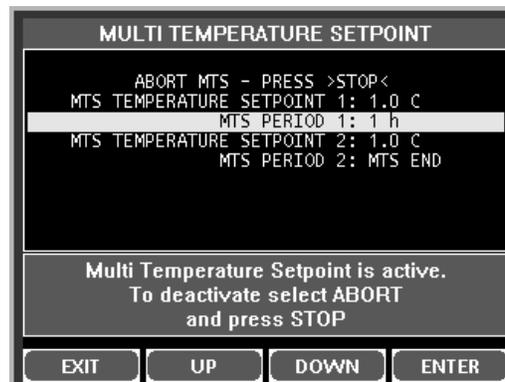


Figure 120: Setting MTS Display Showing Addition of Setpoint 2

- Select EXIT. The Standard Display will appear showing “MTS - Approaching setting 1” indicating MTS is active.

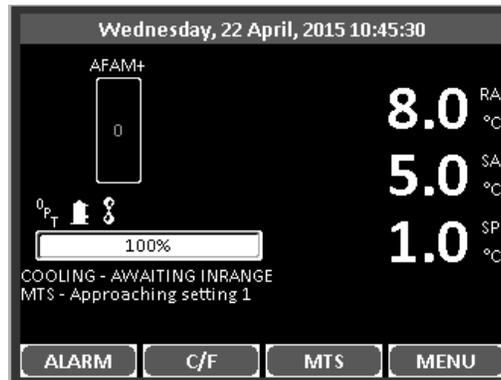


Figure 121: Standard Display Showing MTS In Process

### Stopping Multiple Temperature Setpoint

- Press the MTS Key.
- Scroll down to ABORT MTS - PRESS >STOP< and press STOP.

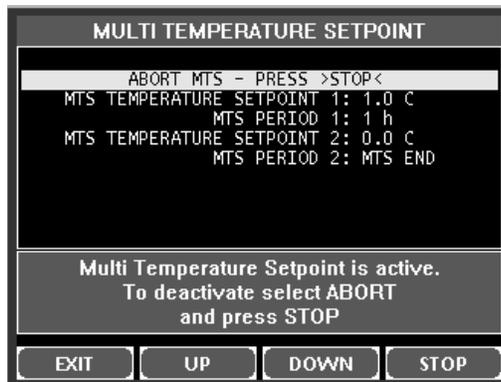


Figure 122: Stopping MTS

- The Standard Display will appear and “MTS - Approaching setting” will disappear from the display. After stopping MTS the unit will continue running with the last MTS setpoint in action.

## Changing Multiple Temperature Setpoint Settings

1. Press the MTS Key.
2. Scroll up and down to select and edit the setting to be changed. Select EXIT to return to Standard Display and continue MTS with the new setting.

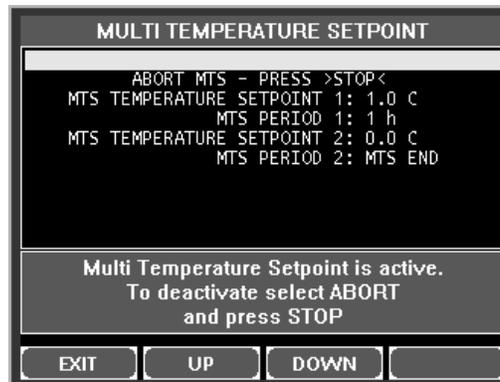


Figure 123: Changing MTS Settings

### Surveillance during the multi temperature setting trip

During the treatment the normal unit surveillance is kept.

### Associated interfaces RMM / REFCON:

The RMM must at no time during the journey be able of changing any involving parameters and settings on the controller.

The RMM interface will show the ending final/last set point through out the trip, even when setting 1 or 2 etc. is running as active with another set point in use.

### Associated tools

LogView must be updated to Version 5.8.2.0 to report the Multi Temperature Setting events

### Various actions:

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

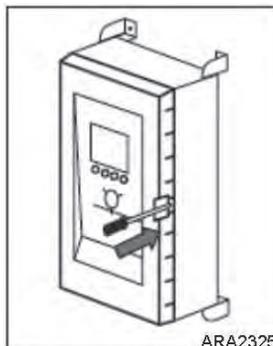
# Controller Maintenance

---

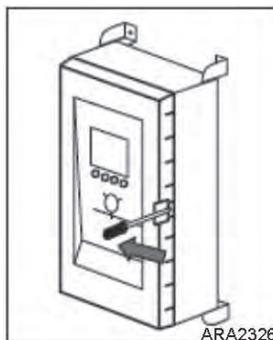
## Controller Door Open and Close Instructions

### Open

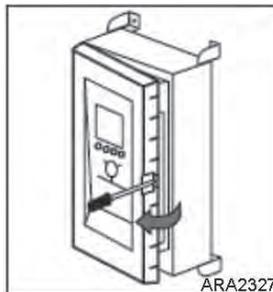
1. Insert a flat blade screwdriver into slot on side of control box door.



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

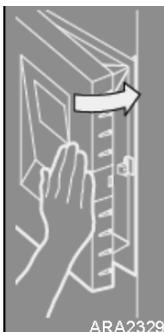


3. With the door catch released, pull door out and open.



### Close

1. To close door, push firmly until you hear a Click sound.



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



## Flash Loading Controller Software

Controller software must be flash loaded when software has been revised. Flash load software complete as follows:

### Download the latest software file from Global Marine Solution Info Central site/Software Update/MP4000.

The Zip file will contain the latest software and the command.ini file. Unzip them to your Desktop. The current version when this manual was published is CM4000 3.2.0.0 w 3.2.3.0 sip Load to SD Card.zip.

### SD Card Setup structure

1. Make sure the SD card is in the un-lock or writeable mode. Small tab on side slide forward is un-locked.
2. If card is new format card so it is clean
3. Create a new directory on the SD card titled MP4000. In the MP4000 directory create two new sub directories titled **Firmware** and **Logs**.

    / **MP4000**

        / **Firmware**

        / **Logs**

4. Copy the command.ini file into the /MP4000 directory of the SD card.
5. Copy the latest software file (.strip) into the \ MP4000 \ Firmware sub directory.

    / **MP4000**

        / command.ini 3/18/2010

        / **Logs**

            Downloads will appear here

        / **Firmware**

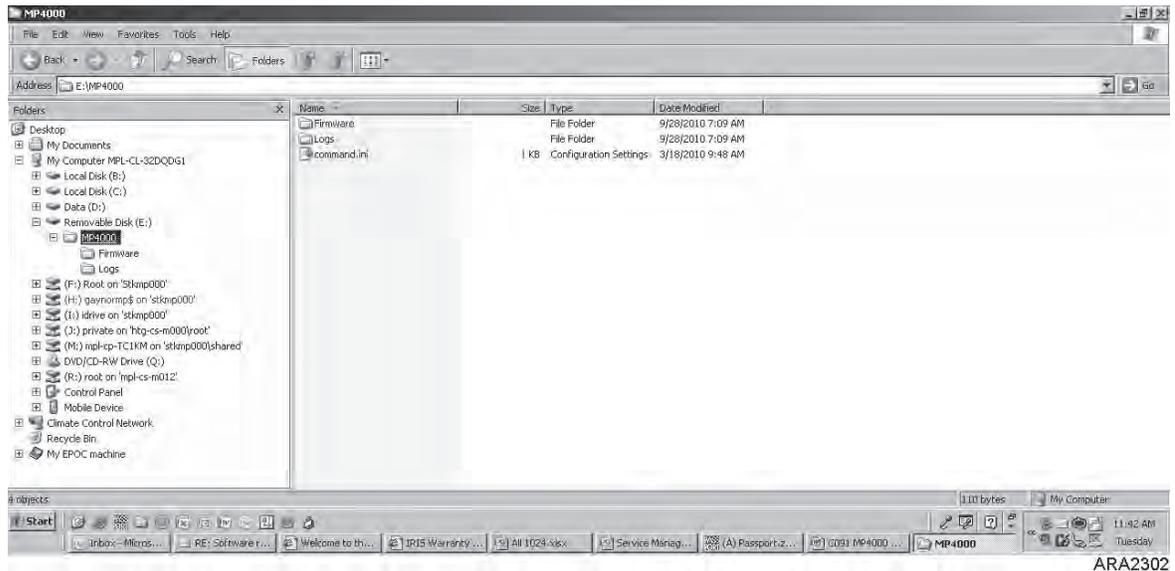
            CM4000\_3.2.0.0\_140822.strip

**See figures 124 and 125.**

**Figure 124**

**Removable Disk (E:) / MP4000**

/command.ini 3/18/2010



**Figure 124: MP4000**

ARA2302

**Figure 125**

**Removable Disk (E:) / MP4000**

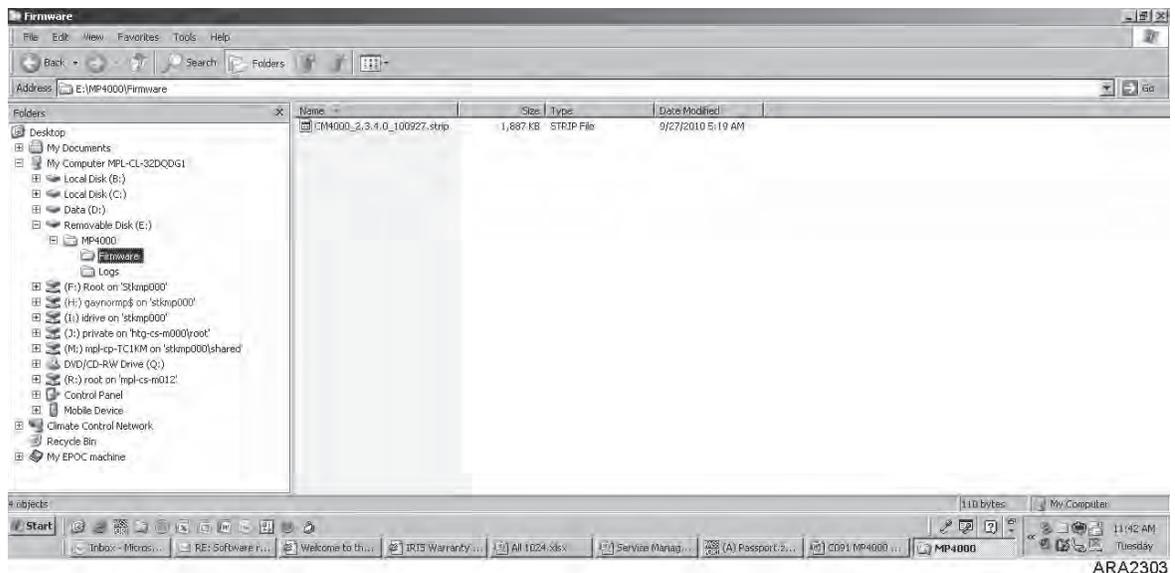
/ Firmware

CM4000\_3.2.0.0\_140822.strip

/ Logs

Downloads will appear here

/command.ini 3/18/2010



**Figure 125: MP4000/Firmware**

ARA2303

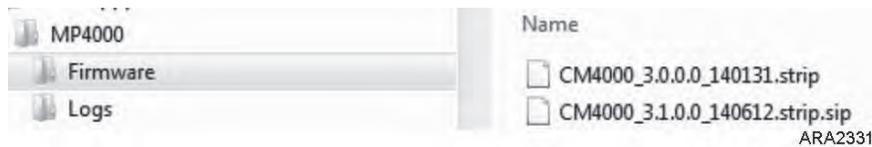
### Software File Format SIP

In version 3.0.0.0 we introduced the SIP file format for adding options like RMM to the unit. Version 3.1.0.0 120612 and later were released in this SIP format.

CM4000\_3.1.0.0.120612.srip.sip

In order to load version 3.1.0.0 or later software the MP4000 controller needs to have 3.0.0.0 software installed first.

Load to SD Card file contains both 3.0.0.0 and 3.1.0.0 or later software.



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

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

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

### Flashload Procedures Battery Power

1. Make sure that the unit is not active (no display).
2. Insert the SD card, with the latest software, into the slot on the side of the controller.
3. Activate the display using battery power by pushing the ON/OFF button. If the software on the SD card is newer than what is on the controller, the upload will take place and progress can be shown on the display.
4. When finished the display will shut down and the operation is finished.

### Flashload Procedures Shore Power

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

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

## MP-4000 Test System Tool

The MP-4000 Test System Tool has the ability to test the following components:

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

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



**Figure 126: Test System Tool**

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

The Tool is sold through Emerson Controls.

Ordering information (Contact)

Wilmor Halamani

Email: [Wilmor.Halamani@Emerson.com](mailto:Wilmor.Halamani@Emerson.com)

Phone 45 70234444

Fax 45 70236044.

1 MP-4000 Test System (item no. 8232- 010)

Delivery terms: ex works

Delivery mode: DHL

Delivery time: 2-3 days upon receipt of order

Payment terms: 14 days net

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

In the event of a MP-4000 Tester Tool part failure, please refer to the following information for replacement.

All of the test plugs are covered under warranty for one (1) year from date of purchase by Emerson Controls.

To order a replacement test plug, please provide the following information:

1. Part number of plug to be replaced
2. Original purchase date of test tool and serial number
3. Company name and shipping address
4. E-Mail or fax the information above to: (JCI will respond with payment terms, if applicable)

Wilmor Halamani

Email: [Wilmor.Halamani@Emerson.com](mailto:Wilmor.Halamani@Emerson.com)

Fax 45 70236044

Part Numbers:

### Controller Module Test Plugs

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

### Power Module Test Plugs

- PM test Adaptor #J1 1934-007

### Expansion Module

- Test Module 1934-006

## Controller Replacement

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



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

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

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

***NOTE: Several programmable features may need to be set to completely configure the unit to customer specifications. Adjust any additional programmable settings to customer requirements before releasing the unit for service.***

# Electrical Maintenance

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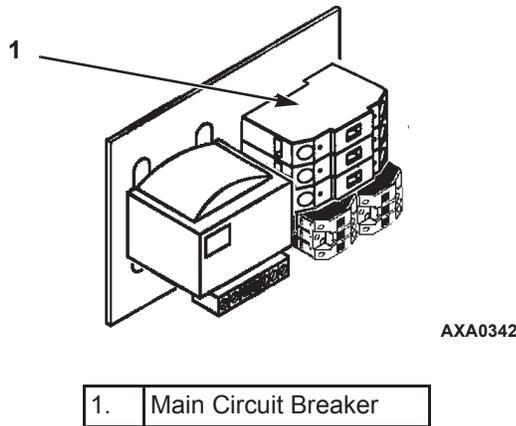
## Unit Protection Devices

### 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.



**Figure 127: Main Circuit Breaker**

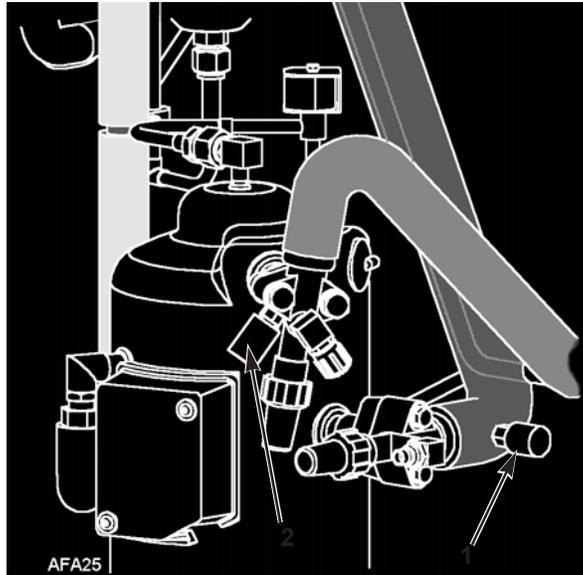
### Evaporator Overheat Protection

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

### High Pressure Cutout Switch

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

- Compressor stops immediately. Evaporator and condenser fans continue normal operation.
- Controller determines that a high pressure cutout switch or compressor motor internal overload protector is open when the unit current draw during compressor operation is normal and then decreases by 7 amps for more than 3 seconds.
- After 1 minute, controller VGA display shows a High Pressure Cutout message:
  - “HIGH PRESSURE CUTOUT CHECK CONDENSER PROBE”: Water pressure switch is open and the condenser temperature is low.
  - “HIGH PRESSURE CUTOUT CHECK CONDENSER FAN”: Water pressure switch is open and the condenser temperature is high.
  - “HIGH PRESSURE CUTOUT CHECK WATER COOLING”: Water pressure switch is closed.



1.	Low Pressure Cutout Switch
2.	High Pressure Cutout Switch

**Figure 128: Low and High Pressure Cutout Switches**

- The controller continues to call for cooling so the compressor will restart when the overload condition is corrected (switch resets) if power is available.
- If the switch remains open for 5 minutes, the controller also turns on the Alarm indicator and records Alarm 37 (Total Power Consumption Too Low).

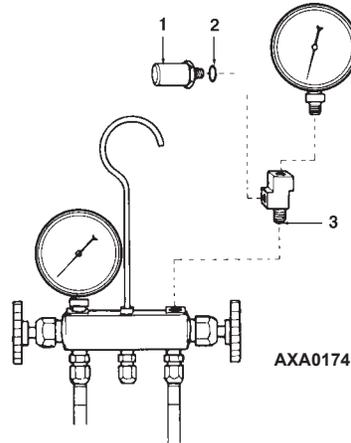
High Pressure Cutout Switch:

- Opens:  $3243 \pm 7$  kPa,  $32.43 \pm 0.48$  bar,  $470 \pm 7$  psig.
- Closes:  $2586$  kPa,  $25.9$  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 129: 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.

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

## High Pressure Cutout Switch Removal

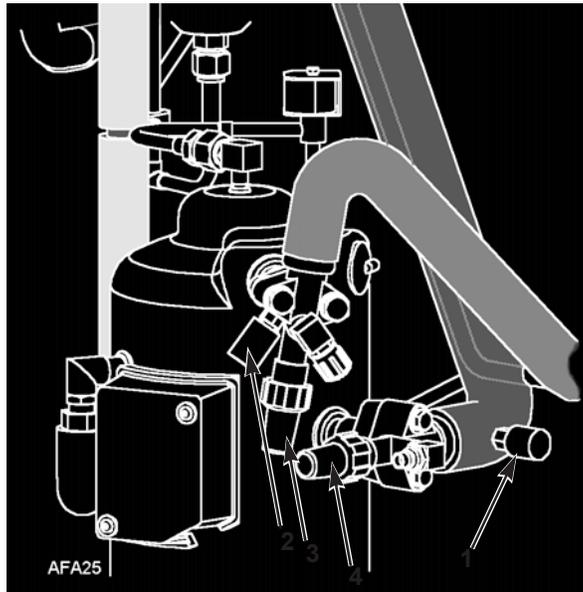
Remove the high pressure cutout switch by performing the following steps:

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 130: Low and High Pressure Cutout Switches**

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

## Low Pressure Cutout Switch

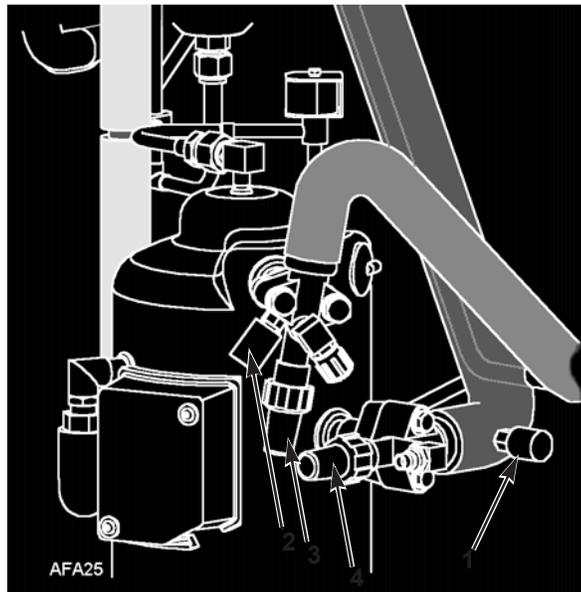
A low pressure cutout switch is located on the compressor suction line. If the suction pressure becomes too low, the switch opens to stop the compressor:

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

Low Pressure Cutout Switch:

- Opens: -17 to -37 kPa, -0.17 to -0.37 bar, 5 to 11 in. Hg vacuum.
- Closes: 28 to 48 kPa, 0.28 to 0.48 bar, 4 to 7 psig.

