CSR

TK 50824-4-MM (Rev. 6, 11/02)

The maintenance information in this manual covers unit models:	System No.
CSR20SL-144 Power Saver.	917144
CSR40-145 Power Saver.	917145
CSR20SL-155 Power Saver.	917155
CSR40SL-167 Power Saver.	917167
For further information, refer to:	**Manual No.**
CSR-20SL MP-3000 Parts Manual	TK 50769
CSR-20SLPS-155 Parts Manual	TK 50897
CSR-40 MP-3000 Parts Manual	TK 50762
Operation, Diagnosis and Refrigeration Maintenance Manuals	
Diagnosing Thermo King Container Refrigeration Systems	TK 41166
Electrostatic Discharge (ESD) Training Guide	TK 40282
Evacuation Station Operation and Field Application	TK 40612
Tool Catalog	TK 5955
The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units.	

This manual is published for informational purposes only and the information so provided should not be considered as all-inclusive or covering all contingencies. If further information is required, Thermo King Corporation should be consulted.

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Recover Refrigerant

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

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

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

R-404A

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

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

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

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Safety Precautions

General Practices

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

Refrigerant

When removing any refrigerant from a unit, use a recovery process that prevents or absolutely minimizes the refrigerant that can escape to the atmosphere. Although fluorocarbon refrigerants are classified as safe refrigerants when proper tools and procedures are used, certain precautions must be observed when handling them or servicing a unit in which they are used. When exposed to the atmosphere in the liquid state, fluorocarbon refrigerants evaporate rapidly, freezing anything they contact.

First Aid

In the event of frost bite, the objectives of First Aid are to protect the frozen area from further injury, to warm the affected area rapidly, and to maintain respiration.

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

***Skin*:** Flush area with large amounts of lukewarm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection/injury. Get medical attention. Wash contaminated clothing before reuse.

***Inhalation*:** Move victim to fresh air and use CPR or mouth-to-mouth ventilation, if necessary. Stay with victim until arrival of emergency medical personnel.

Refrigerant Oil

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

- Do not allow refrigerant oil to contact your eyes.
- Do not allow prolonged or repeated contact with skin or clothing.
- To prevent irritation, you should wash thoroughly immediately after handling refrigerant oil. Rubber gloves are recommended when handling Polyol Ester based refrigerant oil.

Use the following First Aid practices if needed.

Eyes: Immediately flush eyes with large amounts of water for at least 15 minutes while holding the eyelids open. Get prompt medical attention.

Skin: Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.

Inhalation: Move victim to fresh air and restore breathing if necessary. Stay with victim until arrival of emergency personnel.

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

Electrical

High Voltage

When servicing or repairing a refrigeration unit, the possibility of serious or even fatal injury from electrical shock exists. Extreme care must be used when working with a refrigeration unit that is connected to a source of operating power, even if the unit is not running. Lethal voltage potentials can exist at the unit power cord, inside the control box, inside any high voltage junction box, at the motors and within the wiring harnesses.

Precautions

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

First Aid

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

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

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

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

Low Voltage

Control circuits are low voltage (24 Van and 12 Vdc). This voltage potential is not considered dangerous, but the 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.

Servicing Units (or Containers) Equipped with a Microprocessor Controller

Precautions must be taken to prevent electrostatic discharge when servicing the MP-3000 microprocessor and related components. If these precautionary measures are not followed, the risk of significant damage to the electronic components of the unit is possible. 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.

Controller Repair

When servicing the controller, it is necessary to ensure that electrostatic discharges are avoided. Potential differences considerably lower than those which produce a small spark from a finger to a door knob can severely damage or destroy solid-state integrated circuit components. The following procedures must be rigidly adhered to when servicing these units to avoid controller damage or destruction.

1. Disconnect all power to the unit.
2. Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
3. 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.
4. Avoid contacting the electronic components on the circuit boards of the unit being serviced.
5. Leave the circuit boards in their static proof packing materials until ready for installation.
6. If a defective controller is to be returned for repair, it should be returned in the same static protective packing materials from which the replacement component was removed.
7. After servicing the circuit board and any other circuits, the wiring should be checked for possible errors before restoring power.

Welding of Units or Containers

Whenever electric welding is to be performed on any portion of the refrigeration unit, container or container chassis with the refrigeration unit attached, it is necessary to ensure that welding currents are *not* allowed to flow through the electronic circuits of the unit. These procedures must be rigidly adhered to when servicing these units to avoid damage or destruction.

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

Unit 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 unit. Service technicians should read and follow the instructions on all warning delicacies decals

Serial Number Locations

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

- Electric Motors: Nameplate attached to the motor housing.
- Compressor: Nameplate on front of the compressor.
- Unit: Nameplate on unit frame in power cord storage compartment.
- MP-3000 Controller: Nameplate on back of controller.

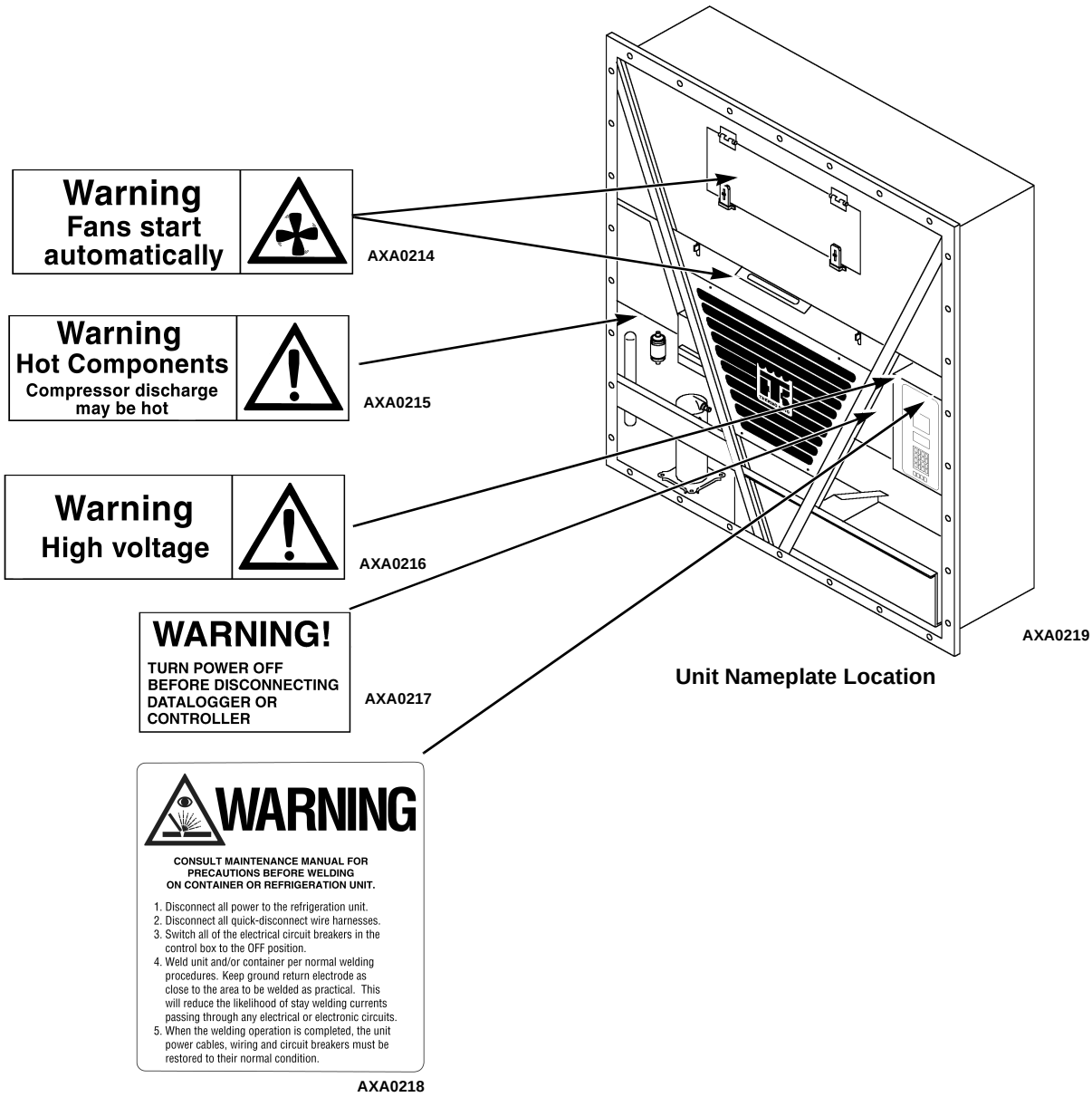


Figure 1: Nameplate and Warning Locations

Service Guide

Pre-trip	Every 1,000 Hours	Annual/ Yearly	Inspect/Service These Items
			Electrical
•			Perform a controller pre-trip 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 compressor oil level.
	•	•	Check for proper discharge and suction pressures.
		•	Check filter drier/in-line filter for a restriction pressures.
			Structural
•	•	•	Visually inspect unit for damaged, loose or broken parts.
•	•	•	Tighten unit, compressor and fan motor mounting bolts.
	•	•	Clean entire unit including condenser and evaporator coils, and defrost drains.

Specifications

System Net Cooling Capacity— Full Cool

CSR20SL Models — Air Cooled Condensing*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	Net Cooling Capacity			Power Consp	Net Cooling Capacity			Power Consp
	Watts	Kcal/hr	BTU/hr	kW@ 460V	Watts	Kcal/hr	BTU/hr	kW@ 380V
21.1 C (70 F)	12,510	10,755	42,680	10.3	10,010	8,605	34,145	8.3
1.7 C (35 F)	8,010	6,890	27,335	8.5	6,410	5,515	21,870	6.9
-17.8 C (0 F)	5,455	4,700	18,600	5.2	4,365	3,760	14,880	4.2
-28.9 C (-20 F)	2,810	2,415	9,580	4.6	2.250	1,935	7,665	3.7

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

CSR40SL Models — Air Cooled Condensing*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	Net Cooling Capacity			Power Consp	Net Cooling Capacity			Power Consp
	Watts	Kcal/hr	BTU/hr	kW@460V	Watts	Kcal/hr	BTU/hr	kW@380V
21.1 C (70 F)	13,790	11,855	47,050	10.8	11,030	9,485	37,640	8.7
1.7 C (35 F)	9,890	8,505	33,750	8.9	7,910	6,805	27,000	7.2
-17.8 C (0 F)	6,020	5,180	20,550	6.1	4,815	4,145	16,440	4.9
-28.9 C (-20 F)	3,960	3,400	13,500	5.0	3,170	2,720	10,800	4.1

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

CSR40 Models — Air Cooled Condensing*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	Net Cooling Capacity			Power Consp	Net Cooling Capacity			Power Consp
	Watts	Kcal/hr	BTU/hr	kW@460V	Watts	Kcal/hr	BTU/hr	kW@380V
21.1 C (70 F)	13,805	11,870	47,100	13.1	11,045	9,495	37,680	10.6
1.7 C (35 F)	10,200	8,770	34,800	12.6	8,160	7,015	27,840	10.2
-17.8 C (0 F)	6,010	5,165	20,500	6.7	4,810	4,130	16,400	5.4
-28.9 C (-20 F)	4,045	3,475	13,800	5.1	3,235	2,780	11,040	4.1

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

System Net Heating Capacity*

Heater Type	460/230V, 3 Phase, 60 Hz Power			380/190V, 3 Phase, 50 Hz Power		
	Heating Capacity			Heating Capacity		
	Watts	Kcal/hr	BTU/hr	Watts	Kcal/hr	BTU/hr
CSR20SL	5,800	4,990	19,800	4,200	3,610	14,335
CSR40SL	5,800	4,990	19,800	4,200	3,610	14,335
CSR40	5,880	5,056	20,068	4,900	4,215	16,720

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

Evaporator Airflow

Model CSR20SL

External Static Pressure (water column)	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	High Speed		Low Speed		High Speed		Low Speed	
	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min
0 mm (0 in.)	4,000	2,350	2,000	1,180	3,300	1,940	1,650	970
10 mm (0.4 in.)	3,500	2,060	1,450	850	2,600	1,530	900	530
20 mm (0.8 in.)	2,900	1,710	—	—	1,800	1,060	—	—
30 mm (1.2 in.)	2,200	1,300	—	—	1,100	650	—	—
40 mm (1.6 in.)	1,400	820	—	—	—	—	—	—

Model CSR40SL

External Static Pressure (water column)	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	High Speed		Low Speed		High Speed		Low Speed	
	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min
0 mm (0 in.)	5,820	3,430	2,800	1,650	4,860	2,860	2,590	1,525
10 mm (0.4 in.)	5,055	2,975	1,750	1,030	3,940	2,320	900	560
20 mm (0.8 in.)	4,365	2,570	—	—	3,040	1,790	—	—
30 mm (1.2 in.)	3,440	2,025	—	—	2,140	1,260	—	—
40 mm (1.6 in.)	2,615	1,540	—	—	—	—	—	—

Model CSR40

External Static Pressure (water column)	460/230V, 3 Phase, 60 Hz Power				380/190V, 3 Phase, 50 Hz Power			
	High Speed		Low Speed		High Speed		Low Speed	
	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min	m^3/hr	ft^3/min
0 mm (0 in.)	6,560	3,860	3,170	1,865	5,480	3,225	2,710	1,595
10 mm (0.4 in.)	5,820	3,425	1,770	1,040	4,530	2,665	930	545
20 mm (0.8 in.)	5,000	2,940	—	—	3,750	2,205	—	—
30 mm (1.2 in.)	4,430	2,610	—	—	2,930	1,725	—	—
40 mm (1.6 in.)	3,520	2,070	—	—	1,870	1,100	—	—

Electrical System

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	0.37 kW @ 460V, 60 Hz
Horsepower	0.50 hp @ 460V, 60 Hz
Number: All Models	1
Reliance Motor:	
RPM	1140 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
Magnetek Motor:	
RPM	1140 rpm @ 460V, 60 Hz
Full Load Amps	1.0 amps @ 460V, 60 Hz; 1.0 amps @ 380V, 50 Hz
Locked Rotor Amps	4.0 amps @ 460V, 60 Hz; 4.0 amps @ 380V, 50 Hz
Evaporator Fan Motors:	
Type	460/380V, 60/50 Hz, 3 Phase
Kilowatts	0.75 kW @ 460V, 60 Hz
Horsepower	1.0 hp @ 460V, 60 Hz
Number:	
CSR20SL	3
CSR40SL	3
CSR40	2
Reliance Motor:	
RPM (Each): High Speed	3450 rpm @ 460V, 60 Hz
Low Speed	1725 rpm @ 460V, 60 Hz
Full Load Amps (Each): High Speed	1.6 amps @ 460V, 60 Hz
Low Speed	0.8 amps @ 460V, 60 Hz
Locked Rotor Amps: High Speed	10.5 amps @ 460V, 60 Hz
Low Speed	9.0 amps @ 460V, 60 Hz
Magnetek Motor:	
RPM (Each): High Speed	3450 rpm @ 460V, 60 Hz
Low Speed	1725 rpm @ 460V, 60 Hz
Full Load Amps (Each): High Speed	1.4 amps @ 460V, 60 Hz
Low Speed	0.55 amps @ 460V, 60 Hz
Locked Rotor Amps: High Speed	10.3 amps @ 460V, 60 Hz
Low Speed	2.9 amps @ 460V, 60 Hz

Electrical System (Continued)

Electrical Resistance Heater Rods:	
Type	460/380V, 60/50 Hz, 3 Phase
Number	6
Watts (Each)	680 Watts @ 460V, 60 Hz
Current Draw (Amps)	5 amps total @ 460V across each phase at heater contractor
Control Circuit Voltage:	
	29 Vac @ 60 Hz
	24 Vac @ 50 Hz
Evaporator Overheat Switch:	
Opens	54 ± 3 C (130 ± 5 F)
Closes	38 ± 4.5 C (100 ± 8 F)

Refrigeration System

Compressor:	
Model No.:	ZM18K4E-TFD-276, Scroll
Refrigerant Charge:	
CSR20SL	3.3 Kg (7.3 lb.) R-404A
CSR40SL	3.4 Kg (7.5 lb.) R-404A
CSR40	3.4 Kg (7.5 lb.) R-404A
Water-Cooled Condenser-Receiver Tank (Option)	1.0 Kg (2.2 lb.) Additional R-404A
Compressor Oil Capacity	1.77 liter (60 oz.)*
Compressor Oil Type:	Polyol Ester Based Type (required), (refer to Tool Catalog)**
High Pressure Cutout Switch:	
Cutout	3243 ± 48 kPa, 32.43 ± 0.48 bar, 470 ± 7 psig
Cutin	2588 ± 262 kPa, 25.88 ± 2.62 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 (Before 1/2001: +21 to -20 kPa, +0.21 to -0.20 bar, 3 psig to 6” Hg vacuum)
Cutin	28 to 48 kPa, 0.28 to 0.48 bar, 4 to 7 psig (Before 1/2001: 48 to 90 kPa, 0.48 to 0.90 bar, 7 to 13 psig)
High Pressure Relief Valve:	
Relief Pressure	3447 +520/-104 kPa, 34.47 +5.20/-1.04 bar, 500 +75/-15 psig
Reset	2758 kPa, 27.58 bar, 400 psig
Liquid Injection Control:	
Modulation Cool or Power Limit	Liquid injection valve opens continuously when cooling capacity is 91% or less. Valve closes when cooling capacity is 90% or more.
Compressor Discharge Temperature Control:	
Liquid Injection Valve Energizes (Opens)	128 to 138 C (262 to 280 F)
Liquid Injection Valve De-energizes (Closes)	6 C (10.7 F) below energize temperature (122 to 132 C [270 to 123 F])
Compressor Shutdown (Auto Reset)	148 C (298 F)

Refrigeration System (Continued)

Liquid Injection Valve (Compressor):	
Voltage	24 Vac
Current	0.85 amps
Cold Resistance	5.6 ohms
Warm Gas Bypass Solenoid Valve:	
Voltage	24 Vac
Current	0.85 amps
Cold Resistance	5.6 ohms
Stepper Valve Regulating Motor:	
Voltage	12 Vdc
Current Draw	0.13 to 0.21 amperes per winding
	0.26 to 0.44 amperes with 2 windings energized
Resistance	75 ± 7.5 ohms across each winding at 24 C (75 F) ambient
Water Pressure Switch (Option):	
Close	117 ± 21 kPa, 1.17 ± 0.20 bar, 17 ± 3 psig
Open	35 ± 21 kPa, 0.35 ± 0.20 bar, 5 ± 3 psig

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

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

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

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

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

**Discharge pressure is determined by condenser fan cycling.

MP-3000 Controller

Temperature Controller:	
Type	MP-3000 microprocessor with thermostat, digital thermometer, programming keypad, mode indicators, LED display and LCD display for displaying unit operating and cargo information
Setpoint Range	-30.0 to +30.0 C (-22.0 to +86.0 F)
Digital Temperature Display	-60.0 to +80.0 C (-76.0 to +176.0 F)
Controller Software (Original Equipment):	
Version	See controller identification decal
Defrost Initiation	
Evaporator Coil Sensor	Manual Switch or Demand Defrost Initiation: Coil must be below 18 C (65 F). Defrost cycle starts when technician or controller request defrost initiation. Timed Defrost Initiation: Coil must be below 10 C (50 F). Defrost cycle starts 1 minute after the hour immediately following a defrost timer request for defrost initiation. For example, if the defrost timer requests a defrost cycle at 7:35, the defrost cycle will start at 8:01. Datalogger will record a Defrost event for each interval in which a Defrost cycle is pending or active (i.e. both the 8:00 and 9:00 data logs).
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 left hand and right hand supply air sensors is too large and unit has operated for 90 minutes since last defrost Temperature difference between the supply air sensors and return air sensor is too large
Defrost Timer: Chilled mode	Supply Temperature at 5.1 C (41.2 F) or Above: Every 8 hours of compressor operation. Supply Temperature at 5.0 C (41.0 F) or Below: Every 2.5 hours of compressor operation. Defrost interval increases 0.5 hours each timed defrost interval. Defrost synchronization creates step intervals of 3, 4, 4, 5, 5, 6, 6 and 7 hours. Maximum time interval in Chilled mode is 7 hours.
Defrost Timer: Frozen mode	Every 8 hours of compressor operation. Defrost interval increases 2 hours each timed defrost interval. Maximum time interval in Frozen mode is 24 hours.
Defrost Timer: 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 pre-trip test occurs.
Defrost Termination:	
Defrost (Coil) Sensor	Chilled mode: Terminates defrost when coil sensor temperature rises to 30 C (86 F); or exceeds 18 C (65 F) for 35 minutes (45 minutes if voltage is below 440V) Frozen mode: Terminates defrost when coil sensor temperature rises to 30 C (86 F); or exceeds 8 C (46 F) for 35 minutes (45 minutes if voltage is below 440V)
Termination Timer	Terminates defrost after 90 minutes at 60 HZ operation if coil sensor has not terminated defrost (120 minutes at 50 Hz operation)
Power Off	Turning **UNIT ON/OFF** switch **OFF** terminates defrost

MP-3000 Controller (Continued)

Compressor Shutdown Protection (Auto Reset):	
Stops Compressor	148 C (298 F)
Allows Compressor Start	90 C (194 F)
Bulb Mode (Option):	
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)
USDA Trip (Option):	
Settings	Off On: Controller activates Defrost Termination Temperature Setting and Defrost Time Setting in Setpoint menu
Defrost Termination Temperature Setting	4 to 30 C (40 to 86 F)
Defrost Time Setting	2 to 8 hours

Dehumidify and Humidify Systems (Options)

Dehumidify System (Option):	
Turn Mode On and Off	Set from “CONTROL” line of the Setpoint menu of the controller
Control Range	50% to 95% Relative Humidity
Setpoint Range (HUMSP)	Setpoint adjustable from 0% to 99% Relative Humidity
Humidify System (Option):	
Turn Mode On and Off	Set from CONTROL line of the Setpoint menu of the controller
Operating Temperature Range	0 to 60 C (32 to 140 F)
Control Range	60% to 95% Relative Humidity
Setpoint Range (HUMSP)	Setpoint adjustable from 0% to 99% Relative Humidity
Air Compressor Output	2.5 m^3/hr @ 0 kPa (1.5 CFM @ 0 psig)
Humidity Tank Heater:	240-600 Vac; 55 to 70 Watts at -17.8 C (0 F) Water Temperature
Humidity Sensor:	
Accuracy:	± 1.5% between 55% and 75% Relative Humidity ± 3.0% between 75% and 95% Relative Humidity
Output Range:	4 to 20 milliamps (20% to 100%) 1% Relative Humidity = 0.2 milliamps

Physical Specifications

Fresh Air Exchange Venting System (Adjustable):	
CSR20SL	0 to 160 m^3/hr (0 to 96 ft^3/min.) @ 60 Hz 0 to 134 m^3/hr (0 to 79 ft^3/min.) @ 50 Hz
CSR40SL and CSR40	0 to 280 m^3/hr (0 to 165 ft^3/min.) @ 60 Hz 0 to 232 m^3/hr (0 to 136 ft^3/min.) @ 50 Hz
Evaporator Fan Blade Specifications:	
CSR20SL:	
Diameter	270 mm (10.6 in.)
Pitch	25°
Number	3
CSR40SL:	
Diameter	312 mm (12.25 in.)
Pitch	25°
Number	3
CSR40:	
Diameter	355 mm (14.0 in.)
Pitch	25°
Number	2
Weight (net):	
CSR20SL Base Unit	392Kg (865 lb.)
CSR40SL Base Unit	402 Kg (885 lb.)
CSR40 Base Unit	413 Kg (910 lb.)
Full TRANSFRESH®Option	13 Kg (28 lb.)
Water-cooled Condenser-Receiver Option	13.6 Kg (30 lb.)
Unit Dimensions:	
A = Flange Width	2025.5 mm (79.74 in.)
B = Gasket Width	1935 mm (76.18 in.)
C = Unit Width	1894 mm (74.57 in.)
D = Flange Height	2235.2 mm (88.00 in.)
E = Gasket Height	2140 mm (84.25 in.)
F = Unit Height	2094 mm (82.44 in.)
G = Gasket Depth	72 mm (2.83 in.) from back of flange
H = Maximum Protrusion	37 mm (1.46 in.) from back of flange
I = Unit Depth: CSR20SL	335.0 mm (13.18 in.) from back of flange
CSR40SL	378.0 mm (14.88 in.) from back of flange
CSR40	420.0 mm (16.54 in.) from back of flange
J = CSR40	Evaporator Access Door
K = CSR20SL and CSR40SL	Evaporator Access Door
L = Condenser Grille	CSR Models Before 4/01
M = Condenser Grille	CSR Models After 4/01

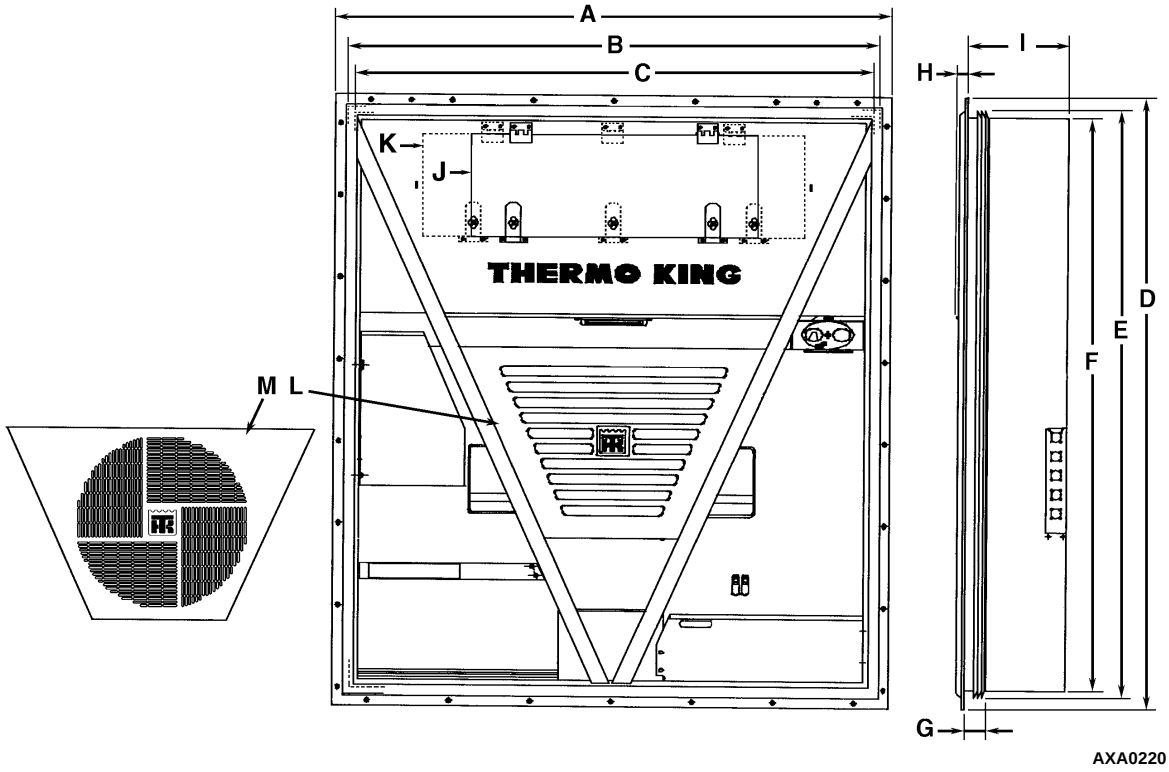


Figure 2: Physical Specifications

Metric Hardware Torque Charts

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

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

*HH = Hex Head, CL = Class.

Unit Description

General Description

Model CSR20SL, CSR40SL and CSR40 units are all-electric, single-piece, refrigeration units with bottom air supply. Each unit is designed to cool and heat containers for shipboard or overland transit. Each unit mounts in the front wall of the container. CSR20SL and CSR40SL units feature a slimline frame. Fork lift pockets are provided for installation and removal of the unit.

The frame and bulkhead panels are constructed of aluminum and are treated to resist corrosion. A hinged, removable evaporator compartment door provides easy service access. All components except the evaporator coil and electric heaters can be replaced from the front of the unit. Each unit is equipped with an 18.3 m (60 ft.) power cable for operation on 460-380V/3 Ph/60-50 Hz power. For operation on 460-380V/3 Ph/60-50 Hz power, plug the 460-380V power cable into the proper power supply. 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. Unit features include a flanged scroll compressor with a liquid injection system; 2-speed evaporator fans; a fresh air exchange system; and a MP-3000 controller with integral data logger.

Scroll Compressor with Liquid Injection Cooling System

The refrigeration unit includes a scroll compressor (one stationary and one orbiting member) with ambient compensated internal overload and high temperature protectors, and a refrigerant injection system.

MP-3000 Controller

The MP-3000 controller incorporates refrigeration system component control, thermostat, digital thermometer, fault indication and data recording capabilities into one self-contained package.

The controller mounts in a weather tight, corrosion resistance enclosure. A large-character LED display (top) provides easy viewing of the control sensor temperature (return or supply air temperature). A 4-line, 20-character LCD display (bottom) display shows important data including the setpoint temperature, controller main menu tree and important unit operating data.

Sixteen general purpose keys are used to enter and scroll through the controller menu tree and message text; initiate pre-trip and function tests; enter new setpoint temperature; and enter trip information. The keyboard supports both numerical and text input. Four special keys provide quick access to set-point temperature change, manual defrost initiation, alternate return/supply air temperature display, and alternate temperature scale (C/F) display.

Status indicator LEDs in the controller display signal compressor, heat, defrost, in-range, alarm, humidity, supply temperature display and return temperature display.

A data logger incorporated in the MP-3000 controller records sensor temperatures as well as loss of power, alarms, unit operating modes, sensor failure, setpoint change and unit shutdown indications. All data recordings are stored in a RAM memory that is backed by battery.

Data logging interval is selectable from 1 minute and 1/2, 1, 2 or 4 hours. The 1 minute interval is intended for special data recording or diagnosis requirements and only records data for 72 minutes. The controller then clears the data logger memory and returns to the previous logging interval.

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.

The data logger clock is factory set at UTC time. All data logs include the time and date; setpoint temperature; and supply, return, USDA1, USDA2 and USDA3 sensor temperatures. All temperature logs can be viewed from the controller’s LCD message display.

A high speed serial communication port provides data retrieval using a DRU-II hand-held data retriever or laptop computer with SmartSponge™ software, or a REFCON power line remote monitoring system.

Dual Speed Evaporator Fans

CSR 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 fans operate on high speed for perishable cargo at setpoints of -9.9 C (14.1 F) and above. At setpoints of -10 C (14 F) and below, the evaporator fans operate on low speed for frozen cargo. The evaporator fan low speed rpm is one-half the high speed rpm.

NOTE: If Economy mode is on:

Fresh Loads: Evaporator fans operate on low speed when container temperature is in-range.

Frozen Loads: Evaporator fans stop during the Null mode; controller operates fans on low speed for 5 minutes every 45 minutes.

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 cargo and chilled load operating conditions. The fresh air vent should be tightly closed when carrying frozen cargo.

Unit Options

Advanced Fresh Air Management (AFAM)

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

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

The system is precalibrated for air exchange rates of 0 to 160 m^3/hr (0 to 96 ft^3/min) on CSR20SL and CSR20SL; and 0 to 280 m^3/hr. (0 to 165 ft^3/min) on CSR40SL, CSR40SL, CSR40 and CSR40. The actual door position is based on the air exchange setting, the power supply frequency (Hertz).

Advanced Fresh Air Management Plus (AFAM+)

An advanced microprocessor controlled fresh air management system also provides programmable control of the O_2 and CO_2 levels in the container, and data logging of the O_2 and CO_2 gas level readings.

The AFAM+ system includes all AFAM system components plus a gas sensor unit, sensor filter, vent loop, pressure relief valve assembly and single purge port. The controller can be set to maintain a minimum O_2 level in the container between 0 and 21% and a maximum CO_2 level in the container between 0 and 25%.

Bulb Mode

The Bulb mode allows the shipper to control the evaporator fan speed and defrost termination temperature during Dehumidification. The Bulb mode screen setting determines the evaporator fan speed: “FLOW CYCLE”, “FLOW HIGH”, or “FLOW LOW”. Setting a Bulb mode fan speed automatically activates the defrost termination temperature setting and the Dehumidify mode (controller sets Humidity mode to on).

Dehumidification Control System

A dehumidification system lowers the relative humidity in the container to the humidity setpoint. The control range is 60% to 95% while the setpoint is adjustable from 0% to 99%.

Dual Voltage

A dual voltage system includes a 15 KVA auto transformer and an 18.3 m (60 ft.) power cable for operation on 230-190V/3 Ph/60-50 Hz power. The power cable is stored below the control box in the condenser section.

The 15 KVA auto transformer steps 230/190V power up to 460/380V. The auto transformer includes a 460-380V/3 Ph/60-50 Hz power receptacle.

For operation on 230/190V power, plug the 460-380V unit power cable into the receptacle on the auto transformer. Then plug the 230/190V power cable into a 230-190V power supply.

Humidification Control System

An optional humidification system increases the relative humidity in the container to the humidity setpoint. The control range 60% to 95% while the setpoint is adjustable from 0% to 99%.

Pressure Gauge Options

A high pressure gauge is available to indicate condenser (high side) pressure. A low pressure gauge is available to indicate compressor suction (low side) pressure.

Remote Monitoring Modem (RMM)

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

Remote Monitoring Receptacle (4-Pin)

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

Recording Thermometer Options

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

- The 31-day Saginomiya Recorder is electric motor driven by a dry cell type battery with a 1 year life expectancy.
- The 31-day Partlow Recorder is mechanically driven by a spring mechanism.
- Partlow Recorder Sensor only.

TRANSFRESH Atmosphere Control System Options

Several TRANSFRESH options are available to meet individual customer needs. The TRANSFRESH system provides a controlled atmosphere within the container. By controlling the container temperature and atmosphere, the respiration rate of fruit and vegetables can be lowered. This allows the product quality to be maintained for longer periods of time.

TRANSFRESH Ready: Provisions for the future installation and use of a TRANSFRESH atmosphere control system are incorporated in the unit. TRANSFRESH compatible A2 (power/defrost) and A3 (communications) cables (without connectors) are factory installed.

Full TRANSFRESH Option: TRANSFRESH system components are installed for use of a TRANSFRESH atmosphere control system. In addition to A2 and A3 cables (with connectors), the security frame, security enclosure with insulation block, TRANSFRESH supplied single purge port, air hose and scrubber cable (A5, with connectors) are factory installed. Purge port includes a removable plug for charging the container with a modified atmosphere.

USDA Cold Treatment Temperature Recording

The MP-3000 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.

Water-Cooled Condenser/Receiver Tank

A water-cooled condenser/receiver provides the unit with above deck and below deck operating capabilities. Condenser fan control can be provided by a **CONDENSER FAN SELECTION** switch or a **WATER PRESSURE** switch.

The **CONDENSER FAN** switch is provided on the control box with the water-cooled condenser option. Place the **CONDENSER FAN ON/OFF** switch in the **WATER** position for water-cooled condenser operation.

The water pressure switch is installed in the water inlet line. When water pressure greater than 117 ± 21, 1.17 ± 0.21 bar, 17 ± 3 psig is provided to the condenser-receiver tank, the water pressure switch opens. This causes the controller to stop the condenser fan.

Operating Modes

NOTE: See "MP-3000 Controller" chapter for complete sequence of operation.

A sequence start of the required loads occurs during initial start-up of the unit and when a control mode shift requires the compressors to start. As the controller relays and unit loads energize, the controller LCD display shows the setpoint temperature. The controller LED display shows the controlling air sensor temperature. The controlling sensor is determined by the setpoint temperature:

Setpoint	Controlling Sensor
-9.9 C (14.1 F) and above	Supply Air Temperature
-10 C (14 F) and below	Return Air Temperature

The MP-3000 controller uses a proportional-integral derivative (PID) algorithm to provide accurate temperature control in direct response to load demand. Therefore it is difficult to predict which operating mode the unit should be in by comparing the setpoint to the return or supply air temperature. The unit operates in either the Fresh (Chill) or Frozen mode. Chill to Frozen mode transition point is -10 C (14 F).

Chill Loads: Controller Setpoint at -9.9 C (14.1 F) or Above

Temperature control by the controller is based on the supply air sensor temperature, the setpoint, the modulation temperature range and the pull-down rate. The evaporator fans operate in high speed (except during defrost).

- Cool with Modulation (down to setpoint)
- Null (compressor and condenser fan stops, evaporator fans operate)
- Heat (resistance heaters on, evaporator fans operate)
- Defrost (resistance heaters on, evaporator fans stop)

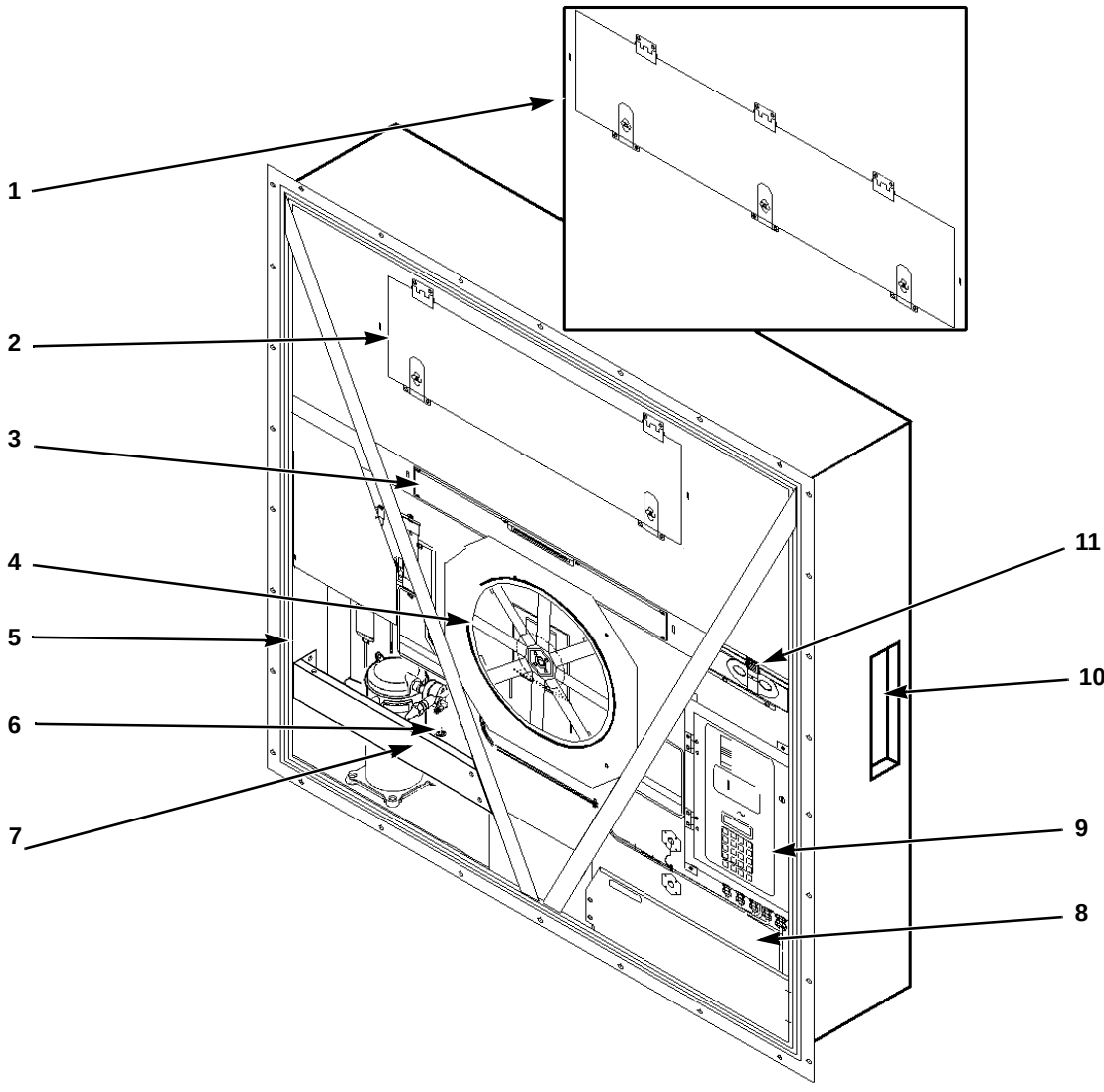
  NOTE: If the Economy mode is set to On, the evaporator fans operate on low speed at setpoints of -9.9 C (14.1 F) and above whenever the container temperature is in-range.

Frozen Loads: Controller Setpoint at -10 C (14 F) or Below

Temperature control by the controller is based on the return air sensor temperature. The evaporator fans operate continuously on low speed (except during Defrost).

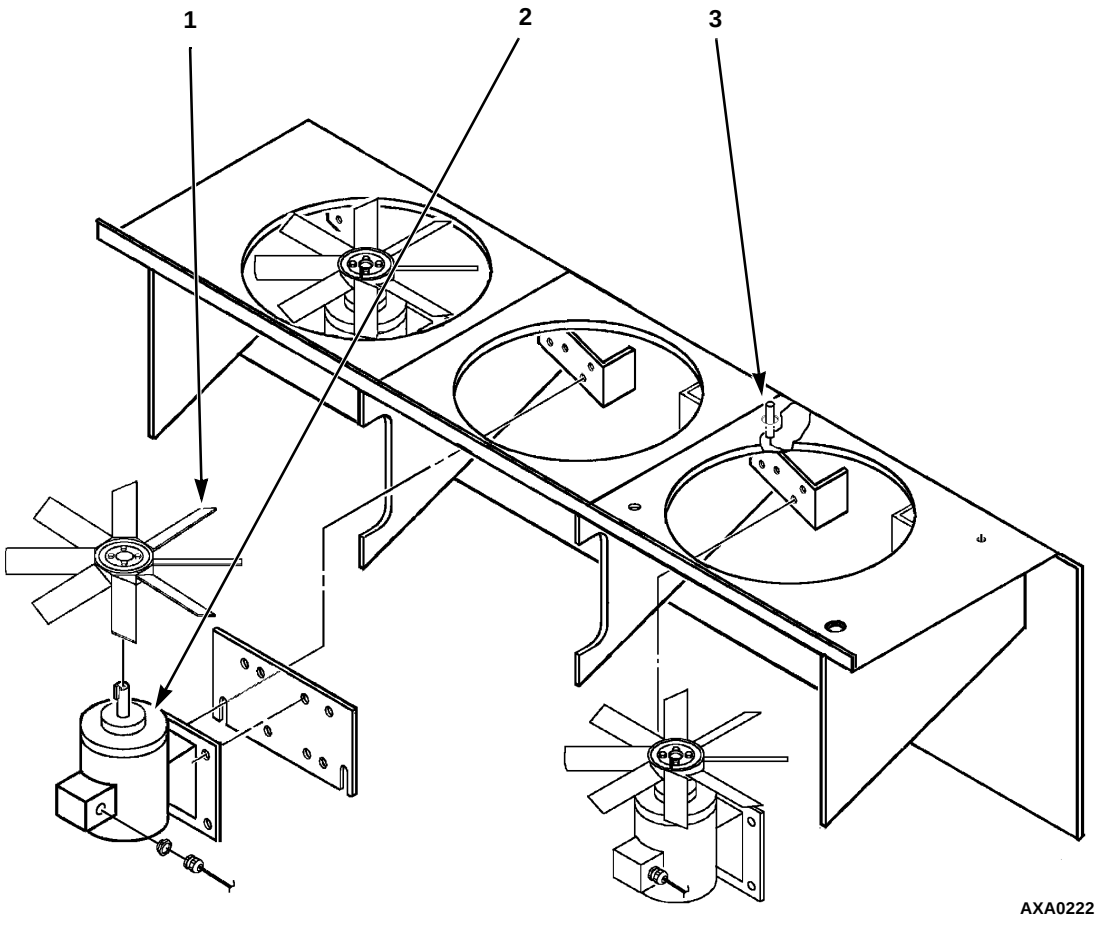
- Cool (down to 1 C [1.8 F] below setpoint)
- Null (compressor and condenser fan stops, evaporator fans operate)
- Defrost (resistance heaters on, evaporator fans stop)

  NOTE: If the Economy mode is set to On, the evaporator fans stop when the unit shifts to Null. The controller automatically starts and operates the evaporator fans on low speed for 5 minutes every 45 minutes while the unit remains in Null.



