THERMO KING

Maintenance Manual

Container Edition
MAGNUM PLUS™ with MP-5000

Revision A

January 2025

TK 62352-4-MM-EN

TRANE TECHNOLOGIES

THERMO KING

Introduction

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

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

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

General Information

The maintenance information in this manual covers unit models:	
MAGNUM PLUS	Check Serial# plate for Item# example TKMAG5K*12345678
MAGNUM PLUS STD - Base Units	098229
For further information, refer to:	
MAGNUM Plus Operator's Manual	TK 62298
MAGNUM Plus Parts List Parts Manual	TK 62370
Diagnosing Thermo King Container Refrigeration Systems	TK 41166
Electrostatic Discharge (ESD) Training Guide	TK 40282
Evacuation Station Operation and Field Application	TK 40612
Tool Catalog	TK 5955
The information in this manual is provided to assist owners, operators, and service people in the proper upkeep and maintenance of Thermo King units.	

Revision History

Revision A	(Jan 2025) New manual.

Recover Refrigerant

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

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

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

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

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

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

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

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

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

R-404A/R-452A

Notice

Equipment Damage!

Use only Polyolester-based refrigeration compressor oil in R-134a/R-513A/R-404A/R-452A systems. See Thermo King Parts Manual for part number.

Notice

System Contamination!

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

Notice

System Contamination!

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

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THERMO KING

Table of Contents

Safety Precautions

Danger, Warning, Caution, and Notice

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

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

⚠ Danger

Hazard!

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

⚠ Warning

Hazard!

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

⚠ Caution

Hazard!

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

Notice

Hazard!

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

General Practices

⚠ Danger

Hazard of Explosion!

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

⚠ Danger

Hazardous Gases - Personal Protective Equipment (PPE) Required!

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

⚠ Danger

Risk of Injury!

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

⚠ Danger

Refrigerant Vapor Hazard!

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

⚠ Warning

Hazard of Explosion!

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

⚠ Warning

Proper Equipment Condition!

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

⚠ Warning

Personal Protective Equipment (PPE) Required!

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

⚠ Warning

Equipment Damage and Risk of Injury!

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

⚠ Warning

Risk of Injury!

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

⚠ Caution

Sharp Edges!

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

Notice

Equipment Damage!

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

Refrigerant Hazards

⚠ Danger

Hazardous Pressures!

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

⚠ Danger

Combustible Hazard!

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

⚠ Warning

Hazardous Gases!

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

⚠ Warning

Personal Protective Equipment (PPE) Required!

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

Notice

Equipment Damage!

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

Electrical Hazards

Electrical Precautions

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

High Voltage

⚠ Danger

Hazardous Voltage!

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

⚠ Warning

Hazardous Voltage!

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

⚠ Warning

Hazardous Voltage!

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

⚠ Warning

Personal Protective Equipment (PPE) Required!

In the event of an electrical accident, all required PPE should be near the work area in accordance with OSHA, NFPE 70E, or other local, state, or country-specific requirements for a Category 3 risk.

⚠ Warning

Hazardous Voltage!

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

⚠ Warning

Risk of Injury!

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

⚠ Warning

Risk of Injury!

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

Low Voltage

⚠ Warning

Live Electrical Components!

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

Electrostatic Discharge Precautions

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

Electrostatic Discharge and the Controller

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

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

Welding on Refrigeration Units or Containers

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

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

First Aid

REFRIGERANT

- **Eyes:** For contact with liquid, immediately flush eyes with large amounts of water and get prompt medical attention.

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

REFRIGERANT OIL

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention.
- **Skin:** Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.
- **Inhalation:** Move victim to fresh air and use Cardio Pulmonary Resuscitation (CPR) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.
- **Ingestion:** Do not induce vomiting. Immediately contact local poison control center or physician.

ENGINE COOLANT

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

BATTERY ACID

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

ELECTRICAL SHOCK

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

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

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

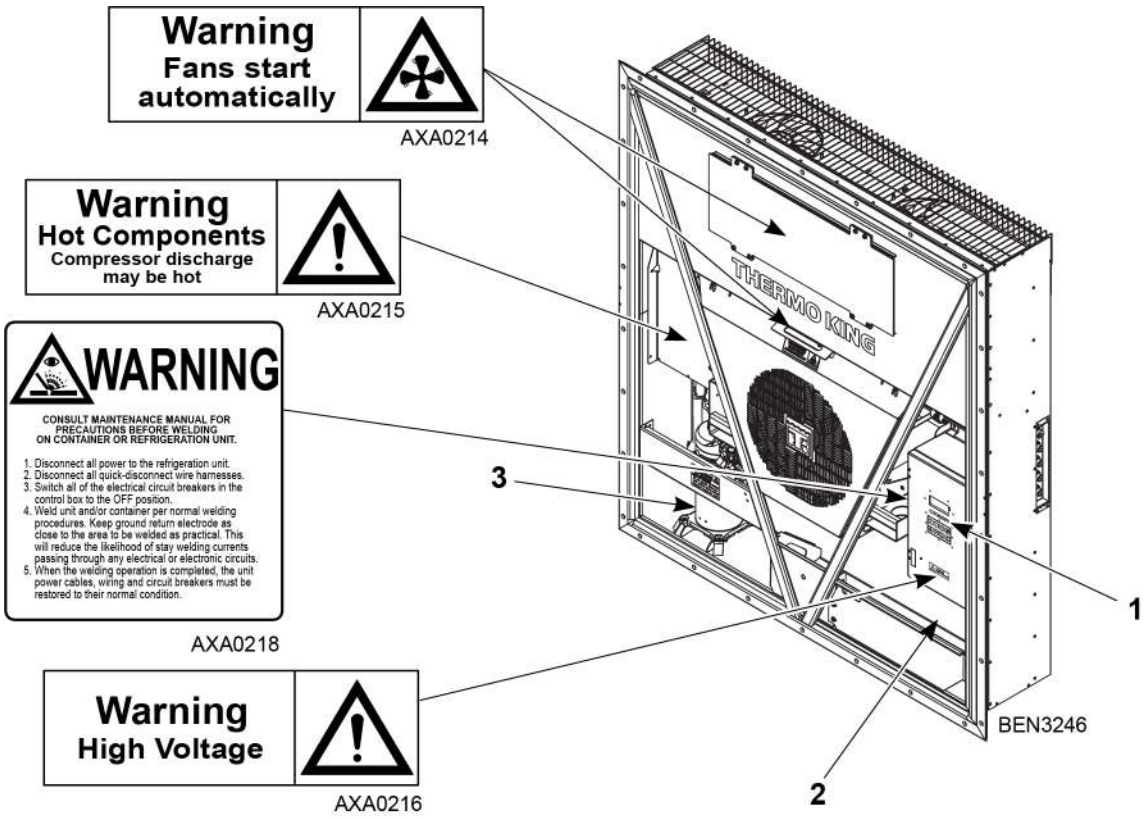
ASPHYXIATION

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

Identifying Unit Safety and Warning Decals

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

Figure 1. Nameplate and Warning Locations



1	Controller Nameplate
2	Unit Nameplate
3	Compressor Nameplate

Serial Number Location

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

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

Component Serial Number Identification

MP-5000 has 5 serial#:

- Control Box Serial# on back side of Controller door
- CM = Controller Module end of plastics
- DM = Display Module backside
- KM = Keypad Module backside
- OM = Option Module end of plastics

Label on MP-5000

BEN3218

ID in Controller

BEN3219

Controller ID Shown in Datalogger

Service Guide

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

Pretrip	Every 1,000 Hours	Annual/ Yearly	Inspect/Service These Items
			Electrical:
•			Perform a controller pretrip inspection (PTI) check.
•	•	•	Visually check condenser fan and evaporator fan.
•	•	•	Visually inspect electrical contacts for damage or loose connections.
•	•	•	Visually inspect wire harnesses for damage or loose connections.
	•	•	Download the data logger and check data for correct logging.
		•	Check operation of protection shutdown circuits.
			Refrigeration:
•	•	•	Check refrigerant charge.
	•	•	Check for proper discharge and suction pressures.
		•	Check filter drier/in-line filter for a restriction pressures.
		•	Leak test the entire unit.
			Structural:
•	•	•	Visually inspect unit for damaged, loose, or broken parts.
•	•	•	Tighten unit, compressor and fan motor mounting bolts.
	•	•	Clean entire unit including condenser and evaporator coils and defrost drains.

Notes:

- *If a unit has been carrying cargo which contains a high level of sulphor or phosphorous (e.g., garlic, salted fish etc.), it is recommended to clean the evaporator coil after each trip.*
- *For the newly added "PTI - Manual Leak Check" feature, leak check the complete unit a minimum of once every 12 months. When this PTI is performed, the counter is reset, and the system will remind the container operator within 12 months to perform this inspection again.*

Specifications

System Net Cooling Capacity - Full Cool

Table 1. MAGNUM PLUS Model - Air Cooled Condensing*

Return air to evaporator coil inlet	460V, 3 Phase, 60 Hz Power		
	Net Cooling Capacity		Power Consumption
	60 Hz Capacity BTU/hr	60 Hz Capacity kW	60 Hz Power kW
21.1 C (70 F)	56,700	16.50	11.50
1.7 C (35 F)	40,945	11.90	11.00
-17.8 C (0 F)	24,785	7.20	7.50
-29 C (-20 F)	17,215	5.00	6.60
-35 C (-31 F)	14,000	4.10	6.00
-40C (-40 F)	12,636	3.70	3.65
*System net cooling capacity with a 37.8 C (100 F) ambient air temperature and R-404A/R-452A.			

Evaporator Airflow

Table 2. System Net Heating Capacity*

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

Table 3. MAGNUM PLUS

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

Electrical System

Compressor Motor	Type	460/380V, 60/50 Hz, 3 Phase
	Kilowatts	4.48 kW @ 460V, 60 Hz
	Horsepower	6.0 hp @ 460V, 60 Hz
	RPM	3550 RPM @ 460V, 60 Hz
	Locked Rotor Amps	70 amps @ 460V, 60 Hz
Condenser Fan Motor	Type	460/380V, 60/50 Hz, 3 Phase
	Kilowatts	0.55 kW @ 460V, 60 Hz
	Horsepower	0.75 hp @ 460V, 60 Hz
	Number (All Models)	1
	RPM	1725 RPM @ 460V, 60 Hz
	Full Load Amps	1.0 amps @ 460V, 60 Hz; 1.0 amps @ 380V, 50 Hz
	Locked Rotor Amps	3.9 amps @ 460V, 60 Hz; 3.7 amps @ 380V, 50 Hz
Evaporator Fan Motors (Prior to March 1st 2025)	Type	460/380V, 60/50 Hz, 3 Phase
	Kilowatts	0.75 kW @ 460V, 60 Hz
	Horsepower	1.0 hp @ 460V, 60 Hz
	RPM (Each) High Speed	3450 RPM @ 460V, 60 Hz
	RPM (Each) Low Speed	1725 RPM @ 460V, 60 Hz
	Full Load Amps (Each) High Speed	1.6 amps @ 460V, 60 Hz
	Full Load Amps (Each) Low Speed	0.8 amps @ 460V, 60 Hz
	Locked Rotor Amps High Speed	10.5 amps @ 460V, 60 Hz
	Locked Rotor Amps Low Speed	9.0 amps @ 460V, 60 Hz
Evaporator Fan Motors (After March 1st 2025)	Type	460/400V, 60/50 Hz, 3 Phase
	Kilowatts	0.485 kW @ 460V, 60 Hz; 0.405 kW @ 460V, 50 Hz
	Horsepower	0.65 hp @ 460V, 60 Hz
	RPM (Each) High Speed	3389 RPM @ 460V, 60 Hz; 2810 RPM @ 400V, 50 Hz
	RPM (Each) Low Speed	1761 RPM @ 460V, 60 Hz; 1470 RPM @ 400V, 50 Hz
	Full Load Amps (Each) High Speed	0.97 amps @ 460V, 60 Hz; 0.96 amps @ 400V, 50 Hz
	Full Load Amps (Each) Low Speed	0.57 amps @ 460V, 60 Hz; 0.60 amps @ 400V, 50 Hz
	Locked Rotor Amps High Speed	5.34 amps @ 460V, 60 Hz
	Locked Rotor Amps Low Speed	1.56 amps @ 460V, 60 Hz
Electrical Resistance Heater Rods	Type	460/380V, 60/50 Hz, 3 Phase
	Number (Normal Capacity)	6 (18 ga wire)
	Number (Normal Capacity)	3 (18 ga wire)
	Number (Extended Capacity)	3 (16 ga wire)
	Watts (Each) (Normal Capacity)	680 Watts @ 460V, 60 Hz
	Watts (Each) (Normal Capacity)	1360 Watts @ 460V, 60 Hz
	Watts (Each) (Extended Capacity)	2000 Watts @ 460V, 60 Hz
	Current Draw (Amps) (Normal Capacity)	5 amps total @ 460V across each phase at heater contractor
	Current Draw (Amps) (Extended Capacity)	4.5 amps total @ 460V across each phase at heater contractor
Control Circuit Voltage		29 Vac @ 60 Hz

Refrigeration System

Compressor		ZMD18KVE-TFD-277, Scroll
Refrigerant Charge		4.0 Kg (8.0 lb.) R-404A/R-452A
Compressor Oil Capacity	***Note:*** *When the compressor is removed from the unit, oil level should be noted or the oil removed from the compressor should be measured so that the same amount of oil can be maintained in the replacement compressor.*	1.77 liter (60 oz.)
Compressor Oil Type	***Note:*** *Do not use or add standard synthetic or mineral oils to the refrigeration system. If Ester based oil becomes contaminated with moisture or with standard oils, dispose of properly - DO NOT USE.*	Polyol Ester Based Type (required), (refer to Tool Catalog)
High Pressure Cutout Switch	Cutout	3240 ± 48 kPa, 32.4 ± 0.5 bar, 470 ± 7 psig
	Cutin	2586 ± 262 kPa, 25.9 ± 2.6 bar, 375 ± 38 psig

Low Pressure Cutout Switch	Cutout	-17 to -37 kPa, -0.17 to -0.37 bar, 5 to 11 in. Hg vacuum
	Cutin	28 to 48 kPa, 0.28 to 0.48 bar, 4 to 7 psig
High Pressure Relief Valve	Relief Temperature	99 C, 210 F
Vapor Injection Control	Modulation Cool or Power Limit	Vapor injection valve is energized (open) continuously when the compressor duty cycle (ON time) is 100 percent (Full Cool). High compressor discharge temperature may cause the vapor injection valve to energize (open) but only while the Compressor Digital Control valve is not energized (closed).
Compressor Discharge Temperature Control	Vapor Injection Valve Energizes (Opens)	138 C (280 F)
	Vapor Injection Valve De-energizes (Closes)	6 C (10.7 F) below energize temperature (132 C [123 F])
Vapor Injection Valve (Compressor)	Voltage	24 Vac
	Current Draw	0.85 amps
	Cold Resistance	5.6 ohms
Compressor Digital Control Valve	Voltage	24 Vac
	Current Draw	0.85 amps

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

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

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

MP-5000 Controller Specifications

Temperature Controller	
Type	MP-5000 is a controller module for the Thermo King Magnum Plus and CFF unit models. Additional requirements can be met by means of expansion modules. The MP-5000 is solely responsible for temperature regulation of the reefer container, but other monitoring equipment can be used in conjunction with the MP-5000, such as a telematics device.
Setpoint Range	-40.0 to +30.0 C (-31.0 to +86.0 F)
Digital Temperature Display	-60.0 to +80.0 C (-76.0 to +176.0 F)
Controller Software (Original Equipment)	
Version	Refer to controller identification decal
Defrost Initiation	
Evaporator Coil Sensor	• Manual Switch or Demand Defrost Initiation: Coil must be below 18 C (65 F). Defrost cycle starts when technician or controller requests defrost initiation. • Timed Defrost Initiation: Coil must be below 4 C (41 F). Defrost cycle starts one minute after the hour immediately following a defrost timer request for defrost initiation. For example, if the defrost timer requests a defrost cycle at 7:35, the defrost cycle will start at 8:01. Datalogger will record a Defrost event for each interval in which a Defrost cycle is pending or active (i.e. both the 8:00 and 9:00 data logs).
Demand Defrost	Demand defrost function initiates defrost when: • Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large for 90 minutes. • Temperature difference between the supply air sensors and return air sensor is too large.
Defrost Timer	
Chilled Mode	Evaporator Coil Temperature must be below 5C (41 F) to activate the defrost compressor hour timer. There is an interval set for defrosting, however, the defrost timer is built intelligent - it detects whether or not there is ice building up on the coil. If there is no ice building up on the coil, it extends the defrost interval, and if there is Ice building up earlier on the coil it reduces the defrost interval. The maximum interval is 48 hours.
Frozen Mode	Every eight hours of compressor operation. Defrost interval increases two hours each timed defrost interval. Maximum time interval in Frozen Mode is 24 hours.
Reset to Base Time	Defrost timer resets if the unit is off more than 12 hours, setpoint is changed more than 5 C (9 F) or PTI pretrip test occurs.
Defrost Termination	
Defrost (Coil) Sensor	• Chilled Mode: Terminates defrost when coil sensor temperature rises to 18 C (65 F). • Frozen Mode: Terminates defrost when coil sensor temperature rises to 18 C (65 F).
Termination Timer	Terminates defrost after 90 minutes at 60 HZ operation if coil sensor has not terminated defrost (120 minutes at 50 Hz operation).
Power Off	Turning Unit On/Off switch Off terminates defrost.
Compressor Shutdown Protection (Auto Reset)	
Stops Compressor	148 C (298 F)
Allows Compressor Start	90 C (194 F)
Bulb Mode	
Evaporator Fan Speed Settings	• Flow High: High speed only. • Flow Low: Low speed only. • Flow Cycle: Fans will cycle between low and high speed every 60 minutes.

Defrost Termination Temperature Setting	4 to 30 C (40 to 86 F)
Battery	
AA	6 AA; 7.2 volts; NiMH; 2000MHA; 2100 life cycle; Rechargeable Batteries
CR2032/BN	Coin cell battery

Physical Specifications

Table 4. Fresh Air Exchange Venting System (Adjustable)

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

Table 5. Evaporator Fan Blade

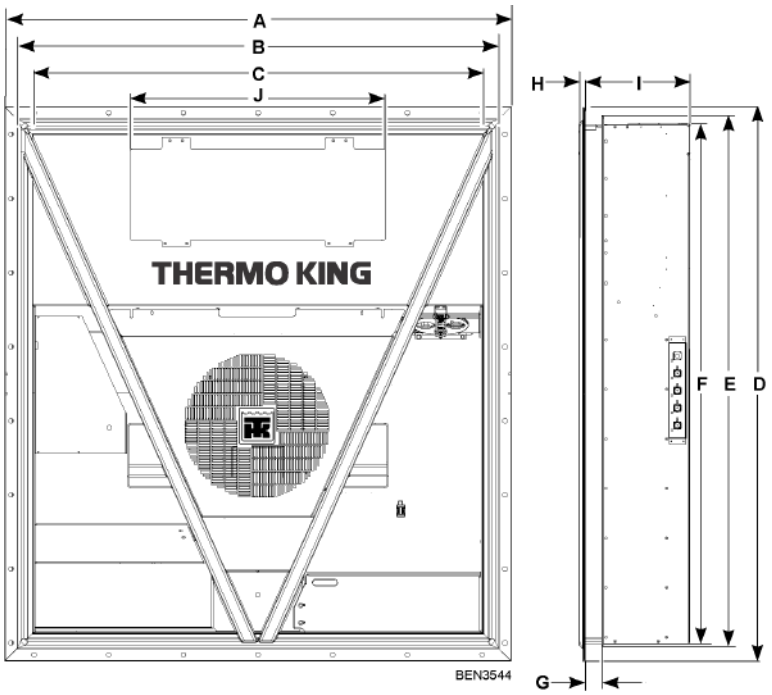
Diameter Pitch Number of Fans	355 mm (14.0 in.) 25° 2

Table 6. Weight (Net)

Base Unit (Prior to March 1st 2025)	357 Kg (787.05 lb.)
Base Unit (After March 1st 2025)	348 Kg (767.20 lb.) (with new evaporator)
Water-Cooled Condenser-Receiver Option	13.6 Kg (30 lb.)

Table 7. Unit Dimensions

A	Flange Width	2025 mm (79.72 in.)
B	Gasket Width	1935 mm (76.18 in.)
C	Unit Width	1782 mm (70.15 in.)
D	Flange Height	2235 mm (87.99 in.)
E	Gasket Height	2140 mm (84.25 in.)
F	Unit Height	2097 mm (82.55 in.)
G	Gasket Depth	68 mm (2.67 in.) from back of flange
H	Maximum Protrusion	31 mm (1.22 in.) from back of flange
I	MAGNUM Plus™	423 mm (16.6 in.) from back of flange
J	Evaporator Access Door	1018 mm (40.07 in.)



Metric Hardware Torque Charts

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

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

Unit Description

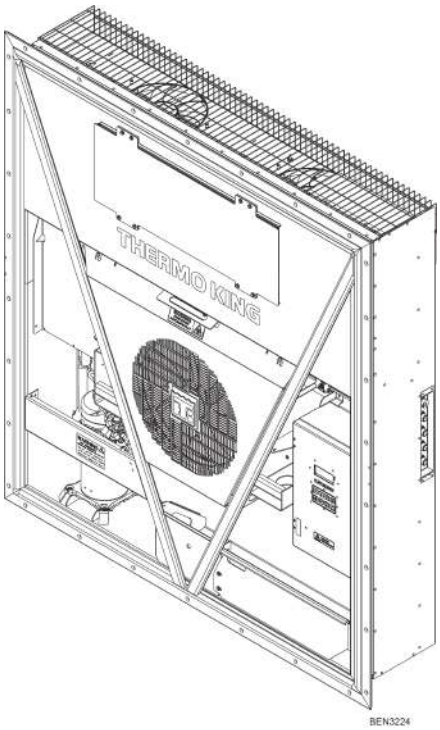
General Description

Units are all-electric, single-piece, refrigeration units with bottom air supply. The unit is designed to cool and heat ISO1496-2 refrigerated containers for shipboard or overland transit (Intermodal), as well as reefer containers used for temporary storage. The unit mounts in the front wall of the container. Forklift pockets are provided for installation and removal of the unit.

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

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

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

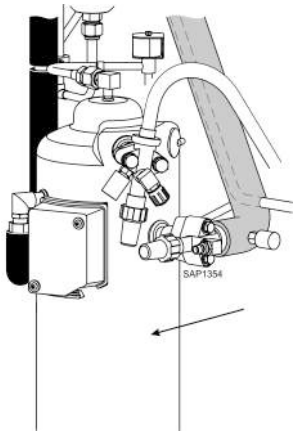


The MAGNUM PLUS container unit features the following components. Each component will be described briefly on the following pages.

Scroll Compressor	Evaporator Fans	Controller / Control box – MP-5000
Compressor Digital Control Valve	Condenser Fan Control	TK Fresh Plus (Optional)
Economizer Heat Exchange System	USDA Cold Treatment Temperature Recording Probes (Optional)	Humidity Sensor (Optional)
Temperature Sensors	Suction/Discharge Pressure Sensor (Optional)	Water-Cooled Condenser (Optional)
Fresh Air Exchange System	Remote Monitoring Receptacle Option (4-pin) (Optional)	
Receiver Tank Sight Glass	Remote Monitoring Modem (RMM, RMM-W, GT Sense) (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.

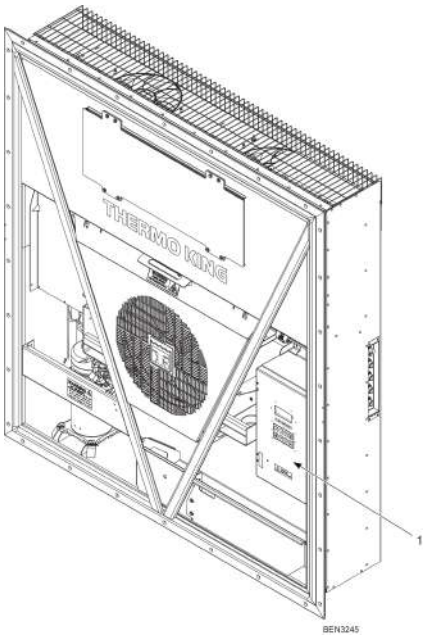
Intermediate Suction Port

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).

MP-5000 Controller

The MP-5000 is an advanced microprocessor controller that has been specially developed for the control and monitoring of refrigeration units. Refer to ("MP-5000 Controller," p. 36) for more detailed information.

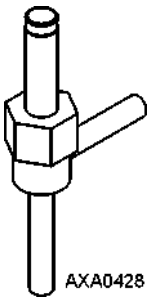
Figure 2. MP–5000 Controller



1	MP-5000 Controller

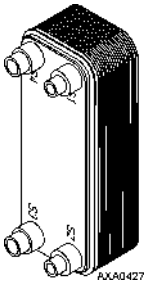
Compressor Digital Control Valve

The controller pulses the Compressor Digital Control solenoid valve between open and closed positions. This provides precise cooling capacity control. No pump down function or warm gas bypass control is used in conjunction with the Compressor Digital Control valve. Refer to ("Compressor Digital Control Valve," p. 107) for more detailed information.



Economizer Heat Exchange System

An economizer heat exchange system replaces the conventional heat exchanger. The economizer Heat Exchange system subcools the liquid refrigerant before it reaches the evaporator expansion valve. Subcooling liquid refrigerant increases the cooling efficiency and capacity of the evaporator. Refer to ("Economizer System," p. 108) for more detailed information.



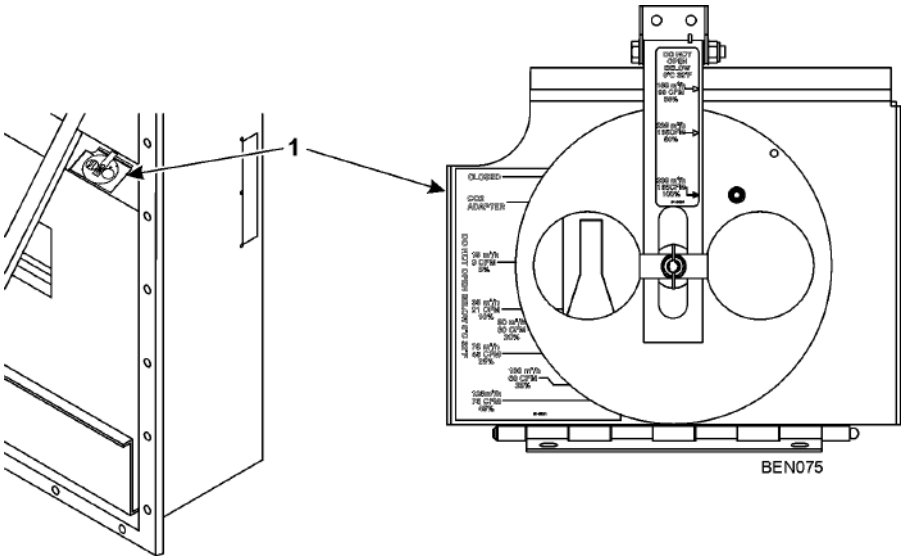
Temperature Sensors

Each sensor element is connected to a cable and packaged in a sealed stainless steel tube. The temperature signal from the sensor is transmitted through the cable. PT1000 type temperature sensors are used to sense temperatures for the following:

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

Fresh Air Exchange System

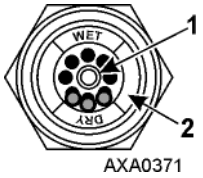
The fresh air exchange system removes harmful gases from containers carrying sensitive perishable commodities. The fresh air vent is located above the control box. The fresh air vent is adjustable to accommodate a variety of frozen and chilled load operating conditions.



1	Fresh Air Exchange Vent

Receiver Tank Sight Glass

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



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

Evaporator Fans

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

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

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

If Non-Optimized mode is on:

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

If Optimized mode is on:

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

Condenser Fan Control

The controller also uses a proportional-integral derivative algorithm to control the condenser temperature and ensure a constant liquid pressure at the expansion valve. The condenser fan operates continuously in high ambients. In low ambient conditions, the controller cycles the condenser fan on and off to maintain a minimum condenser temperature.

The controller maintains a minimum 30 C (86 F) condenser temperature on Chill loads and a minimum 20 C (68 F) condenser temperature on Frozen loads.

USDA Cold Treatment Temperature Recording (Standard)

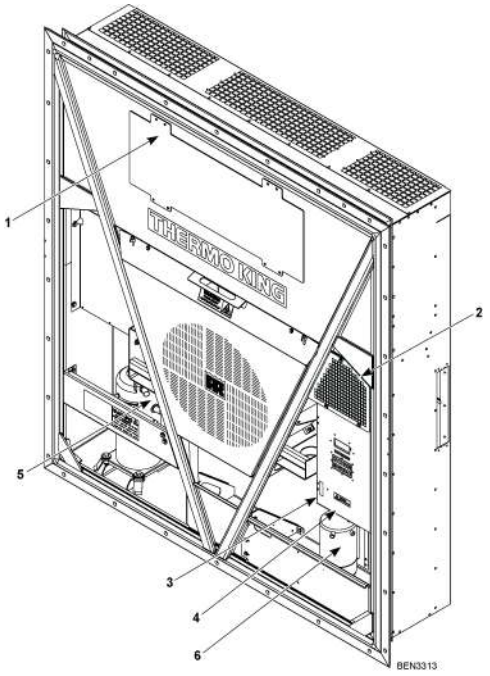
The controller includes provisions for the use of three or four USDA sensors. These sensors allow temperatures in various areas of the load to be monitored and recorded for United States Department of Agriculture use in monitoring Cold Treatment shipments.

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

Unit Options

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

Optional Components



1	Humidity Sensor
2	AVL, TK Fresh, TK Fresh Plus
3	Data retriever (USB-C, Deutch or RM4)
4	Power Line Module (PLM, Telematics) - Inside Control Box
5	Suction/Discharge Pressure Transducer
6	Water-Cooled Condenser

Power Line Module (PLM, Telematics)

A Power Line Module is provided to permit remote monitoring via the power cable, as per ISO 10368 standard. High speed transmission reads all controller information. Data can also be retrieved from the data logger via high speed transmission.

Suction and Discharge Pressure Transducers

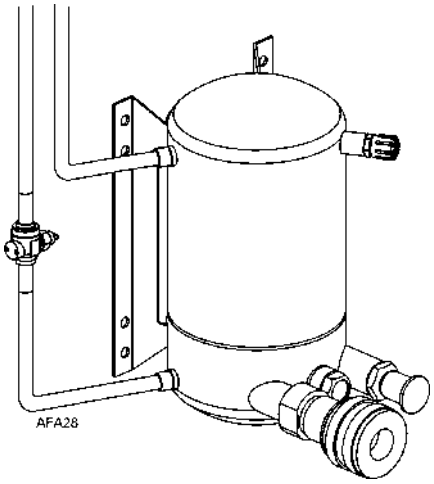
Pressure transducer(s) can be added to the unit to display actual suction or discharge system pressure. The display will show a reading and a bar graph. Unit can be configured suction only, discharge only, or suction and discharge.

Water-Cooled Condenser/Receiver Tank

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

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

Figure 3. Water-Cooled Condenser/Receiver Tank



Air Ventilation Logging (AVL)

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

Refer to ("Air Ventilation Logging (AVL)," p. 101) for more information.

TK Fresh System

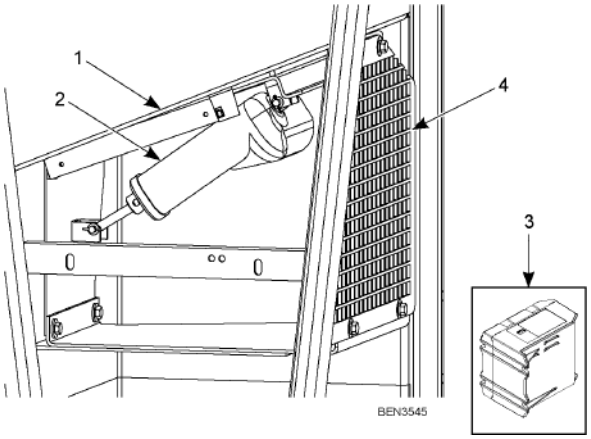
An advanced microprocessor controlled fresh air management system provides programmable control of air exchange rate, programmable delayed vent opening, automatic closure of air exchange vent during low ambient conditions, and data logging of air exchange rate and vent opening delay interval.

The TK Fresh system includes a door control module, vent door and vent grille. The controller sends a communication signal to the door control module to position vent door to desired position. The controller can also be set to delay opening of fresh air vent for up to 48 hours (in 1 hour increments). This allows faster product temperature pull-down. Refer to ("Starting the TK Fresh System," p. 89) for more information.

TK Fresh Operation

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

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



1	Vent Door
2	Door Control Module
3	Option Module (inside control box)
4	Grille

TK Fresh Vent Door Assembly

⚠ Caution

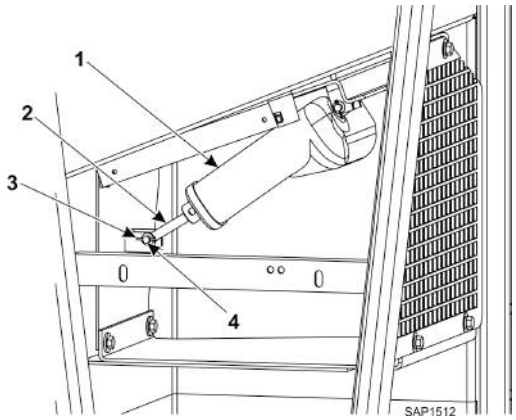
Risk of Injury!

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

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

The default setting for TK Fresh in the Setpoint menu is the last value set (Off, TK Fresh). The Fresh Air Vent Man submenu should be set to TK Fresh 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 TK Fresh system is turned on, the controller automatically operates the vent door based on the previous TK Fresh Delay and TK Fresh Rate settings when power is restored.