## Low Pressure Cutout Switch Removal



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

**Figure 131: Low and High Pressure Cutout Switches**

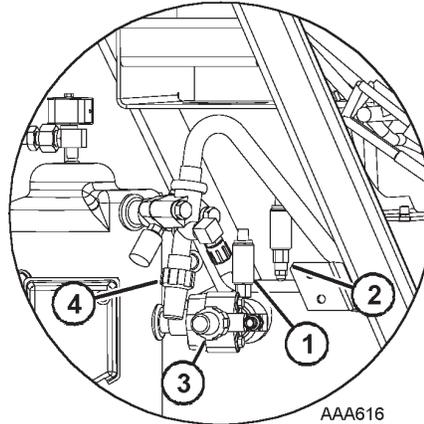
Remove the low pressure cutout switch by performing the following steps:

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

## Low Pressure Cutout Switch Installation

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

1. Install low pressure cutout switch in the suction line.
2. Route wires into the control box and connect to proper terminals.
3. Perform a controller pretrip test to verify system operation.



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

Figure 132: Pressure Sensor Location

## Low Pressure Cutout Switch or Suction Transducer Configuration

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



Figure 133: Low Pressure Cutout Switch Installed

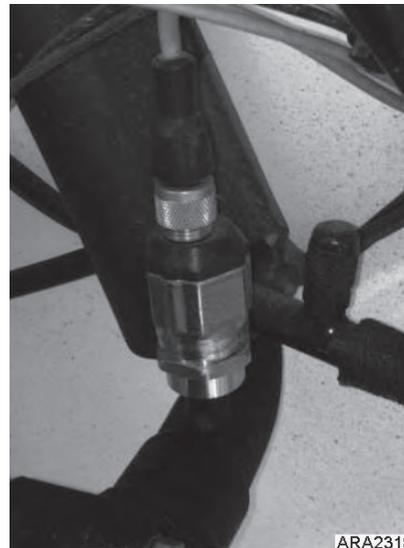


Figure 134: Suction Transducer Installed

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

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

1. Remove LPCO switch from suction tube. Fitting on the suction tube has a Schrader valve in it, unscrew the LPCO.
2. Disconnect the LPCO wires from J9 pins 5 and 6, remove switch and harness from unit.
3. Install a jumper wire on J9 pins 5 to 6.
4. Screw the Suction Transducer on the fitting on the suction tube.
5. Route wire harness into control box.
6. Connect wires to J1 pins 7, 8, 9.
  - a. White wire to pin 7.
  - b. Red wire to pin 8.
  - c. Black wire to pin 9.
7. Secure harness.
8. Start unit, press F4 to enter Menu. Press F3 to scroll down to CONFIGURATION, press F4 to enter, Press F3 to scroll down to OPTIONS, press F4 to enter. Press F3 to scroll down to SUCTION PRESSURE OPTION, press F4 to enter. Press F2 to highlight SENSOR MOUNTED, press and hold F4 to accept and to confirm change.

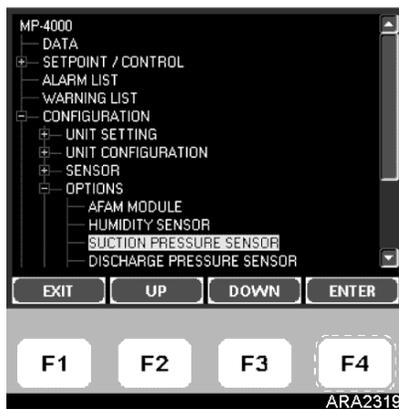


Figure 135: Options Menu



Figure 136: Suction Pressure Option

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

Alarm 120 SUCTION PRESSURE SENSOR ERROR output of sensor outside limits

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

Message 32 LOW PRESS CUTOUT- PLEASE WAIT Suction pressure < 5-11 in. vacuum

Message 33 LPCO TIMER HOLD – PLEASE WAIT Suction pressure > 4-7 psig with 30 second delay

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

**CAUTION: REPAIR WHEN PARTS ARE AVAILALBE, DO NOT RUN WITHOUT LOW PRESSURE PROTECTION.**

## 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.

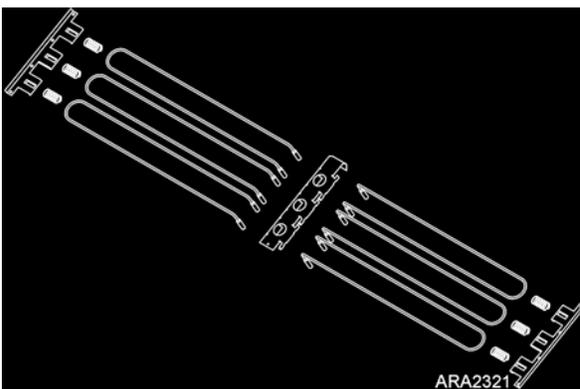


**WARNING:** *The unit will automatically start and operate if 460/380V power is present at the main power module when the controller is disconnected. To prevent personal injury from rotating machinery or dangerous electrical shock from high voltage controls, disconnect the supply power to the unit before preparing the unit for manual emergency mode operation.*

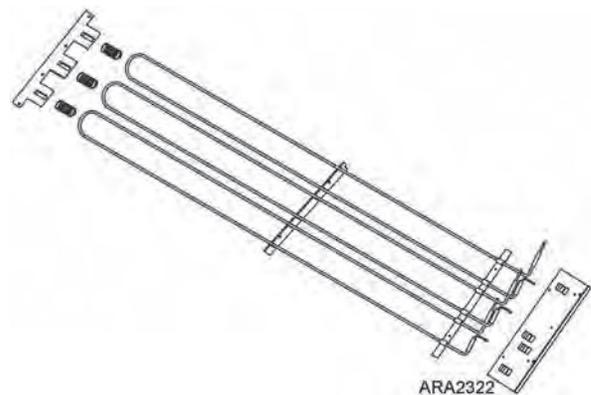
3. Relocate the position of the white and black incoming power cord leads at the 460/380V main circuit breaker.
4. Connect unit power cord to proper power supply.
5. Start the unit again by turning the unit 460/380V main circuit breaker on and the Unit turned On and allow Unit to start and stabilize.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

## Evaporator Heater Selection

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



**Figure 137: Six Short Length Heaters (680 Watts Each)**



**Figure 138: Three Longer Heaters (1360 or 2000 Watts Each)**

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

## Extended Capacity Heaters

If a unit is equipped with the Extended Capacity heaters (2000 Watts) the main CB (42-0352) is adjustable and set to 27 amps. When changing out a MP4000 controller the HEATER ELEMENT TYPE needs to be changed in the configuration menu from NORMAL CAPACITY to EXTENDED CAPACITY. If the heater type is not change the unit will alarm during a PTI on heater capacity low. The only difference between the 1360 Watt (18 GA) and 2000 Watt (16 GA) heater is the wire gauge size. So care should be taken to confirm correct heater element is used when replacement is required.

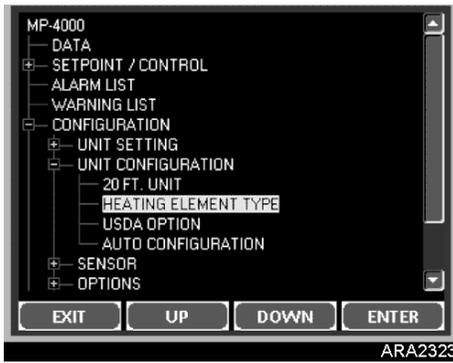


Figure 139: Unit Configuration Menu

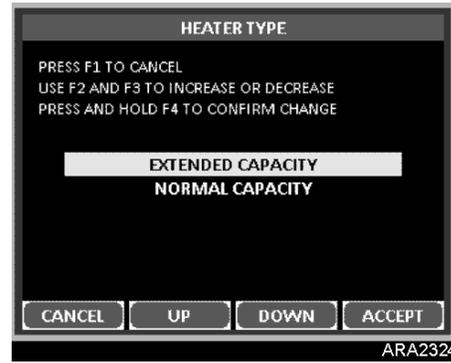


Figure 140: Heater Type

## Electric Heaters Malfunction

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

1. Turn unit power supply off.
2. Remove unit power plug from power supply receptacle.
3. Open the control box door.
4. Test the insulation of each individual heater element.
  - a. Test all 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.*

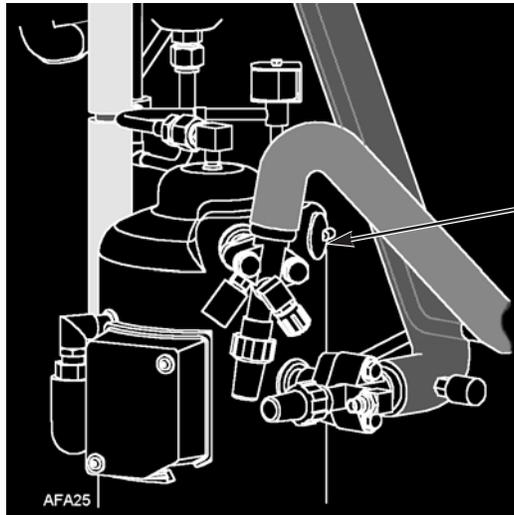


Figure 141: Compressor Discharge Temperature Sensor

## Compressor Discharge Gas Temperature Sensor

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

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

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

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

## Compressor Discharge Temperature Sensor Replacement

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

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

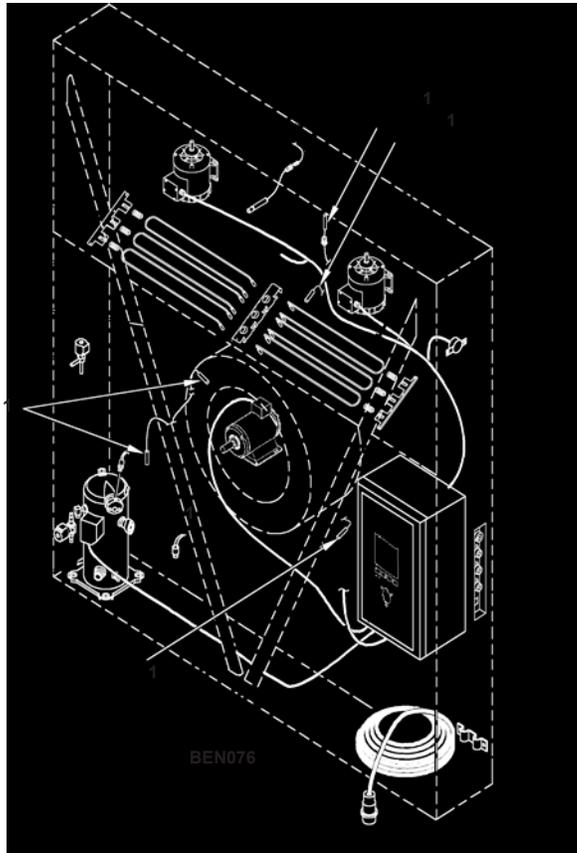


Figure 142: Temperature Sensors

## Temperature Sensors

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

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

## Installing Temperature Sensors

All sensors should be properly installed as follows:

- Supply air sensors must be inserted to the bottom of the sensor tube and completely sealed by the grommet connection.
- Return air sensor installs in a grommet between the evaporator fans.
- Evaporator coil (defrost) sensor must be placed in the middle of the coil and 75 mm deep between the fins.
- Condenser sensor must be placed on the upper left side of the condenser coil and 70 mm deep between the fins.
- Ambient sensor must be placed on the bottom plate of the right forklift pocket.
- Compressor discharge temperature sensor is attached to compressor head by adhesive. See “Compressor Discharge Temperature Sensor Replacement” in the chapter for Refrigeration System Diagnosis and Service.

## Testing the Sensors

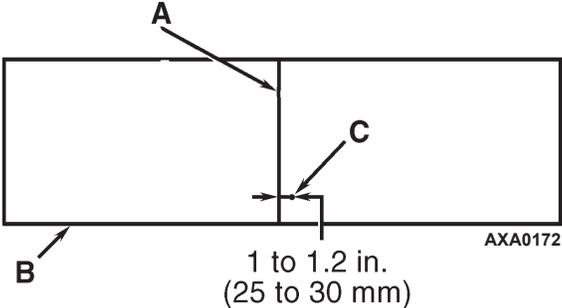
The controller constantly monitors the left hand and right hand supply sensors, return sensor and defrost (evaporator coil) sensor to determine when to initiate a demand defrost. If a demand defrost is requested and defrost has occurred within the last 90 minutes, the controller initiates a probe test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

During a Probe test, the VGA display shows [PROBE TEST PLEASE WAIT]. The controller operates the unit on high speed evaporator fans only for 5 minutes. All sensor temperatures are then compared:

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

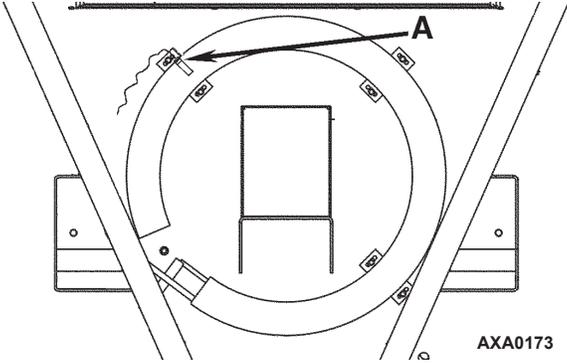
Sensor errors recorded during a probe test are cleared when the next Defrost is initiated or Unit On/Off switch is turned Off.

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



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

Figure 143: MAGNUM+ Evaporator Coil (Defrost) Sensor Location



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

Figure 144: Condenser Coil Sensor Location

## Resistance Values for Temperature Sensors

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

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

**Figure 145: Resistance Values for temperature sensors**

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

## 2. Resistance Values for Compressor Discharge Sensors

<b>Temp. F</b>	<b>Temp. C</b>	<b>Ohms</b>	<b>Temp. F</b>	<b>Temp. C</b>	<b>Ohms</b>
-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

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## 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.

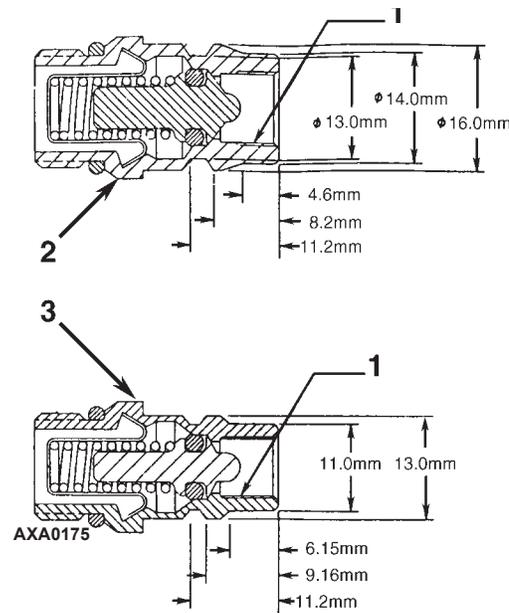
## Detecting Leaks

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 146: 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

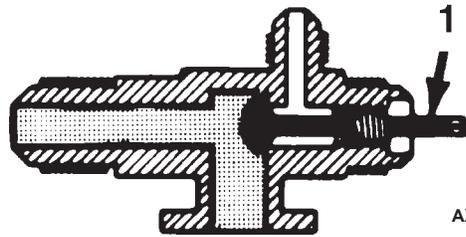
The discharge suction and digital ball service valves isolate the compressor from the high and low sides of the refrigeration system. compressor isolation is needed for system diagnosis, service and repair.

**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.



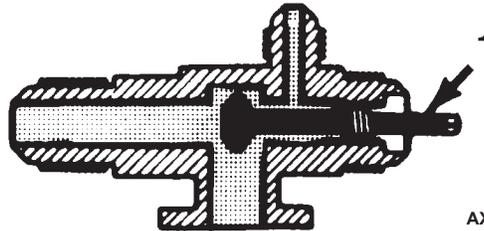
**WARNING:** *Do not start unit with discharge valve in Front Seated position.*



AXA0176

1.	Full Counterclockwise
----	-----------------------

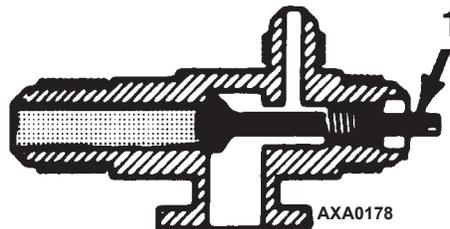
Figure 147: Service Valve Back Seated



AXA0177

1.	1/2 Turn in
----	-------------

Figure 148: Service Valve Open to Port



AXA0178

1.	Full Clockwise
----	----------------

Figure 149: Service Valve Front Seated

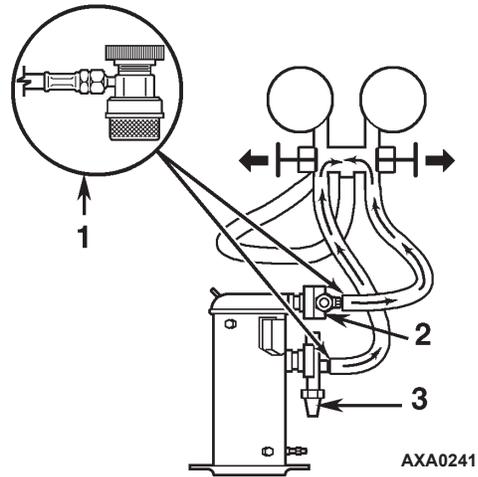
## Working with a Gauge Manifold

### 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.

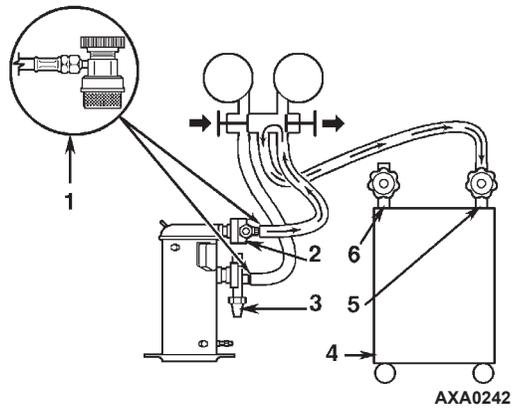
### Gauge Manifold Valve Positions

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



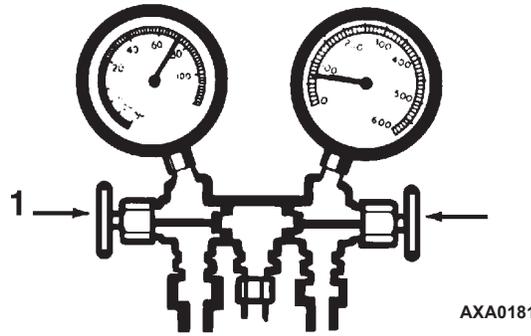
1.	Quick Disconnect Access Valve
2.	Discharge Service Valve (DSV)
3.	Suction Service Valve (SSV)

**Figure 150: Balancing the Pressure**



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

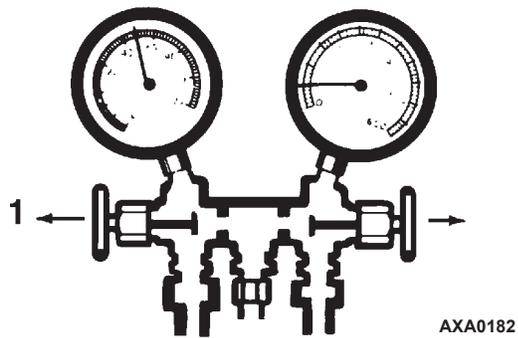
**Figure 151: Removing Refrigerant**



AXA0181

- |    |                   |
|----|-------------------|
| 1. | Close Hand Valves |
|----|-------------------|

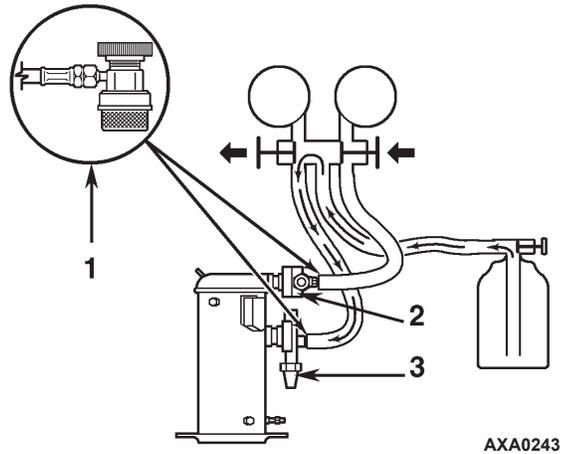
Figure 152: Gauge Manifold Closed to Center Port



AXA0182

- |    |                  |
|----|------------------|
| 1. | Open Hand Valves |
|----|------------------|

Figure 153: Gauge Manifold Open to Center Port



AXA0243

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

Figure 154: Charging the System

## Gauge Manifold Set Installation & Removal

Thermo King recommends the use of access valves or self-sealing, quick disconnect fittings. This limits the loss of refrigerant into the atmosphere. A separate gauge manifold set with low loss fittings (refer to Tool Catalog) should be dedicated for use with R-404A only. Gauge hoses should also be dedicated to R-404A.