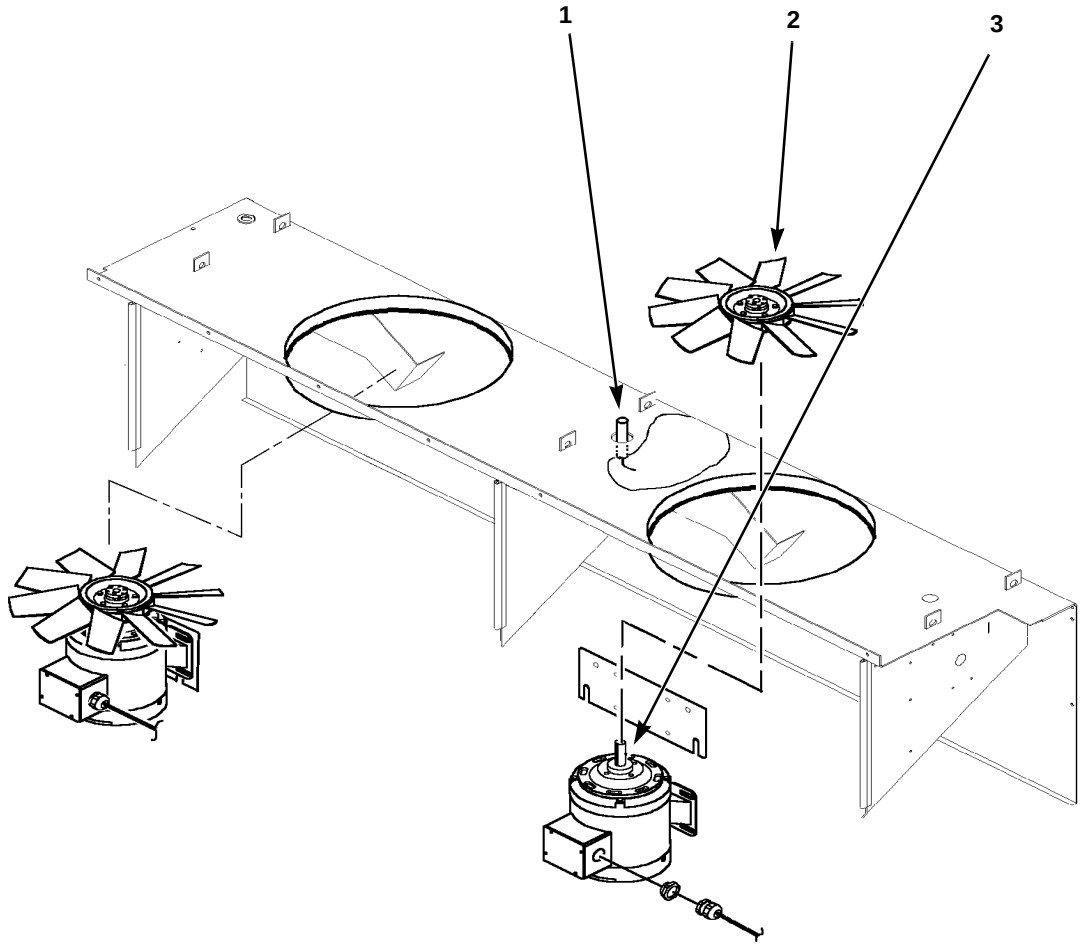
1.	CSR20SL & CSR40SL: Evaporator Access Door, 1399 mm (55.04 in.) Wide with three latches
2.	CSR40: Evaporator Access Door, 1018 mm (40.08 in.) Wide with two latches
3.	Heater Access Panel Location (CSR20SL-144 , CSR20SL-155 , CSR40-145 & CSR40SL-506 Models Only)
4.	Condenser Fan
5.	Compressor Compartment
6.	Supply Air Sensor Probe Holder, Left Hand (Behind Compressor)
7.	Supply Air Sensor Probe Holder, Right Hand
8.	Power Cord Storage Compartment
9.	Control Box
10.	Rear Download and USDA Receptacle Panel (Access from Inside Container)
11.	Fresh Air Exchange Vent

Figure 3: Typical Unit Front View



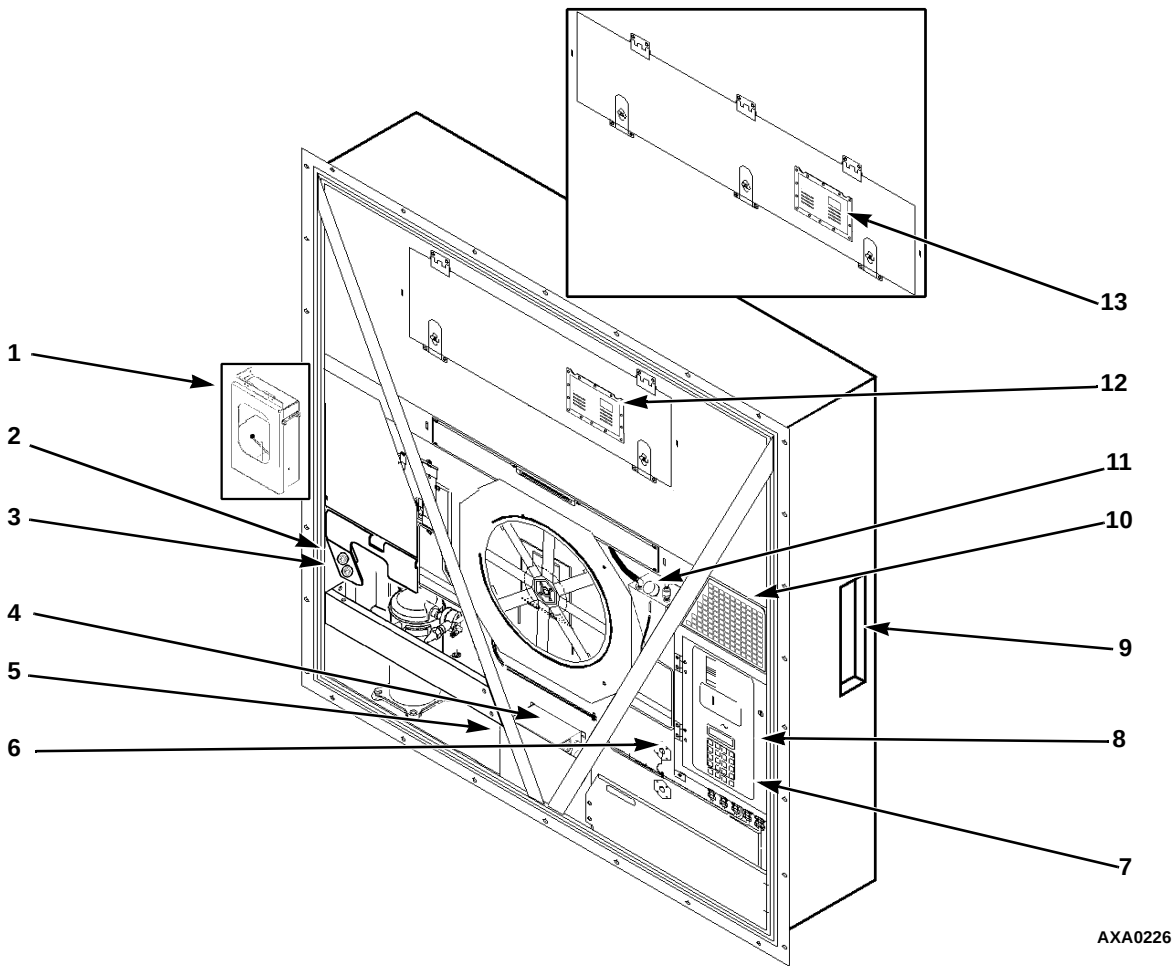
1.	Evaporator Fan Blade (see “Physical Specifications” on page 26 for description)
2.	Evaporator Fan Motor
3.	Return Air Sensor

Figure 4: Evaporator Front View — CSR20SL & CSR40SL



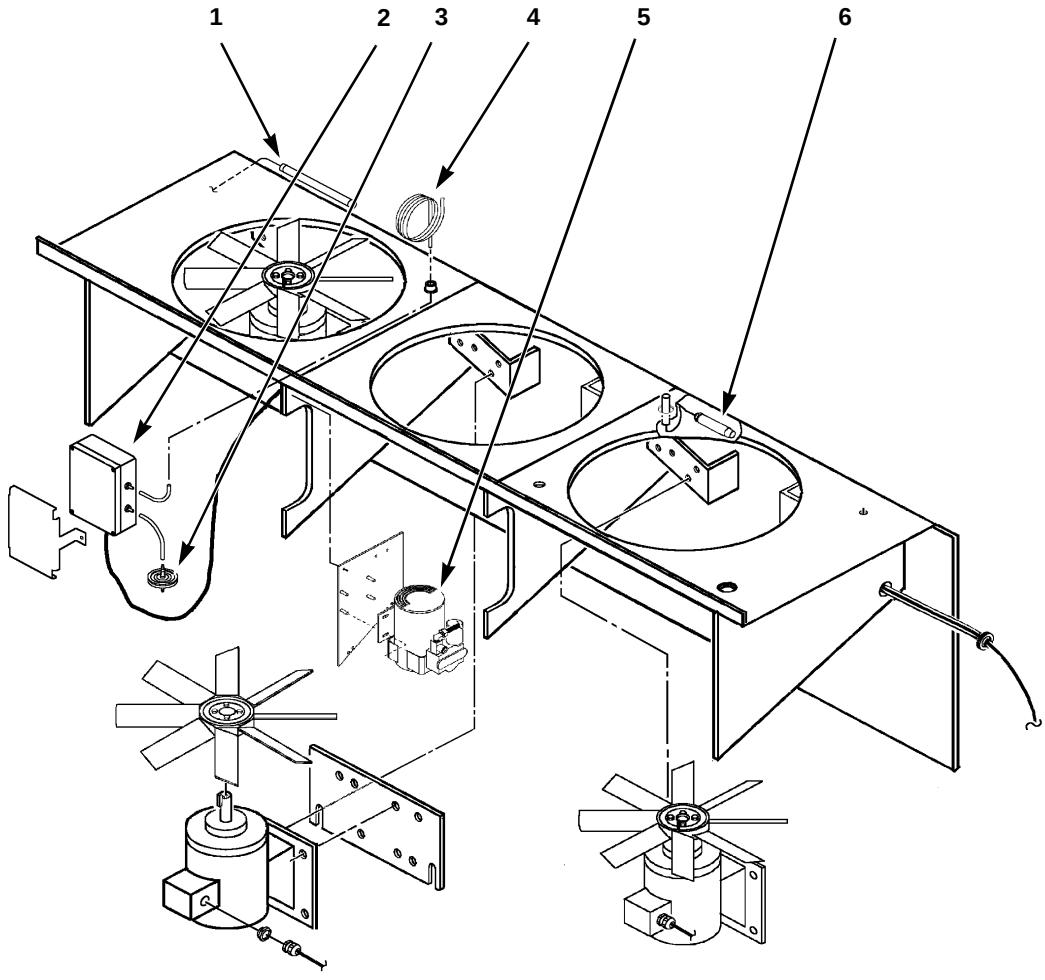
1.	Return Air Sensor
2.	Evaporator Fan Blade (see “Physical Specifications” on page 26 for description)
3.	Evaporate Fan Motor

Figure 5: Evaporator Front View — CSR40



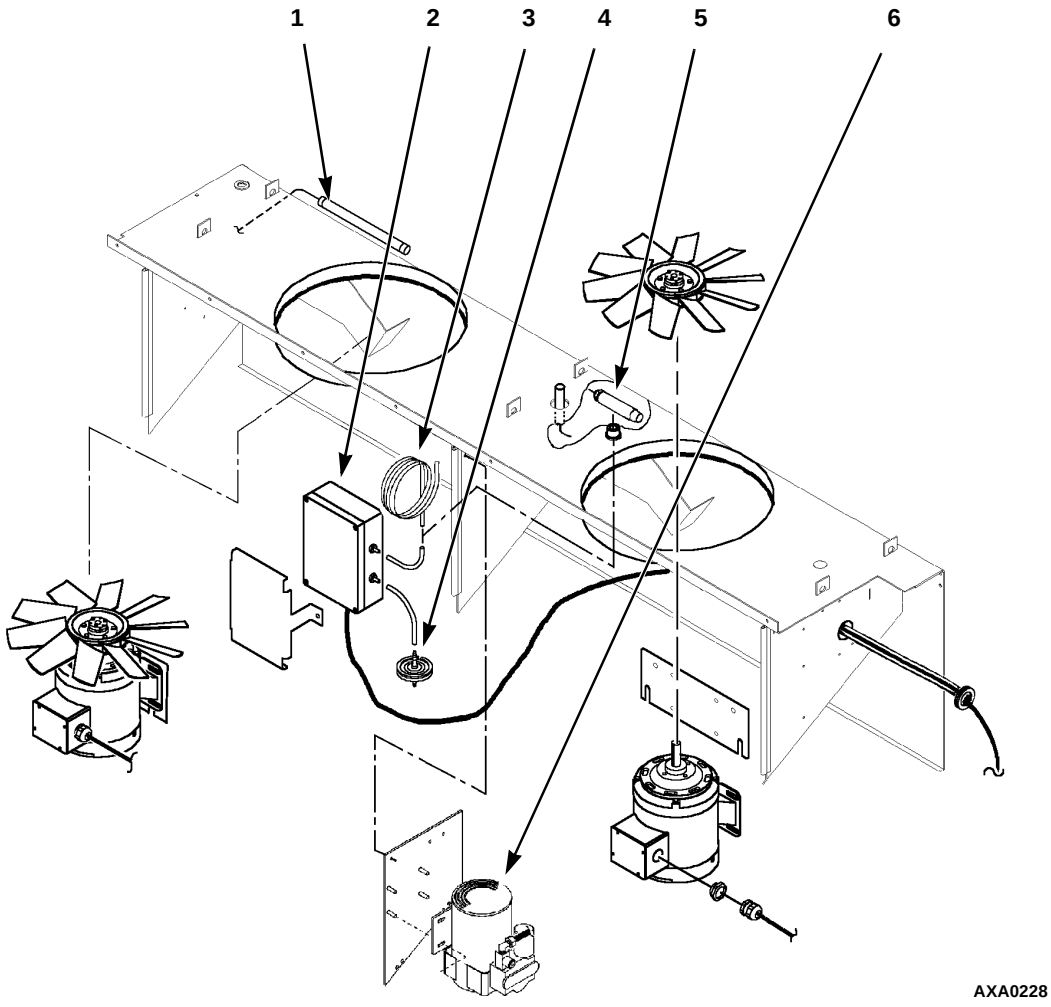
1.	Recording Thermometer Option
2.	Suction Pressure Gauge Option
3.	Discharge Pressure Gauge Option
4.	Dual Voltage Option
5.	TRANSFRESH Download Receptacle Option, see “TRANSFRESH System, Complete” on page 47
6.	Remote Monitor Plug Option (4-Pin Connector on Side of Control Box)
7.	Thermistor Lead Option (Lead inside Control Box)
8.	Remote Monitor Modem for Power Line Communications (REFCON control modem inside Control Box)
9.	USDA Sensor Receptacle Option (Access from Inside Container)
10.	Advanced Fresh Air Management (see “Advanced Fresh Air Management (AFAM) Option” on page 44; or “Advanced Fresh Air Management (AFAM+) Option” on page 45
11.	Humidify System Option, see page 43
12.	TransFresh® Option, Complete, CSR40
13.	TransFresh® Option, Complete, CSR20SL AND CSR40SL

Figure 6: Options — Unit Front View



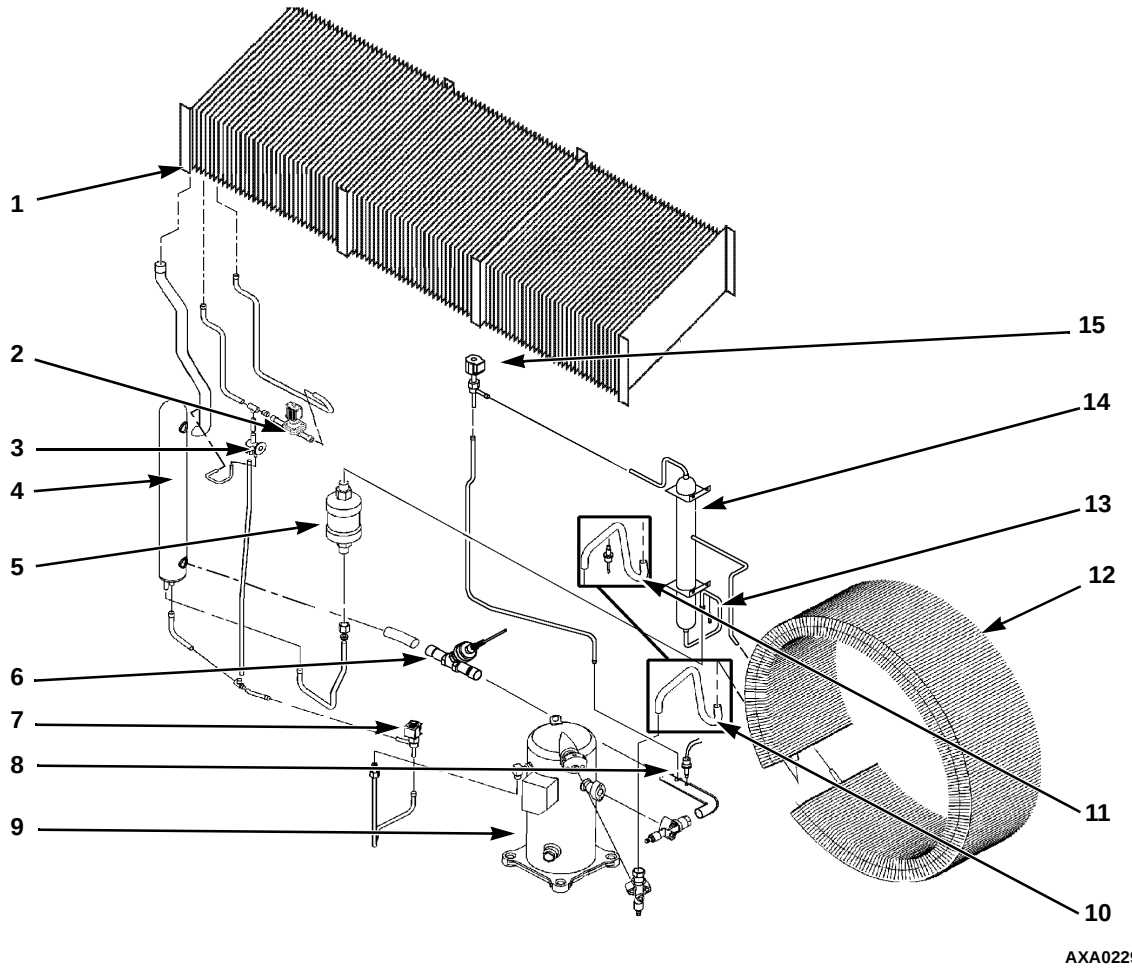
1.	Sensing Bulb Option for Recording Thermometer (Return Air)
2.	Gas Sensor Unit for AFAM+ Option, see page 45
3.	Filter for Gas Sensor for AFAM+ Option
4.	Vent Loop for Gas Sensor for AFAM+ Option
5.	Air Compressor for Humidity System Option, see 43
6.	Humidity Sensor for Dehumidify Option or Humidity Option

Figure 7: CSR20SL, CSR20SL, CSR40SL & CSR40SL Options — Evaporator Front View



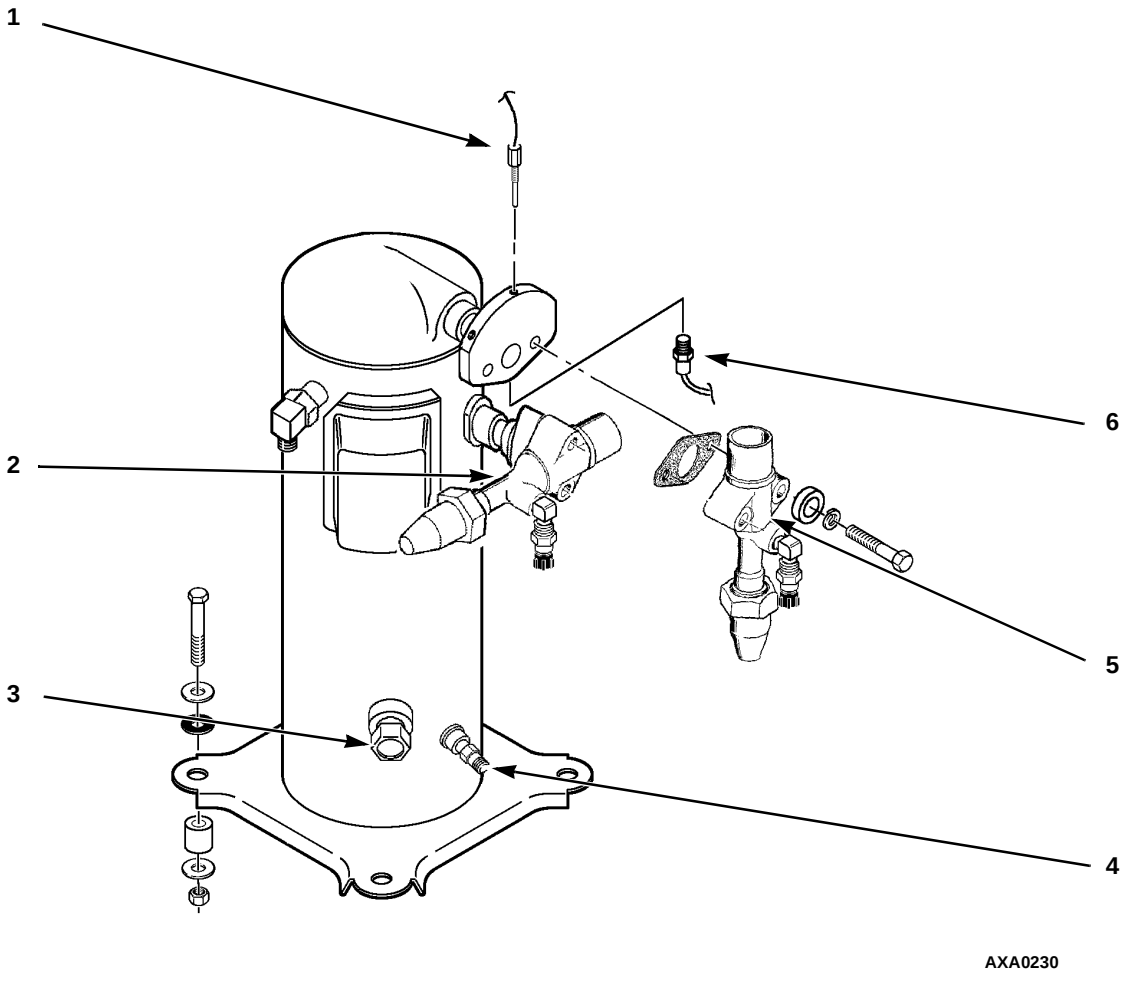
1.	Sensing Bulb Option for recording Thermometer (Return Air)
2.	Gas Sensor Unit for AFAM+ Option, see page 45
3.	Vent Loop for Gas Sensor for AFAM+ Option
4.	Filter for Gas Sensor for AFAM+ Option
5.	Humidity Sensor for Dehumidify Option or Humidity Option
6.	Air Compressor for Humidity System Option, see page 43

Figure 8: CSR40 & CSR40 Options — Evaporator Front View



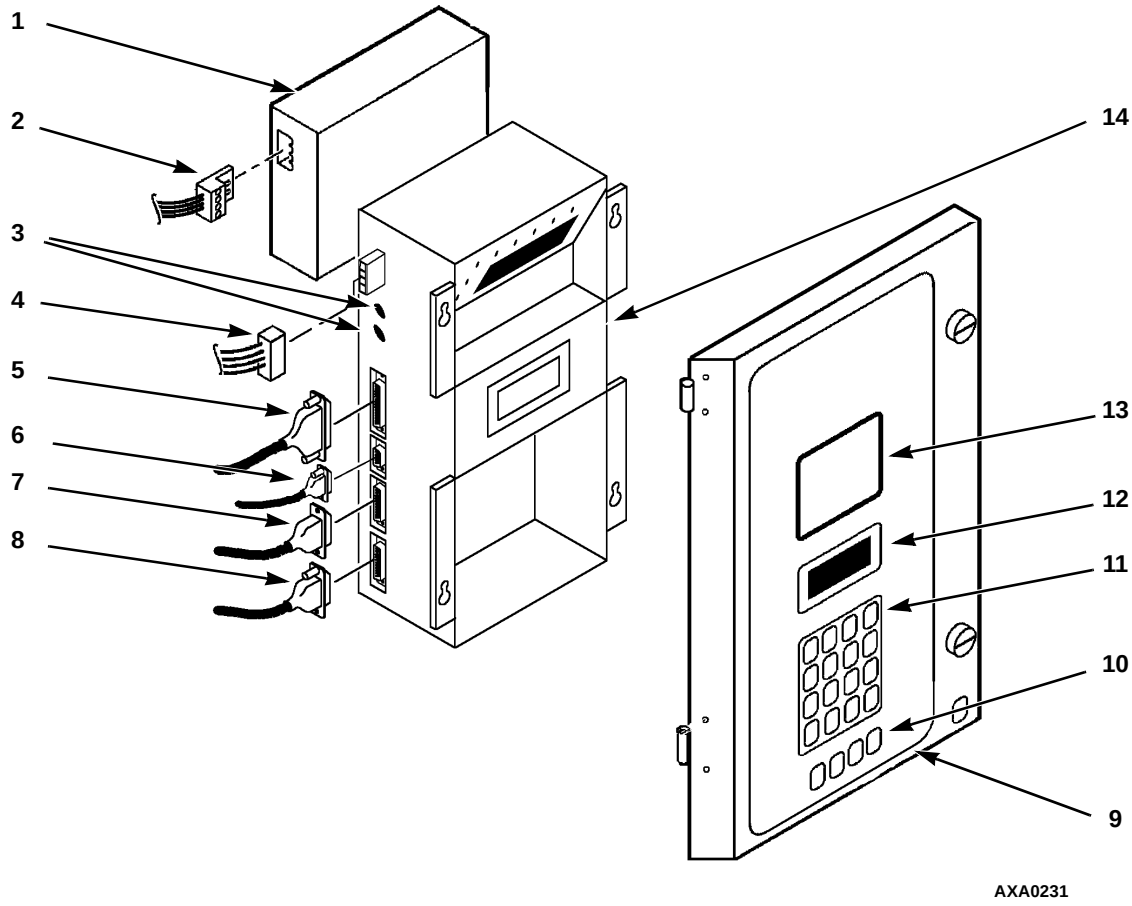
1.	Evaporator Coil	9.	Scroll Compressor (See page 40)
2.	Coil/Dehumidify Valve	10.	Discharge Tube (After 7/00)
3.	Expansion Valve	11.	Discharge Tube with High Pressure Cutout (Before 8/00)
4.	Heat Exchanger	12.	Condenser Coil
5.	One-piece Filter Drier/In-line Filter	13.	High Pressure Relief Valve
6.	Stepper Motor Valve	14.	Receiver Tank
7.	Liquid Injection Solenoid Valve	15.	Warm Gas Bypass Solenoid Valve
8.	Low pressure Cutout Switch		

Figure 9: Refrigeration System



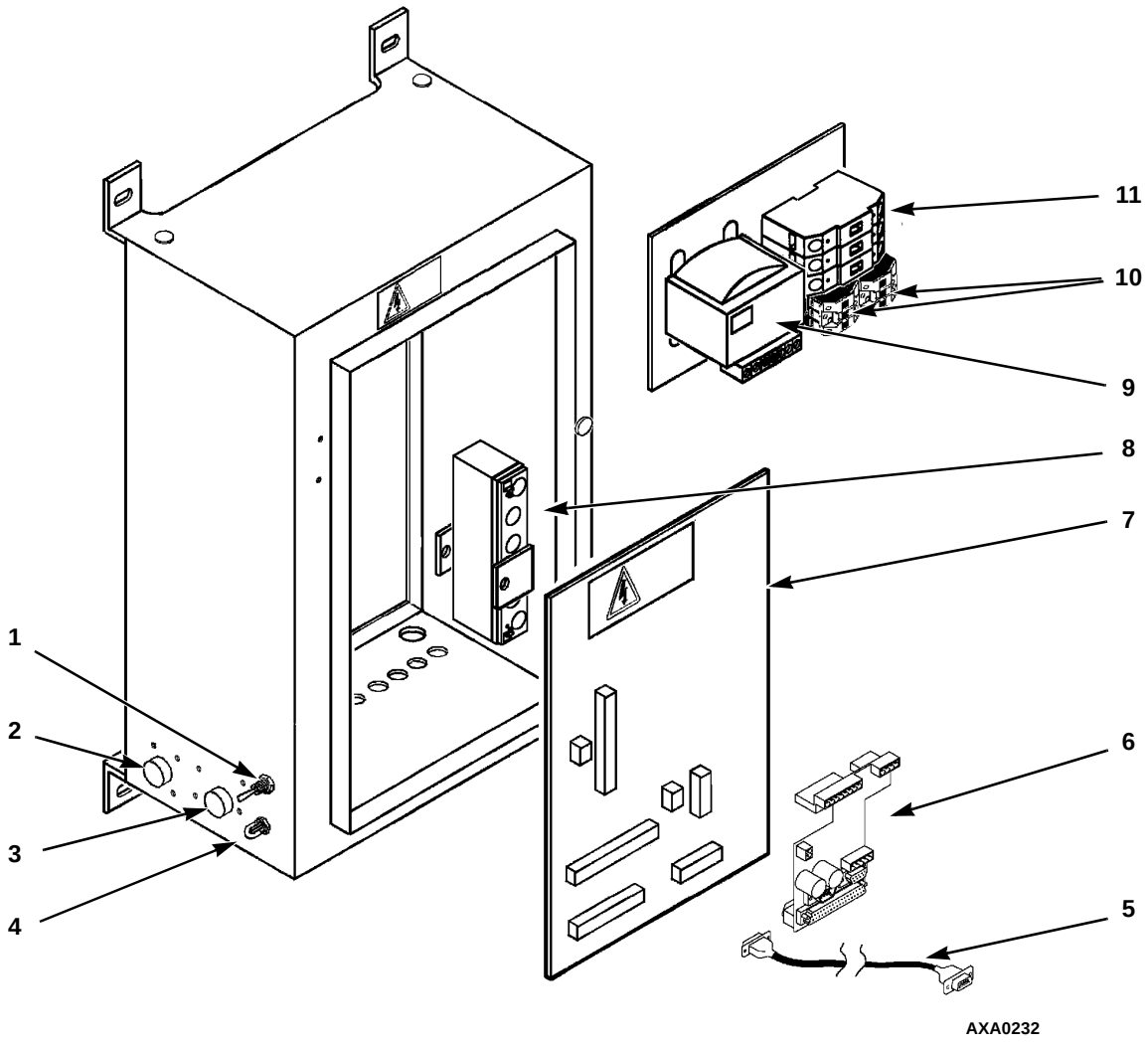
1.	Compressor Discharge Temperature Sensor
2.	Suction Service Valve (Option) with Service Fitting
3.	Compressor Oil Sight Glass
4.	Compressor Oil Fitting
5.	Discharge Service Valve (Option) with Service Fitting
6.	High Pressure Cutout Switch (Units After 7/00)

Figure 10: Scroll Compressor



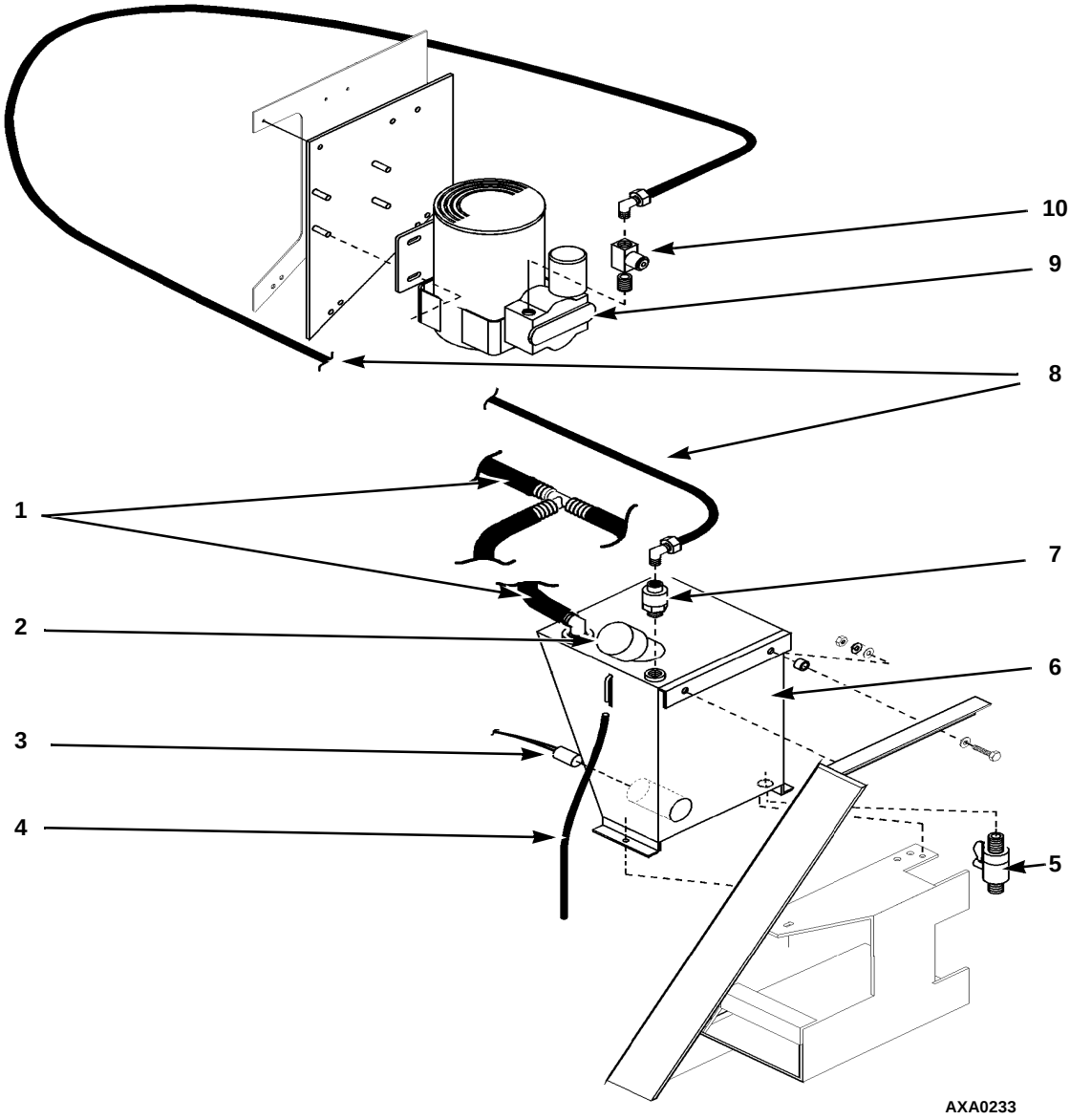
1.	Remote Monitoring Modem (RMM) Option	8.	Cable No. 1 Connection to Controller
2.	Communication Cable for RMM Option	9.	Control Box Cover and Controller Keyboard Decal
3.	Control Circuit Fuses, 2 ampere (2)	10.	Special Function Keypad
4.	Battery Cable Connection to Controller	11.	General Purpose Keypad
5.	Cable No. 2 Connection to Controller	12.	LCD Display (Setpoint Temperature, Message and Controller Main Menu Tree Display)
6.	Download Cable Connection to Controller	13.	LED Display (Return or Supply Air Temperature Display and Status Indicator LEDs)
7.	Cable No. 3 Connection to Controller	14.	MP-3000 Controller

Figure 11: MP-3000 Controller



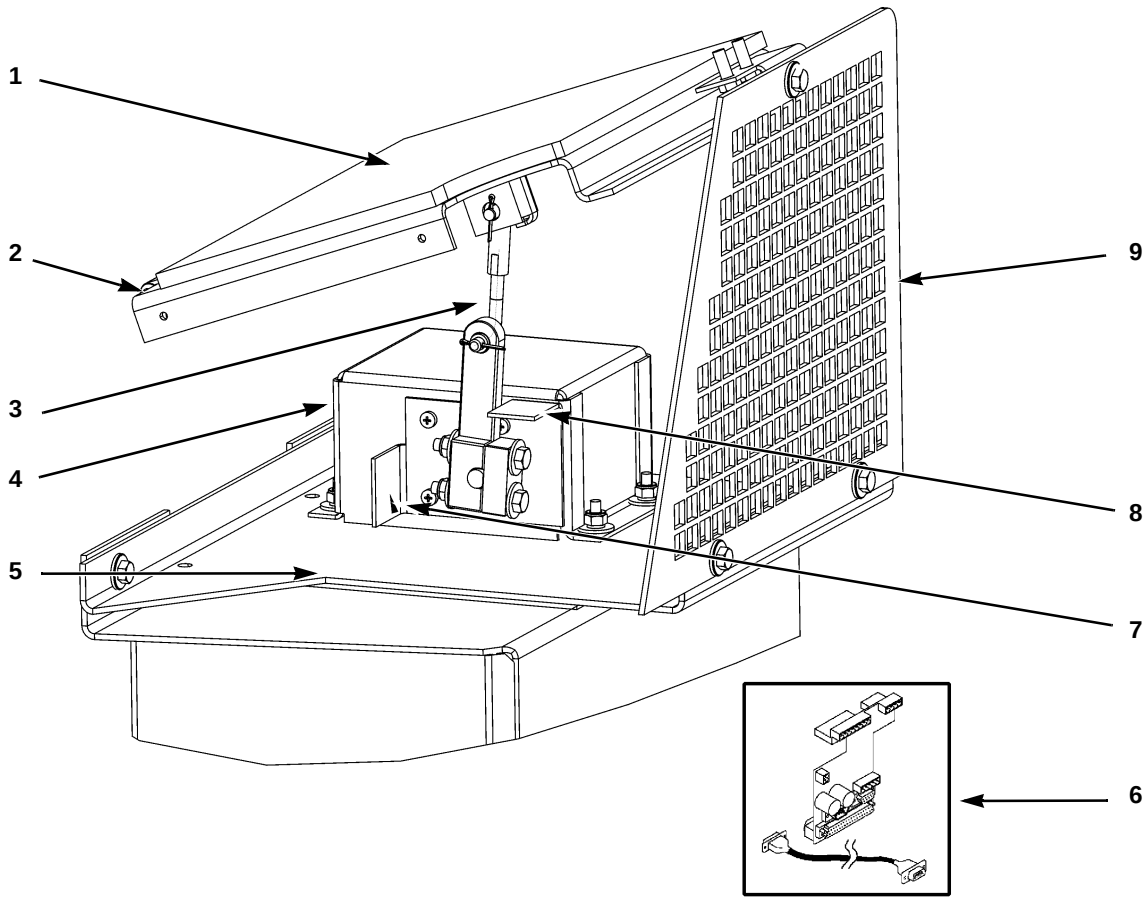
1.	**UNIT ON/OFF** Switch	7.	Main Relay Board
2.	Remote Monitor, 4-Pin (Option)	8.	12 Vdc Battery
3.	Communications Connector for Data Retrieval	9.	Control Power Transformer
4.	Circuit Breaker	10.	Compressor Contactors (2)
5.	Communications Cable for AFAM Option and AFAM+ Option	11.	25 Ampere Main Power Circuit Breaker
6.	Interface Board for AFAM Option and AFAM+ Option		

Figure 12: Unit Control Box



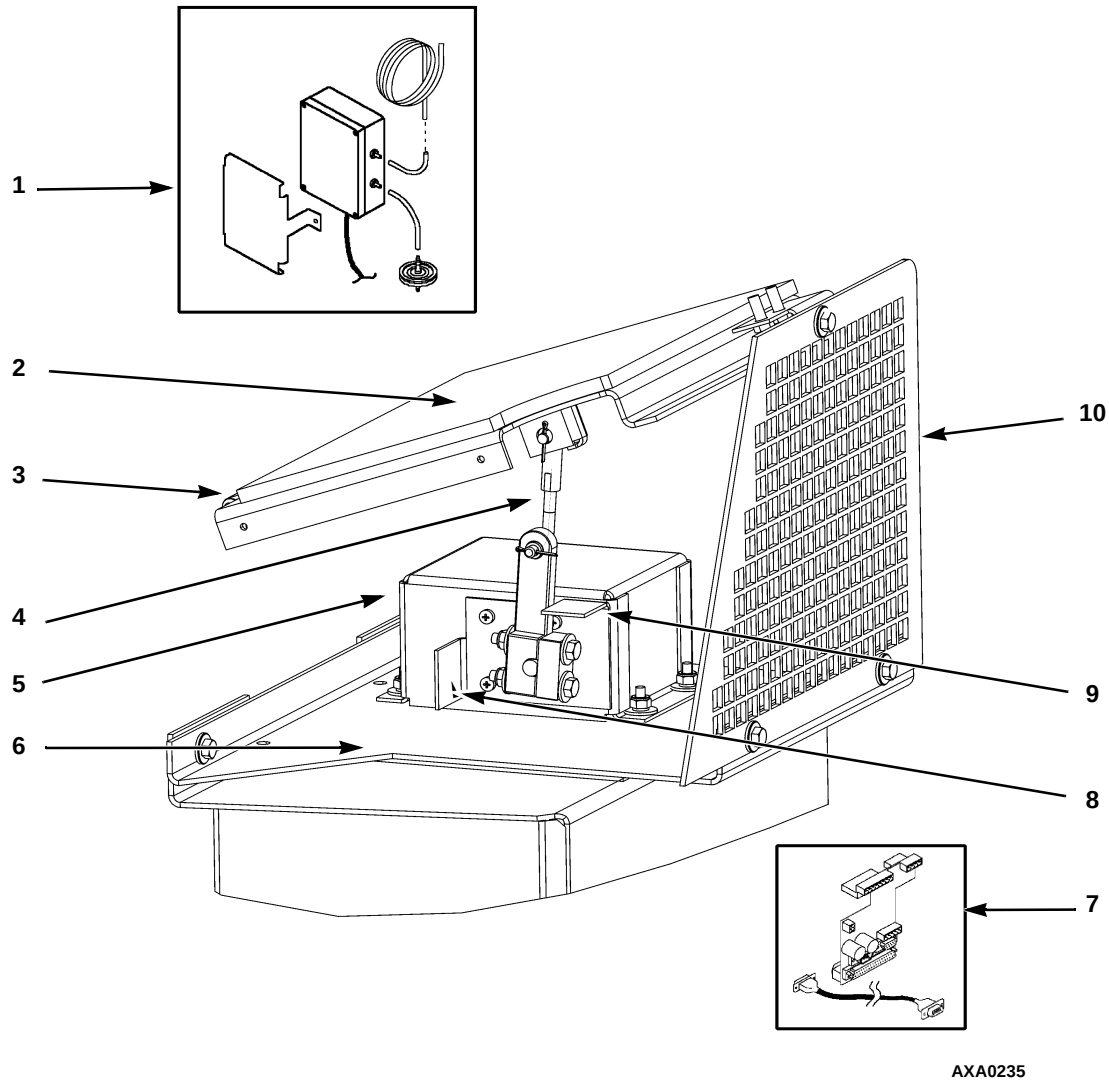
1.	Evaporator Drain Hose	6.	Water Tank
2.	Fill Cap	7.	Water Filter
3.	Water Tank Heater	8.	Water Supply Hose
4.	Tank Overflow Hose	9.	Air Compressor
5.	Drain Cock	10.	Liquid Spray Nozzle

Figure 13: Humidify System Option



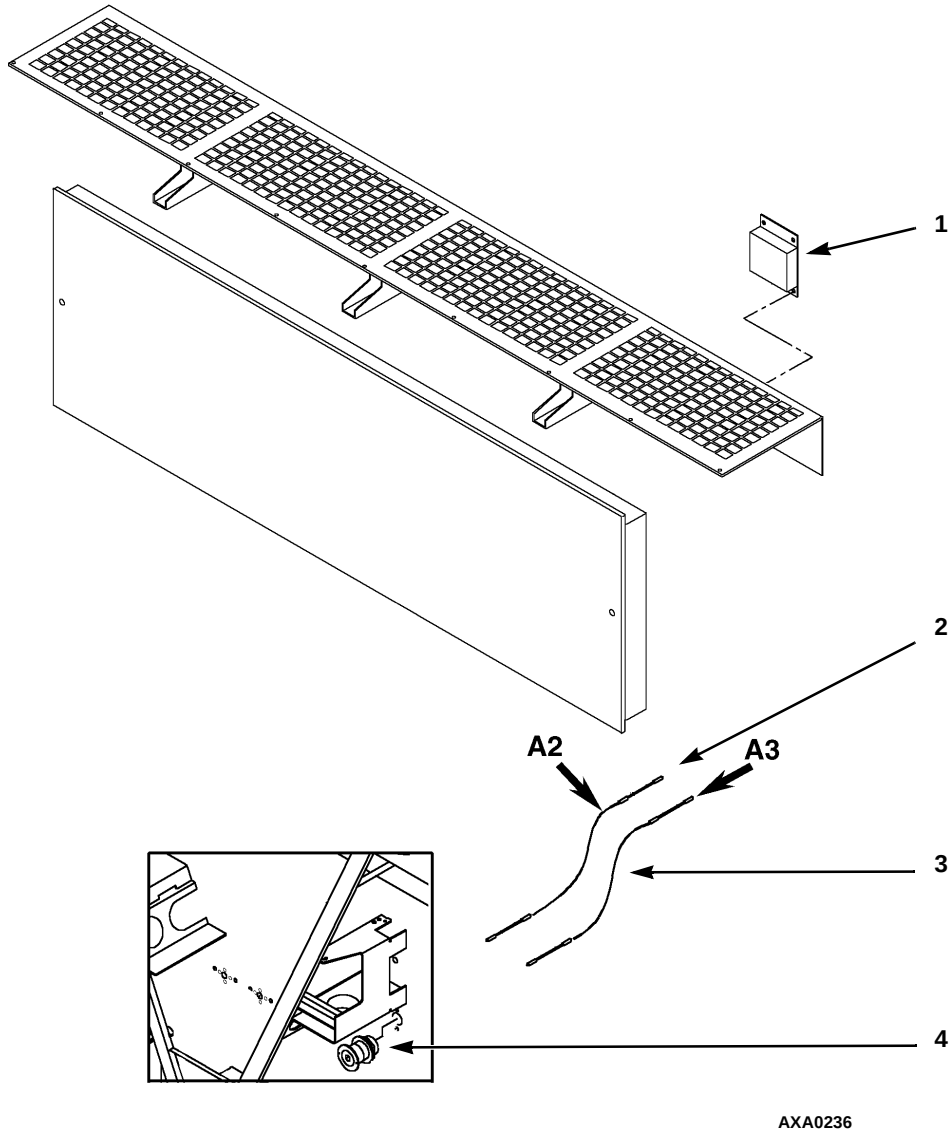
1.	Gasket	6.	Interface Board and Cable (Mounts in Control Box), see page 42
2.	Vent Door Assembly	7.	Stop Bracket, Vent Door Full Open
3.	Linkage Assembly	8.	Stop Bracket, Vent Door Closed
4.	Damper Motor Housing	9.	Grille
5.	Damper Motor Assembly Mounting Bracket		

Figure 14: Advanced Fresh Air Management (AFAM) Option



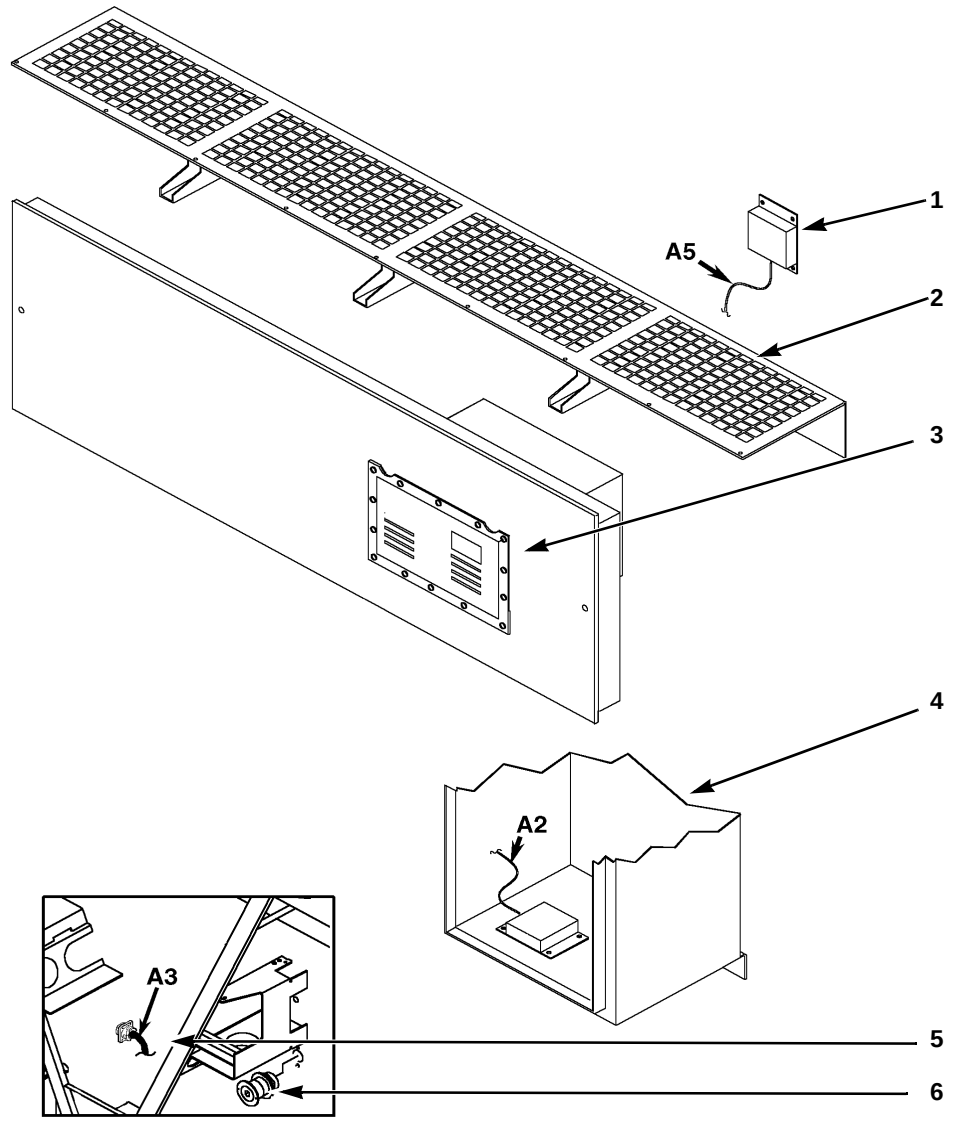
1.	Gas Sensor Assembly (Mounts in Evaporator), see page 37 or 38	6.	Damper Motor Assembly Mounting Bracket
2.	Gasket	7.	Interface Board and Cable (Mounts in Control Box), see page 42
3.	Vent Door Assembly	8.	Stop Bracket, Vent Door Full Open
4.	Linkage Assembly	9.	Stop Bracket, Vent Door Closed
5.	Damper Motor Housing	10.	Grille

Figure 15: Advanced Fresh Air Management (AFAM+) Option



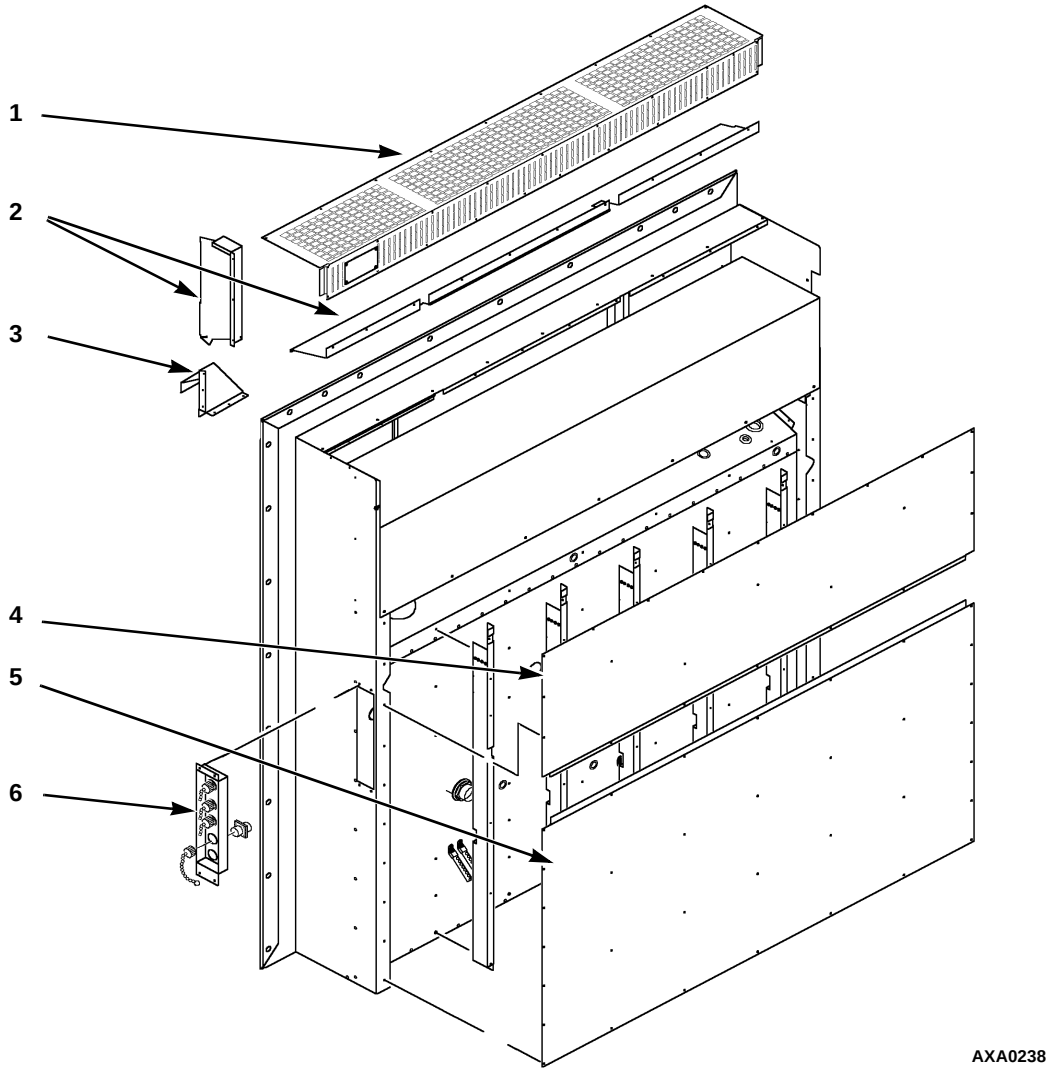
1.	TRANSFRESH Box in Evaporator Grille
2.	A2 Wire Harness to TRANSFRESH Transformer
3.	A3 Wire Harness to TRANSFRESH Download Port
4.	Purge Port

Figure 16: TRANSFRESH Provision Option



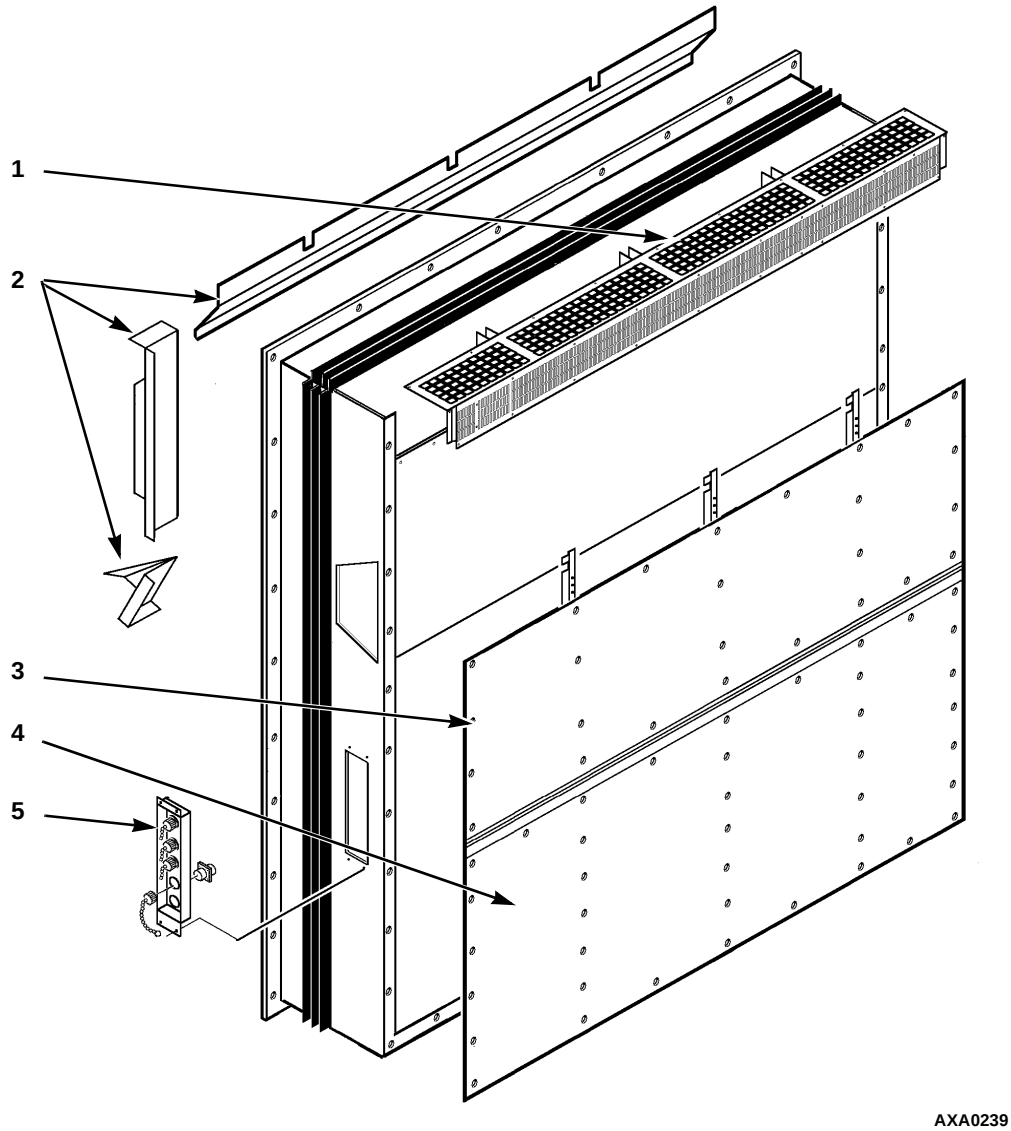
1.	TRANSFRESH Scrubber Connection and A5 Wire Harnesses
2.	Evaporator Grille
3.	TRANSFRESH Security Enclosure
4.	Transformer Assembly mounted in Control Box
5.	TRANSFRESH Download Port
6.	Purge Port

Figure 17: TRANSFRESH System, Complete



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

Figure 18: Unit Back View — All Models without Heater Access Door



1.	Evaporator Grille
2.	Air Channels
3.	Top Rear Plate
4.	Bottom Rear Plate
5.	Receptacle Panel: • Controller Communications and Data Download Port • USDA1/Spare 1 Sensor Connection • USDA2/Spare 2 Sensor Connection • USDA3/Spare 3 Sensor Connection

Figure 19: Unit Back View — Models with Heater Access Door (CSR20SL-144 , CSR40-145, CSR20SL-155 and CSR40SL-506)

Operating Instructions

Unit Controls

Unit Control Box

UNIT ON/OFF Switch:

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

MP-3000 Controller

The MP-3000 microprocessor controls all unit functions to maintain the cargo at the proper temperature. The controller also monitors and records system faults and performs pre-trip.