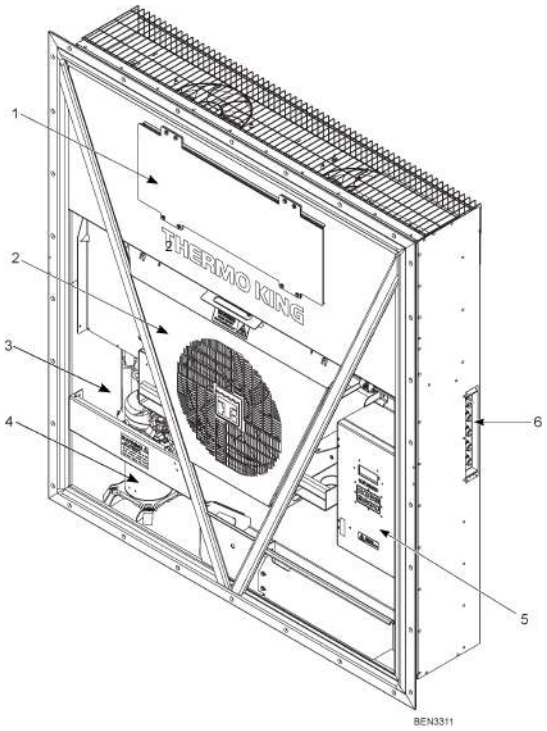


1	Actuator
2	Shaft
3	Cotter Pin
4	Pin Clevis

TK Fresh Plus System

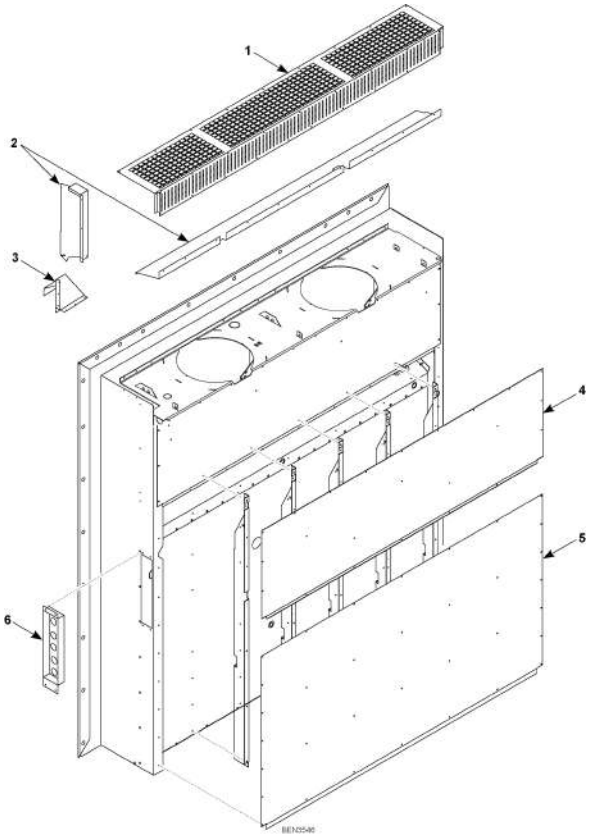
The TK Fresh Plus provides programmable control of the CO_2 level in the container. The controller can be set to control the CO_2 level in the container from 0 to 25 percent.

Unit Front View



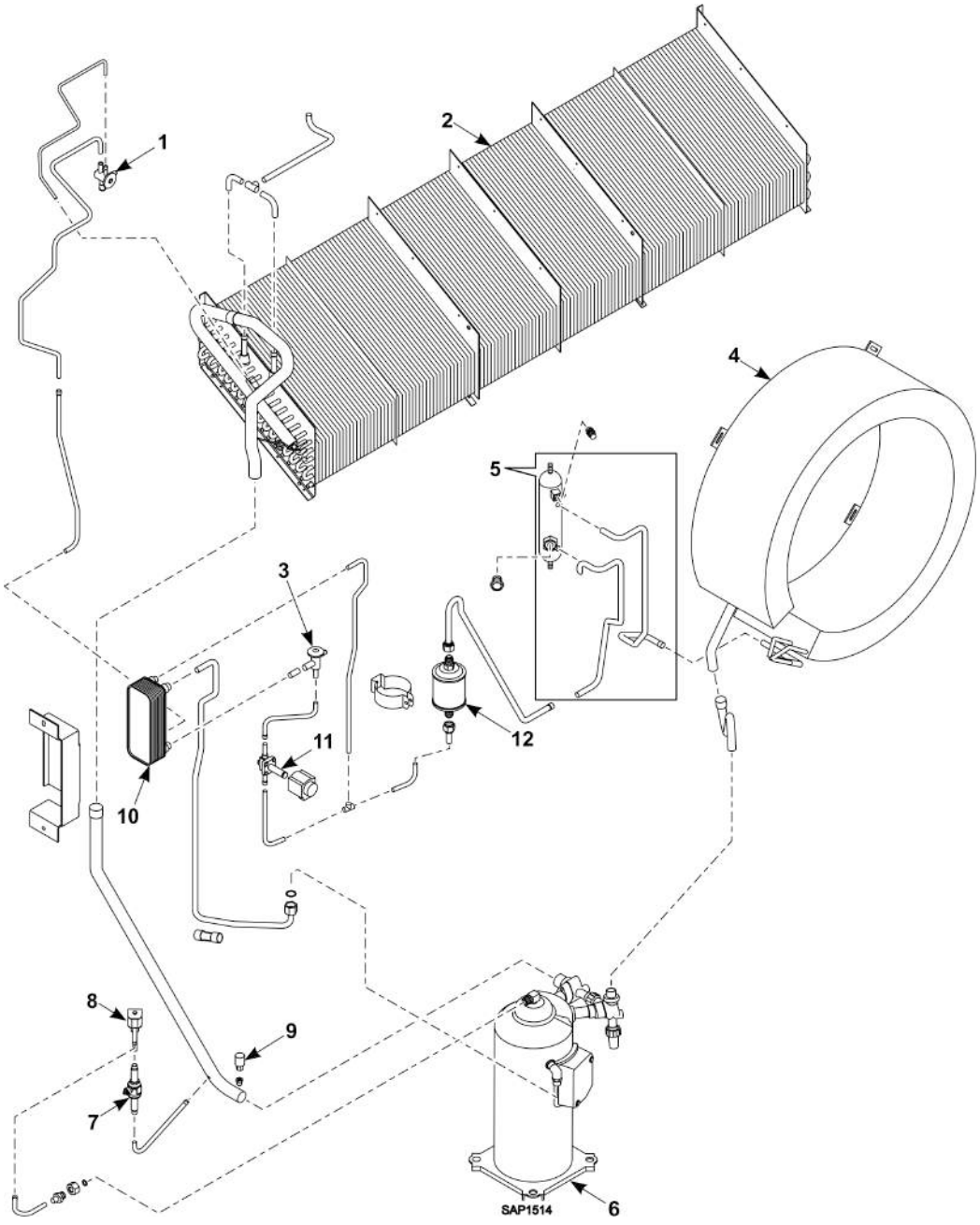
1	Evaporator Access Door
2	Condenser Fan
3	Compressor Compartment
4	Scroll Compressor
5	Control Box
6	Rear Download and USDA Receptacle Panel (Access from Inside Container)

Unit Rear View



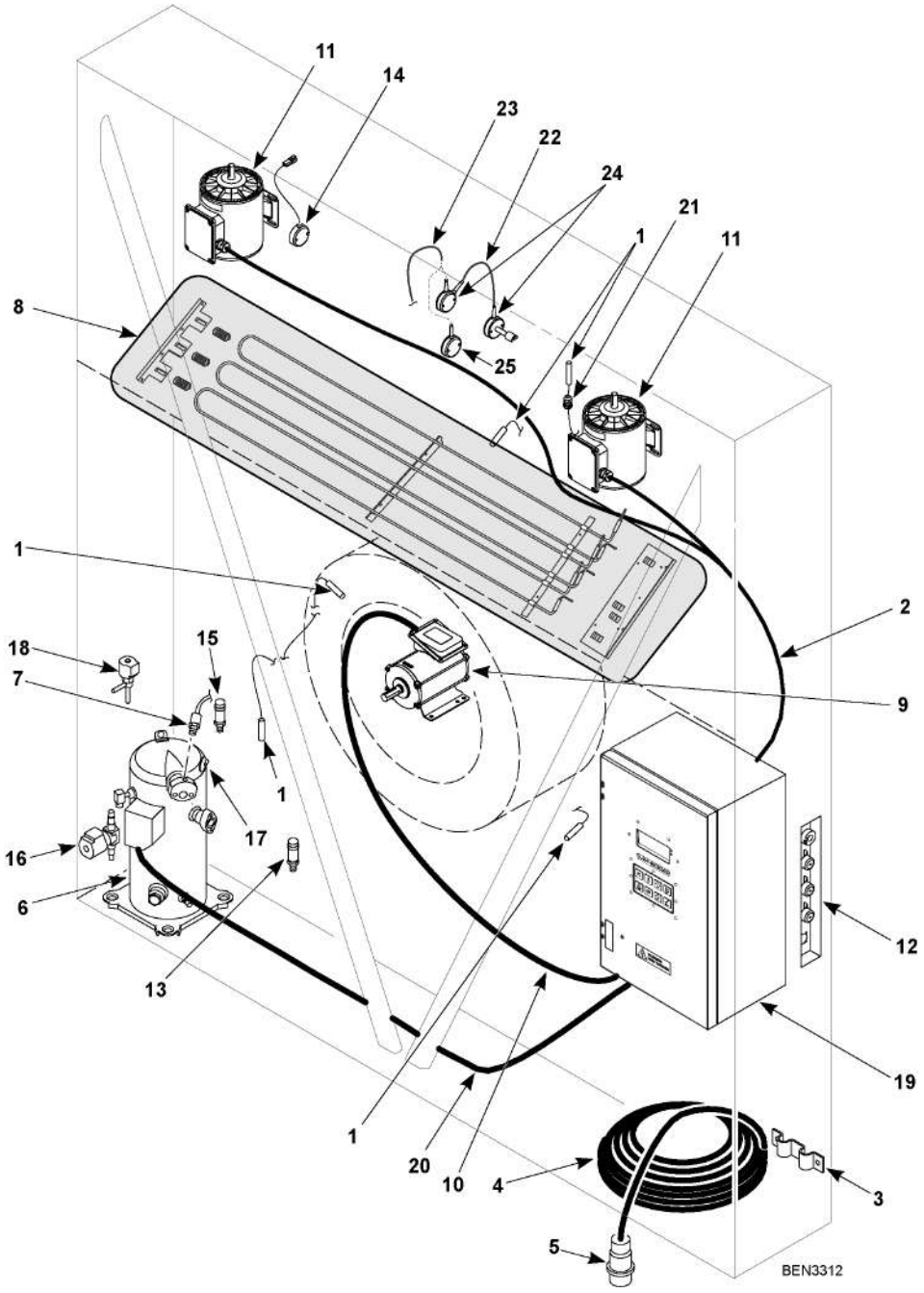
1	Evaporator Grille
2	Air Channels
3	Fresh Air Inlet
4	Top Rear Plate
5	Bottom Rear Plate
6	USDA Receptacle Panel: Controller Communications and Data Download Port, USDA1/Spare 1 Sensor Connection, USDA2/ Spare 2 Sensor Connection, USDA3/Spare 3 Sensor Connection, Cargo (Pulp) Sensor Connection

Figure 4. Refrigeration System



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

Figure 5. Electrical Components



1	Sensor Kit	8	Heater Group	15	Discharge Transducer	22	Cable Connection
2	Evaporator Fans Harness	9	Condenser Fan Motor	16	Vapor Injection Valve	23	Cable Supply
3	Power Cable Bracket	10	Condenser Fan Harness	17	Compressor Sensor	24	Gas Sensor
4	Power Cable	11	Evaporator Fan Motor	18	Digital Valve	25	CO_2 Sensor
5	Power Plug	12	USDA Receptacle Panel	19	Control Box		
6	Scroll Compressor	13	LPCO or Suction Transducer	20	Compressor Cable		
7	HPCO Switch	14	Analog Humidity Sensor	21	Liquid Tite Connector		

Controller Description

MP-5000 Controller

The MP-5000 is an advanced microprocessor controller. It has been specially developed for the control and monitoring of refrigeration units.

Back-up Batteries

The MP-5000 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 **ENTER** key, the controller will energize and stay energized for 60 sec, by pressing any of the Menu keys the 60 sec timer will reset to 20 sec.

Input and Output Signals

The MP-5000 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-5000 controller uses advanced solid-state integrated circuits and contactors 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 (Probe) Sensors 1, 2, and 3
- Compressor Discharge Temperature Sensor
- High Pressure Cutout Switch/ Discharge Pressure Sensor
- Low Pressure Cutout Switch/ Suction Pressure Sensor
- Phase measuring circuits
- Current measuring circuits
- Voltage measuring circuits

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

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

1	MP-5000 Controller
2	Function Keys
3	On/Off Switch

Standard Display

The Standard Display is a five-inch Liquid Crystal Display (LCD). The temperature can be displayed in Celsius or Fahrenheit. The Standard Display will display the controlling sensor and Setpoint. The Setpoint will be with the C or F. Once Enter key is pressed, the Unit status display will change to Main Menu. After two minutes of no key activity, the display will return to the Unit Status Display.

Figure 6. Unit Status Display

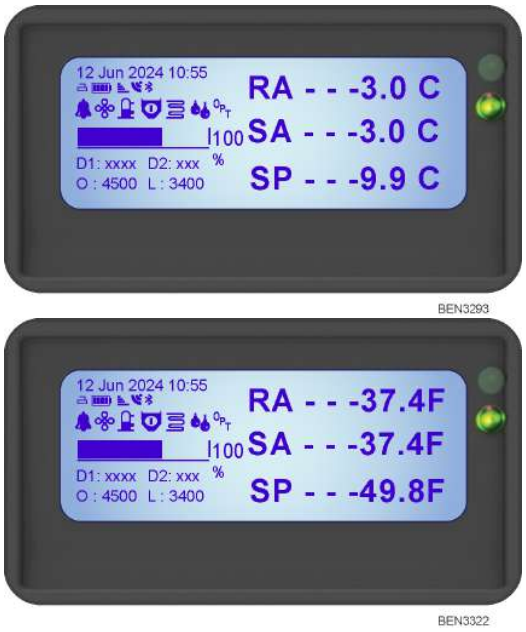


Figure 7. Main Menu

Idle Screen and Check Symbol

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

Happy face = everything is OK

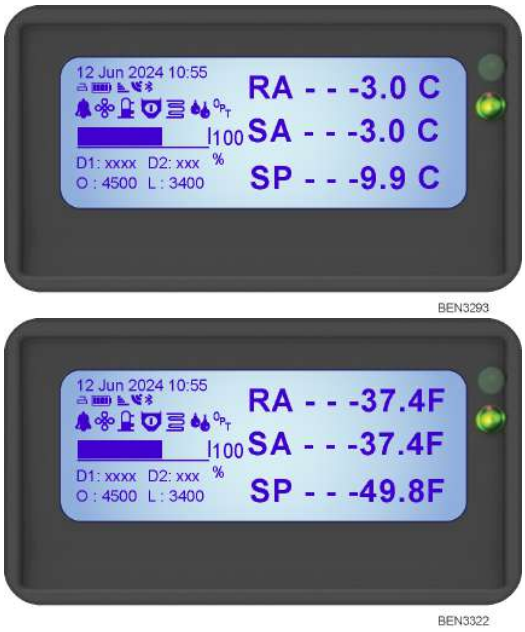
Disgruntled face = there is a message

Unhappy face = there is an alarm

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

Unit Status Display

Figure 8. Unit Status Display



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

- Date and Time / Alarm Warning
- Mode Icons Compressor ON, Heater ON, Evap Fan ON
- SP Setpoint
- SA Supply air sensor
- RA Return air sensor
- Mode Description unit operation
- Capacity Bar Graph Percentage of mode (100% is full)

Display Icons

	Alarm		Smart PTI
	Pretrip Inspection / Test in Progress	$^{0}P_{T}$	Controlling Mode Optimized
	Heating		Bluetooth®
	Evaporator Fan High Speed		Evaporator Fan Low Speed
	Cell Phone		GPS Signal
	Condenser Fan On		RMM

	Watercooled		Battery Full (Datalogger Battery)
	Dehumidification		Battery Charging (Datalogger Battery)
	Defrost		Battery state not known. Temperature to low or high, charger suspended. (Datalogger Battery)
	Compressor On Unloaded		Battery Error (Datalogger Battery)
	Compressor On Loaded without Vapour Injection		Compressor On Loaded with Vapour Injection

Mode Descriptions

Chilled/Cooling (Magnum Plus™ and CFF only)

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

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

Chilled/Heating (Magnum Plus™ and CFF only)

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.

Silent mode

Silent mode is a way to make the reefer unit silent without manual switching it OFF and ON.

Keys and Indicator LEDs

Function Keys

The 8 function keys are located below the display. They allow the operator to move quickly to a specific area of the information or into the controller menu.

Figure 9. Function Keys

The keys that follow are explained from left to right in the Function Key.

F1 Key: Press to view the Defrost commands, PTI commands, Language change, QR code to latest documentation, and to upgrade software via USB-C.

ALARM Key: Press to view an explanation for the current alarms present.

Setpoint Key: Press to enter Setpoint menu. Click **Enter** and **Up** or **Down** keys to increase or decrease the Setpoint. Press and Hold **Enter** until you are returned back to the main screen.

C/F Key: Press to view alternate temperature scale Celsius or Fahrenheit in display.

Up Arrow: Scroll up thru the Menu's.

Down Arrow: Scroll down through the Menu's.

Esc Key: Escape from the current screen and back button.

Enter Key: Press to view the extended Menu for the MP–5000. Validate parameters. With Power Off, press the **Enter** key, the controller will energize and stay energized for 60 sec, by pressing any of the Menu keys the 60 sec timer will reset to 20 sec.

LED Indicator

Two status indicator LEDs are located towards right of the Main Screen display.

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

Unit Status Display

Figure 10. Unit Status Display

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

- Date and Time / Alarm Warning
- Mode Icons Compressor ON, Heater ON, Evap Fan ON
- SP Setpoint
- SA Supply air sensor
- RA Return air sensor
- Mode Description unit operation
- Capacity Bar Graph Percentage of mode (100% is full)

ON/OFF Switch

The ON/OFF switch is used to manually control the power of the Controller. In OFF position the switch breaks the 24Vac and 24Vac +5Vac step-up supplies and the system is off.

This means that no outputs related to high voltage components or safety can be activated.

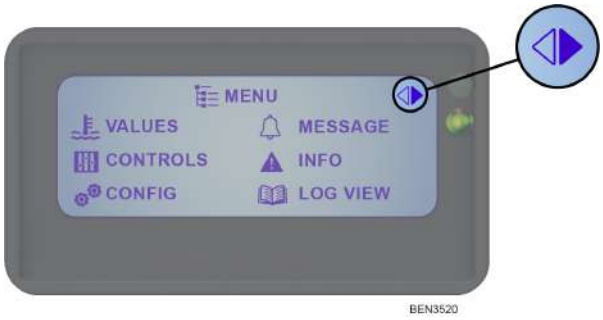
ON/OFF Position:

Main Menu

The Main Menu is comprised of seven submenus. Navigate to the desired item by using the up and down navigation key.

- **Values Menu** - The menu screen in this group are used to display unit operating information including Temperature values, Pressure values, Air values, Unit electrical data etc., and any input to the controller.
- **Controls Menu** - The menu screen in this group are used to enter allowable setpoints.
- **Alarm Menu** - Display a list of alarm code(s) present.
- **Config Menu** - The menu screen in this group are used to change the functionality of the unit operation.
- **Message Menu** - Display a list of message(s) present.
- **Info Menu** - The menu screen in this group gives information on the software version.
- **Log View Menu** - The menu screen in this group displays Display log information, PTI, and Runtime logs.
- **Advance Menu** - The menu screen in this group gives information on contrast settings.

Navigation Icon

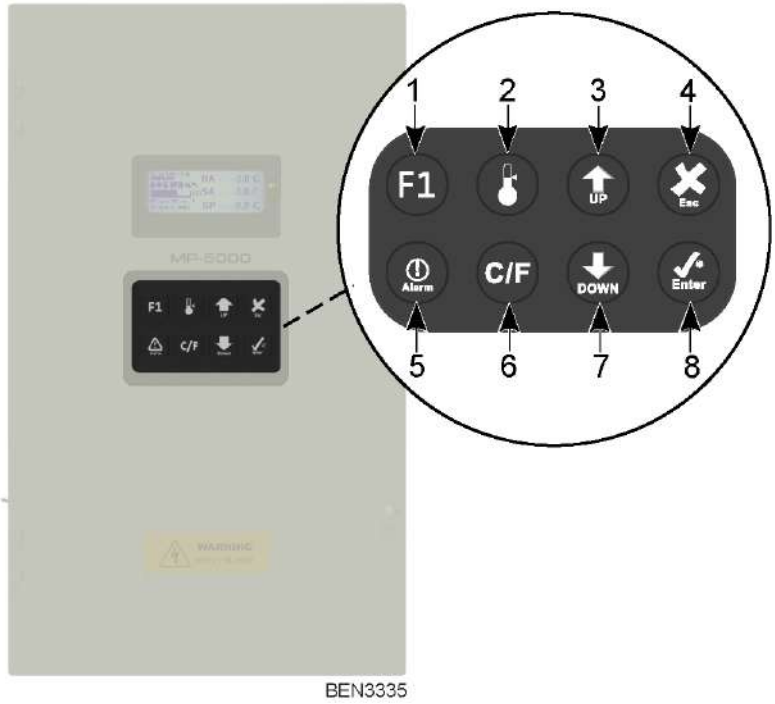


A solid fill in the arrow indicates more screens available. Use Up/Down keys to move to next or prior screen.

Operating Instructions

Function Keys

Figure 11. Function Keys



Function Keys	
1	F1 Key
2	Setpoint Key
3	UP Arrow Key
4	Escape Key
5	ALARM Key
6	C/F Key
7	Down Arrow Key
8	Enter Key

Unit Start-Up

1. Connect unit to high voltage power (360V or 440V) at vessel, shore or genset.
2. Turn circuit breaker on at post to apply power to unit.
3. Toggle switch to On position (ensure main circuit breaks inside control box is in On position).
4. Long press the **Enter** key to turn on the unit. Press the key until the THERMO KING logo is initialized by the display. The display will show the PowerUp message after 5 seconds.

Figure 12. Enter Key to On the Unit

Figure 13. Start-up Screen

Figure 14. PowerUp Message

The standard display will display:

- Date and Time / Alarm Warning
- Mode Icons Compressor ON, Heater ON, Evap Fan ON
- SP Setpoint
- SA Supply air sensor
- RA Return air sensor
- Mode Description unit operation
- Capacity Bar Graph Percentage of mode (100% is full)

F1 Menu

The F1 Menu is activated by pressing the F1 key in Function Key.

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A list of F1 Menu commands are available:

- Defrost Command
- PTI Commands
- Main Menu
- Link
- Language
- USB

Defrost Commands

1. Press the **F1** function key.
2. Use **Down** arrow key to select the **Defrost Commands**. Press **Enter** key to see the Defrost Commands options.

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The Defrost Commands will show the following (looking from top to bottom):

- Start Defrost
- Defrost Delay
- Defrost Reset
- Defrost Info

3. Press the Up and Down arrow keys to scroll between the Defrost Command options.
4. Press the Enter key to select a desired Defrost Commands.

Initiating a Manual Defrost

1. Turn the UNIT ON. Allow Unit to start and stabilize.
   Complete the following steps:
2. Press the F1 function key.
3. Select the **Defrost Commands** option and press enter.

4. Select **Start Defrost** to start the defrost. If the unit operating conditions allow a manual defrost (e.g., evaporator coil temperature is less than 18 C [64 F]), the unit enters Defrost.

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

PTI Commands

Access various PTI Commands for selecting a user activated functionality.

- Manual Function Test: Refer to ("Manual Function Test," p. 49) for detailed information.
- Function Test: Refer to ("Function Test," p. 54) for detailed information.
- PTI: Refer to ("PTI (Pretrip) Tests," p. 48) for detailed information.

1. Turn the UNIT ON. Allow Unit to start and stabilize.
   Complete the following steps:
2. Press the **F1** function key.
3. Use **Down** arrow key to select the **PTI Commands**. Press **Enter** key to see the PTI Commands options.

The PTI Commands will show the following (looking from top to bottom):

- Manual Function Test
- Function Test
- Brief PTI
- Chilled PTI

- Full PTI
- TK Fresh PTI
- TK Fresh Plus PTI
- Humidity Sensor PTI
- Probe Test
- PTI Info

4. Press the Up and Down arrow keys to scroll between the PTI Command options.
5. Press the Enter key to select the desired PTI Commands.
6. Press Esc to return to F1 Menu.

Pretrip Inspection (PTI)

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

   Complete the following steps:
2. Press the **F1** function key.
3. Use Down arrow key to select the **PTI Commands**. Press Enter key to see the PTI Commands options.
4. Press the Up or Down arrow keys to scroll between the PTI Command options to select from the different PTI test.
5. Press the Enter key to accept and start the PTI or test.

   During testing the screen is divided into 3 sections.

   Section 1:
   - Shows the list of tests to be performed and their state.
   - List of possible states.
   - Awaiting: the test has not yet been performed.
   - Testing: the test is ongoing.
   - Pass: the test has been tested, with the result Pass.
   - Fail: the test has been tested, with the result Fail.
   - Skipped: the test is skipped, based on conditions.

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

   Section 3: This section displays actual readings and the expected power consumption.
6. Press the Up or Down keys to scroll between each of the tests.
7. PTI test ends automatically. Pressing **Esc** key 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-5000 Data logger 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.*

PTI (Pretrip) Tests

Notice

Cargo Loss!

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

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

The MP-5000 controller contains special PTI pretrip tests that automatically checks unit refrigeration capacity, heating capacity, temperature control, and individual components including the controller display, contactors, fans, protection devices, and sensors. The test includes measurement of component power consumption and compares test results to expected values.

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

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

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

Note: *Detailed PTI test results are stored in the MP-5000 Data logger for later viewing. Any alarm codes recorded during the test can be viewed through the controller's Alarm List menu at the end of the test.*

Manual Function Test

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

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

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

1. Press the F1 key to open the F1 Menu.
2. Use Down key to select the **PTI Commands**. Press **Enter** key to see the PTI Commands options.
3. Press the Up or Down key to scroll to **Manual Function Test**.
4. Press the Enter key to enter the Manual Function Test Menu.

Unit Component Test

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

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

Table 8. 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: • 40'SL: – 1.0 Amps approx. at 50 Hz – 1.0 Amps approx. at 60 Hz • + 20'SL: , – 1.5 Amps approx. at 50 Hz – 1.5 Amps approx. at 60 Hz Amperes are recorded in the PTI log.	14, 15	5 seconds	X	X	X
EVAP FAN HIGH SPEED TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	With evaporator fan on high speed, amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency. If the minimum phase amp draw is less than 70% of the maximal amp draw both alarm is set. • 40'SL: – 2.1 Amps approx. at 50 Hz – 2.5 Amps approx. at 60 Hz • 20'SL: – 2.7 Amps approx. at 50 Hz – 3.2 Amps approx. at 60 Hz Amperes are recorded in the PTI log.	12, 13	5 seconds	X	X	X
COND FAN TEST SUP RET EVA 5.2C 5.0C 5.1C 1.3A 1.2A 1.3A	With condenser fan on, amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency. If the phase amp draw differs more than 1,0 Amp both alarm is set. • Expected Power Consumption: – 1.2 Amps approx. at 50 Hz – 1.5 Amps approx. at 60 Hz Amperes are recorded in the PTI log.	16, 17	5 seconds	X	X	X

Table 8. PTI, Brief PTI, Function Tests (continued)

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
PROBE TEST SUP RET EVA 5.1C 5.0C 5.1C 2.4A 2.3A 2.4A	Evaporator fans operate on high speed for maximum 3 minutes. Then probe test runs until temperature difference between sensors stops increasing. Maximum temperature difference allowed: • Return/Evaporator: 1.5C (34.7F); return air sensor temperature must be 0.5C (32.9F) above evaporator sensor temperature. • Return/Supply: 0.8C (33.0F); return air sensor temperature must be 0.5C (32.9F) above supply air temperature. • LH Supply/RH Supply (if equipped): 0.5C (32.9F).	128, 129, 130	1 minute minimum to 13 minutes maximum	X	X	X
REVERSE PHASE TEST SUP RET EVA 1.3C 1.0C 1.3C 1.3A 1.2A 1.3A	With condenser fan on, reverse phase selector relay is energized. Condenser fan and compressor reverse current is measured.	58	30 seconds	X	X	X
HEATER TEST SUP RET EVA 1.3C 1.0C 1.3C 5.2A 5.1A 5.2A	Electric heaters are turned on. Amp draw is measured to the expected amp draw, in respect to voltage and frequency. • 4.4 Amps approx. at 400V • 5.1 Amps approx. at 460V Amperes are recorded in the PTI log.	10, 11	5 seconds	X	X	X
DEFROST TEST SUP RET EVA 5.0C 12.0C 15.0C 5.2A 5.1A 5.2A	If evaporator temperature is below +10C, heater remains on until evaporator temperature is above +18C. **Defrosting until EVA > 18C/64F**	20	0-90 Minutes at voltage above 440V 0-120 Minutes at voltage below 440V	X	X	—
TEMPERATURE STABILISATION	With evaporator fan on high speed awaiting the supply, return and evaporator temperatures to stabilize. Delta SUP-RET and Delta RET-EVA must be stable, within 7 seconds. **Awaiting temperature stability**	None	20 to 180 seconds	X	X	—
PRE HEAT TEST SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	Test is skipped if return air temperature is at 5C or above. With electric heaters turned on and evaporator fan on high speed, the test will end when return air temperature is at 5C or above. **Heating until 5C/41F**	None	Instant to 2 hours	X	X	—
PRE COOL TEST SUP RET EVA 5.1C 5.0C 5.1C 2.3A 2.1A 2.3A	If the return air temperature is below 15C (68F) the test is skipped. Unit operates in cool until the return sensor is less then +15C (59F) or 1 hour Cooling until 15C/59F.	None	Instant to 2 hours	X	X	—
VENTILATING	If heater or compressor has been running in the preceding test, the unit is ventilated with evaporator fan on high speed. **Ventilating**	None	60 seconds	X	X	X
COMPRESSOR TEST AMB CON EVA 8.0C 15.0C 5.0C 9.1A 9.0A 9.1A	Compressor loaded, and condenser fan activated for 10 sec. Followed by compressor run alone for 7 sec before the amp draw is measured and compared to the expected amp draw, in respect to voltage and frequency. Amperes are recorded in the PTI log. **Evaluating power consumption**	6, 7	18 seconds	X	X	X

Table 8. PTI, Brief PTI, Function Tests (continued)

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
COMPRESSOR DIGITAL TEST AMB CON EVA 8.0C 25.0C 2.0C 9.1A 9.0A 9.1A	Compressor running loaded, evaporator fan at high speed, and condenser fan maintaining 30-35degC for 15 sec. Next the compressor is unloaded and running for 10 sec Amp draw difference is measured and expected to be at least 0,9 Amp (Con > 35C) or 1,5 Amp (Con < 35C).	119	25 to 35 seconds	X	X	X
COMPRESSOR ECONOMIZER TEST AMB CON EVA 8.0C 45.0C 1.0C 9.1A 9.0A 9.1A	With compressor on (loaded), condenser and evaporator fans at high speed are turned on for 30 seconds. If condenser fan temperature is below 30C (86F) then the test is aborted. Vapor injection valve is turned on. Amp draw difference is measured and verified to be minimum 0.4 amps. **Evaluating Power Consumption Increase**	26	Max 90 seconds	X	X	X
HIGH PRESSURE CUTOUT TEST	Running with compressor fully loaded and with evaporator fan at high speed, awaiting high pressure cut out. The test is ended if the condenser coil probe reads temperature above 70ºC and the HPCO does not occurs. The time observing is depending on the startup temperature and will be increased as long as the condenser temperature is increasing. After the HPCO the compressor signal is removed and the condenser fan is activated to lower the pressure in the condenser. When the temperature gets below 40ºC the compressor is also activated. The test will then look for when the HPCO gets back to normal in maximal 60 seconds. **Awaiting HPCO - Compressor stop**	53, 54	Max 200 seconds	X	X	—
CAPACITY TEST	With compressor fully loaded condenser fan on and evaporator fan at high speed running for the time period. At the end of the test is the cooling capability evaluated. **Evaluating cooling capability**	22	180 seconds for 40’ and 240 seconds for 20’ unit.	—	X	—
APPROACHING 0 TEST	Probe readings and time are recorded in the pti log when started. When supply air temperature is at 0 deg C / 32F the test is ended. If the test is not ended within the time limit the alarm is set. **Approaching 0C/32F**	23	Max 2 hours	X	—	—
MAINTAINING 0C TEST	With the unit running chilled – Non-Optimized, maintaining 0 deg C / 32F. After 30 minutes the probe readings and time are recorded in the pti log. **Maintaining 0C/32F**	None	30 minutes	X	X	—
DEFROST TEST	Test is skipped and Fail if either of alarm 4,5,130 is present. Test is skipped if evaporator temperature is at 5degC or above. With electric heaters turned on, the test will pass when evaporator temperature reach 18degC or above. **Defrosting until EVA > 18C/64F**	4, 5, 20, 130	0 to 90 minutes at voltage above 440V 0 to 120 minutes at voltages below 440V	X	X	X

Table 8. PTI, Brief PTI, Function Tests (continued)

Display*	Description	Possible Alarms	Duration (Time)	PTI	Brief PTI	Function Test
PULLDOWN TO -18 C TEST	With the unit running frozen, approaching -18 deg C / 0F. Probe readings and time are recorded in the pti log when started and when ended. When return air temperature is at -18 deg C / 0F the test is ended. If the test is not ended within the time limit the alarm is set. **Approaching -18C/0F**	22	Max 3 hours	X	X	—
PTI END	"PTI End" are recorded in PTI log and a Trip Start is automatically activated. All alarms are cleared and must be acknowledged by the user. Unit awaits an **ACCEPT** of the just ended test before returning to normal operation. **PASSED - PASSED - PASSED FAILED - FAILED - FAILED**	26	Max 90 seconds	X	X	X
RUNNING PTI 0°C / 32°F 00:00:00 0.0C 10.0C 10.0C	Unit operates in normal mode with 0C (32F) setpoint for 30 minutes after previous test is completed. At the end of 30 minutes, "Chill End" temperatures are recorded in PTI log. Sensor values for supply, return and evaporator sensors are recorded in the event log. ***Note:*** *Controlling Sensor = Supply*	None	Max 120 minutes	X	—	—
RUNNING PTI DEFROST 00:00:00 -18.0C 10.0C 10.0C	Unit operates in normal mode with -18C (0F) setpoint and defrost activated. Defrost terminates when evaporator temperature increases to 18C (65F). ***Note:*** *Controlling Sensor = Return*	20	30 minutes	X	—	—
RUNNING PTI -18°C / 0°F 00:00:00 -18.0C 10.0C 10.0C	Unit operates in normal mode with -18C (0F) setpoint. When return air temperature decreases to setpoint, Frozen Arrival" temperatures are recorded in PTI log. "PTI End" are recorded in PTI log and a Trip Start is automatically activated. ***Note:*** *Controlling Sensor = Return*	22, 60	Max 90 minutes	X	—	—
PTI PASS – PRESS KEY	Unit will remain OFF until any key is pressed. If alarms occurred during PTI, Display shows "PTI FAIL – PRESS KEY". ***Note:*** *Controlling Sensor = Return*	None	Max 180 minutes	X	—	—

***Readings may vary depending on voltage and temperature**

Function Test

The MP-5000 controller contains a special function test that automatically tests individual components including the controller display, sensors, condenser fan, evaporator fan, compressors, etc. The test includes measurement of component power consumption and compares test results to expected values.