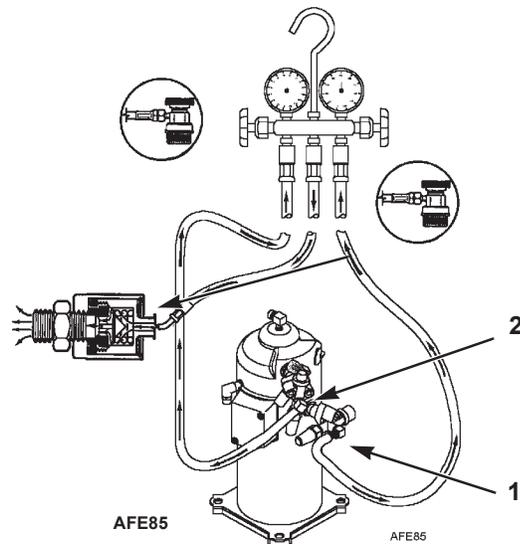
***NOTE: Carefully check to ensure that access connections are functioning properly when any of these devices are used.***

### Gauge Manifold Set Installation

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

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

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



1.	Suction Connection
2.	Discharge Connection

Figure 155: 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.

- 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.*

- 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 156: Receiver Tank Sight Glass

## Leak Testing the Refrigeration System

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

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

If refrigerant has leaked or been removed from the unit:

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

**NOTE: If system leakage is indicated, loosen supply line hose fittings to release pressure. Repair leakage condition.**

12. If system repair is necessary, recheck system after repairs are completed.

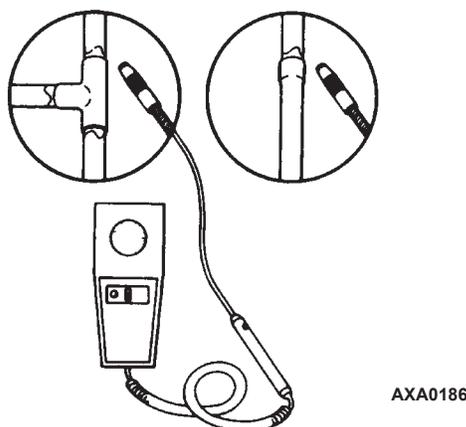
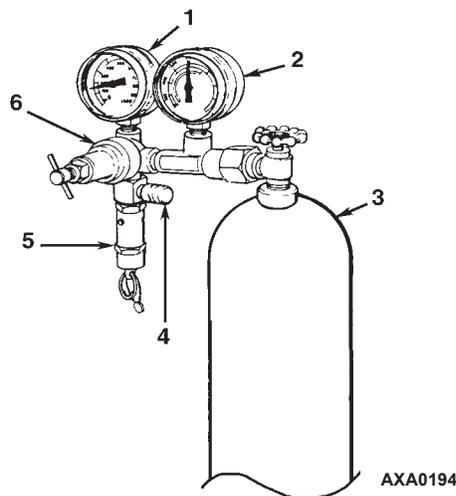


Figure 157: Test for Refrigerant Leaks

## Using Pressurized Nitrogen

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



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

Figure 158: 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.

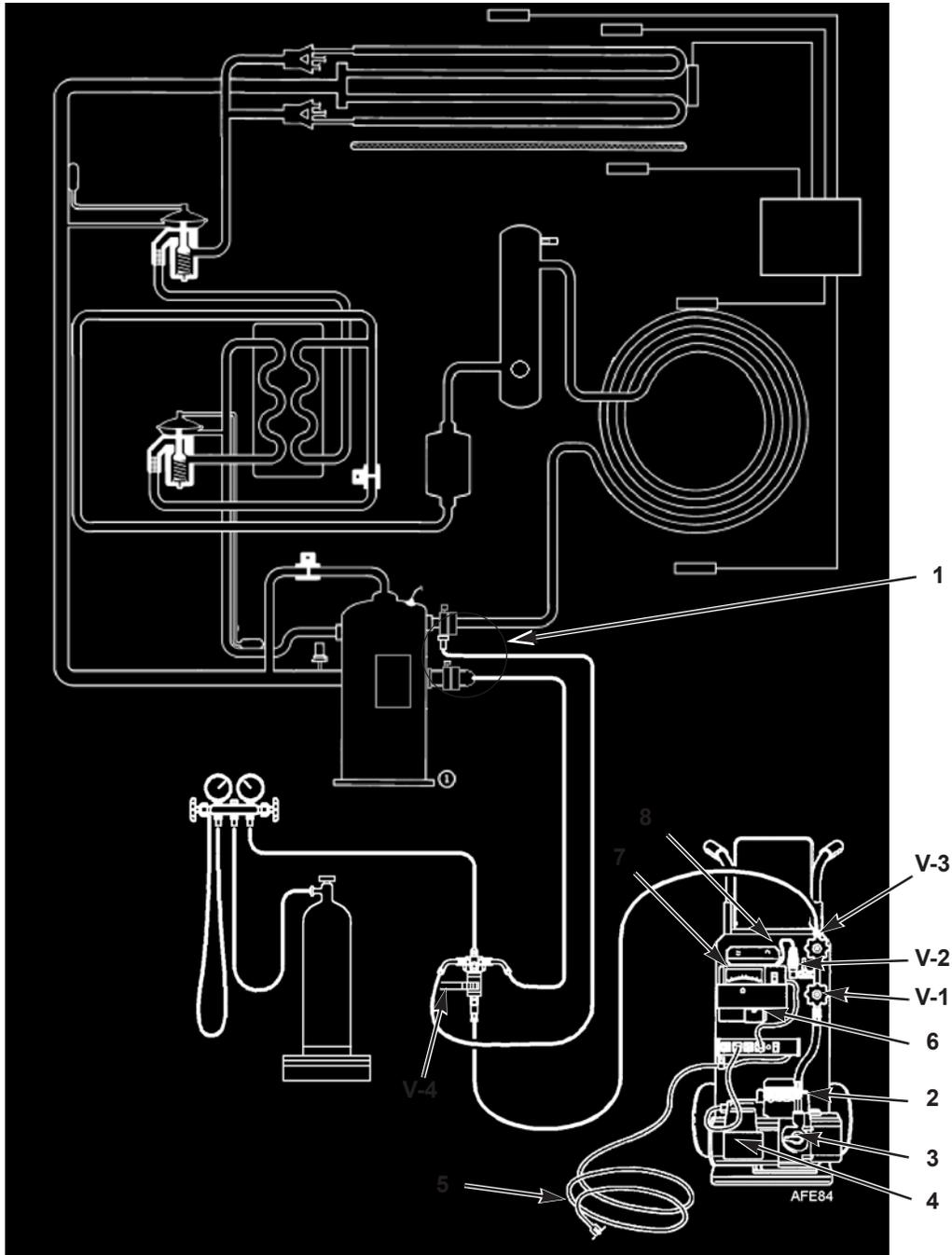
## Purge High Side to Low Side

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 159: 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 159 on page 180. Connect evacuation hoses to the compressor suction and discharge service fittings.
5. Open Evacuation Station valves (V1, V3, and V4). It is only necessary to open valve V2 when a reading on the micron meter is desired. This is especially true when starting to evacuate a unit and large amounts of moisture and oil will be passing by the sensor.
6. Open the vacuum pump Iso-Valve™ built into the pump housing below the handle. It is recommended that the valve be kept open at all times.
7. If connecting a refrigerant tank and gauge manifold to the evacuation station, close the gauge manifold and refrigerant tank valves to prevent refrigerant from being drawn from the tank.

## Unit Evacuation

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

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

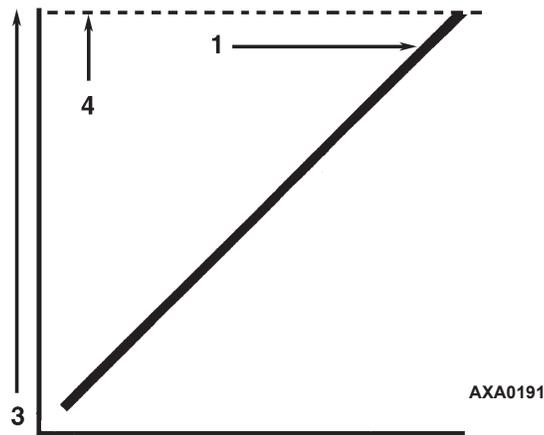
***NOTE: The presence of refrigerant in the compressor oil may prevent a low vacuum reading from being achieved. Compressor oil can continue to outgas for long periods of time.***

2. If the vacuum level appears to stall above 500 microns, back seat the discharge service valve and observe the micron meter.
  - A drop in pressure indicates that the compressor oil is out-gassing and further evacuation is necessary.
  - An increase in pressure indicates that a leak exists or there is moisture in the system. Perform a pressure rise test and evaluate.
3. Close valve V1 when the desired vacuum level has been reached.
4. Wait five minutes and read the micron meter.
  - A system that is leak free and dry will remain below 2000 microns for 5 minutes.
  - A system that rises above 2000 microns but stabilizes below atmospheric pressure is probably contaminated with moisture or has refrigerant out-gassing from the compressor oil. Additional evacuation is required.
  - A system that continues to rise without stabilizing has a leak and must be repaired.
5. If the vacuum level remained below 2000 microns for 5 minutes, the unit is ready to charge. See “Charging the System with Refrigerant”.

## Pressure Rise Test

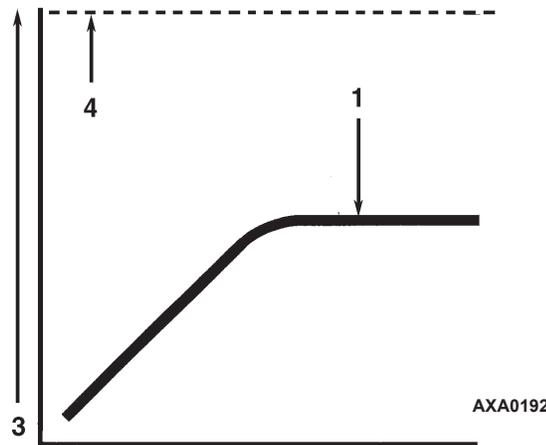
Evacuate the system and close valve V1. With valves V3 and V4 open, the pump is isolated and the system is held under a vacuum. If the micron meter rises, one of the following conditions exist:

- Leak: Watch the movement of the micron meter needle. If the needle continues to rise until it reaches atmospheric pressure, it is an indication that a leak exists somewhere in the system. When a leak is in a system, the vacuum will eventually stabilize at atmospheric pressure (see “Pressure Rise Test Evaluation” in this chapter).
- Moisture: When the needle indicates a rise and then stabilizes at a level below atmospheric pressure, it is an indication that the system is vacuum tight, but is still wet and requires additional dehydration and pumping time. See Figure 161 “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 160: 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 161: 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

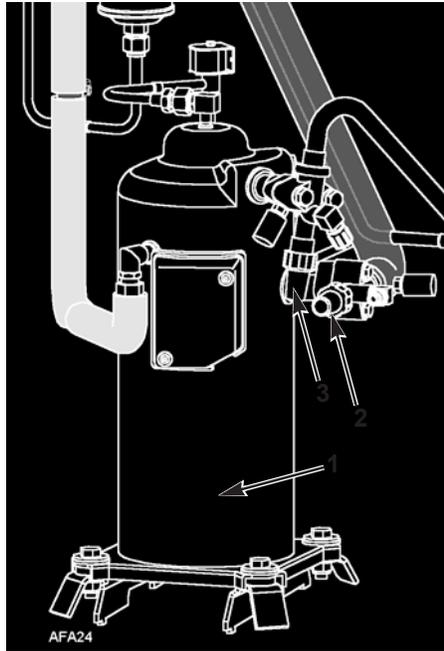
Remove the compressor by performing the following steps:

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 170. for additional information.
3. Recover the refrigerant charge from the compressor. (see “Recovering Refrigerant from the System” on page 181).
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 162: 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.

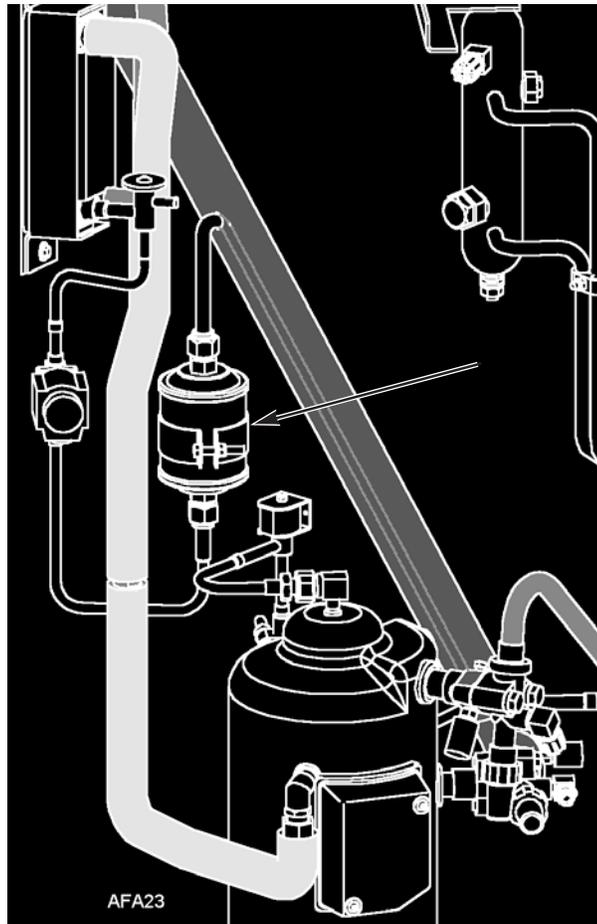
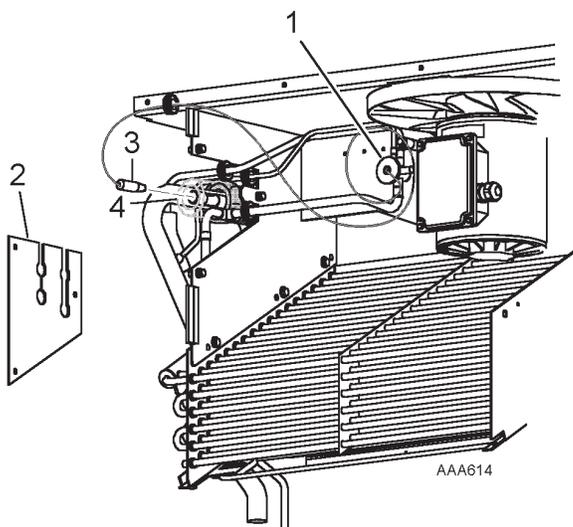


Figure 163: Filter Drier

## 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 164: 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**

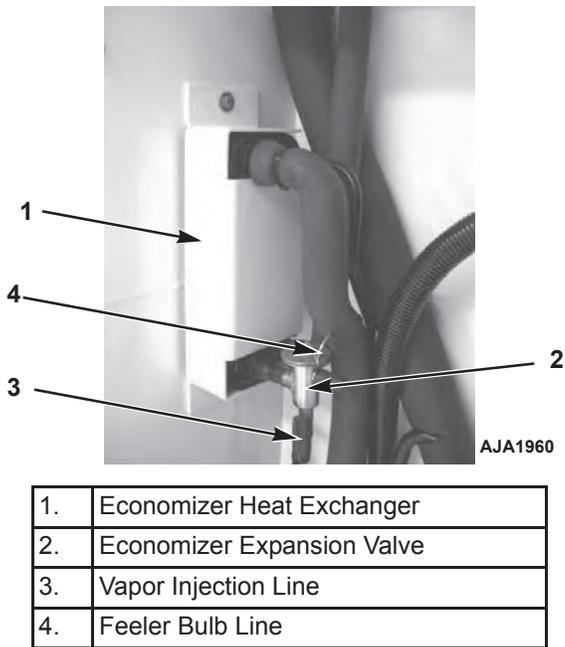
Remove the economizer expansion valve by performing the following steps:

1. Some units have a receive tank outlet valve, if the unit does perform a low side pump down and isolate the low side by closing the compressor service valves. If the unit does not have an outlet valve recover the refrigerant charge from the unit (see “Recovering Refrigerant from the System” on page 181).
2. On the feeler bulb carefully remove the outer insulation, to be reused. Remove cork tape from around element.
3. Unclamp feeler bulb from the suction line in the condenser section.
4. Clean element bulb tube holder and tube.
5. Heat and unsolder the inlet and outlet lines from economizer expansion valve.
6. Remove the old economizer expansion valve from unit and discard.

### **Economizer Expansion Valve Installation**

Install the economizer expansion valve by performing the following steps:

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

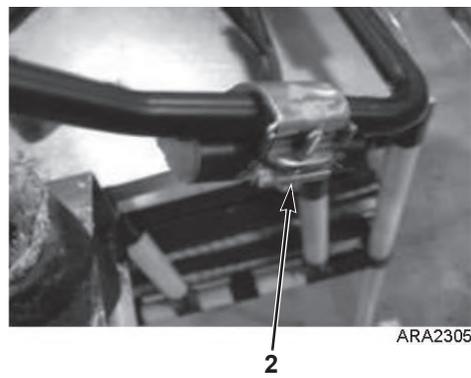
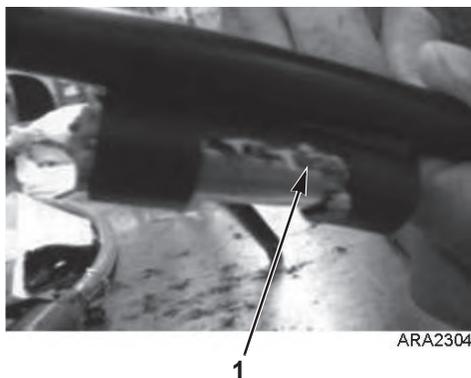


**Figure 165: Economizer Expansion Valve and Heat Exchanger**

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

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

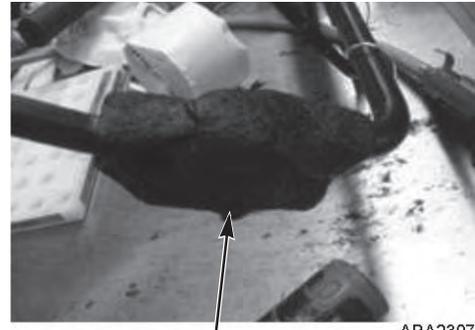
- Pressurize the refrigeration system or the low side and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
- If no leaks are found, recover the refrigerant used for the leak test (see “Recovering Refrigerant from the System” on page 181).
- Evacuate the system or the low side (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
- Locate feeler bulb in former position. The feeler bulb must make good contact or operation will be faulty. Apply heat transfer paste to element bulb holder and install bulb. Install clamp and tighten until bulb will not shift. See photos below.