Keypad: Sixteen general purpose keys are used to display information, change the setpoint, change programmable features and initiate control tasks.

1. **C/F** Key: Press this key to view temperatures in the LED display in the alternate temperature value. Alternate value (C or F) shows while the key is pressed.
2. **RET/SUP** Key: Press this key to view the alternate sensor temperature in the LED display. Alternate sensor (return or supply) shows while the key is pressed.
3. **DEFROST** Key: Press this key to initiate a manual defrost cycle. If the evaporator coil temperature is below 18 C (65 F), the unit will defrost. Otherwise the controller will display "DEFROST NOT ACTIVATED" in the LCD display and the unit will continue normal operation.
4. **SETPOINT** Key: Press this key to change the setpoint. Cursor in the LCD display automatically appears in the "TEMP SETP" line of the Data menu. See "Changing the Setpoint" in the "MP-3000 Controller" chapter for complete instructions.
5. Status Indicator LEDs located in the large LED display signal:
   - **SUPPLY** (Air Temperature)
   - **RETURN** (Air Temperature)
   - **HUMIDITY MODE** (Humidification Option set to On
   - **SETPOINT MENU**)
   - **COMPRESSOR** (Cooling On)
   - **HEAT** (On)
   - **DEFROST**
   - **IN-RANGE** (Temperature)
   - **ALARM**

   The In-range LED illuminates when the controlling air sensor temperature is less than 1.5 C (2.7 F) above set-point (standard). The controller maintains the in-range signal during defrost and after defrost for 60 minutes. If the controlling air sensor temperature goes out-of-range, the controller maintains the in-range signal for 5 more minutes.
6. LED Display: Large red LED display shows current control temperature during normal operation. LED display also shows current test state during a pre-trip (PTI) or function test.
7. LCD Display: A 4-line LCD message display shows setpoint during normal operation. LCD display also shows controller menu and unit operation information when special keys are pressed.

Other Unit Controls

1. Evaporator Overheat Switch: A temperature switch near the evaporator coil opens to de-energize the heater contactor if the evaporator temperature reaches 54 ± 3 C (130 ± 5 F). The switch closes (resets) when the evaporator temperature decreases to 38 ± 4.5 C (100 ±8 F).
2. Water Pressure Switch (Option): When water pressure greater than 117 ± 21, 1.17 ± 0.21 bar, 17 ±3 psig is provided to the condenser-receiver tank, the water pressure switch closes. This causes the controller to stop condenser fan operation. When the water pressure decreases below 35 ± 21 kPa, 0.35 ± 0.21 bar, 5 ± 3 psig, the switch opens, causing the controller to place the unit on air-cooled condenser fan operation.

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

Unit Instruments

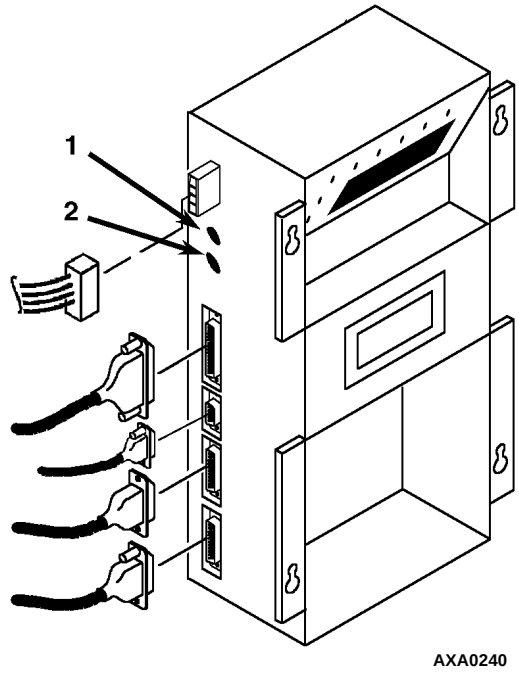
1. Compressor Oil Sight Glass: A compressor oil sight glass indicates the relative level of compressor oil in the compressor sump.
2. Suction Pressure Gauge (Option): A suction pressure gauge indicates the refrigerant pressure in the suction line returning to the compressor.
3. Discharge Pressure Gauge (Option): A discharge pressure gauge indicates the refrigerant pressure in the discharge line leaving the compressor.
4. Thermistor Lead (Option): A thermistor lead is located in the unit control box to provide air temperature verification. The bulb of the thermistor lead is attached to the return or supply air sensor in the evaporator section.
5. Remote Monitor Connector, 4-pin (Option): A receptacle is provided on the side of the control box for connecting the ship's 4-pin bridge light system to the unit. The connector provided circuits for Compressor On, Defrost and In-range. The Remote In-range light is activated when the controlling air sensor temperature is between 1.7 C (3.0 F) above setpoint and 2.5 C (4.5 F) below set-point.
6. Recording Thermometer (Option): The recording thermometer indicates and permanently records the temperature of the air returning to the evaporator section on a calibrated chart.
7. Power Line Communications Modem (Option): A REFCON remote monitoring modem is available to provide remote monitoring via the power cable. High speed transmission reads all controller information.

Unit Protection Devices

1. Main Circuit: A 25 ampere manual reset circuit breaker protects the 460/380V power supply circuit to the unit electric motors and control system transformer. The main power circuit breaker is located in the control box.
2. Control System Circuit: A 7 ampere circuit breaker or a 7 ampere ATO fuse protects the 29 Vac control circuit. The circuit breaker is located in the control box beside the ON/OFF switch. The ATO fuse is located inside the control box on the right side wall.
3. Fuses: A number of fuses are located on the main relay board and controller to protect unit circuits and components.
   - A 2 amp fuse protects the controller's 28 Vac system.
   - A 2 amp fuse protects the controller's battery charging circuit.
4. Compressor Discharge Gas Temperature Sensor: A refrigerant injection system uses the compressor discharge temperature to determine when cold refrigerant will be injected into the center scroll of the compressor to protect the compressor from excessively high operating temperatures.
   a. Chill Mode Liquid Injection:
      - Controller energizes the liquid injection valve when compressor discharge gas temperature increases to 118 to 138 C (244 to 280 F)
      - Controller de-energizes the liquid injection valve to stop liquid injection when the discharge gas temperature decreases to 132 C (270 F).

NOTE: Controller also energizes the liquid injection valve when cooling capacity is 83% or less. Controller de-energizes the valve when cooling capacity is 84% or more.

   b. High Temperature Protection: The controller immediately stops unit operation if the discharge gas temperature increases to 148 C (298 F). The controller activates the Alarm LED and records Alarm 56 (Compressor Temperature Too High). The controller restarts the unit when the condition corrects itself.



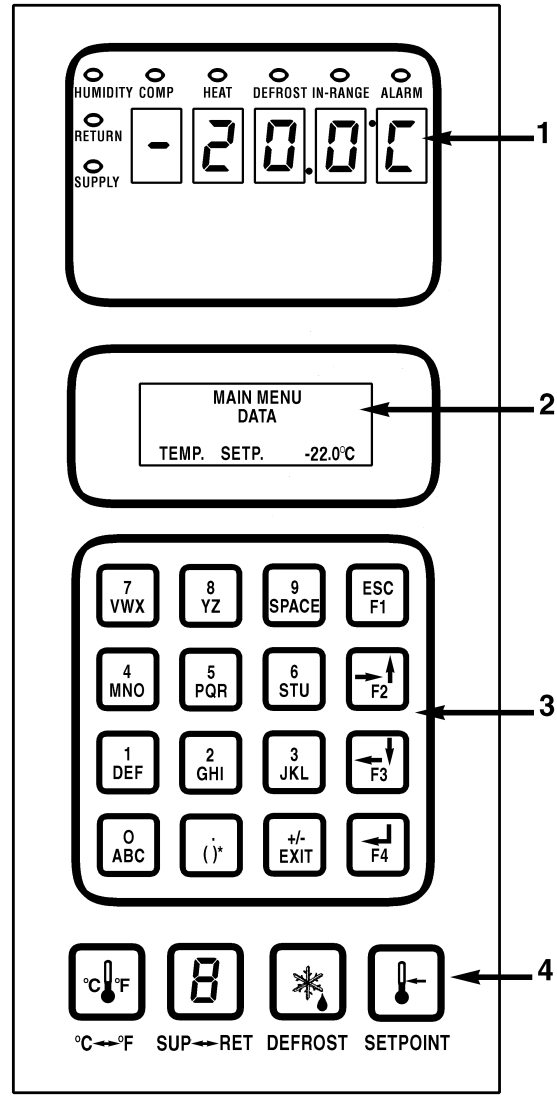
1.	28 Vac Control Circuit Fuse, 2 ampere
2.	Battery Charging Circuit Fuse, 2 ampere

Figure 20: Control Circuit Fuses

Controller Description

The MPC-3000 is an advanced microprocessor controller that has been specially developed for the control and monitoring of refrigeration units. The controller contains the following basic features:

1. LED display for Temperature:
   - Five alpha numeric, 20.32 mm high characters: Numerical hundredths, tens, ones and tenths position, a C for Celsius or F for Fahrenheit for temperature display.
   - LED display shows controlling (return or supply) sensor temperature. Sensor temperature shown in LED display is indicated by status indicator lights. If a sensor is out of range the display shows “+Err” or “-Err”. The ± sign indicates whether the sensor temperature is out of range high or low.
   - The LED display also shows the test stage of a pre-trip (PTI) or function test.
2. LCD display for Setpoint, Messages and Menu:
   - 4 line, 20 character LCD display shows setpoint temperature during normal operation.
   - Alarms, messages and the controller menu also appear in the LCD display when special keys are pressed.
3. Sixteen general purpose keys are used to enter text and scroll through the Controller menu tree.
   a. Text Input: The keyboard supports both numerical and text input. Each key can have more than one meaning. Use the special text keys **F1**, **F2**, **F3** and **F4** to enter text in an information screen:
      - **F1** key: Press the **F1** key, then press another general purpose key to enter the number shown on the key.
      - **F2** key: Press the **F2** key, then press another general purpose key to enter the first letter shown on the key.



AXA0155

1.	LED display for Temperature. Status indicator LEDs identify controlling sensor temperature (return or supply) that appears in display.
2.	LCD display for Setpoint, Messages, and Menu. Use the keypad to scroll through messages and the controller menu.
3.	General purpose keys are used to enter text and scroll through menus.
4.	Special function keys perform specific tasks.

Figure 21: Controller

- **F3** key: Press the **F3** key, then press another general purpose key to enter the second letter shown on the key.
- **F4** key: Press the **F4** key, then press another general purpose key to enter the third letter shown on the key.

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

Text Input Example: To enter "THERMO" in an information screen:

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

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

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

4. Four special function keys (see illustration on 55):
   - **C/F** key: Press to view alternate temperature scale in LED display.
   - **DEFROST** key: Press to initiate defrost. Evaporator coil temperature must be below 10 C (50 F).
   - **SUP/RET** key: Press to view alternate return/supply sensor temperature in LED display.
   - **SETPOINT** key: Press to enter Setpoint menu. The first line of the Setpoint menu is the setpoint temperature. Press **F2** or **F3** key to scroll up or down through the menu list.

   NOTE: Press the* 5 *key to increase the display time of the current LCD data screen by 5 minutes. Maximum display time is 30 minutes for data screens and 100 minutes for manual tests.
5. Status indicator LEDs (see "Status Indicator LEDs and Alarm Codes" in this chapter).
6. Control Transformer: Low voltage control power and ground is supplied to the MP-3000 controller and the main relay board.
7. Main Relay Board: High voltage supply power and low voltage control power and ground are supplied to the main relay board. The main relay board contains:
   - Relays to energize and de-energize unit contactors and solenoids. Component relays include the heater, evaporator fan motor, condenser fan motor, and phase reversal relays.
   - Supply power circuit protection:
     - 20 amp fuses (3) protect the high voltage circuits on the main relay board.

- Control circuit fuse and circuit breaker protection:
  - 7 amp manual reset circuit breaker protects the 24 Vdc control circuit.
  - 2 amp fuse protects the 28V ac control power circuit to the controller.
  - 2 amp fuse protects the battery charger output circuit to the controller.
- Electronics for measuring phase sequence.
- Electronics for measuring amperage.
- Electronics for measuring voltage.
- Zero current transformer for earth leaking measurement (option).

8. Replaceable sensors: return air, left hand supply air, right hand supply air, evaporator coil (defrost), condenser coil, ambient air and compressor discharge line temperature sensors are field replaceable. Three (replaceable) spare sensor receptacles are also provided for USDA temperature recording.
9. Probe test (see “Probe Test” in this chapter).
10. Defrost cycle control (see “Defrost System” in this chapter).
11. Pre-trip (PTI) test capability (see “PTI [Pre-trip] Test” in this chapter).
12. Function test capability (see “Function Test” in this chapter).
13. Data recording capability (see “Data Recording and Downloading Data” in this chapter).
14. Electronic phase selection: The microprocessor relay board monitors the phase of the power supply to ensure proper rotation of the condenser fan and evaporator fans. The controller determines the correct phase sequence for the compressor and energizes the correct compressor contactor.
15. Power limit control (see “Power Limit Mode” in this chapter).
16. Sequential component start-up control: A sequence start of the required loads occurs during initial start-up of the controller and when a control mode shift requires the compressors to start (see “Sequence of Operation” in this chapter).
17. Compressor refrigerant injection cycle control (see “Compressor Liquid Injection” in this chapter).
18. Hourmeters: The MP-3000 controller has multiple built-in hourmeters that can be accessed through the Main menu.
19. Manual emergency control capability. Manual control settings in the control box allow the unit to operate even in the event of a fatal failure of the controller. Manual control offers three operating functions: Heat, Defrost and Cool (see “Manual Emergency Mode Operation” in this chapter).
20. Flash memory: Flash program memory allows the application software to be updated without replacing an EPROM chip on the controller. Application software can be updated in the field using a portable computer and a Loader program. Consequently, the field installed application software version may have a different revision number and may include control features not included in the original factory installed software. If the operation of your unit differs from the Sequence of Operation described for the unit in this manual, enter “MISC. FUNCTIONS” in the Main menu to check that the program version is correct (see “Menu Operating Instructions” in this chapter).

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

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

    - Setpoint Menu: Menu screens in this group are used to enter the temperature setpoint and set the Economy mode. Setpoint menu option functions include: set Bulb mode, set air flow, set Delta T, set humidify or dehumidify operation and enter humidity setpoint, set AFAM, set AFAM delay, set AFAM rate, set O_2 Minimum and set CO_2 Maximum.
    - Data Menu: Menu screens in this group are used to display unit operating information including sensor temperatures, voltage, current and frequency information.
    - Alarm List Menu: Menu screens in this group display a list of alarm code(s).
    - Commands Menu: Menu screens in this group are used to activate pre-trip (PTI) tests, function tests, manual function tests, and power management.
    - Miscellaneous Functions Menu: Menu screens in this group display date/time, C/F, cargo data, program version and run time (hourmeters) information.
    - Configuration Menu: Menu screens in this group display refrigerant type, in-range setting, container ID, contrast (screen), language, unit type, reefer type, zero current status, AFAM option, evaporator type, condenser type, USDA type, VFD minimum frequency, VFD maximum frequency, AFAM units and other unit settings.
    - Data logger Menu: Menu screens in this group display temperature log, event log, set log time and PTI log.
    - REFCON Remote Monitoring (RMM) State: Menu screen show current remote monitoring state (Offline, Zombie or On-line).

22. Active option display: The MP-3000 controller shows a list of active control options in left side of the LCD display. Options that may appear in the display include Bulb mode, Economy mode, Humidify mode and Dehumidify mode.

Status Indicator LEDs

Eight status indicator LEDs are located in the top LED display and signal the following:

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

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

The Alarm LED flashes on and off continuously when a Check Alarm (Level 2 Alarm) or Shutdown Alarm (Level 1 Alarm) occurs. Less serious Log Alarms (Level 3 Alarm) are recorded but do not activate the Alarm LED (see “Alarms Menu” on 78 for more information).

Data Recording and Downloading Data

The MP-3000 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 and USDA3 sensor temperatures; and humidity sensor. All temperature logs can be viewed from the controller's LCD message display.

Data logging intervals are selectable from 1 minute or 0.5, 1, 2 or 4 hours. The 1 minute interval is intended for special data recording or diagnosis requirements.

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. After 72 minutes, controller returns to previous logging interval and clears USDA test data from data logger memory.

If the unit power supply is disconnected, the data logger will continue to register 120 temperature logs (except humidity sensor) when battery voltage is above 11.4 volts. These will be maintained until the unit is re-connected to power, and the battery automatically recharged.

Trip data can be retrieved (but not erased) from the data-logger memory using a DRU-II or SmartSponge™ handheld data retriever, or a REFCON power line remote monitoring system. DRU-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.

General Theory Of Operation

The MPC-3000 controller uses advanced solid-state integrated circuits to monitor and control unit functions. The controller monitors inputs from:

- Supply air sensor, left hand
- Supply air sensor, right hand
- Return air sensor
- Evaporator coil sensor
- Condenser coil sensor
- Ambient sensor
- Humidity sensor
- USDA (Spare) sensors 1, 2 and 3
- Compressor discharge line temperature sensor
- Low Pressure Cutout Switch
- 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
- Warm gas bypass solenoid valve
- Stepper motor valve
- Liquid injection valve
- Dehumidify (coil) valve
- Electric heaters
- Phase selection

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, a coil/dehumidify solenoid valve and a stepper motor valve to provide accurate control of the container temperature in direct response to load demand.

The coil/dehumidify solenoid valve controls the refrigerant flow to one of the evaporator distributors. Closing (energizing) the valve reduces the size of the evaporator coil providing cooling by 50%. The controller energizes (closes) the coil/dehumidify solenoid valve when the modulation capacity is 20% or less. The controller keeps the valve closed until the modulation capacity increases to 25%.

The stepper motor valve is installed in the suction line and controls the amount of refrigerant returning to the compressor. The valve opens and closes in response to a controller voltage signal based on a control temperature differential. The controller uses the setpoint temperature, supply air sensor temperature (left and/or right hand sensors) and pull-down rate for the last 10 seconds, last 20 seconds and last 180 seconds to calculate the control temperature differential.

Supply Air Sensor Control

Temperature control accuracy and protection against frost damage is provided by using two separate sensors (left hand and right hand) to determine the supply temperature used to calculate the control temperature differential:

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

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

Temperature Control Accuracy and Frost Protection

The PID algorithm generally minimizes container temperature fluctuations to ± 0.1 C (± 0.2 F). Additional frost protections is provided by pulsing the electric heaters on and off to increase the supply air temperature if the return air temperature decreases to within 0.3 C (0.5 F) of setpoint. The controller pulses the heater on for 2 to 60 seconds every 60 seconds. The amount of on time depends on the amount of heat required to provide frost protection.

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.

Modulation Display in Data Menu

The percent displayed in the Data menu indicates the modulation capacity that is currently provided. For example, when controller display shows 70%, this means the stepper motor valve has closed to reduce system cooling capacity from 100% to 70% (a 30% reduction).

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.

Initial Unit Start-up and Normal Operation (Standard)

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

Power Limit Management

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

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

Compressor Liquid Injection

During compressor operation, a liquid injection system injects refrigerant into the center scroll of the compressor to protect against excessively high operating temperatures. When liquid injection is active, the controller energizes the liquid injection valve continuously. The controller activates liquid injection when the:

- Chill or Power Limit Mode: When the modulation capacity is 91% or less (in the Data menu display), the controller energizes liquid injection valve continuously.
- Compressor discharge temperature exceeds 128 to 138 C (262 to 280 F). Liquid 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 56 (Compressor Temperature Too High). The controller will restart the unit when the sensor temperature is below 90 C (194 F).

Warm Gas Bypass

During Chill Mode operation, a warm gas bypass system diverts refrigerant from the high side to the suction line as the supply air temperature decreases toward setpoint. This reduces unit cooling capacity and increases refrigerant flow through the compressor. The controller energizes (opens) the warm gas bypass valve when the modulation capacity is approximately 50% or less. Modulation capacity can be viewed in the Data menu display of the controller.

Power Limit Mode

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

Evaporator Fan Control

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

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

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

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

When the Economy mode is set to Off, the evaporator fans operate on low speed. Low speed rpm is one-half the high speed rpm.

Economy Mode Operation

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

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

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

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

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

The Economy mode also modifies the temperature control algorithm on frozen loads to extend the Null mode. The unit continues on Cool operation until return air temperature reaches ECMIN temperature. Default ECMIN setting is 2.0 C (3.6 F) below setpoint. ECMIN temperature is adjustable from 0 to 5 C (0 to 8.9 F) below setpoint through the Configuration menu of the controller.

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

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

Condenser Fan Control

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

Probe Test

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

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

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

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

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

Bulb Mode (Option)

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

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

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

Dehumidify Mode (Option)

NOTE: At setpoints below 5 C (41 F), dehumidification is not energized.

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 can then be controlled between 60% and 95%. The relative humidity setpoint can be set from 0 to 99% from the Setpoint menu.

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

Changing the Humidify/Dehumidify mode program screen from Off to On 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% or more above setpoint and the stepper valve has reduced the unit cooling capacity to 85%, the controller energizes (closes) the coil/dehumidify valve. This reduces the size of the evaporator providing cooling by 50%, causing the coil to become colder and condense more moisture from the container air.
- When the humidity level is 5% or more above setpoint and the stepper valve has reduced the unit cooling capacity to 70%, the controller also 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.

Sequence Of Operation

Unit Start-up

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

- When the **UNIT ON/OFF** switch is turned **ON**, the LED display turns on and then off.
- The setpoint appears briefly in the LED display.

  NOTE: When the setpoint appears in the LED display, both the Return and Supply LEDs are lit.
- The LED then shows the controlling air sensor temperature.
- The controller senses the incoming power phase and selects the correct power phase to unit components.
- About 40 seconds after the unit was turned on, the evaporator fan motors start.

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

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

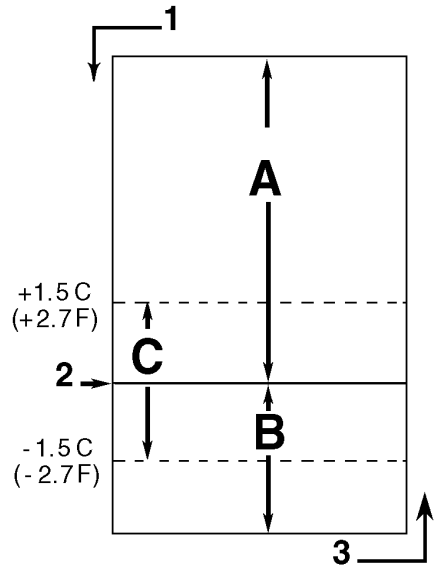
Continuous Temperature Control Operation

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

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

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

- Cool mode with Modulation
- Controller energizes the liquid injection valve continuously when the modulation capacity is 91% or less.
- Controller energizes the warm gas bypass valve when the modulation capacity is approximately 50% or less.
- Controller energizes (closes) the coil/dehumidify valve when the modulation capacity decreases to 20%. The valve remains closed until the modulation capacity increases to 25%.
- Heat mode (electric heaters pulse on and off on a 60 second duty cycle).
- Defrost mode (electric heaters on, evaporator fans off).



A.	Cool with Modulation* (control temperature differential is above setpoint)
B.	Heat (electric heaters pulse on and off on a 60 second duty cycle if the return air temperature decreases to 0.3 C [0.5 F] above setpoint; or the supply air temperature is too low)
C.	In-range (based on supply air temperature)
1.	Decreasing Temperature
2.	Setpoint
3.	Increasing Temperature

*Controller also energizes liquid injection valve and warm gas bypass valve as modulation capacity decreases.

Figure 22: Chill Load Control Sequence (Setpoints at -9.9 C [14.1 F] and Above)

CSR Operating Mode Function Chart

Chill Loads Setpoints at -9.9 C (14.4 F) and Above			Frozen Loads Setpoints at -10 C (14 F) and Below			
Cool w/Mod	**Heat**	**Defrost**	**Cool**	**Null**	**Defrost**	**Unit Function**
•[1]	•					Evaporator Fans High Speed[1]
•[1]			•	•[1]		Evaporator Fans Low Speed[1]
		•		•[1]	•	Evaporator Fans Off[1]
•	•					Proportional-integral Derivative (Supply Air) Control
			•	•		Return Air Sensor Control
		•			•	Evaporator Coil Sensor Control
•			•			Compressor On
•			•			Compressor Liquid Injection On (valve energized)[2]
•						Warm Gas Bypass Solenoid Valve Open (energized)[3]
•			•			Condenser Fan On [4]
•			•[5]			Stepper Motor Valve Modulating (energized)[5]
•						Coil/Dehumidify Solenoid Valve Closed (energized)[6, 7]
•[8]	•	•			•	Electric Heaters Pulsing or On (energized)[8]

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

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

[2]Liquid injection valve:

- Chill or Power Limit Mode: When the modulation capacity is 91% or less.
- Compressor High Temperature Protection: When the compressor discharge temperature exceeds 128 to 138 C (262 to 280 F).

[3]Chill Loads only: Controller Opens (energizes) the warm gas bypass valve continuously when the modulation capacity is approximately 50% or less.

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

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

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

[5]Stepper motor valve modulates: Chill Loads — whenever the unit is in a Cooling mode; Power Limit — whenever the unit is in Power Limit mode.

[6]Coil/Dehumidify Valve: Controller energizes (closes) the coil/dehumidify solenoid valve when the modulation capacity is 20% or less. This closes refrigerant distribution to 50% of the evaporator coil to reduce cooling capacity. The valve remains closed until the modulation capacity increases to 25%.

[7]Dehumidification Option: When the Dehumidify mode is set to On, the supply air temperature must be In-range to close (energize) the coil/dehumidify valve:

- When the humidity is 2% or more above humidity setpoint, the controller closes (energizes) the coil/dehumidify valve.
- When the humidity is more than 5% above humidity setpoint, the controller also pulses the electric heaters on and off.

[8]Controller energizes electric heaters for frost protection, heat, defrost and dehumidification[7]:

- Frost Protection (cooling): If return air temperature is within 0.3 C (0.5 F) of setpoint, heaters pulse on and off on a 60 second duty cycle.
- Heat mode (compressor off): If supply air temperature is too low, heaters pulse on and off on a 60 second duty cycle.
- Defrost mode: Heaters are on until evaporator coil temperature increases to terminate defrost.

Cool with Modulation

- Controller calls for the Cool mode whenever the Control Temperature Differential (based on supply air temperature) is above setpoint.
- Controller turns on the Compressor LED when the compressor is operating.
- Controller opens and closes stepper motor valve to regulate the flow of refrigerant to the compressor. The position of the stepper motor valve balances the unit cooling capacity against the actual load requirements.
- Controller turns on the In-range LED when the supply air sensor temperature is within 1.5 C (2.7 F) of setpoint.
- Supply air sensor control algorithm increases temperature control accuracy and protection against frost damage (see “Chill Loads” under “General Theory of Operation” in this chapter).
- Controller pulses electric heaters on and off for additional frost protection if the return air temperature decreases to within 0.3 C (0.5 F) of setpoint (see “Chill Loads” under “General Theory of Operation” in this chapter).
- Controller turns on the Heat LED whenever the heaters are pulsed on and off.

Heat

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

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

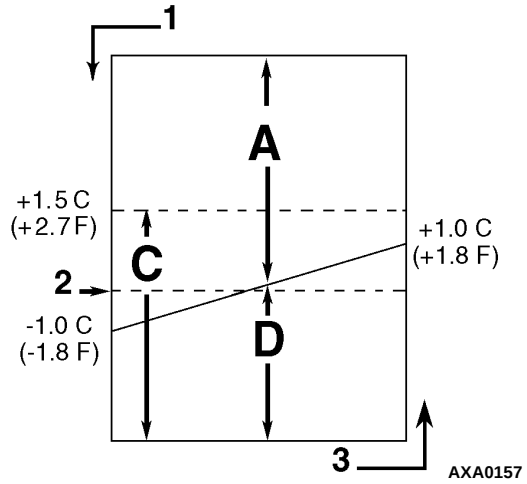
At setpoints of -10 C (14 F) and below, the controller locks out the Modulation and Heat modes. The controller regulates compressor operation based the return air sensor and setpoint temperatures.

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

- Cool mode
- Null mode
- Defrost mode (electric heaters on, evaporator fans off)
- Evaporator fans operate on low speed and continuously circulate air inside the container (except during Defrost; or when Economy mode is on and the unit is in Null mode). See “evaporator Fan Control” on page 63, or “CSR Operating Mode Function.
- Controller LED display shows the return air sensor temperature.
- Controller LCD display shows the setpoint temperature.
- Controller cycles a single-speed condenser fan on for 2 to 30 seconds every 30 seconds when the unit is on air-cooled condenser operation.

The amount of on time depends on the condenser coil, ambient and compressor discharge temperatures.

- Power limit is active during initial start-up and pull-down when the unit is cooling at return air temperatures above -10 C (14 F).



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

Figure 23: Frozen Load Control Sequence (Setpoints at -10 C [14 F] and Below)

Cool

- After initial start-up and pull-down to 1.0 C (1.8 F) below setpoint, the controller calls for the Cool mode whenever:
  - Return air temperature increases more than 1.0 C (1.8 F) above setpoint.
  - Return air temperature is above setpoint and the compressor has been off for 30 minutes.
- Controller turns on the Compressor LED when the compressor is operating.
- Compressor must operate for a minimum of 5 minutes after startup.
- After initial pull-down to setpoint, controller keeps the In-range LED on as long as the return air temperature remains less than 1.5 C (2.7 F) above setpoint.

Null

- The controller calls for Null when the return air temperature decreases more than 1.0 C (1.8 F) below setpoint.
- The controller stops the compressor and condenser fan.
- The controller also de-energizes (closes) the liquid line solenoid valve.
- The evaporator fans continue to operate (except when Economy mode is on).
- Compressor remains off for a minimum of 5 minutes.

Defrost

The evaporator coil sensor temperature must be below 18 C (65 F) to initiate a Demand Defrost or Manual Defrost. The evaporator coil sensor temperature must be below 10 C (50 F) to initiate a Timed Defrost.

- Demand Defrost function initiates Defrost immediately when:
  - Temperature difference between the return air sensor and defrost (evaporator coil) sensor is too large.
  - Temperature difference between the left hand and right hand supply air sensors is too large and unit has operated for more than 90 minutes since last defrost.
  - Temperature difference between the supply sensors and return air sensor is too large.
- Manual Defrost may be initiated immediately by pressing the **DEFROST** key or by REFCON Remote Monitoring Modem (RMM).
- A Timed Defrost always starts at 1 minute past the hour immediately following a defrost timer request for defrost. For example, if the defrost timer requests a defrost cycle at 7:35, the defrost cycle will start at 8:01. The datalogger will record a Defrost event for each

log interval in which a Defrost cycle is pending or active (i.e. both the 8:00 and 9:00 data logs on 1 hour logging interval).

- On Chill Loads (setpoints at -9.9 C [14.1 F] and above), the initial time interval is:
  - 8 hours of compressor operation at supply air temperatures of 5.1 C (41.2 F) or above.
  - 2.5 hours of compressor operation at supply air temperatures of 5.0 C (41.0 F) or below. One-half (0.5) hour is added to the time interval each timed defrost interval. Defrost synchronization creates step intervals of 3, 4, 4, 5, 5, 6, 6 and 7 hours. Maximum time interval is 7 hours.
- On Frozen Loads, the initial time interval is 8 hours. Two (2) hours are added to the time interval each timed defrost interval. Maximum accumulated time interval is 24 hours.
- Defrost timer resets if the unit is off more than 12 hours, setpoint is changed more than 5 C (8.9 F) or PTI (pre-trip) test occurs.

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

When the Defrost mode is initiated:

- The controller stops the compressor, condenser fan and evaporator fans.
- When the compressor stops, the controller turns on the Defrost LED, Heat LED and energizes the heater contactor, turning on the electric heaters.

The controller terminates the Defrost mode when:

- Evaporator temperature:
  - Chill mode: Evaporator coil sensor temperature reaches 30 C (86 F); or exceeds 18 C (65 F) for 35 minutes.
  - Frozen mode: Evaporator coil sensor temperature reaches 30 C (86 F); or exceeds 8 C (46 F) for 35 minutes.
- Interval timer: Controller terminates defrost after 90 minutes on 60 Hz power (120 on 50 Hz power). Alarm code 20 will be generated if this occurs.
- Power off: Turning **UNIT ON/OFF** switch **OFF** terminates defrost.

When the defrost mode is terminated:

- The Heat and Defrost LEDs turn off and the heater contactor is de-energized. The controller starts the compressor to pre-cool the evaporator coil. The condenser fan starts if required.
- The controller pre-cools the evaporator coil to the supply air temperature (or for 3 minutes maximum) to minimize heat energy release into the container. The liquid injection valve is energized if the modulation capacity is 91% or less. The controller then starts the evaporator fans.

Changing the Setpoint

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

To change the controller setpoint, turn the **UNIT ON/OFF** switch **ON**. With the standard LCD message display showing on the controller (i.e. setpoint temperature):

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

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

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

   NOTE: If the setpoint is not entered within 30 seconds, the controller will default (return) to the previous setpoint. If this occurs, repeat steps 1 through 4.

Initiating a Manual Defrost

With the **UNIT ON/OFF** switch **ON**:

1. Press the **DEFROST** key.
   - If the unit operating conditions allow a manual defrost (e.g. evaporator coil temperature is less than 18 C [56 F]), the unit enters Defrost as the Defrost and Heat LEDs turn on. LCD message display shows “DEFROST ACTIVATED”.
   - If unit operating conditions do *not* allow defrost, the LCD message display shows “DEFROST NOT ACTIVATED”.
2. The defrost cycle automatically terminates.

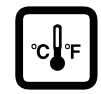
   NOTE: If frost or ice can not be removed from the evaporator coil by an automatic defrost cycle, a “timed” defrost of the evaporator coil can be performed:

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

Displaying Alternate Controlling (Supply or Return) Air Sensor Temperature

The controller can show either the supply or return air temperature in the LED Display. With the **UNIT ON/OFF** switch **ON** and the controller showing the standard LED Display:

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



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

The controller can display temperatures in Celsius or Fahrenheit. With the **UNIT ON/OFF** switch **ON** and controller showing a standard LED display:

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

   NOTE: To change the default temperature unit display, press and hold the C/F key, then press the SETPOINT key for 1 second.

Navigating the Controller Menu

NOTE: To view the controller’s menu or download data when external power is disconnected from the unit, press a special key: C/F key, SUP/RET key, DEFROST key or SETPOINT key. The controller LCD display will appear using 12 Vdc battery power.

The MP-3000 Main menu is divided into eight major menus:

- Setpoint
- Data
- Alarms
- Commands
- Misc. Functions
- Configuration
- Datalogger (optional)
- RMM State

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

F1 key: Press the **F1** key each time you want to exit a submenu and/or retrieve current system data for display.

or 

F2 or **F3** key: Press the **F2** or **F3** key each time you want to scroll up or down to view another item in a menu or submenu; or scroll forward or backward in a menu line.

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

General Operating Tips

- Quickly change display temperature units between C and F: Press and hold the **C/F** key, then press the **SETPOINT** key for 1 second.
- Increase display time for current LCD data screen: Press the **5** key to increase display time by 5 minutes. Maximum display time is 30 minutes for data screens and 100 minutes for manual tests.
- Slowly cool (initial pull-down) a warm load: Set power management to 13 amps.
- Password for Configuration changes is “A”: Press **F2** key, **A** key, **F4** key and then **EXIT** key.
- Delay Defrost for 24 hours during unit diagnosis or testing: Press **7** key and **F1** key at the same time. Press **F3** key to scroll cursor down to “DELAY DEF” menu line. Then press **F4** key, **F2** key, **A** key, **F4** key and **EXIT** key. Cursor moves to end of line and flashes. Press **F3** key to toggle “OFF” to “ON”. Then press and hold **F4** key until cursor stops flashing.
- Perform a “timed” defrost of evaporator coil: Activate “HEAT ON” in the Manual Function Test submenu. Then press **5** key six times. Heaters will be activated for 70 minutes. Unit automatically returns to normal operation.

Setpoint Menu

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

- Opti-Set
- Setpoint Temperature
- Bulb Mode
- Defrost Termination Temperature
- Economy Mode
- Humidity Control
- Humidity Setpoint
- AFAM
- AFAM Delay
- AFAM Rate
- O_2 Minimum
- CO_2 Maximum

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

Changing the Setpoint Temperature

See “Changing the Setpoint” on 68.

Changing the Bulb Mode Setting

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the “TEMP SETP” line.
2. Press **F3** key to scroll to “BULB MODE” line.
3. To change the mode setting, press the **F4** key. An Enter Arrow appears in the menu line and the current setting disappears.
4. Press **F2** key to toggle between “OFF”, “FLOW CYCLE”, “FLOW HIGH” and “FLOW LOW”.
   - “OFF”: Controller removes the “DEFROST TERM.” setting from display. Humidity mode must be manually set to off to stop dehumidify operation.

- "FLOW CYCLE": Evaporator fans cycle between high and low speed every 60 minutes.
- "FLOW HIGH": Evaporator fans operate continuously on high speed.
- "FLOW LOW": Evaporator fans operate continuously on low speed.

5. With the desired state in the menu line, press and hold **F4** key until the cursor stops flashing. The new mode setting appears in the display. When the Bulb mode is active:
   - The defrost termination temperature can be adjusted from 4 to 30 C (40 to 86 F). Lower defrost termination settings may result in less warming of the cargo during defrost.
   - The Dehumidify mode is on. A humidity setpoint for dehumidify system operation must be entered.
6. Press the **F3** key to scroll to the "DEFROST TERM" line.
7. To enter a new defrost termination temperature, press the **F4** key. An Enter Arrow appears in the menu line and the current temperature disappears.
8. Enter (type) the new termination temperature setpoint in the LCD display using the general purpose keypad. The cursor moves to the right of the screen as each key entry is acknowledged and displayed.

   NOTE: The defrost termination temperature setting during Bulb mode operation should be established by the shipper. Always check that the temperature entered in the LCD display is correct before proceeding.
9. Press and hold the **F4** key until the cursor stops flashing. The new setpoint is recorded in the controller and appears in the LCD display.
10. Press the **F3** key to scroll to the "HUM CONTROL" line.
11. To enter a new setpoint, press the **F4** key. An Enter Arrow appears in the menu line and the current setpoint disappears.
12. Enter (type) the new setpoint in the LCD display using the general purpose keypad. The cursor moves to the right of the screen as each key entry is acknowledged and displayed.

    NOTE: The humidity setpoint should be established by the shipper. Always check that the setpoint entered in the LCD display is correct before proceeding.
13. Press and hold the **F4** key until the cursor stops flashing. The new setpoint is recorded in the controller and appears in the LCD display.
14. Press **ESC** key to exit the Setpoint screen.

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

Changing the USDA Trip Setting

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the "TEMP SETP" line.
2. Press **F3** key to scroll to "USDA TRIP" line.
3. To change the mode setting, press the **F4** key. An Enter Arrow appears in the menu line and the current setting disappears.
4. Press **F2** key to toggle between "OFF" and "ON".
   - OFF: Controller removes the Defrost Termination Temperature and Defrost Time settings from display.
   - ON: Controller adds Defrost Termination Temperature setting and Defrost Time setting in the Setpoint menu.
5. With the desired state in the menu line, press and hold **F4** key until the cursor stops flashing. The new mode setting appears in the display. When the "USDA TRIP" is on:
   - The defrost termination temperature can be adjusted from 4 to 30 C (40 to 86 F). Lower defrost termination settings may result in less warming of the cargo during defrost.
   - The defrost time can be adjusted from 2 to 8 hours. Lower defrost time settings result in more frequent defrosts.

6. Press the **F3** key to scroll to the "DEFROST TERM" line.

   a. To enter a new defrost termination temperature, press the **F4** key. An Enter Arrow appears in the menu line and the current temperature disappears.

   b. Enter (type) the new termination temperature setpoint in the LCD display using the general purpose keypad. The cursor moves to the right of the screen as each key entry is acknowledged and displayed.

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

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

7. Press the **F3** key to scroll to the "DEFROST TIME" line.

   a. To enter a new defrost time (interval), press the **F4** key. An Enter Arrow appears in the menu line and the current time disappears.

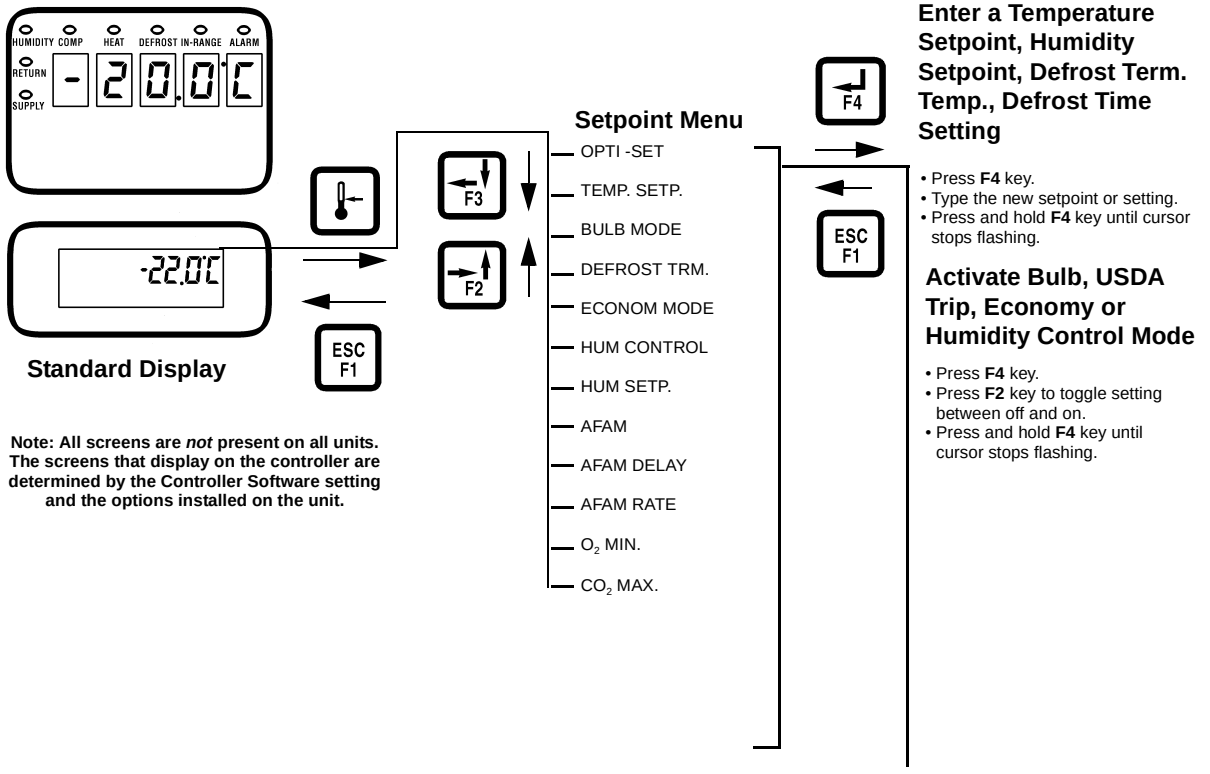
   b. Enter (type) the new time interval in the LCD display using the general purpose keypad. The cursor moves to the right of the screen as the key entry is acknowledged and displayed.