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

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

1. Press the F1 key to open the F1 Menu.
2. Use Down key to select the **PTI Commands**. Press **Enter** key to see the PTI Commands options.
3. Press the Up or Down key to scroll to **Function Test**.
4. Press the 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.

Link

Link menu will display the QR code to access the literature files.

To access the Link menu follow the below instructions:

1. Press the F1 function key.
2. Use Down arrow key to select the Link menu.

3. Press Enter key to view the QR code.

4. Scan the QR code to access to associated literature files.

Language

The Language menu allows the user to view and choose a language from the available list. User can select a language from the available list at one time. All subsequent displays are shown in the selected language. English is the default language.

Language menu can be accessed from F1 function key.

To select the required language, follow the below instructions:

1. Press the F1 function key.
2. Use Down arrow key to select the language menu.

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3. Press Enter key to view the different language option available.
4. Press the Up and Down arrow keys to scroll between the different language options.
5. Press the Enter key to select a required language.

   All subsequent displays are shown in the selected language.

   Note: *If no key is pressed for 3 minutes, language goes back to default language English (unless special Software with container prefix set).*

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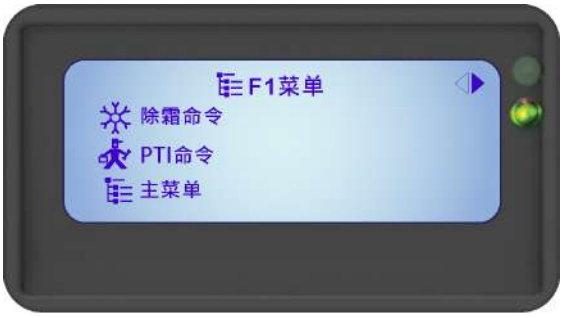

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USB Menu

The USB menu appears in the F1 menu when the USB drive is connected into the standard USB port inside the control box.

1. Press the F1 function key.
2. Use Down arrow key to select the USB menu.

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3. Press Enter key to view the USB options.
4. Press the Up and Down arrow keys to scroll between the different USB options.
5. Press the Enter key to select a required USB option.

The USB menu will display the following:

- Actual SW
- USB Software
- USB Function
- USB Activity

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Setpoint

Changing Setpoint

1. Press the **Temperature** function key to visualize the current setpoint.

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2. After visualizing the current setpoint, press **Enter** key to enter a setpoint value.

BEN3309

3. Press **UP** or **DOWN** navigation key to increase or decrease the setpoint. Press the **Enter** key accept the change.
4. Press **Esc** key to exit.

BEN3310

Alarm

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

1. Press the **Alarm** function key to view the current alarm(s).

The display will show either NO ALARMS or the newest ALARM with the descriptions.

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

2. Write down the first code, press the **Up/Down** navigation keys to view next alarm code when more than one code has been recorded.

   The 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.

3. Hold the **Enter** key to acknowledge the alarm.
4. Clear alarm code by correcting the problem.
5. Press the **Esc** navigation key to exit the Alarm menu.

   To view the alarms, press the Alarm key to display the general unit error.

Clear Alarm

Resolve the problem to clear the alarm code(s) and the red LED will turn off. The display will show NO ALARMS.

Alarm Code States

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

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

Alarm Codes

For a complete list of alarm codes and corrective actions, refer to ("Alarm Codes and Corrective Actions," p. 162).

C/F

The controller can display temperatures in Celsius or Fahrenheit.

1. Press **C/F** navigation key to change only the unit status display to C or F.

2. Press **Enter** from the unit display status.

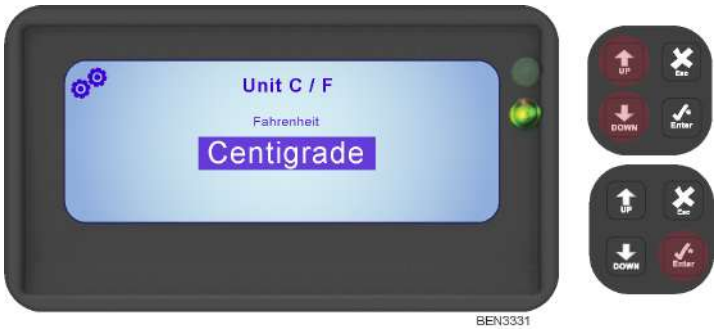
3. Select the **CONFIG** option from Main menu using the down navigation key.

4. Press **Enter** key to see the following options in the **CONFIG**.
   - Unit
   - Options
   - System
   - Time
   - Calibrate

5. Select **Unit** option and press enter key.

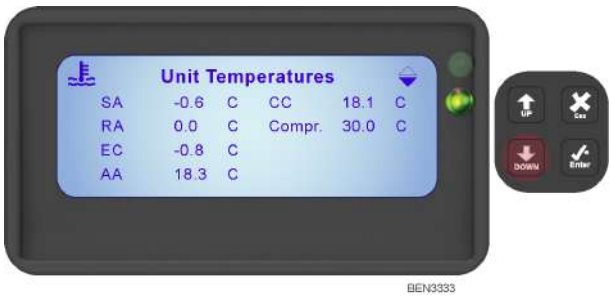
6. Select **Unit C/F** by navigating with down key and press enter.

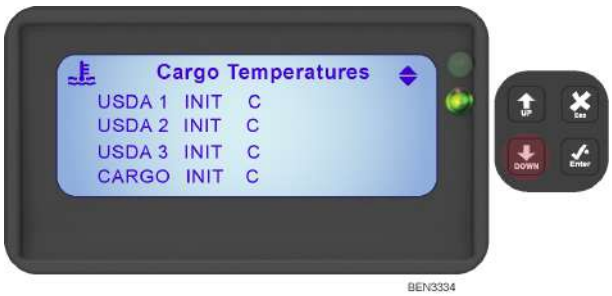
7. Navigate with up and down key and select Celsius or Fahrenheit by pressing **Enter** key.
   To return to Main menu, press **Esc** key 2 times.



8. Navigate with down key and select **VALUES** item by pressing **Enter** key.

Select temperature option and press enter key to visualize all temperature measurements in C or F.





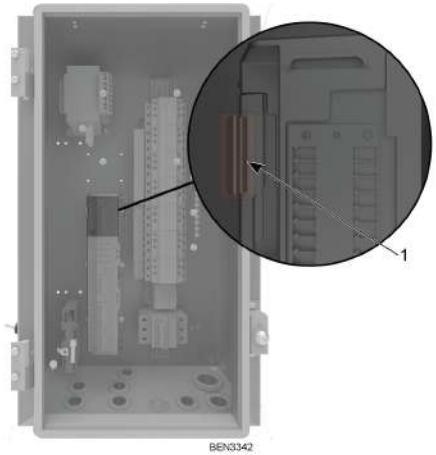
Controller Back-up Battery

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

USB

The standard USB port is located inside the control box. The USB port is used for USB flash drive to unit connections. The data is downloaded through the USB port located inside the control box using a flash drive.

Figure 15. USB Location



1	Standard USB location (located inside the control box)

Flash Drive Connected USB Port: Standard USB 2.0 flash drives that have been formatted can be used in the USB Port. Use of a USB drive eliminates the need for an on-site computer and does not require cables.

Using a properly configured USB flash drive, the following functions may be available: If a USB flash drive is connected to the USB connector, the menu item allows the user to select the desired Flash Drive function.

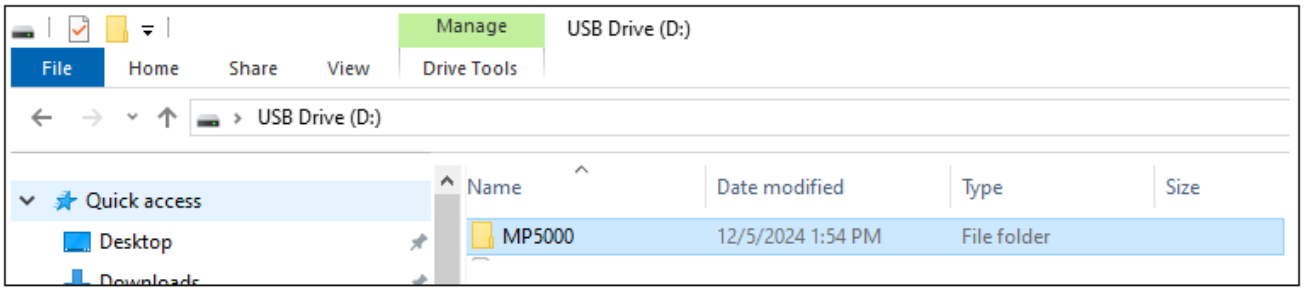
A flash drive connected to the USB can be used to:

- Download the Service Log Data Logger (csv.gz format file)
- Flash load the controller software

Standard USB Flash Drive Structure

The standard USB flash drive consists of an MP5000 folder.

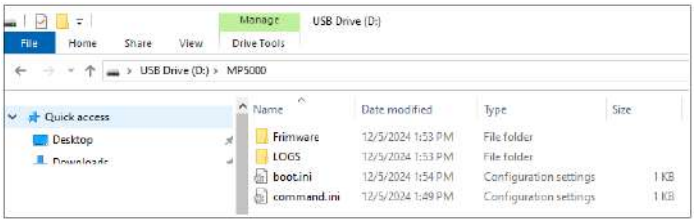
Figure 16. USB Flash Drive



Note: *In this example, the drive name, **D**, is only related to PC handling and has no impact on the card's use in the MP-5000.*

The MP5000 folder contains the following files and folders.

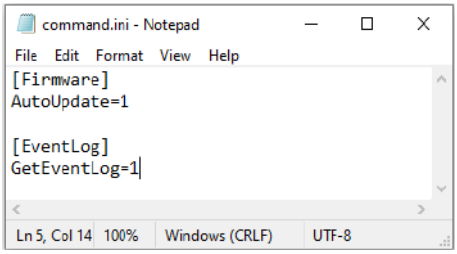
Figure 17. MP5000 Folder



- Frimware
- Logs
- boot.ini
- command.ini

Command.ini File Description

Figure 18. Command.ini



In the MP5000 directory a file named **Command.ini**(a simple text file) must be placed. This file controls the action when the USB drive is inserted in the controller.

This file must include at least the following four lines:

- The AutoUpdate asks for an autoupdate of the software (a normal Flashload).
- The GetEventlog asks for a log to be copied to the USB drive.

All requests can be set to either =1 or =0 for the desired action.

Files and Folders	The firmware for the application (flashload file) must be stored on the USB drive in the **Firmware** folder. The file name holds the version description of the file content, i.e.: **CM5000_1.0.0.0_231224.strip.sip** The retrieved logs from the controller will be placed in the **LOGS** folder. The data logs, only **ONE** from each controller, the name starts with an X and holds the container ID, i.e.: **XLOSU930.001**. The log holds both events and temperature loggings.
Special Action not Normal Used	**Auto Generate USDA report:** In the [Firmware] section, add the below line to have a USDA report to be copied to the USB drive. **GetUSDAXmlLog=1** **Downgrade:** In the [Firmware] section, add the below line to allow the controller to downgrade. **DowngradeEnable=1** Using this feature, only ONE firmware must be present in the **Firmware** folder.

Main Menu

The Main Menu is comprised of seven submenus. Navigate to the desired item by using the up and down navigation key.

- **Values Menu** - The menu screen in this group are used to display unit operating information including Temperature values, Pressure values, Air values, Unit electrical data etc., and any input to the controller.
- **Controls Menu** - The menu screen in this group are used to enter allowable setpoints.
- **Alarm Menu** - Display a list of alarm code(s) present.
- **Config Menu** - The menu screen in this group are used to change the functionality of the unit operation.
- **Message Menu** - Display a list of message(s) present.
- **Info Menu** - The menu screen in this group gives information on the software version.
- **Log View Menu** - The menu screen in this group displays Display log information, PTI, and Runtime logs.
- **Advance Menu** - The menu screen in this group gives information on contrast settings.

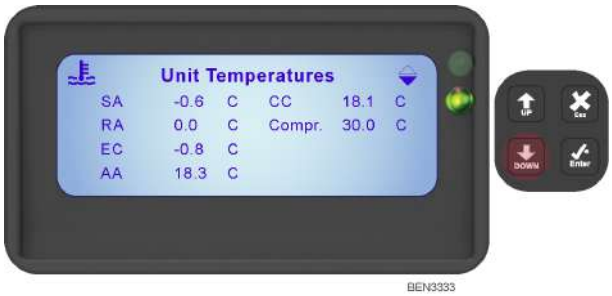
Values Menu

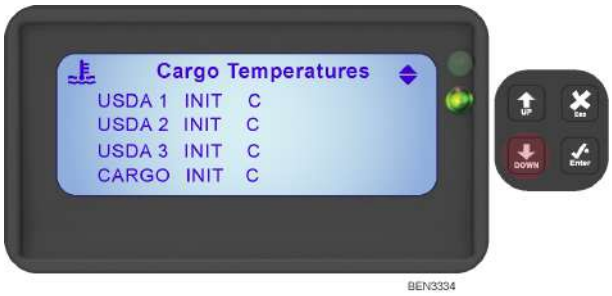
The Values menu displays general unit operating information including temperature values, pressure, air values, internal values, voltage values, digital output and input values, and unit control values. A complete listing of the controller operating menu is located on an 11" x 17" foldout in the Diagrams chapter (Figure 48, p. 190).

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.*

Use the navigation key to scroll left or right to the **Values** menu and then press the down navigation key to access the submenus.

Unit Temperatures values will be the first screen shown. Press down key to see the Cargo temperature submenu.



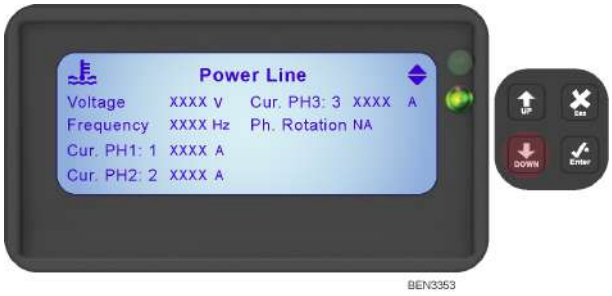


Press down or up using navigation keys to view the different submenus. Press the Esc navigation key to return to the Values menu tab.

Unit Pressures

Cargo Air

Power Line



Digital Outputs

Digital Inputs

Unit Control

Controller Intervals

Controls Menu

The Controls menu displays a list of functions that identifies unit operating features and current settings. A complete listing of the controller Configuration menu is located on an 11" x 17" foldout in the Diagrams chapter (Figure 48, p. 190).

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

1. Press the Enter key to view the Menu screen. Press the Down key to scroll down to the Controls menu.

2. Press the Enter key to expand this menu.
3. Press the UP or DOWN key to scroll to the desired function.
4. Press the Esc key to exit the Controls screen.

The Controls will show the following submenus:

- Trip Start
- OptiSet (optional)
- Temperature Setpoint
- Controlling Mode
- Pulldown Time
- Dehumidify Control
- Dehumidify Setpoint
- Fresh Air Open Valve
- Fresh Air Vent. Man.
- TK Fresh Delay
- TK Fresh Rate
- CO2 Max
- O2 Min
- Water Cooled Condenser
- Energy Logging Reset
- Silent Mode

Trip Start

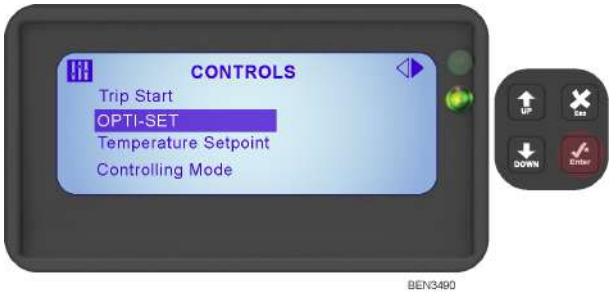
Trip Start submenu display the last activated trip start with date and time and allows to activate the new trip start.

Figure 19. Trip Start

OptiSet™ (Optional)

Allows all the TK Fresh variable to be set by selecting a specify commodity. Refer to ("Change the TK Fresh Plus Settings Using OptiSet," p. 96). TK Fresh must be selected under the CONFIGURATION/OPTIONS/CONTROLLED ATMOSPHERE (CA)/ TK FRESH MODULE for OptiSet to be active or visible.

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 Enter key. The new setpoint is recorded in the controller datalogger and appears in the display.

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

Temperature Setpoint

Controlling Mode

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

Figure 20. Controlling Mode

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

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

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

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

Pulldown Time

When the Pulldown time 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 21. Pulldown Time

Water Cooled Condenser

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

Figure 22. Water Cooled Condenser

Dehumidify 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 DEHUMIDIFY CONTROL to be active or visible. Refer to ("Dehumidify Mode," p. 103) for a complete description.

Figure 23. Dehumidify Control

Dehumidify Setpoint

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

HUMIDITY SENSOR mounted must be selected under the CONFIGURATION/OPTIONS/HUMIDITY SENSOR for DEHUMIDIFY SETPOINT to be active or visible. Refer to ("Dehumidify Mode," p. 103) for a complete description.

Figure 24. Dehumidify Setpoint

AVL (Air Ventilation Logging)

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

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

Enabling AVL

Fresh Air Vent Man - TK Fresh Mode

Can be set to OFF or TK Fresh.

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

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

Refer to ("Starting the TK Fresh System," p. 89) for more information about setting up TK Fresh.

Figure 25. TK Fresh Mode

Fresh Air Vent Man - TK Fresh Plus Mode

Can be set to OFF, TK Fresh, or TK Fresh Plus.

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

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

TK Fresh Plus - Will allow a CO2 Max to be set. Some container prefix allow O2 MIN to be set.

Refer to ("TK Fresh Plus System," p. 94) for more information about setting up TK Fresh Plus.

Figure 26. TK Fresh Plus Mode

TK Fresh Delay

Hours the TK Fresh door will remain closed before opening to a desired TK Fresh Rate or due to gas sensor readings. Selectable from 1 to 48 hours.

Figure 27. TK Fresh Delay

TK Fresh Rate

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

Figure 28. TK Fresh Rate

TK Fresh Plus CO2 Max

Used to set the highest level of Carbon Dioxide allowed in the container. The TK Fresh Plus door will open or close to maintain this level. Active only when TK Fresh Plus is enabled. Selectable from 0% to 25%. Refer to ("Change the CO2 Minimum and Maximum Setting," p. 95) for more information.

Figure 29. CO2 Max

TK Fresh Plus O2 Min

Used to set the lowest level of Oxygen allowed in the container. The TK Fresh Plus door will open or close to maintain this level. Active only when TK Fresh Plus is enabled.

Figure 30. O2 Min

Silent Mode

Silent mode is a way to make the reefer unit silent without manual switching it OFF and ON.

The feature is normally used when the reefer unit is located near public areas where the noise from the unit is annoying and not acceptable during ie. the night-time. The feature is selected either ON or OFF and the start time of day and stop time of day is configured all in the control menu, The time setting is controllable in increments of 5 minutes.

The mode is controlled by the wall clock of the controller and the start and stop time. The wall clock might not be set to the local time, so this must be taken in respect during the selection. In case of a period start prior to midnight the start time will be 'higher' than the stop time.

When the time is in between start and stop the unit operation will be halted, and the unit will not be operating the compressor, fans and heater. When the period ends normal operation will restart and the unit will operate through out the day until the beginning of the next period.

At the temperature log the flag ‘s’ will be set to indicate the halted operation.

Changing the configuration of the mode is documented in the event log.

Since the unit is not allowed to operate during the silent period, the normal surveillance is not ongoing. The surveillance is re-engaged when the unit restart the operation.

Configuration Menu

The Configuration menu displays a list of functions that identifies unit operating features and current settings. A complete listing of the controller Configuration menu is located on an 11” x 17” foldout in the Diagrams chapter (Figure 48, p. 190).

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

1. Press the Enter key to view the Menu screen. Press the Down key to scroll down to the CONFIG menu.

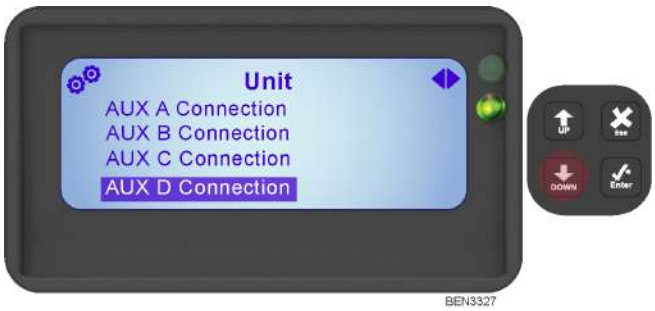
2. Press the Enter key to expand this menu.
3. Press the UP or DOWN key to scroll to the desired function.
4. To set a new Configuration screen value:
   a. Press the Enter key with cursor in the desired menu line.
   b. Press the UP or DOWN key to scroll the value to the desired setting.
   c. Press the Enter key and release when the entry is complete. Press the Esc key. The new value appears in the menu line.
5. Repeat steps 3 and 4 to reset additional configuration values.
6. Press the Esc key to exit the Configurations screen.

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

Figure 31. Configuration Menu

Unit

1. Select **Unit** option and press enter key.
2. Press UP or DOWN using navigation keys to view the different submenus. Press Enter to access and Esc navigation key to return to the Unit menu screen.



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

- Padlock Option : Select ON/OFF.
- USDA Option: When USDA sensor is mounted you can change the setting here.
- Log Interval: Sets the data log interval (1 minute or 1/2, 1, 2, or 4 hours).
- Smart PTI: Select ON/OFF.
- Unit C/F: Allows to select Fahrenheit or Centigrade.

In Range

Pull Down Selection

Economy Min

Economy Max

Padlock Option

USDA Option

Log Interval

Log Smart Option

Aux A to D Option

BEN3411

CO2 calibration Offset

BEN3412

O2 calibration Offset

BEN3413

Cold Start

BEN3414

Retriever

BEN3415

Smart PTI

BEN3416

Smart PTI Max Age

BEN3417

Smart PTI Auto Save

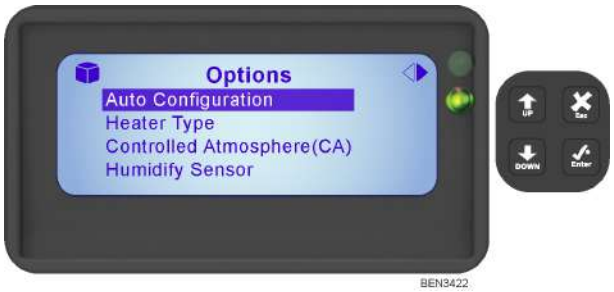
BEN3418

Smart PTI Trail

Unit C/F

Options

1. Select **Options** menu and press enter key.
2. Press UP or DOWN using navigation keys to view the different submenus. Press Enter to access and Esc navigation key to return to the Options menu screen.

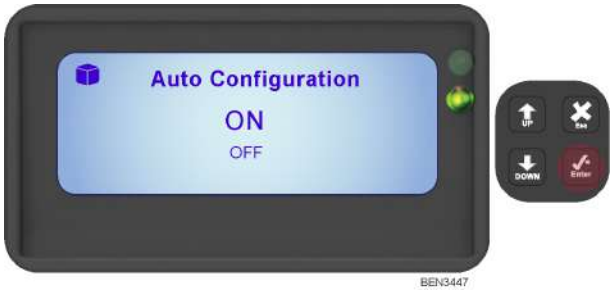


This menu is used to turn ON/OFF a Module/Feature, select a particular option within a module, and tell the controller when a sensor is mounted.

- Auto Configuration: Select ON/OFF.

- Heater Type: Select from Extended Capacity and Normal Capacity.
- Controlled Atmosphere (CA): This turns on the AVL option. Select from None, AVL, TK Fresh, and TK Fresh+. Selecting TK Fresh+ also turns OptiSet ON.
- Humidity Sensor: This setting can be changed when a humidity sensor is mounted.
- Suction Pressure Sensor: This setting can be changed when a suction pressure sensor is mounted.
- Discharge Pressure Sensor: This setting can be changed when a discharge pressure sensor is mounted.
- Condenser Temperature Sensor: This setting can be changed when a condenser temperature sensor is mounted.
- Multiple Setpoint (MTS): Selectable or Not Selectable.
- Cold Treatment (CT): Selectable or Not Selectable
- Fresh Air Option: This setting can be changed when a condenser temperature sensor is mounted.
- Energy Logging: On the MP-5000 Controller: captures live Power Draw, in kW; Total Energy Consumed, in kWh; Trip Duration, (Days, hours, mins); Average kW per Hour; Trip Start Date. In the Download File: actual power draw and cumulative trip power draw; total kWh draw since reefer in service (or since software retrofitted, if applicable).
- Condenser Fan Type: Shows the condenser fan type selection.
- Evaporator Fan Type: Shows the information on evaporator fan.
- High Temperature Suction Pressure Sensor: This setting can be changed when a condenser temperature sensor is mounted.
- Low Temperature Suction Pressure Sensor: This setting can be changed when a condenser temperature sensor is mounted.

Auto Configuration



BEN3447

Heater Type

BEN3448

CA Settings

BEN3464

Humidity Sensor

BEN3453

Suction Pressure Sensor

Discharge Pressure Sensor

Condenser Temp. Sensor

Fresh Air Option

Multiple Setpoint(MTS)

Cold Treatment (CT)

Multiple Setpoint(MTS)O2 ON

Cold Treatment (CT)Energy Logging

Condenser Fan Type

Evaporator Fan Type

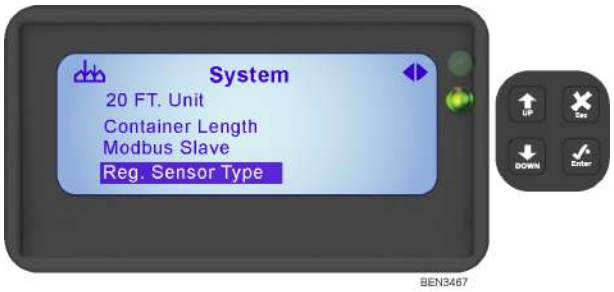
High Temp. Suction Pressure Sensor

Low Temp. Suction Pressure Sensor

System

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

1. Select **System** menu and press enter key.
2. Press UP or DOWN using navigation keys to view the different submenus. Press Enter to access and Esc navigation key to return to the System menu screen.



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

- SW Unit Type: Select the unit type depending the product.
- Refrigerant: Option to set unit refrigerant type.
- Expansion Type: Show the option to select evaporator expansion valve and thermostatic expansion valve.
- 20 FT. Unit: Tells the controller that this is the option chosen.
- Container Length: Option to se container length.
- Container Height: Option to se container height.
- Modbus Slave: Select ON/OFF.
- Reg. Sensor Type: Display the different temperature sensor that are mounted.
- Unit Serial: The TK serial number of the unit itself. This is a ten digit alphanumeric entry found under the UNIT Serial Number on the Serial Plate on the unit.
- Unit ID: A 12 digit alphanumeric unit serial number (old system).
- Controller ID: View and edit the Controller ID.

Container ID

SW Unit Type

Refrigerant

Expansion Type

20 FT. Unit

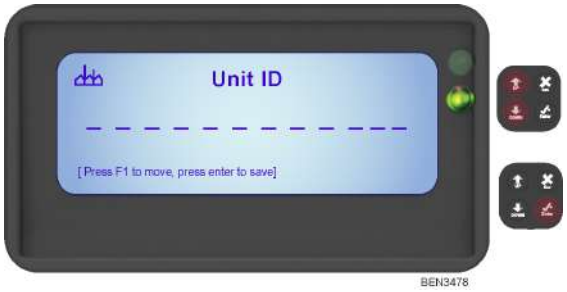
Container Length

Modbus Slave

Reg. Sensor Type

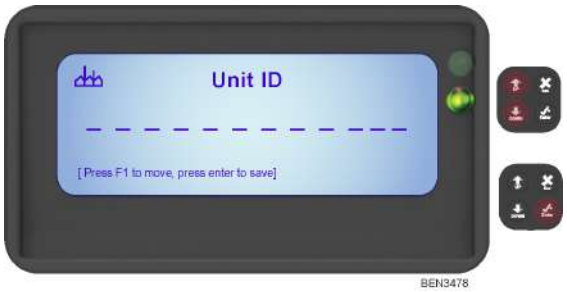
Unit Serial

Unit ID



Unit Serial

Unit ID



Controller ID

Time & Date

Displays current Date and Time, which can be edited.

1. Press the Enter key. Press the Down key to scroll down to the CONIG Menu.
2. Press the Enter key to access the CONFIG menu.
3. Select **Time & Date** menu.

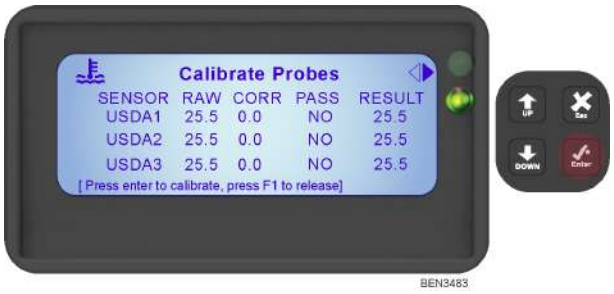
4. Press the Enter key to access the Time & Date screen.
5. Press the Enter key to edit.
6. Enter new time by: Using Up/Down to change the digits and by pressing F1 navigation key to move the cursor on to the next digit.
7. Enter new Date by: Using Up/Down to change the digits and by pressing F1 navigation key to move the cursor on to the next digit.
8. Once you have scrolled the cursor through all the time and date digits, press the Enter key to save.
9. Press the Esc key to exit the Time & Date screen.

Calibrate

1. Select **Calibrate** menu and press enter key.

2. Press UP or DOWN keys to calibrate sensor probes. Press Enter to access and Esc navigation key to return to the CONFIG menu screen.

For CId Treatment refer to "Cold Treatment (CT)," p. 109.



Message Menu

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

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

1. Press the Enter key to view the Main menu.
2. Press the Up or Down key to scroll to the Message menu. Press the Enter key to access.

Display will show either NO MESSAGES or the newest MESSAGE.

Note: *Messages are displayed in sequential order, not in order of occurrence.*
The first alarm code number, alarm state, and alarm description appears in the display id there are messages.

3. Press Up or Down key to view next message when more than one message has been recorded.

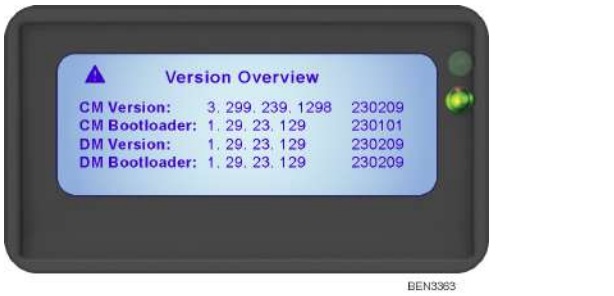
4. To clear all messages from the current display list and turn off the Alarm LED, all problems must be corrected.
5. Press Enter key to acknowledge the message. The message state will change from Active or Not Active to Acknowledge. If no key is pressed for 30 seconds, the controller returns to previous menu level or Unit status display.

For a complete list of status messages and controller actions, see ("Status Messages and Controller Actions," p. 157).

Info Menu

This Info menu displays controller software application version, bootloader version, serial number, and option file version.

1. Press the Enter key to view the Main menu.
2. Press the Up or Down key to scroll to the INFO menu. Press the Enter key to access.
3. Select SW Version and press the Enter key to expand this menu. Press Down key to view the Version Overview.



Log View Menu

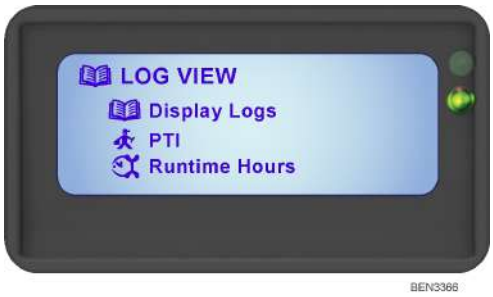
This menu allows the user to check Display log information, PTI, and Runtime logs. Displays results of last logs with its time, PTI logs, and Run time hours for Compressor, Heating elements, Evaporator fan high/low speed, Condenser fan, and Main power on.