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

**Figure 166: Install Feeler Bulb**

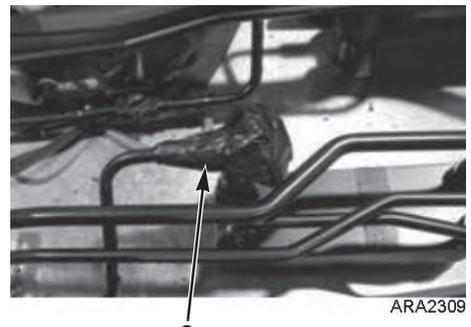
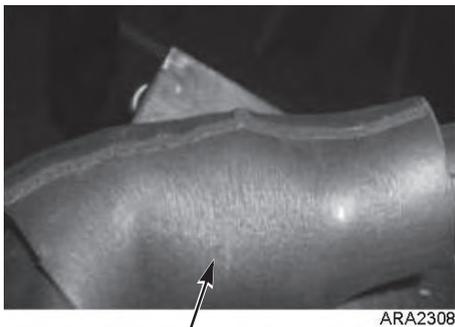
8. Apply cork tape around element making sure all air pockets are removed. See photos below.



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

**Figure 167: Install Cork Tape on Feeler Bulb**

9. Apply the insulation removed in step 2 of “Economizer Expansion Valve Removal”. See photo below.  
 10. Apply cork tape to the complete TXV valve. See photo below.



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

**Figure 168: Install Cork Tape on Feeler Bulb**

11. If low side pump down was performed open compressor service valves. Otherwise recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).  
 12. Start unit and perform a PTI to check performance.

## Economizer Heat Exchanger Replacement

### Economizer Heat Exchanger Removal

Remove the economizer heat exchanger by performing the following steps:

1. Recover the refrigerant charge from the unit (see “Recovering Refrigerant” in this chapter).
2. Unsolder the two liquid and two suction line connections.
3. Unbolt the economizer heat exchanger from the mounting bracket.
4. Lift the heat exchanger assembly from the unit.

## Economizer Heat Exchanger installation

Install the heat exchanger by performing the following steps:

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

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

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## 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.

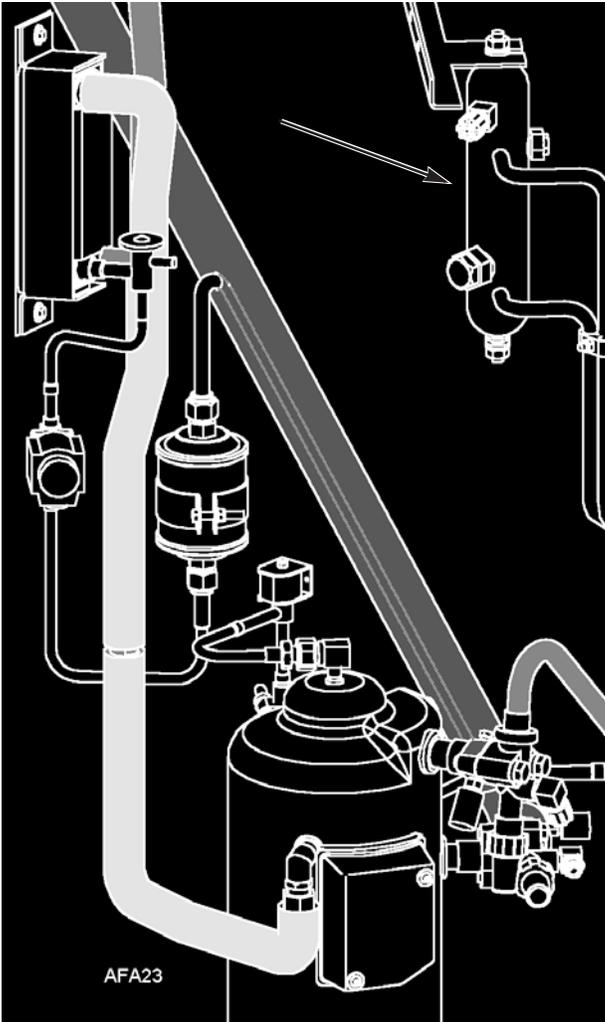


Figure 169: Receiver Tank

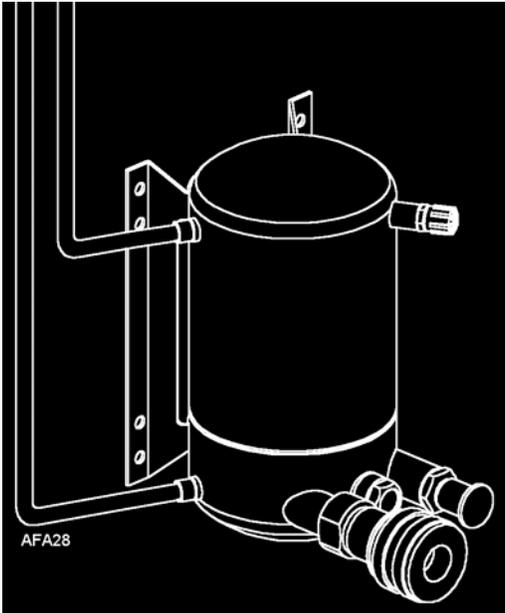


Figure 170: Water-Cooled Condenser Tank

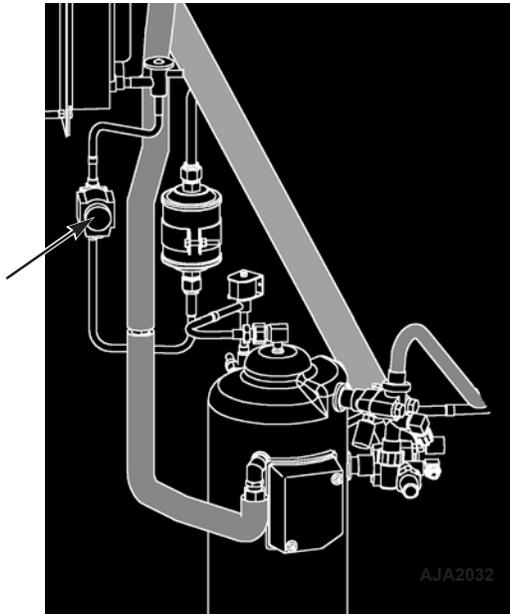


Figure 171: Vapor Injection Valve

## Vapor Injection Valve Replacement

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

### Valve Removal

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

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

### Valve Installation

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

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



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

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

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

### Compressor Digital Control Valve Replacement

#### Digital Control Valve Removal

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

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

#### Digital Control Valve Installation

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

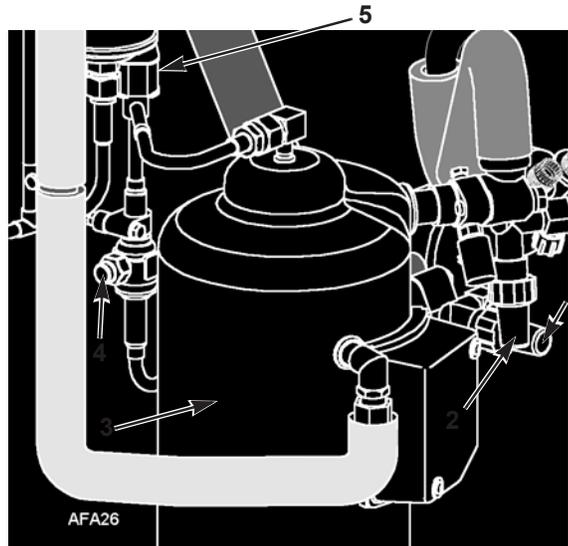
1. Clean the tubes for soldering.
2. Place the new valve in position and solder the liquid line connections.



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

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

5. Reconnect the electrical wires to the valve.
6. Perform a controller pretrip test to verify system operation.



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

**Figure 172: Digital Control Valve**

# Servicing The Unit

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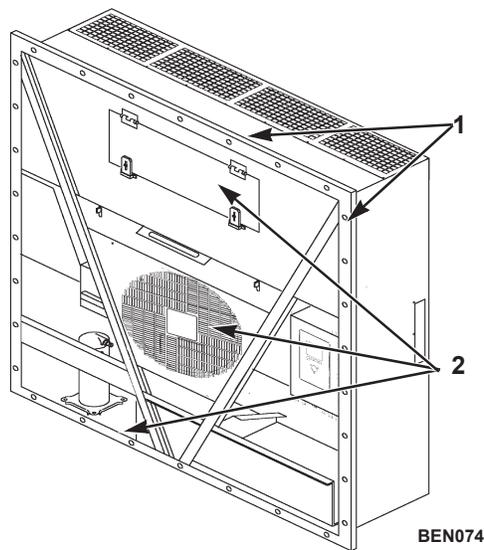
## Taking Care of the Structure

### 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 173: 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.



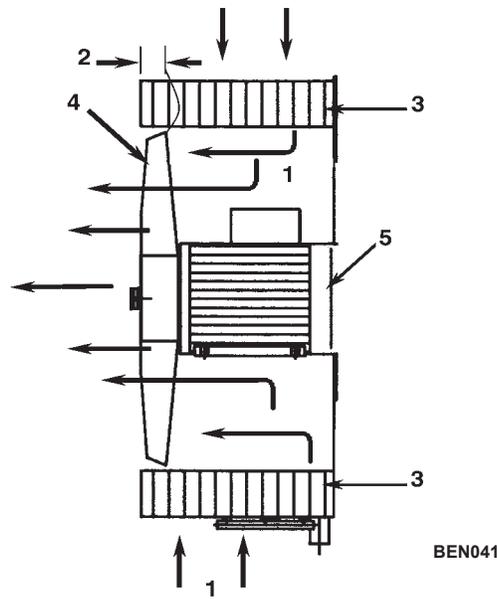
**CAUTION:** *Air pressure must not be high enough to damage coil fins*

## 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.

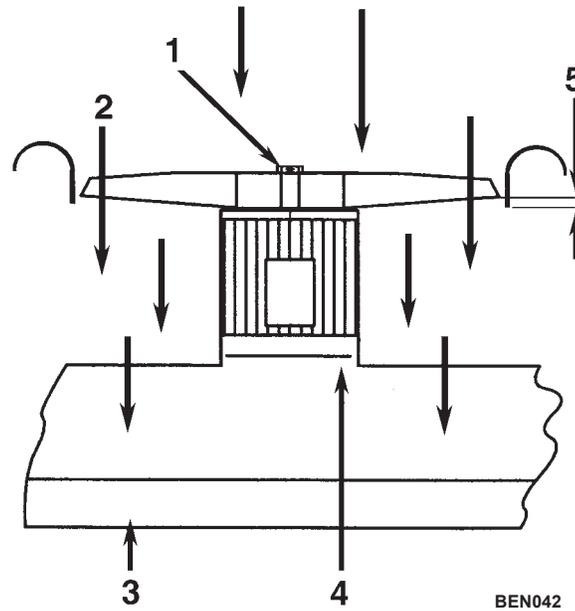


1.	Airflow Direction
2.	10 mm (0.4 in.)
3.	Condenser Coil
4.	Condenser Fan Blade
5.	Condenser Motor

**Figure 174: 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 175: 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:

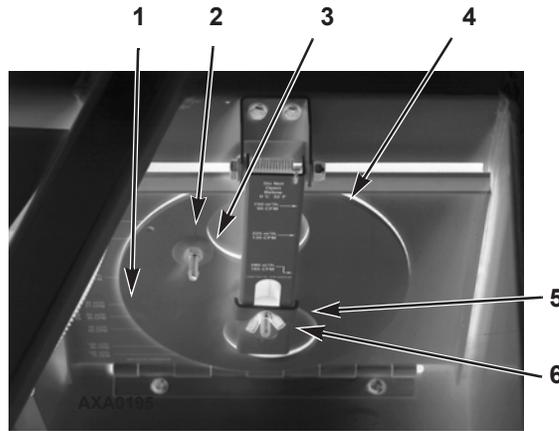
1. Loosen wing nut on handle Bracket, Figure 176
2. Rotate the disk to set the Indicator at the air exchange rate shown on the ventilation scale on the door:
  - MAGNUM+ Models: 0-225m<sup>3</sup>/hr (0-154 ft<sup>3</sup>/min)
3. Tighten the wing nut.

#### 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:



1.	Disk Scale: Low Ventilation Rates
2.	Disk Assembly with Rate Indicator
3.	CO <sub>2</sub> Port
4.	Ventilation Door
5.	Handle Bracket
6.	Wing Nut

**Figure 176: Air Exchange System**

# Diagnosis: Troubleshooting, Warnings and Alarm Codes

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## Introduction

This chapter includes the following:

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

The charts will help you identify and fix unit problems.

## Controller Diagnostics

The MP4000 can be a very helpful diagnostic tool.

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

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

**Brief PTI Test:** The MP-4000 controller contains a special Brief PTI pretrip test that automatically checks unit refrigeration capacity, heating capacity, temperature control, and individual components including the controller display, solid state, contactor, fans, protection devices and sensors. The test includes measurement of component power consumption and compares test results to expected values. The test takes about 25-30 minutes to complete, depending on the container and ambient temperature. Refer to the Brief PTI Test in the Operating Instructions Section.

**Full PTI Test:** The MP-4000 controller contains a special Full PTI pretrip test that automatically checks unit refrigeration capacity, heating capacity, temperature control, and individual components including the controller display, solid state, contactor, fans, protection devices and sensors. The test includes measurement of component power consumption and compares test results to expected values. The test takes up to 2 to 2.5 hours to complete, depending on the container and ambient temperature. Refer to the Full PTI Test Menu in the Operating Instructions Section.

**Functions Test:** The MP-4000 controller contains a special function test that automatically tests individual components including the controller display, sensors, condenser fan, evaporator fan, compressors, etc. The test includes measurement of component power consumption and compares test results to expected values. Refer to the Functions Test Menu in the Operating Instructions Section.

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

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

## Troubleshooting Mechanical Problems

Condition	Possible Cause	Remedy
<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 solid state, motor terminals, motor, fuses on power module
	Open in 29 Vac control circuit	Check fuses and On/Off switch. Replace or repair as required
	Container temperature does not demand compressor operation	Adjust controller setpoint
	Compressor contactor inoperative	Replace compressor contactor
	No output signal from controller	Diagnose and replace power module or controller
	Unit on defrost	Turn Unit On/Off switch Off and then On again
	Detective high pressure or low pressure cutout switch	Replace defective switch
	High condenser head pressure causing high pressure cutout	Check refrigeration system and correct fault
	Defective compressor	Replace compressor
	Controller shut unit down on Compressor Over Temperature	Let compressor cool and controller will reset automatically. Check vapor injection valve and compressor temperature sensor
	Compressor motor internal thermal overload protection open	If compressor contactor is energized, wait 60 minutes for protector to cool and reset.
<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)

Condition	Possible Cause	Remedy
<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. If unit is in Heat or Defrost, unit operation is normal (no remedy required)
	Unit in Cool with Low condenser temperature	check indicator condenser temperature and discharge pressure. Condenser temperature may not require condenser fan operation (no remedy required; condenser fan also pulses on and off on a 30 second cycle to control condenser temperature)
	Water pressure switch Closed (Water-cooled position) (Option)	If unit is on water cooled condenser operation, unit operation is normal. Otherwise water pressure switch must be Open for air-cooled condenser operation.
	Defective water pressure switch; (option)	Replace defective switch
	Loose line connection	Tighten connections
	Open motor internal thermal overload protector	Check for seized bearings or defective thermal overload protector. Repair or replace as necessary
	Defective motor	Replace motor
	Detective condenser fan contactor	Replace defective contactor
	No condenser fan output signal from controller	Diagnose and replace condenser fan relay, power module or controller

<b>Condition</b>	<b>Possible Cause</b>	<b>Remedy</b>
<b>Evaporator fan motor(s) does not operate</b>	Unit on defrost	Check operating mode indicator LEDs
	Loose line connection	Tighten connections
	Open motor internal thermal overload protector	Check for seized bearings or defective thermal overload protector. Repair or replace as necessary
	Defective motor	Replace motor
	No low or high speed evaporator fan output signal from controller output module	Diagnose and replace output module or controller

## Troubleshooting Refrigeration Problems

Condition	Possible Cause	Remedy
<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>	Shortage of refrigerant	Repair leak and recharge
	Low ambient air temperature	No remedy
	Service gauge out of calibration	Replace gauge
<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>		

## Diagnosis: Troubleshooting, Warnings and Alarm Codes

Condition	Possible Cause	Remedy
<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 power module	Diagnose power module and controller. Replace defective component
	Short cycling	See "Unit Short Cycles" under "Mechanical Diagnosis"
	Compressor Digital Control valve stuck close or defective	Replace valve
<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 power module	Diagnose power module 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 power module	Diagnose power module and controller. Replace defective component
Service gauge out of calibration	Adjust or replace gauge	

## Warnings and Controller Actions

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

### Warnings and Controller Actions

Warning No.	Warning Message/Description	Controller Action/Corrective Action
1	<p><b>High Pressure Cut Out – Check Water Cooling</b></p> <ul style="list-style-type: none"> <li>When:                             <ul style="list-style-type: none"> <li>If HPCO is detected and the configuration is set to water cooled condenser.</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Poor cooling water supply.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Controller auto clears message 10 minutes after compressor start-up.</li> <li>Water cooled condensing may be wrongly selected</li> </ul>
6	<p><b>High Pressure Cut Out – Check Condenser Probe</b></p> <ul style="list-style-type: none"> <li>When:                             <ul style="list-style-type: none"> <li>Unit stops due to high pressure cutout and the condensing temperature regulation has not activated the condenser fan.</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Wrong location of condenser probe.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Controller auto clears message 10 minutes after compressor start-up.</li> <li>Check location of condenser probe.</li> </ul>
8	<p><b>High Pressure Cut Out – Please Wait</b></p> <ul style="list-style-type: none"> <li>When:                             <ul style="list-style-type: none"> <li>Unit stops due to high pressure cutout and the condensing temperature regulation has activated the condenser fan.</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Poor cooling of the refrigerant.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Controller auto clears message 10 minutes after compressor start-up.</li> <li>Check for high ambient temperature.</li> <li>Check condenser fan rotation.</li> <li>Check for blocked condenser coil.</li> </ul>
13	<p><b>Evaporator High Temperature – Check Heater System</b></p> <ul style="list-style-type: none"> <li>When:                             <ul style="list-style-type: none"> <li>If the state “Hot Evaporator Section” is active and the control calls for heat the warning is set.</li> <li>The state “Hot Evaporator Section” is defined either by:                                     <ul style="list-style-type: none"> <li>RA probe error and Defrost probe error.</li> <li>RA, SA or defrost probe is above 50C.</li> </ul> </li> <li>The warning is held by a 60 second timer after the conditions disappear.</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Evaporator section temperatures are high.                                     <ul style="list-style-type: none"> <li>Supply Air, Return Air and Defrost, indicates high temperature.</li> </ul> </li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Enter Manual Function Test menu and test (operate) heating element. Check volts and amps to determine problem.</li> <li>Use DATA menu to evaluate evaporator section sensors.</li> <li>Use PROBE TEST to evaluate if evaporator sensors are reading correctly.</li> </ul>