   NOTE: The defrost time setting should be established by the shipper. Always check that the time entered in the LCD display is correct before proceeding.

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

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

   NOTE: If "USDA TRIP" is on, the controller LCD display will show "USDA".



Note: All screens are *not* present on all units. The screens that display on the controller are determined by the Controller Software setting and the options installed on the unit.

Figure 24: Setpoint Menu Screen Flow Diagram

Changing the Economy Mode Setting

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

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

   NOTE: On frozen loads, the Economy mode also modifies the temperature control algorithm to extend the Null mode. See "Economy Min." and "Economy Max." under "Configuration Menu" in this chapter to check the current settings or enter new settings.
6. Press **ESC** key to exit the Setpoint screen.

Changing the Humidity Mode Setting

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the "TEMP SETP" line.
2. Press **F2** key to scroll to "HUM CONTROL" line.
3. To change the mode setting, press **F4** key. Cursor moves to end of menu line and flashes.
4. Press **F2** key to toggle between "OFF" and "ON".
5. With the desired state in the menu line, press and hold **F4** key until cursor stops flashing. New mode setting appears in display.
6. Press **ESC** key to exit the Setpoint screen.

Changing the Humidity Setpoint

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

   NOTE: Always check that the setpoint entered in the LCD display is correct before proceeding.
5. Press and hold the **F4** key until the cursor stops flashing. The new setpoint is recorded in the controller and appears in the LCD display.
6. Press **ESC** key to exit the Setpoint screen.

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

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

AFAM Settings

The AFAM option submenu in the Configuration menu is factory set to AFAM. The controller then adds the AFAM, AFAM Delay and AFAM Rate submenus to the Setpoint menu. If a replacement controller or new software is installed, a controller auto configuration will detect the AFAM option when the AFAM door control module is connected to the controller.

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

AFAM+ Settings

The AFAM option submenu is factory set to AFAM+. The controller then adds the AFAM, AFAM Delay, AFAM Rate, O_2 Min and CO_2 Max submenus to the Setpoint menu. If a replacement controller or new software is installed, a controller auto configuration will detect the AFAM+ option when the AFAM door control module and gas sensor are connected to the controller. When an auto configuration is per-formed, the controller sets the AFAM Option in the Configuration menu to Analyzer. To operate the AFAM+ system, the AFAM Option must be manually set to AFAM+.

- Analyzer: This setting turns on data logging for O_2 and CO_2 gas levels only. The AFAM+ system does not operate.
- AFAM+: This setting turns on the AFAM+ system to control O_2 and CO_2 gas levels. The controller then adds O_2 Min and CO_2 Max submenus to the "SETPOINT" display in addition to the AFAM, AFAM Delay and AFAM Rate submenus.

The default setting for AFAM in the Setpoint menu is the last value set (Off, Units or Demand). AFAM must be set to Demand to control the vent door to the O_2 and CO_2 gas levels.

AFAM or AFAM+ Operation

The system is precalibrated for air exchange rates of 0 to 280 m 3 /hr (0 to 165 ft 3 /min.). The actual door position is based on the air exchange setting, the power supply frequency (Hertz).

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

Starting the AFAM or AFAM+ System

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

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

4. Press **F2** key to toggle between "OFF", "DEMAND" and "UNITS".
   - "OFF": Vent door closes and/or remains closed. AFAM Delay and AFAM Rate settings become blank ("--"). If gas sensor unit is installed on unit, the O_2 Min and CO_2 Max settings also become blank.
   - "DEMAND": Controller uses the O_2 and CO_2 gas levels to adjust the vent door position.
   - "UNITS": Controller uses the fresh air exchange rate to adjust the vent door position. If a gas sensor unit is installed on the unit, control of the O_2 and CO_2 gas levels remains Off.
5. With the desired state in the menu line, press and hold **F4** key until cursor stops flashing. New mode setting appears in display.
6. Press **ESC** key to exit the Setpoint screen.

Changing the AFAM Delay

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

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

NOTE: During unit startup, the AFAM delay prevents the AFAM door from opening until the delay times out. The AFAM delay prevents the AFAM door from opening due to the AFAM Rate, O_2, or CO_2 system settings.

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the "TEMP SETP" line.

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

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

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

Changing the AFAM Rate

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

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

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

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

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

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

Changing the O_2 Minimum Setting

NOTE: The minimum O_2 rate should be established by the shipper.

The O_2 rate sets the desired O_2 level in the container when a gas sensor unit is installed. The actual AFAM door position is based on the O_2 level, CO_2 level and AFAM rate.

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the "TEMP SETP" line.
2. Press **F2** key to scroll to "O2" line. The current rate and units (e.g. "0%") appears in the display.
3. To change the rate, press the **F4** key. An Enter Arrow appears in the menu line and the current rate disappears.
4. Enter (type) the new rate in the LCD display using the general purpose keypad: 0 to 21%.

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

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

Changing the CO_2 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 AFAM door position is based on the CO_2 level, O_2 level and AFAM rate.

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the "TEMP SETP" line.
2. Press **F2** key to scroll to "CO_2" line. The current rate and units (e.g. "2.5%") appears in the display.
3. To change the rate, press the **F4** key. An Enter Arrow appears in the menu line and the current rate disappears.
4. Enter (type) the new rate in the LCD display using the general purpose keypad: 0 to 25%.

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

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

Data Menu

NOTE: Information can ONLY be displayed using the Data menu. Items can NOT be changed. The screens that display on the controller are determined by the controller software setting and the options installed on the unit. All screens are NOT present on all units.

The Data menu displays general unit operating information including sensor temperatures, unit electrical data, etc.

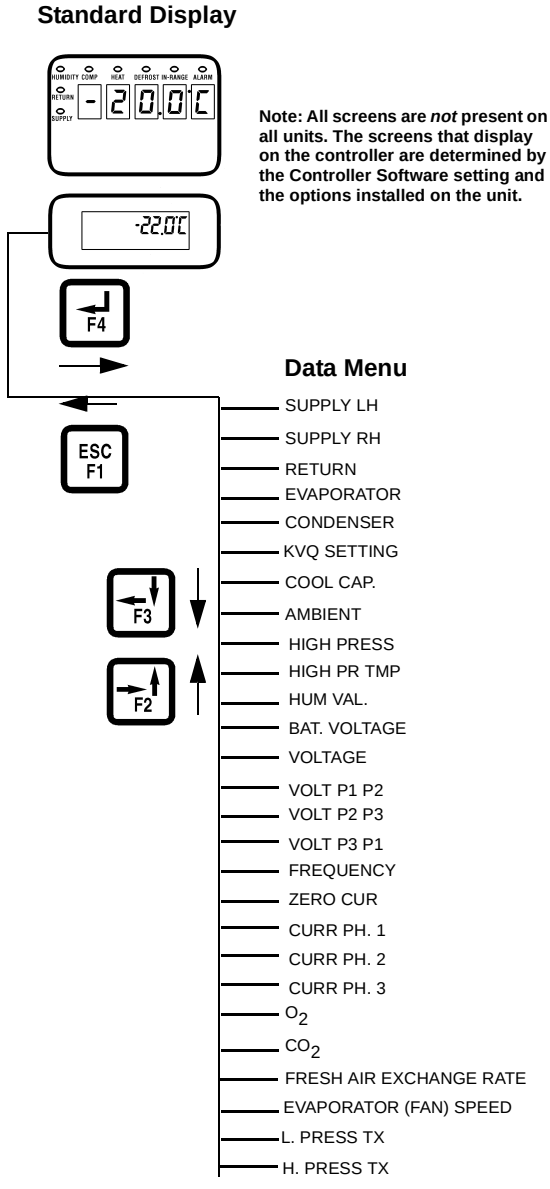
Viewing the Data Menu

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

1. Press **F4** key for directly enter the Data menu. Menu items appear in LCD display.
2. Press the **F3** key to scroll the cursor down through the menu list. The Data menu displays the following functions:
   - Supply Air Temperature, Right Hand
   - Supply Air Temperature, Left Hand
   - Return Air Temperature
   - Evaporator Coil (Defrost) Temperature
   - Condenser Coil Temperature
   - KVQ Valve Setting
   - Cool Capacity
   - Ambient Temperature
   - High Pressure
   - High Pressure Temperature (Compressor Discharge Line Temperature)
   - Relative Humidity
   - Battery Voltage
   - Voltage Average (380/460V Power Supply)
   - Voltage 1 (Main Power Supply) (P1-P2)
   - Voltage 2 (Main Power Supply) (P2-P3)
   - Voltage 3 (Main Power Supply) (P3-P1)
   - Frequency (Main Power Supply)
   - Zero Current
   - Current Phase 1 (Main Power Supply)
   - Current Phase 2 (Main Power Supply)
   - Current Phase 3 (Main Power Supply)
   - O_2
   - CO_2
   - Fresh Air Exchange Rate
   - Evaporator Fan Speed
   - Low Pressure TX
   - High Pressure TX

NOTE: Press the* 5 *key to lock a Data screen in the LCD display for 5 minutes. Press any key to unlock the display.

NOTE: Controller returns to previous menu level or LCD Standard Display after 30 seconds.



Note: All screens are *not* present on all units. The screens that display on the controller are determined by the Controller Software setting and the options installed on the unit.

Figure 25: Data Menu Screen Flow Diagram

Alarms Menu

The Alarm List menu displays alarm codes. Alarm codes are recorded in the controller memory to simplify unit diagnosis procedures. Some alarm codes are only recorded during a pre-trip (PTI) test or function test. Fault codes are retained by the controller in a non-volatile memory. If the Alarm LED is on or flashing on and off, enter the Alarm List to view the alarm code(s).

Alarm Types

There are two types of alarms:

- Shutdown Alarm (Level 1): Alarm LED flashes and unit stops. Shutdown alarms indicate the unit has been stopped to prevent damage to the unit or cargo. The condition must be corrected before restarting the unit. Alarm code 56 (compressor temperature too high) is a shutdown alarm.
- Check Alarm (Level 2): Alarm LED flashes until alarm is acknowledged. Check alarms indicate corrective action should be taken before a problem becomes severe.

Alarm Code States

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

- Not Active: An alarm condition has occurred but no longer exists in the unit. Not Active means the condition was corrected and did not recur for 1 hour; or the **UNIT ON/OFF** switch was turned **OFF** and then **ON**.
    - When a Not Active alarm code is acknowledged (**F4** key pressed while alarm code appears in LCD display), the Alarm LED will turn off and the alarm code disappears from the alarm list.
- Active: An alarm condition has occurred and continues to exist in the unit; or the alarm condition occurred within the past 1 hour but does not currently exist in the unit.
    - If the alarm condition currently exists in the unit and the alarm code is acknowledged, the Alarm LED will stop

flashing but remain on. The alarm code state will change to Acknowledge in the alarm list.

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

- Acknowledge: An alarm code has been viewed and acknowledged in the alarm list. The Alarm LED remains on but does not flash.
  - If the alarm condition is corrected, the Alarm LED will turn off and the alarm code disappears from the alarm list.

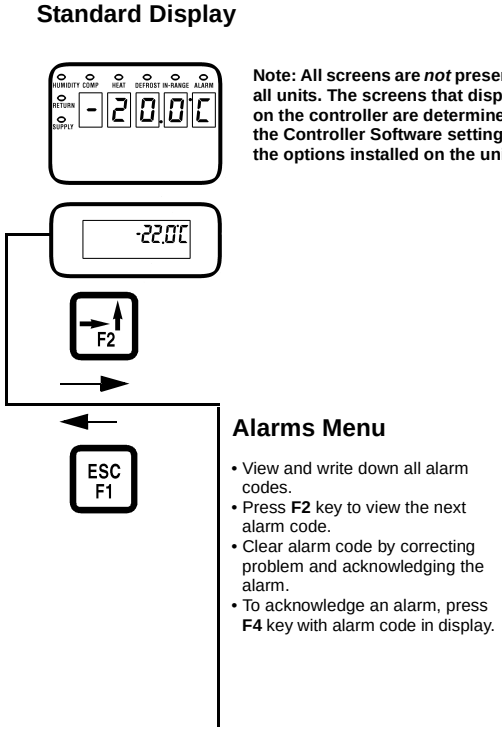


Figure 26: Alarms Menu Screen Flow Diagram

Viewing the Alarm List Menu

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

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

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

2. Write down the first alarm code. Then press **F2** key to view the next alarm code when more than one alarm code has been recorded.
3. Repeat step 4 until all alarm codes have been recorded. To scroll backward to return to a previous alarm code, press **F3** key.
4. To clear all alarm codes from the current display list and turn off the Alarm LED, all problems must be corrected and the alarm code "acknowledged" in the Alarm List menu.

   NOTE: To acknowledge an alarm, press F4 while the alarm code appears on the screen. The alarm state will change from Active or Not Active to Acknowledge.

   NOTE: If no key is pressed for 30 seconds, the controller returns to the previous menu level or the LCD Standard Display.

Alarm List

Alarm Code	Type	Description
00	Check	Supply Air Sensor Open Circuit
01	Check	Check Supply Air Sensor Short Circuit
02	Check	Check Return Air Sensor Open Circuit
03	Check	Check Return Air Sensor Short Circuit
04	Check	Check Evaporator Coil Open Circuit
05	Check	Check Evaporator Coil Sensor Short Circuit
06	Check	Check Compressor Current Too High
07	Check	Check Compressor Current Too Low
10	Check	Check Heater Current Too High
11	Check	Check Heater Current Too Low
12	Check	Check Evaporator Fan High Speed Current Too High
13	Check	Check Evaporator Fan High Speed Current Too Low
14	Check	Check Evaporator Fan Low Speed Current Too High
15	Check	Check Evaporator Fan Low Speed Current Too Low

Alarm List (Continued)

Alarm Code	Type	Description
16	Check	Check Condenser Fan Current Too High
17	Check	Check Condenser Fan Current Too Low
18	Check	Log Power Supply Phase Error
19	Check	Check Temperature Too Far from Setpoint
20	Check	Check Defrost Time Too Long
22	Check	Check Capacity Test 1 Error
23	Check	Check Capacity Test 2 Error
24	Check	Check Capacity Test 3 Error
25	Check	Check Evaporator Temperature Test Error
27	Check	Check Heat Capacity Test Error
28	Check	Suction Stepper Valve Error
29	Check	Liquid Injection Valve Error
30	Check	Bypass (Warm Gas) Valve Error
31	Check	Low Pressure Cutout Error
32	Check	Check Condenser Air Sensor Open Circuit
33	Check	Check Condenser Air Sensor Short Circuit
34	Check	Check Ambient Air Sensor Open Circuit
35	Check	Check Ambient Air Sensor Short Circuit
36	Check	Check Current Too High
37	Check	Check Current Too Low
41	Check	Check Supply Air Temperature Too High
42	Check	Check Supply Air Temperature Too Low
43	Check	Check Return Air Temperature Too High
45	Check	Check Evaporator Coil Temperature Too High
46	Check	Check Evaporator Coil Temperature Too Low
52	Check	Check Probe Error
53	Check	Check High Pressure Cutout Switch Off Error
54	Check	Check High Pressure Cutout Switch On Error
56	Shutdown	Shutdown Compressor Temperature Too High
58	Check	Check Phase Sensor Error
59	Check	Check Delta Current Error

Alarm List (Continued)

Alarm Code	Type	Description
60	Check	Check Humidity Sensor Error
68	Check	AFAM Gas Analyzer Error
69	Check	Gas Analyzer Calibration Error
97	Check	Log Compressor Sensor Open Circuit
98	Check	Log Compressor Sensor Short Circuit
99	Check	Check USDA 1 Sensor Open Circuit
112	Check	Check Zero Current Too High
115	Check	Probe Error Return & Evaporator
116	Check	Probe Error Return & Supply
117	Check	Probe Error Supply RH & Supply LH
118	Check	High Refrigerant Level

Commands Menu

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

- PTI (Pre-trip) Test: Controller automatically completes a test of individual components and checks unit refrigeration capacity, heating capacity and temperature control. See “PTI (Pre-trip) Test” in this chapter for test details.
- Power Management: Sets the power limit and power limit activation (“On”) time.
- Function Test: Controller automatically tests the operation of individual unit components. This is not a performance test of the complete system. See “Function Test” in this chapter for test details.

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

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

Viewing the Commands Menu

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

1. Press the **F1** key to enter the Main menu.
2. Press **F2** key to scroll through Main menu until “COMMANDS” appears in LCD display.
3. Press **F4** key to access the Commands menu. The first command in the submenu appears in the LCD display.
4. Press **F2** or **F3** key to scroll to the desired command:
   - “PTI” (Pre-trip) TEST”
   - “POWER MANAGEMENT”
   - “FUNCTION TEST”
   - “MANUAL FUNCTION TEST”
5. Press **F4** key to activate the command selected.
   - “PTI (Pre-trip) TEST”: LCD display shows PTI Test currently being performed. PTI test ends automatically. Press any key on the controller to return the unit to normal operation.
   - “POWER MANAGEMENT”: LCD display shows current Power Limit setting and Power Time setting. Turn Power Limit feature on and off, change power limit setting or change power limit time.
   - “FUNCTION TEST”: LCD display shows functional test currently being performed. Function test ends automatically. Unit automatically returns to normal operation.
   - “MANUAL FUNCTION TEST”: LCD display shows list of unit components. Test the operation of individual components or turn several components on at the same time to perform a system test.

Function Test

The MP-3000 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 pre-trip test and should not be used instead of the PTI test.

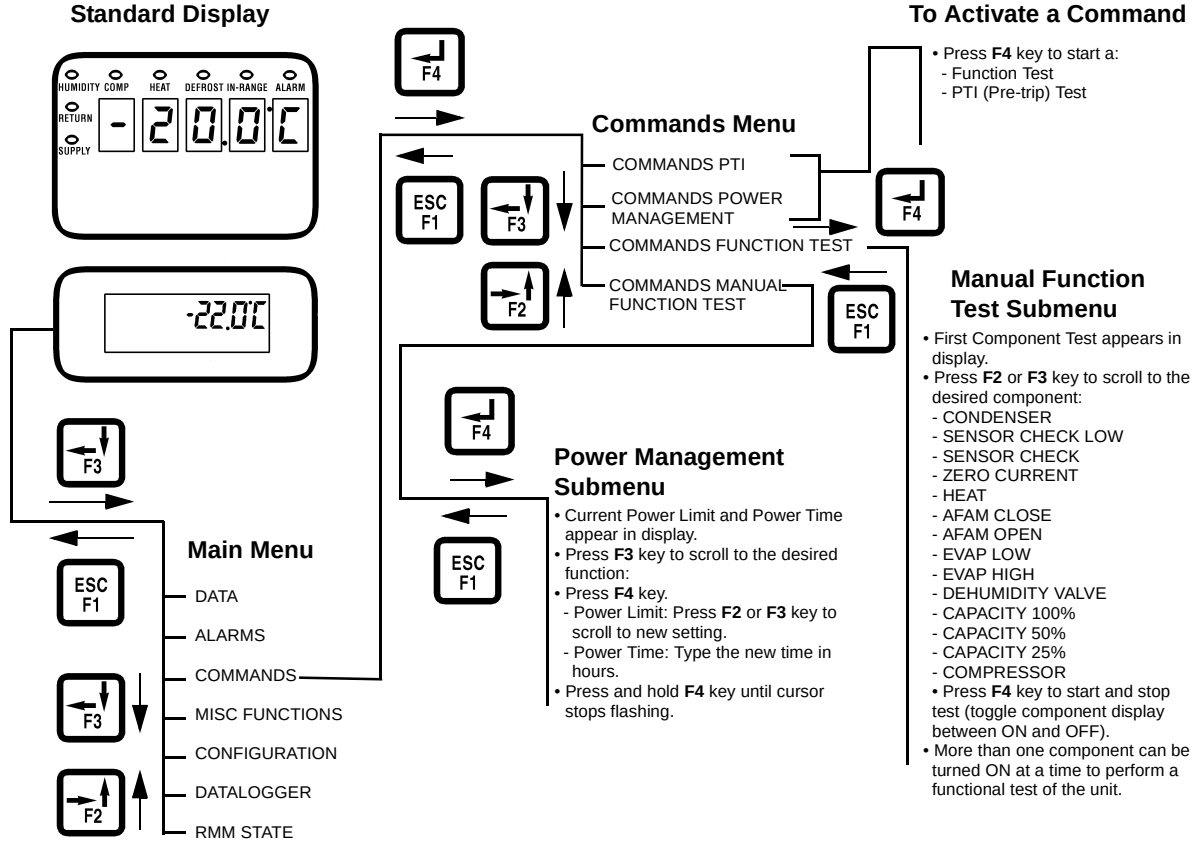


Figure 27: Commands Menu Screen Flow Diagram

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

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

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

CSR & Function Test Procedure

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
F1.00	Display Test Activated 0.1 A 0.0 A 0.1 A	Event Log for Function Test begins. All alarms are turned off. Alarm list is cleared. All lights and bars in display turn on.	None	10 Seconds
F1.01	Sensor Test Activated 0.1 A 0.0 A 0.1 A	All sensors must have values within their measuring range.	00, 01, 02, 03, 04, 05, 28, 31, 32, 33, 34, 35, 97, 98, 112	2 Seconds
F1.02	Evaporator Fan Low Activated 1.1 A 1.0 A 1.1 A	Amp draw is measured and compared to voltage and frequency. • CSR40 : 1.0 Amps approx. at 50 Hz, 1.0 Amps approx. at 60 Hz • CSR20SL and CSR40SL: 1.5 Amps approx. at 50 Hz 1.6 Amps approx. at 60 Hz	14, 15	10 Seconds
F1.03	Evaporator Fan High Activated 2.4 A 2.3 A 2.4 A	Amp draw is measured and compared to voltage and frequency: • CSR40: 2.1 Amps approx. at 50 Hz, 2.5 Amps approx. at 60 Hz • CSR20SL and CSR40SL: 2.8 Amps approx. at 50 Hz 2.8 Amps approx. at 60 Hz	12, 13	10 Seconds
F1.04	Condenser Fan Activated 0.8 A 0.7 A 0.8 A	Amp draw is measured and compared to voltage and frequency: 0.8 Amps Maximum.	16, 17	10 Seconds
F1.05	Reverse Phase Activated 0.8 A 0.7 A 0.8 A	Condenser fan stops. Reverse phase selector relay is energized and condenser motor is started in reverse for 2 seconds. Amp draw difference between correct and wrong motor rotation must be less than 0.2 amps.	58	30 Seconds
F1.06	Compressor Test Activated 7.1 A 7.0 A 7.1 A	With condenser fan on and compressor on, compressor is operated at 25% capacity. Amp draw is measured and compared to voltage. Evaporator temperature and condenser coil temperature are measured and stored. ***NOTE: If the condenser temperature is below 15 C (59 F), the condenser fan remains off for this test.***	06, 0, 31	14 Seconds

CSR & Function Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
F1.07	Injection Valve Test Activated 7.6 A 7.5 A 7.6 A	Condenser fan and compressor remain on. Liquid injection valve is turned on. Amp draw is measured and verified to be a minimum of 0.1 amps higher that test F1.06. ***NOTE: If the condenser fan is off for test F1.06, the fan remains off for this test.***	29, 31	10 Seconds
F1.08	Low Pressure Test Activated 0.8 A 0.7 A 0.8 A	Condenser fan, compressor and liquid injection valve remain on. Stepper valve is closed and low pressure cutout is verified to open. ***NOTE: If the condenser fan is off for test F1.06, the fan remains off for this test.***	31	10 Seconds
F1.09	Warm Gas Bypass Valve Activated 8.3 A 8.2 A 8.3 A	With condenser fan and compressor on, compressor is operated at 25% capacity. Liquid injection valve is off. Bypass valve is turned on. Amp draw measured and verified to be a minimum of 0.2 amps higher that test F1.06. ***NOTE: If the condenser fan is off for test F1.06, the fan remains off for this test.***		
F1.10	Heat Test Activated 5.2 A 5.1 A 5.2 A	Amp draw is measured and compared to voltage: • 4.4 Amps approx. at 400V • 5.1 Amps approx. at 460V	10, 11	10 Seconds
F1.11	Humidify Valve Test Activated 0.1 A 0.0 A 0.1 A	Coil/Dehumidify valve is turned on for 2 seconds, off for 2 seconds and on for 2 seconds to verify valve operation. Function test log ends. Alarms (if any) are cleared from datalogger. However, alarms (if any) remain in alarm list as not active until acknowledged.	None	6 Seconds

Pre-trip (PTI) Test

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

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

The MP-3000 controller contains a special PTI pre-trip test that automatically checks unit refrigeration capacity, heating capacity, temperature control, and individual components including the controller display, contactors, fans, protection devices and sensors. The test includes measurement of component power consumption and compares test results to expected values. The test takes about 2 to 2.5 hours to complete, depending on the container and ambient temperature.

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

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

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

See "CSR Pre-trip (PTI) Test Procedure" below for a detailed description of the PTI Test. Detailed PTI test results are stored in the MP-3000 Datalogger for later viewing. Any alarm codes recorded during the test can be viewed through the controller's Alarm List menu at the end of the test.

CSR Pre-trip (PTI) Test Procedure

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.00	Display Test Activated 0.1 A 0.0 A 0.1 A	Event Log for PTI begins. All alarms are turned off. Alarm list is cleared. All lights and bars in display turn on.	None	10 Seconds
P1.01	Sensor Test Activated 0.1 A 0.0 A 0.1 A	All sensors must have values within their measuring range. When Container ID begins with MAE, MSF or MWC prefix, at least 1 USDA sensor must be installed or USDA No. 1 Open alarm will be logged.	00, 01, 02, 03, 04, 05, 28, 31, 32, 33, 34, 35, 97, 98, 99, 112	10 Seconds
P1.02	Heat Test Activated 5.2 A 5.1 A 5.2 A	Electric heaters are turned on. Amp draw is measured and compared to voltage: • 4.4 Amps approx. at 400V; • 5.1 Amps approx. at 460V. Heater amperes are recorded in PTI log.	10, 11	10 Seconds
P1.03	Defrost Activated 5.2 A 5.1 A 5.2 A	If evaporator sensor is below +10 C (50 F), heat remains on until evaporator sensor reaches +18 C (65 F).	20	1 Hour Maximum
P1.04	Pre-Cool Activated 12.2 A 15.1 A 15.2 A	If the return sensor is above +20 C (68 F), unit operates in Cool until sensor temperature is below +15 C (59 F).	22	1 Hour Maximum

CSR Pre-trip (PTI) Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.05	Evaporator Fan High Activated 2.7 A 2.6 A 2.7 A	Condenser fan and compressor are turned off. With evaporator fan on high speed, Amp draw is measured and compared to voltage and frequency: • CSR40: 2.2 Amps approx. at 50 Hz, 2.6 Amps approx. at 60 Hz • CSR20SL and CSR40SL: 2.7 Amps approx. at 50 Hz, 3.2 Amps approx. at 60 Hz Evaporator fan high speed amperes are recorded in PTI log.	12, 13	10 Seconds
P1.06	Probe Test Activated 2.7 A 2.6 A 2.7 A	Evaporator fans operate on high speed for 3 minutes. Then probe test runs until temperature difference between sensors stops increasing. Maximum temperature difference allowed: • Return/Evaporator: 1.5 C (2.7 F); return air sensor temperature must be 0.5 C (1.0 F) above evaporator sensor temperature • Return/Supply: 0.8 C (1.4 F); return air sensor temperature must be 0.5 C (1.0 F) above supply air temperature • LH Supply/RH Supply (if equipped): 0.5 C (0.9 F)	52	3 Minutes Minimum to 13 Minutes Maximum
P1.07	Condenser Fan Activated 0.8 A 0.7 A 0.8 A	Condenser fan is turned on. Amp draw is measured and compared to voltage and frequency: 1.2 Amps Maximum. Condenser fan amperes are recorded in PTI log.	16, 17	10 Seconds
P1.08	Reverse Phase Activated 0.8 A 0.7 A 0.8 A	Condenser fan stops. Reverse phase selector relay is energized and condenser motor is started in reverse for 2 seconds. Amp draw difference between correct and wrong motor rotation must be less than 0.2 amps.	58	30 Seconds
P1.09	Compressor Test Activated 7.1 A 7.0 A 7.1 A	With condenser fan on and compressor on, compressor is operated at 25% capacity. Amp draw is measured and compared to voltage. Evaporator temperature and condenser coil temperature are measured and recorded with condenser fan amperes in PTI log.	06, 07	14 Seconds
P1.10	Injection Valve Test Activated 7.6 A 7.5 A 7.6 A	Condenser fan and compressor remain on. Liquid injection valve is turned on. Amp draw is measured and verified to be a minimum of 0.2 amps higher that test P1.09.	29	10 seconds

CSR Pre-trip (PTI) Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.11	Low Pressure Test Activated 0.8 A 0.7 A 0.8 A	Condenser fan, compressor and liquid injection valve remain on. Stepper valve is closed (set to 100 value) and low pressure cutout is verified to open.	31	10 seconds
P1.12	Warm Gas Bypass Valve Activated 8.3 A 8.2 A 8.3 A	With condenser fan and compressor on, compressor is operated at 25% capacity. Liquid injection valve is off. Bypass valve is turned on. Amp draw measured and verified to be a minimum of 0.2 amps higher that test P1.09.	30	10 seconds
P1.13	Compressor High Pressure Activated 12.2 A 12.0 A 12.2 A	Stepper valve opened to 50% capacity. With compressor on, evaporator fan operates on high speed until high pressure cutout occurs, causing significant amps drop. Maximum time depends on condenser coil temperature at start of test.	53	10 to 300 Seconds
P1.13	Compressor High Pressure Activated 4.5 A 4.4 A 4.5 A	With compressor off, condenser fan starts and operates until compressor starts, causing a significant amps increase. Compressor is then turned off. Condenser fan operates 60 seconds more to lower condenser temperature.	54	10 to 50 Seconds plus 60 Seconds
P1.14	Evaporator Fan Low Activated 1.1 A 1.0 A 1.1 A	Condenser fan and compressor are turned off. With evaporator fan on low speed, Amp draw is measured and compared to voltage and frequency: • CSR40: 1.0 Amps approx. at 50 Hz, 1.0 Amps approx. at 60 Hz • CSR20SL and CSR40SL: 1.5 Amps approx. at 50 Hz, 1.6 Amps approx. at 60 Hz Evaporator fan low amperes are recorded in the PTI log.	14, 15	10 Seconds
P1.15	Capacity Test 1 Activated 12.1 A 12.0 A 12.1 A	With condenser fan on, compressor on, and evaporator fans on low speed, stepper valve is set to 50% capacity. Liquid injection valve is turned on. A difference of approx. 4.5 C (8.0 F) is required between return and supply air temperatures, depending on return air and condenser coil temperatures.	22	3 Minutes (4 Minutes on CRR20)
P1.16	Capacity Test 2 Activated 13.2 A 13.0 A 13.2 A	With condenser fan on, compressor on, liquid injection valve on and stepper valve set to 50% capacity, evaporator fans are changed to high speed. A difference of approx. 3.0 C (5.4 F) is required between return and supply air temperatures, depending on return air and condenser coil temperatures. However, temperature difference must be less than in test P1.15.	23	2 Minutes

CSR Pre-trip (PTI) Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
P1.17	Capacity Test 3 Activated 11.2 A 11.1 A 11.2 A	Stepper valve is almost closed (set to 250 value). With condenser fan on, compressor on liquid injection on, bypass valve on and evaporator fans on high speed, alarm is recorded if temperature difference exceeds: • CSR40: 1.5 C (2.7 F) • CSR20SL and CSR40SL: 3.0 C (5.4 F)	24	4 Minutes (5 Minutes on CSR20)
P1.18	Heat Test Activated 7.3 A 7.2 A 7.3 A	With heaters on and evaporator fans on high speed, alarm is recorded if supply temperature is not at least 0.4 C (0.7 F) above the return air temperature. Test duration is extended 1 minute if necessary.	27	4 Minutes
P1.19	Evaporator Temperature Test Activated 12.3 A 12.1 A 12.3 A	Stepper valve is set to 50% capacity. With condenser fan on, compressor on, and liquid injection valve on, evaporator fans are turned off. The evaporator coil temperature must decrease to approx. -15 C (+5 F), depending on the return air temperature.	25	5 Minutes Maximum
P1.21	PTI Part 1 End 2.4 A 2.3 A 2.4 A	"PTI Part 1 End" is recorded in PTI log. Return/supply air temperature difference from tests P1.15, P1.16, P1.17 and P1.18 are recorded in PTI log. Condenser fan and compressor stop. Evaporator fans start and operate on high speed.	None	5 Minutes
P1.22	Pre-Heat Activated 7.9 A 7.9 A 7.9 A	If return air temperature is below 5 C (41 F), evaporator fans operate on high speed and heaters turn on. Unit operates until return air temperature is above 5 C (41 F).	None	120 Minutes Maximum
Supply Temp.	PTI Running Setpoint: 0 C (32 F)	Unit operates in normal Cool mode with 0 C (32 F) setpoint. When supply air temperature decreases to setpoint, "Chill Arrival" temperatures are recorded in PTI log.	23	120 Minutes Maximum
Supply Temp.	PTI Running Setpoint: 0 C (32 F)	Unit operates in Normal mode with 0 C (32 F) setpoint for 30 minutes after previous test is completed. At the end of 30 minutes, "Chill End" temperatures are recorded in PTI log.	None	30 Minutes
Return Temp.	Defrost Activated 4.5 A 4.4 A 4.5 A	Unit operates in Normal mode with -18 C (0 F) setpoint. When return air temperature decreases to -18 C (0 F), defrost is initiated. Defrost terminates when evaporator temperature increases to 18 C (65 F).	20	90 Minutes Maximum

CSR Pre-trip (PTI) Test Procedure (Continued)

LED Display (Test No.)	LCD Display (Shows Approx. Amps for 460V, 60 Hz Unit)	Test Description	Possible Alarms	Duration (Time)
Return Temp.	PTI Running Setpoint: -18 C (0 F)	Unit operates in Normal mode with -18 C (0 F) setpoint. When return air temperature decreases to setpoint, "Frozen Arrival" temperatures are recorded in PTI log. If unit is configured with humidity sensor, relative humidity must be between 20% and 95% or a Humidity Sensor alarm is recorded and stored in the PTI log. "PTI End" is recorded in the PTI log. A Trip Start is automatically activated. Current load port, discharge port, comment, and USDA entries are cleared from controller memory. Alarms (if any) are cleared from datalogger. However, alarms (if any) remain in alarm list as not active until acknowledged.	22, 60	180 Minutes Maximum
Return Temp.	PTI PASS: Press (Any) Key	If alarms (errors) occurred during PTI test, LCD display shows PTI FAIL. Press any key to clear display. Unit will remain off unit any key is pressed again.	None	—

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

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

1. Press **F3** key to enter the menu list. Repeatedly press **F2** key to scroll through Main menu until "COMMANDS" appears in LCD display.
2. Press **F4** key to access the Commands menu. The first command in the submenu appears in the LCD display.
3. Press **F2** or **F3** key to scroll to "MANUAL FUNCTION TEST".
4. Press **F4** key to enter the Manual Function Test: "CONDENSER OFF" appears in the LCD display.
5. To test a unit component:
   a. Press **F2** or **F3** key to scroll to desired component test:
      - "CONDENSER"
      - "SENSOR CHECK LOW"
      - "SENSOR CHECK"
      - "ZERO CURRENT"
      - "HEAT"
      - "AFAM CLOSE"
      - "AFAM OPEN"
      - "EVAP LOW."
      - "EVAP HIGH"

- "DEHUMITY VALVE"
- "BYPASS VALVE"
- "CAPACITY 100%"
- "CAPACITY 50%"
- "CAPACITY 25%"
- "COMPRESSOR"

b. Press **F4** key to start the component test. LCD display will change the component state from off to on.

c. Verify component performance: LCD display will show expected current and actual current on phase 1, 2 and 3.

d. Press **F4** key again to stop test. LCD display will change component state from on to off.

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

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

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

   b. Press **F4** key to turn the component on.

   c. Press **F3** key to scroll to select next component. Press **F4** key to turn component on.

   d. Repeat step 6c until all required components are on. For example, to operate unit in Full Cool mode, start the following components:

      - Condenser Fan
      - Compressor
      - Capacity 100%
      - Evaporator High or Low

   e. Observe current draw and system performance to verify component(s) performance.

   f. Press **F4** key again to turn off components individually. Or press **ESC** key to exit Manual Function Test menu and turn *all* components off.

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

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

Power Management

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

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

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

   a. Press **F4** key with cursor in the "POWER LIMIT" menu line. Cursor moves to end of menu line and flashes.

   b. Press **F2** or **F3** key to scroll to the desired power limit setting: "OFF", "13 amps", "15 amps" or "17 amps".

   c. With the desired power limit in the menu line, press and hold **F4** key until cursor stops flashing. Cursor stops flashing and new value appears in display.

6. To change the length of time power limit is active (On):
   a. Press **F2** key to scroll to Power Time menu line (standard setting = 48 hours).
   b. Press **F4** key with cursor in the "POWER TIME" menu line. An Enter Arrow appears in the menu line and the previous time disappears.
   c. Enter new active period in hours.
   d. With the correct hours entered in the menu line, press and hold **F4** key until cursor stops flashing. Cursor stops flashing and new value appears in display.
7. Press **ESC** key to exit the Power Management submenu.

Misc. Functions Menu

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

- Date Time: Sets the controller time and date.
- Run Time: Displays and sets operating hours for the unit and components.
- Program Version: Displays the current software version loaded in the controller: Controller (CTRL), EPROM and program serial numbers (SER NO).

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

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

Viewing the Misc. Functions Menu

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

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

- "DATE TIME"
- "C/F MODE"
- "CARGO DATA"
- "PROGRAM VERSION"
- "RUN TIME"

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

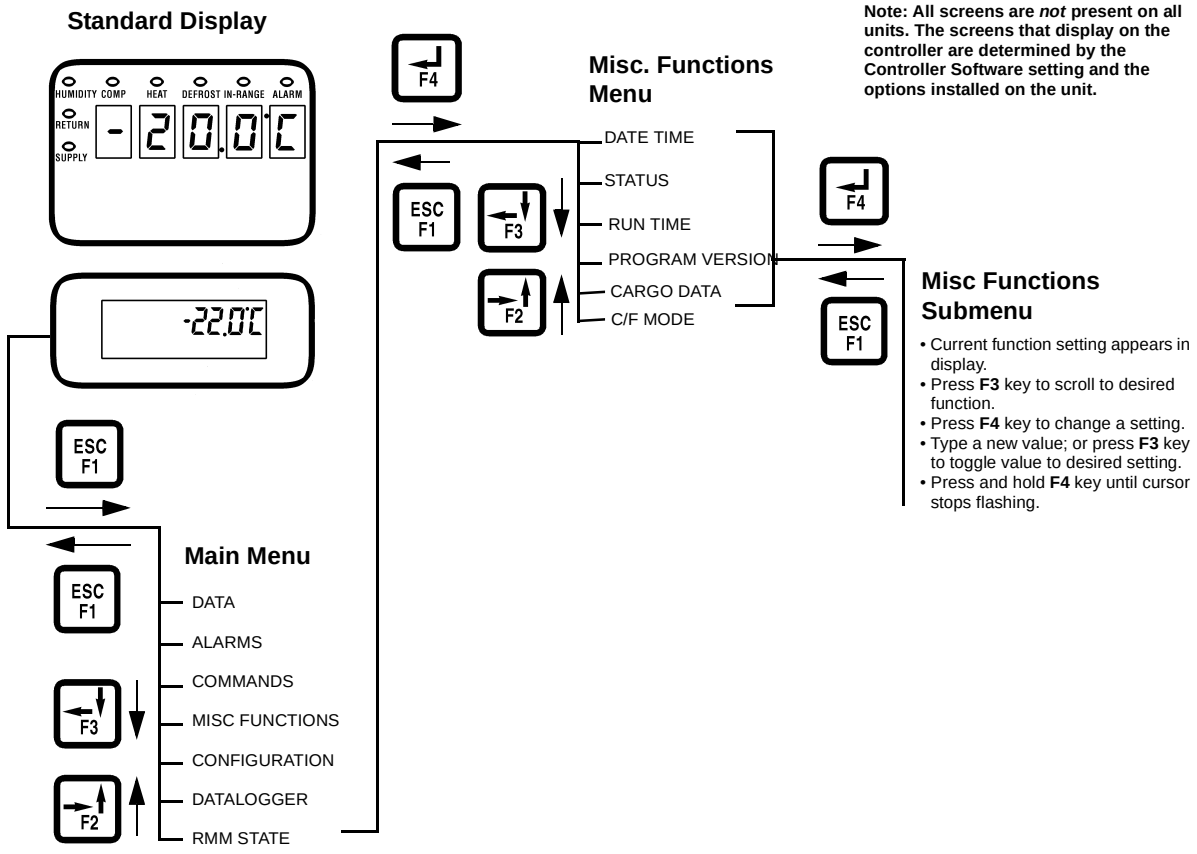


Figure 28: Misc. Functions Menu Screen Flow Diagram

Setting the Date and Time

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

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

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

10. With the correct date entered in the menu line, press **F4** key. Then press **EXIT** key to enter date in controller memory. Cursor stops blinking and new date appears in the display.
11. Press **ESC** key to exit the Date Time screen.

Viewing or Setting Run Time

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

Setting Cargo Data

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

6. When the desired text entry is complete, press **F4** key. Then press **EXIT** key. The cursor stops flashing and the new text appears in the menu line.
7. Repeat steps 5 through 7 until all information has been entered in the Cargo Data screen.
8. Press **ESC** key to exit the Cargo Data screen.

Changing the Temperature Display Value (C/F)

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

Configuration Menu

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

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

Viewing or Setting Functions

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

1. Press the **F3** key to enter the Main menu.
2. Press **F2** key to scroll through Main menu until "CONFIGURATIONS" appears in LCD display.
3. Press **F4** key to access the Configurations screen. Configurations screen appears with cursor in the "IN-RANGE" menu line.
4. Press **F3** key to scroll cursor to view or reset the desired function:
   - "IN-RANGE": Sets the temperature value for the controller's In-range LED and datalogger functions (factory default = 1.5 C [2.7 F]). Enter a value from 0.5 to 5.0 C (0.9 to 8.9 F).
   - "CONTAINER ID": Sets the container identification number. Enter up to 11 characters (numbers or letters).
   - "CONTRAST": Controller automatically regulates black and white contrast value on LCD display according to display temperature. Standard setting is 45. Resetting this value is not recommended.

- "LANGUAGE": English is only setting currently available.
- "ECONOMY MAX": Sets the Economy mode maximum temperature limit (factory default = 0.2 C). Enter a value from 0 to 5.0 C (0 to 8.9 F).
- "ECONOMY MIN": Sets the Economy mode minimum temperature limit (factory default = 2.0 C). Enter a value from 0 to 5.0 C (0 to 8.9 F).
- "UNIT TYPE": View display value (factory default = NO HUM). Controller automatically activates when a humidity sensor is installed for more than 1 minute. Setting this value is not necessary.
- "DEHUMIDIFICATION VALVE"
- "REEFER TYPE": Sets the unit model state to CSR20SL PS or CSR40SL PS/CSR40 PS. Must be manually set to unit type on unit serial number plate.
- "ZERO CURRENT": View display on or off value (factory default = on). However, no errors occur if a Zero Current transformer is not installed and configuration is set to on.
- "SUPPLY LH": View display on or off value (factory default = off). Controller automatically activates when a left hand supply sensor is installed for more than 1 minute. Setting this value is not necessary.
- "AFAM OPTION": Sets the Advanced Fresh Air Management System to None, AFAM, AFAM+ or Analyzer (factory default = None). Controller automatically activates when an AFAM system vent door and/or AFAM+ gas sensor is installed for more than one minute. Setting this value is not necessary. However, to calibrate the gas sensor unit, the container must be opened and aired out for at least 15 minutes. Then close container doors and manually set AFAM Option to Analyzer. Analyzer turns on data logging of gas sensor readings only.
- "EVAPORATOR TYPE": Sets the evaporator fan value to VFD 2 fan, 3 fan or 2 fan. Must be manually set.
- "CONDENSER TYPE": Sets the condenser fan value to 1/2 HP, 2 HP or 3/4 HP. Must be manually set.
- "USDA TYPE": Sets the controller for 3THERM, PT100 or 4THERM type USDA sensors. Must be manually set to activate USDA data logging with NTC (3THERM or 4THERM) type sensors.
- "CHART R": Shows: Not Present, -20 F to 80 F 31 day, -30 C to +25 C 31 day, -25 C to 25 C 31 day.
- "AFAM UNITS": Sets the AFAM system units to "CF" (cubic feet per minute), "M3" (cubic meters per hour) or "PERCENT" (default is M3).
- "AUTO CONFIGURATION": View display on or off value (factory default = off). Set value to on to automatically configure unit to installed components. See "Automatic Configuration of Spare Parts Controller" in this chapter for additional information.
- "UNIT #": Sets the unit serial number. Enter up to 11 characters (number or letters). Serial number must be manually set. Serial number is required to enable automatic detection of PT100 type USDA sensors on units with serial numbers beginning with MAE, MSF or MWC prefix.
- "UNIT ID": An 11 digital alpha-numeric container number.

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

5. To set a new Configuration screen value:
   a. Press **F4** key with cursor in the desired menu line. The Password screen appears.
   b. Press **F2** key, **A** key (password is "A"), **F4** key and then **EXIT** key. An Enter Arrow appears in the hourmeter line.

c. Use the general purpose keypad to enter the desired value; or press the **F3** key to toggle the value to the desired setting.

d. When the entry is complete, press the **F4** key and release. Press the exit key. The new value appears in the menu line.

6. Repeat steps 4 and 5 to reset additional configuration values.

7. Press **ESC** key to exit the Configurations screen.

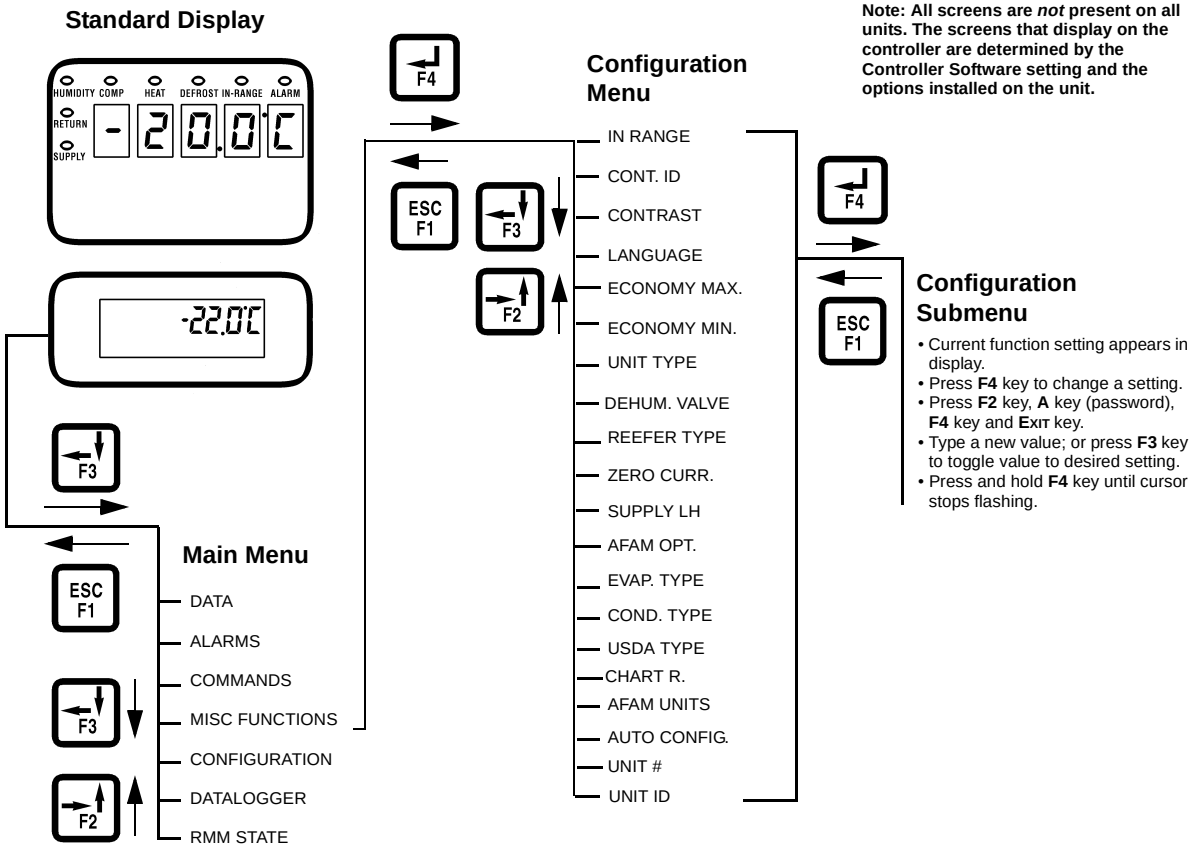


Figure 29: Configuration Menu Screen Flow Diagram

Datalogger Menu

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

- Inspect Temperature Log: Displays temperature logs by time and date for the Setpoint; Supply (Controlling Temp), Return, USDA1, USDA2, USDA3 and ambient sensors; humidity sensor; and event flags.
- Inspect PTI Log: Displays results of last PTI test including component volt and amps data and sensor temperatures. Test values are recorded at the start and end of the Chilled and Frozen mode test.
- Calibrate USDA Probe: Sets a temperature offset in the controller memory to calibrate each USDA sensor to the controller.
- Activate Tripstart: Sets the date and time of the trip start.
- Set Log Time: Sets the data log interval (1 minute or 1/2, 1, 2 or 4 hours).

