CF-II
M53 & M53.1

TK 41133-3-MM (Rev. 8/97)

The maintenance information in this manual covers CF-II unit model:

CF-II M53	**230-190V/460-380V Dual Voltage Unit**	**(090245)**
CF-II M53.1	**460-380V Unit**	**(090254)**

For further information, refer to…

Refrigeration Systems	**TK 5715**
Tool Catalog	**TK 5955**
Parts Manual	**TK 41106**

The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units. For detailed descriptions of our refrigeration systems, see the Thermo King Refrigeration Systems Maintenance Manual.

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-134a

CAUTION: Use ONLY Polyol Ester based refrigeration compressor oil (TK P/N 203-433) in this unit's R-134a refrigeration system.

DO NOT mix Polyol Ester based oil with PAG or standard synthetic compressor oils.

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!

CAUTION: When servicing Thermo King R-134a refrigeration systems, use only those service tools certified for and dedicated to R-134a refrigerant and Polyol Ester based compressor oils. Residual non-HFC refrigerants and non-Ester based oils will contaminate this unit's refrigeration system.

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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. Make 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. Make 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.

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.

First Aid

- 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

Microprocessor Controller Calibration and Repair

When servicing the controller, it is very important to prevent electrostatic discharges to the controller. Potential differences much lower than those which produce a small spark between a finger and door knob can cause severe damage to any solid-state component. When servicing the controller, refer to "General Safety Precautions for Servicing Units Equipped with THERMOGUARD Microprocessor Controllers" in the Electrical Maintenance section of this manual.

Welding of Units and/or Containers

When electric welding is to be performed on any portion of the refrigeration unit, container or container chassis when the refrigeration unit is attached, it is necessary to ensure that welding currents are NOT allowed to flow through the electronic circuits of the unit. Before welding, refer to "General Safety Precautions for Servicing Units Equipped with THERMOGUARD Microprocessor Controllers" in the Electrical Maintenance section of this manual.

ELECTRICAL HAZARDS

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 an operating refrigeration unit. Lethal voltage potentials can exist on connections in the high voltage tray of the control box, the electric motor junction boxes and the Remote Monitor Unit (RMU) box.

Precautions

1. When working on high voltage circuits on the refrigeration unit, do not make any rapid moves. If a tool drops, do not grab for it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
2. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.
3. Do not wear jewelry, watch or rings. These items can short out and cause severe burns to the wearer.
4. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
5. 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.
6. 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.

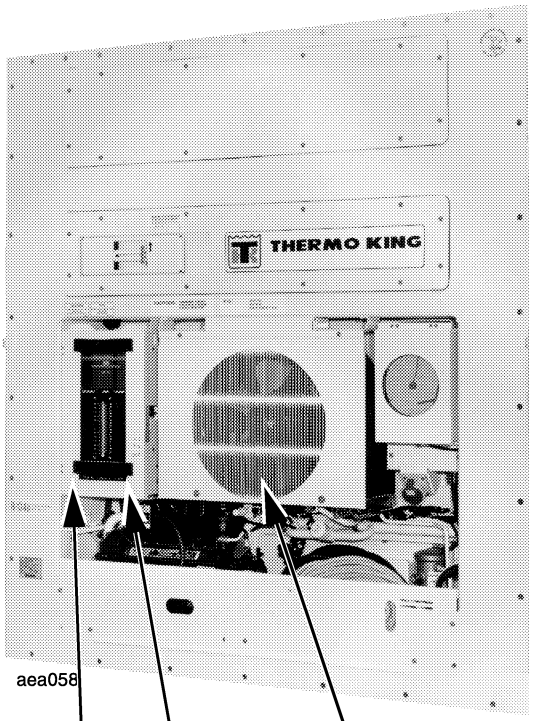
If the victim has to be removed from a live circuit, pull the victim off with a non-conductive material. Use the victim's coat, a rope, wood, or loop your belt around the victim's leg or arm and pull the victim off. DO NOT TOUCH the victim. You can receive a shock from current flowing through the victim's 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 used in the refrigeration unit are low voltage (24 Vac 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 short out electrical circuits and cause severe burns to the wearer.



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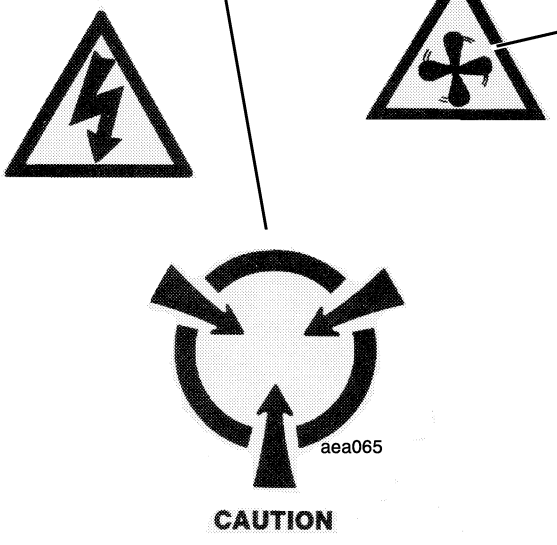
R-134a

CAUTION: Use ONLY Polyol Ester based refrigeration compressor oil (TK P/N 203-433) in this unit's R-134a refrigeration system.

DO NOT mix Polyol Ester based oil with PAG or standard synthetic compressor oils.

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!

CAUTION: When servicing Thermo King R-134a refrigeration systems, use only those service tools certified for and dedicated to R-134a refrigerant and Polyol Ester based compressor oils. Residual non-HFC refrigerants and non-Ester based oils will contaminate this unit's refrigeration system.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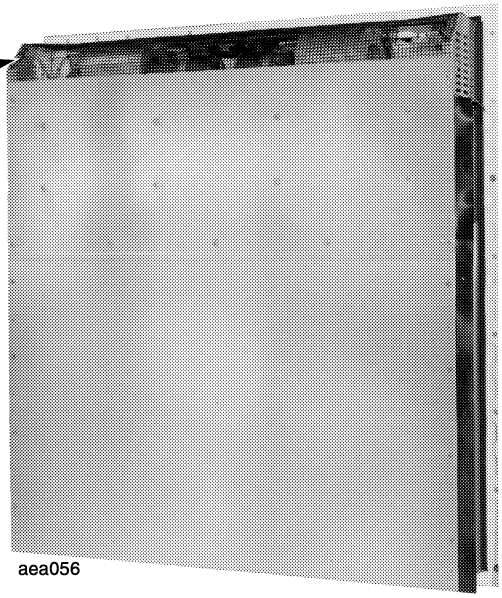
CAUTION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Specifications

Full Cool Operation Net Cooling Capacity*

Return air to evaporator coil inlet	460/230V, 3 Phase, 60 Hz Power					380/190V, 3 Phase, 50 Hz Power				
	Net Cooling Capacity		Power Consumption			Net Cooling Capacity		Power Consumption		
	BTU/hr	Kcal/hr	Amps		KW	BTU/hr	Kcal/hr	Amps		KW
Full Cool Operation			460V	230V				380V	190V	
70 F (21.1 C)	47,000	(11,844)	19.0	38.0	12.0	37,000	(9,324)	14.5	29.0	9.2
35 F (1.7 C)	38,000	(9,576)	17.0	34.0	10.6	33,500	(8,442)	12.5	25.0	8.0
0 F (-17.8 C)	20,000	(5,040)	11.5	23.0	5.8	16,700	(4,208)	8.5	17.0	4.3
-13 F (-25 C)	14,000	(3,528)	10.6	21.2	4.5	11,667	(2,940)	8.8	17.6	3.8

System net cooling capacity with a 100 F (37.8 C) ambient air temperature and R-134a.

System Net Heating Capacity

Heater Type (Location)	Quantity	460/230V, 3 Phase, 60 Hz Power			380/190V, 3 Phase, 50 Hz Power		
		Watts (Total)	Heating Capacity		Watts (Total)	Heating Capacity	
			Btu/hr	(Kcal/hr)		Btu/hr	(Kcal/hr)
Evaporator coil electric resistance rods	2	3,600	12,287	(3,096)	2,460	8,396	(2,116)
Drain pan electric resistance rods	1	1,800	6,143	(1,548)	1,230	4,198	(1,058)
Evaporator blower motors	2	2,100	7,167	(1,806)	1,200	4,096	(1,032)
Total Net Heating Capacity	—	7,500	25,597	(6,450)	4,890	16,690	(4,206)
Defrost Net Heating Capacity**	—	5,400	18,430	(4,644)	3,690	12,594	(3,174)

***Evaporator blower motors and fans are shut off.**

Evaporator Airflow

External Static Pressure (Water Column)	460V, 3 Phase, 60 Hz Power				380 V, 3 Phase, 50 Hz Power			
	High Speed		Low Speed		High Speed		Low Speed	
	ft^3/min	(m^3/hr)	ft^3/min	(m^3/hr)	ft^3/min	(m^3/hr)	ft^3/min	(m^3/hr)
0 in. (0 mm)	3650	(6201)	1850	(3143)	2816	(4784)	1233	(2095)
0.5 in. (12.7 mm)	3400	(5777)	1300	(2209)	2615	(4443)	758	(1288)
0.75 in. (19.0 mm)	3300	(5607)	—	—	2448	(4159)	—	—
1.0 in. (25.4 mm)	3100	(5267)	—	—	2170	(3687)	—	—
2.0 in. (50.8 mm)	2500	(4248)	—	—	1750	(2973)	—	—

REFRIGERATION SYSTEM

Compressor Model No.	3DST-075E TFD 252, Semi-hermetic with Copeland Discus® valve design
Refrigerant Charge	14 lb. (6.35 Kg) R-134a
Compressor Oil Capacity	4 qts. 6 oz. (3.96 liter)*
Compressor Oil Type	Polyol Ester Based Type (required) TK Part No. 203-433**
Discharge Pressure Regulating Valve Setting	70 psig (483 kPa)
High Pressure Cutout Switch: Cutout	350 ± 10 psig (2415 ± 69 kPa)
Cutin	240 ± 10 psig (1656 ± 69 kPa)
Condenser Fan Speed Pressure Switch: Open	200 ± 7 psig (1379 ± 48 kPa)
Close	160 ± 7 psig (1103 ± 48 kPa)
High Pressure Relief Valve: Relief Pressure	500 +50/-15 psig (3447 +345/-104 kPa)
Reset	400 psig (2758 kPa)
Low Pressure Cutout Switch: Cutout	5 to 17 in. Hg vacuum (-17 to -57 kPa)
Cutin	1 to 7 psig (7 to 48 kPa)
Liquid Injection Control (Controls Off Compressor Discharge Temperature):	
Energizes (Opens) Liquid Injection Valve	280 F (137.8 C)
De-energizes (Closes) Liquid Injection Valve	270 F (132.2 C)
Compressor Shutdown (Auto Reset)	298 F (147.8 C)
Liquid Injection Valve (Compressor): Voltage	24 Vac
Cold Resistance	5.6 ohms
Liquid Line Solenoid Valve (Refrigeration System):	
Type	Normally Closed
Voltage	24 Vac
Cold Resistance	5.6 ohms
Suction Line Solenoid Valve: Type	Normally Closed
Voltage	24 Vac
Cold Resistance	5.6 ohms
Modulation Valve: Voltage	12 Vdc
Current Draw	0 to 0.4 amperes, valve open 0.4 to 1.4 amperes, valve modulates to close Above 1.4 amperes, valve closed
Resistance	7.6 ohms at 75 F (23.9 C) ambient

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.

****Use Polyol Ester compressor oil ONLY. DO NOT use or add standard synthetic or mineral oils to this unit's refrigeration system. If Ester based oil becomes contaminated with moisture or with standard oils, dispose of properly—DO NOT USE!***

ELECTRICAL SYSTEM

Compressor Motor:	Type	460/380V, 60/50 Hz, 3 Phase
	Horsepower	7.5 hp — 60 Hz
	RPM	1765 rpm — 60 Hz 1465 rpm — 50 Hz
	Full Load Amps	16.4 amps — 460V, 60 Hz
	Locked Rotor Amps	83.0 amps — 460V, 60 Hz
Condenser Fan Motor:	Type	460/380V, 60/50 Hz, 3 Phase
	Horsepower	1.0 hp — 60 Hz 0.83 hp — 50 Hz
	RPM	1725 rpm — 60 Hz 1140 rpm — 50 Hz
	Full Load Amps	1.65 amps — 60 Hz
	Locked Rotor Amps	13.5 amps — 60 Hz 12.6 amps — 50 Hz
Evaporator Blower Motors:	Type	460/380V, 60/50 Hz, 3 Phase
	Number	2
	Horsepower	1.0 hp — 60 Hz, High Speed 0.25 hp — 60 Hz, Low Speed
	RPM	3450 rpm — 60 Hz, High Speed 1725 rpm — 60 Hz, Low Speed
	Full Load Amps	1.6 amps — 60 Hz, High Speed 0.8 amps — 60 Hz, Low Speed
	Locked Rotor Amps	10.5 amps — 60 Hz, High Speed 3.8 amps — 60 Hz, Low Speed

HUMIDITY MONITOR SENSOR

Operating Temperature Range	32 to 140 F (0 to 60 C)
Power Requirement	12 Vdc
Current Draw	3.5 mA
Sensor Output	3109 to 3600 Ohms; 3353 Ohms at 50% relative humidity; varies 5 Ohms/1% change in relative humidity

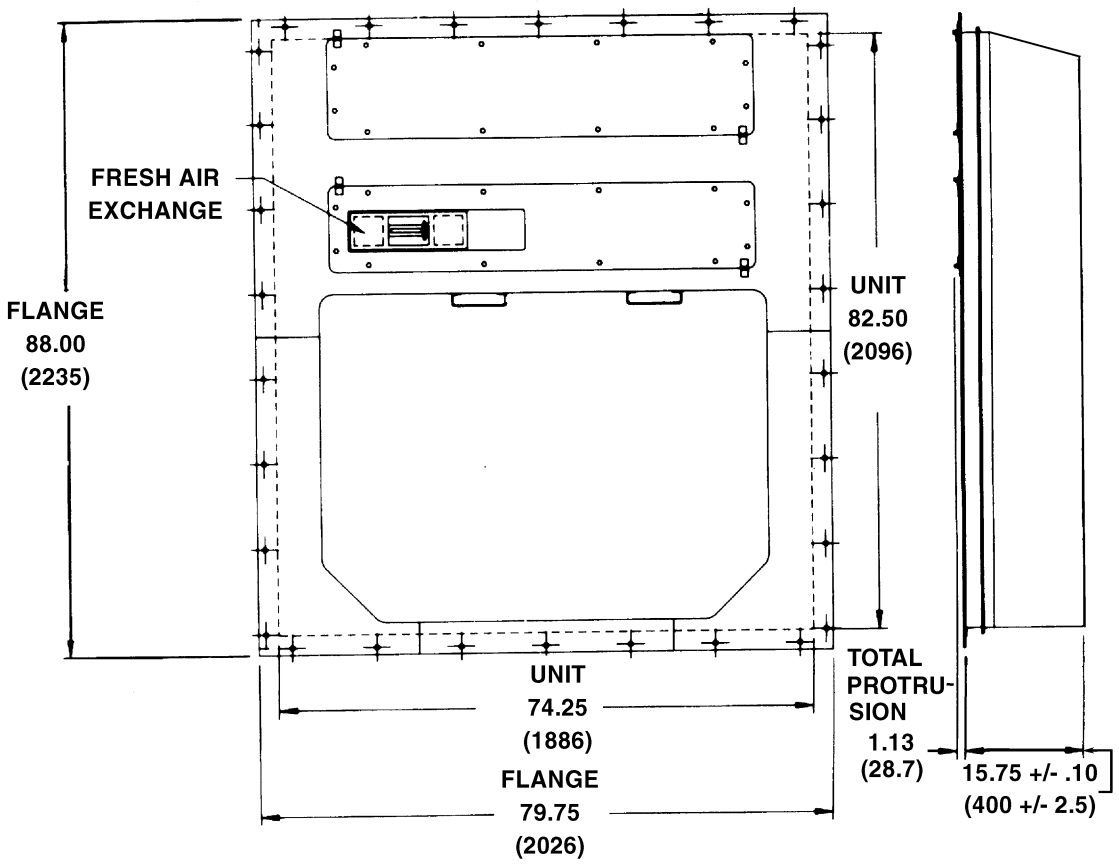
THERMOGUARD µP-A+ MICROPROCESSOR

Temperature Controller:	Type	Electronic THERMOGUARD µP-A+ with digital thermostat, thermometer and fault indictor monitor
	Setpoint Range	-20 to + 80 F (-28.9 to + 26.7 C)
	Digital Temperature Display	-40 to +99.9 F (-40 to + 37.7 C)
Original Equipment Software Version:	CF-II M53	5.00.17
	CF-II M53.1	5.00.19
Software Configuration Block Number		13
Defrost Initiation:	Coil Sensor	Coil must be below 45 F (7.2 C) to initiate defrost by demand, timer or manual switch
Factory Programmed Automatic Default Initiation		5.00 17 software “12H” under dFIn in Microprocessor Menu. The unit defrosts automatically every 12 hours or when the demand defrost function indicates the evaporator coil requires defrost.
Defrost Termination:	Coil Sensor	Terminates defrost when coil sensor temperature exceeds 75 F (23.9 C)
	Interval Timer	Terminates defrost 45 minutes after initiation if coil sensor has not terminated defrost
	Power Off	Turning unit On-Off switch OFF terminates defrost
Evaporator Over Temperature Protection (Operates only when heaters are active)		Opens heater contactor at 100 F (37.8 C). Initiates alarm at 110 F (43.3 C)