**Warnings and Controller Actions (Continued)**

Warning No.	Warning Message/Description	Controller Action/Corrective Action
20	<p><b>Low Voltage On Line – Unit Stopped</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• Low voltage observed, voltage has been below 330 VAC and has not risen above 340VAC yet.</li> <li>• After 30 minutes this warning will set the low voltage alarm.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Poor quality of power source.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Enter Manual Function Test menu and test (operate) components to load the power source. Check volts and amps to help determine the problem.</li> </ul>
21	<p><b>Current Too High – Check Compressor and Fans</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• When the component current draw exceeds expected. 50% above expected amps for 4 minutes.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Digital Control valve malfunction.</li> <li>• Compressor, evaporator fans motor, condenser fan motor or heater current too high.</li> <li>• Defective volt or amp meter on power module.</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> <li>• When the warning is set the current power consumption is logged in the event log.</li> </ul>
22	<p><b>Current Too Low – Check Compressor and Fans</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• When the component current draw exceeds expected. 50% below expected for 4 minutes.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Defective or open high pressure cutout 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 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>

### Warnings and Controller Actions (Continued)

Warning No.	Warning Message/Description	Controller Action/Corrective Action
23	<p><b>Supply Temperature Too High – Check Sensors</b></p> <ul style="list-style-type: none"> <li>• When:                             <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. The state will by time request defrost or/and probe test.</li> </ul> </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>• Using DATA menu inspect readings.</li> <li>• Enter Manual Function Test menu and operate evaporator fan at high speed to evaluate probe spread.</li> </ul>
24	<p><b>Supply Temperature Too Low – Check Evaporator Coil</b></p> <ul style="list-style-type: none"> <li>• When:                             <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. The state will by time request extended defrost, defrost or/and probe test.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Incorrect connection or location of supply or return air sensor.</li> <li>• Air leakage at supply air sensor cable.</li> <li>• Incorrect evaporator fan operation.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Using DATA menu inspect readings.</li> <li>• Enter Manual Function Test menu and operate evaporator fan at high speed to evaluate probe spread.</li> </ul>
25	<p><b>Evaporator Temperature Too High – Check Evaporator Sensor</b></p> <ul style="list-style-type: none"> <li>• When:                             <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> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Probe spread, misplaced probes.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Using DATA menu inspect readings.</li> <li>• Enter Manual Function Test menu and operate evaporator fan at high speed to evaluate probe spread.</li> </ul>

**Warnings and Controller Actions (Continued)**

Warning No.	Warning Message/Description	Controller Action/Corrective Action
26	<p><b>Evaporator Coil Temperature Too Low – Check Evaporator Sensor</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• During Chill or Frozen Mode: Evaporator coil temperature is too low compared to return air temperature under operating conditions. The state will by time request extended defrost, defrost or/and probe test.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Ice on the evaporator coil, need for defrost.</li> <li>• Probe error.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Using DATA menu inspect readings.</li> <li>• Enter Manual Function Test menu and operate evaporator fan at high speed to evaluate probe spread.</li> </ul>
27	<p><b>System Low Pressure – Check Refrigerant Charge</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• The warning is related to the capacity surveillance system which observes the reefer machine capability to create a temperature drop between return air and supply air when expected to be running at high capacity.</li> </ul> </li> <li>• Action:                             <ul style="list-style-type: none"> <li>• If the expected delta temperature is not reached the warning are set and the evaporator fans stopped to prevent heating the cargo.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Lack of refrigerant.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check Refrigerant level.</li> <li>• Check for refrigerant flow through the system, look for restrictions.</li> </ul>
28	<p><b>Frozen Setpoint – Check Air Exchange</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• If AVL door is open in frozen set point mode.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Air ventilation ought to be in position closed when running within frozen mode.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check air ventilation door position.</li> </ul>

### Warnings and Controller Actions (Continued)

Warning No.	Warning Message/Description	Controller Action/Corrective Action
30	<p><b>High Pressure Cut Out – Please Wait</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• Unit stop due to high pressure cutout signal from the HPCO switch.</li> <li>• The warning will go away when the input signal indicates normal condition.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Poor or missing cooling of the refrigerant.</li> </ul> </li> <li>• Action:                             <ul style="list-style-type: none"> <li>• The state will stop / remove the compressor run signal.</li> <li>• The state will overrule regulation of the condenser fan and starts the fan.</li> <li>• This state will activate and hold warning #31 as long as the input signal indicates HPCO.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Controller clears message on compressor start-up.</li> <li>• No direct alarm action based on this situation.</li> <li>• If the state continues:                             <ul style="list-style-type: none"> <li>• Checkup for airflow through the condenser coil, air flow might be blocked.</li> <li>• Checkup for condenser fan rotation and direction, must such air through the coil and blow air out through the grill.</li> </ul> </li> </ul>
31	<p><b>HPCO Timer Hold – Please Wait</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• The warning is a timer based warning to protect the compressor from starting at high pressure. The warning will go away when the holding time after HPCO gets normal has run out.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• HPCO present or has just been present.</li> </ul> </li> <li>• Action:                             <ul style="list-style-type: none"> <li>• The state will stop / remove the compressor run signal.</li> <li>• The state will overrule regulation of the condenser fan and starts the fan.</li> <li>• This state will activate and hold warning #31 as long as the input signal indicates HPCO.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Controller clears message on compressor start-up.</li> <li>• No direct alarm action based on this situation.</li> <li>• If the state continues:                             <ul style="list-style-type: none"> <li>• Checkup for airflow through the condenser coil, air flow might be blocked.</li> <li>• Checkup for condenser fan rotation and direction, must such air through the coil and blow air out through the grill.</li> </ul> </li> </ul>

**Warnings and Controller Actions (Continued)**

Warning No.	Warning Message/Description	Controller Action/Corrective Action
32	<p><b>Low Pressure Cut Out – Please Wait</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• Unit stops due to low pressure cutout signal from the HPCO switch or the suction pressure reading (if present).</li> <li>• If suction pressure sensor is mounted the signal level for LPCO is below -0.27BarR to activate LPCO state and above +0.38BarR to clear the state.</li> <li>• The warning will go away when the input signal indicates normal condition.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Possible causes include low refrigerant charge, defective low pressure cutout switch or open circuit, block TXV or suction line restriction etc.</li> </ul> </li> <li>• Action:                             <ul style="list-style-type: none"> <li>• The state will stop / remove the compressor run signal.</li> <li>• This state will activate and hold warning #33 as long as the input signal indicates LPCO.</li> </ul> </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>
33	<p><b>LPCO Timer Hold – Please Wait</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• The warning is a timer based warning to protect the compressor from starting before the pressure has risen from low pressure. The warning will go away when the holding time after LPCO gets normal has run out.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• LPCO present or has just been present.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Controller clears message on compressor start-up.</li> <li>• No direct alarm action based on this situation.</li> </ul>

### Warnings and Controller Actions (Continued)

Warning No.	Warning Message/Description	Controller Action/Corrective Action
34	<p><b>Compressor Too High Temperature Timer – Please Wait</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• If the compressor temperature gets above 148C, the warning is set.</li> <li>• The warning will go away when the compressor temperature has been below 137C for 60 seconds.</li> <li>• The warning will (also) go away when the compressor temperature gets below 132C.</li> </ul> </li> <li>• Indicates:                             <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> </li> <li>• Action:                             <ul style="list-style-type: none"> <li>• The state will stop / remove the compressor run signal.</li> <li>• The state will overrule regulation of the condenser fan and starts the fan.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• The warning clears itself when the compressor temperature gets normal.</li> </ul>
35	<p><b>Compressor High Temperature</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• If the compressor temperature gets above 138C, the warning is set.</li> <li>• The warning will go away when the compressor temperature gets below 132C.</li> </ul> </li> <li>• Action:                             <ul style="list-style-type: none"> <li>• Compressor running at high discharge temperature results in economizer/vapor injection will be active until discharge temperature decreases to normal.</li> <li>• In temperature log the state will be represented by the char 'c' (small c)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• The warning clears itself when the compressor temperature gets normal.</li> </ul>
36	<p><b>AVL Open – Check FAE and CA Settings</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• If configuration is AVL, the setting is below 125CMH and the AVL sensor indicates full open / dismantled door, the warning is set.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Wrongly dismantled air ventilation door.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check air exchange position vs. setting.</li> </ul>

**Warnings and Controller Actions (Continued)**

Warning No.	Warning Message/Description	Controller Action/Corrective Action
37	<p><b>CO2 Reading Stuck for &gt;24 Hours</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• With AFAM+ option the CO2 level is constantly monitored. If the reading does not change / fluctuates minimum 0.1% within 24 hour the warning is set.</li> <li>• The warning will clear itself 10 minutes after a change has been observed.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Problems with the gas analyzer.</li> </ul> </li> <li>• Action:                             <ul style="list-style-type: none"> <li>• When the warning is set the event “Gas reading surveillance - CO2 reading stuck for 24H at: x.x%” is made in the event log.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check gas analyzer readings.</li> </ul>
38	<p><b>High Voltage On Line</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• High voltage observed, voltage has been above 515 VAC. The Warning will clear when voltage gets below 500 VAC.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• When the warning is set a power line value log is made in the event log. i.e: “CURR: 0.2A PH1: 0.2A PH2: 0.2A PH3: 0.3A VOLT: 529V FREQ: 63Hz “.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Enter Manual Function Test menu and test (operate) components to load the power source. Check volts and amps to help determine the problem.</li> <li>• Possible cause for the problem is a wild running generator set.</li> </ul>
39	<p><b>Battery Charger/Heater – Check Battery</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• The data logger battery charger reports battery charging suspended due to low temperature and the battery internal heater has been on for 2 hours the warning is set.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Fault in the data logger battery circuit.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for battery position, placement and wiring.</li> </ul>
40	<p><b>12V Sensor PSU Problem</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• If the sensor supply (+ 12VDC) for the humidity or pressure transducers is not able of supplying the 12VDC.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Too high load on the sensor supply.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check humidity sensor or transducer.</li> </ul>

### Warnings and Controller Actions (Continued)

Warning No.	Warning Message/Description	Controller Action/Corrective Action
41	<p><b>Power Module Heat Exchanger High Temperature</b></p> <ul style="list-style-type: none"> <li>• When:                             <ul style="list-style-type: none"> <li>• If the power module heat exchanger temperature gets above 95C the heating element is bypassed and not energized. Since activating the heating element is the far most heat applying solid state switch, activating is bypassed to reduce temperature.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• High temperature surrounding the control box.</li> <li>• Poor cooling to the back side of the control box.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for blocked air flow to the back side of the control box.</li> <li>• Ambient temperature might just be high.</li> </ul>
42	<p><b>CA Unit LPCO</b></p> <ul style="list-style-type: none"> <li>• CA Unit is having too frequent LPCO's.</li> </ul>	
43	<p><b>CA Unit HPCO</b></p> <ul style="list-style-type: none"> <li>• CA Unit is having too frequent HPCO's.</li> </ul>	
44	<p><b>CA Unit OBS</b></p> <ul style="list-style-type: none"> <li>• CA Unit needs attention.</li> </ul>	
45	<p><b>Wall Clock Failure</b></p> <ul style="list-style-type: none"> <li>• Occurs if the wall clock has been stopped or restarted as a result of insufficiently voltage.</li> </ul>	<ul style="list-style-type: none"> <li>• The wall clock battery must be replaced.</li> </ul>
45	<p><b>Battery Needs Charging</b></p> <ul style="list-style-type: none"> <li>• Low battery voltage observed. The battery voltage has been below 3.7V. The voltage must be above 2.5V to trig the message.</li> </ul>	<ul style="list-style-type: none"> <li>• Leave the unit on (could be standby mode) for four hours to charge the battery.</li> </ul>

## Alarm Codes, Descriptions and Corrective Actions

**NOTE:** Sensors used with the MP-4000 controller do not require calibration. Check sensor resistance with an ohmmeter.

- Shutdown Alarm (Level 1 Alarm): Alarm light on display flashes and unit stops. Correct alarm condition and acknowledge alarm before restarting.
- Check Alarm (Level 2 Alarm): Alarm light on display flashes until alarm is acknowledged.

### Alarm Codes, Descriptions and Corrective Actions

Code	Description	Corrective Action
00	<p><b>Supply Air Sensor Open Circuit</b></p> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is higher than 1300Ω.</li> <li>• Indicates: <ul style="list-style-type: none"> <li>• Open circuit.</li> <li>• Defective or wrong sensor.</li> <li>• Defective wiring.</li> <li>• Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for damaged sensor wires.</li> <li>• Check sensor connections at controller.</li> <li>• The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 1 and 2. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>• The 2 sensor wires can be switched without affecting the measurement.</li> <li>• Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. The sensor can't be examined without disconnecting it. The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>• The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. The sensor is defined to be 1000Ω@ 0°C. Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. The valid measuring limit for this pt1000 sensor is -100°C(602Ω) +75°C(approx 1300Ω).</li> </ul>

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

Code	Description	Corrective Action
01	<p><b>Supply Air Sensor Short Circuit</b></p> <ul style="list-style-type: none"> <li>When the sensor circuit resistance is lower than 602Ω.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Short circuit.</li> <li>Defective or wrong sensor.</li> <li>Defective wiring.</li> <li>Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check for damaged sensor wires.</li> <li>Check sensor connections at controller.</li> <li>The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 1 and 2. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>The 2 sensor wires can be switched without affecting the measurement.</li> <li>Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. The sensor can't be examined without disconnecting it. The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. The sensor is defined to be 1000Ω@ 0°C. Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. The valid measuring limit for this pt1000 sensor is -100°C(602Ω) +75°C(approx 1300Ω).</li> </ul>

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

Code	Description	Corrective Action
02	<p><b>Return Air Sensor Open Circuit</b></p> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is higher than 1300Ω.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Open circuit.</li> <li>• Defective or wrong sensor.</li> <li>• Defective wiring.</li> <li>• Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for damaged sensor wires.</li> <li>• Check sensor connections at controller.</li> <li>• The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 3 and 4. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>• The 2 sensor wires can be switched without affecting the measurement.</li> <li>• Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. The sensor can't be examined without disconnecting it. The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>• The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. The sensor is defined to be 1000Ω@ 0°C. Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. The valid measuring limit for this pt1000 sensor is -100°C(602Ω) +75°C(approx 1300Ω).</li> </ul>

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

Code	Description	Corrective Action
03	<p><b>Return Air Sensor Short Circuit</b></p> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is lower than 602Ω.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Short circuit.</li> <li>• Defective or wrong sensor.</li> <li>• Defective wiring.</li> <li>• Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for damaged sensor wires.</li> <li>• Check sensor connections at controller.</li> <li>• The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 3 and 4. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>• The 2 sensor wires can be switched without affecting the measurement.</li> <li>• Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. The sensor can't be examined without disconnecting it. The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>• The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. The sensor is defined to be 1000Ω@ 0°C. Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. The valid measuring limit for this pt1000 sensor is -100°C(602Ω) +75°C(approx 1300Ω).</li> </ul>

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

Code	Description	Corrective Action
04	<p><b>Evaporator Coil Sensor Open Circuit</b></p> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is higher than 1300Ω.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Open circuit.</li> <li>• Defective or wrong sensor.</li> <li>• Defective wiring.</li> <li>• Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for damaged sensor wires.</li> <li>• Check sensor connections at controller.</li> <li>• The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 5 and 6. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>• The 2 sensor wires can be switched without affecting the measurement.</li> <li>• Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. The sensor can't be examined without disconnecting it. The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>• The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. The sensor is defined to be 1000Ω@ 0°C. Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. The valid measuring limit for this pt1000 sensor is -100°C(602Ω) +75°C(approx 1300Ω).</li> </ul>

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

Code	Description	Corrective Action
05	<p><b>Evaporator Coil Sensor Short Circuit</b></p> <ul style="list-style-type: none"> <li>When the sensor circuit resistance is lower than 602Ω.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Short circuit.</li> <li>Defective or wrong sensor.</li> <li>Defective wiring.</li> <li>Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check for damaged sensor wires.</li> <li>Check sensor connections at controller.</li> <li>The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 5 and 6. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>The 2 sensor wires can be switched without affecting the measurement.</li> <li>Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. The sensor can't be examined without disconnecting it. The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. The sensor is defined to be 1000Ω@ 0°C. Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. The valid measuring limit for this pt1000 sensor is -100°C(602Ω) +75°C(approx 1300Ω).</li> </ul>
06	<p><b>Compressor Current Too High</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>During compressor test, if Compressor power consumption is 25% above expected current draw or compressor phase current level differs 33% or more.</li> <li>If both alarm #6 and #7 is active this indicates too high phase difference.</li> <li>Expected compressor current is a function of the surrounding conditions.</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 power module.</li> <li>Inaccurate ambient, condenser or evaporator temperature measurement.</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 and condenser sensor temperatures for correct value (± 5 C [± 9 F]) by viewing Data menu.</li> <li>To determine the current draw measurement, enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor full loaded, condenser fan and evaporator fan (high or low).</li> <li>Check power supply volts on all 3 phases.</li> </ul>

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

Code	Description	Corrective Action
07	<p><b>Compressor Current Too Low</b></p> <ul style="list-style-type: none"> <li>• Occurs during pretrip (PTI) or function test only.</li> <li>• During compressor test, if Compressor power consumption is 25% below expected current draw or compressor phase current level differs 33% or more.</li> <li>• If both alarm #6 and #7 is active this indicates too high phase difference.</li> <li>• Expected compressor current is a function of the surrounding conditions.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Defective or open high pressure cutout switch.</li> <li>• Defective or open low pressure cutout switch or transmitter if mounted.</li> <li>• Defective compressor relay.</li> <li>• Defective volt or amp meter on power module.</li> <li>• Low refrigerant charge</li> <li>• Defective compressor.</li> <li>• Defective volt or amp meter on power module.</li> <li>• Inaccurate condenser or evaporator temperature measurement.</li> <li>• Defective or open compressor motor internal over temperature protection switch.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check evaporator, condenser sensor temperatures for correct value (<math>\pm 5\text{ }^{\circ}\text{C}</math> [<math>\pm 9\text{ F}</math>]) by viewing Data menu.</li> <li>• To determine the current draw measurement, enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor full loaded, condenser fan and evaporator fan (high or low).</li> <li>• Check discharge and suction pressure gauge readings.</li> <li>• Check power supply volts on all 3 phases.</li> </ul>
10	<p><b>Heater Current Too High</b></p> <ul style="list-style-type: none"> <li>• Occurs during pretrip (PTI) or function test only.</li> <li>• Heater power consumption is 25% above expected current draw or phase current level differs 33% or more.</li> <li>• If both alarm #10 and #11 is active this indicates too high phase difference.</li> <li>• Expected heater current is a function of the heating element resistance and the power supply voltage.</li> <li>• The Magnum+ may be equipped with extended heating capability.</li> <li>• Normal heating element 4kw@460VAC                             <ul style="list-style-type: none"> <li>- above approximately 6,3Amp / 5,3Amp.</li> </ul> </li> <li>• Extended heating element 6kw@460VAC                             <ul style="list-style-type: none"> <li>- above approximately 9,4Amp / 8,1Amp.</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Incorrect heaters or heater connections.</li> <li>• Defective heater element.</li> <li>• Defective volt or amp meter on power module.</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. Evaluate current draw in relation to expected values.</li> <li>• Enter configuration menu and check the heating element setting.</li> <li>• Check heater resistance.</li> <li>• The electrical resistance towards chassis must be above meg ohm (M<math>\Omega</math>) range.</li> <li>• Normal heating element 4kw@460VAC                             <ul style="list-style-type: none"> <li>- expects 5,0Amp@460VAC</li> <li>- expects 4,3Amp@400VAC</li> <li>- expected resistance 99<math>\Omega</math> on each leg.</li> </ul> </li> <li>• Extended heating element 6kw@460VAC                             <ul style="list-style-type: none"> <li>- expects 7,5Amp@460VAC</li> <li>- expects 6,5Amp@400VAC</li> <li>- expected resistance 66<math>\Omega</math> on each leg.</li> </ul> </li> </ul>