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

Viewing the Datalogger Menu

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

1. Press the **F3** key to enter the Main menu.
2. Press **F3** key to scroll through Main menu until “DATALOGGER” appears in LCD display.
3. Press **F4** key to access the Datalogger menu. The first function appears in the LCD display: “INSPECT TEMP LOG”.
4. Press **F2** or **F3** key to scroll to the desired function:
   - “INSPECT TEMP LOG”
   - “INSPECT PTI LOG”
   - “CALIBRATE USDA SENSOR”
   - “ACTIVATE TRIPSTART”
   - “SET LOG TIME”
   - “INSPECT EVENT LOG”
5. Press **F4** key to access the function selected.

Inspect Temp Log

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

1. Press **F2** key to enter the menu list.
2. Press **F3** key to scroll through Main menu until “DATALOGGER” appears in LCD display.
3. Press **F4** key to access the Datalogger menu. “INSPECT TEMP LOG” appears in the LCD display.
4. Press **F4** key to enter Temp Log. LCD display shows the Log Time and the Setpoint, Supply and Return temperatures of the most recent log in the first screen.
   - To scroll through previous logs of the sensor temperatures currently in the display, press **F3** key. All temperature logs recorded in the datalogger memory may be viewed on the LCD display.
5. To view additional sensor log and event flag screens, press **F4** key again. LCD display shows USDA1, USDA2, USDA3, Relative Humidity (rH), Ambient, sensor readings, and flags etc.
   - To scroll through previous logs of the sensor temperatures currently in the display, press **F3** key.

Event Flags for Temperature Log

T = Tripstart Activated

P = Primary Power Off

D = Defrost in Last Interval

O = Temperature Not In-range

h = Humidity Control Active

E = Evaporator High Temperature

H = High Refrigeration Pressure

d = Defrost terminated on time limit

e = Economy mode activated

s = Reefer unit stopped (after PTI)

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

A = Alarm in last interval

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

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

Inspect Event Log

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

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

PTI Examples

- PTI stores volt and amps of all power consuming components
- PTI stores temperatures logged at both the start and end of Chilled mode and Frozen mode capacity tests

6. Press **ESC** key to exit the Event log.

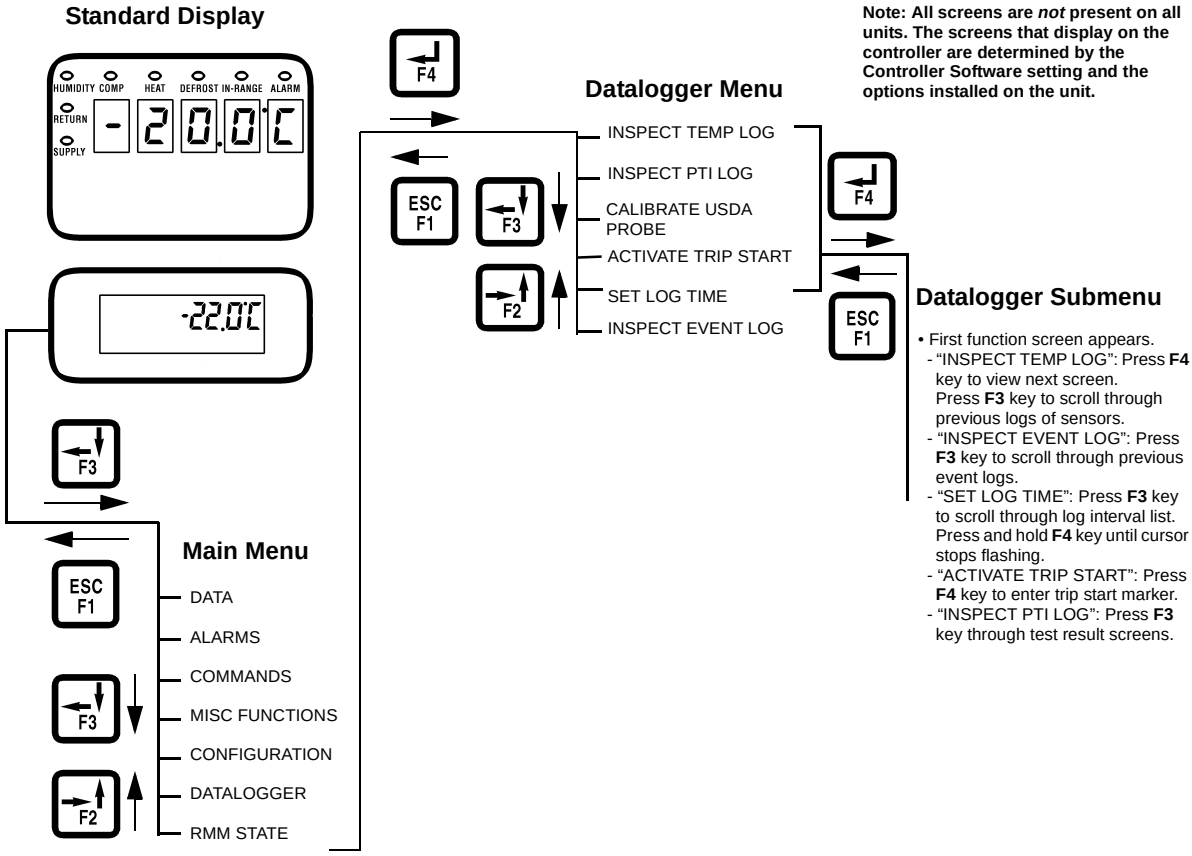


Figure 30: Datalogger Menu Screen Flow Diagram

Calibrate USDA Probe

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. CSR units equipped for NTC style USDA sensors require USDA sensor P/N (refer to Tool Catalog). CSR units equipped for PT100 style USDA sensors require USDA sensor P/N (refer to Tool Catalog).

Ice Bath Preparation

1. The ice bath should consists of an insulated container full of ice made from distilled water with enough distilled water added to cover the top of the ice during the test. A properly filled ice bath should be completely filled with ice all the way to the bottom of the container.
2. Stir the ice bath briskly for one minute before proceeding.
3. Insert the USDA sensors in the ice bath. Wait 5 minutes to allow the sensor temperatures to stabilize at 0 C (32 F).
4. Stir the ice bath frequently while testing and verify ice bath temperature with a fluke 50 series meter or equivalent. Stirring 10 seconds every 3 minutes during the test procedure is adequate.

Calibrating the USDA Sensors

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

   NOTE: The sensors must be completely immersed in the ice bath without contacting the walls of the ice bath container for 5 minutes.
2. Press **F3** key to enter the Main menu.
3. Press **F3** key to scroll through menu list until "DATALOGGER" appears in LCD display.
4. Press **F4** key to access the Datalogger menu. "INSPECT TEMP LOG" appears in the LCD display.
5. Press **F3** key to scroll through submenu until "CALIBRATE USDA PROBE" appears in LCD display.
6. Press **F4** key to enter Calibrate function. The display shows the "ACTUAL" and "NEW CORR" temperature off-sets for each sensor in two rows.
   - The controller displays "OOR" in place of a temperature offset until the sensor comes within 0.3 C (0.5 F) above or below 0 C (32 F).
   - The controller displays the actual temperature offset when the sensor temperature is within 0.3 C (0.5 F) above or below 0 C (32 F).

   NOTE: The sensors should be in the ice bath a total of 15 minutes or more to assure the sensor temperature has bottomed out.
7. Press the **F3** key to release the current actual temperature offsets from the controller memory. Observe the sensor temperatures in the "NEW CORR" row.
8. When all sensor offsets read between + 0.3 C (+0.5 F) and - 0.3 C (-0.5) and have been stable for 5 minutes, press the **F4** key to accept the new temperature offsets. The controller display will show the new offsets in the "ACTUAL" row too.
9. Press **ESC** key to exit the Calibrate menu.

Set a Trip Start

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

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

   NOTE: When a PTI test is completed, the controller automatically enters a Tripstart in the log.
7. Press **ESC** key to exit the Datalogger menu.

Set Log Time

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

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

Set a Trip Start

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

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

   NOTE: When a PTI test is completed, the controller automatically enters a Tripstart in the log.
6. Press **ESC** key to exit the Datalogger menu.

Inspect Event Log

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

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

Event Examples

- Controller alarm status (alarms set/cleared)
- Main power On/Off status (humidity On/Off, temperature setpoint, and main power Hz)
- 12 Vdc battery discharge test (battery voltage, total unit and compressor hours if main power on) — this event logged at once a day
- Change temperature setpoint (new/old setpoint)
- Change RH setpoint (new/old RH setpoint)

- Change RH status (On/Off)
- Event log retrieval
- Temperature log retrieval
- Trip start
- New container ID
- PTI start (Unit configuration)
- PTI part 1 end (Temperature differences for tests 1, 2, 3 and heat test
- PTI end
- Defrost start (logged with demand or manual defrost only)
- Defrost end (start time)

6. Press **ESC** key to exit the Event Log.

RMM State Menu

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

- Offline: No communication between the controller RMM and a REFCON system.
- Zombie: The controller has detected a REFCON system master module and is waiting for communication.
- On-line: The controller RMM is logged-in on a REFCON system.

Viewing the RMM State Screen

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

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

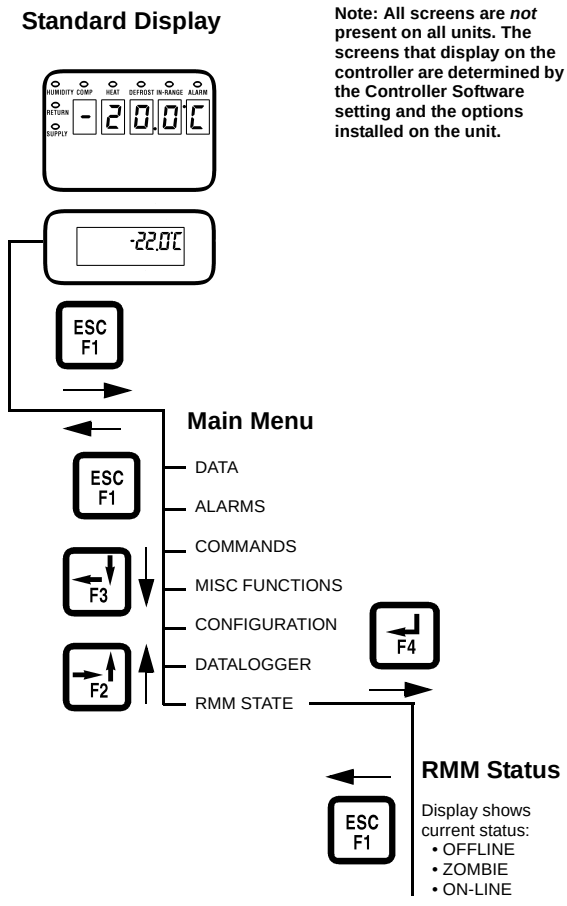


Figure 31: RMM Menu Screen Flow Diagram

Manual Emergency Mode Operation

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

- Position 1: Cool 1: Continuous cooling with condenser fan operation and high speed evaporator fan operation.
- Position 2: Cool 2: Continuous cooling with condenser fan operation, high speed evaporator fan operation and continuous liquid injection.
- Position 3: Not Used

- Position 4: Not Used
- Position 5: Defrost: Heaters are activated (evaporator fans off).
- Position 6: Heat: Evaporator fans operate at high speed to introduce fan motor heat only into the container (no electric heater operation).

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

To select Manual Control:

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

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

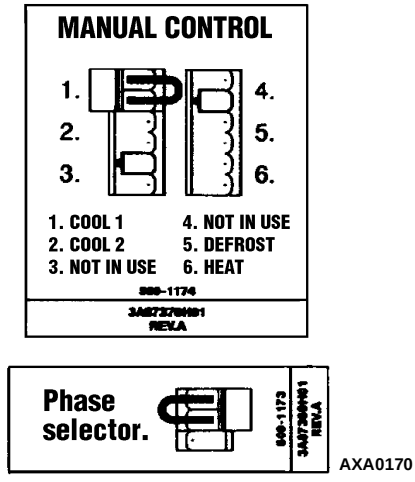


Figure 32: Manual Emergency Control Connections

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

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

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

   NOTE: On CSR units, both the 460/380V main circuit breaker and the UNIT ON/OFF switch must be used to cycle the unit on and off. The UNIT ON/OFF switch must be ON to operate the scroll compressor.

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

Reversing Power Phase on CSR Units

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

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

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

3. Relocate the position of the white and black incoming power cord leads at the 460/380V main circuit breaker.
4. Connect unit power cord to proper power supply.
5. Start the unit again by turning the unit 460/380V main circuit breaker on and the **UNIT ON/OFF** switch **ON**. Check condenser airflow again to confirm correct fan rotation.

Replacing the Controller

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

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

3. Disconnect battery power connection from the controller (top plug on the controller).
4. Disconnect the communication cables from the controller and remote monitoring modem.
5. Remove the screws that secure the remote monitoring modem to the controller.
6. Remove the screws that secure the controller to the inside of the control box door.
7. Remove the controller from the door.
8. Install the replacement controller in the door using the existing hardware. Connect the keyboard cable to the controller.
9. Install the remote monitoring modem on the back of the controller.
10. Connect the communication cables to the remote monitoring modem and controller.
11. Set the **SOFTWARE SELECTION** switch on the back of the controller to position **2**.

    NOTE: Be certain that all connector plugs are fully seated.

CAUTION: Be sure to enter the container ID before releasing the unit for service. The container ID is required to identify the data downloaded from the controller datalogger via a laptop computer or a REFCON remote communications system.

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

NOTE: If a controller from another unit has been installed, see "Controller Software Selection" in this chapter to set software selection dial correctly.

Automatic Configuration of Spare Parts Controller

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

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

- Number of Supply Air Sensors (1 or 2): Controller detects left hand and right supply air sensors.
- Horsepower and Condenser Fan (1/2 hp or 3/4 hp).
- Number of Evaporator Fans (2 or 3)
- Dehumidify (On or Off): If controller detects a humidity sensor, it then checks for current draw on a dehumidify valve.
- Humidification (On or Off): If controller detects a humidity sensor, it then checks for current draw on an air compressor.

  NOTE: Automatic configuration will not detect NTC type USDA sensors. See "USDA Type" under Configuration Menu on 95.

Controller Software Selection

If a replacement controller was removed from another unit, check the small dial located on the back of the controller for the correct software selection. Current active software settings for dial positions are:

- Position 0: All TNE 508 units with Moduload compressor
- Position 1: All CRR-40/TNE 508 units with KVQ valve
- Position 2: All CSR20 PS, CSR40SL PS and CSR40 PS units with a stepper motor valve
- Position 3: All CRR40 DF units
- Position 4: All CSR40 Magnum units
- Position 7: Unit testing and service only.

Changing Software Selection Dial Position:

1. Turn **UNIT ON/OFF** switch **OFF**.
2. Set dial indicator to correct position.
3. Turn **UNIT ON/OFF** switch **ON**. New software selection is loaded during controller start-up.

Flash Loading Controller Software

Controller software must be flash loaded when software has been revised. To flash load software:

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

   NOTE: If the communications cable is defective or not connected to the download port, the controller will start in Emergency mode and LCD display will show "EMERGENCY MODE". Secure cable connection to proceed with flash loading of software.
5. Start flash load program on portable computer.
6. Flash loading of new software is complete when "FLASH LOADING" clears from the LCD display.

7. The controller then checks the new software and loads the new control program into memory.

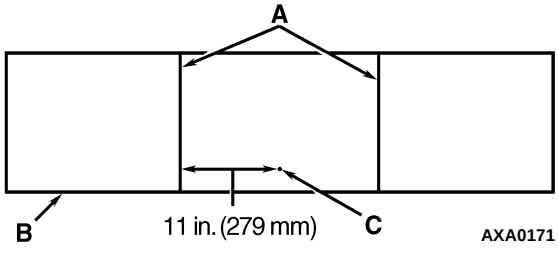
   NOTE: If the flash load procedure is interrupted or fails, the controller will continue to use the previous control program.

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

Temperature Sensors

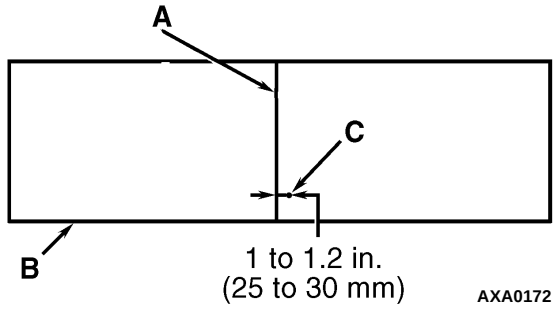
Thermistor type temperature sensors are used. Each sensor is connected to a shielded cable and placed in a sealed stainless steel tube. The temperature signal from the sensor is transmitted through the shielded cable. Temperature sensors include:

- Supply Air, Left Hand
- Supply Air, Right Hand
- Return Air
- Evaporator Coil
- Condenser Coil
- Compressor Discharge Manifold
- Ambient Air



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

Figure 33: CSR20SL and CSR40SL Evaporator Coil (Defrost) Sensor Location



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

Figure 34: CSR40 Evaporator Coil (Defrost) Sensor Location

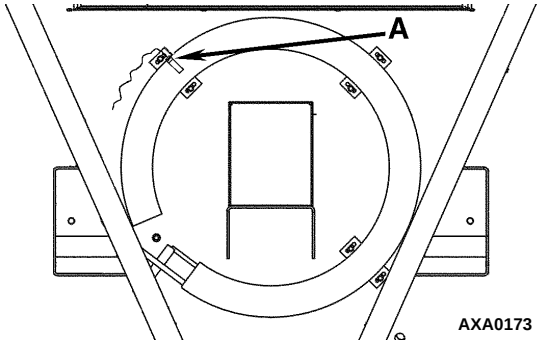
CAUTION: Sensors are permanently calibrated and can be checked using an ohmmeter. Ohm readings should agree with the data shown in the Sensor resistance tables on 105.

All sensors should be properly installed:

- Supply air sensors must be inserted to the bottom of the sensor tube and completely sealed by the grommet connection.
- Left hand supply sensor installs in the sensor tube behind the compressor.
- Right hand supply sensor installed in the sensor tube next to the control box.
- Return air sensor installs in a grommet between the evaporator fans.

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

Temp. F	Temp. C	Ohms	Temp. F	Temp. C	Ohms
-40	-40	42618	53.6	12	3360
-31	-35	32198	57.2	14	3094
-22	-30	24532	60.8	16	2852
-13	-25	18850	64.4	18	2632
-4	-20	14618	68	20	2431
5	-15	11383	71.6	22	2347
10.4	-12	9838	75.2	24	2079
14	-10	8941	78.8	26	1925
17.6	-8	8132	82.4	28	1785
21.2	-6	7406	86	30	1657
24.8	-4	6752	89.6	32	1539
28.4	-2	6164	93.2	34	1430
32	0	5634	96.8	36	1330
35.6	2	5155	100.4	38	1239
39.2	4	4721	104	40	1154
42.8	6	4329	107.6	42	1076
46.4	8	3907	111.2	44	1004
50	10	3652	113	45	970



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

Figure 35: Condenser Coil Sensor Location

Resistance Values for Compressor Discharge Sensors

Temp. F	Temp. C	Ohms	Temp. F	Temp . C	Ohms
-13	-25	1,121,457	185	85	9,202
-4	-20	834,716	194	90	7,869
5	-15	627,284	203	95	6,768
14	-10	475,743	212	100	5,848
23	-5	363,986	221	105	5,091
32	0	280,824	230	110	4,446
41	5	218,406	239	115	3,870
50	10	171,166	248	120	3,354
59	15	135,140	257	125	2,924
68	20	107,440	266	130	2,580
77	25	86,000	275	135	2,279
86	30	69,282	284	140	2,021
95	35	56,158	293	145	1,797
104	40	45,812	302	150	1,591
113	45	37,582	311	155	1,393
122	50	30,986	320	160	1,247
131	55	25,680	329	165	1,118
140	60	21,397	338	170	1,015
149	65	17,914	347	175	920
158	70	15,067	356	180	834
167	75	12,728	365	185	748
176	80	10,793	374	190	679

- Evaporator coil (defrost) sensor must be placed in the middle of the coil and at least 75 mm deep between the fins.
- Condenser sensor must be placed on the upper left side of the condenser coil and at lest 70 mm deep between the fins.
- Ambient sensor must be placed on the bottom plate of the right forklift pocket.
- Compressor sensor must be placed in the manifold on the discharge tube before the discharge service valve. See “Compressor Discharge Temperature Sensor Replacement” in the chapter for Refrigeration System Diagnosis and Service.

Diagnosis and Repair

If the unit appears to be operating incorrectly, view any alarm codes that may be stored in the controller display memory. Diagnose and correct the problem associated with each alarm code (see "Alarm Codes, Alarm Types and Corrective Actions" in this chapter).

NOTE: Defrost can be delayed for 24 hours during unit diagnosis or testing: Press* 7 *key and* F1 *key at the same time from any controller screen display. Press* F3 *key to scroll cursor down to "DELAY DEF" menu line. Then press* F4 *key,* F2 *key,* A *key,* F4 *key and* EXIT *key. Cursor moves to end of line and flashes. Pressure* F3 *key to toggle "OFF" to "ON". Then press and hold* F4 *key until cursor stops flashing.

If you have viewed and corrected these problems and the unit still appears to be operating incorrectly, eliminate any possibility that the problem is caused by failure of components other than the controller.

External Cause Checks

- Poor contact between male and female connector plugs (loose connection).
- Defective wire harness (broken wires, loose connections).
- External electrical causes such as faulty (open or stuck) contactors.
- Malfunction of refrigeration system components.

Error Messages and Controller Actions

The controller displays error messages (In the Miscellaneous Function Menu under Status) on the LCD display for several general faults. More than one error message may appear at a time. Press **F2** or **F3** key to scroll through message displays.

Error Messages and Controller Actions

Message No.	Error Message	Controller Action
1	**Power Error, Check 20A Fuses** **Indicates:** • One or more phases are missing • Compressor is able to draw amps on all phases while heater lacks amps on one or more phases.	• Controller activates Alarm 18 • Controller will try to restart unit after 60 minutes.
2	**High Pressure Cutout, Check Water Cooling** **Indicates:** • Unit stops due to high pressure cutout and water pressure switch is open.	• Controller clears message on compressor start-up. • No alarm is set until Controller determines that unit current draw is too low (Alarm 37) or supply air temperature is too high (Alarm 41).
3	**Probe Test, Please Wait** **Indicates:** • Incorrect temperature difference between Supply-LH, Supply-RH, or Return Air Sensor for 10 minutes with evaporator fan amps OK.	• Controller automatically activates probe test to check for a defective sensor. Message clears when test is complete. • Controller displays new message if test indicates a sensor is defective.
4	**Supply–Right Hand Problem, Sensor Disabled** **Indicates:** • Controller disables sensor due to open or short circuit or sensor failed a Probe Test.	• Controller activates Alarm 52 • Controller activates Alarm 00 or 01, depending on type of sensor failure. • Controller clears message during Defrost mode and when **UNIT ON/OFF** switch is turned **OFF**. • Controller uses left hand supply sensor to control unit if right hand sensor is defective. • Controller uses return sensor plus an offset to control unit if both supply sensors are defective.
5	**Supply–Left Hand Problem, Sensor Disabled** **Indicates:** • Controller disables sensor due to open or short circuit or sensor failed a Probe Test.	• Controller activates Alarm 52 • Controller activates Alarm 00 or 01, depending on type of sensor failure. • Controller clears message during Defrost mode and when **UNIT ON/OFF** switch is turned **OFF**. • Controller uses right hand supply sensor to control unit if left hand sensor is defective. • Controller uses return sensor plus an offset to control unit if both supply sensors are defective.
7	**High Pressure Cutout, Check Condenser Probe** **Indicates:** • Units stops due to high pressure cutout, water pressure switch is closed and condenser temperature is low.	• Controller clears message on compressor start-up. • No alarm is set until Controller determines that unit current draw is too low (Alarm 37) or supply air temperature is too high (Alarm 41).

Error Messages and Controller Actions (Continued)

Message No.	Error Message	Controller Action
8	**Running with High Supply Difference** **Indicates:** • Temperature difference between the left hand and right hand Supply sensors is too large; even after Probe Test indicates no sensor errors. • Possible causes include air leak around sensor cable, low refrigerant charge, defective expansion valve, etc.	• Controller clears message during defrost and when **UNIT ON/OFF** switch is turned **OFF**.
9	**High Pressure Cutout, Check Condenser Fan** **Indicates:** • Unit stops due to high pressure cutout, water pressure switch is closed and condenser temperature is high.	• Controller clears message on compressor start-up. • No alarm is set until Controller determines that unit current draw is too low (Alarm 37) or supply air temperature is too high (Alarm 41).
10	**Condenser Probe Found, Please Change Type** **Indicates:** • Controller is set for CRR40 DF and start-up is initiated on a KVQ/CRR40, CSR40 or CSR40 Magnum unit. Correct by turning **UNIT ON/OFF** switch **OFF**. Then set **CONTROLLER SOFTWARE** switch to correct position. See “Controller Software Selection” on page 103.	• None. On CRR40 DF units, condenser sensor input must be left open.
11	**Scroll Compressor, High Temperature** **Indicates:** • Compressor stops because discharge temperature is above 140 C (284 F). Message remains in display until discharge temperature decreases to normal.	• Controller clears message after compressor start-up.
12	**Scroll Compressor, Low Pressure** **Indicates:** • Low pressure cutout switch is open. • Possible causes include stepper motor valve will not open, warm gas bypass valve will not open, low refrigerant charge, defective low pressure cutout switch, open circuit, etc.	• Controller activates Alarm 31 after 5 minutes. • Controller clears message after compressor start-up.
14	**Evaporator High Temperature Switch Open** **Indicates:** • Controller disables electric heaters due to open high temperature switch circuit. • Possible causes include evaporator temperature over 54 C (130 F), defective heater, defective evaporator overheat switch, open circuit, etc.	• Controller clears message on compressor start-up. • No alarm is set until Controller determines that heater current draw is too high (Alarm 10), unit unit current draw is too high (Alarm 36), or defrost time is too long (Alarm 20).

Alarm Codes, Descriptions and Corrective Actions

NOTE: Sensors used with the MP-3000 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.
- Event Log (Level 3 Alarm): Alarm is recorded in datalogger only (inspect event log).

Alarm Codes, Descriptions and Corrective Actions

Code	Description	Corrective Action

00	**Supply Air Sensor Open Circuit (Check Alarm)**
	• When the sensor circuit resistance is higher than 100,000 ohms.
	• When the temperature is below -70 C (-94 F).
	• Indicates:
	  • Open circuit to left or right hand sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1 or cable No. 3
	  • Defective controller
		• Identify defective sensor (left hand or right hand) by viewing Data menu.
		• Check sensor resistance between pins 1 and 2 on plug J15 and between pins 7 and 8 on plug J14. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check cable No. 1 and cable No. 3 between the controller and relay board.
		• Check evaporator airflow.

01	**Supply Air Sensor Short Circuit (Check Alarm)**
	• When the sensor circuit resistance is lower than 200 ohms.
	• When the temperature is below 80 C (176 F).
	• Indicates:
	  • Short circuit to left or right hand sensor Defective or wrong sensor Defective relay board
	  • Defective cable No. 1 or cable No. 3
	  • Defective controller
		• Identify defective sensor (left hand or right hand) by viewing Data menu.
		• Check sensor resistance between pins 1 and 2 on plug J15 and between pins 7 and 8 on plug J14. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check cable No. 1 and cable No. 3 between the controller and relay board.

02	**Return Air Sensor Open Circuit (Check Alarm)**
	• When the sensor circuit resistance is higher than 100,000 ohms.
	• When the temperature is below -70 C (-94 F).
	• Indicates:
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance between pins 3 and 4 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check cable No. 1 between controller and relay board.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

03	**Return Air Sensor Short Circuit (Check Alarm)**
	• When the sensor circuit resistance is lower than 200 ohms.
	• When the temperature is above 80 C (176 F).
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance between pins 3 and 4 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check cable No. 1 between controller and relay board.

04	**Evaporator Coil Sensor Open Circuit (Check Alarm)**
	• When the sensor circuit resistance is higher than 100,000 ohms.
	• When the temperature is below -70 C (-94 F).
	• Indicates:
	  • Open circuit to sensor Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
	  • Low evaporator coil temperature
		• Check sensor resistance between pins 5 and 6 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check cable No. 1 between controller and relay board.
		• Check evaporator airflow.

05	**Evaporator Coil Sensor Short Circuit (Check Alarm)**
	• When the sensor circuit resistance is lower than 200 ohms.
	• When the temperature is above 80 C (176 F).
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance between pins 5 and 6 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check cable No. 1 between controller and relay board.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

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

07*	**Compressor Current Too Low (Check Alarm)**
	• Occurs during pre-trip (PTI) or function test only.
	• Compressor power consumption is 25% below expected current draw (below approximately 9 amps).
	• Indicates:
	  • Defective or open fuse CB 7A, high pressure cutout switch or connection in plug J19 between pins 7 & 8
	  • No signal on plug J11 on pin 8
	  • Defective compressor relay
	  • Defective volt or amp meter on relay board
	  • Low refrigerant charge
	  • Defective compressor or valve plate
		• Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor 25%, condenser fan and evaporator fan (high and low). If relay does *not* energize and the LED above the compressor relay is *not on*, check for a defective cable No. 2, main relay board or controller.
		• Check discharge and suction pressure gauge readings. Evaluate readings based on current cargo and ambient temperatures.
		• Check volt and ampere meter.
		• Check power supply volts.

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

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

10*	**Heater Current Too High (Check Alarm)**
	• Occurs during pre-trip (PTI) or function test only.
	• Heater power consumption is 25% above expected current draw (above approximately 4.4 amps and 5.1 amps, depending on voltage).
	• Indicates:
	  • Incorrect heaters or heater connections
	  • Defective volt or amp meter on relay board
	  • Defective heater element
		• Enter Manual Function Test and turn heaters on. Check current draw on each phase. Current draw should be about 4.4 amps on each phase at 400V (5.1 amps at 460V).
		• Check heater resistance between H1 and H2, H2 and H3, and H1 and H3. Resistance should be about 99 ohms on each leg.

11*	**Heater Current Too Low (Check Alarm)**
	• Occurs during pre-trip (PTI) or function test only.
	• Heater power consumption is 25% below the expected current draw (below approximately 3.2 amps and 3.8 amps, depending on voltage).
	• Indicates:
	  • Defective high evaporator temperature switch
	  • Defective heater element or heat relay
	  • Defective wire connection
	  • Incorrect heaters or heater connections
		• Enter Manual Function Test and turn heaters on. Make sure the heat relay energizes. Check current draw on each phase. Current draw should be 4.4 on each phase at 400V (5.1 amps at 460V).
		• If heat relay fails to energize, check evaporator high temperature switch. Switch should be closed at temperatures below 54 C (130 F); there should be continuity between pins 5 and 6 in plug J19.
		• Check cable No. 2 between controller and relay board.
		• Check heater resistance between H1 and H2, H2 and H3, and H1 and H3. Resistance should be about 99 ohms on each leg.
		• Check volt and ampere meter.

*If both alarms 10 and 11 are activated, the alarms are caused by a large difference in measured amps. Enter Manual Function Test menu and start HEAT. Check the amps measurements. If necessary, check the resistance between H1 and H2, H2 and H3, and H1 and H3. Resistance should be about 99 ohms on each leg.		

12**	**Evaporator Fan High Speed Current Too High (Check Alarm)**
	• Occurs during pre-trip (PTI) or function test only.
	• When the evaporator fan power consumption is 25% above expected current draw (above 2.0 to 3.0 amps, depending on voltage)
	• Indicates:
	  • Defective or stuck evaporator fan motor
	  • Incorrect motor or motor connections
	  • Defective volt or amp meter on relay board
		• Open evaporator door and make sure all fans rotate freely.
		• Enter Manual Function Test and start evaporator fans on high speed. Make sure all fans start on high speed. Check fan motor volts and amps.
		• Check volt and ampere meter.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

13**	**Evaporator Fan High Speed Current Too Low (Check Alarm)**
	• Occurs during pre-trip (PTI), function test or probe test.
	• When the evaporator fan power consumption is 25% below expected current draw (below 1.6 to 2.4 amps, depending on voltage).
	• Indicates:
	  • Defective evaporator fan motor relay
	  • Defective or open fan motor internal over temperature protection switch
	  • Defective volt or amp meter on relay board
	  • Incorrect motor or motor connections
		• Open evaporator door and make sure all fans rotate freely.
		• Enter Manual Function Test and start evaporator fans on high speed. Make sure all fans start on high speed. If a motor does not start and is very hot, wait 10 minutes for internal over temperature switch to close.
		• Check fan motor volts and amps.
		• Check volt and ampere meter.

14**	**Evaporator Fan Low Speed Current Too High (Check Alarm)**
	• Occurs during pre-trip (PTI) or function test only.
	• Evaporator fan power consumption is 25% above expected current draw (above 1.0 to 2.0 amps, depending on voltage).
	• Indicates:
	  • Defective or stuck evaporator fan motor
	  • Incorrect motor or motor connections
	  • Motor high and low speed connection are interchanged
	  • Defective volt or amp meter on relay board
		• Open evaporator door and make sure all fans rotate freely.
		• Enter Manual Function Test and start evaporator fans on Low speed. Make sure all fans start on low speed. Check fan motor volts and amps.
		• Check volt and ampere meter.

15**	**Evaporator Fan Low Speed Current Too Low (Check Alarm)**
	• Occurs during pre-trip (PTI) or function test only.
	• When the evaporator fan power consumption is 25% below expected current draw (below 0.6 to 1.2 amps, depending on voltage).
	• Indicates:
	  • Defective evaporator fan motor relay
	  • Defective or open fan motor internal over temperature protection switch
	  • Defective volt or amp meter on relay board
	  • Incorrect motor or motor connections
		• Open evaporator door and make sure all fans rotate freely.
		• Enter Manual Function Test and start evaporator fans on low speed. Make sure all fans start on low speed. If a motor does not start and is very hot, wait 10 minutes for internal over temperature switch to close.
		• Check fan motor volts and amps.
		• Check volt and ampere meter.

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

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

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

17*	**Condenser Fan Current Too Low (Check Alarm)**
	• Occurs during pre-trip (PTI) or function test only.
	• Condenser fan power consumption is 25% below expected current draw (below 0.5 to 0.7 amps, depending on voltage).
	• Indicates:
	  • Defective condenser fan motor relay
	  • Defective or open fan motor internal over temperature protection switch
	  • Defective volt or amp meter on relay board
		• Enter Manual Function Test and start condenser fan. Make sure the fan starts. Check fan motor volts and amps.
		• Check power supply volts and amps.
		• Check volt and ampere meter.

18	**Power Supply Phase Error (Alarm)**
	• One or more frequency inputs are missing for more than 20 seconds.
	• Indicates:
	  • One phase on power line is missing
	  • Defective fuse on relay board
	  • Defective digital inputs on relay board
	  • Defective controller
		• Enter Data menu and view voltage reading on each phase.
		• Check all fuses. Check cable No. 1 on relay board.
		• Check cable No. 1 between controller and relay board.
		• Replace relay board. Check voltage reading on each phase.

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

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

19	**Temperature Too Far From Setpoint (Check Alarm)**
	• After 75 minutes of operation, supply or return air temperature is not in-range and does not approach setpoint within preset pull-down rate.
	• Indicates:
	  • Ice or frost on evaporator coil
	  • Low refrigerant charge
	  • Air exchange vent open too much
	  • Container air leakage (doors open)
		• Press **SUP/RET** key to check supply and return air sensor temperatures. Compare temperatures to evaluate unit cooling capacity and performance.
		• Temperature difference should be 4 C to 6 C.
		• Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary.
		• Check refrigerant charge
		NOTE: This alarm can be activated if the supply or return air temperature varies, even if the mean temperature does approach setpoint.

20	**Defrost Time Too Long (Check Alarm)**
	• Heat signal has been on for more than 90 minutes on 60 Hz power during Defrost (120 minutes on 50 Hz power).
	• Indicates:
	  • Low power supply voltage
	  • Defective heater elements
	  • Defective evaporator high temperature protection switch
	  • Defective heat relay
	  • 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.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

22	**Capacity Test 1 Error (Check Alarm)**
	• Occurs during pre-trip (PTI) test only.
	• Difference between supply and return air temperature is too small with low 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
		• Enter Manual Function Test and start evaporator fans on low speed. Then select Sensor Checks test and operate fans 2 to 5 minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (evaporator coil may be 0.5 C [1.0 F] lower due to fan motor heat).
		NOTE: This sensor check does not detect air leakage around the sensor cables.
		• Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on low speed.
		• Check the sensor connections.
		• Enter Manual Function Test menu. Start and check current draw of the following components separately and together: compressor, compressor 100%, condenser fan and evaporator fans (low). 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.

23	**Capacity Test 2 Error (Check Alarm)**
	• Occurs during pre-trip (PTI) test only.
	• Difference between supply and return air temperature is too small with high speed evaporator fans (less than approximately 3.0 C (5.4 F); or temperature difference is less than in test P1.15.
	• When the return air temperature does not reach 0 C (32 F) within preset time.
	• Indicates:
	  • Incorrect location of supply or return air sensor
	  • Air leakage at supply, return or defrost (evaporator coil) sensor cable
	  • Defective supply or return air sensor
	  • Interchanged sensor connections
	  • Incorrect evaporator fan rotation or low speed operation
	  • Incorrect refrigeration system operation
	  • Container/side panels defective, damaged or leaking
		• Enter Manual Function Test and start evaporator fans on high speed. Then select Sensor Checks test and operate fans 2 to 5 minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (evaporator coil may be 0.5 C [1.0 F] lower due to fan motor heat).
		NOTE: This sensor check does not detect air leakage around the sensor cables.
		• 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, compressor 100%, condenser fan and evaporator fans (high). Check discharge and suction pressure readings. Also check the refrigerant charge.
		NOTE: Alarm can be activated in ambient temperatures below -10 C (14 F), even under normal conditions.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

24	**Capacity Test 3 Error (Check Alarm)**
	• Occurs during pre-trip (PTI) test only.
	• Difference between supply and return air temperature is too high with Stepper valve almost closed and high speed evaporator fans (more than 1.5 C [2.7 F]).
	• Indicates:
	  • Defective Stepper valve
	  • Incorrect location of supply or return air sensor
	  • Defective supply or return air sensor
	  • Expansion valve open too much
	  • Incorrect refrigeration system operation
	  • Container/side panels defective, damaged or leaking
		• Enter Manual Function Test and start the following components: Condenser fan, evaporator fan (high), compressor and compressor 25%. Check to be sure the Stepper valve closes.
		• Check the supply and return air sensor connections.
		• Check the supply and return air sensor calibration.
		• Check expansion valve superheat setting.

25	**Evaporator Temperature Test Error (Check Alarm)**
	• Occurs during pre-trip (PTI) test only.
	• Evaporator coil temperature is too high with no evaporator fans running (above about -15 C [+5 F]).
	• Indicates:
	  • Evaporator coil sensor is not in contact with evaporator coil
	  • Return and evaporator coil sensor connections are interchanged
	  • Expansion valve does not open enough or opens too much
		• Check evaporator coil sensor location.
		• Check evaporator coil sensor and return air sensor connections.
		• Check expansion valve superheat setting.

27	**Heat Capacity Test Error (Check Alarm)**
	• Occurs during pre-trip (PTI) test only.
	• Difference between supply and return air temperature is too small with high speed evaporator fans (less than 0.4 C [0.7 F]).
	• Indicates:
	  • Incorrect location of supply or return air sensor
	  • Air leakage at supply, return or evaporator coil sensor cable
	  • Defective supply or return air sensor
	  • Interchanged sensor connections
	  • Defective heater elements
	  • Incorrect evaporator fan rotation or high speed operation
	  • Container/side panels defective, damaged or leaking
		• Enter Manual Function Test and start evaporator fans on high speed. Then select Sensor Checks test and operate fans 2 to 5 minutes. Check supply, return and evaporator coil (defrost) sensor temperatures. Sensor readings should be the same (evaporator coil may be 0.5 C [1.0 F] lower due to fan motor heat).
		NOTE: This sensor check does not detect air leakage around the sensor cables.
		• Open evaporator door and inspect evaporator fan rotation. Make sure fans are rotating correctly on high speed.
		• Check the sensor connections.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

28	**Stepper Motor Valve Error**
	• Stepper motor valve current too low or too high
	• Indicates:
	  • Short circuit to valve
	  • Faulty stepper motor valve or circuit
		• Check the wiring to stepper motor valve using unit wiring diagrams and a digital multimeter.
		  • Disconnect stepper motor valve leads and check circuit resistance. Resistance should be 75 ± 7.5 ohms at 24 C (75 F) between red/green and white/yellow wire leads.
		  • Be sure to maintain the correct polarity or valve will not work.

29	**Liquid Injection Valve Error (Pre-trip) (Check Alarm)** • Occurs during function or pre-trip (PTI) test only. • Indicates: • Faulty bypass valve or circuit	• Energize and de-energize the bypass valve using “Injection Valve” in the Controller Manual Function Test submenu. Confirm by sound that the valve energizes and de-energizes. • If the valve does not operate, check the valve coil for continuity using a high quality multimeter. • Check the circuit wiring in plug J11 for continuity using a high quality multimeter and a wiring diagram.
30	**Bypass (Warm Gas) Valve Error (pre-trip) (Check Alarm)** • Occurs during function or pre-trip (PTI) test only. • Indicates: • Faulty bypass valve or circuit	• Energize and de-energize the bypass valve using “Bypass Valve” in the Controller Manual Function Test submenu. Confirm by sound that the valve energizes and de-energizes. • If the valve does not operate, check the valve coil for continuity using a high quality multimeter. • Check circuit wiring in plug J11 for continuity using a high quality multimeter and a wiring diagram.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

31	**Low Pressure Cutout Error (Check Alarm)**
	• Occurs any time.
	• Compressor does not stop during function or pre-trip (PTI) test.
	• Indicates:
	  • Low refrigerant charge
	  • Refrigeration system restriction at filter drier, stepper motor valve, or expansion valve
	  • Bypass (warm gas) valve will not open (energize)
	  • High refrigerant charge
	  • Defective low pressure cutout switch
		• Check discharge and suction pressure gauge readings:
		  • If refrigerant pressures are low, check for a restriction and leak check the refrigeration system.
		  • If refrigerant pressures are high, check for a high refrigerant charge (see below).
		• Check for a restriction:
		  • Check for frost on down stream side of the filter drier.
		  • Check for Alarm No. 28, stepper suction valve fail.
		  • 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.
		• Check the wiring to stepper motor valve using unit wiring diagrams and a digital multimeter.
		  • Disconnect stepper motor valve leads and check circuit resistance. Resistance should be 75 ± 7.5 ohms at 24 C (75 F) between red/green and white/yellow wire leads. Be sure to maintain correct polarity or valve will not work.
		• Check bypass valve circuit wiring in plug J11 for continuity using a high quality multimeter.
		• If the bypass valve does not operate, check valve coil for continuity using a high quality multimeter.
		• Check for high refrigerant charge: Operate the unit in Chill mode. Adjust setpoint to 3 C (5.4 F) below the ambient temperature. Operate unit until the sup-ply air temperature is close to setpoint temperature. Then check High Pressure Temperature and Condenser Temperature readings in the Data menu.
		• High pressure temperature should be 15 C (27 F) or more above the condenser temperature. If not, the system is probably over charged. Remove 0.25 kg (0.5 lb.) of refrigerant and repeat test. Continue until correct difference between high pressure temperature and condenser temperature is reached.
		• Continuity check low pressure cutout switch wiring using a high quality multimeter. Replace switch.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

32	**Condenser Temperature Sensor Open Circuit (Check Alarm)**
	• When the sensor circuit resistance is higher than 100,000 ohms.
	• When the temperature is below -70 C (-94 F).
	• Indicates:
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance between pins 7 and 8 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check cable No. 1 between controller and relay board.

33	**Condenser Temperature Sensor Short Circuit (Check Alarm)**
	• Sensor circuit resistance is lower than 200 ohms.
	• Temperature is above 80 C (176 F).
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller.
		• Check sensor resistance between pins 7 and 8 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check cable No. 1 between controller and relay board.

34	**Ambient Air Sensor Open Circuit (Check Alarm)**
	• Sensor circuit resistance is higher than 100,000 ohms.
	• Temperature is below -70 C (-94 F).
	• Indicates:
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance between pins 13 and 14 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check cable No. 1 between controller and relay board.

35	**Ambient Air Sensor Short Circuit (Check Alarm)**
	• Sensor circuit resistance is lower than 200 ohms.
	• Temperature is above 80 C (176 F).
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance between pins 13 and 14 on plug J15. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check cable No. 1 between controller and relay board.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

36	**Total Current Too High (Alarm)**
	• When the unit or component current draw is 25% above expected amps for 4 minutes.
	• Indicates:
	  • Stepper valve malfunction
	  • Compressor, evaporator fan motor, condenser fan motor or heater current too high
	  • Defective volt or amp meter on relay board
	  • 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.

37	**Total Current Too Low (Alarm)**
	• Compressor Start-up: Unit or component current draw is 50% below expected amps for 4 minutes.
	• Indicates:
	  • Defective or open fuse CB 7A
	  • Defective or open high pressure cutout switch
	  • Defective evaporator high temperature protection 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 LCD 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.

41	**Supply Air Temperature Too High (Check Alarm)**
	• During Chill or Frozen Mode: Supply air temperature is too high compared to return air temperature under operating conditions.
	• Indicates:
	  • Low refrigerant charge
	  • Incorrect connection or location of supply or return air sensor
	  • Air leakage at supply air sensor cable
	  • Ice or frost on evaporator coil
	  • Incorrect evaporator fan operation
		• Check discharge and suction pressure gauge readings and refrigerant charge.
		• Check for sensor or evaporator fan alarm codes.
		• Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan motor rotation and operation.
		• Check supply and return sensor connections and locations.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

42	**Supply Air Temperature Too Low (Check Alarm)**
	• During Chill or Frozen Mode: Supply air temperature is too low compared to return air temperature under operating conditions.
	• Indicates:
	  • Ice or frost on evaporator coil
	  • Low heating capacity
	  • Incorrect evaporator fan operation
	  • Incorrect connection or location of supply or return air sensors
		• Check for sensor or evaporator fan alarm codes.
		• Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan motor rotation and operation.
		• Check supply and return sensor connections and locations.

43	**Return Air Temperature Too High (Check Alarm)**
	• During Defrost: Return air temperature increases above 40 C (104 F).
	• Indicates:
	  • Defective return or evaporator coil sensor
	  • Return and evaporator coil sensor connections are reversed
		• Check for sensor alarm codes.
		• Check supply and return sensor connections and locations.

45	**Evaporator Coil Temperature Too High (Check Alarm)**
	• During Chill or Frozen Mode: Evaporator coil temperature is too high compared to return air temperature under operating conditions.
	• Indicates:
	  • Low refrigerant charge.
	  • Defective evaporator coil or return air sensor
	  • Incorrect connection or location of evaporator coil or return air sensor
		• Check for sensor alarm codes.
		• Check discharge and suction pressure gauge readings and check refrigerant charge.
		• Check evaporator coil and return air sensor connections and locations.