PHYSICAL SPECIFICATIONS

Fresh Air Exchange Venting System	Pre-calibrated vent door adjustable from 0 to 150 ft^3/min. (0 to 255 m^3/hr) at 0.5 in. (12.7 mm) water column external static pressure
Unit Weight (net):CF-II M53	1430 lb (649 Kg)
CF-II M53.1	1285 lb (583 Kg)

Unit Dimensions: Inches (Millimeters)



COMPRESSOR TORQUE CHART

Copeland Compressor Standard Bolt Torque—Model 3D		
BOLT USAGE	**In.-lb.**	**N•m**
Bottom Plate: Grade 5	400	45.2
Grade 8	525	59.3
Housing Cover	400	45.2
Oil Pump to Housing Cover	300	33.9
Bearing Cover to Housing Cover	300	33.9
Stator Cover: Grade 5	400	45.2
Grade 8	525	59.3
Cylinder Head	525	59.3
Oil Screen Cover	275	31.1
Crankcase Heater Plug	400	45.2
Discharge & Suction Valve:		
5/16 in.—18	225	25.4
1/2 in.—13	500	56.5
Pipe Plug, 1/4 in.	300	33.9
Pipe Plug, 1/8 in.	200	22.6
Oil Sight Glass: Grade 5	40	4.5
Grade 8	75	8.5
Terminal Plate	300	33.9
Nut on Top of Terminal Plate	45	5.1
Nut on Top of Jumper Bar	80	9.0
O-ring Nut on Compressor Oil Filter Inlet	120-144	14-16
Oil-ring Nut on Compressor Oil Filter Outlet	216-240	20-27

Service Guide

Pre-trip	Every 1,000 Hours	Annual/ Yearly	Inspect/Service These Items
			Electrical
•	•	•	Check condenser fan and evaporator blower rotation.
•	•	•	Check defrost initiation and termination.
•	•	•	Check unit cycle sequence.
•	•	•	Inspect electrical contacts.
•	•	•	Inspect wire harness for damaged wires or connections.
	•	•	Check operation of protection shutdown circuits.
		•	Check microprocessor calibration.
			Refrigeration
•	•	•	Check refrigerant charge.
•	•	•	Check for proper suction pressure.
•	•	•	Check compressor oil level.
		•	Check compressor efficiency and pump down refrigeration system.
		•	Replace dehydrator and check discharge and suction pressure.
			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.
			Dehumidification Control System
	•	•	Check system operation.

Unit Description

GENERAL DESCRIPTION

Model CF-II M53 and CF-II M53.1 are all-electric, one-piece, self-contained refrigeration units with bottom air discharge. Each unit is designed to cool and heat large containers for shipboard or overland transit. Each unit mounts in the front wall of the container.

Model CF-II M53 refrigeration units are equipped with two 60 ft (18.3 m) power cables for operation on 460-380V/3 Ph/60-50 Hz power or 230-190V/3 Ph/60-50 Hz power. Both power cables are stored in the cord storage compartment in the condenser section. For operation on 460-380V/3 Ph/60-50 Hz power, plug the 460-380V power cable into the proper power supply. For operation on 230/190V power, a 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. The receptacle will receive the 460-380V unit power plug for unit operation on 230-190V/3 Ph/60-50 Hz power.

Model CF-II M53.1 units are equipped with one 60 ft (18.3 m) power cable for operation on 460-380V/3 Ph/60-50 Hz power. The power cable is stored in the cord storage compartment 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 compressor, condenser fan and evaporator blower motor operation.

Unit features include a semi-hermetic compressor with a liquid injection system; twin, two-speed evaporator blowers; an air exchange system; indicator lights; recording thermometer; remote monitoring receptacle; Integrated Remote Monitor Unit (IRMU) for power line communications; USDA Cold Treatment temperature recording; dehumidification control system and THERMOGUARD µP-A+ Microprocessor temperature controller with discharge air, return air and coil temperature sensors to control, monitor and record operation.

Semi-hermetic Compressor with Liquid Injection Cooling System

The refrigeration unit includes a semi-hermetic Copeland compressor with a forced feed lubrication system, ambient compensated internal overload and high temperature protectors, and a refrigerant injection system.

Two-Speed Evaporator Blowers

Twin, two-speed evaporator blowers operate continuously to circulate air inside the container. The fans operate on high speed at return air temperatures above 24 F (-4.4 C) for perishable cargo. At return air temperatures below 24 F (-4.4 C), the evaporator blowers operate on low speed for frozen cargo.

Air Exchange System

The air exchange system removes harmful gases from containers carrying sensitive perishable commodities.

Indicator Lights

Indicator lights mounted on the control box door signal Unit On, Power Limit, Cool, Modulation, In-range, Null, Heat and Defrost.

Remote Monitoring Receptacle

A remote monitor connector provides 24Vac signals for remote monitoring of Compressor On, Defrost and In-range conditions.

Integrated Remote Monitor Unit (IRMU)

The IRMU is an interface module that allows communications between the µP-A+ Microprocessor and the Thermo King Thermo Net™ system. Data to and from the controller serial port is transmitted at a rate of 19200 buad via the 460/380 volt, 3-phase ship or shore electrical power system.

USDA Cold Treatment Temperature Recording

The THERMOGUARD µP-A+ Microprocessor controller includes provisions for he use of three USDA sensors. These sensors allow temperatures in various areas of the load to be monitored and recorded to United States Department of Agriculture use in monitoring Cold Treatment shipments. The microprocessor must be programmed with a THERMOGUARD MicroPac™ or PC-PAC™ software for six sensor recording to use the USDA features.

Dehumidification Control System

The dehumidification system lowers the relative humidity in the container to the humidity setpoint. The relative humidity setpoint is adjustable between 60% and 100% (factory default setting = 75%).

THERMOGUARD µP-A+ Microprocessor

The Thermo King THERMOGUARD µP-A+ Microprocessor incorporates refrigeration system component control, thermostat, digital thermometer, fault indicator and data recording capabilities into one self-contained package. The µP-A+ Microprocessor Temperature Controller provides accurate air temperature control of perishable and frozen cargo.

The microprocessor mounts inside a weather tight control box. The digital displays and alarm light are clearly visible through a window in the control box door. A specially designed door latch on the control box cover provides quick access to microprocessor keypads.

UNIT FEATURES

- 460-380V/3Ph/60-50 Hz, 60 ft (18.3 m) Power Cable and Plug
- Dual Voltage Feature (CF-II M53 Only): 15 KVA Auto Transformer with 460-380V Power Receptacle and 230-190V/3 Ph/60-50 Hz, 60 ft (18.3 m) Power Cable and Plug
- 3DST Semi-hermetic Compressor w/7.5 Hp Motor
- R-134a w/Polyol Ester Compressor Oil (TK P/N 203-433)
- µP-A+ Microprocessor Controller Software
  - Proportional-integral Derivative Capacity Control Algorithm
  - Microprocessor Displays Controlling Air Sensor Temperature:
    - Discharge Air Sensor During Cool, Modulation Cool and Null on Fresh Loads.
    - Return Air Sensor During Heat on Fresh Loads
    - Return Air Sensor During Cool and Null on Frozen Loads
- Compressor Bump Start
- Pump Down on Pressure Switch for Return Air Temperature ≥ 17 F (-8.4 C)
- Pump Down Timed for 30 Seconds for Return Air Temperature <17 F (-8.4 C)
- Factory Programmed Automatic Defrost (“12H”); 12 hour in-range defrost internal and 6 hour pull-down defrost interval
- Container Dehumidification Control System; Microprocessor is programmable for relative humidity control setpoints from 60% to 100%
- Dual Valve Suction Modulation System with Modulation Valve and Suction Line Solenoid Valve
- Discharge Line Pressure Regulating Valve
- Single-Speed Condenser Fan Motor
- Two-Speed Evaporator Blower Motors
- Bottom Evaporator Air Discharge
- Automatic Phase Selection

- Integrated Remote Monitor Unit, High Data Rate
- USDA Cold Treatment Three (3) Sensor Temperature Recording
- Fresh Air Exchange System
- ABS Certification
- Power Limit Current Sensing
- Saginomiya SKM Recording Thermometer
- Mode Indicators (LEDs)
- Stainless Steel Receiver Tank with Two Moisture Indicating Sight Glasses
- Remote Monitor Connector, 24 Vac

PROTECTION FEATURES

- 25 Ampere Main Power Circuit Breaker
- Control System Circuit Breakers
- Refrigerant High Pressure Relief Valve
- Refrigerant High Pressure Cutout Switch
- Evaporator High Temperature Protection w/Coil Sensor
- Compressor Liquid Injection System to Regulate Compressor Discharge Temperatures
- Internal Overload Protection for Fan Motors
- Internal Overload Protection for Compressor Motor

OPERATING MODES

NOTE: See µP-A+ Microprocessor Temperature Controller chapter for complete sequence of operation.

When the unit is started, two four-digit fluorescent displays on the microprocessor illuminate. A sequence start of the required loads occurs during initial startup of the microprocessor and when a control mode shift requires the compressor to start. After the microprocessor relays and unit loads energize, the digital displays indicate the setpoint temperature and the return air temperature.

NOTE: If the compressor has been OFF for more than 8 hours, the microprocessor performs a compressor bump start.

The µP-A+ Microprocessor uses a complex proportional-integral derivative 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 discharge air temperature.

The unit operates in either the Fresh or Frozen mode. The Fresh to Frozen mode transition point is 24 F (-4.4 C).

Fresh Loads: Microprocessor Setpoint Above 24 F (-4.4 C)

Temperature control by the microprocessor is based on the discharge or return air sensor temperature, the setpoint, the modulation temperature range and the pull-down rate. The evaporator blowers operate in high speed.

- Cool
- Modulation Cool
- Null (compressor pumps down low side and stops, evaporator blowers operate, if condenser fan is ON, it will operate for approximately two minutes and then stop)
- Heat (resistance heaters on, evaporator blowers operate)
- Defrost (resistance heaters on, evaporator blowers stop)

Frozen Loads: Microprocessor Setpoint Below 24 F (-4.4 C)

Temperature control by microprocessor is based on the return air sensor temperature. The evaporator blowers operate on low speed (when container return air sensor temperature drops below 24 F [-4.4 C]).

- Cool
- Null (compressor pumps down low side*, evaporator blowers operate, if condenser fan is ON, it will operate for approximately two minutes and then stop)
- Defrost (resistance heaters on, evaporator blowers stop)

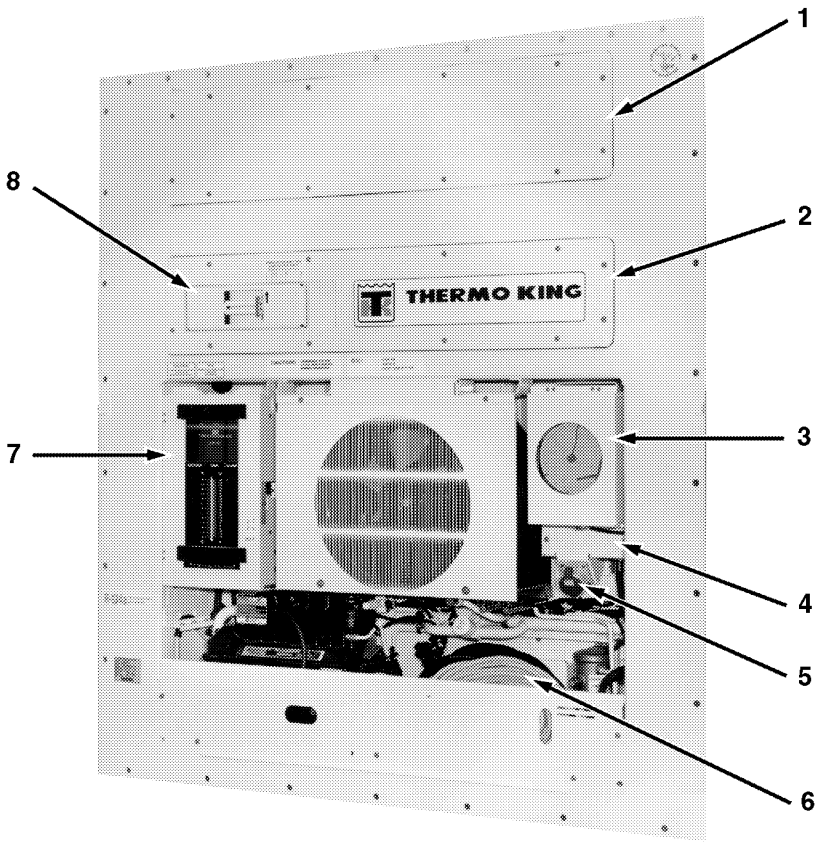
NOTE: At return air temperatures above 17 F (-8.4 C), the unit pumps down until the low pressure cutout switch opens. At return air temperatures below 17 F (-8.4 C), the unit pumps down for 30 seconds and then stops.

SERIAL NUMBER LOCATIONS

Electric Motors: Nameplate attached to the motor housing.

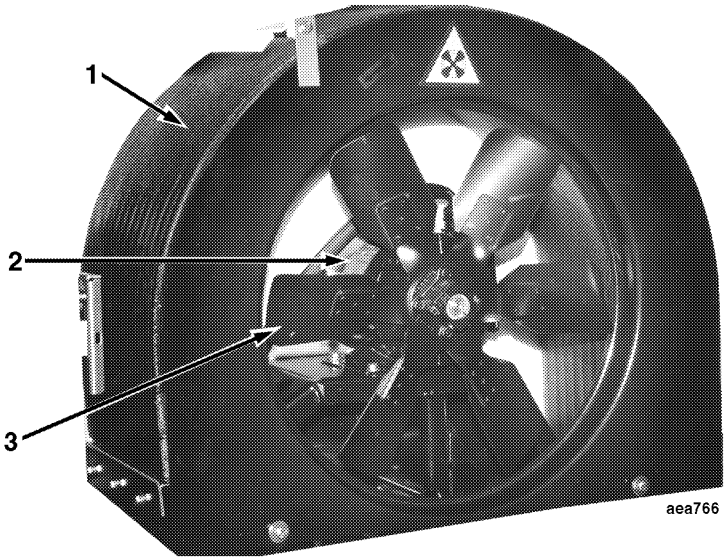
Compressor: Nameplate on front of the compressor.