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

Code	Description	Corrective Action
11	<p><b>Heater Current Too Low</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>Heater power consumption is 25% below expected current draw or phase current level differs 33% or more.</li> <li>If both alarm #10 and #11 is active this indicates too high phase difference.</li> <li>Expected heater current is a function of the heating element resistance and the power supply voltage.</li> <li>The Magnum+ may be equipped with extended heating capability.</li> <li>Normal heating element 4kw@460VAC                             <ul style="list-style-type: none"> <li>below approximately 3,7Amp / 3,2Amp.</li> </ul> </li> <li>Extended heating element 6kw@460VAC                             <ul style="list-style-type: none"> <li>below approximately 5,6Amp / 4,8Amp.</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Incorrect heaters or heater connections.</li> <li>Defective heating element.</li> <li>Defective volt or amp meter on power module.</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. Evaluate current draw in relation to expected values.</li> <li>Enter configuration menu and check the heating element setting.</li> <li>Check heater resistance.</li> <li>The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>Normal heating element 4kw@460VAC                             <ul style="list-style-type: none"> <li>expects 5,0Amp@460VAC</li> <li>expects 4,3Amp@400VAC</li> <li>expected resistance 99Ω on each leg.</li> </ul> </li> <li>Extended heating element 6kw@460VAC                             <ul style="list-style-type: none"> <li>expects 7,5Amp@460VAC</li> <li>expects 6,5Amp@400VAC</li> <li>expected resistance 66Ω on each leg.</li> </ul> </li> </ul>
12	<p><b>Evaporator Fan High Speed Current Too High</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>Fan power consumption is 33% above expected current draw or phase current level differs 33% or more.</li> <li>If both alarm #12 and #13 is active this indicates too high phase difference.</li> <li>Expected fan current is a function of the power line frequency and the supply voltage.</li> <li>With 20' setting above approximately                             <ul style="list-style-type: none"> <li>3,4Amp@400VAC/50Hz</li> <li>4,2Amp@460VAC/60Hz</li> </ul> </li> <li>With 40' setting above approximately                             <ul style="list-style-type: none"> <li>2,7Amp@400VAC/50Hz</li> <li>3,4Amp@460VAC/60Hz</li> </ul> </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 power module.</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>With 20' setting expect                             <ul style="list-style-type: none"> <li>2,4Amp@400VAC/50Hz</li> <li>3,1Amp@460VAC/60Hz</li> </ul> </li> <li>With 40' setting expect                             <ul style="list-style-type: none"> <li>1,8Amp@400VAC/50Hz</li> <li>2,4Amp@460VAC/60Hz</li> </ul> </li> </ul>

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

Code	Description	Corrective Action
13	<p><b>Evaporator Fan High Speed Current Too Low</b></p> <ul style="list-style-type: none"> <li>• Occurs during pretrip (PTI) or function test only.</li> <li>• Fan power consumption is 33% below expected current draw or phase current level differs 33% or more.</li> <li>• If both alarm #12 and #13 is active this indicates too high phase difference.</li> <li>• Expected fan current is a function of the power line frequency and the supply voltage.</li> <li>• With 20' setting below approximately                             <ul style="list-style-type: none"> <li>- 1,4Amp@400VAC/50Hz</li> <li>- 2,0Amp@460VAC/60Hz</li> </ul> </li> <li>• With 40' setting below approximately                             <ul style="list-style-type: none"> <li>- 0,9Amp@400VAC/50Hz</li> <li>- 1,4Amp@460VAC/60Hz</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Defective or open fan motor internal over temperature protection switch.</li> <li>• Incorrect motor or motor connections.</li> <li>• Defective volt or amp meter on power module.</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>• 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>• With 20' setting expect                             <ul style="list-style-type: none"> <li>- 2,4Amp@400VAC/50Hz</li> <li>- 3,1Amp@460VAC/60Hz</li> </ul> </li> <li>• With 40' setting expect                             <ul style="list-style-type: none"> <li>- 1,8Amp@400VAC/50Hz</li> <li>- 2,4Amp@460VAC/60Hz</li> </ul> </li> </ul>
14	<p><b>Evaporator Fan Low Speed Current Too High</b></p> <ul style="list-style-type: none"> <li>• Occurs during pretrip (PTI) or function test only.</li> <li>• Fan power consumption is 33% above expected current draw or phase current level differs 33% or more.</li> <li>• If both alarm #14 and #15 is active this indicates too high phase difference.</li> <li>• Expected fan current is a function of the power line frequency and the supply voltage.</li> <li>• With 20' setting above approximately                             <ul style="list-style-type: none"> <li>- 1,0Amp@400VAC/50Hz</li> <li>- 1,2Amp@460VAC/60Hz</li> </ul> </li> <li>• With 40' setting above approximately                             <ul style="list-style-type: none"> <li>- 1,0Amp@400VAC/50Hz</li> <li>- 1,2Amp@460VAC/60Hz</li> </ul> </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 power module.</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>• With 20' setting expect                             <ul style="list-style-type: none"> <li>- 0,8Amp@400VAC/50Hz</li> <li>0,9Amp@460VAC/60Hz</li> </ul> </li> <li>• With 40' setting expect                             <ul style="list-style-type: none"> <li>- 0,8Amp@400VAC/50Hz</li> <li>- 0,9Amp@460VAC/60Hz</li> </ul> </li> </ul>

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

Code	Description	Corrective Action
15	<p><b>Evaporator Fan Low Speed Current Too Low</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>Fan power consumption is 33% below expected current draw or phase current level differs 33% or more.</li> <li>If both alarm #14 and #15 is active this indicates too high phase difference.</li> <li>Expected fan current is a function of the power line frequency and the supply voltage.</li> <li>With 20' setting below approximately                             <ul style="list-style-type: none"> <li>0,5Amp@400VAC/50Hz</li> <li>0,6Amp@460VAC/60Hz</li> </ul> </li> <li>With 40' setting below approximately                             <ul style="list-style-type: none"> <li>0,5Amp@400VAC/50Hz</li> <li>0,6Amp@460VAC/60Hz</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Defective or open fan motor internal over temperature protection switch.</li> <li>Incorrect motor or motor connections.</li> <li>Defective volt or amp meter on power module.</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>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>With 20' setting expect                             <ul style="list-style-type: none"> <li>0,8Amp@400VAC/50Hz</li> <li>0,9Amp@460VAC/60Hz</li> </ul> </li> <li>With 40' setting expect                             <ul style="list-style-type: none"> <li>0,8Amp@400VAC/50Hz</li> <li>0,9Amp@460VAC/60Hz</li> </ul> </li> </ul>
16	<p><b>Condenser Fan Current Too High</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>Fan power consumption is 33% above expected current draw or phase current level differs 33% or more.</li> <li>If both alarm #16 and #17 is active this indicates too high phase difference.</li> <li>Expected fan current is a function of the power line frequency and the supply voltage.</li> <li>Above approximately                             <ul style="list-style-type: none"> <li>1,5Amp@400VAC/50Hz</li> <li>1,8Amp@460VAC/60Hz</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Defective or stuck condenser fan motor.</li> <li>Incorrect motor or motor connections.</li> <li>Defective volt or amp meter on power module.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Enter Manual Function Test and start condenser fan. Make sure the fan starts.</li> <li>Check fan motor volts and amps.</li> <li>Expect                             <ul style="list-style-type: none"> <li>1,0Amp@400VAC/50Hz</li> <li>1,2Amp@460VAC/60Hz</li> </ul> </li> </ul>

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

Code	Description	Corrective Action
17	<p><b>Condenser Fan Current Too Low</b></p> <ul style="list-style-type: none"> <li>• Occurs during pretrip (PTI) or function test only.</li> <li>• Fan power consumption is 33% below expected current draw or phase current level differs 33% or more.</li> <li>• If both alarm #16 and #17 is active this indicates too high phase difference.</li> <li>• Expected fan current is a function of the power line frequency and the supply voltage.</li> <li>• Above approximately                             <ul style="list-style-type: none"> <li>- 0,5Amp@400VAC/50Hz</li> <li>- 0,6Amp@460VAC/60Hz</li> </ul> </li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Defective condenser fan motor relay.</li> <li>• Incorrect motor or motor connections.</li> <li>• Defective or open fan motor internal over temperature protection switch.</li> <li>• Defective volt or amp meter on power module.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Enter Manual Function Test and start condenser fan. Make sure the fan starts.</li> <li>• Check fan motor volts and amps.</li> <li>• Expect                             <ul style="list-style-type: none"> <li>- 1,0Amp@400VAC/50Hz</li> <li>- 1,2Amp@460VAC/60Hz</li> </ul> </li> </ul>
18	<p><b>Power Supply Phase Error</b></p> <ul style="list-style-type: none"> <li>• <b>Shutdown Alarm</b></li> <li>• The power module is not capable of detecting the rotation direction.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Phase(s) missing at the power supply line.</li> <li>• Defective fuse at power module.</li> <li>• Power module failure.</li> <li>• Heating element problem (used for current load to decide the rotation direction).</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check fuses on the power module.</li> <li>• Check power line voltage on all 3 phases.</li> <li>• Use the tester to detect the problem.</li> <li>• Replace power module.</li> </ul>
19	<p><b>Temperature Too Far From Setpoint</b></p> <ul style="list-style-type: none"> <li>• Occurs during Normal Run only.</li> <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>• Use DATA menu to check supply and return air sensor temperatures.</li> <li>• Compare temperatures to evaluate unit cooling capacity and performance.</li> <li>• Temperature difference should be 4 C to 6 C (7.2 F to 10.8 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><i>NOTE: This alarm can be activated if the supply or return air temperature varies, even if the mean temperature does approach setpoint.</i></b></p>

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

Code	Description	Corrective Action
20	<p><b>Defrost Time Too Long</b></p> <ul style="list-style-type: none"> <li>• May occur during any defrost.</li> <li>• Heat signal has been on for too long.</li> <li>• Time limit is 90 minutes with supply voltage above 440VAC and 120 minutes below 440VAC.</li> <li>• Indicates: <ul style="list-style-type: none"> <li>• Low power supply voltage.</li> <li>• Defective heater elements.</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>
22	<p><b>Capacity Test 1 Error</b></p> <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 and let operate fans for 5 minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (evaporator coil may be 0.5 C [1.0 F] lower due to fan motor heat).</li> <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> <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>

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

Code	Description	Corrective Action
23	<p><b>Capacity Test 2 Error</b></p> <ul style="list-style-type: none"> <li>• Occurs during pretrip (PTI) test only.</li> <li>• When the supply air temperature does not reach 0 °C (32 F) within preset time.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Incorrect location of supply air sensor.</li> <li>• Air leakage at supply sensor cable.</li> <li>• Defective supply 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>• Air exchange vent open too much.</li> <li>• Low refrigerant charge.</li> <li>• Cooling circuit defective.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Enter Manual Function Test and start evaporator fans on high speed and let operate fans for 5 minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (supply air may be 0.5 °C [1.0 F] higher due to fan motor heat).</li> <li>• Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on low and high 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>
26	<p><b>Vapor Injection Error</b></p> <ul style="list-style-type: none"> <li>• Occurs during pti, brief pti and function tests.</li> <li>• Power consumption does not increase when activating economizer valve.</li> <li>• Current consumption not correct for valve position.</li> </ul>	<ul style="list-style-type: none"> <li>• Enter Manual Function Test and start compressor and evaporator fans on high speed, with digital valve off, operate vapor injection valve and observe current consumption change. An increase in current consumption is expected.</li> <li>• Check vapor valve function.</li> <li>• Evaluate economizer Tx valve operation.</li> </ul> <p><b><i>NOTE: This alarm can be activated in low ambient temperatures where condenser temperature may not be high.</i></b></p>

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

Code	Description	Corrective Action
31	<p><b>Low Pressure Cut Out</b></p> <ul style="list-style-type: none"> <li>• If Low pressure switch is mounted.                             <ul style="list-style-type: none"> <li>• The switch is OPEN.</li> </ul> </li> <li>• If pressure transducer is mounted.                             <ul style="list-style-type: none"> <li>• The suction pressure has been measured below -0,27BarR and has not yet increased above +0,38BarR.</li> </ul> </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> <li>• Defective low pressure transmitter.</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 downstream 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>• If Low pressure switch is mounted                             <ul style="list-style-type: none"> <li>• Check low pressure cutout switch wiring.</li> <li>• Measure the voltage across the switch, located at J9 pin 6 and pin 5.                                     <ul style="list-style-type: none"> <li>- Switch closed (normal) voltage is 0VDC.</li> <li>- Switch open (LPCO) voltage is approx. 12VDC.</li> </ul> </li> <li>• Replace switch.</li> </ul> </li> <li>• If pressure transducer is mounted,                             <ul style="list-style-type: none"> <li>• Measure the transducer supply voltage at J1 pin 8 related to J1 pin 9 (GND). Expects to be approx. 12VDC.</li> <li>• Measure the transducer output voltage at J1 pin 7 related to J1 pin 9 (GND). Expects to be above 0,5VDC (0BarR = 0,8VDC)</li> </ul> </li> </ul>

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

Code	Description	Corrective Action
32	<p><b>Condenser Temperature Sensor Open Circuit</b></p> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is above 1785Ω.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Open circuit.</li> <li>• Defective or wrong sensor.</li> <li>• Defective wiring.</li> <li>• Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for damaged sensor wires.</li> <li>• Check for sensor connections at controller.</li> <li>• The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 7 and 8. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>• The 2 sensor wires can be switched without affecting the measurement.</li> <li>• Disconnect the sensor, use an Ohm (<math>\Omega</math>) measuring device, measure the electrical resistance between the two sensor wires. The sensor can't be examined without disconnecting it. The electrical resistance towards chassis must be above meg ohm (M<math>\Omega</math>) range.</li> <li>• The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. The sensor is defined to be 1000<math>\Omega</math>@ 0°C. Normal condition measuring with disconnected sensor is 960<math>\Omega</math>@-10°C, 1000<math>\Omega</math>@0°C, 1039<math>\Omega</math>@+10°C, 1058<math>\Omega</math>@+15°C, 1078<math>\Omega</math>@+20°C. The valid measuring limit for this pt1000 sensor is -100°C(602<math>\Omega</math>) +200°C(approx 1758<math>\Omega</math>).</li> </ul>

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

Code	Description	Corrective Action
33	<p><b>Condenser Temperature Sensor Short Circuit</b></p> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is below 602Ω.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Open circuit.</li> <li>• Defective or wrong sensor.</li> <li>• Defective wiring</li> <li>• Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for damaged sensor wires.</li> <li>• Check sensor connections at controller.</li> <li>• The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 7 and 8. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>• The 2 sensor wires can be switched without affecting the measurement.</li> <li>• Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. The sensor can't be examined without disconnecting it. The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>• The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. The sensor is defined to be 1000Ω@ 0°C. Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. The valid measuring limit for this pt1000 sensor is -100°C(602Ω) +200°C(approx 1758Ω).</li> </ul>

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

Code	Description	Corrective Action
34	<p><b>Ambient Air Sensor Open Circuit</b></p> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is above 1785Ω.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Open circuit.</li> <li>• Defective or wrong sensor.</li> <li>• Defective wiring.</li> <li>• Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for damaged sensor wires.</li> <li>• Check sensor connections at controller.</li> <li>• The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 9 and 10. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>• The 2 sensor wires can be switched without affecting the measurement.</li> <li>• Disconnect the sensor, use an Ohm (<math>\Omega</math>) measuring device, measure the electrical resistance between the two sensor wires. The sensor can't be examined without disconnecting it. The electrical resistance towards chassis must be above meg ohm (M<math>\Omega</math>) range.</li> <li>• The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. The sensor is defined to be 1000<math>\Omega</math>@ 0°C. Normal condition measuring with disconnected sensor is 960<math>\Omega</math>@-10°C, 1000<math>\Omega</math>@0°C, 1039<math>\Omega</math>@+10°C, 1058<math>\Omega</math>@+15°C, 1078<math>\Omega</math>@+20°C. The valid measuring limit for this pt1000 sensor is -100°C(602<math>\Omega</math>) +200°C(approx 1758<math>\Omega</math>).</li> </ul>

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

Code	Description	Corrective Action
35	<p><b>Ambient Air Sensor Short Circuit</b></p> <ul style="list-style-type: none"> <li>When the sensor circuit resistance is below 602Ω.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Short circuit.</li> <li>Defective or wrong sensor.</li> <li>Defective wiring.</li> <li>Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check for damaged sensor wires.</li> <li>Check sensor connections at controller.</li> <li>The sensor is a pt1000 – 2 wire sensor, connected to the MP-4000 at connector J3 pin 9 and 10. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>The 2 sensor wires can be switched without affecting the measurement.</li> <li>Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. The sensor can't be examined without disconnecting it. The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>The sensor is a pt1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. The sensor is defined to be 1000Ω@ 0°C. Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. The valid measuring limit for this pt1000 sensor is -100°C(602Ω) +200°C(approx 1758Ω).</li> </ul>
43	<p><b>Return Air temperature Too High</b></p> <ul style="list-style-type: none"> <li>Occurs during defrost.</li> <li>With dehumidify operation; during defrost the return air temperature increases above 38 °C (100 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>

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

Code	Description	Corrective Action
44	<p><b>Return Air temperature Too Low</b></p> <ul style="list-style-type: none"> <li>• Occurs during Normal Run only.</li> <li>• Only active with the surveillance active (OOCL option)</li> <li>• During dehumidify operation or if ambient air temperature is below set point:                             <ul style="list-style-type: none"> <li>• If return air temperature is below set point -3C.</li> </ul> </li> <li>• Else (other operation range):                             <ul style="list-style-type: none"> <li>• If return air temperature is below set point -1C.</li> </ul> </li> <li>• The alarm state has to be present for 15minutes before the alarm is set.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Container/side panels defective, damaged or leaking.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Using DATA menu to evaluate sensors.</li> <li>• Use PROBE TEST to help determine the problem.</li> <li>• Replace sensor.</li> </ul>
51	<p><b>Power Line Voltage Too Low</b></p> <ul style="list-style-type: none"> <li>• <b>Shutdown Alarm</b></li> <li>• Occurs if line voltage has been below 330VAC and is below 340 volts for 30 minutes.</li> <li>• During the 30 minutes and until voltage gets back above 340VAC the compressor is stopped, for protecting the unit.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Poor power supply.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Using DATA menu to evaluate the power line quality.</li> <li>• Refer to the electrical specifications in the Specifications Section for correct power requirements.</li> </ul>
52	<p><b>Probe Error</b></p> <ul style="list-style-type: none"> <li>• Occurs during pretrip (PTI) test or probe test in Chilled mode.</li> <li>• Temperature difference between supply and return air is above 1,5C and the system is not capable of pinpointing which probe is failing.</li> <li>• Temperature difference between supply and return air and evaporator coil is above 1,5C and the system is not capable of pinpointing which probe is failing.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Sensor error.</li> <li>• Sensor misplacement.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Using MANUAL FUNCTION TEST, ventilate with evaporator fan high speed and evaluate the readings.</li> <li>• Check sensor connections.</li> <li>• Replace sensor.</li> <li>• Check sensor.</li> </ul>

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

Code	Description	Corrective Action
53	<p><b>High Pressure Switch Off Error</b></p> <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.                             <ul style="list-style-type: none"> <li>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> </li> </ul>
54	<p><b>High Pressure Switch On Error</b></p> <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.                             <ul style="list-style-type: none"> <li>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> <li>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> </li> </ul>
56	<p><b>Compressor Temperature Too High</b></p> <ul style="list-style-type: none"> <li><b>Shutdown Alarm</b></li> <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.</li> <li>Defective vapor injection.</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) Vapor Injection Valve to determine if valve opens (energizes).</li> <li>Check compressor discharge sensor resistance. Resistance must be approx. 86,000 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><i>NOTE: Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.</i></b></p>