A complete listing of the controller operating menu is located on an 11" x 17" foldout in the Diagrams chapter (Figure 48, p. 190).

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

1. Press the Enter key access Menu view. Press the Down key to scroll down to the Log View menu.

2. Press the Enter key to access the Log View menu.



3. Press the Up or Down key to scroll to the desired function.
4. Press the Enter key to access the function selected.

Notes:

- *In Display Logs, "NO LOGS" appears only when there is no display log condition and a maximum of 20 logs can be shown.*
- *In PTI, "NO LOGS WITHIN RANGE" appears only when there is no PTI log condition, and a maximum of 40 logs can be displayed.*

Advance Menu

The advance menu screen gives information on contrast settings.

Changing Screen Contrast

Change the screen contrast temporarily as follows:

1. Press the Enter key access Menu view. Press the Down key to scroll down to the Advance menu.

2. Press the Enter key to access the Advance menu.

3. Select Contrast Setting and press enter to change the contrast.

4. Press Enter to edit. Press Up and Down navigation key to change the contrast.
5. Press Enter key to save the new Contrast Setting.

TK Fresh System

Starting the TK Fresh System

1. Press the Enter key to enter the main menu. Press the UP or DOWN key to scroll to Config menu and press Enter to expand the menu.

2. Press the UP or DOWN key to scroll to Options menu and press Enter to expand the menu.

3. Press the UP or DOWN key to scroll to Controlled Atmosphere (CA) menu and press Enter to enter the menu.

4. Press the UP or DOWN key to select TK Fresh and Press and hold Enter to accept the selection.

5. Press the Esc key several times to return to the standard display.
6. Press the Enter key to enter the main menu. Press the UP or DOWN key to scroll to Controls menu and Press Enter to expand the menu.

7. Press the UP or DOWN key to scroll to Fresh Air Vent Man menu. Press the Enter key to enter the Fresh Air Vent Man menu.

⚠ Warning

Risk of Injury!

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

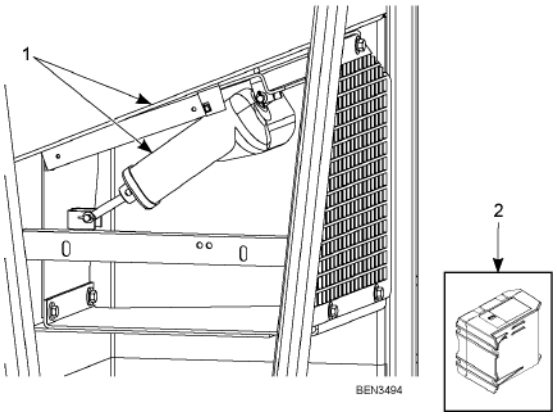
8. Press the UP or DOWN key to scroll between [OFF] and [TK Fresh].
   - [OFF]: Vent door closes and/or remains closed. TK Fresh Delay and TK Fresh Rate settings disappear.
   - [TK Fresh]: Controller uses enter TK Fresh Delay and TK Fresh Rate time to adjust FAE door to user setting.

9. Press Esc key to return to the Controls menu.
10. Press the Esc key several times to return to the standard display.

Change the TK Fresh Delay

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

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



1	Vent Door Assembly and Damper Motor
2	TK Fresh Plus Option Module (Mounts on Back of Controller in Control Box)

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

1. Press the Enter key to enter the main menu. Press the UP or Down key to scroll to Controls menu and Press Enter to expand the menu.

2. Press the UP or DOWN key to scroll to TK Fresh Delay.

⚠ Warning

Risk of Injury!

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

3. Press the Enter key to enter the TK Fresh Delay menu. The current setting (“0”) appears in the display.

4. Press the UP or Down key to increase or decrease the time delay.
5. Press Enter to save. The new time delay is recorded in the controller and appears in the display.
6. Press the Esc key to exit the Controls menu.

Change the TK Fresh Rate

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

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

1. Press the Enter key to enter the main menu. Press the UP or DOWN key to scroll to Controls menu and Press Enter to expand the menu.

2. Press the UP or DOWN key to scroll to TK Fresh Rate.

3. Press Enter to see the TK Fresh Rate menu. The current rate and units (e.g. “0 CMH”) appears in the display.

⚠ Warning

Risk of Injury!

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

4. Press the UP or DOWN key to increase or decrease the TK Fresh Rate.
5. Press Enter to save. The new time delay is recorded in the controller and appears in the display.
6. Press the Esc key to exit the Controls menu.

TK Fresh Plus System

An advanced microprocessor controlled TK Fresh Plus system provides:

- Programmable control of the CO_2 level in the container
- Data logging of the CO_2 gas level reading
- Gas sensor unit
- Sensor filter
- Vent loop

The controller can be set to control the CO_2 level in the container from 0 to 25 percent.

Set TK Fresh Plus System Values

The Controlled Atmosphere (CA) option submenu in the Config menu is factory set to TK Fresh Plus. The controller then adds the TK Fresh, TK Fresh Delay, TK Fresh Rate, and CO_2 Max submenus to the Controls menu. If a replacement controller or new software is installed, a controller auto configuration will detect the TK Fresh Plus option when the TK Fresh door control module and gas sensor are connected to the controller.

- TK Fresh Plus: This setting turns on the TK Fresh Plus system to control the CO_2 gas level. The controller then adds CO_2 Max and TK Fresh Dela submenus to the Controls menu.

The default setting for TK Fresh in the Controls menu is the last value set (Off, TK Fresh, or TK Fresh Plus). Controlled Atmosphere (CA) and Fresh Air Vent Man must be set to TK Fresh Plus to control the vent door to the CO_2 gas level.

1. Press the Enter key to enter the main menu. Press the Up or Down key to scroll to Config menu and press Enter key to see the submenus.
2. Press the Up or Down key to scroll to Options menu and press Enter key to expand the submenu.
3. Press the Up or Down key to scroll to Controlled Atmosphere (CA) menu and press Enter key.
4. Press the Up or Down key to select TK Fresh Plus and press and hold Enter key to accept the selection.

5. Press the Esc key several times to return to the standard display.
6. Press the Enter key to enter the main menu. Press the Up or Down key to scroll to Controls menu and press Enter to expand the menu.
7. Press the Up or Down key to scroll to Fresh Air Vent Man.
8. Press the Enter key to access the Fresh Air Vent Man menu.

⚠ Warning

Risk of Injury!

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

9. Press the Up or Down key to scroll between [OFF], [TK Fresh], and [TK Fresh Plus].
   - [OFF]: Vent door closes and/or remains closed. TK Fresh Delay and CO_2 Max settings disappear.
   - [TK Fresh]: Controller uses enter TK Fresh Delay and TK Fresh Rate time to adjust FAE door to user setting.

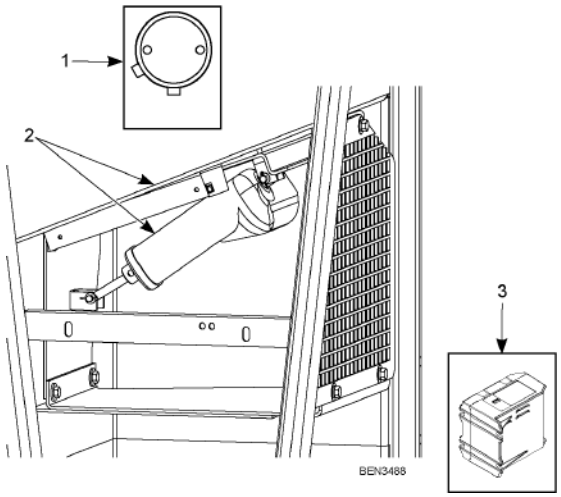
- [TK Fresh]: Controller uses enter TK Fresh Delay and CO_2 Max to adjust FAE door to user setting.

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

Change the TK Fresh Delay

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

The TK Fresh delay setting keeps the fresh air vent closed for a preset time when the unit starts. This allows faster product temperature pull-down. The TK Fresh delay can be set from 1 to 72 hours in 1-hour increments. Refer to ("Change the TK Fresh Delay," p. 90) for the procedure to set the delay.



1	Gas Sensor Assembly (Mounts in Evaporator)
2	Vent Door Assembly and Damper Motor
3	TK Fresh Plus Option Module (Mounts on Back of Controller in Control Box)

Note: *During unit startup, the TK Fresh delay prevents the TK Fresh door from opening until the delay times out. The TK Fresh delay prevents the TK Fresh door from opening due to the TK Fresh Rate or CO_2 system settings.*

Change the CO2 Minimum and Maximum Setting

Note: *The minimum CO_2 rate should be established by the shipper.*

The CO_2 rate sets the desired CO_2 level in the container when a gas sensor unit is installed. The actual TK Fresh door position is based on the CO2 level and TK Fresh delay.

1. Press the Enter key to enter the main menu. Press the UP or DOWN key to scroll to Controls menu and press Enter to expand the menu.
2. Press the UP or DOWN key to scroll to CO2 MAX.
3. Press the ENTER key to enter the CO2 MAX menu. The current rate and units (e.g. "0.0 percent") appears in the display.

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

⚠ Warning

Risk of Injury!

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

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

Change the TK Fresh Plus Settings Using OptiSet

1. Press the Enter key to enter the main menu. Press the Up or Down key to scroll to Controls menu and press Enter to expand the menu.

2. Press the UP or DOWN key to scroll to OptiSet Menu.

3. Press Enter key.
4. Use UP or DOWN keys to scroll to desired product.
5. Press and hold Enter key to auto enter product settings.

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

6. Display will show selected product.
7. Press Esc key to returned to the main menu.

Modify OptiSet Product Settings

1. Press the Enter key to enter the main menu. Press the UP or DOWN key to scroll to Controls menu and Press Enter to expand the menu.
2. Press Down 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 Tk Fresh DELAY, Optimized Mode, Humidity Control, and Humidity Setpoint.*
   - Evaporator Fan Speed
   - Defrost Termination Temperature
   - Humidity Control
   - Humidity Setpoint
   - TK Fresh Delay
   - O2 Minimum (if applicable)
   - CO2 Maximum

Notice

Cargo Loss!

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

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

Testing TK Fresh / TK Fresh Plus System

The system consists of the following main parts:

- Gas Analyzer: Mounted in evaporator section
- Option Module: Located above controller inside control box
- Damper Motor: Mounted above control box
- Vent (FAE) Door: Opens to allow air exchange in and out of the container

TK Fresh Plus Option Alarm Codes

Code 122 - O2 Sensor Calibration Error (PTI Only) (if equipped).

System Operation Verification

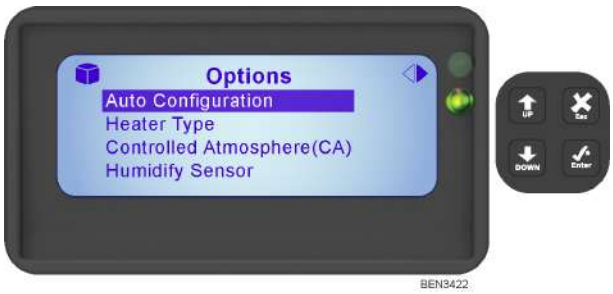
If the system appears not to be operating properly, it is best to verify that the controller can recognize if the TK Fresh Plus option is installed. Use the Auto Configuration function found in the Config menu. Select setting to ON. Allow the configuration steps to complete. The last step of the configuration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

Notes:

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

To select Auto Configuration:

1. Enter Config menu, select Options, then Auto Configuration.



2. Turn Auto Configuration ON by using UP key.

3. Press and hold Enter key to Accept.

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

Alarm Codes and Actions

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

Notice

Equipment Damage!

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

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

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

Pulsating Vent Door

TK Fresh Plus Door Closes Automatically

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

Pulsating TK Fresh Plus Door

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

TK Fresh Plus set to "TK Fresh" and the TK Fresh Rate set to 75 CMH

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

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

TK Fresh Plus Enabled

In the past once the CO_2 level reached the maximum setpoint, the door would start to ramp open. Once the CO_2 level decrease the door would start to ramp closed. Now once the CO_2 level reaches the maximum setpoint, the door opens fully for a calculated period of time. The door will then close for a calculated period time. If the CO_2 level remains above the maximum setpoint, the calculated period of time the door is open will be increased and the period of time closed will decrease.

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

Air Ventilation Logging (AVL)

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

Configuration Instructions

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

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

Figure 32. 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.

Unit Operation

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.

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 138 C (280 F).

Power Limit Mode

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

Evaporator Fan Control

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

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

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

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

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

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

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

Condenser Fan Control

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

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

Probe Test

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

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

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

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

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

Dehumidify Mode

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

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

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

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

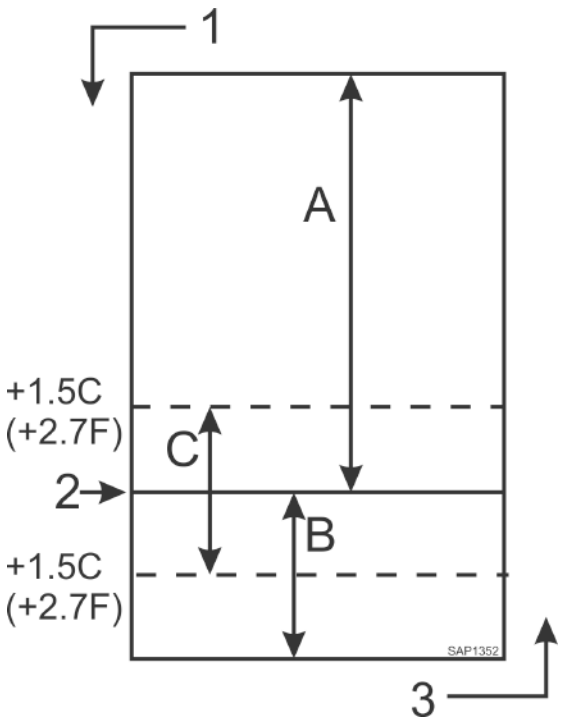
Continuous Temperature Control Operation

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

The controller regulates the compressor, digital control valve, and electric heaters based on a Control Temperature Differential (Refer to "Compressor Digital Control Valve," p. 107 for more detail). This means the unit operating mode can not be predicted based only on the setpoint and supply air temperature. At setpoints of -9.9 C (14.1 F) and above, the controller operates the unit on the following:

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

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



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

Table 9. MAGNUM PLUS Operating Mode Function Chart

Chill Loads Setpoints at -9.9 C (14.4 F) and Above			Frozen Loads Setpoints at -10 C (14 F) and Below			
Cool w/Mod	**Heat**	**Defrost**	**Cool**	**Null**	**Defrost**	**Unit Function**
•[1]	•					Evaporator Fans High Speed[1]
•[1]			•	•[1]		Evaporator Fans Low Speed[1]
		•		•[1]	•	Evaporator Fans Off[1]
•	•					Proportional-integral Derivative (Supply Air) Control
			•	•		Return Air Sensor Control
		•			•	Evaporator Coil Sensor Control
•			•			Compressor On

Table 9. MAGNUM PLUS Operating Mode Function Chart (continued)

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

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

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

[2]Vapor injection valve:

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

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

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

[4]Digital Control valve modulates:

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

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

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

Cool with Modulation

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

Heat

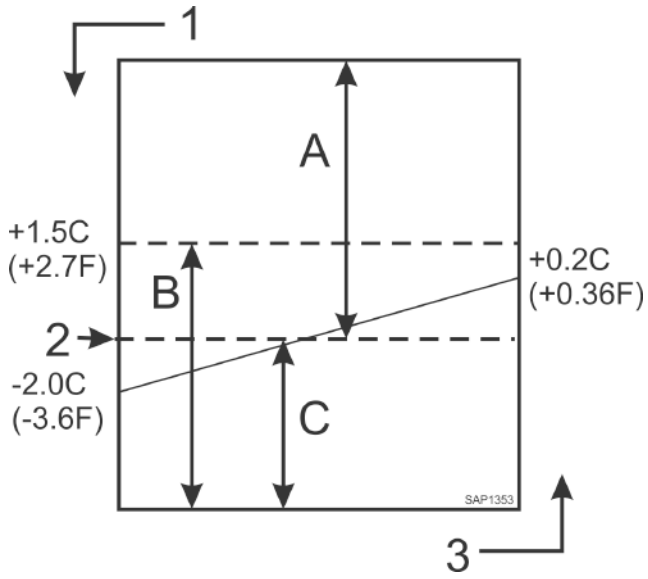
- If the supply air temperature is too low and the Control Temperature Differential is below the setpoint, the controller stops the compressor. The fans (low speed) are kept on to determine if fan heat is sufficient to increase temperature to setpoint. If not, switch to high speed. If not sufficient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

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

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

- Cool mode.
- Null mode.
- Defrost mode (electric heaters on, evaporator fans off).

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



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

Cool

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

Null

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

Defrost

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

- Demand Defrost function initiates Defrost immediately when:
  - Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large.
  - Temperature difference between the supply sensors and return air sensor is too large.
- Manual Defrost may be initiated immediately by pressing the DEFROST key or by REFCON Remote Monitoring Modem (RMM).

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

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

When the Defrost mode is initiated:

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

The controller terminates the Defrost mode when:

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

When the defrost mode is terminated:

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

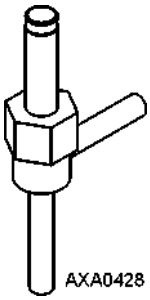
The controller pre-cools the evaporator coil to the supply air temperature (or for 3 minutes maximum) to minimize heat energy release into the container. The controller then starts the evaporator fans.

Compressor Digital Control Valve

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

The controller uses a proportional-integral derivative (PID) algorithm to provide accurate temperature control. This is in direct response to load demand. However, instead of generating a voltage signal to position a suction line modulation valve to regulate cooling capacity, the algorithm establishes a pulse width signal to cycle the Compressor Digital Control valve open and closed on a duty cycle. The percent ON time (compressor pumping time) in the duty cycle equals the cooling capacity percent required to meet the current load demand.

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

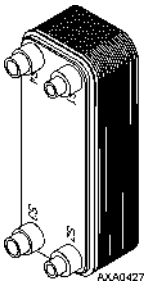


Economizer System

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

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

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



Data Recording and Downloading Data

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

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

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

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

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

temperature logs. For example, downloading 90 days of data logs would take about 95 seconds for event logs only and about 210 seconds for temperature logs only.

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

Cold Treatment (CT)

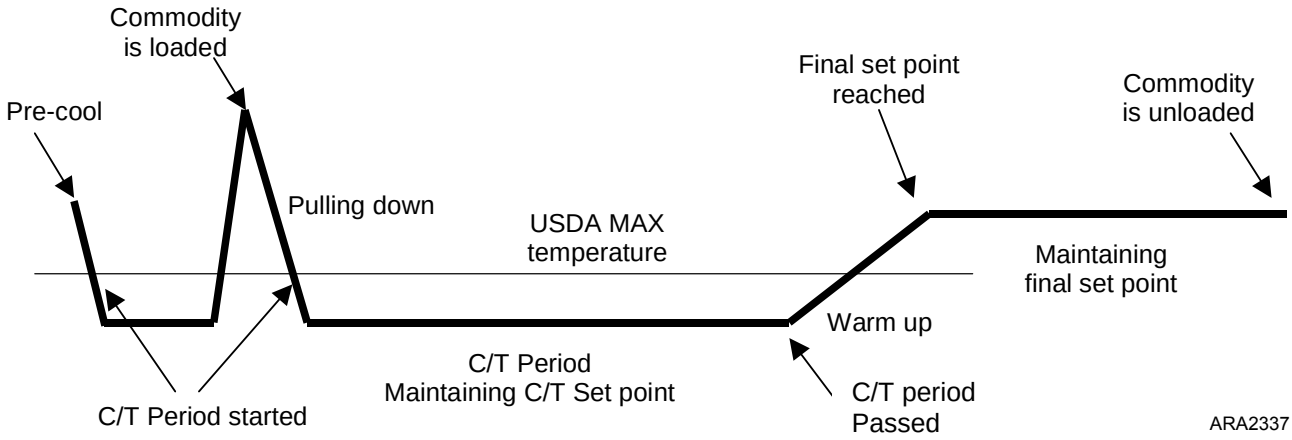
This feature is designed to maintain a temperature below the actual setpoint for a period of time (per USDA specifications), and then increase the temperature to the final setpoint. If at any time one of the USDA sensor temperature reading goes above the USDA Max the CT period will begin again.

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 33. Details of CT Log



Trip Action and Unit Mode

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

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

2023/04/27 11:33 KBD Cold Treatment Activity - Option made possible - not yet activated.
2023/04/27 11:33 KBD Cold Treatment Activity - C/t set point 0.0C.
2023/04/27 11:33 KBD Cold Treatment Activity - Period/Days 3days.
2023/04/27 11:34 KBD Cold Treatment Activity - USDA max 3.0C.
2023/04/27 11:34 KBD Cold Treatment Activity - Final set point 5.0C.
2023/04/27 11:39 KBD Cold Treatment Activity - DE-ACTIVATED/STOPPED before time.
2023/05/03 10:30 KBD Cold Treatment Activity - ACTIVATED.
2023/05/03 10:30 AUTO Cold Treatment Activity - Initiated. C/t SP:1.0C - USDA max:3.0C - Period:3days - Final SP:5.0C.
2023/05/03 13:32 AUTO Cold Treatment Activity - Period started. C/t SP:1.0C - USDA max:3.0C - Period:3days.
2023/05/04 14:31 AUTO Cold Treatment Activity - Period started. C/t SP:1.0C - USDA max:3.0C - Period:3days.
2023/05/07 15:00 AUTO Cold Treatment Activity - Period passed OK. 2023/05/08 10:30 AUTO Cold Treatment Activity - Ended. Final SP:5.0C.

Unit Requirements

To activate CT the unit must have:

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

Activating Cold Treatment

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

Calibrate Probe (Optional)

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

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

Ice Bath Preparation

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

Calibrating the USDA Sensors

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

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

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

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

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

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

Starting Cold Treatment

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

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

Stopping Cold Treatment

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

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

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

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

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

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

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

Controller Maintenance

Controller Replacement

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

> **⚠ Danger**
>
> **Hazardous Voltage!**
>
> **The unit can automatically start and operate if 460V/380V power is present, On/Off switch is in On, and circuit breaker is On. Before any repair in high voltage area, switch circuit breaker to Off, and disconnect power cord, place lock-out-mark to main power cable plug. Failure to follow these instructions could result in personal injury or dangerous electrical shock from high voltage controls.**

3. Disconnect the unit power cord from the power supply.
4. At the same time, remove the controller.
5. Install the replacement controller.
6. Connect the keyboard cable to the controller.
7. Connect the Harness to the controller.
8. Recheck all connector plugs to verify they are fully seated.
9. Review the Configurations Menu instructions ("Configuration Menu," p. 74). Reset information as required.

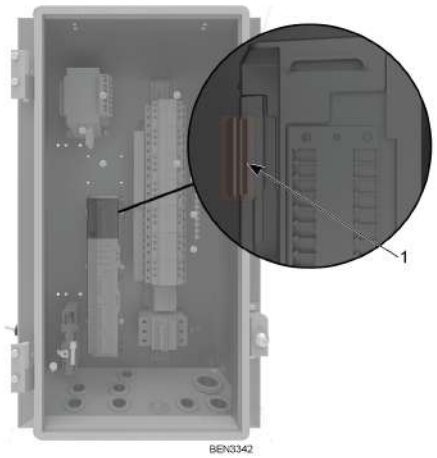
Notes:

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

Flashloading Controller Software

1. Copy release file "TK_Recovery_Update" from release folder to USB drive. Refer to "Standard USB Flash Drive Structure," p. 63 to see the files and folder.
2. Power down the unit completely.
3. Open the control box and plug in USB drive.

Figure 34. USB Location



1	Standard USB location (located inside the control box)

4. Power up the unit.
5. After about 30 seconds, the screen below is displayed.

BEN937

6. The flashload takes approximately five seconds. Upon completion, the screen below is displayed.

BEN938

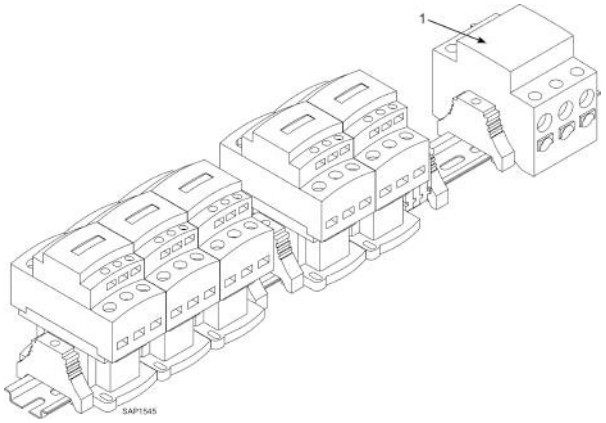
7. Remove the USB once this screen appears. This screen will remain displayed for approximately 10 seconds before reboot.
8. The rebooting takes approximately 45 seconds or until the splash screen/main display is displayed.

Electrical Maintenance

Unit Protection Devices

Main Circuit Breaker

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



1	Main Circuit Breaker

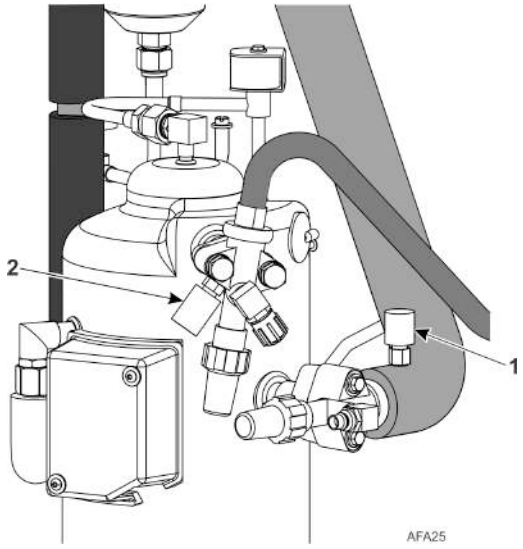
Evaporator Overheat Protection

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

High Pressure Cutout Switch

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

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



1	Low Pressure Cutout Switch
2	High Pressure Cutout Switch

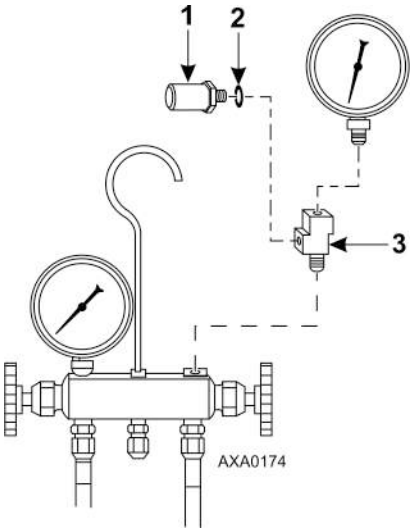
- The controller continues to call for cooling so the compressor will restart when the overload condition is corrected (switch resets) if power is available.
- If the switch remains open for five minutes, the controller also turns on the Alarm indicator and records Alarm 37 (Total Power Consumption Too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

The high pressure cutout switch opens at 3243 ± 7 kPa, 32.43 ± 0.48 bar, 470 ± 7 psig, and closes at 2586kPa, 25.9 bar, 375 psig. To test the switch, rework a gauge manifold in accordance with "High Pressure Cutout Manifold," p. 115.

High Pressure Cutout Manifold

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

High Pressure Cutout Manifold



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

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

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

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

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

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

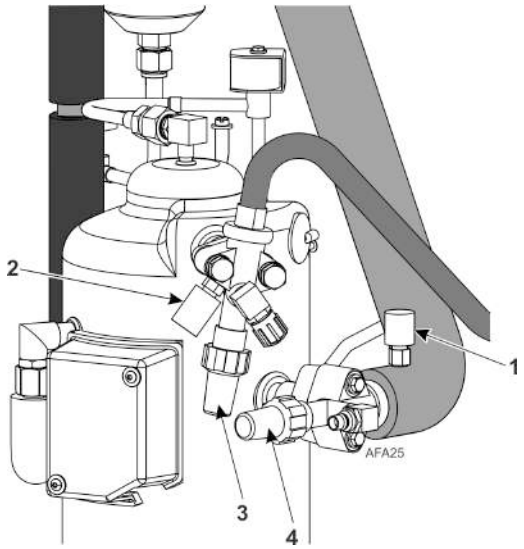
High Pressure Cutout Switch Removal/Installation

Removal

1. Isolate the compressor from the system.
   a. Front seat the discharge service valve by turning the valve fully clockwise.
   b. Front seat the suction service valve by turning the valve fully clockwise. Turn the digital service valve one quarter turn to the right.
2. Recover the refrigerant from the compressor. Refer to ("Recovering Refrigerant from System," p. 134).
3. Disconnect the high pressure cutout switch wires from the control box.
4. Remove the high pressure cutout switch from the compressor flange.

Installation

1. Apply Locktite sealant to the threads of the switch.
2. Install switch in compressor flange.
3. Pressurize the compressor with refrigerant and check for leaks.
4. Evacuate the compressor. Refer to ("Evacuation and Cleanup of Refrigeration System," p. 135).



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

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

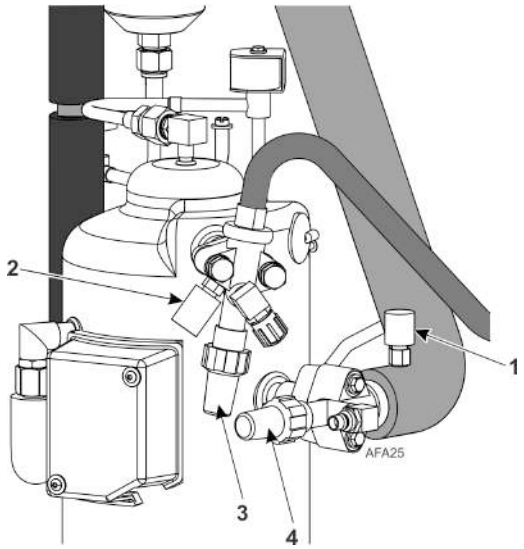
Low Pressure Cutout Switch

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

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

Removal

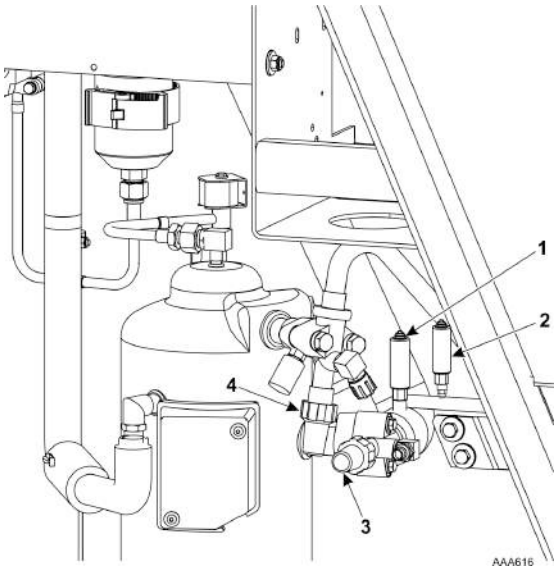
1. Disconnect the low pressure cutout switch wires from the control box.
2. Remove the low pressure cutout switch from the suction line. The fitting on the suction line has a shrader valve which will prevent refrigerant leakage.



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

Installation

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



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

Low Pressure Cutout Switch or Suction Transducer Configuration

These units could have either a Low Pressure Cutout switch or a Suction Transducer installed.

Low Pressure Cutout Switch Installed

Suction Transducer Installed

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

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

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

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

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

Alarm 120 SUCTION PRESSURE SENSOR ERROR output of sensor outside limits

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

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

Notice

Equipment Damage!

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

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

Discharge and Low Pressure Sensors (Optional)

The unit can be configured discharge only, suction only, or discharge and suction. The sensors are located on the discharge or suction tubes near the compressor. The controller will display the actual discharge or suction system pressure. The display will show a reading and a bar graph. If the unit is configured with a suction sensor, the LPCO will be eliminated.

To configure a sensor in the unit, refer to ("Configuration Menu," p. 74).

Removal

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

Installation

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

Condenser Fan and Evaporator Fan Rotation

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

Check Condenser Fan Rotation

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

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

Check Evaporator Fan Rotation

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

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

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

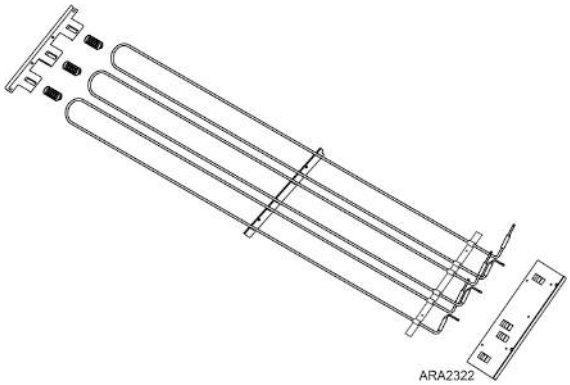
Note: *Evaporator fan motor wires EF1, EF2, and EF3 are used on low speed fan operation. Wires EF11, EF12, and EF13 are used on high speed fan operation.*

Evaporator Heater Selection

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

- Heater Long 1360 Watts (Normal) 45-2441
- Heater Long 2000 Watts (Extended) 45-2451

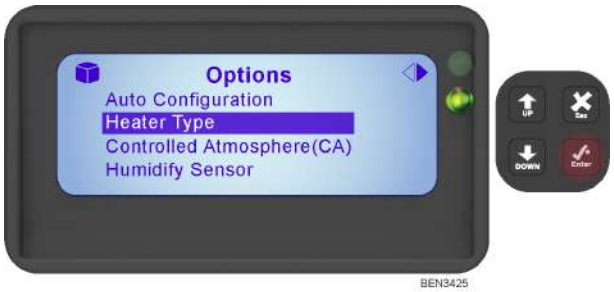
Three Longer Heaters (1360 or 2000 Watts Each)



Extended Capacity Heaters

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

Unit Configuration Menu



Heater Type

Electric Heaters Malfunction

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

1. Turn unit power supply off.
2. Remove unit power plug from power supply receptacle.

3. Open the control box door.
4. Test the insulation of each individual heater element.
   a. Test all three legs of the heater circuit to a good ground connection. Connect a calibrated 500 Vdc insulation tester between each outgoing heater contactor terminal and ground.
   b. If the resistance between any contactor terminal and ground is below 1.0 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 1.0 meg ohms, the heater element is defective. On a loaded container, remove the defective heater from service by disconnecting at the control box. If the container is empty, remove the evaporator cover from the rear of the unit and replace the heater or correct any defective wiring. Repeat step 5a.