46	**Evaporator Coil Temperature Too Low (Check Alarm)**
	• During Chill or Frozen Mode: Evaporator coil temperature is too low compared to return air temperature under actual operating conditions.
	• Controller initiates defrost if no recent defrost.
	• Indicates:
	  • Airflow is blocked in the container
	  • Evaporator fans do not operate
	  • Fresh air exchange vent open too much on frozen load
	  • Defective evaporator coil or return air sensor
		• Check for sensor or evaporator fan alarm codes.
		• Open evaporator door. Inspect coil for ice or frost and initiate manual defrost if necessary. Check for correct evaporator fan rotation and operation.
		• Inspect return air grille and cargo load. Remove any debris or cargo from blocking return air grille.
		• At setpoints below 5 C (41 F), maximum air vent setting is not allowed.
		• Check evaporator coil and return air sensor connections and locations.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

52	**Probe Error (Check Alarm)**
	• Occurs during pre-trip (PTI) test or probe test failed in Chilled mode.
	• Temperature difference between return air and evaporator coil sensors is too high (1.5 C [2.7 F] difference maximum)
	• Temperature difference between return air and supply air sensors is too high (0.8 C [1.5 F] difference maximum)
	• Temperature difference between LH supply and RH supply sensors is too high (0.5 C [1.0 F] difference maximum)
	• Indicates:
	  • Incorrect temperature reading on one sensor
	  • Supply air sensor not placed in airflow stream
		• Check sensor connections. Check sensor resistance of each sensor. Resistance must be 2,000 ohms at 25 C (77 F).
		• Check left hand and right hand supply air sensor locations.
		NOTE: Code 52 has been replaced by codes 115, 116, 117 in the current revision of the controller software. If code 52 appears on the controller screen, the controller software is not current and need updating.

53	**High Pressure Cutout Switch Off Error (Check Alarm)**
	• Occurs during pre-trip (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%, compressor and evaporator fans (high). Discharge pressure should increase and compressor should stop at 2250 kPa, 22.5 bar, 326 psig (high pressure cutout switch opens).

54	**High Pressure Cutout Switch On Error (Check Alarm)**
	• Occurs during pre-trip (PTI) test only.
	• Compressor does not start within normal time during high pressure cutout switch test.
	• Indicates:
	  • High pressure cutout switch did not respond to pressure change within 5 seconds
	  • Air in refrigeration system
	  • Defective high pressure cutout switch
		• Check discharge and suction pressure gauge readings.
		• Enter Manual Function Test menu. Start the following components together: compressor 100%, 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)

Alarm Codes, Descriptions and Corrective Actions (Continued)

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

57	**AFAM Control Module or Motor Error (Check Alarm)**
	• Controller is unable to adjust vent door to desired position.
	• Indicates:
	  • Frozen or stuck vent door
	  • Defective linkage
	  • Defective control module
	  • Open circuit to control module or motor
	  • Defective motor
		• Visually inspect the vent door and linkage for ice or obstruction. Check for proper linkage adjustment.
		• Check wiring connections to the AFAM circuit board for continuity using a high quality multimeter.
		• Check motor winding for continuity using a high quality multimeter.

58	**Phase Sensor Error (Check Alarm)**
	• Occurs during pre-trip (PTI) or function test only.
	• During Phase Sensor Test, amperage difference between correct and wrong condenser fan rotation is more than 0.2 amps.
	• Indicates:
	  • Defective phase relay
	  • Defective relay board
	  • Defective relay board cable No. 2
		• Start a Function Test. During step F1.05, check whether the phase relays on relay board receive a signal (LED energizes). Verify that the relays respond and shift to reverse phase.

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

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

60	**Humidity Sensor Error (Check Alarm)**
	• Occurs during pre-trip (PTI) test only.
	• Relative humidity reading is not between 20% and 95%.
	• Indicates:
	  • Sensor disconnected
	  • Wrong controller software configuration
	  • Defective sensor
		• Check sensor connections.
		• Check controller configuration for correct humidity setting.
		• Replace sensor.

68	**AFAM Gas Analyzer Error (Check Alarm)**
	• Gas analyzer circuit resistance is too high or too low.
	• Indicates:
	  • Sensor disconnected
	  • Wrong controller software configuration
	  • Short circuit to sensor
	  • Defective sensor
		• Check sensor connections.
		• Check controller configuration for correct AFAM setting.
		• Replace sensor.

69	**AFAM+ Gas Analyzer Error (Check Alarm)** • Indicates problem with sensor	• Check sensor connections • Check controller configuration for correct AFAM setting. • Replace sensor.

97	**Compressor Sensor Open Circuit (Check Alarm)**
	• When the sensor circuit resistance is higher than 10,000,000 ohms.
	• Temperature is below -30 C (-22 F).
	• Indicates:
	  • Open circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance between pins 9 and 10 on plug J15. Resistance must be 100,000 ohms at 25 C (77 F).
		• Check cable No. 1 between controller and relay board.
		NOTE: Unit will operate normally without compressor sensor. However, controller compressor high temperature protection is not active.

98	**Compressor Sensor Short Circuit (Check Alarm)**
	• Sensor circuit resistance lower than 200 ohms.
	• Temperature above 180 C (356 F).
	• Indicates:
	  • Short circuit to sensor
	  • Defective or wrong sensor
	  • Defective relay board
	  • Defective cable No. 1
	  • Defective controller
		• Check sensor resistance between pins 9 and 10 on plug J15. Resistance must be 100,000 ohms at 25 C (77 F).
		• Check cable No. 1 between controller and relay board.

Alarm Codes, Descriptions and Corrective Actions (Continued)

Code	Description	Corrective Action

99	**USDA 1 Sensor Open Circuit (Check Alarm)**
	• Occurs during pre-trip (PTI) test only.
	• Container ID starts with MAE, MSF or MWC.
	• Temperature below -50 C (-58 F).
	• Indicates:
	  • All 3 USDA sensors are missing
	  • Defective cable No. 3
		• Check USDA sensors and sensor connections.
		• Check cable No. 3 between controller and relay board.

112	**Zero Current Too High (Check Alarm)** • Ground (zero current) circuit is 30 milliamps. • Indicates: • Defective motor or heater insulation to ground	• Enter Manual Function Test menu and test (operate) each motor and heater separately. Note when alarm occurs.
115	**Probe Error (Check Alarm)** • Occurs during pre-trip (PTI) test or probe test failed in Chilled mode. • Temperature difference between return air and evaporator coil sensors is too high (1.5 C [2.7 F] difference maximum) •	• Check sensor connections. Check sensor resistance of each sensor. Resistance must be 2,000 ohms at 25 C (77 F).
116	**Probe Error (Check Alarm)** • Occurs during pre-trip (PTI) test or probe test failed in Chilled mode. • Temperature difference between return air and supply air sensors is too high (0.8 C [1.5 F] difference maximum)	• Check sensor connections. Check sensor resistance of each sensor. Resistance must be 2,000 ohms at 25 C (77 F).
117	**Probe Error (Check Alarm)** • Occurs during pre-trip (PTI) test or probe test failed in Chilled mode. • Temperature difference between LH supply and RH supply sensors is too high (0.5 C [1.0 F] difference maximum)	• Check sensor connections. Check sensor resistance of each sensor. Resistance must be 2,000 ohms at 25 C (77 F). • Check left hand and right hand supply air sensor locations.
118	**High Refrigerant Level (Check Alarm)** • Detects overcharge of refrigerant	• Correct overcharged refrigerant level

High Pressure Cutout Switch

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

- Compressor *stops* immediately. Evaporator and condenser fans continue normal operation.
- Controller determines that a high pressure cutout switch or compressor motor internal overload protector is open when the unit current draw during compressor operation is normal and then decreases by 7 amps for more than 3 seconds.
- After 1 minute, controller LCD display shows a High Pressure Cutout message:
  - "HIGH PRESSURE CUTOUT CHECK CONDENSER PROBE": Water pressure switch is open and the condenser temperature is low.
  - "HIGH PRESSURE CUTOUT CHECK CONDENSER FAN": Water pressure switch is open and the condenser temperature is high.
  - "HIGH PRESSURE CUTOUT CHECK WATER COOLING": Water pressure switch is closed.
- The controller continues to call for cooling so the compressor will restart when the overload condition is corrected (switch resets) if power is available.
- If the switch remains open for 5 minutes, the controller also turns on the Alarm LED and records Alarm 37 (Total Power Consumption Too Low).

High Pressure Cutout Switch:

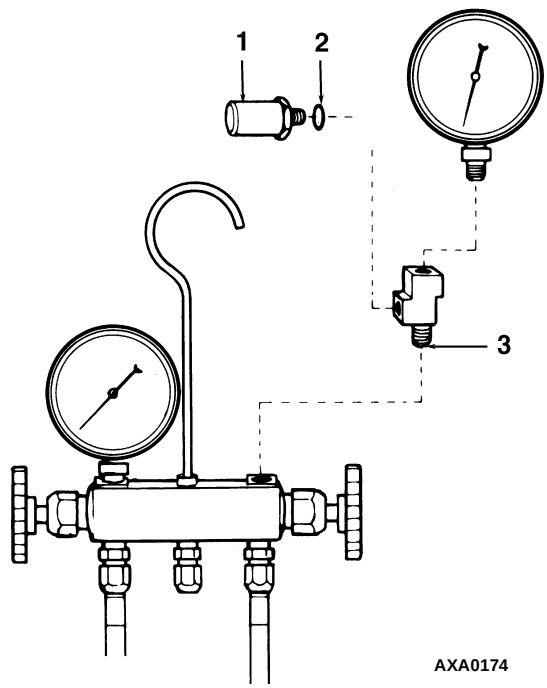
Opens: 3243 ± 7 kPa, 32.43 ± 0.48 bar, 470 ± 7 psig.

Closes: 2758 kPa, 27.58 bar, 400 psig.

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

High Pressure Cutout Manifold

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



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

Figure 36: High Pressure Cutout Manifold

3. Raise the discharge pressure of the compressor by blocking the condenser coil airflow. Temporarily cover the compressor compartment, control box and power cord storage compartment with cardboard to reduce condenser coil airflow. This should increase the discharge pressure enough to cause the switch to open. When the switch opens:

- The compressor and evaporator fans should *stop* immediately.

  NOTE: The discharge pressure should never be allowed to exceed 2,760 kPa, 27.6 bar, 400 psig.

4. Be sure to remove the cardboard installed in step 3.

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

Low Pressure Cutout Switch

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

- Compressor *stops* immediately.
- Evaporator and condenser fans continue normal operation.
- Compressor will restart if the low refrigerant condition is corrected (switch closes) as long as power is available. The low pressure switch resets (closes) when the pressure increases to 28 to 48 kPa, 0.28 to 0.48 bar, 4 to 7 psig (48 to 90 kPa, 0.48 to 0.90 bar, 7 to 13 psig before 1/2001).

Low Pressure Cutout Switch:

Opens: -17 to -37 kPa, -0.17 to -0.37 bar, 5 to 11 in. Hg vacuum (+21 to -21 kPa, +0.21 to -0.21 bar, 3 psig to 6 in. Hg vacuum before 1/2001)

Closes: 28 to 48 kPa, 0.28 to 0.48 bar, 4 to 7 psig (48 to 90 kPa, 0.48 to 0.90 bar, 7 to 13 psig before 1/2001)

Condenser Fan and Evaporator Fan Rotation

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

Condenser Fan

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.

Evaporator Fans

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

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

If an evaporator fans rotate 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.

Electric Heaters

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:

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

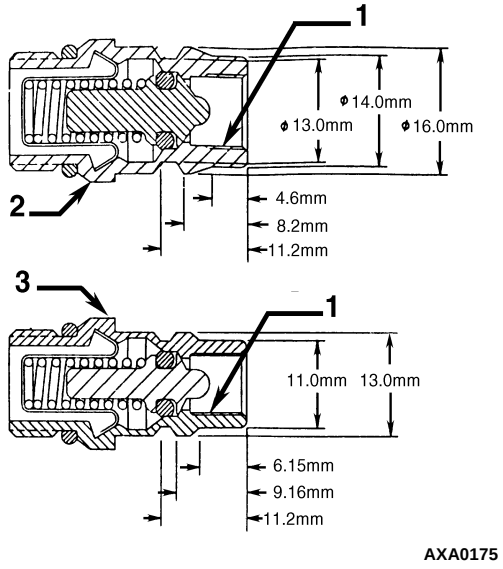
NOTE: When repairing heater connections, protect the new connections from the ingress of moisture with heat shrink tubing. All heaters should be secured to prevent contact with sharp metal edges.

Refrigeration Maintenance and Service Operations

NOTE: 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.

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

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



AXA0175

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

Figure 37: Service Fittings Specifications

Service Tools

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

Unit Service Fittings

Special fittings are used on R-404A systems to prevent mixing of non-HFC refrigerants in R-134A units. These fittings are located in three places on CRR refrigeration systems:

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

Leak Detection

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

Gauge Manifold Set

A new gauge manifold set (refer to Tool Catalog) should be dedicated for use with R-134a only. Gauge hoses should also be dedicated to R-404A.

Vacuum Pump

A two-stage (refer to Tool Catalog), three-stage or five-stage pump is recommended for evacuation. Purging the system with dry nitrogen is recommended before evacuation. Because residual refrigerant may be present in used vacuum pumps, a new vacuum pump should be used and dedicated strictly as an R-134a 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.

System Cleanup

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

Refrigerant Recovery

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

Compressor 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.

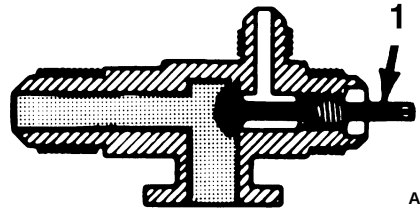
Compressor Discharge and Suction Service Valves

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

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

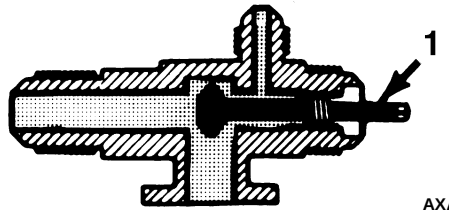
- Back Seated: Normal operation position.
- Open to Service Port: Position for servicing.
- Front Seated: To check or remove compressor.

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



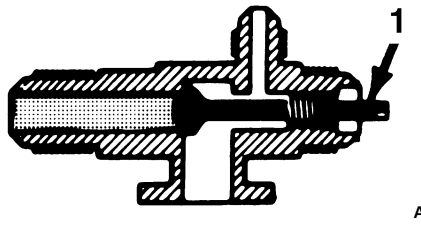
1.	Full Counterclockwise

Figure 38: Service Valve Back Seated



1.	1/2 Turn in

Figure 39: Service Valve Open to Port

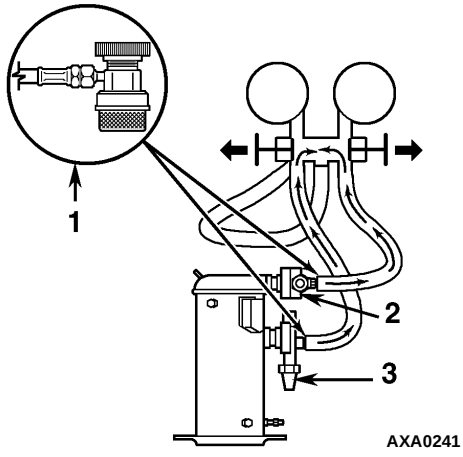


1.	Full Clockwise

Figure 40: Service Valve Front Seated

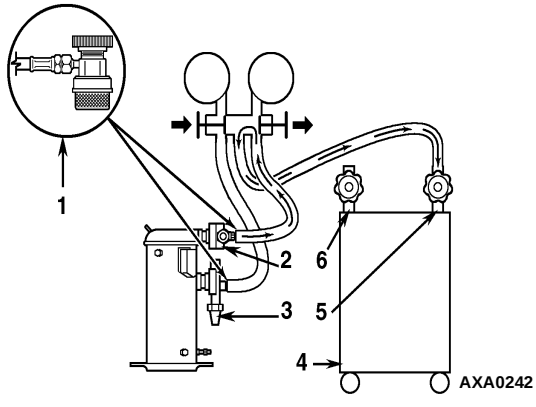
Gauge Manifold Valve Positions

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



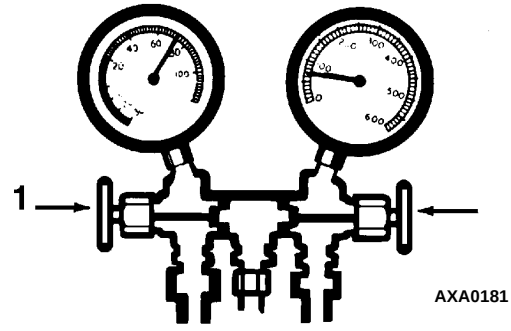
1.	Quick Disconnect Access Valve
2.	Discharge Service Valve (DSV)
3.	Suction Service Valve (SSV)

Figure 41: Balancing the Pressure



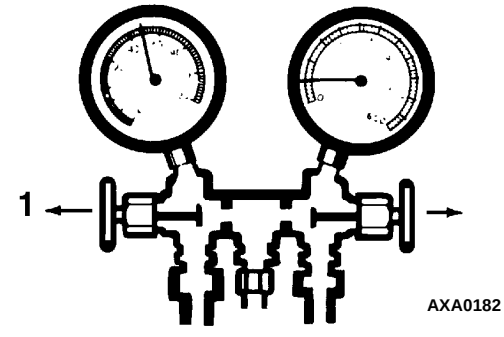
1.	Quick Disconnect Access Valve
2.	Discharge Service Valve (DSV)
3.	Suction Service Valve (SSV)
4.	Reclaimer
5.	In
6.	Out

Figure 42: Removing Refrigerant



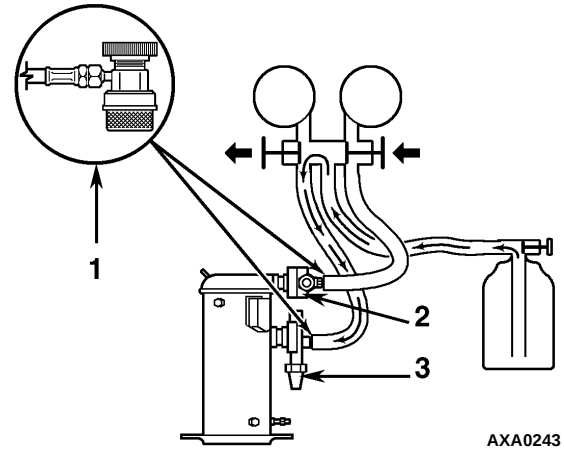
1.	Close Hand Valves

Figure 43: Gauge Manifold Closed to Center Port



1.	Open Hand Valves

Figure 44: Gauge Manifold Open to Center Port



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

Figure 45: Charging the System

Gauge Manifold Set (With Low Loss Fittings) Attachment And Purging

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

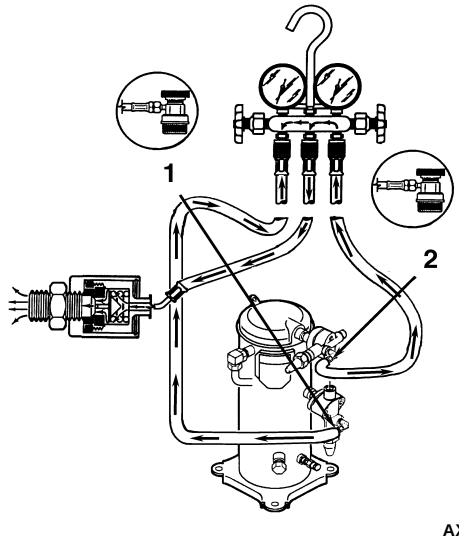
NOTE: When any of these devices are used, carefully check to ensure that access connections are functioning properly.

Gauge Manifold Set Installation

NOTE: The following procedure purges the gauge hoses and 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. Then attach low hose (compound gauge) to the suction line valve port.
5. With 69 kPa, 0.69 bar, 10 psig or greater pressure in the low side (unit operating on Cool), open the suction service manifold hand valve fully. Then 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. Then rotate discharge fitting hand wheel clockwise to open (depress) discharge line port valve to the high hose.
10. Slowly screw a 1/2 inch ACME fitting into the manifold's service (center) line to purge the high and service hoses. Remove ACME fitting after purging.
11. Close discharge service manifold hand valve fully to center port. You are now ready to use the gauge manifold to check system pressures or perform *most* service procedures.

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



1.	Suction Connection
2.	Discharge Connection

Figure 46: Purging Gauge Manifold

Gauge Manifold Set Removal

NOTE: To ensure minimum refrigerant release to the atmosphere, THE SYSTEM SHOULD BE RUNNING. 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%" test from the Manual Function Test menu of the controller.

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

3. Rotate the suction hose coupler hand wheel counterclockwise to withdraw the fitting stem from the suction line port valve. Then turn the unit off.
4. Remove the gauge lines from the suction and discharge service fittings and cap the service ports.
5. Secure all manifold lines to manifold hose anchors when the manifold is not in use.

Checking Compressor Oil

CAUTION: Use ONLY Polyol Ester based refrigeration compressor oil, refer to Tool Catalog.

CAUTION: DO NOT mix Polyol Ester based and standard synthetic compressor oils.

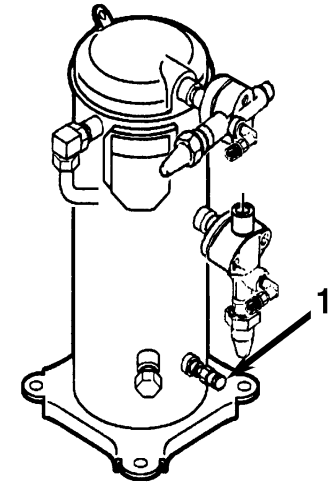
CAUTION: Rubber gloves are recommended when handling Ester based compressor oil.

CAUTION: Keep Polyol Ester based compressor oil in tightly sealed containers. If Ester based oil becomes contaminated with moisture or standard oils, dispose of properly — DO NOT USE!

The compressor oil should be checked during pre-trip inspections and when there is evidence of oil loss (oil leaks) or when components in the refrigeration system have been removed for service or replacement.

To Check Compressor Oil Level with an Ambient Air Temperature Above 10 C (50 F)

Install gauge manifold on the compressor. Operate the unit on Cool with a 138 kPa, 1.38 bar, 20 psig minimum suction pressure and a 689 kPa, 6.89 bar, 100 psig discharge pressure for 15 minutes or more. After the unit has maintained the above conditions for 15 minutes, observe the compressor oil level. The oil should be 1/2 to 3/4 up in the sight glass.



1.	Add and Remove Compressor Oil at the Compressor Oil Fitting

Figure 47: Adjusting Compressor Oil Level

To Check Compressor Oil Level with an Ambient Air Temperature Below 10 C (50 F)

With the evaporator temperature below 10 C (50 F), initiate a Manual Defrost to operate the unit through a complete Defrost cycle. After completing the defrost cycle, operate the unit on Cool for a few minutes. After 2 to 3 minutes, observe the oil level. The oil should be 1/2 to 3/4 up in the sight glass.

If the container is empty, you can operate the unit on the heat cycle instead of the defrost cycle.

Adding Compressor Oil

1. With the unit off, remove the cap from oil pressure fitting.
2. Use a commercial hand pump, force oil in through the oil pressure fitting. Slowly add oil. Add Polyol Ester oil only! Refer to Tool Catalog.
3. When the compressor oil sight glass is 1/2 to 3/4 full, remove hand pump and replace the cap on the oil pressure.
4. Start and operate the unit on Cool using the Capacity 100% test from the manual Function Test menu of the controller. Recheck the oil level and refrigerant charge level before returning the unit to service.

Removing Excess Compressor Oil

1. Install an access valve actuator on the oil pressure fitting.
2. Operate the unit on Cool using the Capacity 100% test from the manual Function Test menu of the controller. Remove oil while watching the level in the compressor sight glass.

   NOTE: Heavy foaming of the oil as it leaves the compressor may indicate an excess of refrigerant in the oil. Remove the access valve actuator and operate the system for 15 minutes to ensure warm sump. Then recheck the oil level.
3. When the compressor oil sight glass is 1/2 to 3/4 full, remove hand pump and replace the cap on the oil pressure.
4. Operate the unit and recheck the oil level before returning the unit to service.

Refrigerant Charge

NOTE: CSR units do not have sight glasses installed in the refrigeration system. Therefore, the refrigerant charge level can not be visually inspected

Perform a controller pre-trip test to determine that a the unit contains an adequate charge of refrigerant for cooling. If the unit passes the pre-trip test, the refrigerant charge is OK.

A pre-trip test should be performed during pre-trip 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.

NOTE: See "Receiver Tank Sight Glass" under "Unit Instruments" in the Operating Instructions chapter for information about checking the moisture indicator in the sight glass.

Unit Refrigerant Charge:

- CSR20SL: 3.5Kg (7.7 lb.) R-404A (Standard Receiver).
- CSR40SL and CSR40: 3.6Kg (8.0 lb.) R-404A (Standard Receiver).
- Water-Cooled Condenser-Receiver Tank Option: 1.0 Kg (2.2 lb.) Additional R-404A

NOTE: Inspect the unit for refrigerant leaks with a reliable leak detector if the unit is suspected of being low on R-404A charge.

CAUTION: When adding R-404A to the unit, be careful not to OVERCHARGE the unit.

Refrigerant Leak Test Procedure

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 Attachment and Purging" for proper procedures).

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

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

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

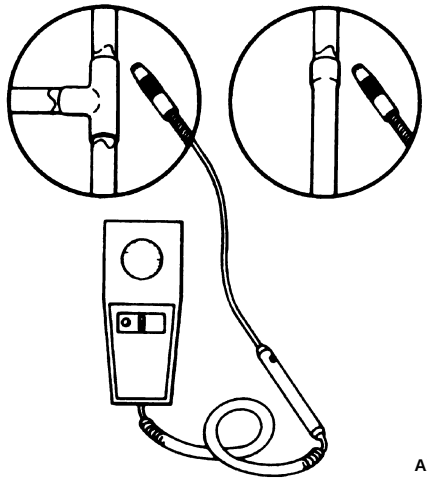


Figure 48: Test for Refrigerant Leaks

Using Pressurized Nitrogen

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

Safety Precautions

Observe the proper handling of cylinders:

1. Always keep protective cap on cylinder when not in use.
2. Secure cylinder in proper storage area or fastened to cart.
3. *Do not* expose to excessive heat or direct sun light.
4. *Do not* drop, dent, or damage cylinder.
5. 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.
6. Open valve slowly; use regulators and safety valves that are in good working order.
7. The regulator should have two gauges; one to read tank pressure, the other to read line pressure. Properly maintained equipment will allow leak testing, purging, or dehydration to be done safely.

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

Dehydration, pressure testing, purging and soldering can be accomplished with the use of dry nitrogen (N_2). The proper equipment and application of equipment is of greatest importance.

Procedure

1. Attach gauge manifold set (refer to “Gauge Manifold Set Attachment and Purging” for proper procedure for connecting to compressor).
2. Close both hand valves on the gauge manifold (front seated).
3. Connect charging hose to a source of nitrogen. Adjust pressure regulator to the proper pressure for the required procedure.
4. Purge system high side to low side.

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.

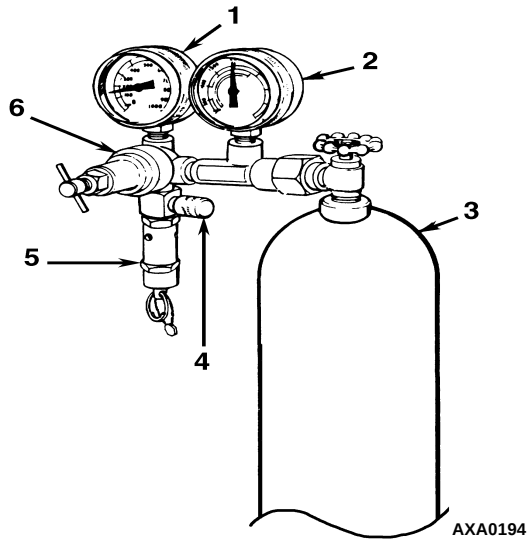
Refrigerant Recovery

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

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

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

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



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

Figure 49: Typical Pressurized Gas Bottle with Pressure Regulator and Gauges

Vapor Recovery

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

Evacuation and Cleanup of the Refrigeration System

Whenever contaminants have entered the system, a thorough clean up is required to prevent damage or loss of compressor.

It is well known by the refrigeration service industry that the purpose of evacuation is to remove moisture and air from the refrigeration system before charging with new refrigerant after a system has been opened. 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.

We know that the presence of moisture, oxygen, and heat under certain conditions can result in many forms of damage. Corrosion, sludge, copper plating, oil breakdown, carbon formation, and eventual compressor failure can be caused by these contaminants.

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.

Compressor Oil Color Code

- Black Oil — indicates carbonization caused by air in the system.
- Brown Oil — indicates copper plating caused by moisture in the system.
- Gray or Metallic Oil — indicates bearing wear or piston scoring.

NOTE: If the compressor oil is discolored, perform a compressor oil acid test (refer to Tool Catalog for oil test kit). If the compressor oil shows an acid condition, change the oil, the in-line oil filter, the filter drier and perform a refrigeration system cleanup.

Unit Preparation and Hookup

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

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

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

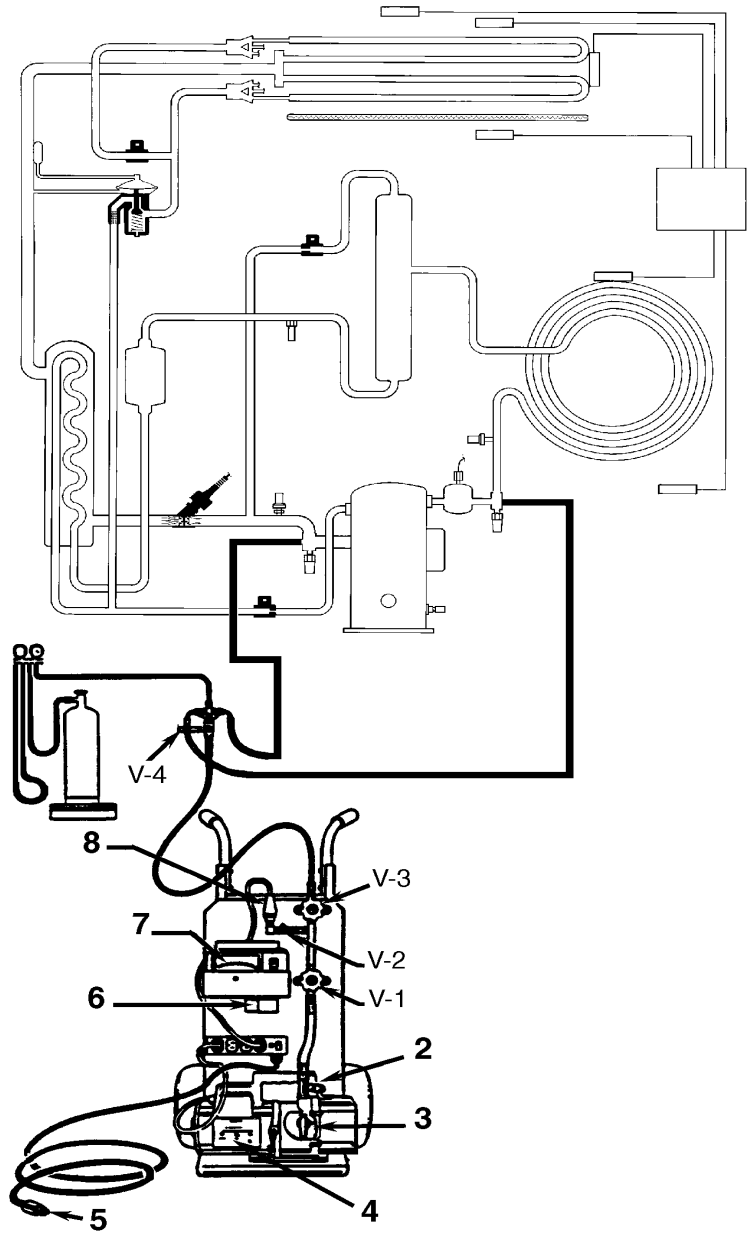
3. Confirm that the evacuation station functions properly and determine “Blank Off” pressure. The “Blank Off” pressure of the vacuum pump is the deepest vacuum that the vacuum pump can attain when isolated from the rest of the system. If a vacuum pump (isolated from a system) is started and the micron meter responds quickly by going to a deep vacuum, the operator can be confident that the pump and oil are in good condition. If the vacuum pump fails to reach a deep vacuum within 5 minutes, the operator should suspect the condition of the oil or the pump. It is recommended that the pump oil be changed first to see if the rate of reaching a deep vacuum is improved.
4. Connect the evacuation station and refrigerant tank with gauge manifold (optional) to the unit as indicated in figure “Evacuation Station and Unit Hook-up” on page 141. 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 or more hours.
    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.



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

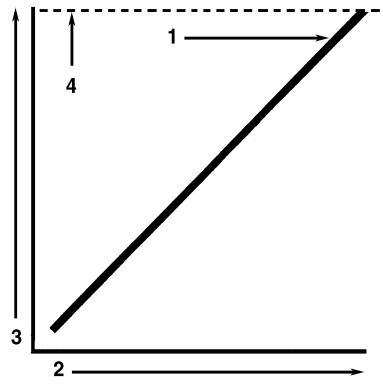
Figure 50: Evacuation Station and Unit Hook-up

2. If the vacuum level appears to stall above 500 microns, back seat the discharge service valve and observe the micron meter.
   - A drop in pressure indicates that the compressor oil is out-gassing and further evacuation is necessary.
   - An increase in pressure indicates that a leak exists or there is moisture in the system. Perform a pressure rise test and evaluate.
3. Close valve V1 when the desired vacuum level has been reached.
4. Wait five minutes and read the micron meter.
   - A system that is leak free and dry will remain below 2000 microns for 5 minutes.
   - A system that rises above 2000 microns but stabilizes below atmospheric pressure is probably contaminated with moisture or has refrigerant out-gassing from the compressor oil. Additional evacuation is required.
   - A system that continues to rise without stabilizing has a leak and must be repaired.
5. If the vacuum level remained below 2000 microns for 5 minutes, the unit is ready to charge. See “Charging the System with Refrigerant” on page 143.

Pressure Rise Test

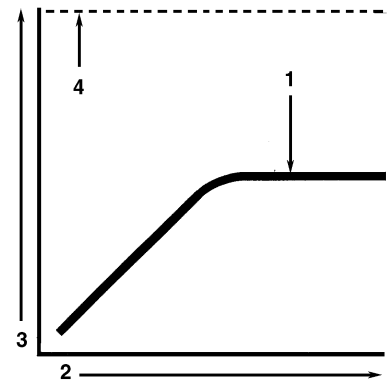
Evacuate the system and close valve V1. With valves V3 and V4 open, the pump is isolated and the system is held under a vacuum. If the micron meter rises, one of the following conditions exist:

- Leak: Watch the movement of the micron meter needle. If the needle continues to rise until it reaches atmospheric pressure, it is an indication that a leak exists somewhere in the system. When a leak is in a system, the vacuum will eventually stabilize at atmospheric pressure (see “Pressure Rise Test Evaluation” in this chapter).
- Moisture: When the needle indicates a rise and then stabilizes at a level below atmospheric pressure, it is an indication that the system is vacuum tight, but is still wet and requires additional dehydration and pumping time. See Figure 52 “Pressure Rise Levels Off After Evacuation Indicates Moisture in System”.



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

Figure 51: Constant Pressure Rise After Evacuation Indicates System Leak



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

Figure 52: Pressure Rise Levels Off After Evacuation Indicates Moisture in System

Factors Affecting the Speed of System Evacuation

It is almost impossible to state the exact amount of time required to evacuate any system. 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. To obtain optimum pumping speed, keep hoses as short as possible and as large in diameter as possible. 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

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

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

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

Charging the System with Refrigerant

Unit Charging by weight (from an Evacuated Condition)

1. Close valve V4.
2. Open the gas ballast valve (located on top of the pump housing behind the handle).
3. Stop the vacuum pump.
4. The discharge valve remains mid-seated.
5. Connect the refrigerant tank with gauge manifold to the evacuation station (see “Evacuation Station and Unit Hookup” in this chapter).
6. Weigh the tank of refrigerant.
7. Check the unit data plate for the required weight of refrigerant charge then 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. With the unit off, open the gauge manifold hand valve and charge liquid refrigerant into the system.
10. 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 pre-trip test to verify correct refrigerant charge and unit operation.

Stepper Motor Valve Replacement

The stepper motor valve is used to control the flow of refrigerant to the compressor when the unit is operating in the Modulation mode. As the supply air temperature approaches setpoint, the controller sends an electrical signal to the stepper motor to close the valve a precise amount. This throttles the suction gas returning to the compressor and reduces cooling capacity.

Service of the stepper motor valve includes replacement of the complete valve.

Replacement

1. Remove the compressor compartment bracket.
2. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
3. Disconnect the unit from the three-phase power supply.
4. Unplug the motor wire harness.
5. Unsolder the compressor side stepper motor valve joints from the suction line. Unsolder and remove modulation valve.
6. Clean the tubes for soldering. Position the new valve in position in the suction line.
7. Solder both valve connections.

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

8. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
9. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
10. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
11. Plug the motor wire harness into the unit wire harness.
12. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
13. Perform a controller pre-trip test to verify system operation.

Compressor Replacement

Removal

1. Remove the compressor compartment bracket.
2. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
3. Remove discharge service valve, suction service valve, and liquid injection valve line from the compressor.
4. Remove the compressor discharge temperature sensor from the discharge valve manifold.
5. Disconnect the unit from the three-phase power supply.
6. Remove the three-phase electric power connection from the compressor.
7. Remove the compressor mounting tray bolts and nuts.
8. Slide the compressor from the unit.
9. Keep the compressor ports covered to prevent dust, dirt, etc., from falling into the compressor.
10. Drain and measure the compressor oil that remains in the compressor.

NOTE: The compressor oil must be removed from the compressor and measured so that the same amount of oil can be added before placing the new compressor or repaired compressor in the unit.

Installation

1. Add new compressor oil to the new compressor. Add an amount equal to the amount removed from the old compressor.

   CAUTION: Use ONLY Polyol Ester based refrigeration compressor oil (refer to Tool Catalog). Keep Polyol Ester based compressor oil in tightly sealed containers. If Ester based oil becomes contaminated with moisture or standard oils, dispose of properly—DO NOT USE!

2. Slide the compressor into the unit. Install mounting bolts, washers and nuts, and tighten.
3. Bolt the discharge and suction service valves to the compressor. Use a new gasket coated with compressor oil on the discharge valve.
4. Connect liquid injection line to compressor body.
5. Apply refrigerant locktite to the threads of the compressor discharge temperature sensor. Install the switches.
6. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
7. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
8. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
9. Connect three-phase electric power to the compressor.
10. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
11. Perform a controller pre-trip test to verify system operation. Check compressor oil level.

    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 added before placing the new compressor or repaired compressor in the unit.

Condenser Coil Replacement

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Remove the condenser fan grille, condenser fan blade and condenser fan shroud.
3. Remove the condenser coil support brackets from the coil.
4. Unsolder the coil inlet and liquid line connections.
5. Support the coil and unbolt the condenser coil mounting brackets. Slide the 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.

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

4. Pressurize the system and test for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
5. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
6. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
7. Replace the condenser coil support brackets, condenser fan shroud and condenser fan grille.
8. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
9. Perform a controller pre-trip test to verify system operation. Check compressor oil level.

Filter Drier/In-line Filter Replacement

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Place the new filter drier near the unit for immediate installation.
3. Using two wrenches, “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 to prevent twisting the tubing when the nuts are being loosened or tightened.
6. Pressurize the refrigeration system and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
7. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
8. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
9. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
10. Perform a controller pre-trip test to verify system operation.

Expansion Valve Replacement

NOTE: Because the feeler bulb is located in the evaporator section, complete replacement of the expansion valve can only be performed on an empty container. If the expansion valve fails on a loaded container, temporarily locate the feeler bulb on the suction line in the condenser section. Locate the feeler bulb as close to the evaporator section as possible. Remove the insulating tape from the suction line. Clamp the feeler bulb on the suction line. Then completely cover the feeler bulb and suction line with insulating tape.

Removal

1. Recover the refrigerant charge from the unit (see “Refrigerant Recovery” in this chapter).
2. Remove insulating tape and unclamp feeler bulb from the suction line in the condenser section. Note the position of the feeler bulb on the side of the suction line.
3. Remove insulating tape from expansion valve outlet line.
4. Heat and unsolder the equalizer line from expansion valve.
5. Heat and unsolder the liquid line inlet and outlet connections to expansion valve in condenser section.
6. Remove expansion valve from unit.

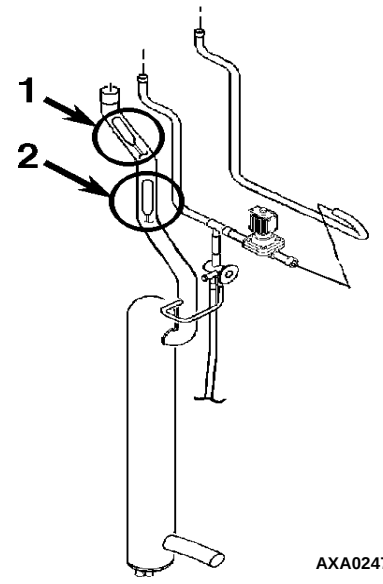
Installation

1. Clean the liquid lines and equalizer lines for soldering.
2. Place new expansion valve in position in liquid line.

3. Solder liquid line inlet and outlet line connections to valve.

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

4. Solder equalizer line to expansion valve.
5. Pressurize the refrigeration system and check for leaks (see "Refrigerant Leak Test Procedure" in this chapter).
6. If no leaks are found, recover the refrigerant used for the leak test (see "Refrigerant Recovery" in this chapter).
7. Evacuate the system (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
8. Clean the suction line to a bright polished condition. Install the feeler bulb of new power head in the feeler bulb clamp on the suction line. Locate bulb on the suction line in former position. The feeler bulb must make good contact with the suction line or operation will be faulty. Cover with insulating tape.
9. Cover expansion valve outlet line with insulating tape.
10. Recharge the unit with R-404A (see "Charging the System with Refrigerant" in this chapter).
11. Perform a controller pre-trip test to verify system operation and correct feeler bulb installation.



1.	Normal Feeler Bulb Location in Evaporator Section
2.	Temporary Feeler Bulb Location in Condenser Section when Replacing the Expansion Valve on a Loaded Container

Figure 53: Expansion Valve Feeler Bulb Location

Heat Exchanger Replacement

Removal

1. Recover the refrigerant charge from the unit (see "Refrigerant Recovery" in this chapter).
2. Remove the "U" mounting clamps that hold the heat exchanger assembly to the wall of the condenser section.
3. Unsolder the liquid inlet and outlet line connections.
4. Note position of feeler bulb on the side of the suction line. Remove tape and feeler bulb from the suction line.
5. Unsolder the suction inlet and outlet line connections.
6. Lift the heat exchanger assembly from the unit.

Installation

1. Clean the tubes for soldering.
2. Place the heat exchanger assembly in the unit and install the mounting hardware.
3. Solder the suction line connections.

   NOTE: It is strongly recommended that dry nitrogen be used to purge the system during any solder operations (see "Using Pressurized Nitrogen" in this chapter).

4. Solder the liquid line connections.
5. Pressurize the low side and check for leaks (see "Refrigerant Leak Test Procedure" in this chapter).
6. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in this chapter).
7. Evacuate the low side (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
8. Clean suction line to a bright polished condition. Install feeler bulb in the feeler bulb clamps on the suction line. Locate bulb on the suction line in former position. The feeler bulb must make good contact with the suction line or operation will be faulty. Cover with insulating tape.
9. Recharge the unit with R-404A (see "Charging the System with Refrigerant" in this chapter).
10. Perform a controller pre-trip test to verify system operation and correct feeler bulb installation.

Receiver Tank Replacement

Removal

1. Recover the refrigerant charge from the unit (see "Refrigerant Recovery" in this chapter).
2. Unsolder the liquid inlet, liquid outlet and warm gas bypass valve line connections.
3. Loosen the mounting nuts and remove the tankate bulb on the suction

Installation

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

   NOTE: It is strongly recommended that dry nitrogen be used to purge the system during any solder operations (see "Using Pressurized Nitrogen" in this chapter).

3. Pressurize the refrigeration system and check for leaks (see "Refrigerant Leak Test Procedure" in this chapter).
4. If no leaks are found, recover the refrigerant used for the leak test (see "Refrigerant Recovery" in this chapter).
5. Evacuate the system (see "Evacuation and Cleanup of the Refrigeration System" in this chapter).
6. Recharge the unit with R-404A (see "Charging the System with Refrigerant" in this chapter).
7. Perform a controller pre-trip test to verify system operation.

Low or High Pressure Cutout Switch Replacement

Removal

1. Recover the refrigerant charge from the unit (see "Refrigerant Recovery" in this chapter).
2. Turn the **UNIT ON/OFF** switch **OFF**. Disconnect electrical connections to the switch.
3. Unsolder the switch:
   - High pressure cutout switch: Unsolder from the liquid line.
   - Low pressure cutout switch: Unsolder from the suction line.

Installation

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

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

3. Check for refrigerant leaks (see “Refrigerant Leak Test Procedure” in this chapter).
   - High pressure cutout switch: Pressurize the high side with refrigerant and check for leaks.
   - Low pressure cutout switch: Pressurize the low side with refrigerant and check for leaks. If no leaks are found, recover the leak test gas (see “Refrigerant Recovery” in this chapter).
4. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
5. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).
6. Reconnect the electrical wires to the switch.
7. Recharge the unit with R-404A (see “Refrigerant Charge” this chapter).
8. Perform a controller pre-trip test to verify system operation.

Compressor Discharge Temperature Sensor or High Pressure Cutout Switch

NOTE: Replacement procedure when high pressure cutout switch is located in compressor discharge manifold.

Removal

1. Front seat the compressor suction service valve and discharge service valve.

CAUTION: Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor startup.

2. Purge the high pressure from the compressor head through the service port on the discharge line.
3. Disconnect the leads from the wire harness and remove the defective switch or sensor from the compressor discharge manifold.

Warm Gas Bypass Valve, Liquid Injection Valve or Coil/Dehumidify 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 (see “Refrigerant Recovery” in this chapter).
2. Turn the **UNIT ON/OFF** switch **OFF**. Disconnect electrical connections to valve coil.
3. Coil/dehumidify valve: Remove insulating tape from liquid line.
4. Unsolder the liquid line connections to the valve.
5. Remove the valve from the unit.

Installation

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

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

3. Pressurize the low side with refrigerant and check for leaks (see “Refrigerant Leak Test Procedure” in this chapter).
4. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in this chapter).
5. Evacuate the system (see “Evacuation and Cleanup of the Refrigeration System” in this chapter).

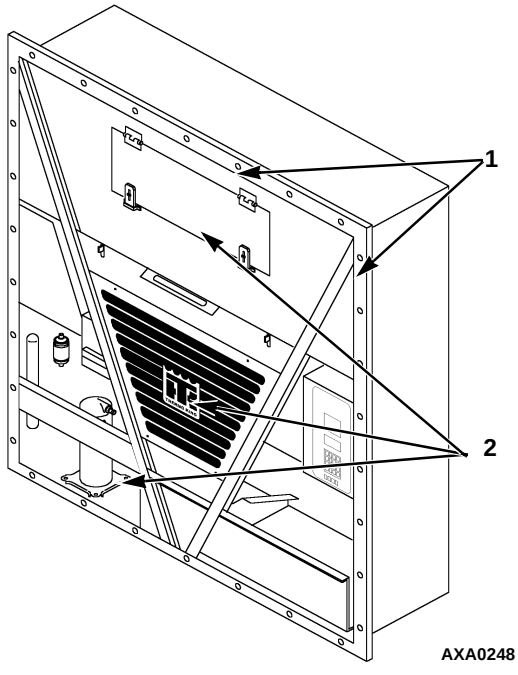
6. Reconnect the electrical wires to the valve.
7. Recharge the unit with R-404A (see “Charging the System with Refrigerant” in this chapter).
8. Perform a controller pre-trip test to verify system operation.

Mounting Bolts

Check and tighten all unit, compressor, and fan motor mounting bolts during pre-trip 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).

Unit Inspection

Inspect the unit during unit pre-trip 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.



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

Figure 54: Mounting Bolts

Condenser Coil

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

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

If a build up of salt or debris is present on the condenser coil, the coil should be cleaned using a mild alkaline cleaner with a pH of 9.5 to 10.5. For example, a 2-3% 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.

Evaporator Coil

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

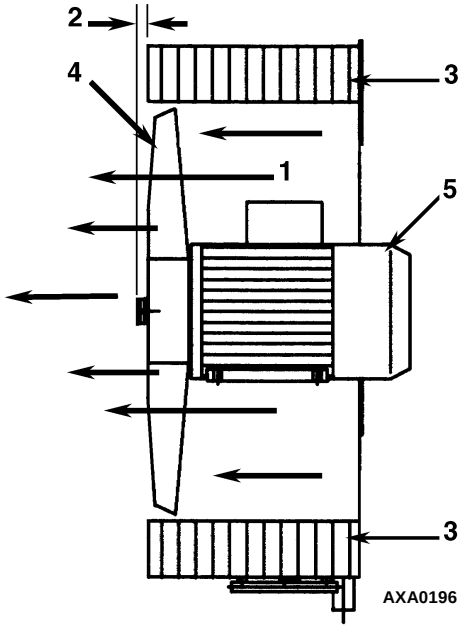
CAUTION: Air pressure must not be high enough to damage coil fins.