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

Code	Description	Corrective Action
57	<p><b>FAE Device Error</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip testing if the expected door endpoints can't be reached.</li> <li>Occurs during normal operation                             <ul style="list-style-type: none"> <li>If the AFAM+ module isn't detected.</li> <li>During door position calibration the expected door endpoints feedback can't be reached.</li> <li>During pulsing movement the expected door endpoints feedback can't be reached.</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Stocked air vent. door motor.</li> <li>Failing or missing AFAM+ module.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Inspect AFAM+ module connection to the controller.</li> <li>Using STATES MENU / EXPANSION MODULE to inspect the observed presence and readings of the AFAM+ module.                             <ul style="list-style-type: none"> <li>From backside left bay is bay 1</li> <li>From backside right bay is bay 2</li> </ul> </li> <li>If the module is not found use the tester to decide the problem.</li> <li>Inspect wiring from AFAM+ motor to AFAM+ module.</li> <li>Using MANUAL FUNCTION TEST move and Inspect air vent door movement.</li> <li>Inspect air vent.</li> <li>Replace AFAM+ motor.</li> </ul>
58	<p><b>Phase Sensor Error</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) or function test only.</li> <li>During Phase Sensor Test, while direction is reversed, the condenser fan and compressor is tested.                             <ul style="list-style-type: none"> <li>If the current consumption of the condenser fan is below 0,5A on each phase.</li> <li>If the current consumption of the compressor is below 2,0A on each phase.</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Defective phase relay.</li> <li>Defective power module.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Start a Manual Function Test. With reverse phase direction selected, check the condenser fan runs reversed direction and the compressor is activated and makes loud noise. Allow only for short time activation max. 5 sec.</li> </ul>
59	<p><b>Delta Current Error</b></p> <ul style="list-style-type: none"> <li>100% ampere difference between current phases, max reading must be above 1,5A.</li> <li>The alarm is protected by a timer which demand the state to be present for 3 minutes before the alarm is set.</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> <li>Blown fuse.</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> <li>Check fuses.</li> </ul>
60	<p><b>Humidity Sensor Error</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test.</li> <li>Relative humidity reading is less than 15%.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Sensor disconnected.</li> <li>Wrong controller software configuration, sensor might be disconnected or removed.</li> <li>Defective sensor</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check sensor connections.</li> <li>Check controller configuration menu for correct humidity setting.</li> <li>Replace sensor.</li> </ul>

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

<b>Code</b>	<b>Description</b>	<b>Corrective Action</b>
<b>65</b>	<p><b>CO2 Too High</b></p> <ul style="list-style-type: none"> <li>Occurs during Normal Run with AFAM+ enabled.</li> <li>If the CO2 level has been within 0.6% of set point for at least one hour and then gets 1.6% above set point.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Need of ventilation with fresh air                                     <ul style="list-style-type: none"> <li>Stocked air vent door.</li> <li>Air Vent. Motor defect.</li> </ul> </li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Using Manual Function Test - Check air vent door functionality.</li> <li>Check wiring.</li> </ul>
<b>66</b>	<p><b>CO2 Too Low</b></p> <ul style="list-style-type: none"> <li>Occurs during Normal Run with AFAM+ enabled.</li> <li>If the CO2 level has been within 0.6% of set point for one hour and then gets 1.6% below set point.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Not intended ventilation with fresh air                                     <ul style="list-style-type: none"> <li>Stocked air vent door.</li> <li>Air Vent. Motor defect.</li> <li>Container doors open.</li> </ul> </li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Using Manual Function Test - Check air vent door functionality.</li> <li>Check wiring.</li> <li>Check container doors.</li> </ul>
<b>68</b>	<p><b>Gas Analyzer Error</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only.</li> <li>With O2 ON, If Both O2 and CO2 sensor reading is not ready and valid within 10 minutes.</li> <li>Occurs during normal run with AFAM+ enabled.                             <ul style="list-style-type: none"> <li>If the sensor is capable of producing valid reading for 10 minutes.</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Failing sensor, not capable of heating up or create conditions for valid reading.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Redo AFAM+ PTI.</li> <li>Replace sensor.</li> </ul>
<b>69</b>	<p><b>Gas Analyzer Calibration Error</b></p> <ul style="list-style-type: none"> <li>Occurs during AFAM+ PTI test.                             <ul style="list-style-type: none"> <li>After ventilation if the CO2 reading is below 0% or above 2%.</li> </ul> </li> <li>Occurs during normal run with AFAM+ enabled.                             <ul style="list-style-type: none"> <li>With O2 ON, if (CO2+O2) is not within 10% to 30%.</li> <li>With O2 OFF, if CO2 is above 25%.</li> </ul> </li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Sensor lost the calibration.</li> <li>Failing sensor.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Redo the test.</li> <li>Replace sensor.</li> </ul>

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

Code	Description	Corrective Action
70	<p><b>O2 Sensor Error</b></p> <ul style="list-style-type: none"> <li>• Occurs during pretrip (PTI) test only.</li> <li>• If the sensor reading is not ready and valid within 10 minutes.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Failing sensor, not capable of heating up or create conditions for valid reading.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Redo the test.</li> <li>• Replace sensor.</li> </ul>
71	<p><b>CO2 Sensor Error</b></p> <ul style="list-style-type: none"> <li>• Occurs during pretrip (PTI) test only.</li> <li>• If the sensor reading is not ready and valid within 10 minutes.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Failing sensor, not capable of heating up or create conditions for valid reading.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Redo the test.</li> <li>• Replace sensor.</li> </ul>

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

Code	Description	Corrective Action
97	<p><b>Compressor Sensor Open Circuit</b></p> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is above 3000kΩ.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Open circuit.</li> <li>• Defective or wrong sensor.</li> <li>• Defective wiring.</li> <li>• Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for damaged sensor wires.</li> <li>• Check sensor connections at controller.</li> <li>• The compressor temperature sensor is a NTC – 2 wire sensor. The sensor is located/connected to the MP-4000 at connector J3 pin 13 and 14. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>• The 2 sensor wires can be switched without affecting the measurement.</li> <li>• Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires.</li> <li>• The sensor can't be examined without disconnecting it.</li> <li>• The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>• The sensor is a NTC thermistor type - negative temperature coefficient, which in this case means that the resistance of the sensor decreases with temperature.                             <ul style="list-style-type: none"> <li>• The sensor is defined to be 86000Ω@ 25°C.</li> <li>• Normal condition measuring with disconnected sensor is                                     <ul style="list-style-type: none"> <li>- 475kΩ@-10°C,</li> <li>- 280kΩ@0°C,</li> <li>- 171kΩ@+10°C,</li> <li>- 135kΩ@+15°C,</li> <li>- 107kΩ@+20°C.</li> </ul> </li> </ul> </li> <li>• The valid measuring limit for this sensor is -25°C(approx 1MΩ) +185°C(approx 550Ω).</li> </ul> <p><b><i>NOTE: OPEN circuit state is not reasonable since open indicates high electrical resistance which with this type of sensor is possible at very low temperature. Instead -30°C is shown as temperature. The needed protection compressor temperature vice is at the high temperature end of the scale.</i></b></p>

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

Code	Description	Corrective Action
98	<p><b>Compressor Sensor Short Circuit</b></p> <ul style="list-style-type: none"> <li>• When the sensor circuit resistance is below 550Ω.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Short circuit.</li> <li>• Defective or wrong sensor.</li> <li>• Defective wiring.</li> <li>• Defective controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for damaged sensor wires.</li> <li>• Check sensor connections at controller.</li> <li>• The compressor temperature sensor is a NTC – 2 wire sensor. The sensor is located/connected to the MP-4000 at connector J3 pin 13 and 14. CM-4000 upper left connector J3, 17 pin wide, pin number 1 is the right pin, seen at the backside of the controller.</li> <li>• The 2 sensor wires can be switched without affecting the measurement.</li> <li>• Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires.</li> <li>• The sensor can't be examined without disconnecting it.</li> <li>• The electrical resistance towards chassis must be above meg ohm (MΩ) range.</li> <li>• The sensor is a NTC thermistor type - negative temperature coefficient, which in this case means that the resistance of the sensor decreases with temperature.</li> <li>• The sensor is defined to be 86000Ω@ 25°C.</li> <li>• Normal condition measuring with disconnected sensor is                             <ul style="list-style-type: none"> <li>- 475kΩ@-10°C,</li> <li>- 280kΩ@0°C,</li> <li>- 171kΩ@+10°C,</li> <li>- 135kΩ@+15°C,</li> <li>- 107kΩ@+20°C.</li> </ul> </li> <li>• The valid measuring limit for this sensor is -25°C(approx 1MΩ) +185°C(approx 550Ω).</li> </ul> <p><b><i>NOTE: OPEN circuit state is not reasonable since open indicates high electrical resistance which with this type of sensor is possible at very low temperature. Instead -30°C is shown as temperature. The needed protection compressor temperature vice is at the high temperature end of the scale.</i></b></p>

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

Code	Description	Corrective Action
119	<p><b>Digital Valve Error</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test only.</li> <li>Compressor Current consumption not correct for valve position.</li> </ul>	<ul style="list-style-type: none"> <li>Using Manual Function Test, <b>without</b> compressor and fans active check the function of the valve by observing the sound or feel of the valve while activating/deactivating.</li> <li>Using Manual Function Test, with compressor and fans active check the function of the valve. <ul style="list-style-type: none"> <li>The current consumption during NOT energized valve must be higher than during energized position.</li> <li>With Condenser coil temperature above 35C the expected increase is min 0,9A and below 35C expected limit is 1,5A.</li> </ul> </li> </ul>
120	<p><b>Suction Pressure Sensor Error</b></p> <ul style="list-style-type: none"> <li>Occurs during Normal Run if the sensor is detected to be out of range, open or short circuit.</li> <li>Occurs during pretrip (PTI) test if the sensor readings do not act correct during compressor activity. <ul style="list-style-type: none"> <li>Expected to decrease 0,15Bar from stopped to compressor running loaded.</li> </ul> </li> <li>Indicates: <ul style="list-style-type: none"> <li>Wrong location of the sensor.</li> <li>Sensor failure.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Using DATA menu evaluate sensor readings.</li> <li>Check wiring to be correct and connected.</li> <li>Check J1 plug is plugged into MRB.</li> <li>Check voltage at J1 pin7 to be 0.5 – 4.5 volts.</li> <li>Replace sensor.</li> </ul>
121	<p><b>Discharge Pressure Sensor Error</b></p> <ul style="list-style-type: none"> <li>Occurs during Normal Run if the sensor is detected to be out of range, open or short circuit.</li> <li>Occurs during pretrip (PTI) test if the sensor readings do not act correct during compressor activity. <ul style="list-style-type: none"> <li>Expected to increase 0,15Bar from stopped to compressor running loaded.</li> </ul> </li> <li>Indicates: <ul style="list-style-type: none"> <li>Wrong location of the sensor.</li> <li>Sensor failure.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Using DATA menu evaluate sensor readings.</li> <li>Check wiring to be correct and connected.</li> <li>Check J1plug is plugged into MRB.</li> <li>Check voltage at J1 pin4 to be 0.5 – 4.5 VDC.</li> <li>Replace sensor.</li> </ul>
122	<p><b>O2 Sensor Calibration Error</b></p> <ul style="list-style-type: none"> <li>Occurs during AFAM+ PTI test.</li> <li>Occurs only if the setting O2 SENSOR USAGE is ON.</li> <li>After ventilation if the O2 reading is below 17% or above 25%.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Sensor lost the calibration.</li> <li>Failing sensor.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Open doors and ventilate container.</li> <li>Redo the test.</li> <li>Recalibrate sensor.</li> <li>Replace the sensor.</li> </ul>

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

Code	Description	Corrective Action
123	<p><b>Datalogger Battery Error</b></p> <ul style="list-style-type: none"> <li>• In cold ambient if the battery heater (battery internal) is not capable of heating up the battery, ready for charging within 2 hours.</li> <li>• If the battery is not connected.</li> <li>• If the battery voltage is below 3,0VDC.</li> </ul>	<ul style="list-style-type: none"> <li>• Using DATA menu to determine the state of the battery. Evaluate temperature and voltage.</li> <li>• Check the battery physically, dismount and examine wires and the connection to the controller.</li> <li>• Replace battery.</li> </ul>
124	<p><b>Cold Treatment Restart</b></p> <ul style="list-style-type: none"> <li>• Occurs during Normal Run and only with cold Treatment active.</li> <li>• Only active with the surveillance active (OOCL option).</li> <li>• Indicates: <ul style="list-style-type: none"> <li>• Cold treatment period is restarted due to temperatures.</li> <li>• Problem with cooling process,</li> <li>• Too long duration of power off.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Unit will automatically restart the treatment period.</li> </ul>
127	<p><b>Alarm General Unit Error</b></p> <ul style="list-style-type: none"> <li>• The surveillance has determined that the unit is not capable of continue running, and has shut down.</li> <li>• The reason is displayed at the controller main screen, and is stated at the event next to the alarm event.</li> <li>• Known reason to the shutdown state is: <ul style="list-style-type: none"> <li>• "SET POINT OUT OF RANGE"</li> <li>• "VOLTAGE OUT OF RANGE"</li> <li>• "POWER LINE PHASE ERROR"</li> <li>• "REGULATION PROBE ERROR"</li> <li>• "COMPRESSOR TEMPERATURE HIGH"</li> </ul> </li> </ul>	<p>"SET POINT OUT OF RANGE"</p> <ul style="list-style-type: none"> <li>• The temperature set point is outside valid operation range. +30°C to -40°C (+35°C with extended range).</li> <li>• Check configurations and settings on the controller.</li> </ul> <p>"VOLTAGE OUT OF RANGE"</p> <ul style="list-style-type: none"> <li>• The measured voltage is below 330VAC.</li> <li>• Check power line voltage while loaded.</li> </ul> <p>"POWER LINE PHASE ERROR"</p> <ul style="list-style-type: none"> <li>• The phase detection system detects phase error or not capable of securing the correct rotation.</li> <li>• Check power line voltage and quality.</li> </ul> <p>"REGULATION PROBE ERROR"</p> <ul style="list-style-type: none"> <li>• If supply and return air temperature sensor and evaporator coil temperature sensors ALL indicate OPEN or SHORT circuit, the software is not capable of determine a reasonable action related to the cargo.</li> <li>• Follow steps related to the sensor alarms.</li> </ul> <p>"COMPRESSOR TEMPERATURE HIGH"</p> <ul style="list-style-type: none"> <li>• The compressor temperature is measured to be above 148°C. The state will stay until compressor temperature is measured to be below 132°C.</li> <li>• Check refrigerant level and flow through the cooling circuit.</li> </ul>

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

Code	Description	Corrective Action
128	<p><b>Supply Air Temperature Probe Error</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test and probe test only.</li> <li>After ventilation with the evaporator fans.</li> <li>If the supply and return air temperature sensor differs more than 1,5C and the return air temperature is within 1,5C of evaporator coil temperature.</li> <li>If evaporator coil temperature sensor is failing, if the supply and return air temperature sensors differs more than 1,5C. Both alarm 129 and 128 will be set.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Failing sensors.</li> <li>Misplaced sensors.</li> <li>Failing controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Use the DATA menu to detect the failing sensor.</li> <li>Replace sensors.</li> <li>Use the tester to determine the problem.</li> </ul>
129	<p><b>Return Air Temperature Probe Error</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test and probe test only.</li> <li>After ventilation with the evaporator fans.</li> <li>If the supply and return air temperature sensor differs more than 1,5C and the supply air temperature is within 1,5C of evaporator coil temperature.</li> <li>If evaporator coil temperature sensor is failing, if the supply and return air temperature sensors differs more than 1,5C. Both alarm 129 and 128 will be set.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Failing sensors.</li> <li>Misplaced sensors.</li> <li>Failing controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Use the DATA menu to detect the failing sensor.</li> <li>Replace sensors.</li> <li>Use the tester to determine the problem.</li> </ul>
130	<p><b>Evaporator Coil Temperature Probe Error</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test and probe test only.</li> <li>After ventilation with the evaporator fans.</li> <li>If the evaporator coil temperature differs more than 1,5C from the mean value of supply and return air temperature.</li> <li>Indicates: <ul style="list-style-type: none"> <li>Failing sensors.</li> <li>Misplaced sensors.</li> <li>Failing controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Use the DATA menu to detect the failing sensor.</li> <li>Replace sensors.</li> <li>Use the tester to determine the problem.</li> </ul>

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

Code	Description	Corrective Action
131	<p><b>Ambient Condenser Temperature Probe Error</b></p> <ul style="list-style-type: none"> <li>Occurs during pretrip (PTI) test and probe test only.</li> <li>After ventilation with the condenser fan.</li> <li>If the ambient air and condenser coil temperature sensor readings differs more than 2.5C.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Failing sensors.</li> <li>Misplaced sensors.</li> <li>Failing controller.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Use the DATA menu to detect the failing sensor.</li> <li>Replace sensors.</li> <li>Use the tester to determine the problem.</li> </ul>
132	<p><b>Power Module Sensor Error</b></p> <ul style="list-style-type: none"> <li>The surveillance continually evaluates the measurements reported by the power module.</li> <li>The surveillance includes a timer with a timeout at 60 seconds before the alarm is set.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Power module located readings outside allowed range.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Use DATA menu to determine the failing reading.</li> <li>The accepted limit for                             <ul style="list-style-type: none"> <li>Line AC voltage is 180 to 700VAC.</li> <li>Power line current is 0mA to 32A.</li> <li>Radiator temperature is -100C to 200C.</li> </ul> </li> <li>Check for latest software revision.</li> <li>Use tester to determine the problem.</li> </ul>
133	<p><b>Power Module Network Error</b></p> <ul style="list-style-type: none"> <li>The surveillance has not received valid status communication from the power module for 10 seconds.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Communication problem.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Check connection between controller and power module.</li> <li>Use tester to determine the problem.</li> </ul>
134	<p><b>Controller Error</b></p> <ul style="list-style-type: none"> <li>The surveillance has determined the state "controller internal error".</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>The controller is failing one way or another.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Use the tester to determine the problem.</li> </ul>
135	<p><b>Power Module Error</b></p> <ul style="list-style-type: none"> <li>The surveillance has determined the state "Power module error".</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>The power module is failing one way or another.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Use the tester to determine the problem.</li> </ul>
136	<p><b>Transducer Circuit Error</b></p> <ul style="list-style-type: none"> <li>The controller is not capable of generating the expected voltage for the 12V transducer sensors, (suction pressure and discharge pressure, AVL and humidity sensor).</li> </ul>	<ul style="list-style-type: none"> <li>Replace Data logger Battery.</li> <li>Use the tester to determine the problem.</li> </ul>

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

Code	Description	Corrective Action
137	<p><b>Sensor System Overload</b></p> <ul style="list-style-type: none"> <li>The controller sensor measurement is overloaded.</li> <li>This situation will probably introduce wrong readings at other sensors than the one introducing the overload.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Not intended voltage is introduced at one of the sensor inputs.</li> <li>Transducer, connection or cabling with voltage supply for the sensor might short circuit this voltage supply onto the measuring input.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Sensor input which might initiate the problem:                             <ul style="list-style-type: none"> <li>At connector J3:                                     <ul style="list-style-type: none"> <li>Humidity sensor (4-20mA type) pin 15-16.</li> </ul> </li> <li>At connector J1:                                     <ul style="list-style-type: none"> <li>AVL position pin 1-3.</li> <li>Discharge pressure pin 4-6.</li> <li>Suction pressure pin 7-9.</li> </ul> </li> </ul> </li> <li>At least one of the sensors circuits holds a short between sensor voltage and sensor signal.</li> <li>Problem might be located anywhere from the connection to the sensor itself.</li> <li>Action:                             <ul style="list-style-type: none"> <li>Disconnect sensors and look for a non intended short between sensor voltage and the sensor line.</li> <li>The sensor with the problem might show up with its own alarm.</li> </ul> </li> </ul>
138	<p><b>AVL Sensor Error</b></p> <ul style="list-style-type: none"> <li>Occurs if the sensor is detected to be out of range, open or short circuit.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Sensor failure.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Using DATA menu evaluate sensor readings.</li> <li>Check wiring to be correct and connected.</li> <li>Check J1 plug is plugged and connected to controller.</li> <li>Check voltage at J1 pin 1 to be 0.5 – 4.5 VDC.</li> <li>Check supply voltage at J1 pin 3 (GND) to pin 2 to be approximately 12.6VDC.</li> <li>Replace sensor.</li> </ul>
139	<p><b>Internal File Handling Error</b></p> <ul style="list-style-type: none"> <li>Occurs if the read or write process of nonvolatile information (i.e. Configuration and settings) fails.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Internal file read or write failure.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Replace controller.</li> </ul>
140	<p><b>Evaporator Section Too Hot</b></p> <ul style="list-style-type: none"> <li>Occurs if supply air, return air or evaporator coil temperature reads temperature at or above 60C.</li> <li>Indicates:                             <ul style="list-style-type: none"> <li>Failing heater circuit, hanging output.</li> <li>Failing evaporator fan.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Observe temperature readings to locate the problem.</li> <li>Use manual function test to determine the failing component.</li> <li>Use the tester to determine the problem.</li> </ul>