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

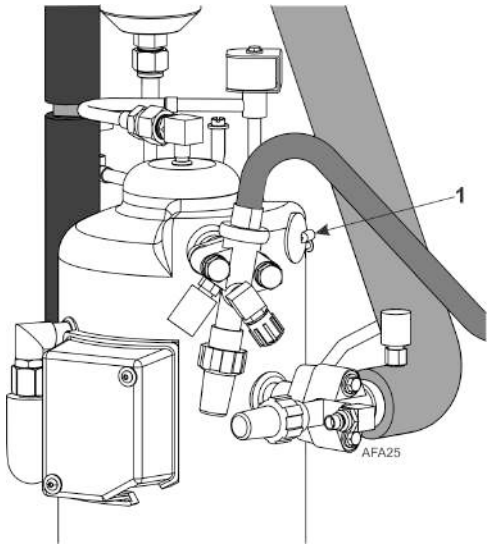
Compressor Discharge Temperature Sensor

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

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

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

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



1	Compressor Discharge Temperature Sensor

Replacement

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

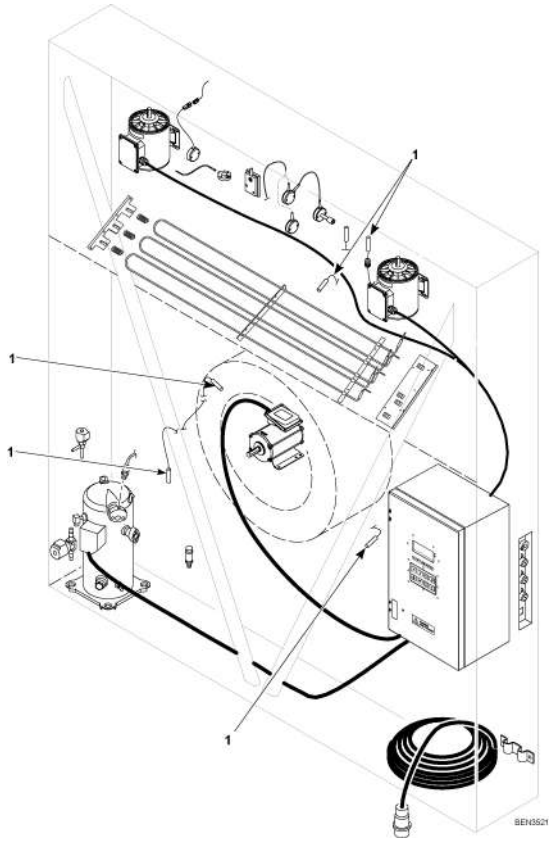
1. Shut off power to system.
2. Disconnect the compressor discharge sensor wires from J4A pin 11 and GRD on the controller.
3. Cut silicone seal under rim of sensor using razor blade.

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 J4A pin 11 and GRD on the controller.

Temperature Sensors

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

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



1	Temperature Sensors

Sensor Installation

All sensors should be properly installed as follows:

- Supply air sensors must be inserted to the bottom of the sensor tube and completely sealed by the grommet connection.

- Return air sensor installs in a grommet between the evaporator fans.
- Evaporator coil (defrost) sensor must be placed in the middle of the coil and 75 mm deep between the fins.
- Condenser sensor must be placed on the upper left side of the condenser coil and 70 mm deep between the fins.
- Ambient sensor must be placed on the bottom plate of the right forklift pocket.
- Compressor discharge temperature sensor is attached to compressor head by adhesive. Refer to ("Compressor Discharge Temperature Sensor," p. 121).

Sensor Testing

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

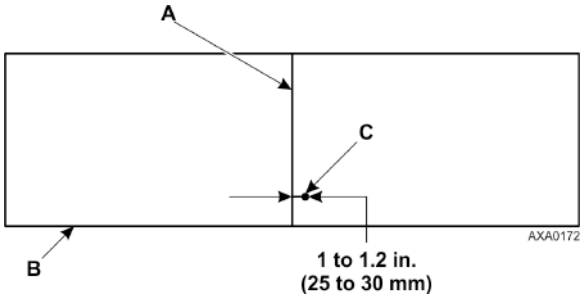
During a Probe test, the VGA display shows [PROBE TEST PLEASE WAIT]. The controller operates the unit on high speed evaporator fans only for five minutes. All sensor temperatures are then compared.

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

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

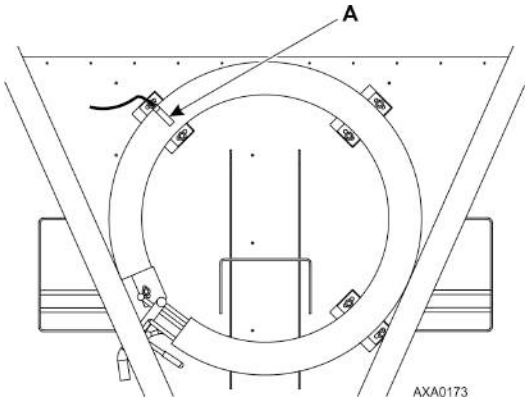
Note: *A manual probe test can be performed by a technician by selecting "SENSOR CHECK" from the Manual Test Function menu.*

Evaporator Coil (Defrost) Sensor Location



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

Condenser Coil Sensor Location



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

Resistance Values for Temperature Sensors

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

Table 10. Supply, Return, Evaporator Coil, Condenser Coil, and Ambient Air Sensors

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

Table 11. Compressor Discharge Sensors

°F	°C	Ohms	°F	°C	Ohms
-13	-25	1,121,457	185	85	9,202
-4	-20	834,716	194	90	7,869
5	-15	627,284	203	95	6,768
14	-10	475,743	212	100	5,848
23	-5	363,986	221	105	5,091
32	0	280,824	230	110	4,446
41	5	218,406	239	115	3,870
50	10	171,166	248	120	3,354
59	15	135,140	257	125	2,924
68	20	107,440	266	130	2,580
77	25	86,000	275	135	2,279
86	30	69,282	284	140	2,021
95	35	56,158	293	145	1,797
104	40	45,812	302	150	1,591
113	45	37,582	311	155	1,393
122	50	30,986	320	160	1,247
131	55	25,680	329	165	1,118

Table 11. Compressor Discharge Sensors (continued)

°F	°C	Ohms	°F	°C	Ohms
140	60	21,397	338	170	1,015
149	65	17,914	347	175	920
158	70	15,067	356	180	834
167	75	12,728	365	185	748
176	80	10,793	374	190	679

Refrigeration Maintenance

Introduction

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

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

Tools

Notice

System Contamination!

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

Vacuum Pump

A two-stage, three-stage, or five-stage pump is recommended for evacuation. Purging the system with dry nitrogen is recommended before evacuation. Because residual refrigerant may be present in used vacuum pumps, a new vacuum pump should be used and dedicated strictly as an R-404A/R-452A refrigerant pump. Use only recommended vacuum pump oils and change oil after every major evacuation. Because vacuum pump oils are highly refined to obtain low vacuums, failure to follow these recommendations may result in acidic conditions that will destroy the pump.

Filters and Cartridges

Cleanup devices such as suction line filters and compressor oil filters may be used if they are properly cleaned and new filters and cartridges are used. All standard petroleum and synthetic compressor oils must be removed to prevent the contamination of R-404A/R-452A systems.

Refrigerant Recovery Equipment

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

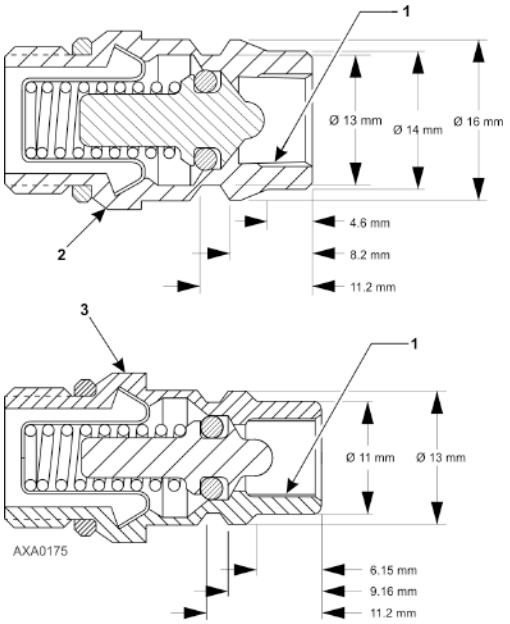
Detecting Leaks

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

Special Service Fittings

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

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



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

Oil Acid Test

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

Isolate Compressor

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

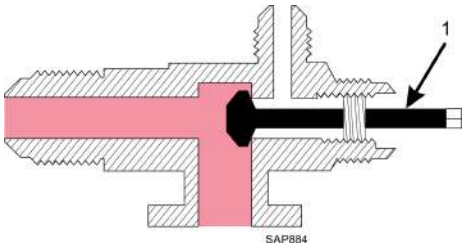
Note: *The valves are a permanently assembled unit and must be replaced in total if defective. The only maintenance possible on the discharge or suction service valve is to periodically tighten the packing nut or to replace the packing.*

⚠ Warning

Hazard of Explosion!

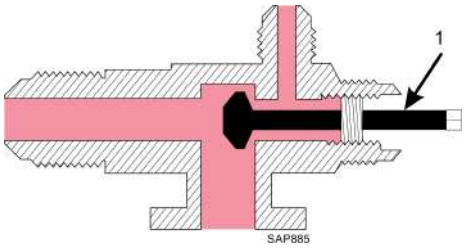
Do not start unit with discharge valve in front seated position.

Service Valve Back Seated (Operating Position)



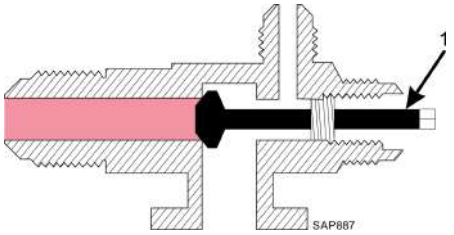
1	Full Counterclockwise

Service Valve Open to Port (Servicing Position)



1	1/2 Turn In

Service Valve Front Seated (Check or Remove Compressor)



1	Full Clockwise

Gauge Manifold Set

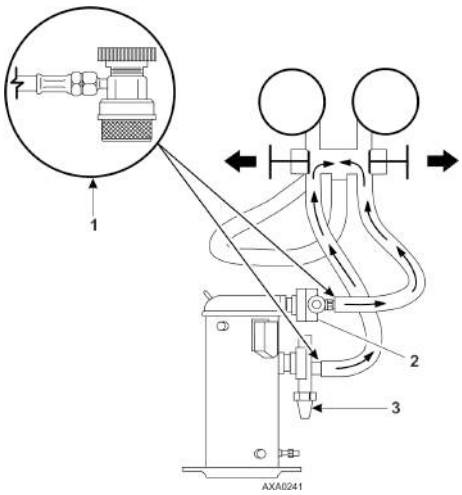
Using a New Gauge Manifold Set

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

Gauge Manifold Valve Positions

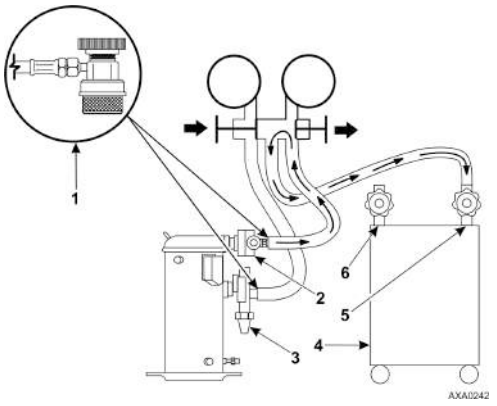
The gauges indicate low and high side pressures. Operate one or both hand valves to perform the different service operations.

Balancing the Pressure



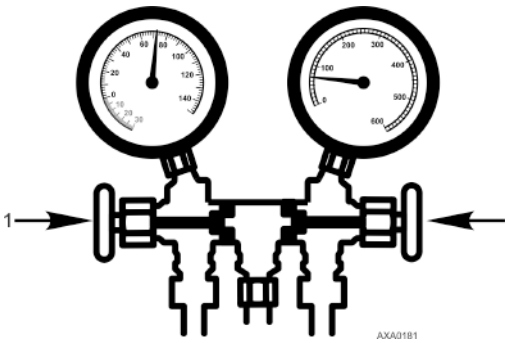
1	Quick Disconnect Access Valve
2	Discharge Service Valve (DSV)
3	Suction Service Valve (SSV)

Removing Refrigerant



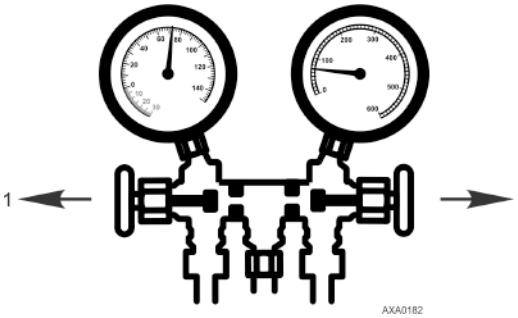
1	Quick Disconnect Access Valve
2	Discharge Service Valve (DSV)
3	Suction Service Valve (SSV)
4	Reclaimer
5	In
6	Out

Gauge Manifold Closed to Center Port



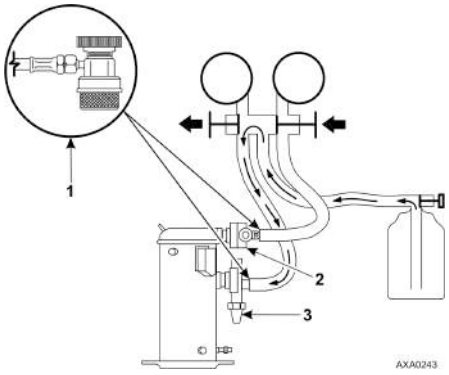
1	Close Hand Valves

Gauge Manifold Open to Center Port



1	Open Hand Valves

Charging the System



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

Gauge Manifold Set Installation and Removal

Thermo King recommends the use of access valves or self-sealing, quick disconnect fittings. This limits the loss of refrigerant into the atmosphere. A separate gauge manifold set with low loss fittings (refer to Tool Catalog) should be dedicated for use with R-404A/R-452A only. Gauge hoses should also be dedicated to R-404A/R-452A.

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

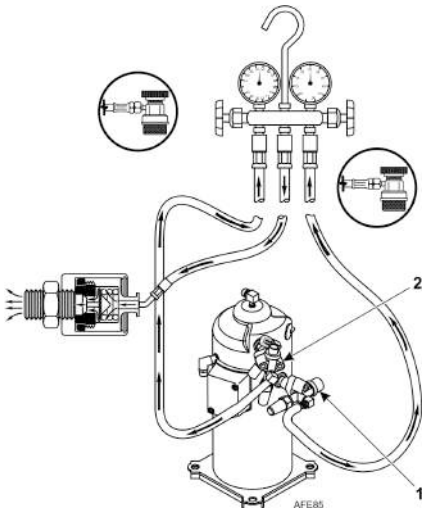
Installation

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

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

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

Purging Gauge Manifold



1	Suction Connection
2	Discharge Connection

Removal

⚠ Warning

Personal Protective Equipment (PPE) Required!

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

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

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

Checking Refrigerant Charge

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

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

Notice

Cargo Loss!

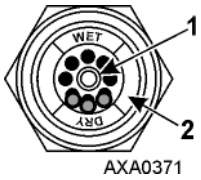
When adjusting the controller setpoint to check refrigerant charge, return controller to the setpoint indicated on the shipping manifest.

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

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

Receiver Tank Sight Glass

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



AXA0371

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

Leak Testing Refrigeration System

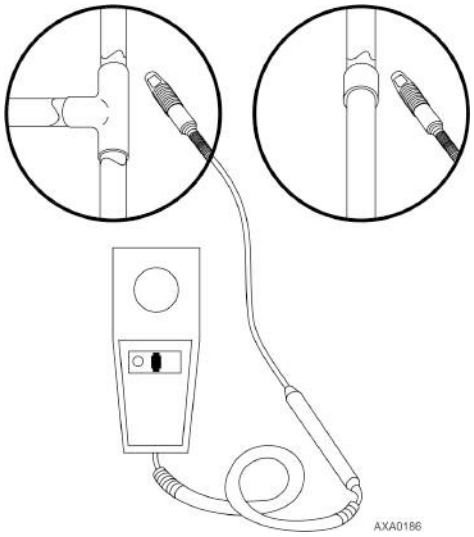
Use a reliable Halogen leak detector such as model H10G (refer to Tool Catalog), to leak test the refrigeration system. Inspect carefully for signs of compressor oil leakage which is the first sign of a leak in the refrigeration system.

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

If refrigerant has leaked or been removed from the unit:

1. Check entire system for possible component damage and refrigerant oil loss.
2. Attach gauge manifold set (Refer to "Gauge Manifold Set," p. 128 for proper procedures).
3. Attach refrigerant bottle charging hose to center of gauge manifold and purge charging hose of air.
4. Pressurize the system with refrigerant (gas only) until 345 kPa, 3.45 bar, 50 psig vapor pressure is achieved.
5. Leak check the system with an electronic leak detector to inspect all joints and connections (Use soap solution as an alternative test component). If no leaks are found but the system has lost its refrigerant charge, proceed to the next step.
6. Close both hand valves on gauge manifold (front seated).
7. Disconnect the refrigerant charging hose.
8. Connect the charging hose to a source of nitrogen. Adjust the pressure regulator to 1380 kPa, 13.80 bar, 200 psig. Refer to ("Using Pressurized Nitrogen," p. 133).
9. Pressurize the system with nitrogen to 1380 kPa, 13.80 bar, 200 psig.
10. Close the supply valve on the nitrogen bottle.
11. Use an electronic leak tester to inspect all joints and connections. Use a soap solution as an alternative test component.

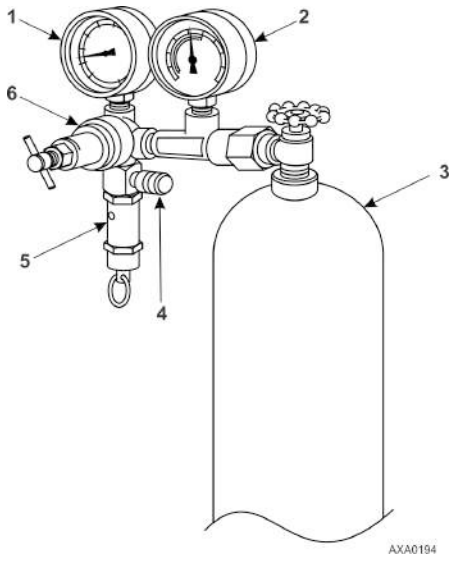
    Note: *If system leakage is indicated, loosen supply line hose fittings to release pressure. Repair leakage condition.*
12. If system repair is necessary, recheck system after repairs are completed.



Using Pressurized Nitrogen

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

Typical Pressurized Gas Bottle



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

Safety Precautions

Observe the proper handling of cylinders:

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

⚠ Caution

Risk of Injury!

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

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

Purge High Side to Low Side

1. Attach gauge manifold set (Refer to "Gauge Manifold Set," p. 128 for proper procedure for connecting to compressor).
2. Close both hand valves on the gauge manifold (front seated).
3. Connect charging hose to a source of nitrogen. Adjust pressure regulator to the proper pressure for the required procedure.

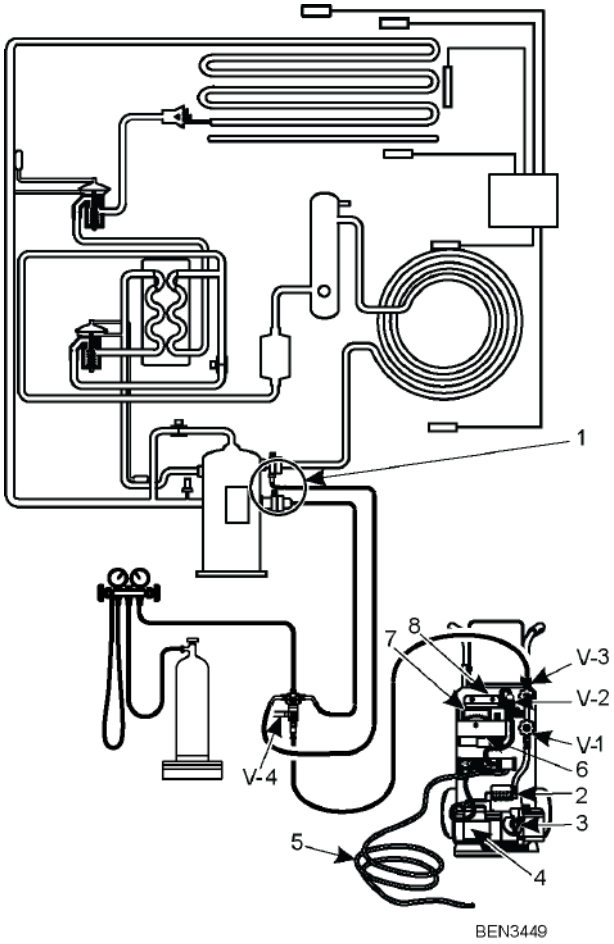
4. Purge system high side to low side.

Maximum Gas Pressures

The following procedures should utilize the following maximum gas pressure:

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

Figure 35. Evacuation Station and Unit Hook-up



1	Special, self-sealing quick disconnect couplers are required for R-404A/R-452A units	3	Iso Valve	5	To 220/190 Vac Power	7	Micron Meter
2	Gas Ballast Valve	4	Two-stage Vacuum Pump	6	Calibration Standard	8	Sensor

Recovering Refrigerant from System

Notice

Risk of Injury!

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

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

refrigerant from the unit includes the following:

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

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

Perform the following steps to recover vapor from the system.

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

Evacuation and Cleanup of Refrigeration System

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

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

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

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

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

Unit Preparation and Hookup

⚠ Caution

Risk of Injury!

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

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

Note: *Replace the one-piece filter drier when major system contamination requires evacuation and cleanup of the refrigeration system.*

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

Unit Evacuation

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

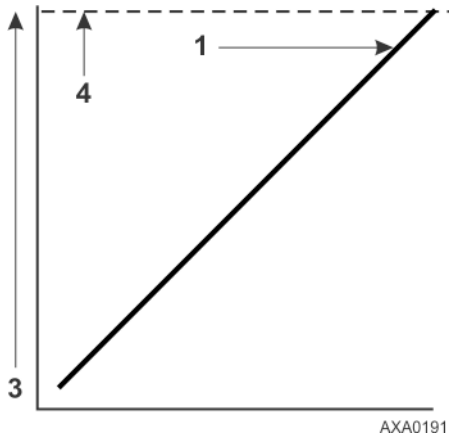
   When the meter has stabilized, the value indicated on the micron meter is the equilibrium pressure. This reading must be 2000 microns or less.

   Note: *The presence of refrigerant in the compressor oil may prevent a low vacuum reading from being achieved. Compressor oil can continue to outgas for long periods of time.*
2. If the vacuum level appears to stall above 500 microns, back seat the discharge service valve and observe the micron meter.
   - A drop in pressure indicates that the compressor oil is out-gassing and further evacuation is necessary.
   - An increase in pressure indicates that a leak exists or there is moisture in the system. Perform a pressure rise test and evaluate.
3. Close valve V1 when the desired vacuum level has been reached.
4. Wait five minutes and read the micron meter.
   - A system that is leak free and dry will remain below 2000 microns for five minutes.
   - A system that rises above 2000 microns but stabilizes below atmospheric pressure is probably contaminated with moisture or has refrigerant out-gassing from the compressor oil. Additional evacuation is required.
   - A system that continues to rise without stabilizing has a leak and must be repaired.
5. If the vacuum level remained below 2000 microns for five minutes, the unit is ready to charge. Refer to (“Charging System with Refrigerant,” p. 138).

Pressure Rise Test

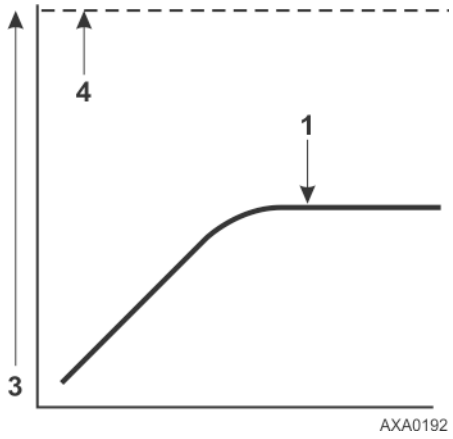
Evacuate the system and close valve V1. With valves V3 and V4 open, the pump is isolated and the system is held under a vacuum. If the micron meter rises, one of the following conditions exist:

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



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

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



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

Factors Affecting Speed of System Evacuation

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

- System size
- Amount of moisture contained in the system
- Ambient temperature
- Internal restrictions within the system
- External restrictions between the system and the vacuum pump

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

Heat Saves Time

⚠ Warning

Hazardous Gases!

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

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

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

Charging System with Refrigerant

Unit Charging by Weight (from an Evacuated Condition)

1. Close valve V4.
2. Open the gas ballast valve (located on top of the pump housing behind the handle).
3. Stop the vacuum pump.
4. Mid-seat the discharge valve.
5. Connect the refrigerant tank with gauge manifold to the evacuation station (Refer to "Unit Preparation and Hookup," p. 135).
6. Weigh the tank of refrigerant.
7. Check the unit data plate for the required weight of refrigerant charge. Subtract the amount of the charge to be input to your unit from the total weight of the tank of refrigerant. This provides final tank weight after the unit receives a full system refrigerant charge.
8. Set the refrigerant tank for liquid removal. Open the hand valve on the tank.
9. Turn the unit off.
10. Open the gauge manifold hand valve and charge liquid refrigerant into the system.
11. Close the refrigerant tank hand valve when the correct amount (by weight) of refrigerant has been added or if the system will take no more liquid. The unit is now ready to have the evacuation station removed.

Evacuation Station Removal

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

Compressor Replacement

Removal

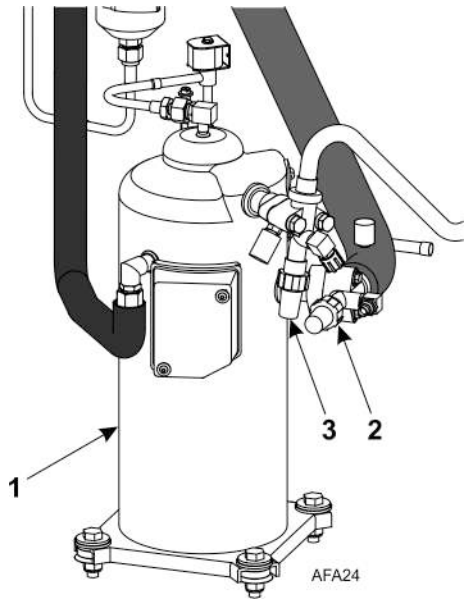
1. Remove the compressor compartment bracket.
2. Isolate the compressor from the system.
   a. Front seat the discharge service valve by turning the valve fully clockwise.
   b. Front seat the suction service valve by turning the valve fully clockwise.

c. Turn the digital service valve one quarter turn to the right. Refer to "Isolate Compressor," p. 127 for additional information.

3. Recover the refrigerant charge from the compressor. Refer to "Recovering Refrigerant from System," p. 134
4. Remove discharge service valve, suction service valve, digital control valve line and vapor injection valve line from the compressor.
5. Remove compressor discharge temperature sensor from the discharge valve manifold.
6. Disconnect the unit from the three-phase power supply.
7. Remove the three-phase electric power connection from the compressor.
8. Remove the compressor mounting tray bolts and nuts.
9. Slide the compressor from the unit.
10. Keep compressor ports covered to prevent dust, dirt, etc., from falling into compressor.

Installation

1. Slide the compressor into the unit. Install mounting bolts, washers and nuts, and tighten.
2. Bolt the discharge and suction service valves to the compressor. Use a new gasket coated with compressor oil on the discharge valve.
3. Connect vapor injection line and digital control valve line to compressor body.
4. Apply refrigerant locktite to the threads of the compressor discharge temperature sensor. Install the switches.
5. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 132).
6. If no leaks are found, recover the refrigerant used for the leak test (Refer to "Leak Testing Refrigeration System," p. 132).
7. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 135).
8. Connect three-phase electric power to the compressor.
9. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 138).
10. Perform a controller pretrip test to verify system operation.



1	Scroll Compressor
2	Suction Service Valve
3	Discharge Service Valve

Condenser Coil Replacement

Removal

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

Installation

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

   Important: *It is strongly recommended that dry nitrogen be used to purge the system during any solder operations (Refer to "Using Pressurized Nitrogen," p. 133).*
4. Perform a controller pretrip test to verify system operation. Check compressor oil level.
5. Pressurize the system and test for leaks (Refer to "Leak Testing Refrigeration System," p. 132). Repair leak if required.
6. Recover the leak test gas if no leaks were found.
7. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 135).
8. Replace the condenser coil support brackets, condenser fan shroud and condenser fan grille.
9. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 138).

Filter Drier/In-line Filter Replacement

Removal

1. Recover the refrigerant charge from the unit.
2. Place the new filter drier near the unit for immediate installation.
3. "Crack" both the inlet and outlet nuts on the filter drier. Use two wrenches on flare fittings to prevent line damage.
4. Separate the filter drier line mountings.
5. Remove the filter bracket clamping nuts and bolts.
6. Remove the old filter drier from the unit.

Installation

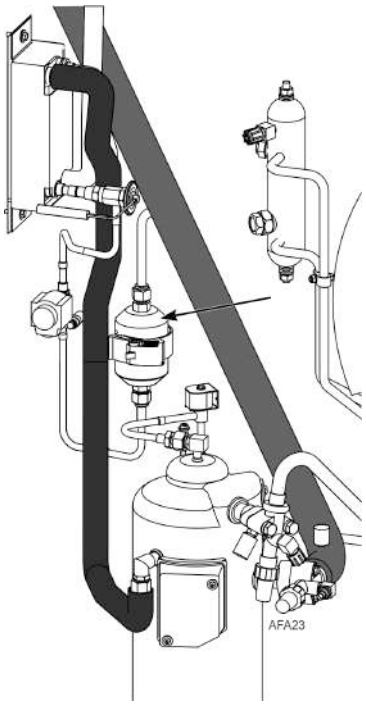
1. Remove the sealing caps from the new filter drier.
2. Apply clean compressor oil to filter drier threads.
3. Install new filter drier in unit. Finger tighten mounting nuts.

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

   Note: *Always hold the body of the dehydrator (or liquid filter) near the flange fittings. This will prevent twisting the tubing when the nuts are being loosened or tightened.*
6. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 132). Repair leaks if required.
7. Recover the refrigerant used for the leak test if no leaks were found.
8. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 135).
9. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 138).

10. Perform a controller pretrip test to verify system operation.

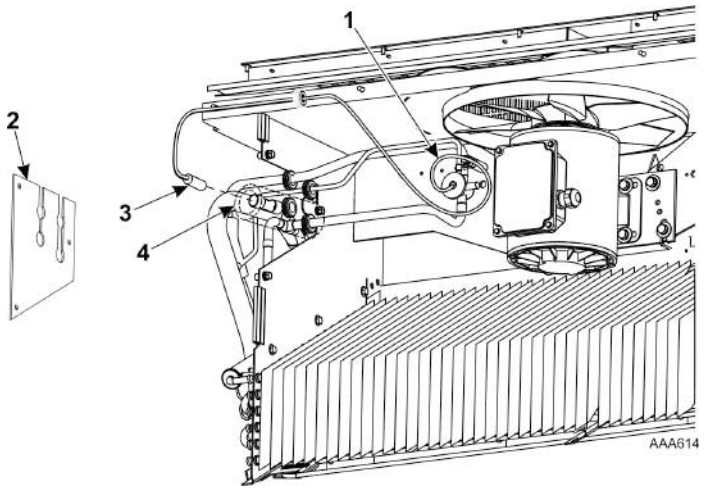
Figure 36. Filter Drier



Evaporator Expansion Valve (TXV) Replacement

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

1. Perform a low side pump down or reclaim charge depending on the unit. Release the 2-3 lbs pressure from the low side.
2. Open the evaporator access panel.
3. Install plywood or heavy cardboard on top of coil on the left and right side. This will protect the coil from damage.
4. Remove the left side motor and fan and position in right side opening. Do not unwire the motor the harness is long enough.
5. Remove TXV standoff mount.
6. Remove the panel to gain access to the TXV element.
7. Cut the one ty band off the insulation around the element. Peel back the insulation to expose the clamp holding the element. Loosen the clamp and remove the element from the tube.
8. Unsolder the three tubes to the TXV and remove the valve from the unit.
9. Prepare the tubes in the unit and on the new TXV for installation.
10. Solder in the new TXV. Use 15% silver solder 203-364.
11. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 132). Repair leak if required.
12. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 135).
13. Install element in tube on suction line. Tighten clamp. Reapply insulation around bulb and secure with a ty band.
14. Install the element access panel and install grommets. Install TXV mount.
15. Install left side motor and fan.
16. Open service valves or recharge unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 138).
17. Perform a controller pretrip test to verify system operation.