Unit: Nameplate on left-hand lower corner of the unit frame.



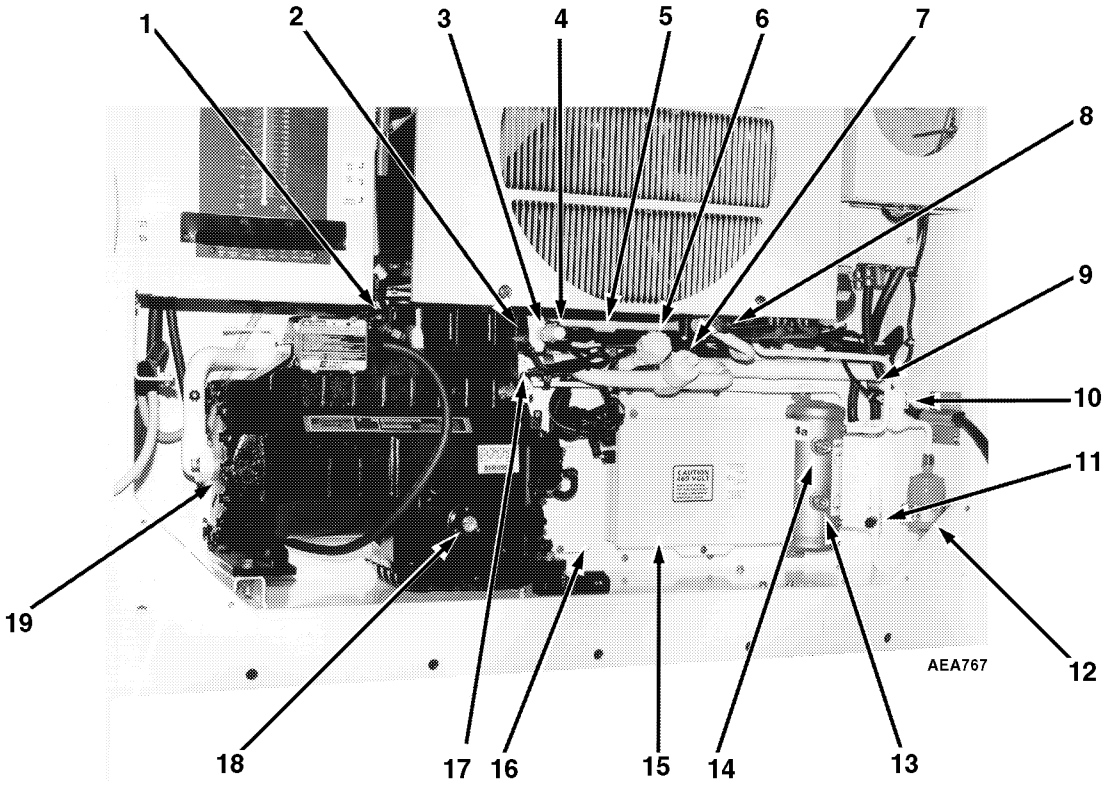
1	Upper Evaporator Access Panel (Blower Motor, Return Air Sensor, Recording Thermometer Sensor and Coil Sensor)
2	Lower Evaporator Access Panel (Expansion Valve and Electric Heaters)
3	Recording Thermometer
4	Dual Voltage Transformer Box (CF-II M53 Only)
5	460/380V Power Receptacle (CF-II M53 Only)
6	Power Cord Storage Compartment
7	Unit Control Box
8	Fresh Air Exchange System

Front View



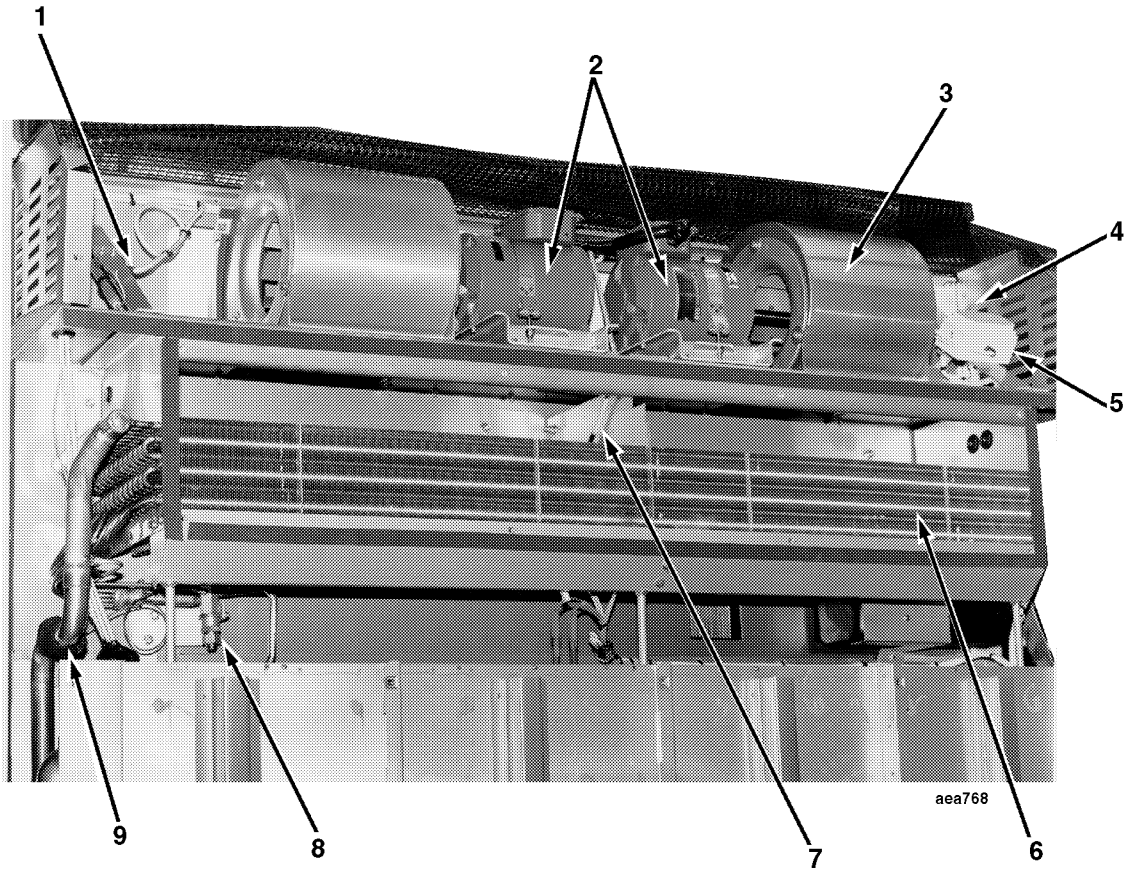
1	Circular Condenser Coil
2	Condenser Fan Motor
3	Condenser Fan Blade Assembly

Condenser Fan Section



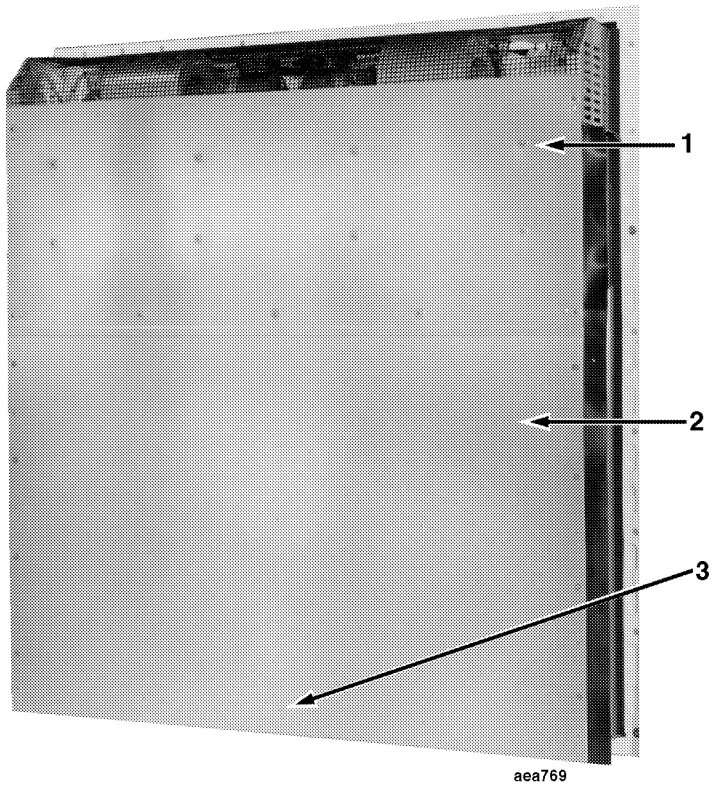
1	High Pressure Cutout Switch
2	Compressor Discharge Temperature Sensor
3	Discharge Service Valve
4	Condenser Fan Pressure Switch
5	Discharge Check Valve
6	Suction Line Solenoid Valve
7	Modulation Valve
8	Discharge Pressure Regulator Valve
9	High Pressure Relief Valve
10	Liquid Line Solenoid
11	Receiver Tank Outlet Valve
12	Filter Drier
13	“Add” Sight Glass
14	“Full” Sight Glass
15	Remote Monitor Box
16	Discharge Air Sensor Access Panel
17	Liquid Injection Valve
18	Compressor Oil sight Glass
19	Compressor

Compressor Compartment



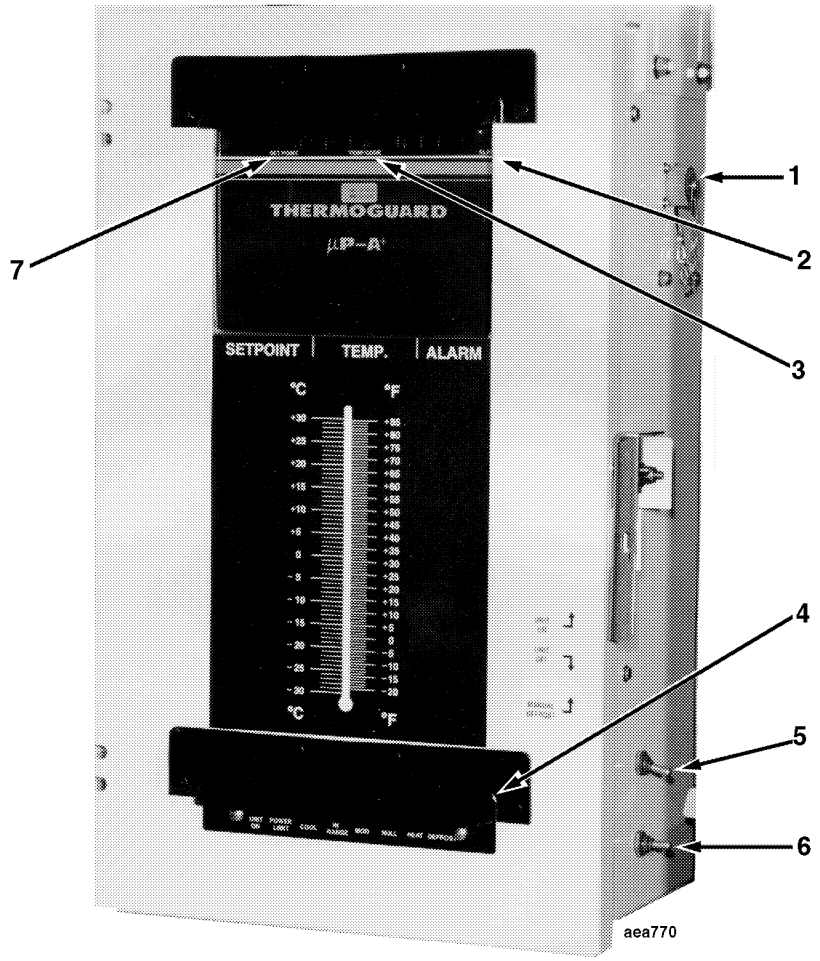
1	Return Air Sensor and Recording Thermometer Bulb
2	Evaporator Blower Motors
3	Evaporator Blower Housing
4	USDA Sensor Assembly (Unable to See)
5	Humidity Sensor
6	Evaporator Coil
7	Coil Sensor
8	Expansion Valve
9	Expansion Valve Feeler Bulb

Evaporator Section Back View



1	Upper Evaporator Access Panel
2	Lower Evaporator Access Panel
3	Discharge Air Sensor Location in Air Plenum (Accessible From the Power Cord Storage Compartment in Condenser Section)

Back View

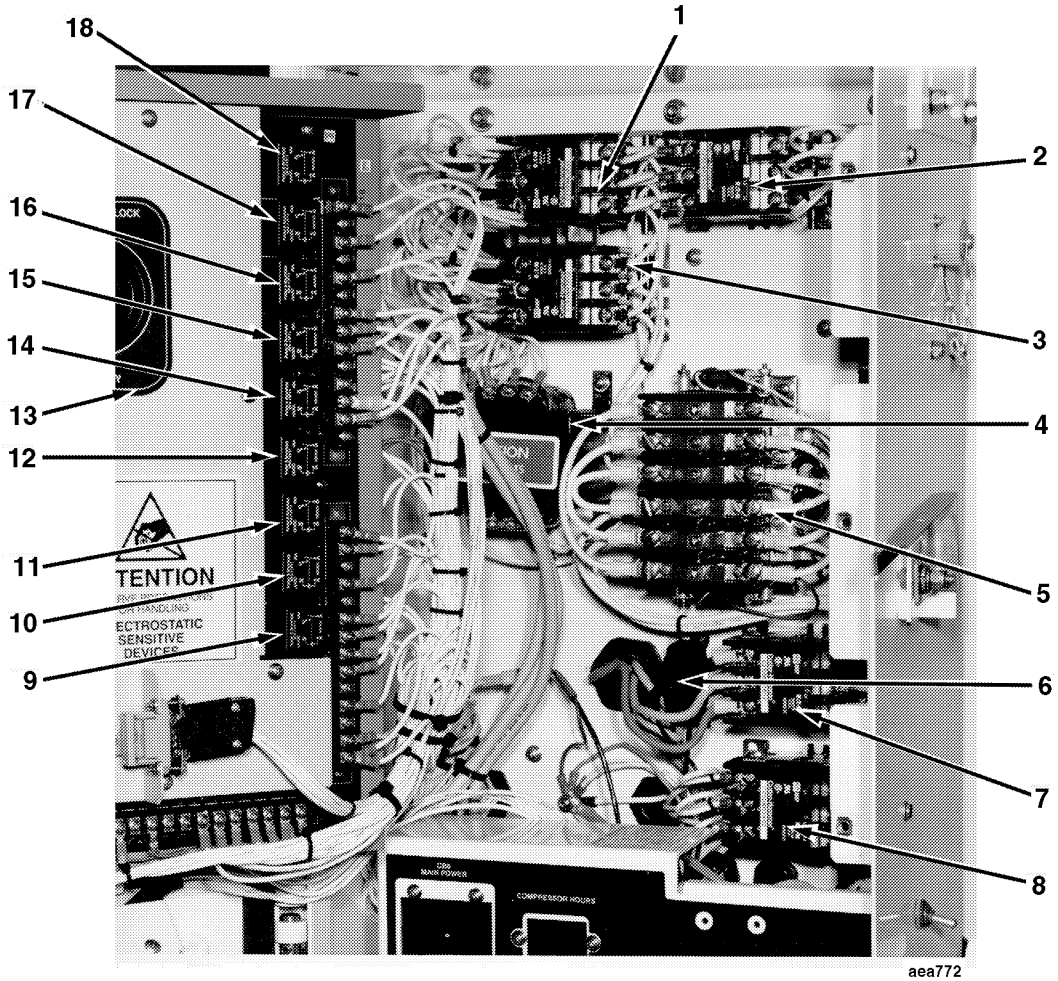


1	Remote Monitor Connector
2	Alarm Light
3	Temperature Readout Display
4	Mode LEDs
5	Unit On-Off Switch
6	Manual Defrost Switch
7	Setpoint Readout Display