Defrost Drains

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

Condenser Fan Location

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

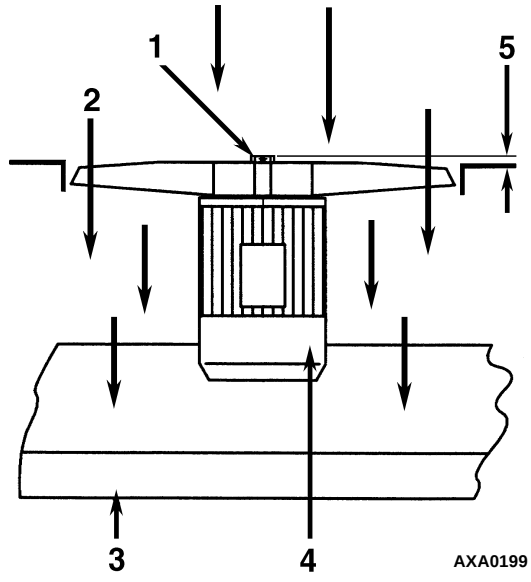


1.	Airflow Direction
2.	10 mm (0.4 in.)
3.	Condenser Coil
4.	Condenser Fan Blade
5.	Condenser Motor

Figure 55: Condenser Fan Blade Placement

Evaporator Fan Location

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



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

Figure 56: Evaporator Fan Blade Placement

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.

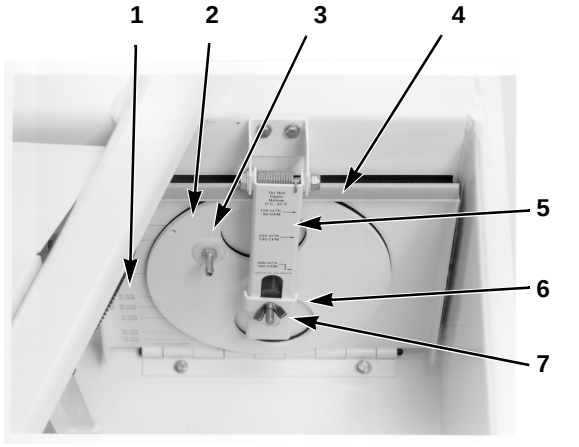
Disk Adjustment: Low Ventilation Rates

1. Loosen wing nut on handle assembly.
2. Rotate the disk to set the Indicator at the air exchange rate shown on the ventilation scale on the door:
   - CSR20SL Models: 0 to 160 m^3/hr. (0 and 96 ft^3/min.).
   - CSR40SL and CSR40 Models: 0 to 125 m^3/hr. (0 and 75 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:
   - CSR40SL and CSR40 Models: 150, 225 and 280 m^3/hr. (90, 135 and 165 ft^3/min.).



1.	Disk Scale: Low Ventilation Rates
2.	Disk Assembly with Rate Indicator
3.	CO_2 Port
4.	Ventilation Door
5.	Handle Assembly with Scale: High Ventilation Rates (CSR40SL & CSR40 Models Only)
6.	Handle Bracket
7.	Wing Nut

Figure 57: Air Exchange System

Advanced Fresh Air Management (AFAM) or Advanced Fresh Air Management Plus (AFAM+) Door (Options)

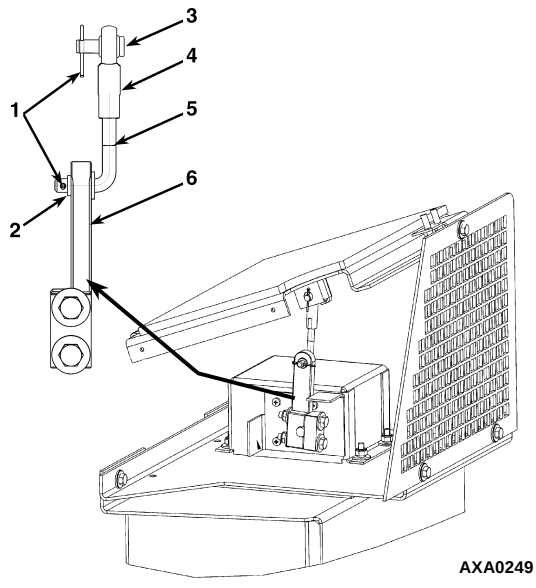
A microprocessor controlled AFAM or AFAM+ door provides programmable control of the air exchange rate. The vent door is adjusted to the desired position by a vent door motor and linkage assembly. The system is precalibrated for air exchange rates of 0 to 280 m3/hr. (0 to 165 ft3/min.). The use of the AFAM or AFAM+ option should be established by the shipper.

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

The default setting for AFAM in the Setpoint menu is the last value set (Off, Units, or Demand). The AFAM submenu should be set to Units to control vent door to the fresh air exchange rate setting. On CRR PS+ units, the controller also adjusts the vent door position to track the VFD fan speed to maintain the fresh air exchange rate. AFAM must be set to Demand to control the vent door to the O_2 and CO_2 gas levels for the AFAM+ system.

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

Alarm Code	Alarm Type	Description
57	Check	AFAM Control Module or Motor Error: Indicates a frozen or stuck vent door or problem with control module or its wiring or motor current draw is not with limits.
68	Check	AFAM + Gas Analyzer Error: Indicates problem with gas analyzer.
69	Check	AFAM+ Gas analyzer calibration: indicates a problem with a sensor

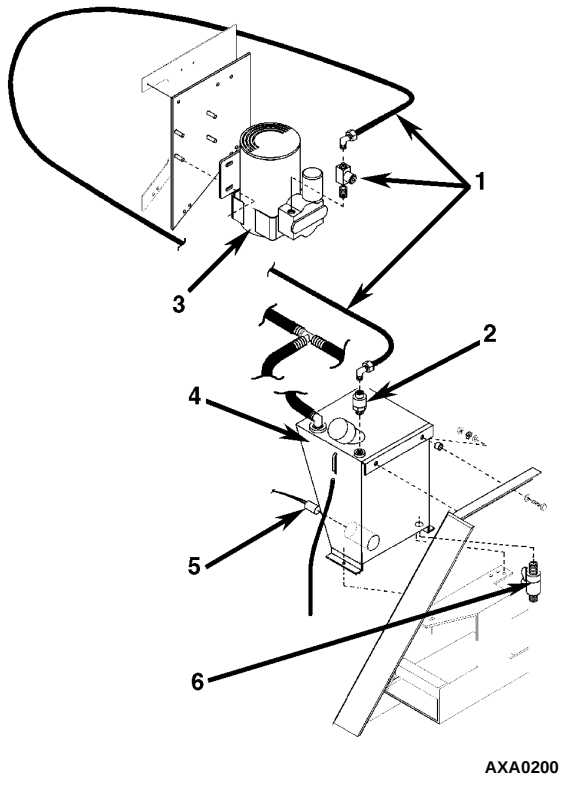


1.	Cotter Pins
2.	Shoulder Washer
3.	Pin
4.	Rod End
5.	L-Rod
6.	Vent Motor Linkage

Figure 58: AFAM System Linkage Adjustment

Humidify System (Option)

The Humidify mode increases the humidity level in the container by injecting atomized water directly into the evaporator supply air stream. The use of the Humidify mode should be established by the shipper. The Humidify mode option is turned on from the “CONTROL” line in the Setpoint menu of the controller. See “Changing the Humidity Mode Setting” under “Setpoint Menu Screen Flow Diagram” on page 72 to set the Humidify system to On. The Humidity LED turns on when the Humidify mode is set to On.



1.	Water Supply Hose and Atomizing Nozzle: Inspect every 1,000 hours and clean if necessary.
2.	Filter: Inspect every 1,000 hours and clean if necessary.
3.	Air Compressor: Inspect once a year.
4.	Water Tank: • Pre-trip inspection: Check the water level. • Every 1,000 hours: Inspect the water tank and clean if necessary.
5.	Water Tank Heater: Check for correct operation in ambient temperatures below 4 C (40 F).
6.	Drain Cock

Figure 59: Humidify System (Option)

The controller energizes (operates) the air compressor when the humidity level in the container is more than 2% below the humidity setpoint. The air compressor atomizes and injects water into the evaporator supply air stream to add moisture to the container air.

The evaporator drain hoses are routed to the water tank to replenish the water level during unit operation. However, water usage will vary depending upon the load and ambient conditions. An overflow hose on the water tank removes excess water when particularly wet loads are transported or when the humidify system is not operating.

NOTE: Only demineralized or distilled water should be used to prevent plugging of the atomizing nozzle.

Pre-trip Inspection

The following items should be inspected before loading the container:

- Check the water level in the water tank to maintain an
- adequate water supply.
- Check humidify system operation by starting the unit, setting the Humidify mode to On and adjusting the humidify setpoint (HUMSP) more than 2% above the current humidity level in the container. Verify that the air compressor operates and that water is drawn into the atomizing nozzle and injected into the return air stream.

Inspection and Cleaning

The following items should be periodically serviced:

- Clean and inspect the filter in the water supply hose on the water tank every 1,000 operating hours. Clean the filter screen with fresh water and a soft brush.
- Inspect the water tank, water supply line and atomizing nozzle every 1,000 hours and clean if necessary. Use fresh water, a soft brush and compressed air to clean and blow clear components.
- Inspect the air compressor for signs of overheating once a year.

Partlow (Model SR) Recording Thermometer (Option)

The 31-day Partlow Recorder is mechanically driven by a spring wound mechanism. The sensor bulb is mounted in the evaporator to record the supply air temperature.

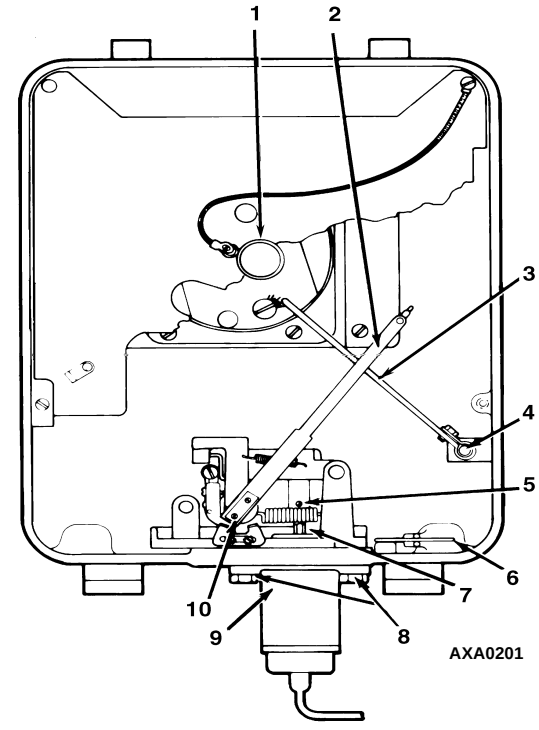
The recording thermometer should be inspected and cleaned to ensure that the stylus produces smooth clean lines and records accurate temperature readings. When changing charts, wipe the stylus and chart platen with a clean, damp cloth to remove material transferred from the back of the chart to the platen by the pressure of the stylus.

Recording Chart Replacement

1. To change the charts, remove the knurled chart nut from the drive shaft and remove the chart.
2. Install the new chart on the chart drive shaft. Position the chart edge under the four clips.
3. Replace the chant nut loosely and rotate the chart so that the correct time is indicated by the stylus. In order to operate the stylus with the door open for the purpose of checking or zeroing the control, the lifter arm can be locked in this lowered position by pushing down on the lifter arm shaft and rotating the arm on its pivot point. If the lifter arm does not retract away from the stylus when the door is closed, reposition the arm on the shaft by loosening the Allen screw on the lifter arm.
4. Hold the recording chart in position and tighten the chart nut finger tight.
5. Lower the pen by rotating the lifting arm counterclockwise and pushing the pen against the chart. If there is insufficient pressure on the stylus to mark the chart, carefully grip the pivot end of the stylus warm where it is riveted to the stamping with a pair of long-nosed pliers. Bend the stamping toward the instrument. Care must be used not to bend the stylus arm, but only the stamping to which it is attached.

Marking System Calibration

1. Visually inspect the recording thermometer sensing bulb located in the evaporator near the supply air grille. Make sure it is securely fastened and clear of debris.
2. Start the unit and adjust the temperature setpoint to 0 C (32 F). Operate the unit until the supply air temperature reaches 0 C (32 F). Enter the Data menu on the controller display and view the supply air temperature screen. Press the **5** key two times to lock the screen on the display for 10 minutes.
3. Wait at least 5 minutes to allow the recording thermometer sensing bulb temperature to stabilize. Then compare the supply air temperature in the controller display with the recording stylus of the recorder. Write down both readings.
4. If the average difference is 0.6 C (1.0 F) or less, *do not* attempt to recalibrate.
5. If the recorder needs recalibration:
   a. Loosen the Allen setscrew (S) using a small slotted screwdriver.
   b. Adjust shaft (J) with a 5 mm (3/16 in.) open end wrench until the recording stylus pointer is aligned to the temperature reading that agrees with the supply air temperature in the controller display. To decrease the stylus temperature reading, turn the shaft to the left (clockwise). To increase the reading, turn the shaft to the right (counterclockwise).
   c. Tighten Allen setscrew (S).
   d. Wait another 5 minutes while the unit operates on Cool. Verify that the recording thermometer reading is stable and agrees with the supply air temperature in the controller display.
   e. Press any key to unlock the controller display screen.



1.	Knurled Knob
2.	Recording Stylus
3.	Lifter Arm
4.	Allen Screw
5.	Set Screw “S”
6.	Key Mounting Clip
7.	Adjustment Shaft “J”
8.	Element Flange Screws “D”
9.	Thermal Element
10.	Stamping

Figure 60: Partlow (SR) Recording Thermometer

Element Replacement

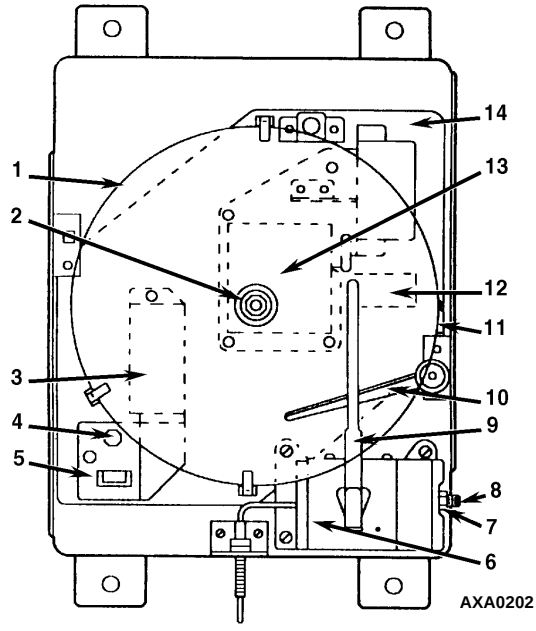
The thermal element is field replaceable. To replace the element:

1. Remove element flange screws (D) and withdraw the thermal element from the recorder case. Care must be taken not to bend the hex shaft which extends from the recorder case.
2. Remove the old sensing bulb and capillary from the unit.
3. Install the new sensing bulb and capillary in the unit. The capillary of the new thermal element may be bent, but *do not* bend the bulb.
4. Install a new thermal element in the recorder case.
5. Replace the element flange screws (D) and tighten securely.
6. Check the calibration of the recorder. Recalibrate the recorder if necessary.

Saginomiya (Model SKM) Recording Thermometer (Option)

The 31-day Saginomiya Recorder is electric motor driven by a dry cell type battery with a 1 year life expectancy. The sensor bulb is mounted in the evaporator to record the return air temperature.

The recording thermometer should be inspected and cleaned to ensure that the stylus produces smooth clean lines and records accurate temperature readings.



1.	Recording Chart
2.	Chart Nut
3.	Battery
4.	Test Button
5.	Battery Voltage Indicator
6.	Power Element Assembly
7.	Setting Screw (Calibration)
8.	Lock Screw (Calibration)
9.	Recording Pen
10.	Lifting Arm
11.	Time Scale Plate
12.	Terminal Board
13.	Quartz Motor and Reducing Gear Assembly
14.	Recording Platen

Figure 61: Saginomiya (SKM) Recording Thermometer

Battery

The recording chart is driven by a battery-powered quartz motor and reducing gear. The battery charge should be checked during unit pre-trip inspection or once a month. To check the battery charge, press the button the voltage indicator:

- Blue Zone — Battery good. If the indicator needle remains in the blue zone when the test button is depressed, the battery has sufficient power to operate the recorder.
- White Zone — Replace battery within 30 days. If the indicator needle remains in the white zone when the test button is depressed during a pre-trip inspection, replace the battery. Although the battery may operate the recorder up to 30 more days, replacing the battery before it is completely dead is recommended.
- Red Zone — Dead battery. If the indicator needle remains in the red zone when the test button is depressed, the battery is dead and must be replaced.

To replace the battery:

1. Raise the stylus away from the chart by rotating the pen lift gear clockwise 30 degrees and releasing the lifting arm. The pen will remain in the raised position. Remove the knurled chart nut from the drive shaft and remove the chart.
2. Loosen the four setscrews that hold the recording platen in the recorder. The setscrews do not remove from the recorder base.
3. Rotate the recording platen counterclockwise and remove the platen.
4. Remove the battery from the recorder.
5. Install a new battery in the recorder making sure the battery's positive (+) and negative (-) poles are correctly aligned.
6. Press the button on the voltage indicator to make sure the indicator needle is the in blue zone.
7. Check to see that the quartz motor is running. Look through the inspection window and make sure the internal flywheel on the quartz motor is revolving.
8. Replace the recording platen on the recorder base and rotate clockwise to view setscrews. Tighten four set-screws that hold the platen in the recorder
9. Replace the recording chart and chart nut on the chart drive shaft and tighten the chart nut finger tight
10. Lower the pen by rotating the lifting arm counterclockwise and push the pen against the chart.

Recording Chart Replacement

1. To change the charts, raise the stylus away from the chart by rotating the pen lifting arm clockwise 30 degrees and releasing the lifting arm. The pen will remain in the raised position. Remove the knurled chart nut from the drive shaft and remove the chart.
2. Install the new chart in the slot on the platen and on the chart drive shaft. Position the chart edge under three hold-down flanges.
3. Replace the chant nut loosely and rotate the chart so that the correct date and time are indicated by the arrow on the time scale plate. Finally hold the recording chart in position and tighten the chart nut finger tight.
4. Lower the pen by rotating the lifting arm counterclockwise and pushing the pen against the chart.

Marking System Calibration

1. Visually inspect the recording thermometer sensing bulb located in the evaporator near the return air grille. Make sure it is securely fastened and clear of debris.
2. Start the unit and adjust the temperature setpoint to 0 C (32 F). Operate the unit until the return air temperature reaches 0 C (32 F). Enter the View menu on the controller display and scroll to the return air temperature ("RET") screen. Press the **ENTER** key to lock the "RET" screen on the display.

3. Wait at least 5 minutes to allow the recording thermometer sensing bulb temperature to stabilize. Then compare the “RET” temperature in the controller display with the recording stylus of the recorder. Write down both readings.
4. If the average difference is 0.6 C (1.0 F) or less, *do not* attempt to recalibrate.
5. If the recorder needs recalibration:
    a. Place the pen in the recording position (lowered against chart)
    b. Loosen the lock screw using a small Phillips screwdriver.
    c. Adjust the setting screw with a small slotted screwdriver or a 7 mm (9/32 in.) open end wrench. Rotate the setting screw clockwise until the recording pen temperature reading is 2 to 4 C (4 to 6 F) higher than the temperature reading of the test instrument.

    NOTE: Turning the setting screw one complete revolution (360 degrees) changes the temperature reading of the pen by approximately 5 C (9 F).

    d. Then rotate the setting screw counterclockwise to lower the recording pen reading until the pen reading agrees with the “RET” controller display.
    e. Tighten the lock screw.
    f. Wait another 5 minutes while the unit operates on Cool. Verify that the recording thermometer reading is stable and agrees with the “RET” temperature in the controller display.
    g. Press any key to unlock the controller display screen.

Power Element Assembly Replacement

The recording thermometer’s power element is field replaceable. To replace the element assembly:

1. Raise the stylus away from the chart. Remove the knurled chart nut and chart.
2. Remove the recording platen.
3. Loosen five mounting screws that mount the capillary holding plate and element assembly in the recorder. Remove the power element assembly (includes recording pen assembly).
4. Remove the old sensing bulb and capillary from the unit.
5. Install the new sensing bulb and capillary in the unit. The capillary of the new thermal element may be bent, but *do not* bend the bulb.
6. Install the capillary in the recorder and securely tighten five mounting screws.
7. Replace the recording platen, recording chart and chart nut. Lower the recording pen.
8. Check the calibration of the recorder. Recalibrate the recorder if necessary.

Timer (Quartz Motor and Reducing Gear) Replacement

The quartz motor is field replaceable. To replace the motor and reducing gear assembly:

1. Raise the stylus away from the chart. Remove the knurled chart nut and chart.
2. Remove the recording platen.
3. Loosen the two terminal screws on the terminal board and remove the motor wires.
4. Loosen the five screws that mount the motor assembly in the recorder. Remove the motor assembly.
5. Install new motor assembly. Install an securely tighten five mounting screws.
6. Connect the motor wires to the terminal board. Make sure the red positive (+) and black negative (-) wire are correctly aligned.
7. Check to see that the quartz motor is running. Look through the inspection window and make sure the internal flywheel on the quartz motor is revolving.
8. Replace the recording platen, recording chart and chart nut. Lower the recording pen.

Battery Voltage Indicator

The battery voltage indicator is field replaceable. If the indicator needle oscillates when the test button is depressed, or the needle remains in the red zone when a new battery is installed, replace the voltage indicator assembly:

1. Remove the knurled chart nut and chart. Remove the recording platen.
2. Loosen the two terminal screws on the terminal board and remove the voltage indicator wires.
3. Loosen the two mounting screws that mount the voltage indicator assembly in the recorder. Remove the voltage indicator (includes battery holder).
4. Install a new voltage indicator. Install and securely tighten the two mounting screws.
5. Connect the voltage indicator wires to the terminal board. Make sure the red positive (+) wire and black negative (-) wire are correctly aligned.
6. Reinstall the battery in the battery holder (with correct polarity). Check the voltage indicator by depressing the test button to make sure the indicator needle is in the blue zone. Also check to see that the quartz motor is operating (flywheel revolving).
7. Replace the recording platen, recording chart and chart nut. Lower the recording pen.

Diagnosis

Mechanical Diagnosis

Condition	Possible Cause	Remedy
Compressor does not operate—no amperage draw	Controller on; unit start sequence still timing	Wait up to 2minutes for compressor start-up
	No power to unit (condenser and evaporator fans do not operate)	Locate fault and repair: power source, power plug, CB1 main circuit breaker, motor contactor, motor terminals, motor
	Open in 29 Vac control circuit	Check fuses and **ON/OFF** switch. Replace or repair as required
	Container temperature does not demand compressor operation	Adjust controller setpoint
	Compressor contactor inoperative	Replace compressor contactor
	No output signal from controller	Diagnose and replace main relay board or controller
	Unit on defrost	Turn **UNIT ON/OFF** switch **OFF** and then **ON** again
	Detective high pressure or low pressure cutout switch	Replace defective switch
	High condenser head pressure causing high pressure cutout	Check refrigeration system and correct fault
	Defective compressor	Replace compressor
	Controller shut unit down on Compressor Over Temperature (fault code 82)	Let compressor cool and controller will reset automatically. Check liquid injection valve and compressor temperature sensor
	Compressor motor internal thermal overload protection open	If compressor contactor is energized, wait 60 minutes for protector to cool and reset.
Compressor does not operate—excessive amperage draw or intermittent cycling on overload	Rotating scroll stuck	Replace compressor
	Seized or frozen compressor bearings	Replace compressor
	Improperly wired	Check/correct wiring against wiring diagram
	Low line voltage	Check line voltage — determine location of voltage drop
	Contacts in compressor contactor not closing completely	Check by operating manually. Repair or replace.
	Open circuit in compressor motor winding	Check motor stator connections. Check stator winding for continuity. If open, replace compressor
	Defective compressor motor internal thermal overload protector	Replace thermal overload protector or compressor
	Refrigerant overcharge or high side restriction causing cycling on high pressure cutout	Check for restricted filter drier, in-line filter or high side; or refrigerant overcharge
	Inefficient condenser operation causing cycling on high pressure cutout	Check condenser airflow, condenser fan motor, fan blade, condenser grille, condenser coil temperature sensor, water pressure switch (option), water flow rate (option) and water-cooled condenser-receiver tank (option)

Condition	Possible Cause	Remedy
Compressor contactor burned out	Low line voltage	Increase line voltage to at least 90% of compressor motor rating
	Excessive line voltage	Reduce line voltage to at least 110% of compressor motor rating
	Short cycling	Eliminate cause of short cycling
Unit short cycles	Refrigerant overcharge causing cycling on high pressure cutout	Purge system
	Inefficient condenser operation causing cycling on high pressure cutout	Check condenser airflow, condenser fan motor, condenser fan grille, condenser fan pressure switch, water pressure switch (option), water flow rate (option) and water-cooled condenser-receiver tank (option)
Noisy compressor	Loose mounting bolts	Tighten mounting bolts
	Oil slugging or refrigerant flooding back	Perform controller pre-trip 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 lights. If unit is in Heat or Defrost, unit operation is normal (no remedy required)
	Unit in Cool with Low condenser temperature	Check indicator lights condenser temperature and discharge pressure. Condenser temperature may not require condenser fan operation (no remedy required; condenser fan also pulses on and off on a 30 second cycle to control condenser temperature)
	Water pressure switch Closed (Water-cooled position) (Option)	If unit is on water cooled condenser operation, unit operation is normal.Otherwise water pressure switch must be Open for air-cooled condenser operation.
	Defective water pressure switch; (option)	Replace defective switch
	Loose line connection	Tighten connections
	Open motor internal thermal overload protector	Check for seized bearings or defective thermal overload protector. Repair or replace as necessary
	Defective motor	Replace motor
	Detective condenser fan contactor	Replace defective contactor
	No condenser fan output signal from controller	Diagnose and replace condenser fan relay, main relay board or controller

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

Refrigeration Diagnosis

Condition	Possible Cause	Remedy
Load temperature too high—unit not cooling	Compressor does not operate	See “Mechanical Diagnosis”
	Controller setpoint too high	Adjust controller setpoint
	Defective container insulation or poor fitting doors	Repair container
	Shortage of refrigerant	Repair leak and recharge
	Overcharge of refrigerant	Purge system
	Air in refrigeration system	Evacuate and recharge
	Liquid injection valve open	Check liquid injection valve circuit and compressor discharge temperature sensor
	Warm gas bypass valve open	Check bypass valve circuit
	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
	Stepper motor 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

Condition	Possible Cause	Remedy
Head pressure too low ***NOTE: This unit has a suction modulation 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	See “Condenser Fan Motor Does Not Operate” under “Mechanical Diagnosis”
	Condenser fan grille damaged or missing	Repair or replace grille
	Condenser fan blade damaged	Replace fan blade
	High ambient air temperature	No remedy
	Restricted dehydrator or high side	Replace filter drier or clear restriction
	Defective service gauge	Replace gauge
Compressor loses oil	Refrigerant leak	Repair leak and recharge
Compressor oil migrates to system	Short cycling	See “Unit Short Cycles” under “Mechanical Diagnosis”
Rapid cycling between Cool, Null and Heat modes	Air short cycling through evaporator	Check and correct cargo load
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Short cycling	See “Unit Short Cycles” under “Mechanical Diagnosis”
	Stepper motor valve stuck close or defective	Replace valve
Hot liquid line	Shortage of refrigerant	Repair or recharge
	Expansion valve open too wide	Adjust or replace expansion valve
Frosted liquid line	Liquid line restricted	Remove restriction
	Restricted filter drier	Replace filter drier
Frosted or sweating suction line	Expansion valve admitting excess refrigerant	Check feeler bulb and adjust expansion valve
	Evaporator coil needs defrosting	Check defrost circuit including controller and evaporator coil sensor
	Evaporator fan does not operate	See “Evaporator Fan Motor Does Not Operate” under “Mechanical Diagnosis”
	Warm gas bypass valve open	Normal when unit is in Modulation and container temperature is near setpoint

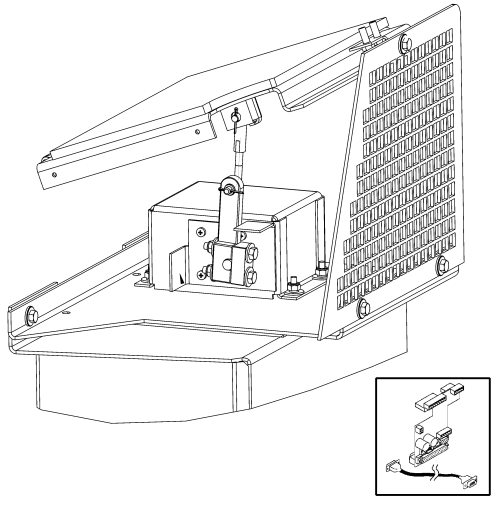
Condition	Possible Cause	Remedy
Unit in vacuum—frost on expansion valve only	Ice plugging expansion valve screen or orifice	Apply hot wet cloth to expansion valve. Moisture indicated by increase in suction pressure. Replace filter drier
High suction pressure	Overcharge of refrigerant	Purge system
	Expansion valve open too much	Adjust or replace valve
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Service gauge out of calibration	Adjust or replace service gauge
Low suction pressure ***NOTE: This unit has a suction modulation capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is on Modulation Cool (control temperature within 10 C [18 F] of setpoint or in Power Limit mode).***	Shortage of refrigerant	Repair leak and recharge
	Low ambient air temperature	No remedy
	Iced or dirty evaporator coil	Defrost or clean evaporator coil
	Restricted lines	Locate and clear restriction
	Plugged filter drier	Replace filter drier
	Expansion valve closed too much	Adjust or replace valve
	Expansion valve feeler bulb improperly mounted, poorly insulated or making poor contact	Correct feeler bulb installation
	Evaporator fans off	Check evaporator fan motors and control circuit and correct fault
	Defective controller or main relay board	Diagnose main relay board and controller. Replace defective component
	Service gauge out of calibration	Adjust or replace gauge

Advanced Fresh Air Management (AFAM) System

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

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

The system is precalibrated for air exchange rates of 0 to 280 m^3/hr. (0 to 165 ft^3/min.). The actual door position is based on the air exchange setting and the power supply frequency (Hertz).



AXA0250

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

Figure 62: AFAM System

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

Setting AFAM System Values

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

The AFAM option submenu in the Configuration menu is factory set to AFAM. The controller then adds the AFAM, AFAM Delay and AFAM Rate submenus to the Setpoint menu. If a replacement controller or new software is installed, a controller auto configuration will detect the AFAM option when the AFAM door control module is connected to the controller.

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

Starting the AFAM System

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

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

4. Press **F2** key to toggle between "OFF", "DEMAND" and "UNITS".
   - Off: Vent door closes and/or remains closed. AFAM DELAY and AFAM RATE settings become blank ("--"). If gas sensor unit is installed on unit, the O_2 min and CO_2 max settings also become blank.
   - Demand: Controller uses the O_2 and CO_2 gas levels to adjust the vent door position.
   - Units: Controller uses the fresh air exchange rate to adjust the vent door position. If a gas sensor unit is installed on the unit, control of the O_2 and CO_2 gas levels remains off.
5. With "UNITS" in the menu line, press and hold **F4** key until cursor stops flashing. "UNITS" now appears in display.
6. Press **ESC** key to exit the Setpoint screen.

Changing the AFAM Delay

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

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

NOTE: During unit startup, the AFAM delay prevents the AFAM door from opening until the delay times out. The AFAM delay prevents the AFAM door from opening due to the AFAM Rate, O_2, or CO_2 system settings.

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

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

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

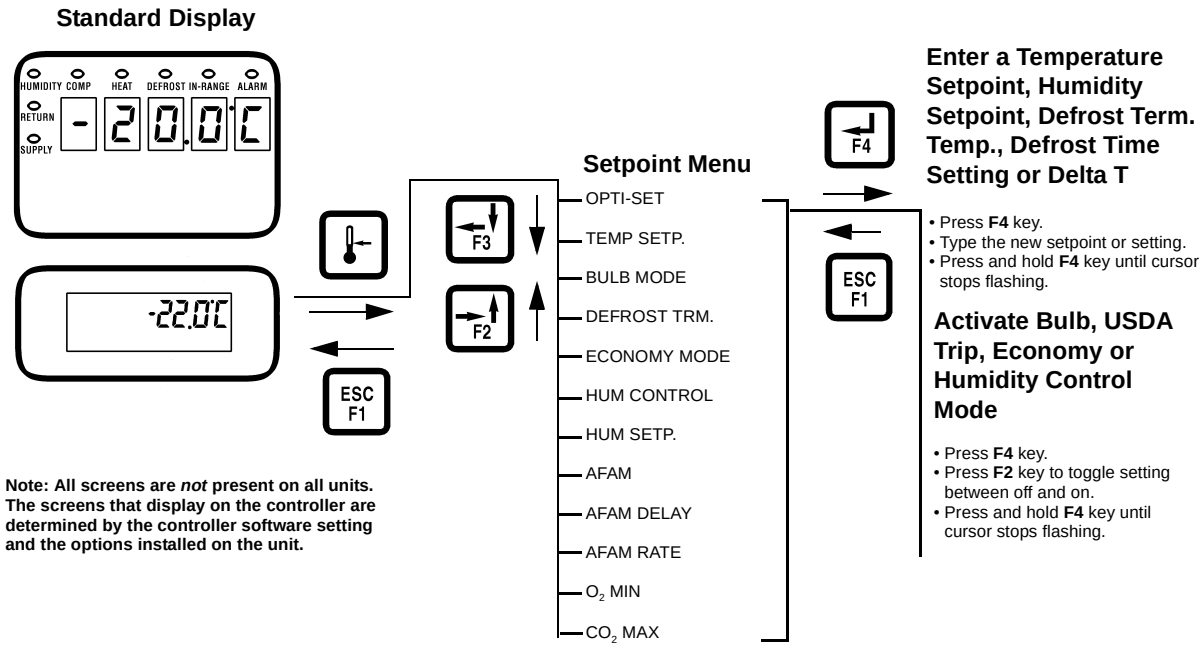


Figure 63: Setpoint Menu Screen Flow Diagram

Changing the AFAM Rate

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

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

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

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

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

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

Setting AFAM Units in the Configuration Menu

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

1. Press the **F3** key to enter the Main menu.
2. Press **F2** key to scroll through Main menu until “CONFIGURATIONS” appears in LCD display.
3. Press **F4** key to access the Configurations screen. Configurations screen appears with cursor in the “IN-RANGE” menu line.
4. Press **F3** key to scroll cursor to “AFAM UNITS”.
5. To set a new value, press **F4** key. The Password screen appears.
6. Enter the password. Press **F2** key, **A** key (password is “A”), **F4** key and then **EXIT** key. An Enter Arrow appears in the hourmeter line.
7. Press the **F3** key to toggle the value to the desired setting (default is “M3”): • “M3” (Cubic Meters per Hour) • “CF” (Cubic Feet per Minute) • “PERCENT”.
8. When the desired value appears in the display, press and hold the **F4** key until the cursor stops flashing. The new value appears in the menu line.
9. Press **ESC** key to exit the Configurations screen.

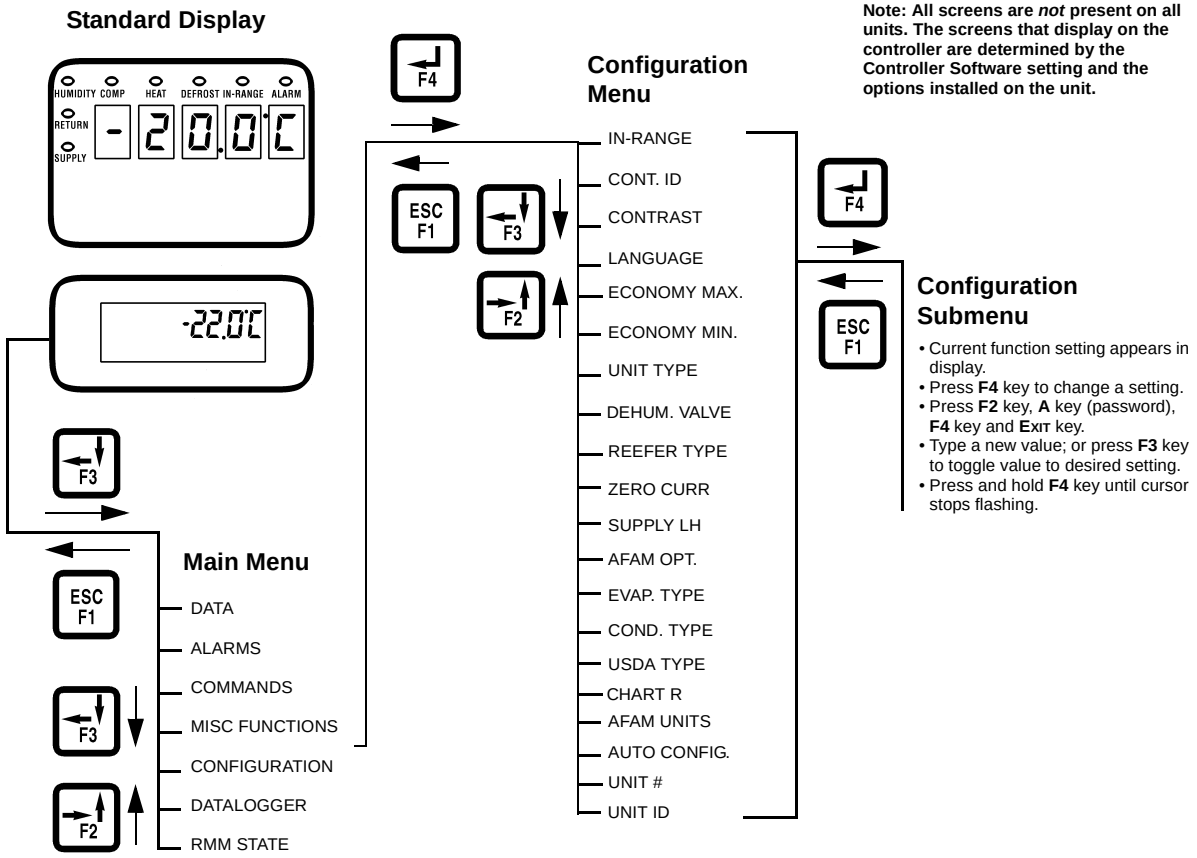


Figure 64: Configuration Menu Screen Flow Diagram

Advanced Fresh Air Management Plus (AFAM+) System

An advanced microprocessor controlled fresh air management system also provides programmable control of the O_2 and CO_2 levels in the container, and data logging of the O_2 and CO_2 gas level readings.

The AFAM+ system includes all AFAM system components plus a gas sensor unit, sensor filter, vent loop, pressure relief valve assembly and single purge port. The controller can be set to control the O_2 level in the container between 0 to 21% and the CO_2 level between 0 to 25%.

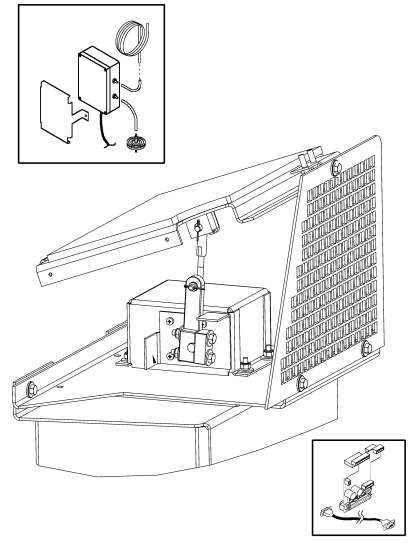
Setting AFAM+ System Values

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

The AFAM option submenu in the Configuration menu is factory set to AFAM+. The controller then adds the AFAM, AFAM Delay, AFAM Rate, O_2 Min and CO_2 Max submenus to the Setpoint menu. If a replacement controller or new software is installed, a controller auto configuration will detect the AFAM+ option when the AFAM door control module and gas sensor are connected to the controller. When an auto configuration is performed, the controller sets the AFAM Option in the Configuration menu to Analyzer. To operate the AFAM+ system, the AFAM Option must be manually set to AFAM+.

- Analyzer: This setting turns on data logging for O_2 and CO_2 gas levels only. The AFAM+ system does not operate.
- AFAM+: This setting turns on the AFAM+ system to control O_2 and CO_2 gas levels. The controller then adds O_2 Min and CO_2 Max submenus to the Setpoint display in addition to the AFAM, AFAM Delay and AFAM Rate submenus.

The default setting for AFAM in the Setpoint menu is the last value set (Off, Units or Demand). AFAM must be set to Demand to control the vent door to the O_2 and CO_2 gas levels.



AXA0251

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

Figure 65: AFAM+ System

Starting the AFAM+ System

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the “TEMP SETP” line.
2. Press **F2** key to scroll to “AFAM” line.
3. To change the mode setting, press **F4** key. Cursor moves to end of menu line and flashes.

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

4. Press **F2** key to toggle between "OFF", "DEMAND" and "UNITS".
   - Off: Vent door closes. AFAM Delay, AFAM Rate, O_2 Min and CO_2 Max settings become blank ("--").
   - Demand: Controller uses the O_2 and CO_2 gas levels to adjust the vent door position. AFAM Rate setting becomes blank.
   - Units: Controller uses the fresh air exchange rate to adjust the vent door position. O_2 Min and CO_2 Max settings become blank.
5. With "DEMAND" in the menu line, press and hold **F4** key until cursor stops flashing. "DEMAND" now appears in display.
6. Press **ESC** key to exit the Setpoint screen

Changing the AFAM Delay

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

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

NOTE: During unit startup, the AFAM Delay prevents the AFAM door from opening until the delay times out or the container temperature is in-range. The AFAM delay prevents the AFAM door from opening due to the AFAM Rate, O_2 or CO_2 system settings.

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

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

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

Changing the O_2 Minimum Setting

NOTE: The minimum O_2 rate should be established by the shipper.

The O_2 rate sets the desired O_2 level in the container when a gas sensor unit is installed. The actual AFAM door position is based on the O_2 level, CO_2 level and AFAM delay.

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the "TEMP SETP" line.
2. Press **F2** key to scroll to "O_2" line. The current rate and units (e.g. "0%") appears in the display.
3. To change the rate, press the **F4** key. An Enter Arrow appears in the menu line and the current rate disappears.
4. Enter (type) the new rate in the LCD display using the general purpose keypad: 0 to 21%.

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

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

Changing the CO_2 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 AFAM door position is based on the CO_2 level, O_2 level and AFAM delay.

1. Press the **SETPOINT** key. The Setpoint menu appears with the cursor in the "TEMP SETP" line.
2. Press **F2** key to scroll to "CO_2" line. The current rate and units (e.g. "2.5%") appears in the display.
3. To change the rate, press the **F4** key. An Enter Arrow appears in the menu line and the current rate disappears.
4. Enter (type) the new rate in the LCD display using the general purpose keypad: 0 to 25%.

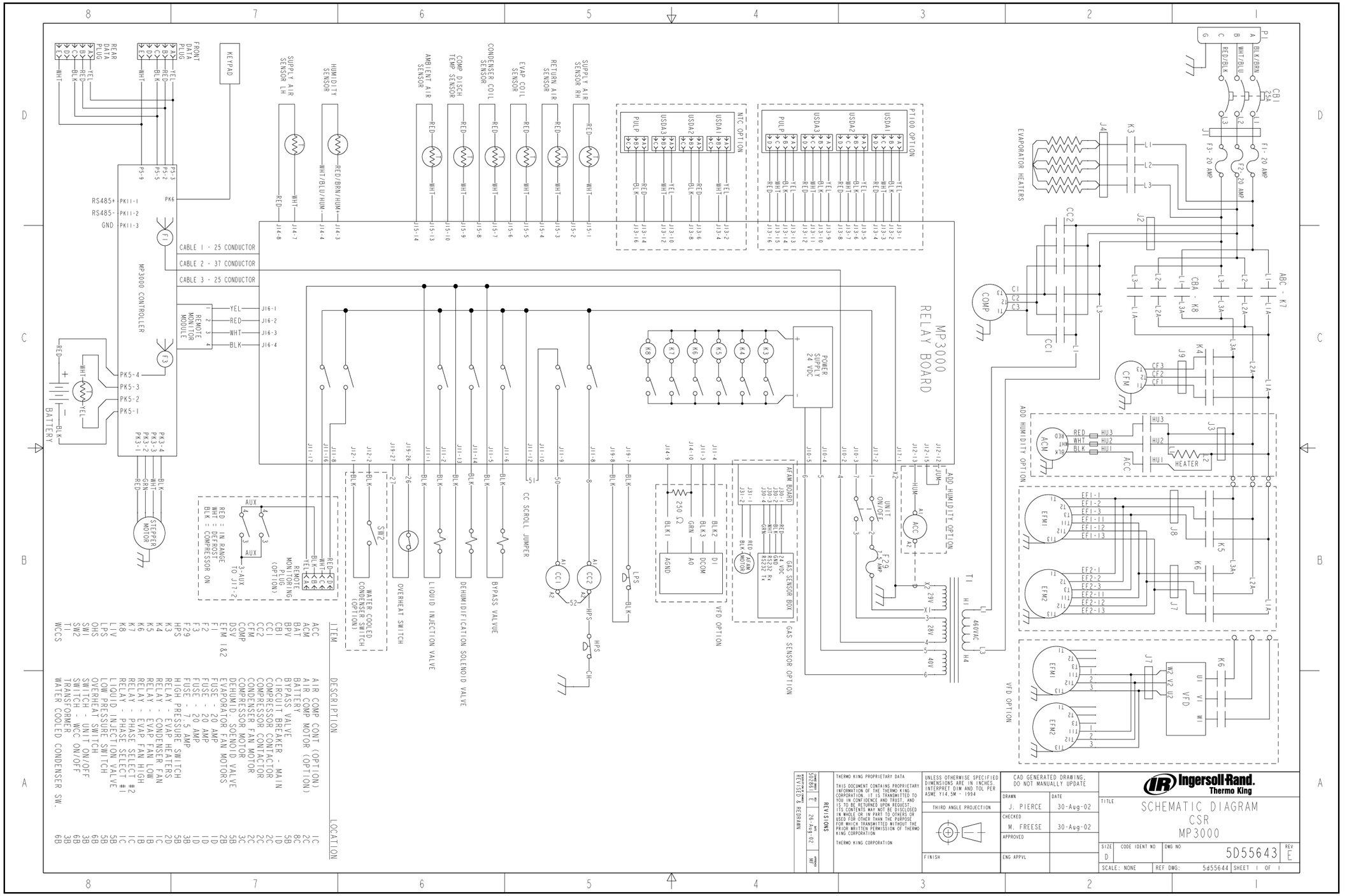
WARNING: The vent door and motor actuator arm may move immediately again when the rate is entered. Keep hands and tools away from the air exchange system components to prevent personal injury or unit damage.