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

Economizer Expansion Valve Replacement

Removal

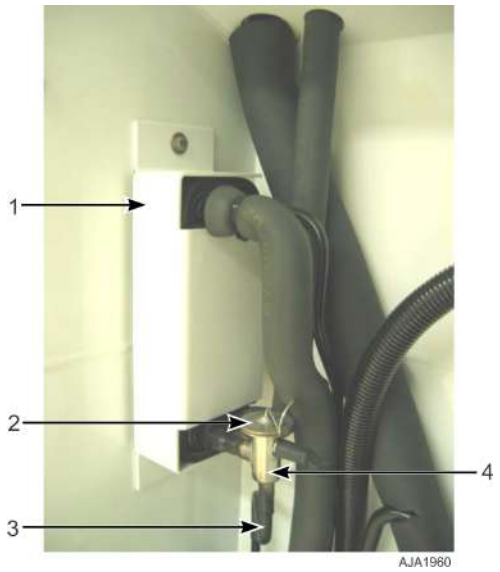
Remove the economizer expansion valve as follows:

1. Some units have a receive tank outlet valve, if the unit does perform a low side pump down and isolate the low side by closing the compressor service valves. If the unit does not have an outlet valve recover the refrigerant charge from the unit (Refer to "Recovering Refrigerant from System," p. 134).
2. On the feeler bulb carefully remove the outer insulation, to be reused. Remove cork tape from around element.
3. Unclamp feeler bulb from the suction line in the condenser section.
4. Clean element bulb tube holder and tube.
5. Heat and unsolder the inlet and outlet lines from economizer expansion valve.
6. Remove the old economizer expansion valve from unit and discard.

Installation

Install the economizer expansion valve as follows:

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

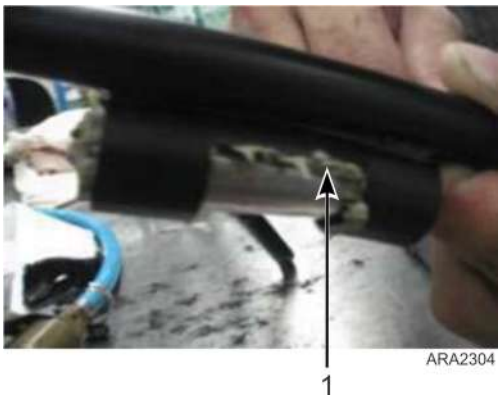


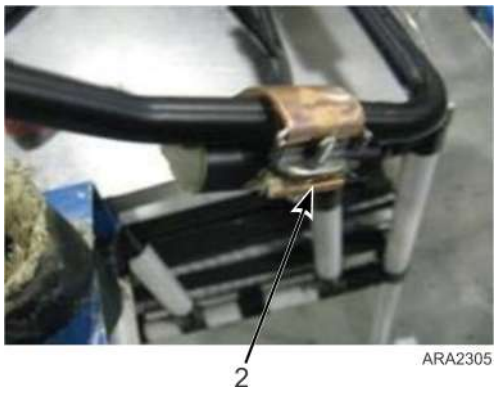
1	Economizer Heat Exchanger
2	Economizer Expansion Valve
3	Vapor Injection Line
4	Feeler Bulb Line

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

   Note: *Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (Refer to "Using Pressurized Nitrogen," p. 133).*

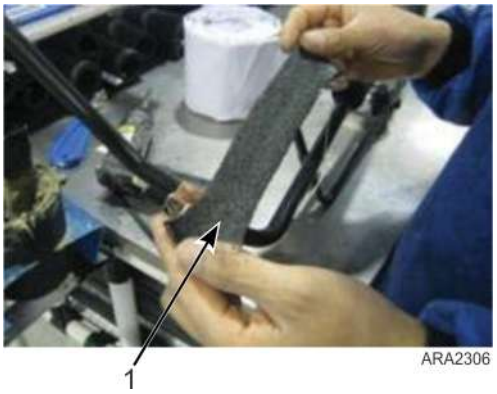
4. Pressurize the refrigeration system or the low side and check for leaks (Refer to "Leak Testing Refrigeration System," p. 132).
5. If no leaks are found, recover the refrigerant used for the leak test (Refer to "Recovering Refrigerant from System," p. 134).
6. Evacuate the system or the low side (Refer to "Evacuation and Cleanup of Refrigeration System," p. 135).
7. Locate feeler bulb in former position. The feeler bulb must make good contact or operation will be faulty. Apply heat transfer paste to element bulb holder and install bulb. Install clamp and tighten until bulb will not shift. See photos below.

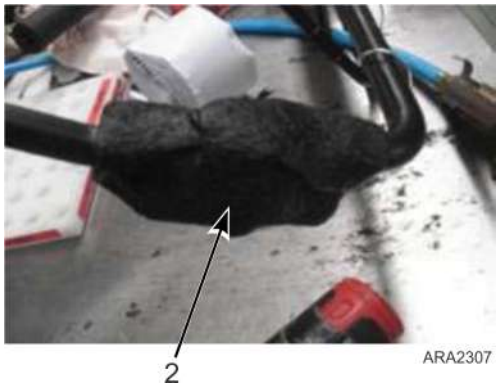




1	Apply heat transfer paste to bulb holder before installing TXV bulb.
2	Tighten clamp to verify bulb is secure.

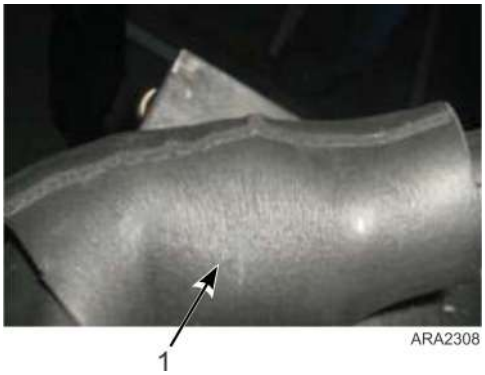
8. Apply cork tape around element making sure all air pockets are removed. See photos below.

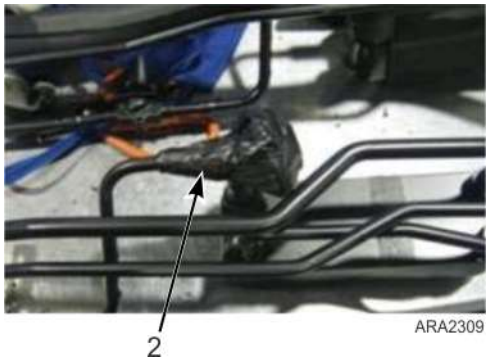




1	Wrap feeler bulb with cork tape.
2	Verify bulb is fully covered.

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





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

11. If low side pump down was performed open compressor service valves. Otherwise, recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 138).
12. Start unit and perform a PTI to check performance.

Economizer Heat Exchanger Replacement

Removal

1. Recover the refrigerant charge from the unit (Refer to "Recovering Refrigerant from System," p. 134).
2. Unsolder the two liquid and two suction line connections.
3. Unbolt the economizer heat exchanger from the mounting bracket.
4. Lift the heat exchanger assembly from the unit.

Installation

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

Important: *Thermo King strongly recommends that dry nitrogen be used to purge the system during any solder operations (Refer to "Using Pressurized Nitrogen," p. 133).*

3. Solder the liquid and suction lines to the economizer heat exchanger.
4. Pressurize the low side and check for leaks (Refer to "Leak Testing Refrigeration System," p. 132).
5. If no leaks are found, recover the leak test gas (Refer to "Leak Testing Refrigeration System," p. 132).
6. Evacuate the low side (Refer to "Evacuation and Cleanup of Refrigeration System," p. 135).
7. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 138).
8. Perform a controller pretrip test to verify system operation.

Receiver Tank/ Water-Cooled Condenser Tank Replacement

Removal

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

Installation

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

   Important: *It is strongly recommended that dry nitrogen be used to purge the system during any solder operations (Refer to "Using Pressurized Nitrogen," p. 133).*
3. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 132).
4. If no leaks are found, recover the refrigerant used for the leak test.
5. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 135).
6. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 138).
7. Perform a controller pretrip test to verify system operation.

Figure 37. Receiver Tank

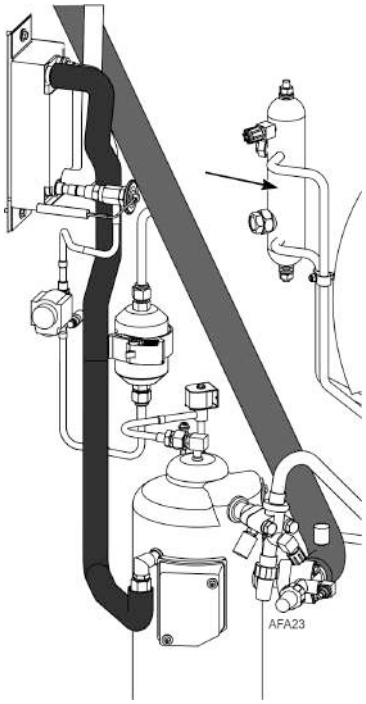
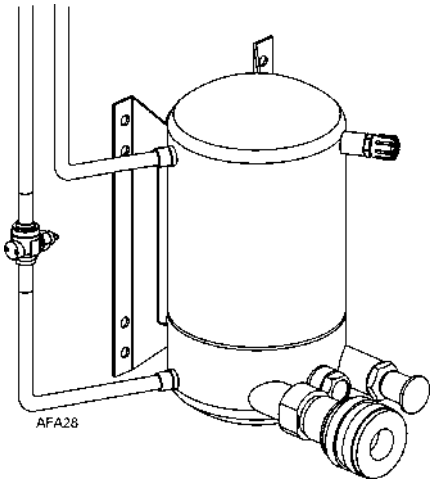


Figure 38. Water-Cooled Condenser Tank



Vapor Injection Valve Replacement

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

Removal

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

Installation

1. Clean the tubes for soldering.

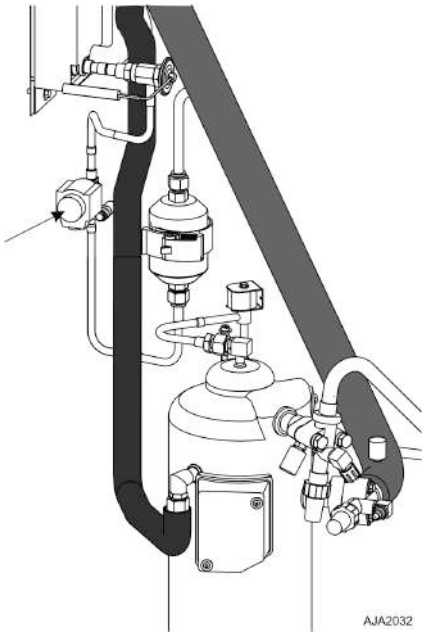
Notice

Equipment Damage!

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

2. Place the new valve in position and solder the liquid line connections.
3. Pressurize the refrigeration system and check for leaks (Refer to "Leak Testing Refrigeration System," p. 132). Repair leak if required.
4. Recover the refrigerant used for the leak test if no leaks were found.
5. Evacuate the system (Refer to "Evacuation and Cleanup of Refrigeration System," p. 135).
6. Recharge the unit with R-404A/R-452A (Refer to "Charging System with Refrigerant," p. 138).
7. Perform a controller pretrip test to verify system operation.

Figure 39. Vapor Injection Valve



Compressor Digital Control Valve Replacement

Removal

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

Installation

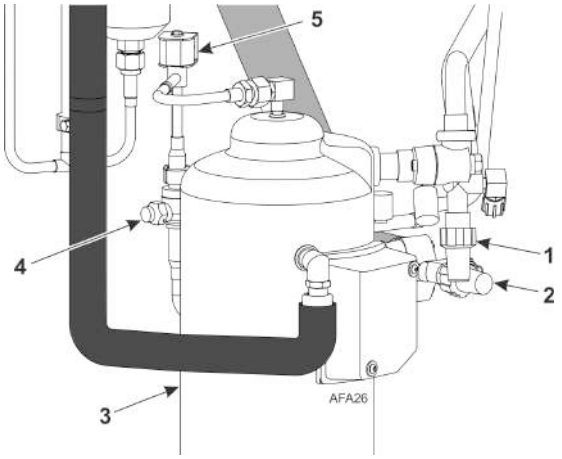
1. Clean the tubes for soldering.

Notice

Equipment Damage!

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

2. Place the new valve in position and solder the liquid line connections.
3. Perform a leak test (Refer to "Leak Testing Refrigeration System," p. 132). Repair leak if required.
4. Check the refrigerant charge (Refer to "Checking Refrigerant Charge," p. 131).
5. Reconnect the electrical wires to the valve.
6. Perform a controller pretrip test to verify system operation.



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

Servicing the Unit

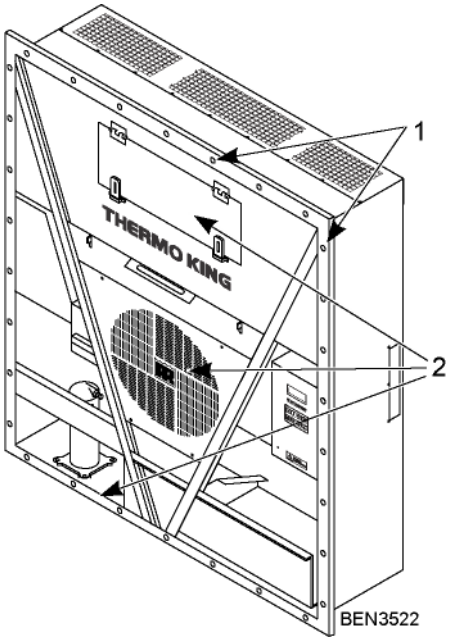
Taking Care of the Structure

Inspecting Unit

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

Checking Mounting Bolts

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



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

Cleaning the Condenser Coil

Notice

Equipment Damage!

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

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

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

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

Cleaning the Evaporator Coil

Notice

Equipment Damage!

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

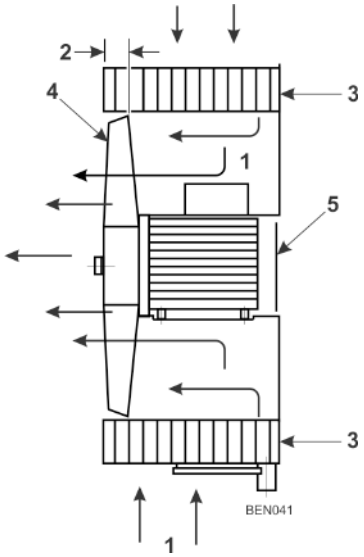
Clean the evaporator coil by blowing low pressure compressed air from the bottom side of the coil upward (opposite direction of normal airflow). Inspect coil and fins for damage and repair if necessary.

Cleaning the Defrost Drains

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

Positioning the Condenser Fan Blade

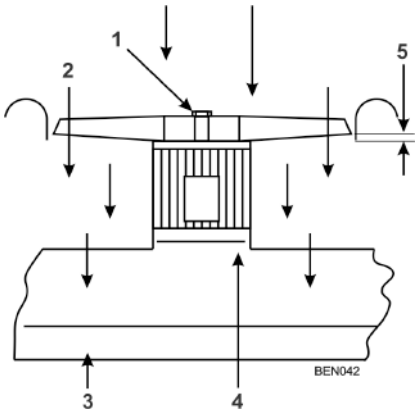
Place fan blade on motor shaft with hub located on the outside of the blade for proper airflow direction. When mounting the fan blade and hub assembly on the fanshaft, center the assembly in the orifice. Position the front of the fan blade 10 mm (0.4 in.) in from the outer edge of the fan orifice.



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

Positioning the Evaporator Fan Blade

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



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

Adjusting the Fresh Air Exchange System

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

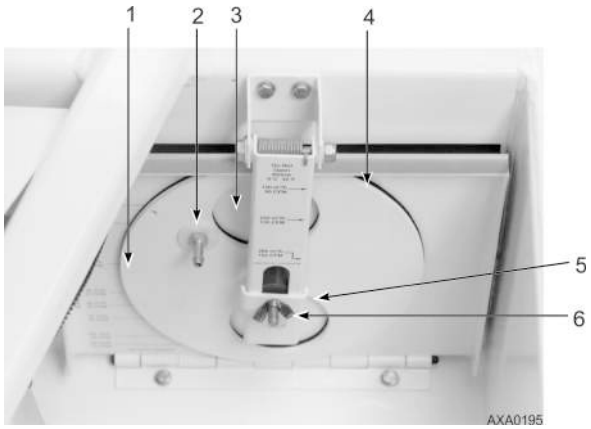
Note: *Set the disk or door position to the ventilation rate indicated on the shipping manifest.*

Disk Adjustment - Low Ventilation Rates

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

Handle Adjustment - High Ventilation Rates

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



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

Diagnostics

Introduction

This section includes the following:

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

The tables shown will help identify and fix unit problems.

MP-5000 Diagnostics

The MP-5000 can be a very helpful diagnostic tool. The following menu areas of the MP-5000 controller will help you diagnose problems occurring with the MAGNUM Plus™ unit.

Alarms and Messages: Displays the code conditions. Alarms and messages are recorded in the controller memory to simplify unit diagnostic procedures. Some alarm codes are only recorded during a Pretrip (PTI) test or function test. Messages are retained by the controller in a non-volatile memory. If the Red LED is on or flashing, enter the Alarms tabular menu to view the alarm.

Brief PTI Test: The MP-5000 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.

Full PTI Test: The MP-5000 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.

Functions Test: The MP-5000 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.

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

Values: Displays general unit operating information including temperature values, pressure and air values, internal values, voltage values, digital output and input values, and unit control values.

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

Mechanical Diagnostics

Condition	Possible Cause	Remedy
Compressor does not operate - no amperage draw.	Controller on; unit start sequence still timing.	Wait up to two minutes for compressor start-up.
	No power to unit (condenser and evaporator fans do not operate).	Locate fault and repair: power source, power plug, CB1 main circuit breaker, motor contactors, motor terminals, motor.
	Open in 29 Vac control circuit.	Check fuses and On/Off switch. Replace or repair as required.
	Container temperature does not demand compressor operation.	Adjust controller setpoint.
	Compressor contactor inoperative.	Replace compressor contactor.
	No output signal from controller.	Diagnose and replace the controller.
	Unit on defrost.	Turn Unit On/Off switch Off and then On again.
	Detective high pressure or low pressure cutout switch.	Replace defective switch.
	High condenser head pressure causing high pressure cutout.	Check refrigeration system and correct fault.
	Defective compressor.	Replace compressor.
	Controller shut unit down on Compressor Over Temperature.	Let compressor cool and controller will reset automatically. Check vapor injection valve and compressor temperature sensor.
	Compressor motor internal thermal overload protection open.	If compressor contactor is energized, wait 60 minutes for protector to cool and reset.
Compressor does not operate - excessive amperage draw or intermittent cycling on overload.	Rotating scroll stuck.	Replace compressor.
	Seized or frozen compressor bearings.	Replace compressor.
	Improperly wired.	Check/correct wiring against wiring diagram.
	Low line voltage.	Check line voltage - determine location of voltage drop.
	Contacts in compressor contactor not closing completely.	Check by operating manually. Repair or replace.
	Open circuit in compressor motor winding.	Check motor stator connections. Check stator winding for continuity. If open, replace compressor.
	Defective compressor motor internal thermal overload protector.	Replace thermal overload protector or compressor.
	Refrigerant overcharge or high side restriction causing cycling on high pressure cutout.	Check for restricted filter drier, in-line filter or high side; or refrigerant overcharge.
	Inefficient condenser operation causing cycling on high pressure cutout.	Check condenser airflow, condenser fan motor, fan blade, condenser grille, condenser coil temperature sensor, water pressure switch (option), water flow rate (option) and water-cooled condenser-receiver tank (option).
Compressor contactor burned out.	Low line voltage.	Increase line voltage to at least 90 percent of compressor motor rating.
	Excessive line voltage.	Reduce line voltage to at least 110 percent of compressor motor rating.
	Short cycling.	Eliminate cause of short cycling.

Condition	Possible Cause	Remedy
Unit short cycles.	Refrigerant overcharge causing cycling on high pressure cutout.	Purge system.
	Inefficient condenser operation causing cycling on high pressure cutout.	Check condenser airflow, condenser fan motor, condenser fan grille, condenser fan pressure switch, water pressure switch (option), water flow rate (option) and water-cooled condenser-receiver tank (option).
Noisy compressor	Loose mounting bolts.	Tighten mounting bolts.
	Oil slugging or refrigerant flooding back.	Perform controller pretrip test to check refrigerant charge. Check expansion valve adjustment. Check compressor for compressor oil.
	Scroll rotating backwards.	Check phase correction system and check unit wiring.
	Defective compressor.	Repair or replace compressor.
Condenser fan motor does not operate.	Unit in Heat or Defrost.	Check indicator. If unit is in Heat or Defrost, unit operation is normal (no remedy required).
	Unit in Cool with low condenser temperature.	Check indicator condenser temperature and discharge pressure. Condenser temperature may not require condenser fan operation (no remedy required; condenser fan also pulses on and off on a 30 second cycle to control condenser temperature).
	Water pressure switch closed (Water-cooled position) (Option).	If unit is on water cooled condenser operation, unit operation is normal. Otherwise water pressure switch must be Open for air-cooled condenser operation.
	Defective water pressure switch (option).	Replace defective switch.
	Loose line connection.	Tighten connections.
	Open motor internal thermal overload protector.	Check for seized bearings or defective thermal overload protector. Repair or replace as necessary.
	Defective motor.	Replace motor.
	Detective condenser fan contactor.	Replace defective contactor
	No condenser fan output signal from controller.	Diagnose and replace condenser fan contactor or controller.
Evaporator fan motor(s) does not operate.	Unit on defrost.	Check operating mode indicator LEDs.
	Loose line connection.	Tighten connections.
	Open motor internal thermal overload protector.	Check for seized bearings or defective thermal overload protector. Repair or replace as necessary.
	Defective motor.	Replace motor.
	No low or high speed evaporator fan output signal from controller output module.	Diagnose and replace output module or controller.

Refrigeration Diagnostics

Condition	Possible Cause	Remedy
Load temperature too high - unit not cooling.	Compressor does not operate.	Refer to ("Mechanical Diagnostics," p. 153).
	Controller setpoint too high.	Adjust controller setpoint.
	Defective container insulation or poor fitting doors.	Repair container.
	Shortage of refrigerant.	Repair leak and recharge.
	Overcharge of refrigerant.	Purge system.
	Air in refrigeration system.	Evacuate and recharge.
	Vapor injection valve open.	Check vapor injection valve circuit and compressor discharge temperature sensor.
	Too much compressor oil in system.	Remove compressor oil from compressor.
	Iced or dirty evaporator coil.	Defrost or clean evaporator coil.
	Restricted lines on high side.	Clear restriction.
	Plugged filter drier/in-line filter.	Change filter drier.
	Compressor Digital Control Valve defective.	Replace defective valve.
	Condenser coil dirty or airflow restricted.	Clean condenser coil, clear restriction, or repair or replace fan motor or condenser fan blade.
	No water flow to water-cooled condenser.	Restore water flow to water-cooled condenser-receiver tank.
	Defective water pressure switch (Option).	Replace switch.
	Expansion valve open too much.	Adjust or replace valve.
	Expansion valve power element lost its charge.	Replace power element.
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact.	Correct feeler bulb installation.
Head pressure too low. ***Note:*** *This unit has a digital capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is in Modulation Cool (control temperature within 10 C (18 F) of setpoint or in Power Limit mode).*	Shortage of refrigerant.	Repair leak and recharge.
	Low ambient air temperature.	No remedy.
	Service gauge out of calibration.	Replace gauge.
Head pressure too high.	Refrigerant overcharge.	Purge system.
	Air in refrigeration system.	Evacuate and recharge.
	Dirty or restricted condenser coil.	Clean condenser coil.
	Condenser fan not operating.	Refer to "Condenser Fan Motor Does Not Operate" ("Mechanical Diagnostics," p. 153).
	Condenser fan grille damaged or missing.	Repair or replace grille.
	Condenser fan blade damaged.	Replace fan blade.
	High ambient air temperature.	No remedy.
	Restricted dehydrator or high side.	Replace filter drier or clear restriction.
	Defective service gauge.	Replace gauge.

Condition	Possible Cause	Remedy
Compressor loses oil.	Refrigerant leak.	Repair leak and recharge.
Compressor oil migrates to system.	Short cycling.	Refer to "Unit Short Cycles" ("Mechanical Diagnostics," p. 153).
Rapid cycling between Cool, Null, and Heat modes.	Air short cycling through evaporator.	Check and correct cargo load.
	Defective controller.	Diagnose the controller. Replace defective component.
	Short cycling.	Refer to "Unit Short Cycles" ("Mechanical Diagnostics," p. 153).
	Compressor Digital Control valve stuck close or defective.	Replace valve.
Hot liquid line.	Shortage of refrigerant.	Repair or recharge.
	Expansion valve open too wide.	Adjust or replace expansion valve.
Frosted liquid line.	Liquid line restricted.	Remove restriction.
	Restricted filter drier.	Replace filter drier.
Frosted or sweating suction line.	Expansion valve admitting excess refrigerant.	Check feeler bulb and adjust expansion valve.
	Evaporator coil needs defrosting.	Check defrost circuit including controller and evaporator coil sensor.
	Evaporator fan does not operate.	Refer to "Evaporator Fan Motor Does Not Operate" ("Mechanical Diagnostics," p. 153).
Unit in vacuum - frost on expansion valve only.	Ice plugging expansion valve screen or orifice.	Apply hot wet cloth to expansion valve. Moisture indicated by increase in suction pressure. Replace filter drier.
High suction pressure.	Overcharge of refrigerant.	Purge system.
	Expansion valve open too much.	Adjust or replace valve.
	Defective controller.	Diagnose the controller. Replace defective component.
	Service gauge out of calibration.	Adjust or replace service gauge.
Low suction pressure. ***Note:*** *This unit has a digital capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is in Modulation Cool (control temperature within 10 C (18 F) of setpoint or in Power Limit mode).*	Shortage of refrigerant.	Repair leak and recharge.
	Low ambient air temperature.	No remedy.
	Iced or dirty evaporator coil.	Defrost or clean evaporator coil.
	Restricted lines.	Locate and clear restriction.
	Plugged filter drier.	Replace filter drier.
	Expansion valve closed too much.	Adjust or replace valve.
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact.	Correct feeler bulb installation.
	Evaporator fans off.	Check evaporator fan motors and control circuit and correct fault.
	Defective controller.	Diagnose the controller. Replace defective component.
	Service gauge out of calibration.	Adjust or replace gauge.

Status Messages and Controller Actions

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

Status Message	Description	Controller Action/Corrective Action
1	High Pressure Cut Out - Check Water Cooling • When: – If HPCO is detected and the configuration is set to water cooled condenser. • Indicates: – Poor cooling water supply.	• Controller auto clears message 10 minutes after compressor start-up. • Water cooled condensing may be wrongly selected.
6	High Pressure Cut Out - Check Condenser Probe • When: – Unit stops due to high pressure cutout and the condensing temperature regulation has not activated the condenser fan. • Indicates: – Wrong location of condenser probe.	• Controller auto clears message 10 minutes after compressor start-up. • Check location of condenser probe.
8	High Pressure Cut Out - Please Wait • When: – Unit stops due to high pressure cutout and the condensing temperature regulation has activated the condenser fan. • Indicates: – Poor cooling of the refrigerant.	• Controller auto clears message 10 minutes after compressor start-up. • Check for high ambient temperature. • Check condenser fan rotation. • Check for blocked condenser coil.
13	Evaporator High Temperature - Check Heater System • When: – If the state "Hot Evaporator Section" is active and the control calls for heat, the message is set. – The state "Hot Evaporator Section" is defined either by: • RA probe error and Defrost probe error. • RA, SA, or defrost probe is above 50C. – The message is held by a 60 second timer after the conditions clear. • Indicates: – Evaporator section temperatures are high. • Supply Air, Return Air, and Defrost indicates high temperature.	• Enter Manual Function Test menu and test (operate) heating element. Check volts and amps to determine problem. • Use DATA menu to evaluate evaporator section sensors. • Use PROBE TEST to evaluate if evaporator sensors are reading correctly.
20	Low Voltage On Line - Unit Stopped • When: – Low voltage observed, voltage has been below 330 VAC and has not risen above 340 VAC yet. – After 30 minutes this message will set the low voltage alarm. • Indicates: – Poor quality of power source.	• Enter Manual Function Test menu and test (operate) components to load the power source. • Check volts and amps to help determine the problem.

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

Status Message	Description	Controller Action/Corrective Action
26	Evaporator Coil Temperature Too Low - Check Evaporator Sensor • When: – During Chill or Frozen Mode: Evaporator coil temperature is too low compared to return air temperature under operating conditions. The state will by time request extended defrost, defrost or/and probe test. • Indicates: – Ice on the evaporator coil, need for defrost. – Probe error.	• Use DATA menu to inspect readings. • Enter Manual Function Test menu and operate evaporator fan at high speed to evaluate probe spread.
27	System Low Pressure - Check Refrigerant Charge • When: – The message is related to the capacity surveillance system which observes the reefer machine capability to create a temperature drop between return air and supply air when expected to be running at high capacity. • Action: – If the expected delta temperature is not reached, the message is set and the evaporator fans stopped to prevent heating the cargo. • Indicates: – Lack of refrigerant.	• Check Refrigerant level. • Check for refrigerant flow through the system, look for restrictions.
28	Frozen Setpoint - Check Air Exchange • When: – If AVL door is open in frozen set point mode. • Indicates: – Air ventilation ought to be in position closed when running within frozen mode.	• Check air ventilation door position.
30	High Pressure Cut Out - Please Wait • When: – Unit stop due to high pressure cutout signal from the HPCO switch. – The message will clear when the input signal indicates normal condition. • Indicates: – Poor or missing cooling of the refrigerant. • Action: – The state will stop / remove the compressor run signal. – The state will overrule regulation of the condenser fan and starts the fan. – This state will activate and hold message 31 as long as the input signal indicates HPCO.	• Controller clears message on compressor start-up. • No direct alarm action based on this situation. • If the state continues: – Check for airflow through the condenser coil, air flow might be blocked. – Check for condenser fan rotation and direction, must suction air through the coil and blow air out through the grill.

Status Message	Description	Controller Action/Corrective Action
31	HPCO Timer Hold - Please Wait • When: – The message is timer based to protect the compressor from starting at high pressure. The message will go away when the holding time after HPCO gets normal has run out. • Indicates: – HPCO present or has just been present. • Action: – The state will stop / remove the compressor run signal. – The state will overrule regulation of the condenser fan and starts the fan. – This state will activate and hold message 31 as long as the input signal indicates HPCO.	• Controller clears message on compressor start-up. • No direct alarm action based on this situation. • If the state continues: – Check for airflow through the condenser coil, air flow might be blocked. – Check for condenser fan rotation and direction, must suction air through the coil and blow air out through the grill.
32	Low Pressure Cut Out - Please Wait • When: – Unit stops due to low pressure cutout signal from the HPCO switch or the suction pressure reading (if present). – If suction pressure sensor is mounted the signal level for LPCO is below -0.27 bar to activate LPCO state and above +0.38 bar to clear the state. – The message will clear when the input signal indicates normal condition. • Indicates: – Possible causes include low refrigerant charge, defective low pressure cutout switch or open circuit, block TXV or suction line restriction etc. • Action: – The state will stop / remove the compressor run signal. – This state will activate and hold status message 33 as long as the input signal indicates LPCO.	• Controller activates Alarm Code 31 after five minutes. • Controller clears message after compressor start-up.
33	LPCO Timer Hold - Please Wait • When: – The message is timer based to protect the compressor from starting before the pressure has risen from low pressure. The message will clear when the holding time after LPCO gets normal has run out. • Indicates: – LPCO present or has just been present.	• Controller clears message on compressor start-up. • No direct alarm action based on this situation.
34	Compressor Too High Temperature Timer – Please Wait • When: – If the compressor temperature gets above 148C, the message is set. – The message will clear when the compressor temperature has been below 137C for 60 seconds. – The message will (also) clear when the compressor temperature gets below 132C. • Indicates: – Compressor stops because discharge temperature is above 148 C (300 F). Message remains in display until discharge temperature decreases to normal. • Action: – The state will stop / remove the compressor run signal. – The state will overrule regulation of the condenser fan and starts the fan.	• The message clears itself when the compressor temperature is normal.

Status Message	Description	Controller Action/Corrective Action
35	Compressor High Temperature • When: – If the compressor temperature gets above 138C, the message is set. – The message will clear when the compressor temperature gets below 132C. • Action: – Compressor running at high discharge temperature results in economizer/vapor injection will be active until discharge temperature decreases to normal. – In temperature log the state will be represented by the char 'c' (small c).	• The message clears itself when the compressor temperature is normal.
36	AVL Open - Check FAE and CA Settings • When: – If configuration is AVL, the setting is below 125CMH and the AVL sensor indicates full open / dismounted door, the message is set. • Indicates: – Wrongly dismounted air ventilation door.	• Check gas analyzer readings.
37	CO2 Reading Stuck for greater than 24 Hours • When: – With TK Fresh Plus option the CO2 level is constantly monitored. If the reading does not change / fluctuates minimum 0.1% within 24 hour the message is set. – The message will clear itself 10 minutes after a change has been observed.	• Check air exchange position vs setting. • Check gas analyzer readings.
38	High Voltage On Line • When: – High voltage observed, voltage has been above 515 Vac. The message will clear when voltage gets below 500 Vac. • Indicates: – When the message is set, a power line value log is made in the event log, i.e., "CURR: 0.2A PH1: 0.2A PH2: 0.2A PH3: 0.3A VOLT: 529V FREQ: 63Hz ".	• Enter Manual Function Test menu and test (operate) components to load the power source. • Check volts and amps to help determine the problem. • Possible cause for the problem is a wild running generator set.
39	Battery Charger/Heater - Check Battery • When: – The data logger battery charger reports battery charging suspended due to low temperature and the battery internal heater has been on for two hours, the message is set. • Indicates: – Fault in the data logger battery circuit.	• Check for battery position, placement, and wiring.
40	12V/5V Sensor PSU Problem • When: – If the sensor supply (+ 12 Vdc) for the humidity or (+5 Vdc) pressure transducers is not able of supplying the 12 Vdc or 5 Vdc. • Indicates: – Too high load on the sensor supply. – Due to overload of the sensor supply, the power supply is not capable of enabling the 12 Vdc or 5 Vdc supply for the transducers.	• Check for overload of the 12 Vdc or 5 Vdc transducer supply which is used for: – humidity transducer J1A pin 1 – suction pressure transducer J1A pin 5 – discharge pressure transducer J1B pin 8 – AVL transducer J1B pin 2 • Search for short circuit transducer or wire, between the 12 Vdc or 5 Vdc pin/wire to ground.