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

Code	Description	Corrective Action
141	<p><b>Power Module Heat Exchanger Too Hot</b></p> <ul style="list-style-type: none"> <li>• Occurs if the power module heat exchanger temperature gets above 105C.</li> <li>• Since activating the heating element is the far most heat applying solid state switch, activating is bypassed to reduce temperature.</li> <li>• Indicates:                             <ul style="list-style-type: none"> <li>• Poor cooling to the back side of the control box.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Check for blocked air flow to the back side of the control box.</li> <li>• Ambient temperature might just be high.</li> </ul>
157	<p><b>Data Logger Battery Failure</b></p> <p>Firmware version 3.3.0 or newer:</p> <ul style="list-style-type: none"> <li>• Occurs if the battery is connected and the battery protection circuit is activated as a result of over-current, over-charge or over-discharge.</li> <li>• Battery voltage must stay below 2.5V after the battery has been charged for 3 minutes.</li> </ul>	<ul style="list-style-type: none"> <li>• Check the battery physically, dismount and examine wires and the connection to the controller.</li> <li>• Replace battery.</li> </ul>

# Wiring and Schematic Diagrams Index

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<b>Dwg No.</b>	<b>Drawing Title</b>	<b>Page</b>
1e54052	Wiring Schematic	255
1e54051	Wiring Diagram	256-257
	MAGNUM Refrigeration System Components	258-259
	MP-4000 Menu Flow Diagram	260

CODE	DESCRIPTION	LOC
AVL	AIR VENT LOGGIN	40
BAT	BATTERY	4C
CBI	CBI BREAKER - MAIN	3B
CCI	CONDENSER CONTACTOR	4A
CFM	CONDENSER FAN MOTOR	7A
COMP	COMPRESSOR MOTOR	4A
DCV	DIGITAL CONTROL VALVE	6D
EVAP	EVAPORATOR FAN MOTORS	6A,7A
F3	FUSE - 20 AMP	5B
F4	FUSE - 20 AMP	5B
F5	FUSE - 20 AMP	5B
HP	HIGH PRESSURE	6D
LP	LOW PRESSURE	6D
LPS	LOW PRESSURE CUT OFF SWITCH	4B
LP	RELAY - PHASE SELECT #1	4B
LP	RELAY - PHASE SELECT #2	4B
LP	LOW PRESSURE TRANSDUCER	4B
LPS	LOW PRESSURE CUT OFF SWITCH	7D
MP	MICRO PROCESSOR	6A,7B
S1	SOL. STATE RELAY - EVAP HEATERS	6B
S2	SOL. STATE RELAY - EVAP	6B
S3	SOL. STATE RELAY - EVAP	6B
TD	TEMPERATURE SENSOR	7B
TEO	TRANSFORMER	3C
TX	TRANSFORMER OPTION	3C
VIV	VAPOR TRAPLECTION VALVE	7D

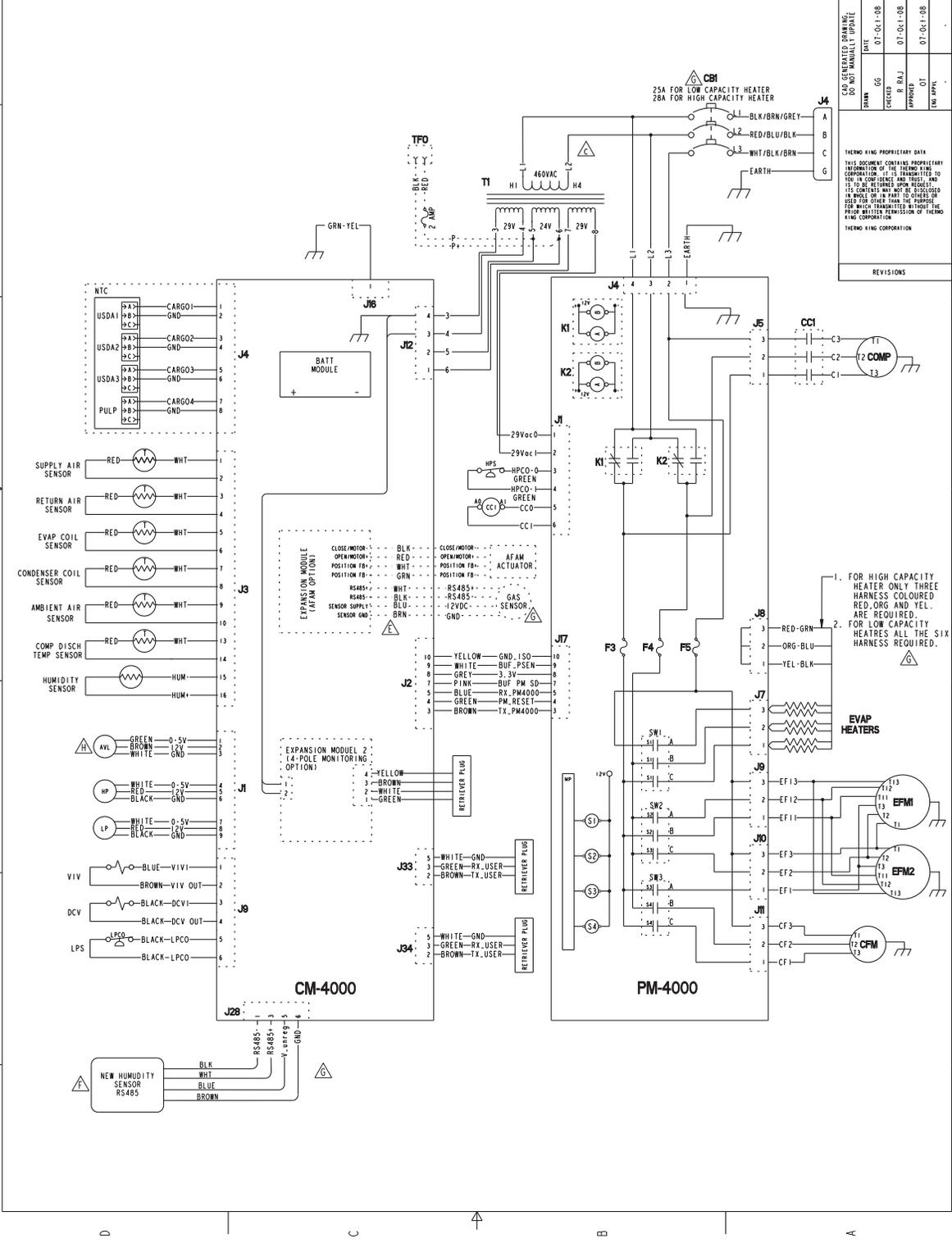
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537225	B	19-Nov-09	OT
543422	C	17-Jun-10	OT
555806	D	18-Jan-11	OT
558428	E	17-Mar-11	OT
537793	F	02-Nov-11	OT
555925	G	07-Feb-12	OT

RELEASED  
ADDED 4-POLE MONITORING OPTION  
ADDED L3 CONNECTED WITH CBI L3  
COLOR CODE OF GAS SENSOR UPDATED  
COLOR CODE OF GAS SENSOR & AFAM ACTUATOR TERMINALS UPDATED  
ADDED NEW HUMIDITY SENSOR RS485  
CHART RECORDER OPTION REMOVED  
ONE SENSOR SHAPE UPDATED  
HIGH CAPACITY HEATER OPTION ADDED  
SWAPPED THE COLORS OF THE PINS 1 & 2 OF THE J1 CONNECTOR

DATE: 07-01-08  
BY: R PAJ  
CHECKED: OT  
APPROVED: OT  
REV: 07-01-08  
BY: R PAJ  
CHECKED: OT  
APPROVED: OT

SCALE: NONE  
SHEET: 1 OF 1  
REV: 1  
Dwg No: IE54052  
Title: SCHEMATIC DIAGRAM MAGNUM

Schematic Diagram



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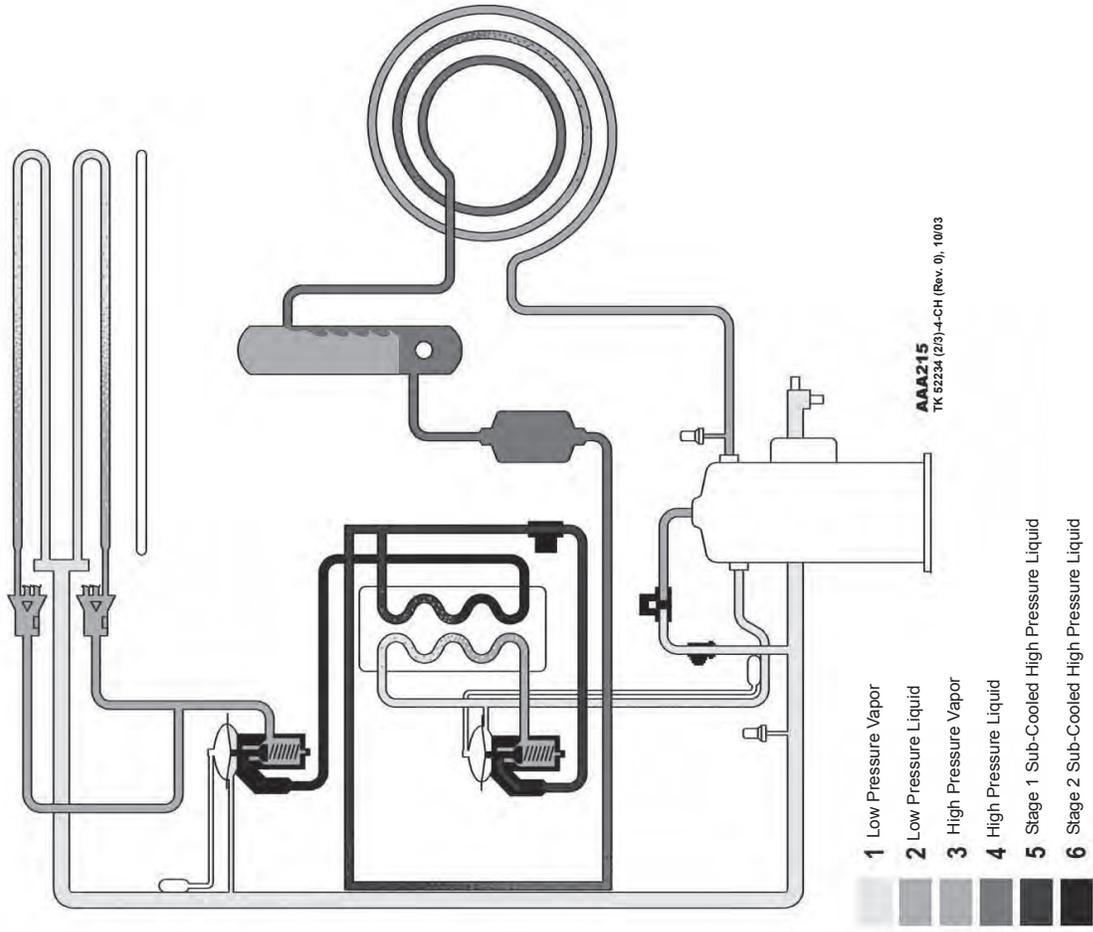
REVISIONS

REV	DATE	BY	CHKD	APPV	DESCRIPTION
1	07-01-08	R PAJ	OT	OT	ADDED 4-POLE MONITORING OPTION
2	07-01-08	R PAJ	OT	OT	ADDED L3 CONNECTED WITH CBI L3
3	07-01-08	R PAJ	OT	OT	COLOR CODE OF GAS SENSOR & AFAM ACTUATOR TERMINALS UPDATED
4	07-01-08	R PAJ	OT	OT	ADDED NEW HUMIDITY SENSOR RS485
5	07-01-08	R PAJ	OT	OT	CHART RECORDER OPTION REMOVED
6	07-01-08	R PAJ	OT	OT	ONE SENSOR SHAPE UPDATED
7	07-01-08	R PAJ	OT	OT	HIGH CAPACITY HEATER OPTION ADDED
8	07-01-08	R PAJ	OT	OT	SWAPPED THE COLORS OF THE PINS 1 & 2 OF THE J1 CONNECTOR

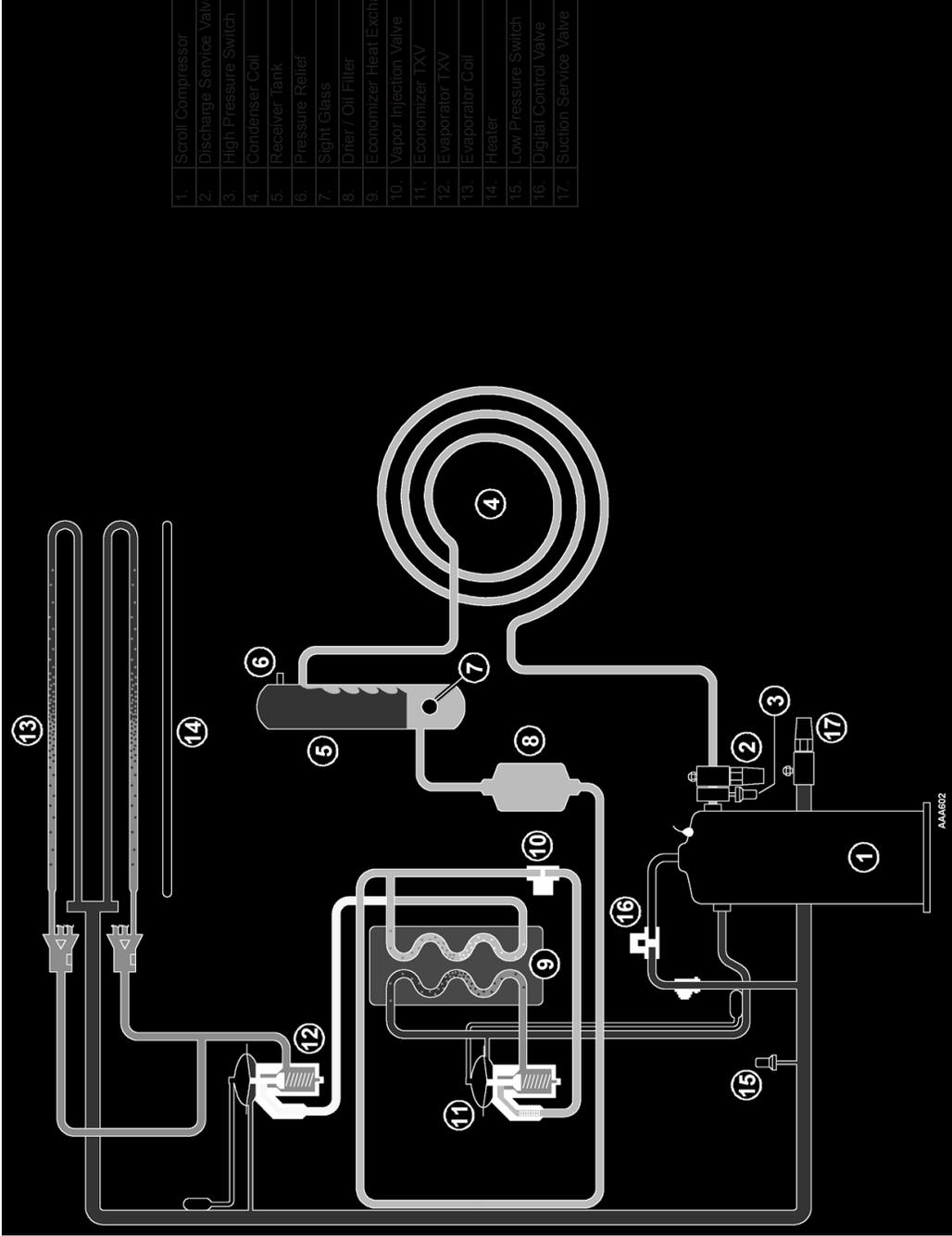




Magnum+ Refrigeration System Components



MAGNUM+ Components



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

# CONTROLLER MENU GUIDE



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

**NOTE:** When a function key (F1, F3, F3 or F4) is pressed, the screen remains at that level until another function key is pressed.

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

- Press Alarm Key to Quickly view/Acknowledge Alarms (F1).
- Press CF key to view alternate temperature scale in LED display (F2).

- Press SETPOINT Key to Quickly change Setpoint (F3)
- Press MENU Key to view the main menu (F4)
- Press DEFROST key to initiate a manual defrost. Evaporator coil temperature must be below 10C (50F) (°).
- Press PTI key to enter the Pte Trip menu.

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

- Press F4 key.

**To Scroll in a Menu or a Text Line:**

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

**To Exit a Menu or Text Line:**

- Press F1 key.

**To Lock a LCD Data Screen Display:**  
Maximum display time is 30 minutes for data screens and 100 minutes for manual tests. Press F1 key to exit display.

The screenshot shows the following data on the screen:

- Top left: Tuesday, 05 January, 2009 14:27:58
- Top right: RA 6.0 °C, SA 6.0 °C, SP 6.0 °C
- Bottom left: 25% battery icon, 100% CHILLED HEATING indicator
- Bottom center: PTI icon, F1, F2, F3, F4 function keys
- Bottom right: ON/OFF indicator

## MAIN MENU

F2

F3

F4

## DATA

F1 Alarms Menu

F2 C TO F

F3 SETPOINT

F4 MENU

Compressor

Supply LH

Ambient

Humidity

Evaporator

Condensator

USDA 1, 2, 3

Cargo

Cur. Ph. 1

Cur. Ph. 2

Cur. Ph. 3

Voltage

Current

AVL Position

Modulation

Frequency

Desch. Press

Battery c. current

Bat. Temp

CO2

CO2

Fresh Air Ex.

O2

Battery Voltage

pt 1000 spare

## SETPOINT/CONTROL

F2

F3

F4

Cold Treatment

Multiple Temp. Set

DPHSET

Temp. Setp.

Controlling Mode

Full Down Selection

Watercool

Hum. Control

AFAM Dasy

Hum. Setpoint

AVL Open Valve

Defrost Tim. Temp

Defrost Interval

Spec. 24-48h Defrost

USDA Trip

AFAM Mode

AFAM Dasy

Hum. Setpoint

AFAM Rate

CO2 Max.

CO2 Min.

Smart PTI

Hum. Setpoint

AFAM Rate

CO2 Max.

CO2 Min.

Smart PTI

Hum. Setpoint

AFAM Rate

CO2 Max.

CO2 Min.

Smart PTI

Hum. Setpoint

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Smart PTI

Hum. Setpoint

AFAM Rate

CO2 Max.





Ingersoll Rand's Climate Solutions sector delivers energy-efficient HVACR solutions for customers globally. Its world class brands include Thermo King, the leader in transport temperature control and Trane, a provider of energy efficient heating, ventilating and air conditioning systems, building and contracting services, parts support and advanced controls for commercial buildings and homes.

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