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

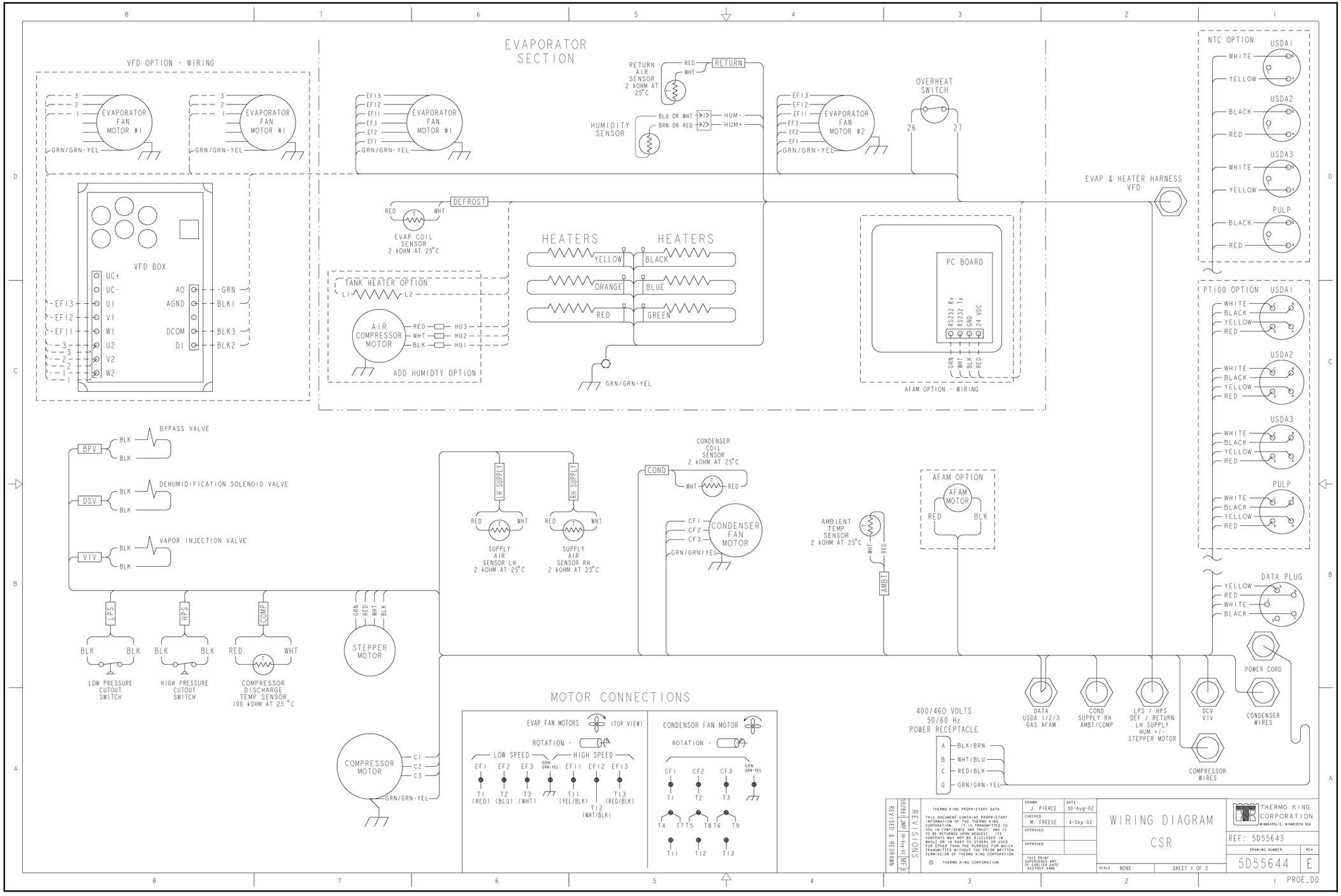
Index

Wiring and Schematic Diagrams Index

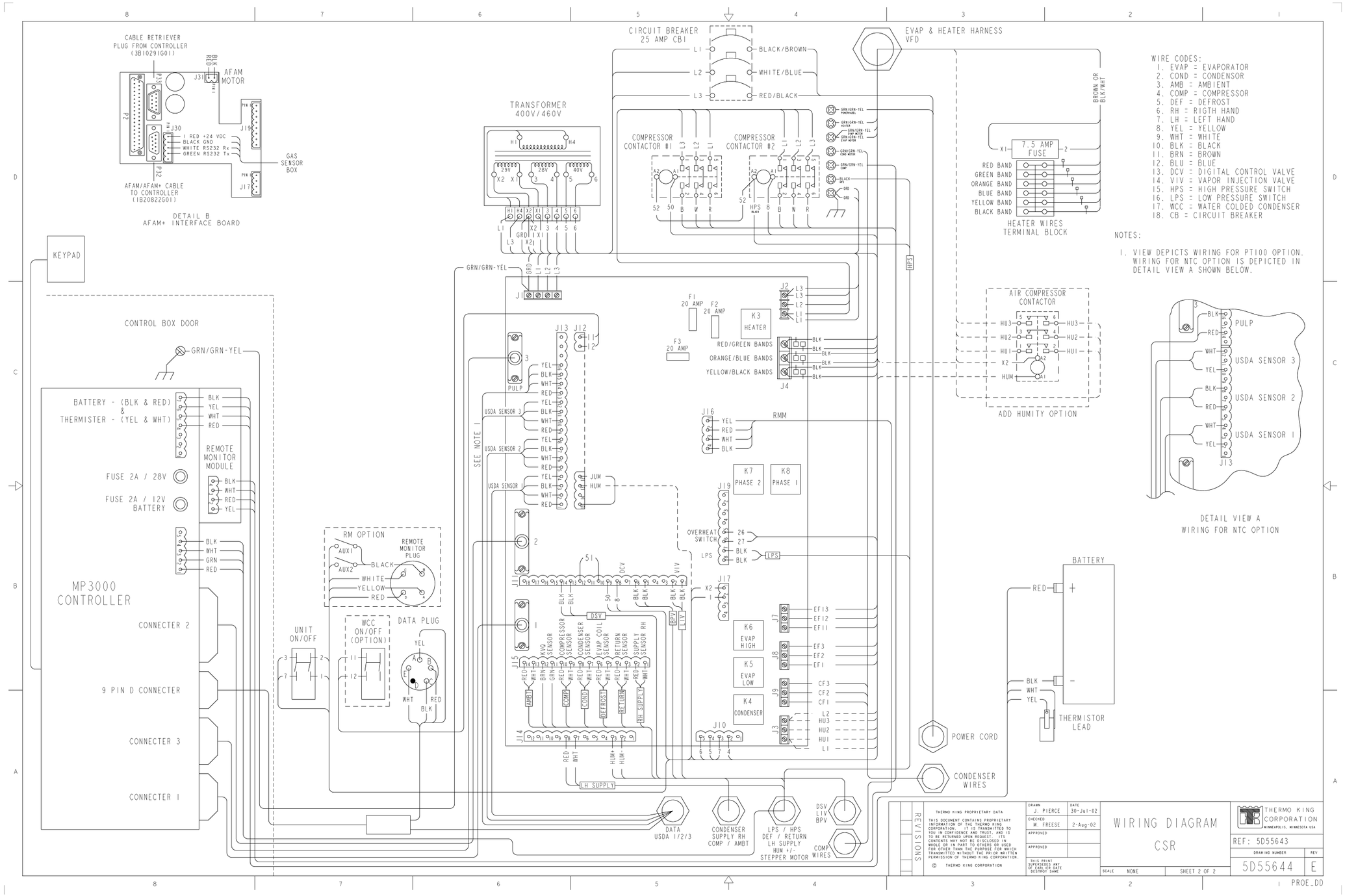
CSR Wiring Schematic



CSR Wiring Diagram–Page 1 of 2



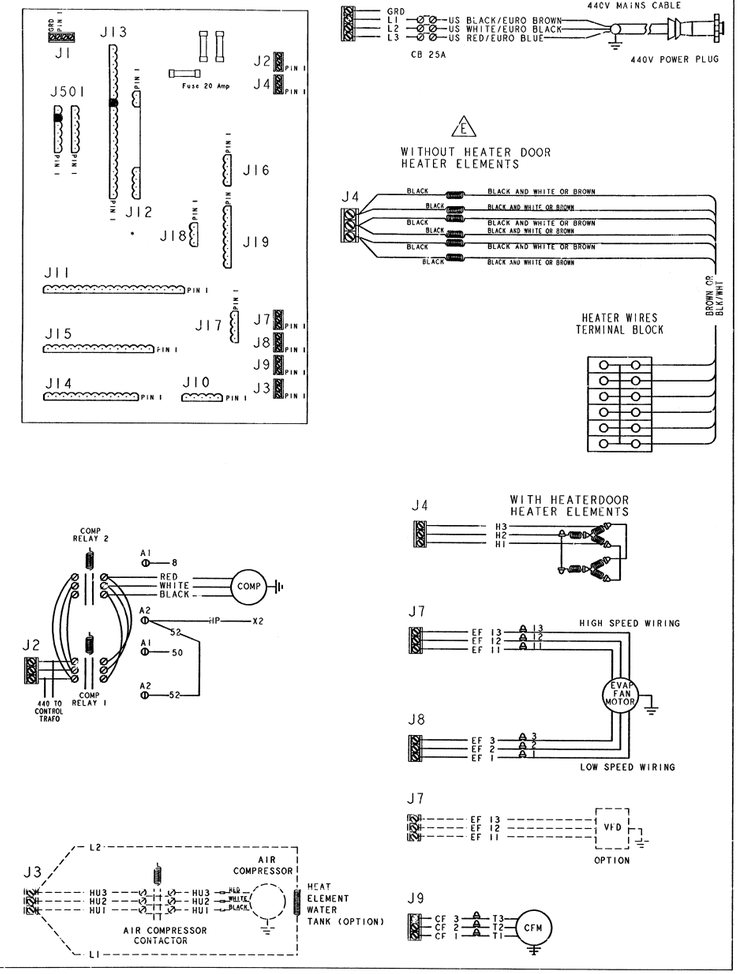
CSR Wiring Diagram–Page 2 of 2



MPC2000ID/MP3000 Controller High Voltage Wiring Diagram

REVISIONS						
CHANGE ORDER	SYM	DESCRIPTION	DATE	BY	CH'D	APP
76515	B	PIN 1 ADDED IN DIAGRAM	05-Jan-00	LH	OT	OT
76869	C	J1: ADDED EUROPE STYLE, J4: COLOR CODE ADDED	22-Feb-00	LH	OT	OT
78594	D	UPDATED VIEW J18	16-Nov-00	LH	OT	OT
79342	E	REVISED "WITHOUT HEATER DOOR" WIRING	05-Mar-01	JMP	JMP	HY

DIAGRAM CHART NO.: 5D52861



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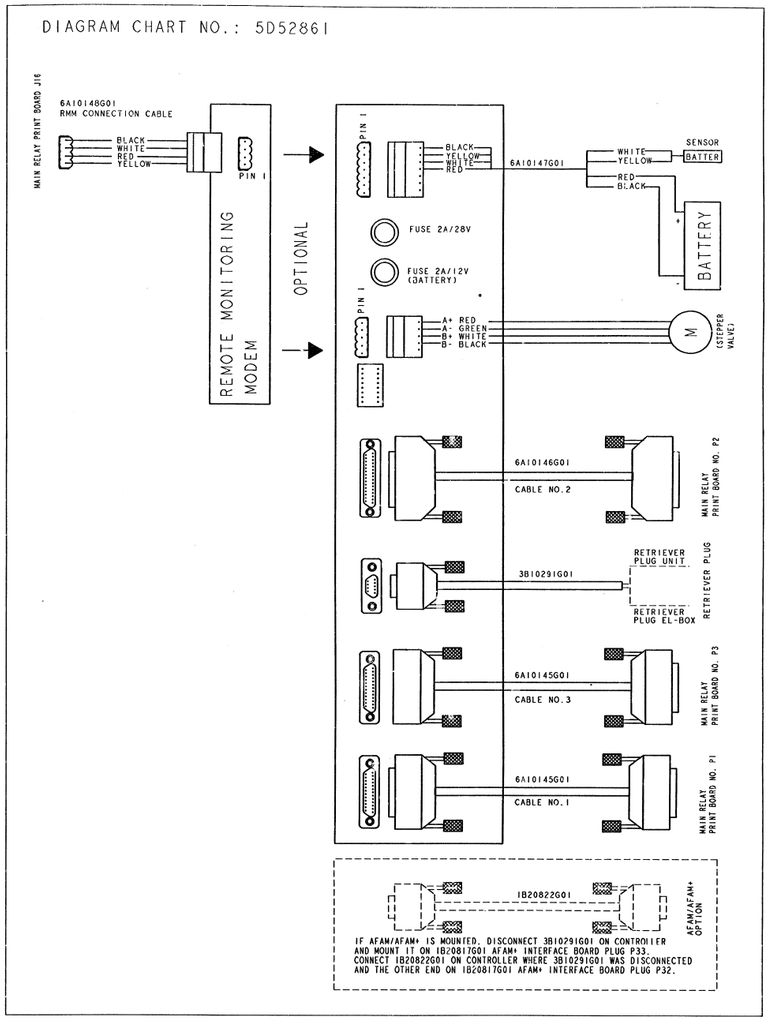


G05	G04	G03	G02	G01	ITEM NO	PART/DWG NUMBER	REV.	DESCRIPTION	MATERIAL SPEC	WEIGHT
					REV			LIST OF MATERIAL		

FOR TOLERANCES NOT SPECIFIED SEE TKS09-109 TKS11-131

THIRD ANGLE PROJECTION

LIMITS NOT ACCUMULATIVE OVER A CONTINUOUS LINE OF DIMENSIONS

DRAWING CONFORMS TO ANSI Y14.5M-1982

DESIGN DIMENSIONS ARE IN INCHES DIMENSIONS IN () ARE MILLIMETRIC EQUIVALENT.

FINISH: NONE

THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME

		DATE
DRAWN	LH	08-Nov-99
CHECKED	OT	08-Nov-99
APPROVED	OT	08-Nov-99
APPROVED	-	-

DIAGRAM WIRING HIGH VOLTAGE MPC 2000ID/MP3000

THERMO KING CORPORATION MINNEAPOLIS, MINNESOTA USA

SCALE: NONE | SHEET 1 OF 1

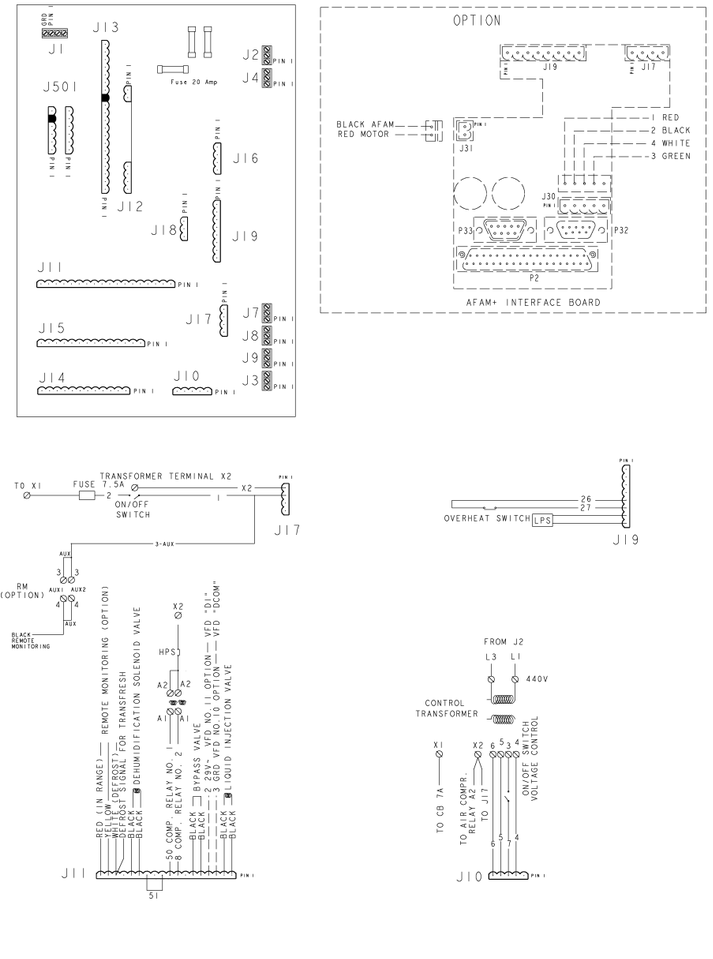
DRAWING NUMBER: 5D52861 | REV: E

PROE_D

MPC2000ID/MP3000 Controller Low Voltage Wiring Diagram

CHANGE ORDER	SYM	DESCRIPTION	DATE	BY	CH'D	APP
500555	F	CB 7A CHANGED TO FUSE 7.5 A	16-Oct-01	LG	OT	OT
76515	B	PIN 1 ADDED TO DIGRAM	05-Jan-00	LH	OT	OT
76902	C	ADDED RM OPTION	06-Mar-00	CJK	CJK	OT
77491	D	ADDED INFORMATION ABOUT VFD WIRING	24-May-00	KH	OT	OT
78594	E	UPDATED VIEW J18	16-Nov-00	LH	OT	OT

DIAGRAM CHART NO.: 5D52862



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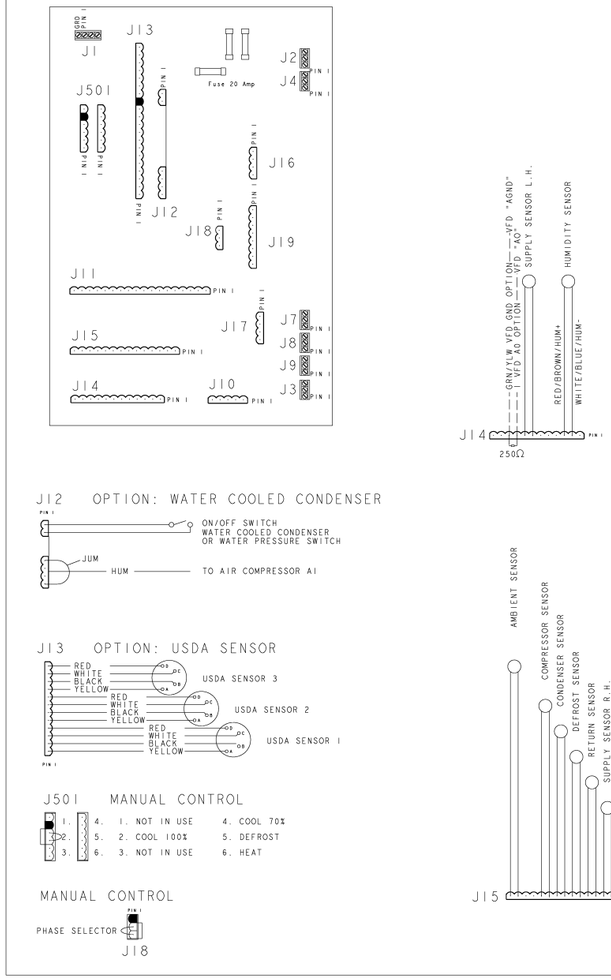

G05	G04	G03	G02	G01	ITEM NO	PART/DWG NUMBER	REV.	DESCRIPTION	MATERIAL SPEC	WEIGHT
					REV			LIST OF MATERIAL		

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FINISH NONE

		DATE
DRAWN	LH	08-Nov-99
CHECKED	OT	08-Nov-99
APPROVED	OT	08-Nov-99
APPROVED	-	-

THIS PRINT SUPERSEDES ANY OF EARLIER DATE DESTROY SAME

DIAGRAM WIRING LOW VOLTAGE MPC 2000ID/MP3000

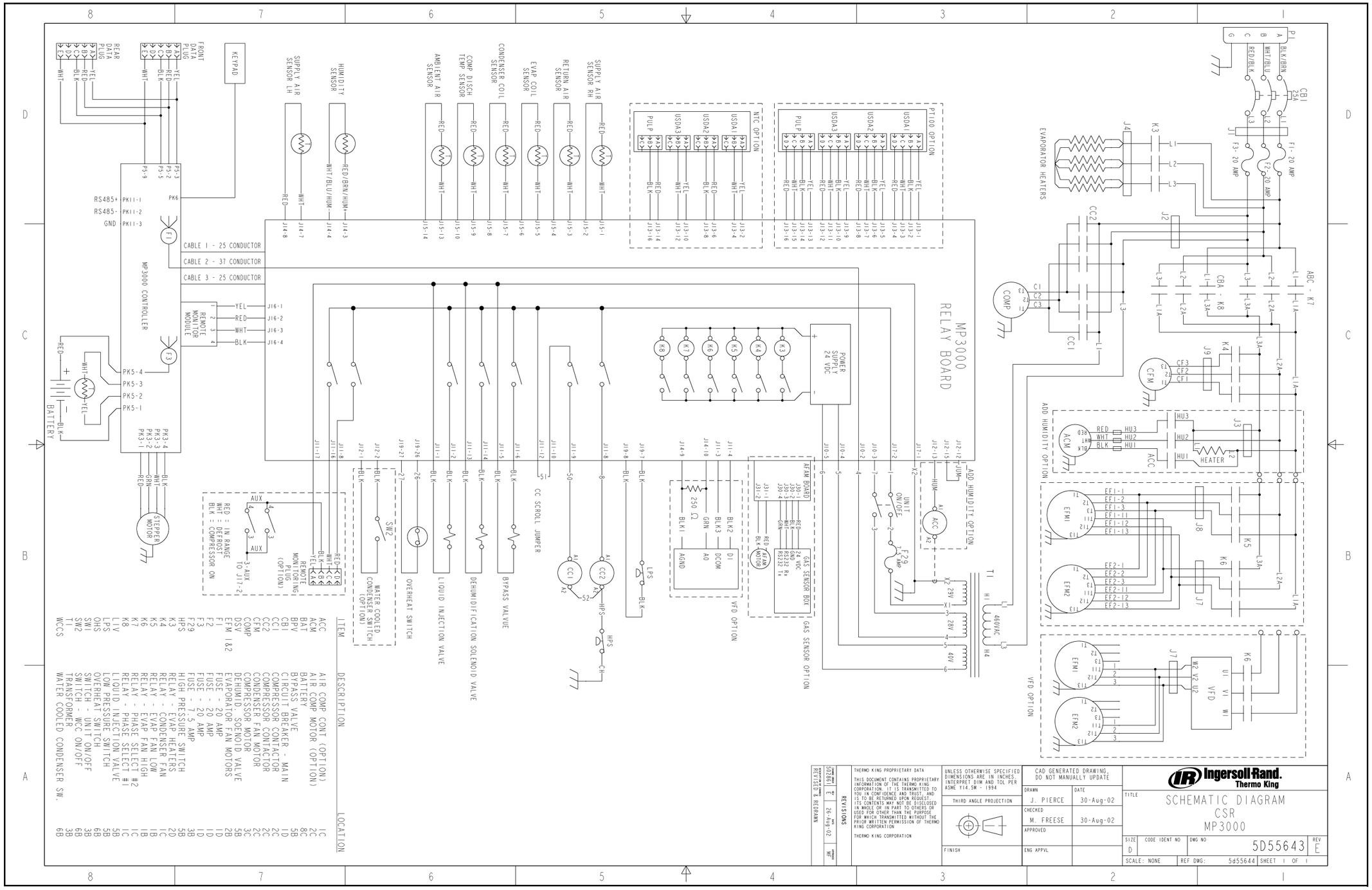
SCALE NONE SHEET 1 OF 1

THERMO KING CORPORATION MINNEAPOLIS, MINNESOTA USA

DRAWING NUMBER	REV
5D52862	F

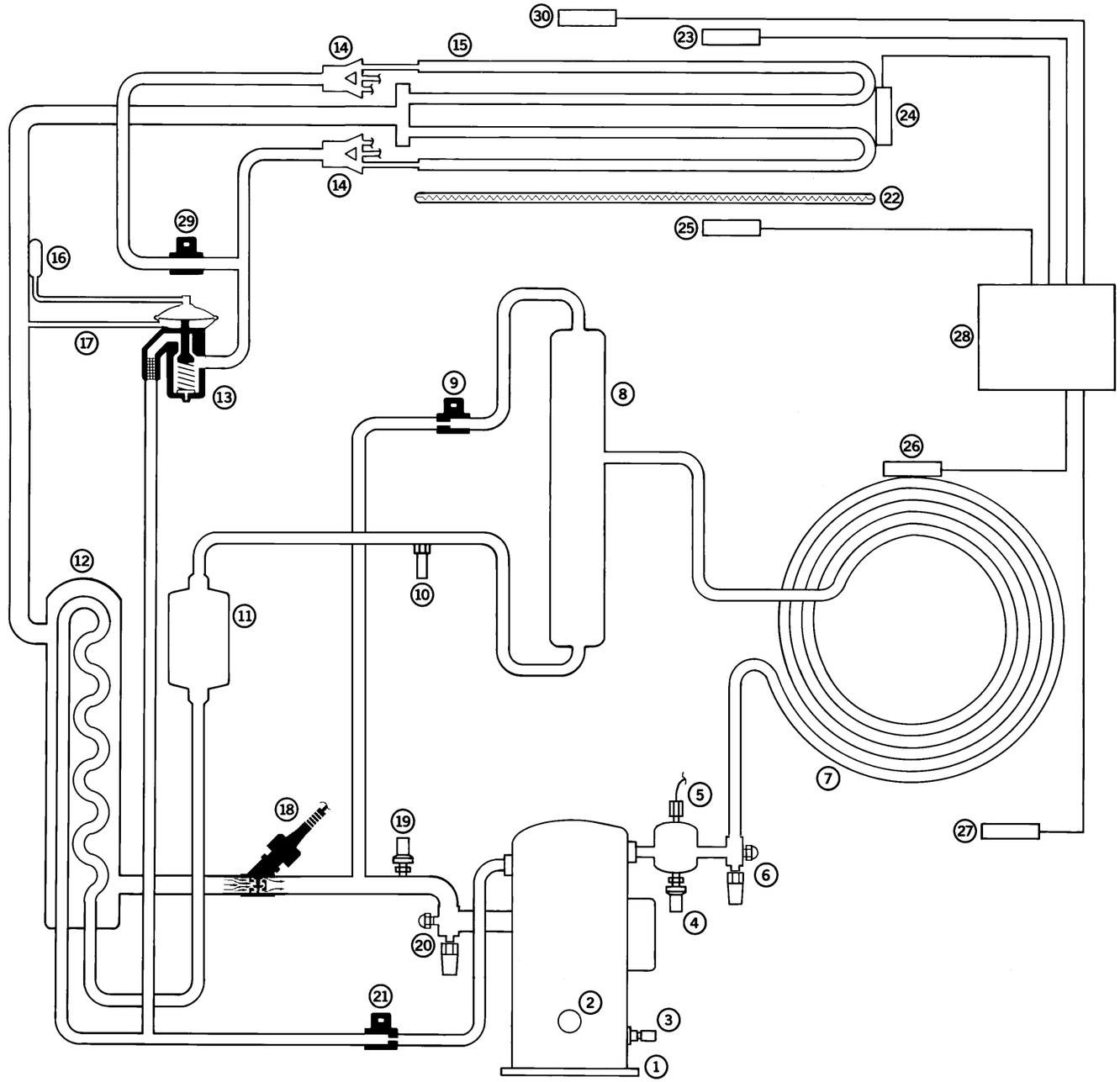
PROE_D

CSR Wiring Schematic MPC 2000ID/MP3000 Receiver 2 Fan Schematic Diagram



CSR Refrigeration System Components

1. Scroll Compressor
2. Sight Glass
3. Oil Fill / Drain Fitting
4. High Pressure Cutout Switch
5. Compressor Discharge Line Temperature Sensor
6. Discharge Service Valve (Option)
7. Condenser Coil (Circular)
8. Receiver Tank
9. Warm Gas Bypass Valve
10. High Pressure Relief Valve
11. Dehydrator (Filter Drier)
12. Heat Exchanger
13. Expansion Valve (TXV)
14. Distributor
15. Evaporator Coil
16. Expansion Valve Feeler Bulb
17. Equalizer Line
18. Stepper Motor Valve
19. Low Pressure Cutout Switch
20. Suction Service Valve
21. Liquid Injection Valve
22. Electric Heater
23. Return Air Sensor
24. Defrost (Evaporator Coil) Sensor
25. Supply Air Sensor
26. Condenser Coil Sensor
27. Ambient Sensor
28. Controller (MP-3000)
29. Coil/Dehumidify Solenoid Valve
30. Humidity Sensor



AXA0261

Flow and Pressure Diagram, CSR, Full Cool

1. Scroll Compressor
Compressor operation has a delay on initial start-up and when the unit shifts to a cooling mode requiring the compressor to start.

4. High Pressure Cutout Switch (HPCO)
Is a normally closed switch.
It opens at 3240 ± 50 kPa, 32.4 ± 0.5 bar, 470 ± 7 psig.
It closes at 2590 ± 260 kPa, 25.9 ± 2.6 bar, 375 ± 38 psig.

5. Compressor Discharge (Head) Temperature Sensor
Controller cycles condenser fan on typically when the compressor discharge temperature is above 50 C (122 F) and increasing.

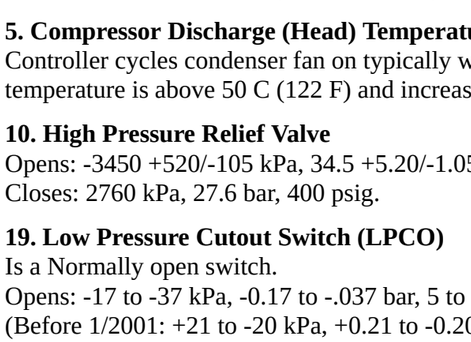
10. High Pressure Relief Valve
Opens: -3450 +520/-105 kPa, 34.5 +5.20/-1.05 bar, 500 +75/-15 psig.
Closes: 2760 kPa, 27.6 bar, 400 psig.

19. Low Pressure Cutout Switch (LPCO)
Is a Normally open switch.
Opens: -17 to -37 kPa, -0.17 to -.037 bar, 5 to 11 in. Hg vacuum.
(Before 1/2001: +21 to -20 kPa, +0.21 to -0.20 bar, 3 psig to 6” Hg vacuum).
Closes: 28 to 48 kPa, 0.28 to 48 bar, 4 to 7 psig.
(Before 1/2001:) 48 to -90 kPa, 0.48 to 0.90 bar, 7 to 13 psig

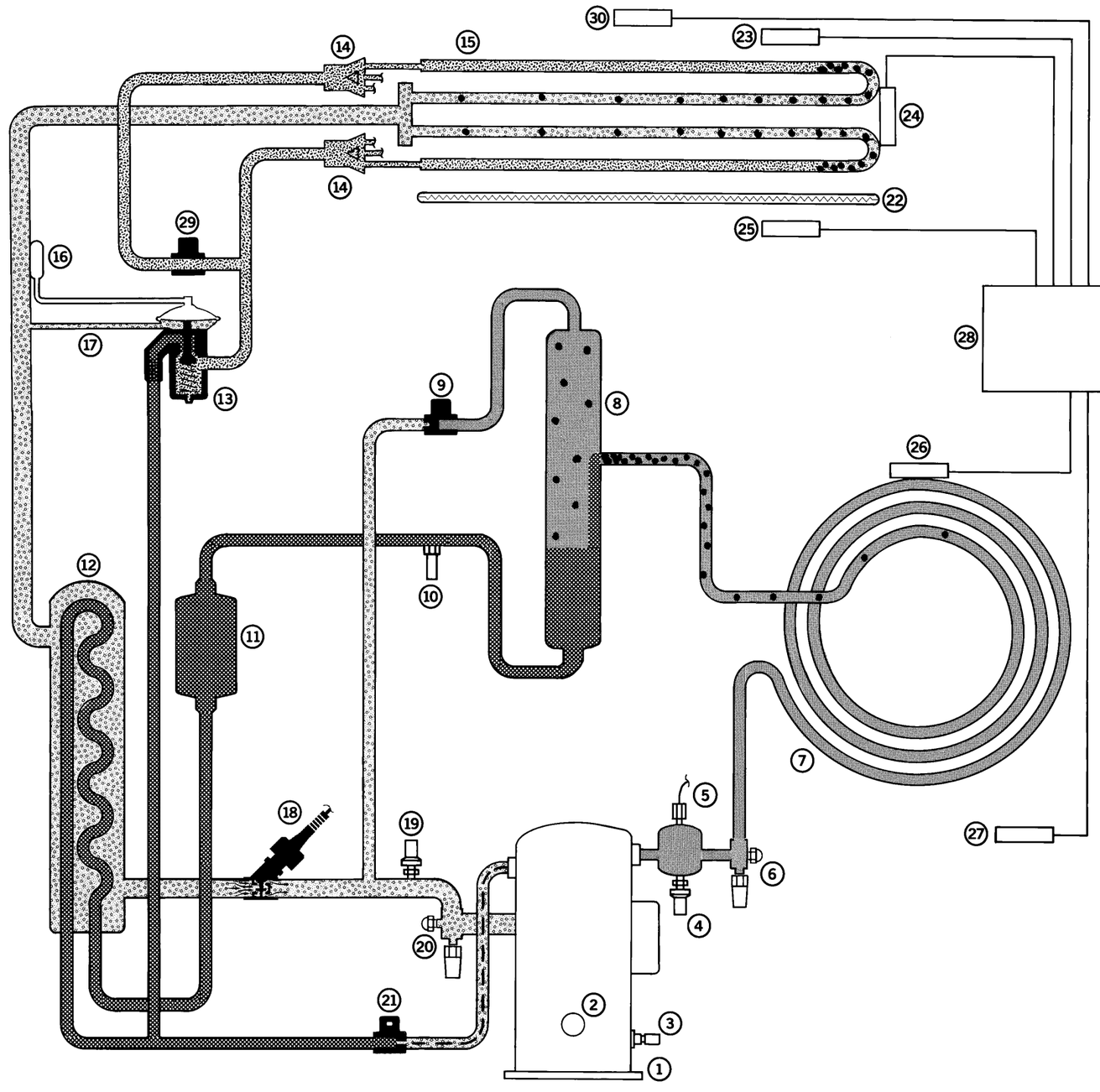
22. Electric Heaters
During the Defrost and Heat mode, the electric heaters are pulsed on and off.

26. Condenser Coil Temperature Sensor
Controller cycles condenser fan on typically when the condenser coil temperature is above 35 C (95 F).

28. Controller
MP-3000 with digital thermostat, thermometer and fault indicator monitor.



AXA0265



AXA0262

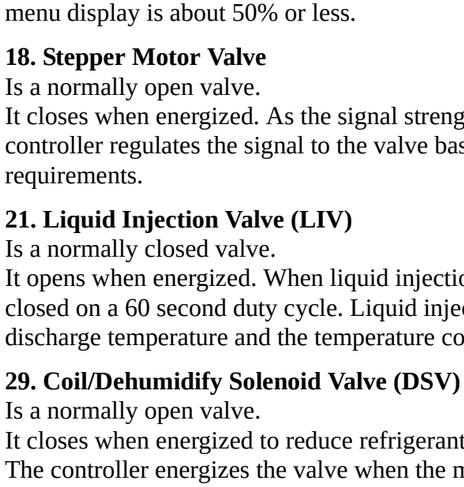
Flow and Pressure Diagram, CSR, Cool with Modulation (or Power Limit)

9. Warm Gas Bypass Valve
Is a normally closed solenoid.
It opens when energized to reduce cooling capacity when the Cooling Capacity in the Data menu display is about 50% or less.

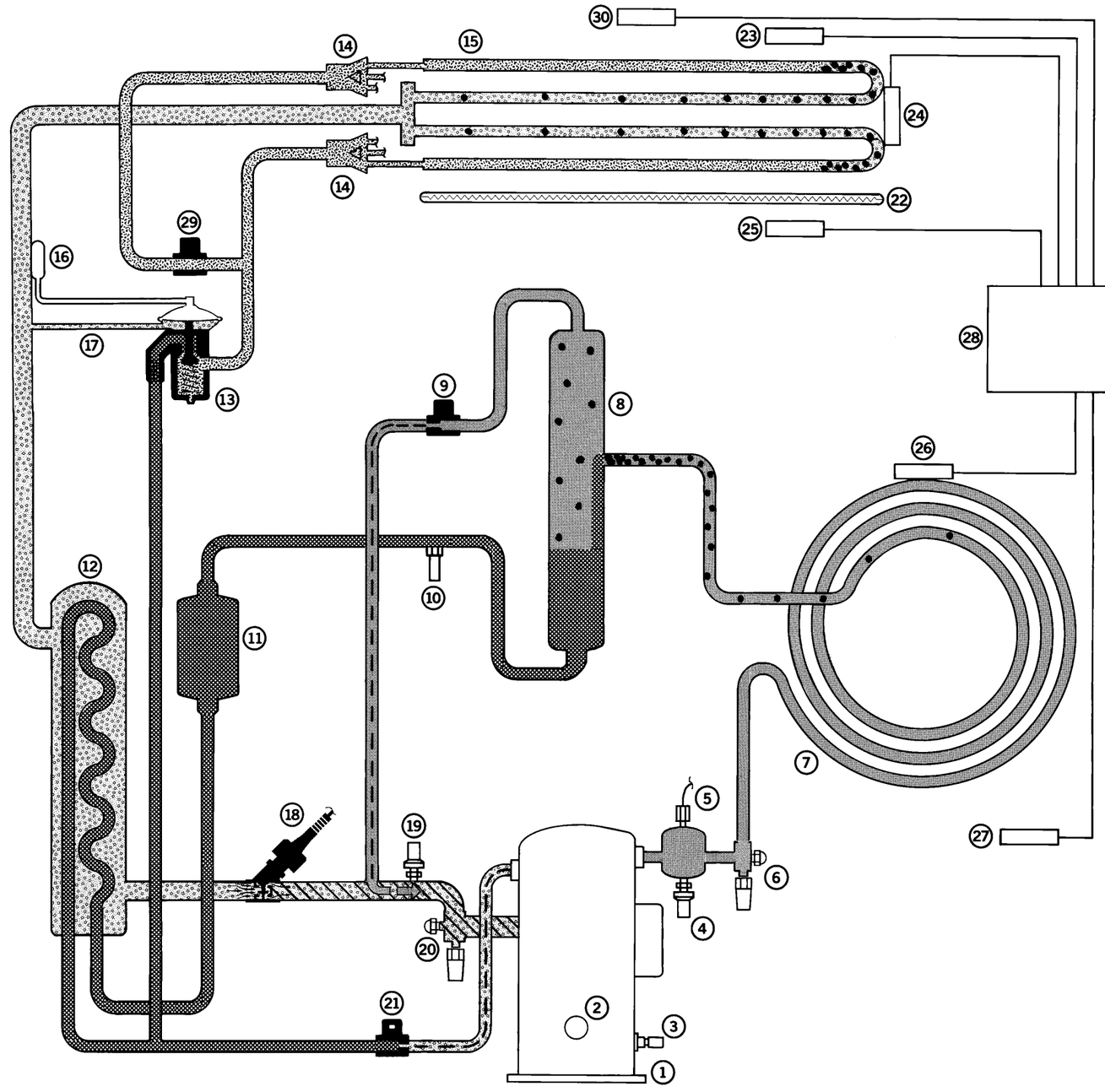
18. Stepper Motor Valve
Is a normally open valve.
It closes when energized. As the signal strength is increased, the valve closes more. The controller regulates the signal to the valve based on sensor temperature and power limit requirements.

21. Liquid Injection Valve (LIV)
Is a normally closed valve.
It opens when energized. When liquid injection is required, the valve is pulsed open and closed on a 60 second duty cycle. Liquid injection is controlled by the compressor discharge temperature and the temperature control algorithm.

29. Coil/Dehumidify Solenoid Valve (DSV)
Is a normally open valve.
It closes when energized to reduce refrigerant distribution to 50% of the evaporator coil. The controller energizes the valve when the modulation capacity decreases to 20%. The valve remains energized until the modulation capacity increases to 25%.



AXA0263



AXA0264

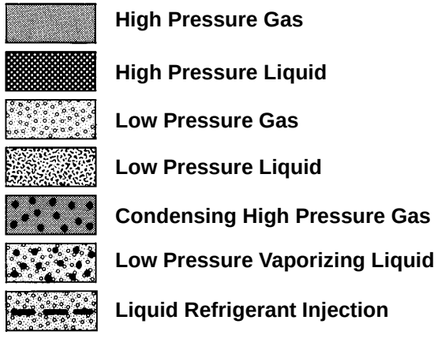
Flow and Pressure Diagram, CSR, Dehumidification

NOTE: At setpoints below 5 C (41 F), the dehumidification is not energized.

29. Coil/Dehumidify Solenoid Valve (DSV)
Is a normally open valve.
If the container humidity is 2% or more above the humidity setpoint, the temperature is in-range and the Cooling Capacity in the Data menu display is 85% or less; the controller will energize (close) the normally open solenoid. This closes refrigerant distribution to 50% of the evaporator coil, thereby lowering the temperature of the active part of the coil and condensing more moisture from the container air.

22. Electric Heaters
If the container humidity is 5% or more above the humidity setpoint, the temperature is in-range and the Cooling Capacity in the Data menu display is 70% or less; the controller will pulse the electric heaters on and off in addition to energizing (closing) the dehumidify solenoid valve. This increases the cooling load on the evaporator coil, thereby lowering the temperature of the entire coil and condensing more moisture from the container air.

30. Humidity Sensor (rH) (Option)
The humidity sensor is located at the top right hand side of the evaporator fan deck and measures the humidity of the return air from the cargo space.



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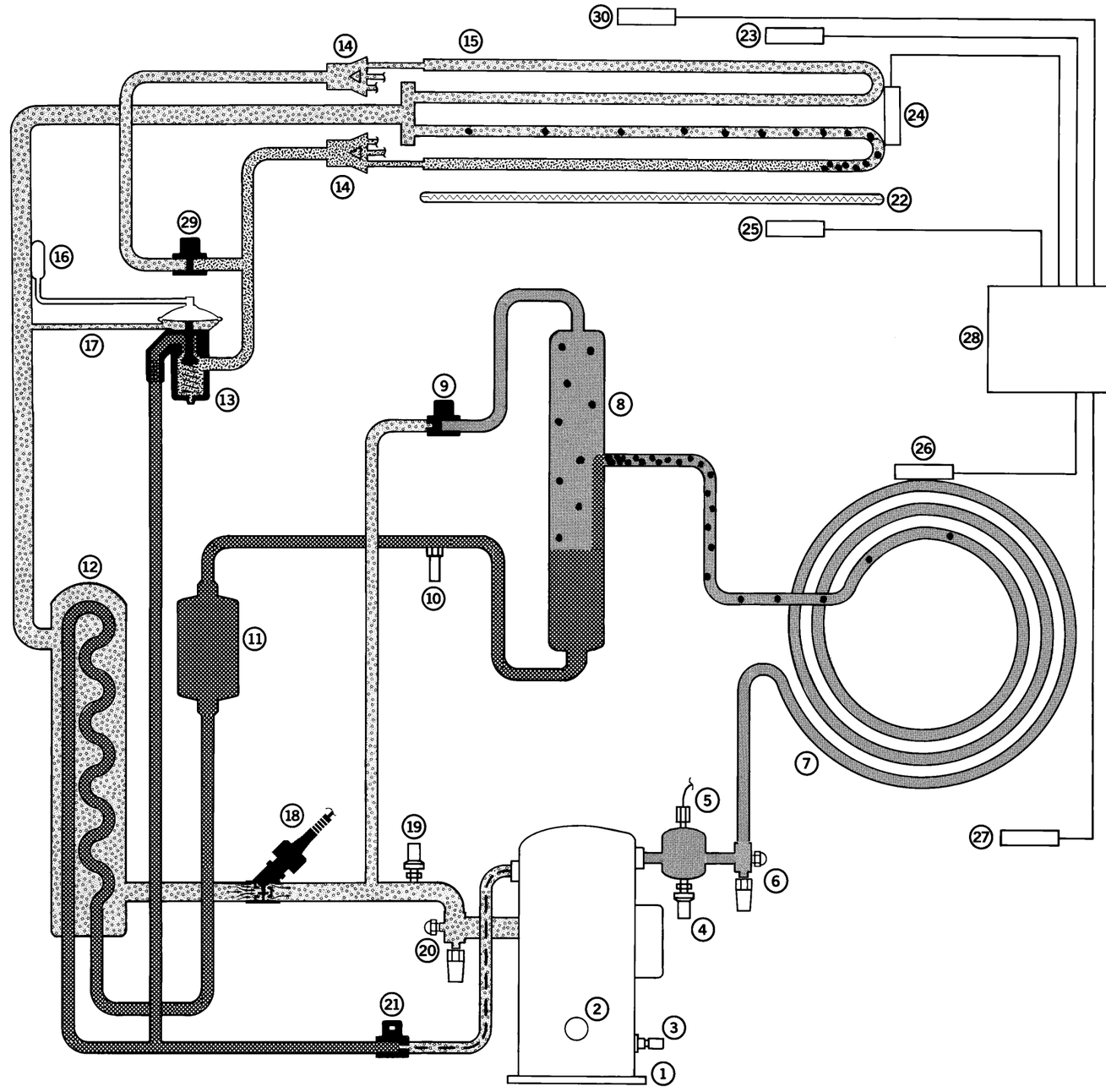

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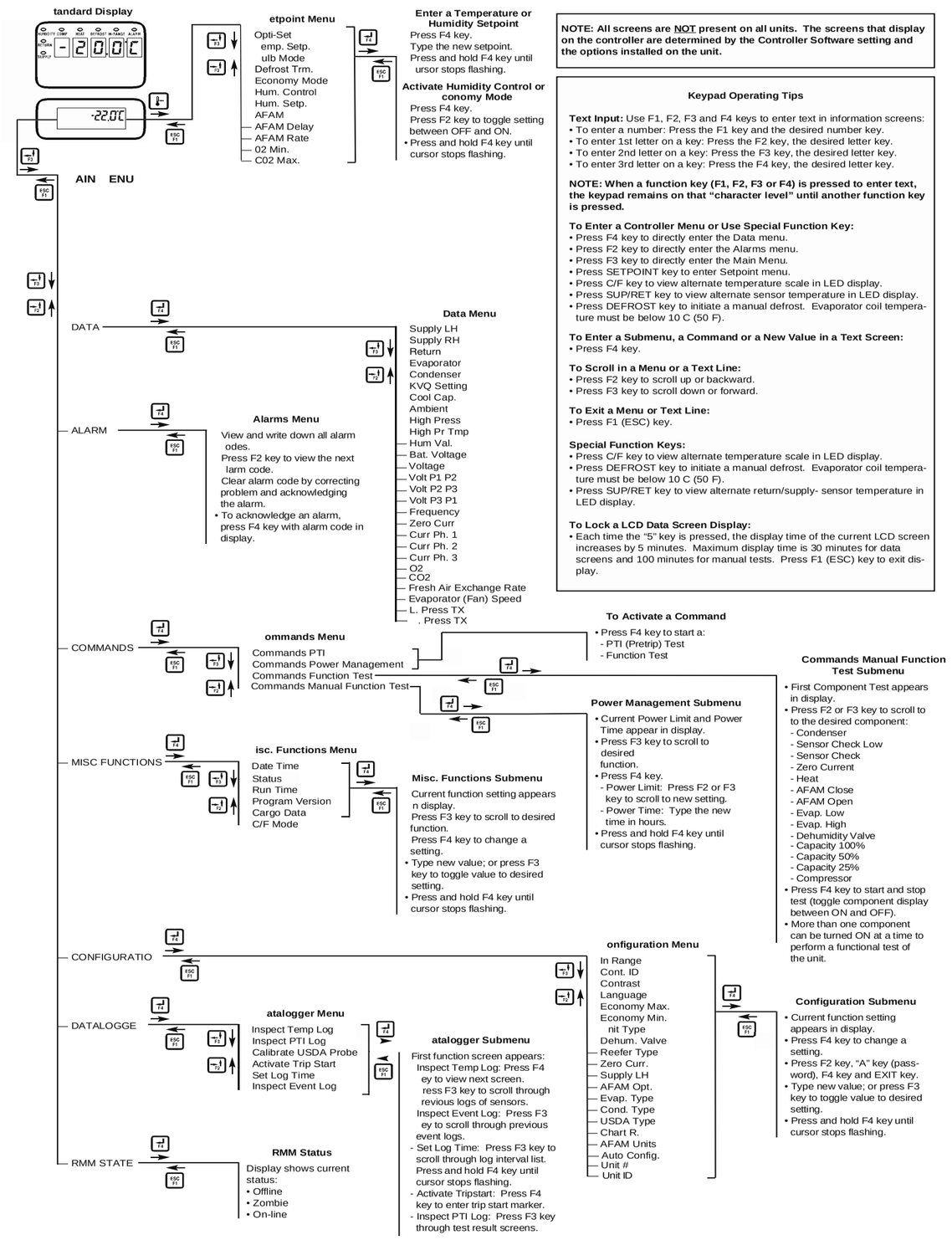

NOTE: All screens are NOT present on all units. The screens that display on the controller are determined by the Controller Software setting and the options installed on the unit.

Keypad Operating Tips

Text Input: Use F1, F2, F3 and F4 keys to enter text in information screens:
- To enter a number: Press the F1 key and the desired number key.
- To enter 1st letter on a key: Press the F2 key, the desired letter key.
- To enter 2nd letter on a key: Press the F3 key, the desired letter key.
- To enter 3rd letter on a key: Press the F4 key, the desired letter key.

NOTE: When a function key (F1, F2, F3 or F4) is pressed to enter text, the keypad remains on that "character level" until another function key is pressed.

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

To Enter a Submenu, a Command or a New Value in a Text Screen:
- Press F4 key.

To Scroll in a Menu or a Text Line:
- Press F2 key to scroll up or backward.
- Press F3 key to scroll down or forward.

To Exit a Menu or Text Line:
- Press F1 (ESC) key.

Special Function Keys:
- Press C/F key to view alternate temperature scale in LED display.
- Press DEFROST key to initiate a manual defrost. Evaporator coil temperature must be below 10 C (50 F).
- Press SUP/RET key to view alternate return/supply- sensor temperature in LED display.

To Lock a LCD Data Screen Display:
- Each time the "5" key is pressed, the display time of the current LCD screen increases by 5 minutes. Maximum display time is 30 minutes for data screens and 100 minutes for manual tests. Press F1 (ESC) key to exit display.