Alarm Codes and Corrective Actions

Note: *Sensors used with the MP-5000 controller do not require calibration. Check sensor resistance with an ohmmeter.*

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

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

Code	Description	Corrective Action
00	Supply Air Temperature Sensor Open Circuit • When the sensor circuit resistance is higher than 1300Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a PT1000 – 2 wire sensor, connected to the MP-5000 at connector J3A pin 1 and 3. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can not be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a PT1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this PT1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).
01	Supply Air Temperature Sensor Short Circuit • When the sensor circuit resistance is lower than 602Ω. • Indicates: – Short circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a PT1000 – 2 wire sensor, connected to the MP-5000 at connector J3A pin 1 and 3. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can not be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a PT1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this PT1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).

Code	Description	Corrective Action
02	Return Air Temperature Sensor Open Circuit • When the sensor circuit resistance is higher than 1300Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a PT1000 – 2 wire sensor, connected to the MP-5000 at connector J3A pin 5 and 7. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can not be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a PT1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this PT1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).
03	Return Air Temperature Sensor Short Circuit • When the sensor circuit resistance is lower than 602Ω. • Indicates: – Short circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a PT1000 – 2 wire sensor, connected to the MP-5000 at connector J3A pin 5 and 7. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can not be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a PT1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this PT1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).

Code	Description	Corrective Action
04	Evaporator Coil Temperature Sensor Open Circuit • When the sensor circuit resistance is higher than 1300Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a PT1000 – 2 wire sensor, connected to the MP-5000 at connector J3A pin 9 and 11. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can not be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a PT1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this PT1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).
05	Evaporator Coil Temperature Sensor Short Circuit • When the sensor circuit resistance is lower than 602Ω. • Indicates: – Short circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a PT1000 – 2 wire sensor, connected to the MP-5000 at connector J3A pin 9 and 11. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can not be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a PT1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this PT1000 sensor is -100°C (602Ω) +75°C (approx 1300Ω).

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

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

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

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

Code	Description	Corrective Action
18	Power Supply Phase Error • Shutdown Alarm • The current transmitter and/or controller is not capable of detecting the rotation direction. • Indicates: – Phase(s) missing at the power supply line. – Current transmitter and/or Controller failure. – Heating element problem (used for current load to decide the rotation direction).	• Check power line voltage on all three phases. • Use the tester to detect the problem. • Replace the current transmitter and/or controller.
19	Temperature Too Far From Set Point • Occurs during Normal Run only. • After 75 minutes of operation, supply or return air temperature is not in-range and does not approach setpoint within preset pull-down rate. • Indicates: – Ice or frost on evaporator coil. – Low refrigerant charge. – Air exchange vent open too much. – Container air leakage (doors open).	• Use DATA menu to check supply and return air sensor temperatures. • Compare temperatures to evaluate unit cooling capacity and performance. • Temperature difference should be 4 C to 6 C (7.2 F to 10.8 F). • Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. • Check refrigerant charge. ***Note:*** *This alarm can be activated if the supply or return air temperature varies, even if the mean temperature does approach setpoint.*
20	Defrost Duration Too Long • May occur during any defrost. • Heat signal has been on for too long. • Time limit is 90 minutes with supply voltage above 440VAC and 120 minutes below 440VAC. • Indicates: – Low power supply voltage. – Defective heater elements. – Evaporator fans running during defrost. – Evaporator sensor placed wrong.	• Initiate a manual defrost and check amperage draw and evaporator coil temperature. Evaluate defrost performance. • Open evaporator door and check location of evaporator coil sensor. ***Note:*** *This alarm can be activated at low voltage and very low box temperature conditions, even under normal operating conditions.*
22	Capacity Test 1 Error • Occurs during pretrip (PTI) test only. • Difference between supply and return air temperature is too small with high speed evaporator fans (less than approximately 4.5 C [8 F]). • When the return air temperature does not reach -18 C (0 F) within preset time. • Indicates: – Incorrect location of supply or return air sensor. – Air leakage at supply sensor cable. – Defective supply or return air sensor. – Interchanged sensor connections. – Incorrect evaporator fan rotation or high speed operation. – Incorrect refrigeration system operation. – Container/side panels defective, damaged or leaking. – Economizer circuit defective.	• Enter Manual Function Test and start evaporator fans on high speed and let operate fans for 5 minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (evaporator coil may be 0.5 C [1.0 F] lower due to fan motor heat). • Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on high speed. • Check the sensor connections. • Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, vapor on, condenser fan and evaporator fans (high). Check discharge and suction pressure readings. Also check the refrigerant charge. ***Note:*** *This alarm can be activated in ambient temperatures below -10 C (14 F), even under normal conditions.*

Code	Description	Corrective Action
23	Capacity Test 2 Error • Occurs during pretrip (PTI) test only. • When the supply air temperature does not reach 0 °C (32 F) within preset time. • Indicates: – Incorrect location of supply air sensor. – Air leakage at supply sensor cable. – Defective supply air sensor. – Interchanged sensor connections. – Incorrect evaporator fan rotation or high speed operation. – Incorrect refrigeration system operation. – Container/side panels defective, damaged or leaking. – Air exchange vent open too much. – Low refrigerant charge. – Cooling circuit defective.	• Enter Manual Function Test and start evaporator fans on high speed and let operate fans for five minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (supply air may be 0.5 °C [1.0 F] higher due to fan motor heat). • Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on low and high speed. • Check the sensor connections. • Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, vapor on, condenser fan and evaporator fans (high). Check discharge and suction pressure readings. Also check the refrigerant charge.
26	Vapor Injection Error • Occurs during pti, brief pti and function tests. • Power consumption does not increase when activating economizer valve. • Current consumption not correct for valve position.	• Enter Manual Function Test and start compressor and evaporator fans on high speed, with digital valve off, operate vapor injection valve and observe current consumption change. An increase in current consumption is expected. • Check vapor valve function. • Evaluate economizer Tx valve operation. ***Note:*** *This alarm can be activated in low ambient temperatures where condenser temperature may not be high.*
31	Low Pressure Cut Out • If low pressure switch is mounted. – The switch is OPEN. • If pressure transducer is mounted. – The suction pressure has been measured below -0,27BarR and has not yet increased above +0,38BarR. • Indicates: – Low refrigerant charge. – Refrigeration system restriction at filter drier or expansion valve. – Defective low pressure cutout switch. – Defective low pressure transmitter.	• Check discharge and suction pressure gauge readings: – If refrigerant pressures are low, check for a restriction and leak check the refrigeration system. – If refrigerant pressures are high, check for a high refrigerant charge (see below). • Check for a restriction: – Check for frost on downstream side of the filter drier. – Check for high evaporator superheat using supply air sensor temperature readings in Data menu or a frost pattern on expansion valve side of the evaporator coil. A large temperature difference between the left hand and right hand supply air sensors indicates a possible evaporator restriction or incorrect superheat. • If low pressure switch is mounted: – Check low pressure cutout switch wiring. – Measure the voltage across the switch, located at J1A pin 15 and 17. • Switch closed (normal) voltage is 0VDC. • Switch open (LPCO) voltage is approx. 12VDC. – Replace switch. • If pressure transducer is mounted: – Measure the transducer supply voltage at J1A pin 5 related to J1A pin 9 (GND). Expect to be approximately 5 Vdc. – Measure the transducer output voltage at J1A pin 7 related to J1A pin 9 (GND). Expect to be above 0.5 Vdc (0 BarR = 0.8 Vdc).

Code	Description	Corrective Action
32	Condenser Coil Temperature Sensor Open Circuit • When the sensor circuit resistance is above 1785Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a PT1000 – 2 wire sensor, connected to the MP-5000 at connector J3B pin 2 and 4. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can not be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a PT1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this pt1000 sensor is -100°C (602Ω) +200°C (approx 1758Ω).
33	Condenser Coil Temperature Sensor Short Circuit • When the sensor circuit resistance is below 602Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a PT1000 – 2 wire sensor, connected to the MP-5000 at connector J3B pin 2 and 4. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can not be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a PT1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this PT1000 sensor is -100°C (602Ω) +200°C (approx 1758Ω).

Code	Description	Corrective Action
34	Ambient Air Temperature Sensor Open Circuit • When the sensor circuit resistance is above 1785Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a PT1000 – 2 wire sensor, connected to the MP-5000 at connector J3B pin 6 and 8. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can not be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a PT1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this PT1000 sensor is -100°C (602Ω) +200°C (approx 1758Ω).
35	Ambient Air Temperature Sensor Short Circuit • When the sensor circuit resistance is below 602Ω. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check sensor connections at controller. • The sensor is a PT1000 – 2 wire sensor, connected to the MP-5000 at connector J3B pin 6 and 8. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. – The sensor can not be examined without disconnecting it. – The electrical resistance towards chassis must be above meg ohm (MΩ) range. • The sensor is a PT1000 – positive temperature coefficient, which means that the electrical resistance of the sensor increases with temperature. – The sensor is defined to be 1000Ω@ 0°C. – Normal condition measuring with disconnected sensor is 960Ω@-10°C, 1000Ω@0°C, 1039Ω@+10°C, 1058Ω@+15°C, 1078Ω@+20°C. – The valid measuring limit for this PT1000 sensor is -100°C (602Ω) +200°C (approx 1758Ω).
43	Return Air Temperature Too High • Occurs during defrost. • With dehumidify operation; during defrost the return air temperature increases above 38 °C (100 F). • Indicates: – Defective return or evaporator coil sensor. – Return and evaporator coil sensor connections are reversed.	• Check for sensor alarm codes. • Check supply and return sensor connections and locations.

Code	Description	Corrective Action
44	Return Air Temperature Too Low • Occurs during Normal Run only. • Only active with the surveillance active (OOCL option) • During dehumidify operation or if ambient air temperature is below set point: – If return air temperature is below set point -3C. • Else (other operation range): – If return air temperature is below set point -1C. • The alarm state has to be present for 15 minutes before the alarm is set. • Indicates: – Container/side panels defective, damaged or leaking.	• Using DATA menu to evaluate sensors. • Use PROBE TEST to help determine the problem. • Replace sensor.
51	Power Line Voltage Too Low • Shutdown Alarm • Occurs if line voltage has been below 330VAC and is below 340 volts for 30 minutes. • During the 30 minutes and until voltage gets back above 340VAC the compressor is stopped, for protecting the unit. • Indicates: – Poor power supply.	• Using DATA menu to evaluate the power line quality. • Refer to the electrical specifications in the Specifications Section for correct power requirements.
52	Probe Error • Occurs during pretrip (PTI) test or probe test in Chilled mode. • Temperature difference between supply and return air is above 1,5C and the system is not capable of pinpointing which probe is failing. • Temperature difference between supply and return air and evaporator coil is above 1,5C and the system is not capable of pinpointing which probe is failing. • Indicates: – Sensor error. – Sensor misplacement.	• Using MANUAL FUNCTION TEST, ventilate with evaporator fan high speed and evaluate the readings. • Check sensor connections. • Replace sensor. • Check sensor.
53	High Pressure Switch Off Error • Occurs during pretrip (PTI) test only. • Compressor does not stop during high pressure cutout switch test. • Indicates: – Faulty compressor contactor or control circuit. – Low refrigerant charge. – Defective high pressure cutout switch. – Strong winds causing cooling of condenser coil in low ambient conditions.	• Check discharge and suction pressure gauge readings and check refrigerant charge. • Enter Manual Function Test menu. – Start the following components together: compressor 100 percent, compressor and evaporator fans (high). Discharge pressure should increase and compressor should stop at 2250 kPa, 22.5 bar, 326 psig (high pressure cutout switch opens).
54	High Pressure Switch On Error • Occurs during pretrip (PTI) test only. • Compressor does not start within normal time during high pressure cutout switch test. • Indicates: – High pressure cutout switch did not respond to pressure change within five seconds. – Air in refrigeration system. – Defective high pressure cutout switch.	• Check discharge and suction pressure gauge readings. • Enter Manual Function Test menu. – Start the following components together: compressor 100 percent, compressor and evaporator fans (high). Discharge pressure should increase and compressor should stop at 2250 kPa, 22.5 bar, 326 psig (high pressure cutout switch opens). – Then start condenser fan. Discharge pressure must drop quickly (10 to 20 seconds) to 1550 kPa, 15.5 bar, 225 psig and compressor should start (switch closes).

Code	Description	Corrective Action
56	Compressor Temperature Too High • Shutdown Alarm • Compressor discharge line temperature is above 148 C (298 F). Compressor stopped until discharge line temperature decreases to normal. • Indicates: – Air in refrigeration system. – Low refrigerant charge. – Defective compressor. – Defective vapor injection.	• Operate unit on Cool and check discharge and suction pressure gauge readings. • Enter Manual Function Test menu and test (operate) Vapor Injection Valve to determine if valve opens (energizes). • Check compressor discharge sensor resistance. Resistance must be approx. 86,000 ohms at 25 C (77 F). • Check discharge line temperature with a separate electronic thermometer and compare to "HIGH PR TEMP" shown in the Data menu of controller. ***Note:*** *Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.*
57	FAE Device Error • Occurs during pretrip testing if the expected door endpoints can't be reached. • Occurs during normal operation. – If the TK Fresh Plus module isn't detected. – During door position calibration the expected door endpoints feedback can't be reached. – During pulsing movement the expected door end points feedback can't be reached. • Indicates: – Stocked air vent. door motor. – Failing or missing TK Fresh Plus module.	• Inspect TK Fresh Plus module connection to the controller. • Using STATES MENU / EXPANSION MODULE to inspect the observed presence and readings of the TK Fresh Plus module. If the module is not found use the tester to decide the problem. – From backside left bay is bay 1 – From backside right bay is bay 2 • Inspect wiring from TK Fresh Plus motor to TK Fresh Plus module. • Using MANUAL FUNCTION TEST move and Inspect air vent door movement. • Inspect air vent. • Replace TK Fresh Plus motor.
58	Phase Sensor Error • Occurs during pretrip (PTI) or function test only. • During Phase Sensor Test, while direction is reversed, the condenser fan and compressor is tested. – If the current consumption of the condenser fan is below 0,5A on each phase. – If the current consumption of the compressor is below 2,0A on each phase. • Indicates: – Defective phase relay. – Defective controller.	• Start a Manual Function Test. With reverse phase direction selected, check the condenser fan runs reversed direction and the compressor is activated and makes loud noise. Allow only for short time activation max. 5 sec.
59	Delta Current Error • 100% ampere difference between current phases, max reading must be above 1,5A. • The alarm is protected by a timer which demand the state to be present for three minutes before the alarm is set. • Indicates: – Open connection on one phase of power supply to a motor or heater element. – Blown fuse.	• Enter Manual Function Test menu and test (operate) each 3-phase component to locate defective connection. • Check fuses.

Code	Description	Corrective Action
60	Humidity Sensor Error • Occurs during Pre-Trip (PTI) test: – The last defrost must be more than 5 minutes away and Return Air Temperature must be above -1C to allow for the alarm to be set. – 4-20mA Humidity sensor type: Relative humidity reading is less than 15%. – Modbus sensor type: Modbus communication with the sensor is lost for 3 retries. • Occurs during: – The unit mode must be chilled, The humidity control set to ON, the last defrost must be more than 5 minutes away and Return Air Temperature must be above -10C to allow for the alarm to be set. – 4-20mA Humidity sensor type: Relative humidity reading is less than 15%. Error must be persistent for 60 minutes. – Modbus sensor type: Modbus communication with the sensor is lost for 11 retry equals approximately 5 minutes. • Indicates: – Sensor disconnected. – Wrong controller configuration, sensor might be disconnected or removed. – Defective sensor. • If the alarm occurs together with the 'Sensor System Overload" alarm 137, the sensor input might be short circuit.	• Check sensor connections. • Check controller configuration menu for correct humidity setting. • Replace sensor.

Code	Description	Corrective Action
97	Compressor temperature Sensor Open Circuit • When the sensor circuit resistance is above 1MΩ and the ambient air temperature is above -10°C. – Since the sensor is a NTC-type, readings above 1MΩ will occur when the temperature is below approximately -25°C. • Indicates: – Open circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check for sensor connections at controller. • The compressor temperature sensor is a NTC – 2 wire sensor. The sensor is located/connected to the MP-5000 at connector J2B pin 6 and 8. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. • The sensor can't be examined without disconnecting it. • The electrical resistance towards chassis must be above mega ohm (MΩ) range. • The sensor is a NTC thermistor type - negative temperature coefficient, which in this case means that the resistance of the sensor decreases with temperature. – The sensor is defined to be 86000Ω@ 25°C. – Normal condition measuring with disconnected sensor is: • 475kΩ@-10°C • 280kΩ@0°C • 171kΩ@+10°C • 135kΩ@+15°C • 107kΩ@+20°C – The valid measuring limit for this sensor is -25°C (approx. 1MΩ) +185°C (approx. 550Ω). ***Note:*** *OPEN circuit state may not be reasonable since open indicates high electrical resistance, which with this type of sensor is possible at very low temperature. If the Ambient Air Temperature indicates temperatures above -10°C the sensor is expected not to be below -25°C and the alarm may be set. If the measured resistance gets above the limit the reading is replaced with -30°C. The needed protection compressor temperature vice is at the high temperature end of the scale.*

Code	Description	Corrective Action
98	Compressor temperature Sensor Short Circuit • When the sensor circuit resistance is below 550Ω. • Indicates: – Short circuit. – Defective or wrong sensor. – Defective wiring. – Defective controller.	• Check for damaged sensor wires. • Check for sensor connections at controller. • The compressor temperature sensor is a NTC – 2 wire sensor. The sensor is located/connected to the MP-5000 at connector J2B pin 6 and 8. • The 2 sensor wires can be switched without affecting the measurement. • Disconnect the sensor, use an Ohm (Ω) measuring device, measure the electrical resistance between the two sensor wires. • The sensor can't be examined without disconnecting it. • The electrical resistance towards chassis must be above mega ohm (MΩ) range. • The sensor is a NTC thermistor type - negative temperature coefficient, which in this case means that the resistance of the sensor decreases with temperature. – The sensor is defined to be 86000Ω@ 25°C. – Normal condition measuring with disconnected sensor is: • 475kΩ@-10°C • 280kΩ@0°C • 171kΩ@+10°C • 135kΩ@+15°C • 107kΩ@+20°C – The valid measuring limit for this sensor is -25°C (approx. 1MΩ) +185°C (approx. 550Ω).
119	Digital Valve Error • Occurs during Pre-Trip (PTI) test if: – Compressor Current consumption is not correct for valve position. • Occurs during normal run. – If unit operation indicates problem with the modulation of the compressor cooling capacity. – The compressor startup is tested for power consumption change based on activating modulation for the compressor. – The change from un-loaded to loaded must increase the power draw more than 0,6A. • With this alarm NOT ACKNOWLEDGED, the unit will offset the regulation temperature set point +1,5C (up), to compensate for low temperature peaks.	• Using Manual Function Test, without compressor and fans active check the function of the valve by observing the sound or feel of the valve while activating/deactivating. • Using Manual Function Test, with compressor and fans active check the function of the valve. – The current consumption during NOT energized valve must be higher than during energized position. – With Condenser coil temperature above 35C the expected increase is min 0,9A and below 35C expected limit is 1,5A.
120	Suction Pressure Sensor Error • Occurs during Normal Run if the sensor is detected to be out of range, open or short circuit. • Occurs during Pre-Trip (PTI) test if the sensor readings do not act correct during compressor activity. – Expected to decrease 0,15Bar from stopped to compressor running loaded. • Indicates: – Wrong location of the sensor. – Sensor failure.	• Using DATA menu evaluate sensor readings. • Check wiring to be correct and connected. • Check voltage at J1A pin 7 to be 0.5 to 4.5 Vdc. • Replace sensor.

Code	Description	Corrective Action
121	Discharge Pressure Sensor Error • Occurs during Normal Run if the sensor is detected to be out of range, open or short circuit. • Occurs during Pre-Trip (PTI) test if the sensor readings do not act correct during compressor activity. – Expected to decrease 0,15Bar from stopped to compressor running loaded. • Indicates: – Wrong location of the sensor. – Sensor failure.	• Using DATA menu evaluate sensor readings. • Check wiring to be correct and connected. • Check voltage at J1A pin 7 to be 0.5 to 4.5 Vdc. • Replace sensor.
123	Data logger Battery Error • In cold ambient if the battery heater (battery internal) is not capable of heating up the battery, ready for charging within 2 hours. • If the battery is not connected. • If the battery voltage is below 3.0VDC.	• Using DATA menu to determine the state of the battery. Evaluate temperature and voltage. • Check the battery physically, dismount and examine wires and the connection to the controller. • Replace battery.
124	Cold Treatment Restart • Occurs during Normal Run and only with cold Treatment active. • Only active with the surveillance active (OOCL option) • Indicates: – Cold treatment period is restarted due to temperatures. – Problem with cooling process – Too long duration of power off.	• Unit will automatically restart the treatment period.
127	General Unit Error • The surveillance has determined that the unit is not capable of continue running, and has shut down. • The reason is displayed at the controller main screen, and is stated at the event next to the alarm event. • Known reason to the shutdown state is: – "SET POINT OUT OF RANGE" – "VOLTAGE OUT OF RANGE" – "POWER LINE PHASE ERROR" – "REGULATION PROBE ERROR" – "COMPRESSOR TEMPERATURE HIGH"	"SET POINT OUT OF RANGE" • The temperature set point is outside valid operation range. +30°C to -40°C (+35°C with extended range). • Check configurations and settings on the controller. "VOLTAGE OUT OF RANGE" • The measured voltage is below 330VAC. • Check power line voltage while loaded. "POWER LINE PHASE ERROR" • The phase detection system detects phase error or not capable of securing the correct rotation. • Check power line voltage and quality. "REGULATION PROBE ERROR" • If supply and return air temperature sensor and evaporator coil temperature sensors ALL indicate OPEN or SHORT circuit, the software is not capable of determine a reasonable action related to the cargo. • Following steps related to the sensor alarms. "COMPRESSOR TEMPERATURE HIGH" • The compressor temperature is measured to be above 148°C. The state will stay until compressor temperature is measured to be below 132°C. • Check refrigerant level and flow through the cooling circuit.

Code	Description	Corrective Action
128	Supply Air Temperature Sensor Error • Occurs during Pre-Trip (PTI) test and probe test only. • After ventilation with the evaporator fans. • If the supply and return air temperature sensor differs more than 1,5C and the return air temperature is within 1,5C of evaporator coil temperature. • If evaporator coil temperature sensor is failing, if the supply and return air temperature sensors differs more than 1,5C. Both alarm 129 and 128 will be set. • Indicates: – Failing sensors. – Misplaced sensors. – Failing controller.	• Use the DATA menu to detect the failing sensor. • Replace sensors. • Use the tester to determine the problem.
129	Return Air Temperature Sensor Error • Occurs during Pre-Trip (PTI) test and probe test only. • After ventilation with the evaporator fans. • If the supply and return air temperature sensor differs more than 1,5C and the supply air temperature is within 1,5C of evaporator coil temperature. • If evaporator coil temperature sensor is failing, if the supply and return air temperature sensors differs more than 1,5C. Both alarm 129 and 128 will be set. • Indicates: – Failing sensors. – Misplaced sensors. – Failing controller.	• Use the DATA menu to detect the failing sensor. • Replace sensors. • Use the tester to determine the problem.
130	Evaporator Coil Temperature Sensor Error • Occurs during Pre-Trip (PTI) test and probe test only. • After ventilation with the evaporator fans. • If the evaporator coil temperature differs more than 1,5C from the mean value of supply and return air temperature. • Indicates: – Failing sensors. – Misplaced sensors. – Failing controller.	• Use the DATA menu to detect the failing sensor. • Replace sensors. • Use the tester to determine the problem.
131	Ambient Air – Condenser Coil Temperature Sensor Error • Occurs during Pre-Trip (PTI) test and probe test only. • After ventilation with the condenser fan. • If the ambient air and condenser coil temperature sensor readings differs more than 2.5C. • Indicates: – Failing sensors. – Misplaced sensors. – Failing controller.	• Use the DATA menu to detect the failing sensor. • Replace sensors. • Use the tester to determine the problem.
132	Current Transmitter and/or Controller Module Sensor Error • The surveillance continually evaluates the measurements reported by the current transmitter and/or controller. • The surveillance includes a timer with a timeout at 60 seconds before the alarm is set. • Indicates: – Current transmitter and/or controller module located readings outside allowed range.	• Use DATA menu to determine the failing reading. • The accepted limit for: – Line AC voltage is 180 to 700VAC. – Power line current is 0mA to 32A. – Radiator temperature is -100C to 200C. • Check for latest software revision. • Use tester to determine the problem.

Code	Description	Corrective Action
134	Controller Error • The surveillance has determined the state "controller internal error". • Indicates: – The controller is failing one way or another.	• Use the tester to determine the problem.
136	Controller Transducer Circuit Error • The controller is not capable of generating the expected voltage for the 12V LPCO and transducer sensors, (suction pressure and discharge pressure, AVL and humidity sensor).	• Replace Data logger Battery. • Use the tester to determine the problem.
137	Sensor System Overload • The controller sensor measurement is overloaded. • This situation will probably introduce wrong readings at other sensors than the one introducing the overload. • Indicates: – Not intended voltage is introduced at one of the sensor inputs. – Transducer, connection or cabling with voltage supply for the sensor might short circuit this voltage supply onto the measuring input.	• Sensor input which might initiate the problem: – At connector J1A: • Humidity sensor (4-20mA type) pin 1 and 3. • Suction pressure pin 5, 7, and 9. – At connector J1B: • AVL position pin 2, 4, and 6. • Discharge pressure pin 8, 10, and 12. • At least one of the sensors circuits holds a short between sensor voltage and sensor signal. • Problem might be located any were from the connection to the sensor itself. • Action: – Disconnect sensors and look for a non intended short between sensor voltage and the sensor line. – The sensor with the problem might show up with its own alarm.
138	AVL Sensor Error • Occurs if the sensor is detected to be out of range, open or short circuit. • Indicates: – Sensor failure.	• Using DATA menu evaluate sensor readings. • Check wiring to be correct and connected. • Check voltage at J1B pin 4 to be 0.5 - 4.5 Vdc. • Check supply voltage at J1B pin 6 (GND) to pin 2 to be approximately 12.6 Vdc. • Replace sensor.
139	Internal File Handling Error • Occurs if the read or write process of nonvolatile information (i.e., Configuration and settings) fails. • Indicates: – Internal file read or write failure.	• Replace controller.
140	Evaporator Section Too Hot • Occurs if supply air, return air or evaporator coil temperature reads temperature at or above 60C. • Indicates: – Failing heater circuit, hanging output. – Failing evaporator fan.	• Observe temperature readings to locate the problem. • Use manual function test to determine the failing component. • Use the tester to determine the problem.
157	Data logger Battery Failure • Firmware version 3.3.0 or newer: – Occur if the battery is connected and the battery protection circuit is activated as a result of overcurrent, over-charge or over-discharge. – Battery voltage must stay below 2.5V after the battery has been charged for three minutes.	• Check the battery physically, dismount and examine wires and the connection to the controller. • Replace battery.

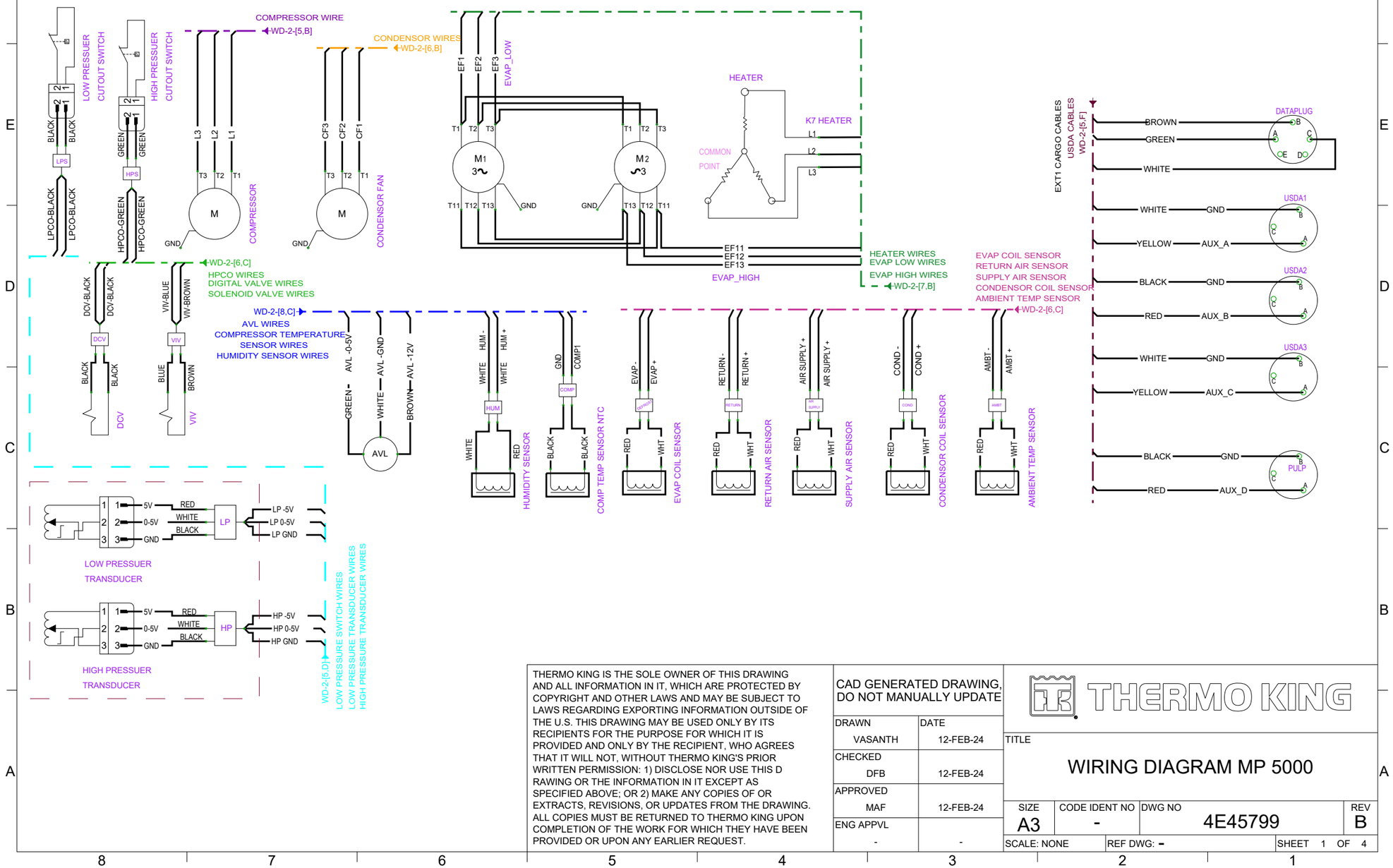
Diagrams

Diagram Index

Drawing No.	Title	Page
4E45799	MAGNUM Plus™ Wiring Diagram	Figure 40, p. 182,Figure 41, p. 183, Figure 42, p. 184, Figure 43, p. 185
4E45779	MAGNUM Plus™ Schematic Diagram	Figure 44, p. 186, Figure 45, p. 187
	MAGNUM Plus™ Refrigeration System Components	Figure 46, p. 188 to Figure 47, p. 189
	MP-5000 Menu Flow Diagram	Figure 48, p. 190

Figure 40. 4E45799 (Sheet 1 of 4)

REVISIONS				
CHANGE NOTICE	REV	DESCRIPTION	DATE	APPROVED
1562537	A	RELEASED	12-FEB-24	MAF
1661972	B	RELOCATION OF TERMINAL BLOCKS ON PAGE 2	18-NOV-24	MAF



CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

	DRAWN	DATE
	VASANTH	12-FEB-24
CHECKED	DFB	12-FEB-24
APPROVED	MAF	12-FEB-24
ENG APPVL	-	-

THERMO KING

TITLE: WIRING DIAGRAM MP 5000

SIZE	CODE IDENT NO	DWG NO	REV
A3	-	4E45799	B

SCALE: NONE | REF DWG: - | SHEET 1 OF 4

Figure 41. 4E45799 (Sheet 2 of 4)