Control Box

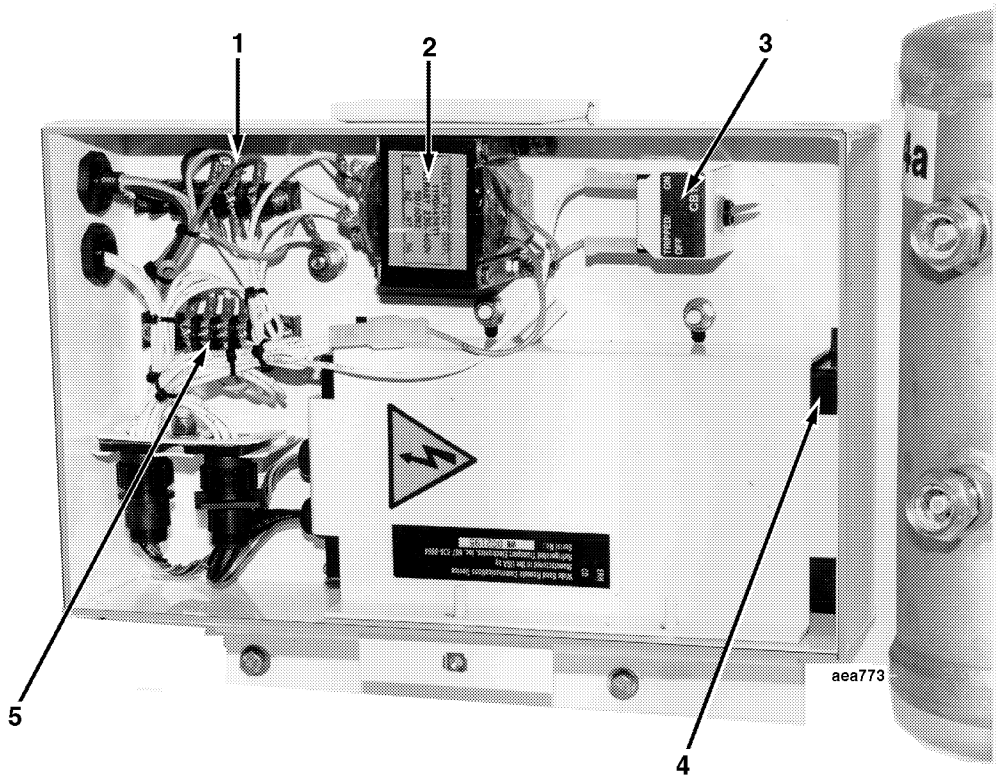
1	THERMOGUARD® µP-A+ Microprocessor Circuit Board
2	12 Vdc Remote Battery Pack Receptacle
3	Serial (PC-PAC™) Connector for Data Retrieval
4	Thermometer Temperature Display/Edit LEDs

Microprocessor Front



1	Evaporator Fan Contactor—High Speed
2	Condenser Fan Contactor—High Speed
3	Evaporator Fan Contactor—Low Speed
4	Control System Circuit Transformer
5	Phase Selection Contactor
6	Current Sensor
7	Compressor Contactor
8	Heater Contactor
9	Heater Relay K9
10	Suction Line Solenoid Relay K8
11	Compressor High Speed Relay K7
12	Not Used K6
13	Condenser Fan High Speed Relay K5
14	Evaporator Fan Low Speed Relay K4
15	Access for Microprocessor Clock Battery
16	Evaporator Fan High Speed Relay 3
17	Liquid Line Solenoid Relay K2
18	Liquid Injection Valve Solenoid (Suction Line) Relay K1

High Voltage Tray



1	High Voltage Connections
2	IRMU Transformer
3	IRMU Circuit Breaker
4	Remote Communications Device
5	Data Connections

Remote Monitor Box

UNIT CONTROLS

1. ON-OFF SWITCH.

   a. ON position. Unit will operate on cool or heat depending on the microprocessor setpoint temperature and the container air temperature.

   b. OFF position. The unit will not operate.

2. MANUAL DEFROST SWITCH. The unit can be placed in defrost with the manual defrost switch. If the evaporator coil temperature is below 45 F (7.2 C), the unit will defrost. Otherwise the unit will continue normal operation.

3. THERMOGUARD µP-A+ MICROPROCESSOR. The microprocessor controls all unit functions to maintain the cargo at the proper temperature. The microprocessor also monitors and records system faults, limits power demand and performs pre-trip.

4. CONDENSER FAN PRESSURE SWITCH. The condenser fan pressure switch determines the condenser fan motor operation. When the condenser head pressure rises above 200 ± 7 psig (1379 ± 48 kPa), the condenser fan pressure switch opens and initiates high speed fan operation. When the condenser head pressure falls below 160 ± 7 psig (1103 ± 48 kPa), the condenser fan pressure switch closes and stops condenser fan operation.

5. LOW PRESSURE CUTOUT SWITCH. The low pressure cutout switch opens and shuts off the unit after a pump down of the refrigeration system. The switch opens when the suction pressure drops to 5 in. to 17 in. He vacuum (-16.9 to -57 kPa).

   NOTE: At return air temperatures below 17 F (-8.3 C), the unit pumps down for 30 seconds and then the compressor shuts off.

   NOTE: The low pressure cutout switch on this unit does NOT cause the microprocessor to stop unit operation due to low refrigerant charge.

6. DISCHARGE PRESSURE REGULATOR VALVE. The discharge pressure regulator valve (non-adjustable) maintains a minimum refrigerant discharge pressure in the compressor head of 70 psig (483 kPa). A check valve in the discharge line prevents refrigerant from condensing and draining back into the compressor when the unit is OFF for extended periods.

UNIT INSTRUMENTS

1. STATUS INDICATOR LEDs signal the following:

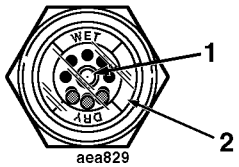
   - Unit ON
   - Power Limit
   - Cool
   - MOD (Modulation)
   - In-Range
   - Null
   - Heat
   - Defrost

   The In-range LED illuminates when the controlling air sensor temperature is within 3 F (1.7 C) above and 3 F (1.7 C) below the microprocessor setpoint. The microprocessor inhibits the out-of-range alarm during defrost.

   NOTE: The microprocessor will not respond to an out-of-range condition for 3 hours after the termination of a defrost cycle or for 1 hour during normal operation to avoid nuisance alarms.

2. REMOTE MONITOR CONNECTOR. A receptacle is provided on the side of the control box for connecting the ship's 4-pin remote monitor system to the unit. The connector provides circuits for Compressor On, Defrost and In-range. The remote in-range light is activated when the return air sensor temperature is within 3 F (1.7 C) above or 3 F (1.7 C) below the microprocessor setpoint.

3. RECEIVER TANK SIGHT GLASSES. A stainless steel receiver tank contains two sight glasses to indicate the level of refrigerant in the tank for checking the refrigerant charge. A moisture indicator in each sight glass changes color to indicate the level of moisture in the system. Check the color of the indicator against the color decal in the sight glass. The dry eye in the sight glass is LIGHT GREEN when the system is dry and YELLOW when the system is wet (contains excessive moisture).



1	Moisture Indicator: Light Green = Dry Yellow = Wet
2	Outer Ring is Color Coded. Compare to Indicator

Danfoss Sight Glass (All Brass)

NOTE: It is important that service personnel operate the CF-II unit for 2 to 3 hours before reading the moisture indicator and determining that moisture is present in a system.

Moisture indicators on CF-II units that stand idle for several hours in ambient temperatures below 75 F (24 C) may indicate a wet (yellow eye) condition. This occurs because the solubility of moisture in R-134a becomes lower as the refrigerant temperature drops. As moisture separates from the refrigerant, the sight glass indicator senses this moisture concentration and may turn slightly yellow.

Therefore, to ensure an accurate moisture level reading, operate the unit for 2 to 3 hours. This thoroughly circulates refrigerant and compressor oil through the system and raises the refrigerant temperature above 100 F (38 C). If the moisture indicator remains yellow after 2 to 3 hours of system operation, replace the filter drier. Then operate the unit 2 to 3 hours more and recheck the moisture indicator. If the moisture indicator still remains yellow, evacuate the refrigeration system. Then remove compressor oil charge. Recharge the unit with correct refrigerant and compressor oil.

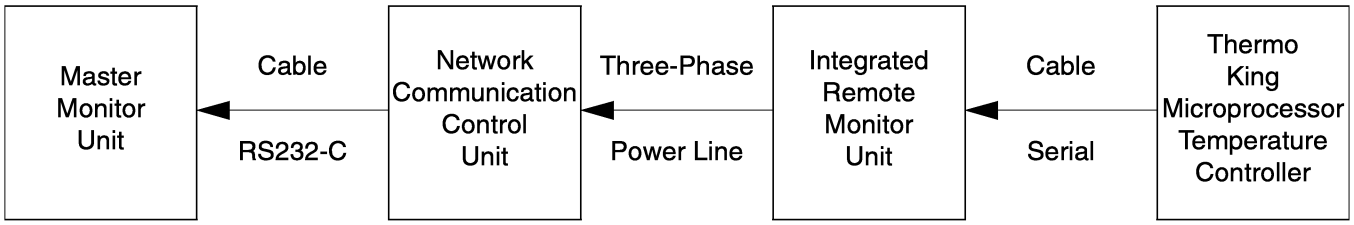
4. COMPRESSOR OIL SIGHT GLASS. A compressor oil sight glass indicates the relative level of compressor oil in the compressor sump.

5. 31-DAY RECORDING THERMOMETER. The recording thermometer indicates and permanently records the temperature of the air returning to the evaporator section on a calibrated chart.

6. INTEGRATED REMOTE MONITORING UNIT (IRMU). The IRMU is a component of the Thermo King Remote Monitoring System which allows a remote computer, referred to as the Master Monitor Unit (MMU) to communicate over the three-phase power lines to the refrigeration unit's THERMO-GUARD Microprocessor controller. The IRMU is located in the power cord storage compartment. It is physically connected to the controller by a serial communications cable, and also to the three phase power line where it derives its power.

When the unit is initially turned on, the IRMU communicates with the controller and retrieves a complete image of the microprocessor's data logging memory. This high speed data transfer occurs within approximately 60 seconds after the 8's disappear during the microprocessor's initialization. At periodic intervals, during normal operation, the IRMU will obtain current operating status information from the microprocessor. This information is added to its data logging memory.

Thermo King Remote Monitoring System



The MMU continuously retrieves unit status information such as container ID number, unit operating mode, setpoint, return air temperature, discharge air temperature and defrost status from the IRMU and monitors the unit for alarm conditions. The MMU (via the IRMU) also allows the shipper to request additional information, initiate defrost, change setpoint or operate pre-trip or diagnostic routines.

See the Thermo King Remote Monitoring System handbook for a complete description of the functions available and their specific operation.

UNIT PROTECTION DEVICES

1. CIRCUIT BREAKERS. A 25 ampere manual reset circuit breaker protects the 230/190V power supply circuit to the unit electric motors and control system transformer. The unit power circuit breaker is located in the control box.

   Manual reset circuit breakers protect the control circuits. A 5 ampere circuit breaker protects the contactor output circuit, a 5 ampere circuit breaker protects the microprocessor power input circuit, a 1.5 ampere circuit breaker protects the modulation signal output circuit, a 3 ampere circuit breaker protects the mode indicator LED circuit, and a 1.5 ampere circuit breaker protects the remote monitor circuit.

2. COMPRESSOR DISCHARGE GAS TEMPERATURE SENSOR. A refrigerant injection system uses a compressor discharge gas temperature sensor to determine when cold refrigerant vapor will be injected into the compressor suction cavity to protect the compressor from excessively high operating temperatures. If the compressor discharge gas temperature rises to 280 F (137.8 C), the microprocessor energizes the liquid injection valve. Refrigerant vapor is then injected into the compressor suction cavity through a metered orifice. When the discharge gas temperature drops to 270 F (132.2 C), the microprocessor de-energizes the injection valve to stop refrigerant vapor injection.

   NOTE: The liquid injection valve also energizes whenever the modulation valve closes 50% or more (70% on temperature pull-down).

   If the discharge gas temperature rises above 298 F (147.8 C), the microprocessor de-energizes the compressor and evaporator blower contactors, stopping the compressor and evaporator blowers. However, the condenser fan continues to operate on high speed. After the high temperature switch resets, the condenser fan continues to operate for 1 minute and then the unit restarts. The compressor and evaporator blowers restart and operate until high compressor temperature recurs. Alarm code 82 (High Compressor Temperature) will be displayed on the digital temperature readout when the [CODE] key is pressed.

3. EVAPORATOR OVER TEMPERATURE PROTECTION. An evaporator coil sensor monitors coil temperature during heat and defrost modes. When the coil sensor temperature reaches 100 F (37.8 C) a signal is sent to the microprocessor, de-energizing the heater contactor and shutting the heaters off. If the coil sensor reaches 110 F (43.3 C), Fault code 09 (Evaporator Over Temperature) is displayed on the digital temperature setpoint readout when the Alarm [CODE] key is manually depressed.

4. HIGH PRESSURE CUTOUT (HPCO) SWITCH. The refrigerant high pressure cutout opens, interrupting 24 Vac control power to the compressor contactor if the compressor discharge pressure rises above 350 ± 10 psig (2415 ± 69 kPa). This immediately stops the compressor and evaporator blowers. However, the condenser fan continues to operate on high speed. After the high pressure cutout resets, the condenser fan continues to operate for 1 minute and then the unit restarts. The compressor and evaporator blowers restart and operate until high discharge pressure recurs. Fault code 10 (High Refrigerant Pressure/Temp) is displayed on the digital temperature setpoint readout when the Alarm [CODE] key is manually depressed. The high pressure switch closes when the pressure drops back to 240 ± 10 psig (1656 ± 69 kPa).

5. HIGH PRESSURE RELIEF VALVE. A high pressure relief valve is installed in the refrigerant piping system to avoid excessive pressure build-up within the refrigeration system from extraordinary and unforeseen circumstances. The valve is a spring-loaded piston that lifts when refrigerant pressure exceeds 500 +50/-15 psig (3447 +347/-104 kPa). The valve will reset when this pressure drops to 400 psig (2758 kPa). The valve is non-repairable and requires no adjustment. If the valve fails to reseat properly, remove the refrigerant charge and replace the valve.

   The high pressure relief valve is located on a high pressure line near the condenser. Its location is such that when the pressure is expelled from the valve, it would be directed away from anyone servicing the unit.

6. OVERLOAD PROTECTION. The condenser fan, evaporator blower motors and compressor motor include internal overload protection with automatic reset.

7. PHASE SEQUENCE SELECTOR. An automatic phase sequence selector senses incoming power to ensure proper condenser fan and evaporator blower motor and compressor rotation.

PRE-TRIP INSPECTION

The following inspections should be made before the container is loaded:

1. Visually check the unit for physical damage.

2. Check the electrical connections in the unit control box, making sure they are fastened securely.

3. Check the conditions of wires and terminals. Repair or replace if necessary.

4. Check the refrigeration system for leaks. Inspect for evidence of oil leaks at all joints and connections.

5. Check the condenser and evaporator coils. Clean if necessary. Use an air jet directed against the coil from the air discharge side. Also inspect the condenser fan grille for damage. If the grille is damaged or missing, abnormally high head pressure may result. Repair or replace the grille if necessary.

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

6. Check the mounting bolts on the unit, compressor and fan motors. Tighten if necessary.

7. Clean the defrost drains.

8. Install a new chart on the recording thermometer.
9. Observe the unit for proper operation and functions during Pre-load Operation.

POWER SELECTION

CF-II M53 refrigeration units are designed to operate on 460/380V or 230/190V, 3 Phase, 60-50 Hz electric power from a 4-wire power source. To operate the refrigeration unit, plug the 460/380V power cord into the proper power source. To operate the unit on 230/190V power, plug the 460/380V power cord into the auto transformer receptacle. Then plug the 230/190V power cord into the proper power source.

CF-II M53.1 refrigeration units are designed to operate on 460/380V, 3 phase, 60-50 Hz electric power from a 4-wire power source. To operate the unit, plug the 460/380V power cord into the proper power source.

CAUTION: Power supply connections from the unit to the power source should always be made with the refrigeration unit On-Off switch and the power supply On-Off switch in the OFF position. Never attempt to start or stop the refrigeration unit using the power cord.

PRE-LOAD OPERATION

Pre-Trip Conditions

To properly perform the long pre-trip function (LPPP on menu) on CF-II refrigeration units with the µP-A+ Microprocessor Temperature Controller, the following conditions must exist:

- The container must be empty with the rear doors closed.
- The internal container temperature (return air temperature on microprocessor display) must be less than 70 F (21.1 C) and no more than 10 F (5.6 C) above ambient temperature.
- If ambient conditions are hot and humid (water is condensing on the evaporator coil), it may be necessary to operate the unit to reduce the amount of moisture on the coil. Operate the unit on Cool until the evaporator return air temperature is less than 35 F (1.7 C). Manually defrost the unit before starting pre-trip checks.

Pre-Trip Checks

1. **CF-II M53**: Connect the unit to 460/380V or 230/190V, 3 phase, 60-50 Hz power source. Also plug the 460/380V power plug into the receptacle on the auto transformer for operation on 230/190V power.

   CF-II M53.1: Connect the unit to a 460/380V, 3 phase, 60-50 Hz power source.

2. Turn the power supply On-Off switch to ON.
3. Switch the refrigeration unit On-Off switch to ON position. After a seven-second delay, the setpoint and Temp/Code display lights should fill with 8's. Five seconds later, the setpoint and present air sensor temperature are displayed. As the setpoint and present air temperature are displayed, the microprocessor relays and unit loads will energize, starting the condenser fan and evaporator blower motors.

   NOTE: The unit will start and display the previous setpoint and the present (controlling) air sensor temperature.

   If the microprocessor calls for cooling, the compressor motor will start 5 seconds after the fan motors start.

   NOTE: When the compressor has been off more than 8 hours, the microprocessor cycles the compressor On and Off 3 times to bump start the compressor.

   NOTE: If the unit does not start, repeat steps 2 and 3. If the unit still does not start, refer to "Fault Indication Diagnosis" in the Electrical Maintenance section of this manual.

4. Adjust microprocessor setpoint to the desired temperature by pressing the [UP] or [DOWN] arrow key. Wait four seconds for all three digits to appear on the digital display. Press the [ENTER] key when the desired setpoint is displayed to place it in the microprocessor memory. The setpoint display will indicate LOAD for four (4) seconds before displaying the new setpoint.

   NOTE: If the [ENTER] key is not pressed within ten (10) seconds, the microprocessor will default (return) to the previous setpoint. If this occurs, repeat step 4.

5. Check the direction of the condenser airflow (see "Condenser Fan and Evaporator Blower Rotation" under Electrical Maintenance chapter of this manual).

6. Check direction of evaporator airflow (see "Condenser Fan and Evaporator Blower Rotation" under Electrical Maintenance chapter of this manual).

7. Allow the unit to operate one-half hour before loading to remove residual container heat and moisture and pre-cool the container interior.

8. Check unit modes while the unit pre-cools by selecting MENU. Press the [UP] or [DOWN] arrow key to scroll through the MENU. You may perform an automatic Long Pre-trip (LPPP) test. With the Temp/Code display indicating LPPP (for Long Pre-trip), press [SELECT]. When the Edit LED flashes, press [ENTER]. The unit will operate in the Long Pre-trip test mode and then return to normal operation.

   NOTE: See "Pre-trip Test" in Thermoguard μP-A+ Microprocessor Temperature Controller chapter for detailed description of automatic pre-trip tests.

   Observe the unit for proper operation and functions during pre-trip test. If the Alarm light is flashing at the end of the pre-trip test, press the CODE key to change the Temp/Code display to indicate the alarm codes. The first digit in the Temp/Code display indicates the total number of alarms while the second and third digits indicate the number of the alarm code of the most recent fault.

   Write down each Alarm code as it appears in the Temp/Code display. Press the CODE key to view the next alarm code. Continue pressing the CODE key until all codes have been viewed and recorded.

   To remove the alarm codes from the Temp/Code display and reset the alarm system, press the CLEAR key when the number 1 alarm code is visible on the Temp/Code display. A permanent record of the alarm codes remains stored in the Microprocessor Trip data recording memory for retrieval via the MicroPac™ portable microcomputer or PC-PAC™ software.

   NOTE: Press CLEAR key ONLY after alarm codes are documented and problems repaired. Pressing the CLEAR key will erase all alarm codes from the Temp/Code display memory.

   CAUTION: Some unit malfunctions will cause an Alarm and unit shutdown condition. When the CLEAR key is pressed, the unit will start automatically.

9. Press [SELECT] to enter the MENU to view the desired air temperature reading on the Temp/Code display. Sensor temperature display selections include:

   a. rA—displays return air temperature for 30 seconds regardless of default sensor setting.

   b. dA—displays discharge air temperature for 30 seconds regardless of default sensor setting.

   c. COIL—displays evaporator coil temperature reading for 30 seconds. The evaporator coil temperature is used for defrost cycle control and evaporator over temperature protection.

   NOTE: After 30 seconds the unit will return to display of setpoint and present air sensor temperature.

NOTE: Pressing the [ENTER] key after the desired MENU item is displayed will hold the MENU display on the screen for 5 minutes.

NOTE: Pressing the [CLEAR] key at any place in the menu will return the controller to the setpoint display.

10. Initiate Start-of-Trip by pressing the [SELECT] key to enter the MENU. Press the [UP] or [DOWN] arrow key to scroll to SSSS. Then press the [SELECT] key and then [ENTER]. Display will indicate SSSS and then return to display the selected setpoint and return air sensor temperature.

    NOTE: After successful completion of a Long Pretrip (LPPP), a Start-of-Trip is automatically initiated by the microprocessor.

11. Set the air exchange system to the desired air exchange rate.

12. Set dehumidification system to desired relative humidity.

    NOTE: See "Turning Dehumidification System On and Adjusting Relative Humidity Setpoint" in the electrical Maintenance chapter for instructions on setpoint adjustment.

13. Stop the unit by moving the On-Off switch to the OFF position.

14. Check the battery charge on the recording thermometer battery.

LOADING PROCEDURE

1. Make sure the unit On-Off switch is OFF before opening the container doors. (The unit may be operating when loading the container from a warehouse with door seals.)

2. Spot check and record load temperature while loading. Especially note any off-temperature product.

POST LOAD PROCEDURE

1. Make sure all doors are closed and locked.

2. Switch the On-Off switch to ON position.

3. Press the [UP] or [DOWN] arrow key to adjust the microprocessor setpoint to the desired temperature. Press the [ENTER] key after the desired setpoint is displayed.

   NOTE: If the [ENTER] key is not pressed within 10 seconds, the microprocessor will default to the previous setpoint. If this occurs, repeat step 3.

4. Enter trip ID information into the microprocessor memory using the MicroPac™ portable microcomputer or PC-PAC™ software (see instructions of MicroPac™ portable microcomputer or PC-PAC™ software).

5. One-half hour after loading, defrost the unit by momentarily pressing the Manual Defrost switch. If the evaporator coil temperature is below 45 F (7.2 C), the unit will defrost. Defrost will stop automatically.

STARTING THE UNIT ON SHIP

CAUTION: Supply power connections from the refrigeration unit to the power source must always be made with the refrigeration unit On-Off switch and the power supply On-Off switch in the OFF positions. Never attempt to start or stop the refrigeration unit with the unit power cable.

1. **CF-II M53**: Connect the unit to 460/380V 60-50 Hz or 230/190V 60-50 Hz power source. Also plug the 460/380V power plug into the auto transformer receptacle for operation on 230/190V power. Turn the power supply On-Off switch to the ON position.

   CF-II M53.1: Connect the unit to a 460/380V, 60-50 Hz power source. Turn the power supply ON-Off switch to the ON position.

2. Turn the unit On-Off switch to the ON position and check for condenser fan and evaporator blower motor operation (see "Condenser Fan and Evaporator Blower Rotation" in the Electrical Maintenance section of this manual). If the unit was properly pre-tripped, correct condenser fan rotation will also indicate correct evaporator blower rotation.

3. Press the [UP] or [DOWN] arrow key to adjust the microprocessor setpoint to the desired temperature setting. Press the [ENTER] key when the desired setpoint is displayed.

   NOTE: If the [ENTER] key is not pressed within 10 seconds, the microprocessor will default to the previous setpoint. If this occurs, repeat step 3.

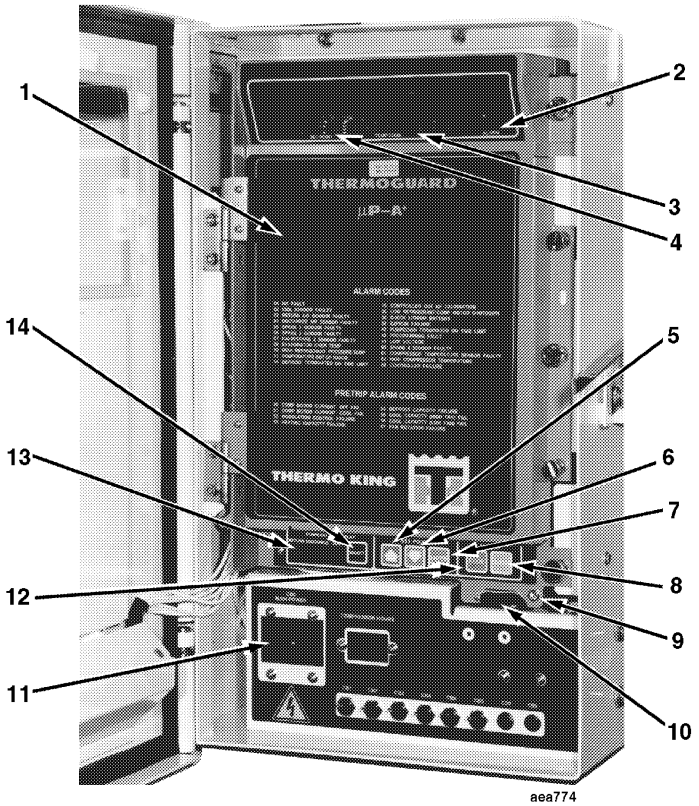
POST TRIP PROCEDURE

Trip data recorded by the THERMOGUARD µP-A+ Microprocessor may be down loaded to the MicroPac™ portable microcomputer or PC-PAC™ software via the communications port on the front of the microprocessor. (See instructions on the MicroPac™ portable microcomputer or PC-PAC™ software manual [TK P/N 204-886].)

Thermoguard µP-A+ Microprocessor Temperature Controller

THERMOGUARD µP-A+ Microprocessor Operating Instructions

Operator/User Action	System Response
1. STARTING THE UNIT	
• Check that Thermoguard µP-A+ Microprocessor Temperature Controller On-Off switch is in the OFF position	None
• Connect the unit power plug to a proper power source (see nameplate)	None
• Switch the Unit On-Off switch to the ON position	Setpoint and Temp/Code will indicate 8888 88888
• Wait 20 seconds for the unit to start	The unit will start and display the previous setpoint and the present air sensor temperature. Return or discharge air sensor is indicated by LEDs
NOTE: If the unit does not start, repeat the above steps. If it still does not start, see "Mechanical Diagnosis" on page 129.	



1	THERMOGUARD® µ P-A+ Microprocessor Temperature Controller
2	Alarm Light
3	Temperature Readout Display
4	Setpoint Readout Display
5	Setpoint Increase Key
6	Setpoint Decrease key
7	Setpoint Enter Key
8	Alarm Clear Key
9	12 Vdc Remote Battery Receptacle
10	Serial (PC-PAC™) Connector for Data Retrieval
11	Main Power Circuit Breaker
12	Alarm Code key
13	Temperature Display/Edit LEDs
14	Select Key (and Setpoint Enable Key)

Operator/User Action	System Response
2. ENTERING THE SETPOINT:	
NOTE: If power source is not available, connect 12V battery to battery jack and press [SELECT] key.	(Pressing the [SELECT] key when 12 Vdc is present awakens the Controller, permitting operation of items 2 through 4.)
• Select the desired setpoint temperature using the [UP] and [DOWN] arrow keys	The setpoint temperature will increase or decrease
• Wait 4 seconds for all three digits to appear. Adjust the third (tenths) digit if necessary	The selected setpoint will be displayed
• Press the [ENTER] key when the desired setpoint is displayed to place the setpoint in controller memory	The setpoint display will indicate LOAD for 4 seconds before displaying the new setpoint
NOTE: If [ENTER] is not pressed within 10 seconds, the controller will default to the previous setpoint. If this occurs, repeat the above steps.	
3. MENU SELECTION:	
• Press the [SELECT] key to enter the menu list	The display will show "---"
• Use the [UP] and [DOWN] arrow keys to scroll through the menu. To change a variable or enter a mode, press [SELECT] while viewing that item	If a temperature (rA, dA, Coil, SP1, SP2, SP3, SP4 or CHS) is being displayed when [SELECT] is pressed, the unit will go to the calibration mode. To calibrate, press the [UP] and [DOWN] arrow keys at the same time. The EDIT LED will now flash. Then press the ENTER] key
• The edit LED will flash to indicate that the [ENTER] key needs to be pressed to enter the new value	
• Press the [ENTER] key to calibrate a sensor, change a variable, or initiate a Start of Trip or Pre-trip function	
NOTE: If the [ENTER] key is not pressed, the display will default back to standard display within 30 seconds.	
• To exit the menu list, press the [CLEAR] key	

Operator/User Action		System Response	
3. MENU SELECTION: (Continued):			
• Menu List:			
---	Top of Menu List	When [SELECT] is pressed, the display will show:	
rA	Return Air temperature	C rA	Calibrate Return Air Sensor
dA	Discharge Air temperature	C dA	Calibrate Discharge Air Sensor
Coil	Evaporator Coil temperature	Ccoil	Calibrate Evaporator Coil Sensor
SP1	Spare Sensor 1 temperature	CSP1	Calibrate spare 1 sensor
SP2	Spare Sensor 2 temperature	CSP2	Calibrate spare 2 sensor
SP3	Spare Sensor 3 temperature	CSP3	Calibrate spare 3 sensor
Curr	Compressor Drive Motor Current Current at 230 Vac reads actual. For 460 Vac units, the current is one-half the number displayed (divide reading by 2).		View ONLY. Factory power limit setting is 27.0 A.
PcCA	Percent Capacity (Percent Modulation Valve is Closed)		View ONLY.
Ldur	Number of Data Logs using battery power after primary power is turned Off	Sdur	Select a new data log number (1 to 240) by scrolling to the desired setting. Factory data log setting is 48
dFln	Time between defrosts	12H	Version 5.00 17 software factory setting is 12 hours. Select a new defrost interval (dd or 1 to 48 hours) by scrolling to the desired setting
dSPL	Degrees F or C	dSPL	Select degrees C or F by scrolling to desired setting
SSSS	Mark Start of Trip	SSSS	Mark Start of Trip
SPPP	Short Pre-trip (mode verification)	SPPP	The unit will function in each mode of operation
LPPP	Long Pre-trip	LPPP	LPPP will be displayed until [ENTER] is pressed, then LPPP1 through LPPP5 are displayed as the unit operates in each of 5 functional tests. The display will indicate LPPP PASS or LPPP FAIL at the end of the test