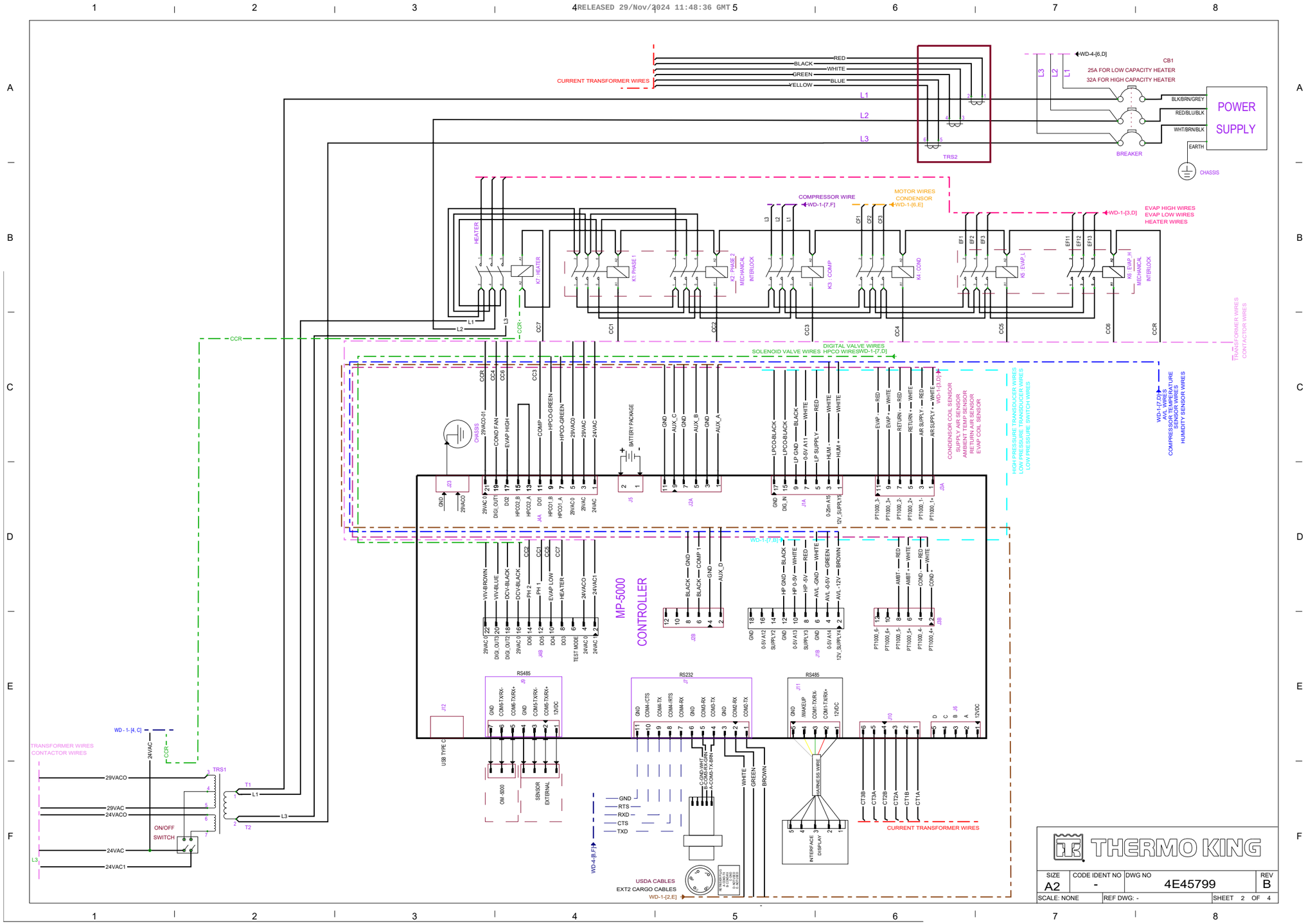
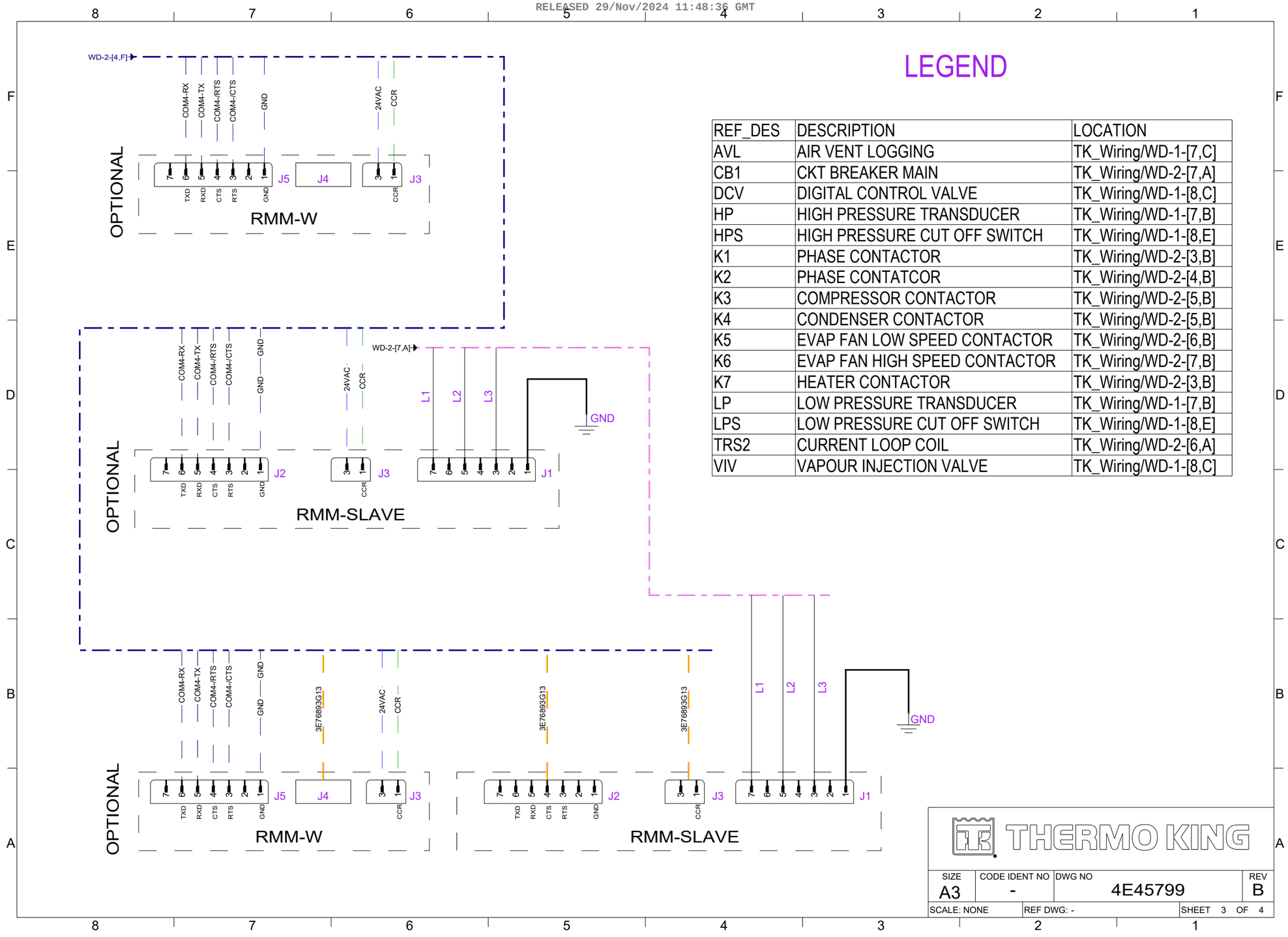


Figure 42. 4E45799 (Sheet 3 of 4)



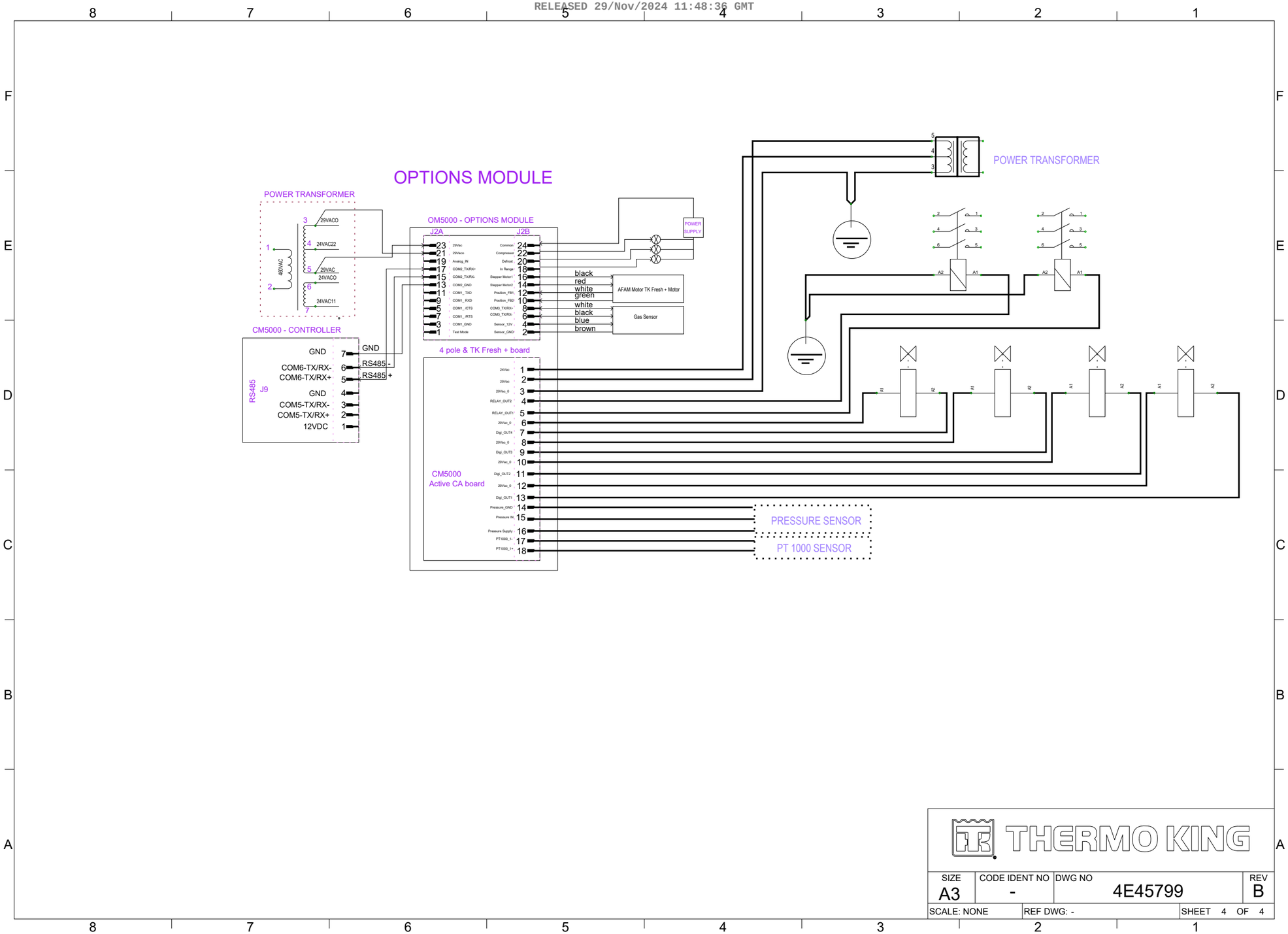
LEGEND

REF_DES	DESCRIPTION	LOCATION
AVL	AIR VENT LOGGING	TK_Wiring/WD-1-[7,C]
CB1	CKT BREAKER MAIN	TK_Wiring/WD-2-[7,A]
DCV	DIGITAL CONTROL VALVE	TK_Wiring/WD-1-[8,C]
HP	HIGH PRESSURE TRANSDUCER	TK_Wiring/WD-1-[7,B]
HPS	HIGH PRESSURE CUT OFF SWITCH	TK_Wiring/WD-1-[8,E]
K1	PHASE CONTACTOR	TK_Wiring/WD-2-[3,B]
K2	PHASE CONTATCOR	TK_Wiring/WD-2-[4,B]
K3	COMPRESSOR CONTACTOR	TK_Wiring/WD-2-[5,B]
K4	CONDENSER CONTACTOR	TK_Wiring/WD-2-[5,B]
K5	EVAP FAN LOW SPEED CONTACTOR	TK_Wiring/WD-2-[6,B]
K6	EVAP FAN HIGH SPEED CONTACTOR	TK_Wiring/WD-2-[7,B]
K7	HEATER CONTACTOR	TK_Wiring/WD-2-[3,B]
LP	LOW PRESSURE TRANSDUCER	TK_Wiring/WD-1-[7,B]
LPS	LOW PRESSURE CUT OFF SWITCH	TK_Wiring/WD-1-[8,E]
TRS2	CURRENT LOOP COIL	TK_Wiring/WD-2-[6,A]
VIV	VAPOUR INJECTION VALVE	TK_Wiring/WD-1-[8,C]

THERMO KING

SIZE	CODE IDENT NO	DWG NO	REV
A3	-	4E45799	B
SCALE: NONE	REF DWG: -	SHEET 3 OF 4	

Figure 43. 4E45799 (Sheet 4 of 4)

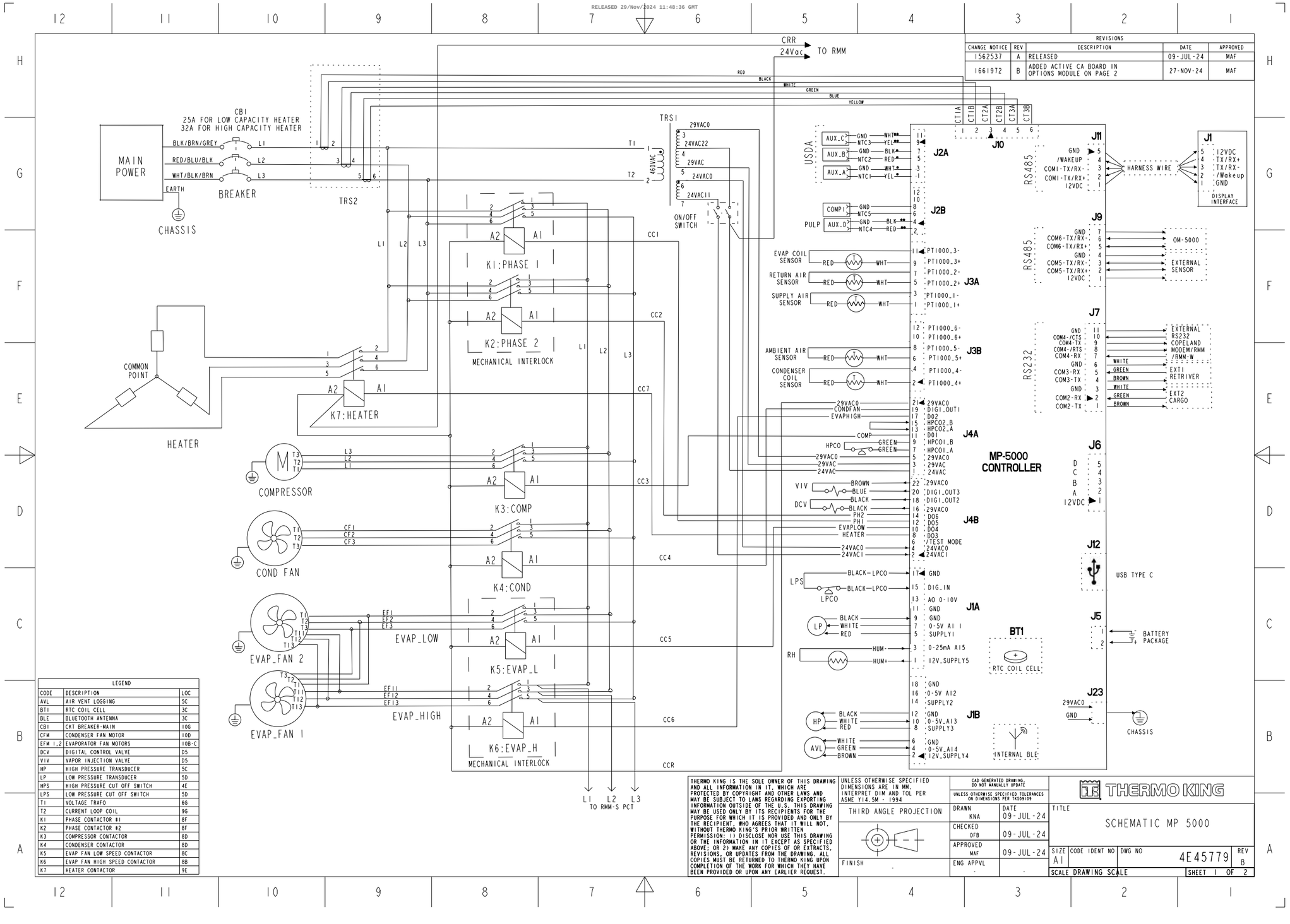


THERMO KING

SIZE	CODE IDENT NO	DWG NO	REV
A3	-	4E45799	B

SCALE: NONE	REF DWG: -	SHEET 4 OF 4

Figure 44. 4E45779 (Sheet 1 of 2)



LEGEND		
CODE	DESCRIPTION	LOC
AVL	AIR VENT LOGGING	5C
BTI	RTC COIL CELL	3C
BLE	BLUETOOTH ANTENNA	3C
CBI	CKT BREAKER-MAIN	10G
CFM	CONDENSER FAN MOTOR	10D
EFM 1,2	EVAPORATOR FAN MOTORS	10B-C
DCV	DIGITAL CONTROL VALVE	D5
VIV	VAPOR INJECTION VALVE	D5
HP	HIGH PRESSURE TRANSDUCER	5C
LP	LOW PRESSURE TRANSDUCER	5D
HPS	HIGH PRESSURE CUT OFF SWITCH	4E
LPS	LOW PRESSURE CUT OFF SWITCH	5D
T1	VOLTAGE TRAFO	6G
T2	CURRENT LOOP COIL	9G
K1	PHASE CONTACTOR #1	8F
K2	PHASE CONTACTOR #2	8F
K3	COMPRESSOR CONTACTOR	8D
K4	CONDENSER CONTACTOR	8D
K5	EVAP FAN LOW SPEED CONTACTOR	8C
K6	EVAP FAN HIGH SPEED CONTACTOR	8B
K7	HEATER CONTACTOR	9E

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

THIRD ANGLE PROJECTION

FINISH -

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS PER TKS09109

DRAWN	KNA	09-JUL-24
CHECKED	DFB	09-JUL-24
APPROVED	MAF	09-JUL-24
ENG APPVL	-	-

THERMO KING

TITLE: SCHEMATIC MP 5000

SIZE	CODE IDENT NO	DWG NO	REV
A1		4E45779	B

SCALE DRAWING SCALE | SHEET 1 OF 2

Figure 45. 4E45779 (Sheet 2 of 2)

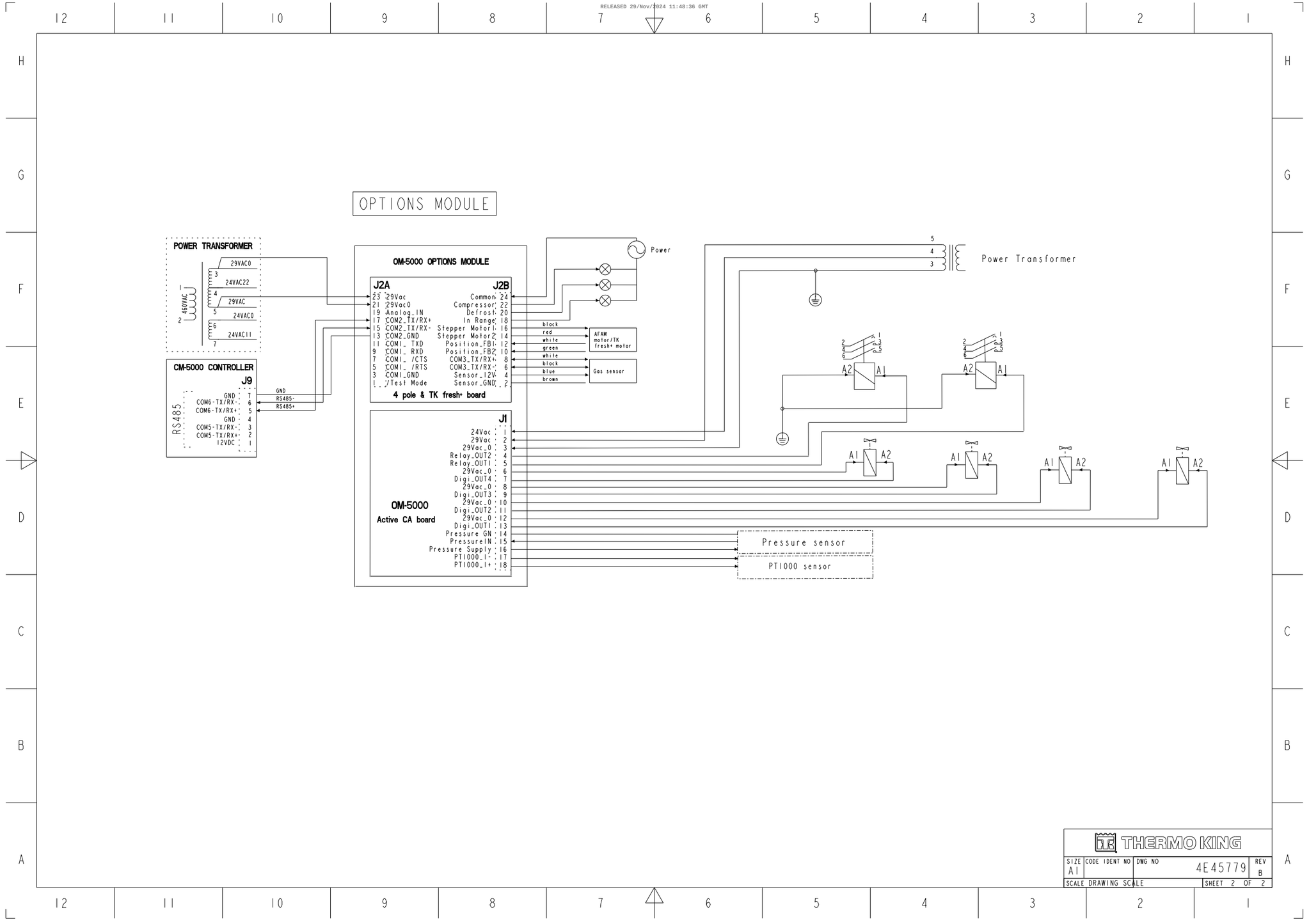


Figure 46. MAGNUM Plus™ Refrigeration System Components

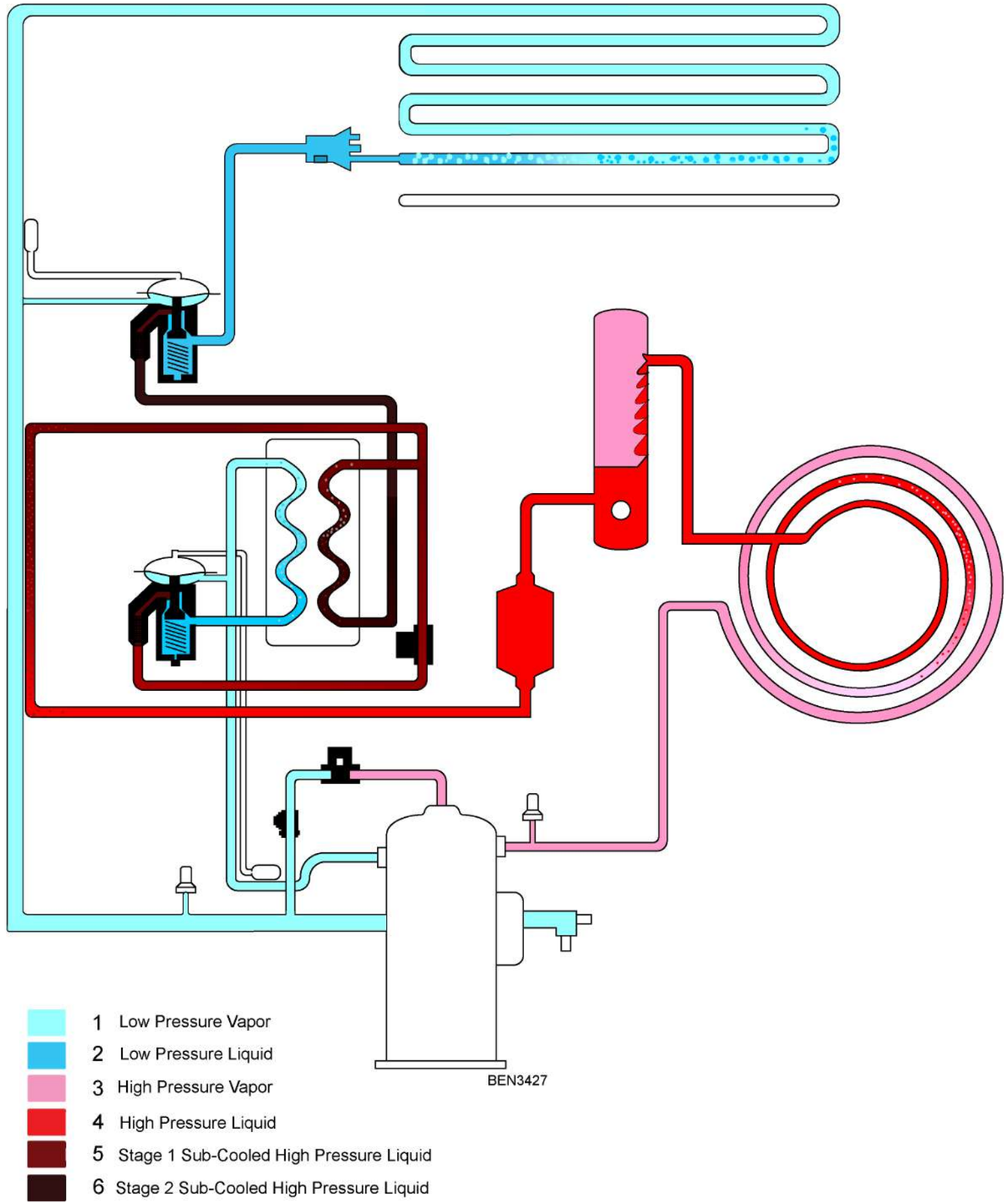
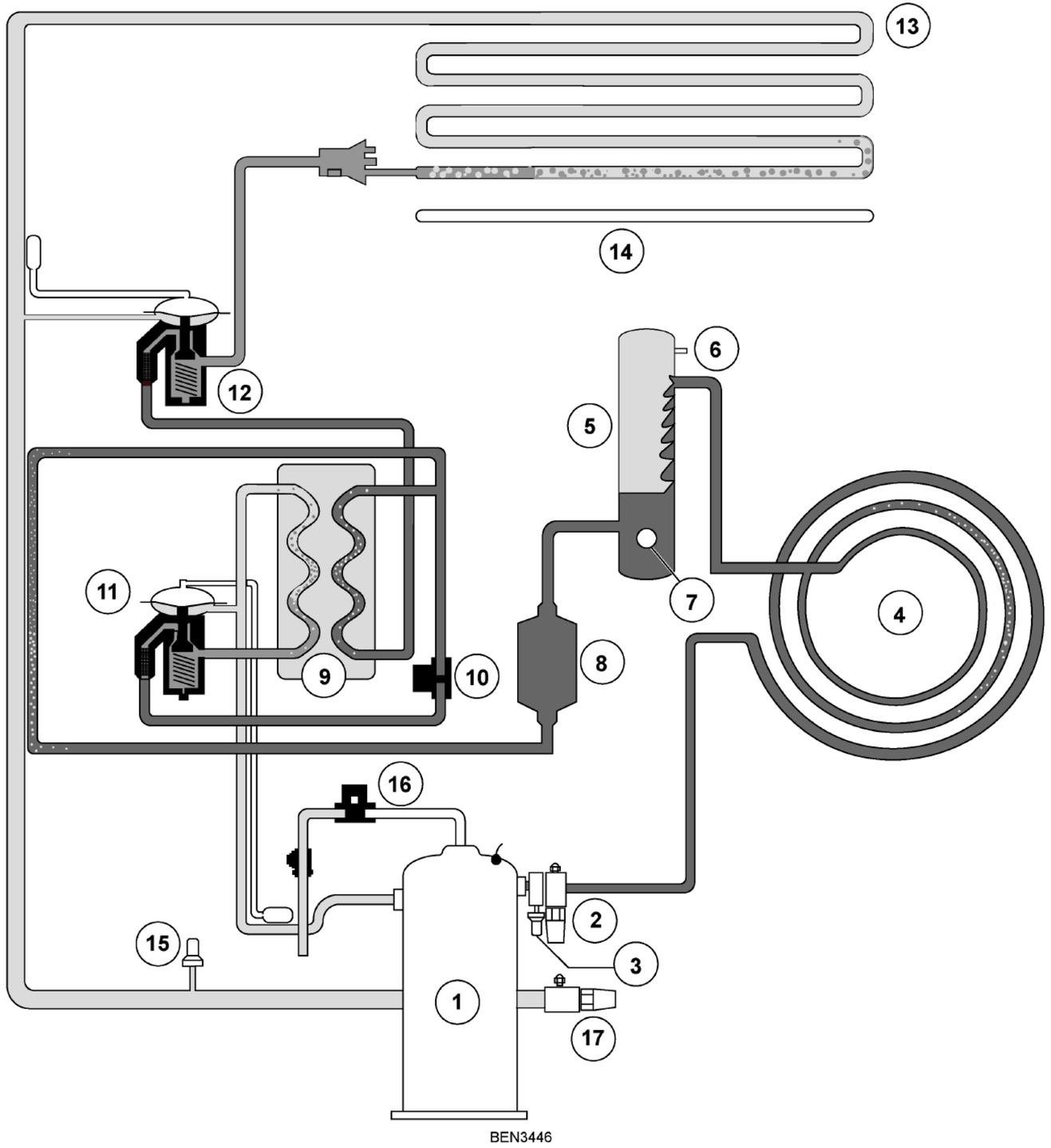


Figure 47. MAGNUM Plus™ Components



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

Figure 48. MP-5000 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, Setpoint, Alarm, and C/F) is pressed, the screen remains at that level until another function key is pressed.

To Enter a Controller Menu or Use Function Key:

- Press F1 key to initiate a manual defrost. Evaporator coil temperature must be below 18C (64F) (*).
- Press Alarm Key to view/acknowledge Alarms.
  - View and write down all alarm code.
  - Press up key to view the next alarm code.
  - Clear alarm code by correcting problem and acknowledging the alarm.
  - To acknowledge an alarm, press Enter key with alarm code in display.
- Press Setpoint key to change the Setpoint.
- Press C/F key to view alternate temperature scale in LED display.
- Press Enter Key to view the Main menu (Enter)
- Press Esc key to exit from the previous menu and to view Unit display menu.

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

- Press Enter key and Use Up or Down key to enter the values.

To Scroll in a Menu or a Text Line

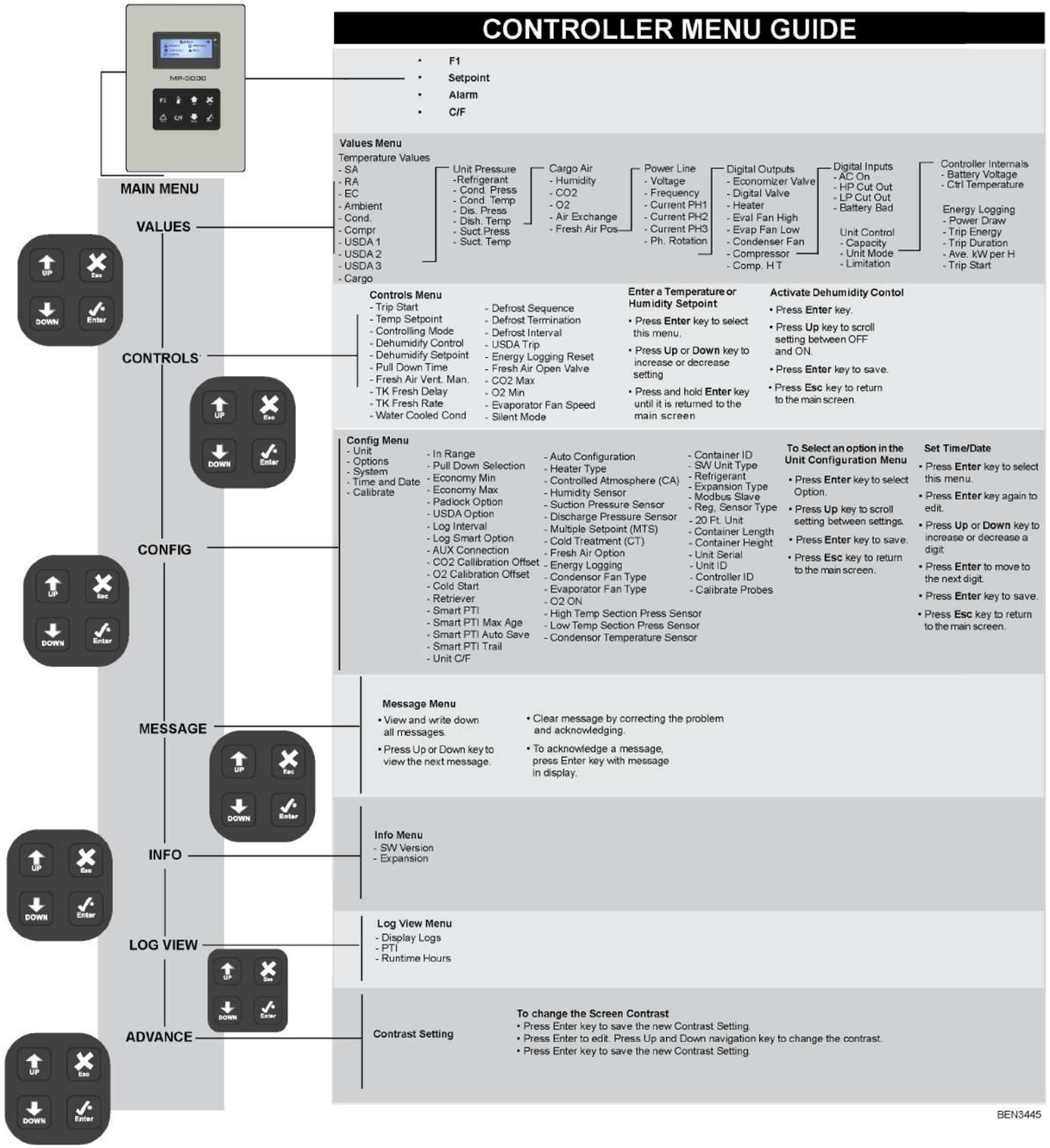
- Press Up key to scroll up or backward.
- Press Down key to scroll down or forward.

To Exit a Menu or Text Line

- Press Esc key.

To Lock a LCD Data Screen Display:

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



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

TK 62352-4-MM-EN 02 Jan 2025
Supersedes (New)