Operator/User Action		System Response	
3. MENU SELECTION: (Continued):			
CLo	Review the Time and Date	Hour	View ONLY. Press [SELECT] repetitively to view Hour, Min, Day, Mon and Year
GrAc	Enter Guarded Access menu	0000	Access code needed to enter
SP4	Spare Sensor 4 temperature	CSP4	Calibrate spare 4 sensor
CHS	Compressor temperature Liquid injection turns ON at 280 F (138 C), OFF at 270 F (132 C)	CCHS	Calibrate CHS sensor
Lb	Microprocessor (Lithium) battery voltage		View ONLY. Minimum voltage is 3.3V
Chr	Review compressor ON hours		View ONLY
rH	Relative humidity	rH	View relative humidity, setpoint and container relative humidity. See "Dehumidification Control System" in the electrical Maintenance chapter for instructions on setpoint adjustment or turning dehumidification system ON or OFF
NOTE: The Menu display will time out in 30 seconds (15 minutes in calibration mode) after the last key is pressed.			Press [ENTER] key to hold menu item in display for 5 minutes. Press [CLEAR] key to exit menu
4. ALARM CONDITIONS:			
• If alarm light is flashing, press the [CODE] key to change the Temp/Code display to indicate the alarm codes • Press the [CODE] key to indicate any additional alarm codes in memory • Write down all alarm codes as they appear in Temp/Code display • Press [CLEAR] key only after all alarm codes are documented and problems repaired. [CLEAR] key will erase all alarm codes from display memory when alarm number 1 is displayed		The Temp/Code display will indicate the total number of alarms and the alarm code of the most recent fault. The first digit indicates the number of the alarm. The second and third digits indicate the alarm code	
NOTE: Some alarm codes will shut unit off.			
CAUTION: Unit will automatically start if [CLEAR] key is pressed.			

GENERAL DESCRIPTION

The Thermo King THERMOGUARD µP-A+ Microprocessor Temperature Controller combines the functions of a digital thermostat, digital thermometer, fault indicator monitor and defrost control into one package. The microprocessor contains the following basic features:

1. Two digital displays on front panel:

   SETPOINT: Three digits (numerical tens, ones and tenths position), a C for Celsius or F for Fahrenheit, and a minus (-) sign for temperature setpoint display. Pressing the [SELECT] key also displays the MENU in this display.

   TEMP/CODE: Three digits (numerical tens, ones and tenths position) and a minus sign for sensor temperature display (selectable). The keypad can be used to display other information in this display.

   Pressing the [CODE] key, for example, displays three digits. The first digit indicates the number of faults in memory. The last two digits indicate which faults occurred. Codes identify No Fault, 21 different Fault conditions and 8 Pre-trip Fault conditions listed below:

   ALARM CODES

   00 NO FAULT
   02 COIL SENSOR FAULTY
   03 RETURN AIR SENSOR FAULTY
   04 DISCHARGE AIR SENSOR FAULTY
   05 SPARE 1 SENSOR FAULTY
   06 SPARE 2 SENSOR FAULTY
   07 CALIB/SPARE 3 SENSOR FAULTY
   09 EVAPORATOR OVER TEMP
   10 HIGH REFRIGERANT PRESSURE
   11 TEMPERATURE OUT-OF-RANGE
   14 DEFROST TERMINATED ON TIME LIMIT
   15 CONTROLLER OUT OF CALIBRATION
   36 LOW REFRIGERANT/COMP MOTOR SHUTDOWN
   38 CHECK LITHIUM BATTERY
   39 E2PROM FAILURE
   40 PUMPDOWN TERMINATED ON TIME LIMIT
   42 PROGRAMMING FAULT
   44 LOW VOLTAGE
   80 SPARE 4 SENSOR FAULTY
   81 COMPRESSOR TEMPERATURE SENSOR FAULTY
   82 HIGH COMPRESSOR TEMPERATURE
   88 CONTROLLER FAILURE

   PRE-TRIP ALARM CODES

   50 COMP MOTOR CURRENT—OFF FAIL
   51 COMP MOTOR CURRENT—COOL FAIL
   52 MODULATION CONTROL FAILURE
   53 HEATING CAPACITY FAILURE
   54 DEFROST CAPACITY FAILURE
   55 COOL CAPACITY (HIGH FAN) FAIL
   56 COOL CAPACITY (LOW FAN) FAIL
   57 FAN ROTATION FAILURE

2. Alarm indicator light flashes when the microprocessor has detected an alarm condition. An alarm code is recorded in the microprocessor memory to simplify unit diagnosis and troubleshooting procedures. The first eight fault codes plus the most recent fault code are retained by the microprocessor in a non-volatile memory in order of their occurrence (see codes above).

3. Alarm indicator output terminals for remote location monitor (not used on this application).

4. Keypad:

   a. CODE Key: Select fault code readout on digital display.

   b. CLEAR Key: Clear fault code from digital display and exit MENU (return to standard microprocessor display).

c. SELECT Key: Places you in (enters) the MENU list and selects items for display or change.

d. UP ARROW Key: Increase temperature setpoint or scroll up through MENU display.

e. DOWN ARROW Key: Decrease temperature setpoint or scroll down through MENU display.

f. ENTER KEY: Enter temperature setpoint into memory of microprocessor when setpoint appears in SET POINT display. This key also enters other menu information and commands.

5. Temperature display LEDs:

   RETURN LED: Illuminates when the microprocessor displays the return air temperature in the TEMP/CODE display.

   DISCHARGE LED: Illuminates when the microprocessor displays the discharge air temperature in the TEMP/CODE display.

   EDIT LED: Illuminates (flashes) when the [ENTER] key must be pressed to enter information or a command into the microprocessor.

6. Mode light output terminals (see "Status Indicator LEDs" under Unit Instruments in Operating Instructions chapter).

7. Replaceable return air, discharge air and evaporator coil temperature sensors. To display a sensor temperature, see item 21, MENU.

8. Unit function output relay terminals including modulation output circuitry.

9. Defrost cycle control (see "Defrost System" in Electrical Maintenance chapter).

10. Pump-down cycle control (see "Sequence of Operation" in this chapter).

11. Internal self-checking/diagnostic capability.

12. Pre-trip test capability (see "Pre-trip Test" under Menu Operating Instructions in this chapter).

13. Data recording capability. The THERMOGUARD µP-A+ Microprocessor records the return and discharge air temperatures as well as loss of power, alarm, unit operating mode, sensor failure, setpoint change and unit shutdown indications due to a fault every hour for approximately one year.

    Trip data can be retrieved (but not erased) from the microprocessor memory using the MicroPac™ portable microcomputer, PC-PAC software or Thermo Net™ system. The microcomputer is connected to the built-in serial communications port on the front of the microprocessor. A tabular report or graph can be displayed on the PC-PAC™ screen. More detailed reports may be printed in either a graphical or tabular format on a high speed printer external to the portable microcomputer.

    Trip data from separate units is denoted by the identification information entered into the microprocessor at the beginning of the trip by the MicroPac portable microcomputer, PC-PAC software or Thermo Net™ system. Identification data may include the date, container ID number, operator identification, point of origin, product, setpoint and other information up to a total of 80 characters (numerals or alphabetical letters). The container ID number is always resident in the microprocessor memory.

14. Power monitor control. A current transformer senses the compressor drive motor current draw and sends an input signal to the microprocessor. When the current exceeds a predetermined threshold (27 amps, 230V unit; 13.5 amp 460V unit), the microprocessor limits unit power consumption by sending an output signal to the modulation valve. The modulation valve closes to restrict the flow of refrigerant to the compressor to limit the compressor drive motor current draw to the preselected threshold.

15. Sequential component startup control. A sequence start of the required loads occurs during initial startup of the microprocessor and when a control mode shift requires the compressor to start (see "Sequence of Operation" in this chapter).

16. Evaporator blower and condenser fan speed control (see "Sequence of Operation" in this chapter).

17. Wake-up (setpoint enable) capability on auxiliary power for setpoint adjustment or downloading of microprocessor data recording memory. Pressing the [SELECT] key when 12 Vdc battery power is present awakens the controller. Battery power keeps the microprocessor energized for 5 minutes when ac power is not supplied to the unit.

18. Compressor refrigerant injection cycle control (see "Compressor Liquid Injection System" in the Electrical Maintenance chapter).

19. Application software version, configuration block number and boot block software version display when [ENTER] key is pressed (see "Reviewing Application Software Version" under Menu Operating Instructions in this chapter).

20. Flash program memory allows the application software to be updated without replacing a EPROM chip on the microprocessor. Application software can be updated in the field using a portable computer and Thermo King flash loading 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. The application software version is identified by a six digit number (e.g. 05.00.17). If the operation of your unit differs from the Sequence of Operation described in this manual, check the application software version and configuration block number. If the configuration number is not 13, the unit will not function properly. See "Setting the Configuration Block Selection", page 51.

    To check the application software version, see "Reviewing Application Software Version" under Menu Operating Instructions in this chapter.

21. MENU (enter by pressing the [SELECT] key, then the [UP] or [DOWN] arrow keys):

SET POINT	TEMP/CODE
Display	**Display Description**
- - - -	Enter/Exit
rA	Return air temperature
dA	Discharge air temperature
Coil	Evaporator coil temperature
SP1	Spare sensor 1 temperature
SP2	Spare sensor 2 temperature
SP3	Spare sensor 3 temperature
Curr	Compressor drive motor current @ 230 Vac. For 460 Vac units, the current is one-half the number displayed.
PcCA	Percent capacity (percent modulation is closed)
Ldur	Number of data logs using battery power after primary power is turned OFF
dFln	Time between defrosts
dSPL	Degrees F or C
SSSS	Mark start of trip command (no TEMP/CODE display)
SPPP	Short pre-trip command (no TEMP/CODE display)
LPPP	Long pre-trip command (no TEMP/CODE display)
CLo	Review the time and date
GrAc	Enter guarded access menu via code
SP4	Spare sensor 4 temperature
CHS	Compressor temperature
Lb	Battery voltage (Lithium battery)
Chr	Review compressor ON hours
rH	Relative humidity

22. Guarded Access MENU (access restricted by special access code). Enter access code "0007" in the microprocessor display to enter guarded access menu (see "Enter Guarded Access Menu" under Menu Operating Instructions in this chapter.

SETPOINT	TEMP/CODE
Display	**Display Description**
Cld	Set container identification number
CLo	Set time and date
Chr	Reset compressor ON hours
Cb	Configuration block selection

GENERAL THEORY OF OPERATION

The THERMOGUARD µP-A+ Microprocessor uses advanced solid-state integrated circuits to monitor and control all unit functions. A return air sensor, discharge air sensor and evaporator coil sensor monitor system temperatures. The microprocessor also monitors input from the compressor discharge high pressure cutout, compressor discharge gas temperature sensor, condenser fan pressure switch, low pressure cutout switch, manual defrost switch and current sensor.

Output signals from the microprocessor automatically regulate all unit functions including the compressor operation, condenser fan motor operation, evaporator blower motor speed, suction line solenoid valve, modulation valve, liquid line solenoid valve, compressor liquid injection valve, evaporator electric heaters, automatic defrost initiation, and all status indicator functions including the Alarm light and Unit On, Cool, Modulation, Null, Heat, Defrost, In-range and Power Limit LEDs.

Fresh Loads (Setpoint Above 24 F [-4.4 C])

At setpoints above 24 F (-4.4 C), the microprocessor uses a proportional-integral derivative capacity control system during cooling. The system uses a suction line solenoid valve and a direct acting modulation valve to provide accurate control of the container temperature in direct response to load demand. The suction line solenoid valve and modulation valve are installed in the suction line and control the amount of refrigerant returning to the compressor. The modulation valve opens and closes in response to a microprocessor output signal. The microprocessor generates the output signal based on a calculated temperature differential. During the Cool, Modulation Cool and Null modes, the microprocessor calculates the control temperature differential based on the setpoint temperature; discharge air sensor temperature; the modulation temperature range and the pull-down rate. During the Heat mode, the microprocessor calculates the control temperature differential based on the setpoint temperature, return air temperature, modulation temperature range and the pull-down rate.

If the discharge air sensor fails, the temperature of the return air sensor minus 2.5 F (1.4 C) is used for temperature control. If the return air sensor fails, the discharge air sensor is used for temperature control. If both sensors fail, the microprocessor will immediately shut down unit operation.

Frozen Loads (Setpoint Below 24 F [-4.4 C])

At setpoints below 24 F (-4.4 C), the microprocessor controls unit operation based on the return air sensor temperature and setpoint temperature. If the return air sensor becomes disconnected or fails while it is being used to control unit operation, the microprocessor will automatically switch and control unit operation from the discharge air sensor plus 8 F (4.5 C). If the discharge air sensor also fails, the microprocessor will operate the unit continuously on Cool.

All microprocessor control circuits are protected by manual reset circuit breakers.

POWER SPECIFICATIONS

Voltage: 9.0 to 18 Vdc, unfiltered, full-wave, single phase (60/50 Hz) rectified power supply.

Current: Control devices — 2.0 amperes maximum with relays energized. Status indicator LEDs — 0.5 ampere maximum. Modulation valve signal — 1.4 amperes maximum.

SEQUENCE OF OPERATION

Unit Start-up

A sequence start of the required loads occurs during initial startup of the microprocessor and when a control mode shift requires the compressor to start.

When the unit is turned ON, the Mode LEDs and Alarm Light turn On and then Off again. Approximately 7 seconds later the microprocessor SETPOINT and TEMP/CODE displays indicate 8888 88888 and the Alarm Light begins flashing to test the alarm circuit. Five (5) seconds later, the setpoint and controlling air sensor temperatures will be displayed and the condenser fan and evaporator blower motors start. If the microprocessor calls for cooling, the compressor motor will start 5 seconds later.

Compressor Bump Start: The modulation valve remains open; the suction line solenoid valve opens (energizes); the liquid line solenoid valve remains closed; and the compressor is energized continuously during startup. However, if the compressor has been OFF more than 8 hours, the microprocessor then cycles the compressor ON 3 seconds and OFF 3 seconds three consecutive times to bump start the compressor. After the third OFF period, the microprocessor energizes the compressor continuously. The modulation valve and suction line solenoid valve remain open and the liquid line solenoid valve remains closed until the compressor is energized continuously. The microprocessor also bump starts the compressor after a heat or defrost cycle.

Microprocessor Setpoint Above 24 F (-4.4 C)

At setpoints above 24 F (-4.4 C), the microprocessor operates the unit on Cool, Modulation, Null, Heat and Defrost.

After unit start-up, the microprocessor regulates the compressor, suction line solenoid valve, modulation valve, electric heaters and mode indicator LEDs based on a CALCULATED TEMPERATURE DIFFERENTIAL (see "General Theory of Operation" in this chapter for more detail).

At return air temperatures above 24 F (-4.4 C), the microprocessor operates the evaporator blowers on high speed. The evaporator blowers operate continuously to circulate air inside the container.

TEMP/CODE Display and In-range LED: The microprocessor displays the controlling air sensor temperature. The microprocessor also uses the controlling air sensor to regulate the In-range LED. The controlling air sensor is the discharge air sensor during the Cool, Modulation Cool and Null modes. The controlling air sensor is the return air sensor during the Heat mode.

Cool

With the suction line solenoid open (energized) and the modulation valve fully open, the unit provides maximum cooling capacity. The unit operates in the Cool mode whenever the Calculated Temperature Differential is more than 2.5 F (1.4 2.4 C) above the microprocessor setpoint. Power monitor is active when the unit is operating in the Cool mode.

OPERATING MODE CONTROL SEQUENCE TABLE

Unit Function	Controller Setpoint Above 24 F (-4.4 C)					Controller Setpoint Below 24 F (-4.4 C)		
	Cool[1]	Mod. Cool	Null[2]	Heat	Defr	Cool[1]	Null[2]	Defr
High Speed Evaporator Blowers[3]	•[3]	•[3]	•[3]	•[3]				
Low Speed Evaporator Blowers[3]						•[3]	•	
Calculated Temperature Differential Using Discharge Sensor[4]	•	•	•					
Calculated Temperature Differential Using Return Sensor[4]				•				
Return Air Sensor Control						•	•	
Coil Sensor Control					•			•
Compressor Operation[5]	•	•				•		
High Speed Condenser Fan Operation[6]	•[6]	•[6]	•[6]			•[6]	•[6]	
Condenser Fan OFF[6]	•[6]	•[6]	•[6]			•[6]	•[6]	
Suction Line Solenoid Open (energized)	•[7]					•[7]		
Liquid Line Solenoid Open (energized)	•	•				•		
Modulation Valve Open (de-energized)	•[1]		•	•	•	•[1]		•
Modulation Valve Modulating[1] (energized)	•[1]	•				•[1]		
Electric Heaters "On"	•[8]	•[8]		•	•			•
Liquid Injection[9]	•[9]	•[9]				•[9]		

[1] *High unit current draw may cause the power monitor function to energize the modulation valve during the Cool mode to limit compressor current draw.*

[2] *Compressor and condenser fan continue to operate to pump down the low side to 5 to 17 inch Hg vacuum (-17 to -57 kPa) at return air temperatures above 17 F (-8.4 C). At return air temperatures below 17 F (-8.4 C), the compressor and condenser fan operate for 30 seconds to pump down the low side. The microprocessor automatically terminates the pump down cycle.*

[3] *Evaporator blower speed is controlled by the evaporator return air sensor temperature. At return air temperatures above 24 F (-4-4 C), the evaporator blowers operate on high speed. At return air temperatures below 24 F (-4.4 C), the microprocessor shifts the evaporator blowers to low speed.*

[4] *The calculated temperature differential is determined by the microprocessor based on the setpoint, the pull-down rate, the modulation temperature range and the resistance of the discharge air sensor or return air sensor.*

[5] *Five (5) second delay on initial unit start-up or unit shift to a cooling mode requiring compressor start-up. The microprocessor cycles the compressor On and Off 3 times to bump start the compressor after the compressor has been off more than 8 hours, or after a heat or defrost cycle.*

[6] *The condenser fan pressure switch and microprocessor determine condenser fan speed operation: Condenser fan operates on High Speed or OFF during Cool mode or Modulation. Also, the condenser fan operates for approximately two minutes during Null and then stops.*

[7] *The suction line solenoid valve opens (energizes) whenever the compressor starts. On rising temperature, the suction line solenoid remains de-energized (closed) until the CONTROL TEMPERATURE DIFFERENTIAL increases to 3.5 to 5.3 F (2.4 to 3.4 C) above setpoint.*

[8] *Electric heaters may be energized to lower container relative humidity when dehumidification system is ON.*

[9] *Liquid injection valve operation is controlled by compressor discharge (gas) temperature. During Modulation Cool, liquid injection valve may also be energized when the modulation valve is closed 50% or more (70% or more on temperature pull-down).*

The condenser fan operates continuously. The condenser operates on high speed when the condenser fan switch is open and turns OFF when the condenser fan switch is closed.

Modulation Cool

The unit shifts to Modulation Cool when the Calculated Temperature Differential decreases to approximately 2.5 F (1.4 C) above the microprocessor setpoint.

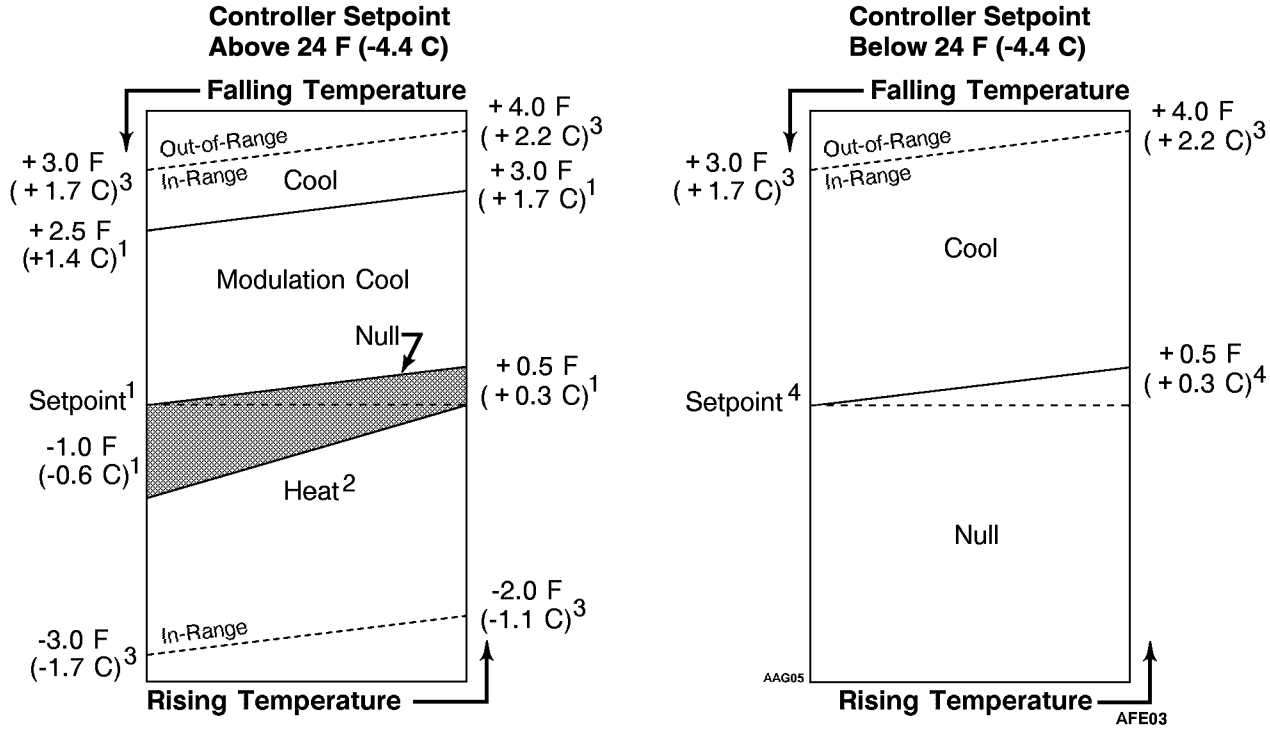
The microprocessor de-energizes (closes) the suction line solenoid valve, diverting all refrigerant returning to the compressor through the modulation valve. The modulation valve closes and opens to regulate the flow of refrigerant to the compressor, placing the unit in Modulation Cool. The position of the modulation valve is proportional to the microprocessor signal, balancing the unit capacity against the actual load requirements.

The condenser fan operates on high speed when the condenser fan switch is open and turns OFF when the condenser fan switch is closed.

Liquid Injection: The liquid injection valve will be energized whenever the modulation valve is closed 50% or more (70% on temperature pull-down).

In-range LED: When the CONTROLLING AIR SENSOR TEMPERATURE drops within 3 F (1.7 C) of setpoint, the microprocessor energizes the In-range LED. In-range LED operation is not affected by the pull-down rate.

Software Version 5.00.17 and 5.00.19 Control Sequence Chart for Configuration Block Cb13



[1]Calculated Temperature Differential Using Discharge Sensor

[2]Calculated Temperature Differential Using Return Sensor

[3]Controlling Air Sensor Temperature

[4]Return Air Sensor Temperature

Null

When the CALCULATED TEMPERATURE DIFFERENTIAL decreases to approximately zero, the microprocessor closes (de-energizes) the liquid line solenoid valve and ramps the modulation valve open to permit the compressor to pump down the refrigeration system. When the pressure in the suction line drops to 5 to 17 in. Hg vacuum (-17 to -57 kPa), the low pressure cutout opens. This causes the microprocessor to de-energize the compressor contactor. The compressor stops, placing the unit in the Null mode. If the condenser fan was ON, it will operate on high speed for approximately two minutes and then stop. If the condenser fan was OFF (based on condensing pressure), the condenser fan will remain OFF. The evaporator blowers continue to operate.

Heat

If the CALCULATED TEMPERATURE DIFFERENTIAL decreases to 1 F (0.6 C) below setpoint, the microprocessor energizes the heater contactor. The heater contactor supplies current to the electric heaters, placing the unit in the Heat mode. During the heat mode, the microprocessor uses the return air sensor to calculate the temperature differential.

In-range LED and Alarm Light: If the CONTROLLING AIR SENSOR temperature decreases to 3 F (1.7 C) below setpoint, the microprocessor turns the In-range LED off. If the controlling air sensor temperature remains out-of-range for 1 hour (3 hours after a defrost cycle), the microprocessor will also shut down all unit operation and activate the Alarm Light. Alarm code 11 is recorded in the microprocessor's memory.

Rising Temperature

On rising temperature, the microprocessor will energize the In-range LED when the CONTROLLING AIR SENSOR TEMPERATURE increases to 2 F (1.1 C) below setpoint.

The unit will operate in the Heat mode until the CALCULATED TEMPERATURE DIFFERENTIAL increases to setpoint. The microprocessor then de-energizes the heater contactor, returning the unit to the Null mode.

If the CALCULATED TEMPERATURE DIFFERENTIAL increases to 0.5 F (0.3 C) above setpoint, the microprocessor will start the compressor motor and operate the unit in Modulation Cool.

NOTE: The microprocessor will bump start the compressor if the unit operated in the HEAT mode.

NOTE: When the modulation valve is closed 50% or more (70% during pull-down), the liquid injection valve will also be energized (injecting)

If the CALCULATED TEMPERATURE DIFFERENTIAL increases to 3.0 F (1.7 C) above setpoint, the microprocessor de-energizes the modulation valve. With the modulation valve open, the unit operates in Cool. However, the suction line solenoid valve remains closed (de-energized) until the CALCULATED TEMPERATURE DIFFERENTIAL increases to 3.5 to 5.3 F (2.4 to 3.4 C) above setpoint.

If the CONTROLLING AIR SENSOR TEMPERATURE increases to 4 F (2.2 C) above setpoint (after energizing the in-range LED), the microprocessor de-energizes the in-range LED. If the controlling air sensor temperature remains out-of-range for 1 hour (3 hours after a defrost cycle), the microprocessor will energize the Alarm LED. Fault code 11, temperature out-of-range, will be displayed on the digital TEMP/CODE readout when the Alarm [CODE] key is manually depressed.

Defrost

When the evaporator coil sensor is below 45 F (7.2 C), defrost can be initiated by the manual defrost switch or by the microprocessor. Immediately upon initiating defrost, the defrost LED will illuminate and the unit will pump down. The compressor and evaporator blowers will stop. If the condenser fan was ON, it will continue to operate for two minutes and then stop. If the condenser fan was OFF (based

on condenser pressure), it will remain OFF. The heater contactor will energize and supply current to the heaters.

When the frost has melted and the evaporator coil temperature reaches 75 F (23.9 C), the defrost cycle will terminate. Immediately, the defrost LED will go out and the condenser fan and evaporator blower motors will start. The compressor will start 5 seconds after the fan motors start.

NOTE: The microprocessor will bump start the compressor after a Defrost Cycle.

Microprocessor Setpoint Below 24 F (-4.4 C)

At setpoints below 24 F (-4.4 C), the microprocessor locks out the Modulation Cool and Heat modes. The microprocessor operates the unit in the Cool, Null and Defrost modes using only the return air sensor and setpoint temperatures to determine operating mode switch points.

The evaporator blower motor speed is regulated by the microprocessor based on the return air sensor temperature. The evaporator blowers operate on high speed until the container return air temperature decreases below 24 F (-4.4 C). When the return air temperature decreases to 24 F (-4.4 C), the microprocessor shifts the evaporator blowers to low speed.

TEMP/CODE Display and In-range LED: The microprocessor displays the controlling air sensor temperature. The microprocessor also uses the controlling air sensor to regulate the in-range LED. The controlling air sensor is the return air sensor during the Cool and Null modes.

Cool

The unit operates in the Cool mode whenever the return air temperature is above the microprocessor setpoint. Power monitor is active when the unit is operating in the Cool mode. The condenser fan operates on high speed when the condenser fan switch is open and turns OFF when the condenser fan switch is closed.

In-range LED: When the RETURN AIR TEMPERATURE decreases to 3 F (1.7 C) above setpoint, the microprocessor energizes the in-range LED.

Null

When the RETURN AIR TEMPERATURE decreases to setpoint, the microprocessor de-energizes the liquid line solenoid to pump down the refrigeration system. At setpoints above 17 F (-8.4 C), the compressor and condenser fan operate until the suction line pressure drops to 5 to 17 in. Hg vacuum (-17 to -57 kPa) to open the low pressure cutout switch. At setpoints below 17 F (-8.4 C), the microprocessor operates the compressor and condenser fan for 30 seconds. If the condenser fan was ON, it will operate on high speed for approximately two minutes and then stop. If the condenser fan was OFF (based on condensing pressure), it will remain OFF. The evaporator blowers continue to operate.

Rising Temperature

If the RETURN AIR TEMPERATURE increases to 0.5 F (0.3 C) above setpoint, the microprocessor energizes the compressor motor, placing the unit in the Cool mode.

If the RETURN AIR TEMPERATURE increases to 4 F (2.2 C) above setpoint, the microprocessor de-energizes the in-range LED. If the return air temperature remains out-of-range for 1 hour (3 hours after a defrost cycle), the microprocessor will energize the Alarm light. Fault code 11, temperature out-of-range, will be displayed on the digital TEMP/CODE readout when the Alarm [CODE] key is manually depressed.

Defrost

When the evaporator coil sensor is below 45 F (7.2 C), defrost can be initiated by the manual defrost switch or the microprocessor. Immediately upon initiating defrost, the defrost LED will illuminate and the unit will pump down. The compressor and evaporator blowers will then stop. The heater contactor will energize and supply current to the

heaters. If the condenser fan was ON, it will continue to operate for two minutes and then stop. If the condenser fan was OFF (based on condensing pressure), it will remain OFF.

When the frost has melted and the evaporator coil temperature reaches 75 F (23.9 C), the defrost cycle will terminate. Immediately, the defrost LED will go out and the condenser fan and evaporator blower motors will start. The compressor will start 5 seconds after the fan motors start.

NOTE: The microprocessor will bump start the compressor after a Defrost cycle.

MENU OPERATING INSTRUCTIONS

Calibration (rA, dA, Coil, SP1, SP2, and SP3)

NOTE: Extreme care must be exercised when calibrating to follow the exact procedures as specified—especially ICE BATH preparation. See "Dehumidification Control System" in Electrical Maintenance for SP4 (Humidity Sensor Input) calibration procedure.

The microprocessor calibration of the return and discharge air sensors should be checked every 1,000 operating hours to verify accuracy. Calibration of the coil and spare sensors should also be checked periodically. Calibration may be checked by using an ice bath (see "Ice Bath Preparation").

The calibration procedure sets the microprocessor to a 32 F (0 C) reference point. During calibration, the microprocessor stores an offset number (-6 to +6) for the calibration of the sensors. This calibration procedure makes the microprocessor temperature display accurate to ± 0.1 F (0.06 C) at 32 F (0 C).

Ice Bath Preparation

1. The ice bath should consist 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 discharge air and return air sensors in the ice bath. Wait 5 minutes to allow the sensor temperatures to stabilize at 32 F (0 C).
4. Stir the ice bath frequently while testing and verify ice bath temperature with a mercury-in-glass thermometer. Stirring 10 seconds every 3 minutes during the test procedure is adequate.

Calibration Checking Procedure

1. With the discharge air and return air sensors removed from the unit and inserted in the ice bath (see "Ice Bath Preparation"), operate the microprocessor.

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

2. Monitor the sensor temperature on the right Temp/Code display. The temperature displayed on the Temp/Code display must be 32 ± 0.1 F (0 ± 0.1 C) in the Discharge [dA] and Return [rA] air modes. If not, recheck the temperature of the ice bath and calibrate the microprocessor.

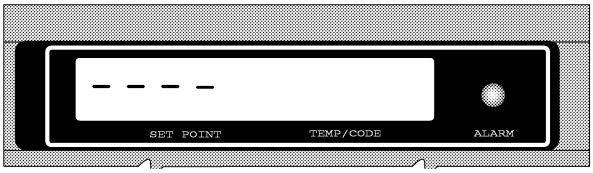
   NOTE: The return air [rA on MENU] sensor and discharge air [dA on MENU] sensor temperature can both be monitored by alternately pressing the [UP] and [DOWN] arrows while in the MENU.

   NOTE: Pressing the [ENTER] key will hold the current MENU display in the screen display for 5 minutes. Pressing the [CLEAR] key will return the microprocessor to the standard display from anywhere in the MENU.

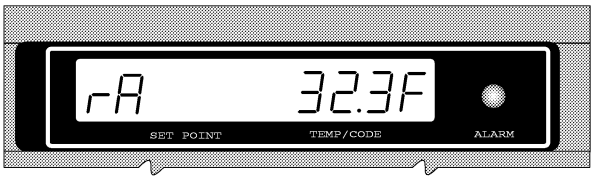
Calibration Procedure

If the temperature displayed on the TEMP/CODE display is not within 0.1 F (0.1 C) of the ice bath temperature in the preceding "Calibration Checking Procedure," calibrate the microprocessor.

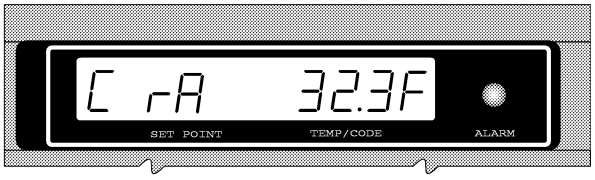
1. Press the [SELECT] key to enter the MENU (----).



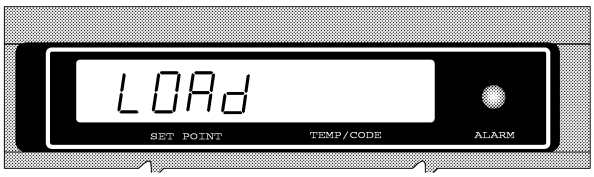
2. Then press the [UP] arrow key to view rA in the SETPOINT display. Verify that the temperature reading on the TEMP/CODE display is stabilized.



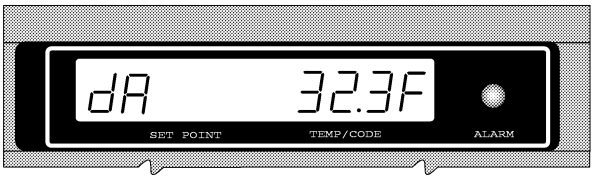
3. Press the [SELECT] key to enter Calibration mode. SETPOINT display will show [C rA]. The microprocessor will stay in this mode for 15 minutes. To return to the standard display and exit calibration, press the [CLEAR] key.



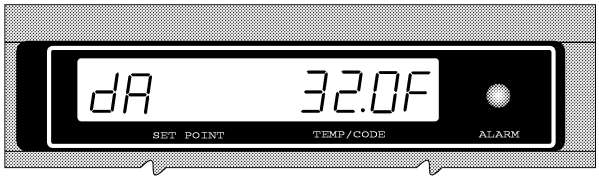
4. Press both the [UP] and [DOWN] arrow keys at the same time and hold. The EDIT LED will flash. While holding (pressing the [UP] and [DOWN] keys), press the [ENTER] key. The SETPOINT display will display "LOAd".



5. Press the [UP] arrow key again to select the Discharge Sensor [dA]. Again verify that the temperature in the TEMP/CODE display has stabilized. Repeat steps 2 and 3.



6. With the discharge and return air sensors still in the ice bath, check (view) the temperature of each sensor in the TEMP/CODE display. The temperature displayed must be 32 ± 0.1 F (0 ± 0.1 C) in the DISCHARGE (dA) and RETURN (rA) MENU modes.



If not, recheck the temperature of the ice bath and repeat the calibration procedure.

NOTE: The evaporator coil sensor (COIL) or spare sensors (SP1, SP2, and SP3) may also be calibrated using the previous procedure. Enter the MENU and press the [UP] arrow key until "COIL" (or SP1, SP2, and SP3) appears in the SETPOINT display. Then repeat steps 2 and 3.

7. Remove sensors from the ice bath and install in the evaporator section. Return the unit to normal operation.

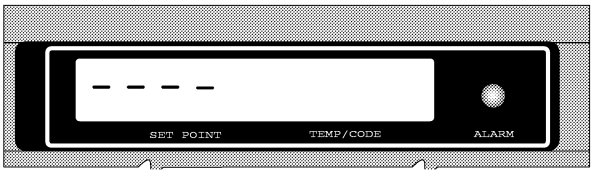
Compressor Drive Motor Current (Curr)

A current transformer senses the compressor motor current draw and sends an input signal to the microprocessor. When the current exceeds a predetermined threshold, the microprocessor closes the modulation valve to restrict the flow of refrigerant to the compressor.

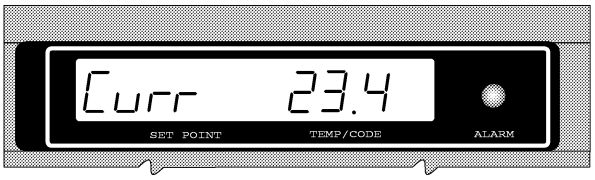
Restricting the flow of refrigerant to the compressor limits the compressor drive motor current draw to a pre-selected threshold. The Thermo King factory default setting is 27.0 amperes. The actual limit will be one-half this on a 460 Vac unit (i.e. actual limit is 13.5 amps when display shows 27.0 on this unit).

To view the compressor motor current draw with the unit operating:

1. Press [SELECT] key to enter the MENU. The display will show "----".



2. Press the [UP] or [DOWN] arrow key to scroll to "Curr". The three digit number following "Curr" is the present current draw reading. On 460 Vac units, the actual current draw is one-half the number displayed (divide reading by 2).



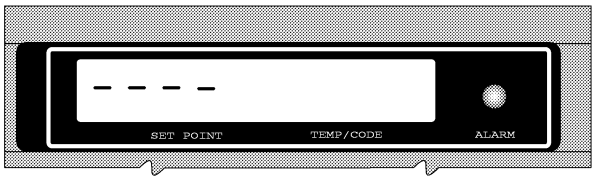
3. To exit the MENU, press the [CLEAR] key.

   NOTE: If no keys are pressed for 30 seconds, the microprocessor will exit the MENU mode automatically and the standard display will appear.

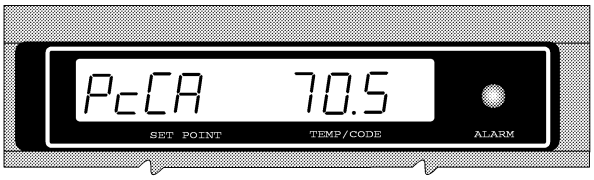
Percent Capacity Display (PcCA)

To view the cooling capacity reduction of the unit in percent during modulation:

1. With the unit operating on Modulation, press the [SELECT] key to enter the MENU. The display will show "----".



2. Press the [UP] or [DOWN] arrow key to scroll to "PcCA". The three digit number following PcCA is the percent the modulation valve is closed (reduction in cooling capacity).



   NOTE: Pressing the [ENTER] key will hold current MENU display in the screen display for 5 minutes.

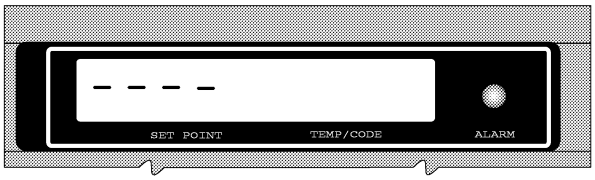
3. To exit the MENU, press the [CLEAR] key.

   NOTE: If no keys are pressed for 30 seconds, the microprocessor will exit the MENU mode automatically and the standard display will appear.

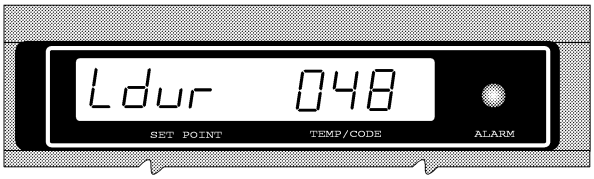
Data Recording Using Optional Remote Battery Power (Ldur)

The microprocessor records the return air and discharge air temperatures, operating modes and alarms using battery power when the primary power is turned OFF. The factory default setting is 48. To change the number of data logs the microprocessor records on battery power:

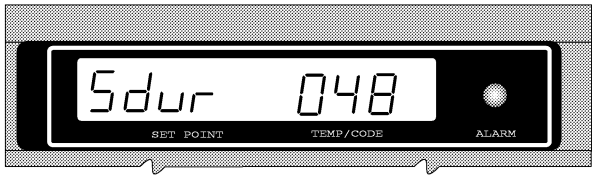
1. Turn the unit On-Off switch ON or operate microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show "----".



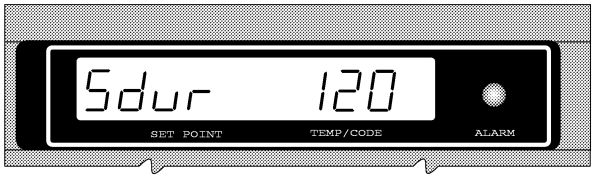
3. Press the [UP] or [DOWN] arrow key to scroll to "Ldur". The three digit number following Ldur is the number of data logs the microprocessor will record after primary power is turned OFF.



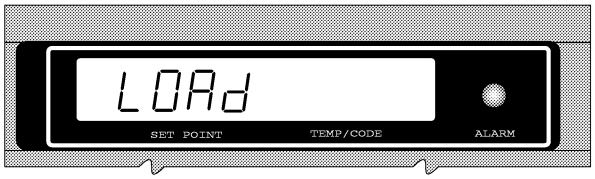
4. To change the Ldur variable (number of data logs), press the [SELECT] key while "Ldur" is shown in the SETPOINT display. "Sdur" will appear in the display beside the current value in memory.



5. Press the [UP] or [DOWN] arrow key to scroll to the desired variable setting (1 to 240). The EDIT LED will begin to flash.



6. When the desired variable appears in the display, press the [ENTER] key. The display will show "LOAd" for 3 seconds, then return to display "Ldur" and the new variable.



7. To exit the MENU, press the [CLEAR] key.

NOTE: If no keys are pressed for 30 seconds, the microprocessor will exit the MENU mode automatically and the standard display will appear.

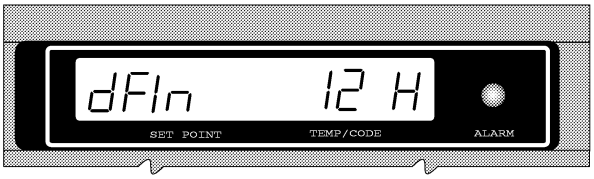
Automatic Defrost Interval (dFIn)

The microprocessor automatically initiates defrost using a demand defrost algorithm or an internal defrost timer. The defrost interval is the period of time between the end of one defrost cycle and the beginning of the next. The factory default setting is 12H (12 hour defrost intervals; 6 hour defrost interval during temperature pull-down). To change the automatic defrost interval:

NOTE: See "Defrost" in the Electrical Maintenance chapter of this manual for a detailed description of the demand defrost algorithm or internal defrost timer.

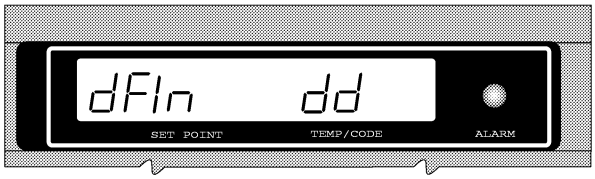
1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show "---".

3. Press the [UP] or [DOWN] arrow key to scroll to "dFln". The code or number (dd or 1 H through 48 H) following dFln indicates the defrost interval.



4. To change the dFln variable (automatic defrost interval), press the [SELECT] key while "dFln" appears on the display. "dFln" and the current defrost setting will remain on the display. The EDIT LED will begin to flash.

5. Press the [UP] or [DOWN] arrow key to scroll to the desired variable setting (dd or 1 through 48 hours).



6. Press the [ENTER] key. The display will show "LOAd" for 3 seconds and then display "dFln" followed by the new defrost interval setting.

   NOTE: Demand defrost (dd) always remains active (on) when an hourly defrost interval is selected. Defrost can occur every 90 minutes if the coil is iced.

7. To exit the MENU, press the [CLEAR] key.

   NOTE: If no keys are pressed to 30 seconds, the microprocessor will exit the MENU mode automatically and the standard display will appear.

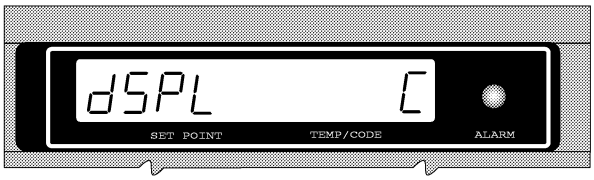
Degrees F or C Temperature Display (dSPL)

The microprocessor can display temperatures in Fahrenheit or Celsius. To change the microprocessor temperature display setting:

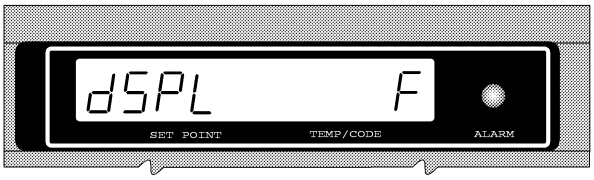
1. Turn the unit On-Off switch ON or operate microprocessor using battery power.

2. Press the [SELECT] key to enter the MENU. The display will show "----".

3. Pressing the [UP] or [DOWN] arrow key, scroll to "dSPL". The value in memory (C or F) will appear in the right corner of the display.



4. Press the [SELECT] key while "dSPL" appears on the display. The EDIT LED will flash. Press the [UP] or [DOWN] arrow key to scroll to the desired variable setting (F or C).

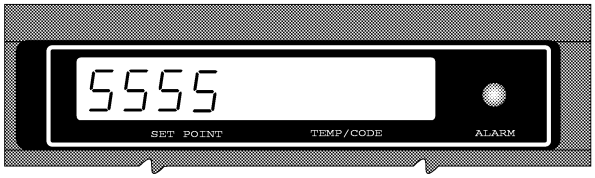


5. Press the [ENTER] key to load the new setting into the microprocessor. The display will show "LOAd" for 3 seconds and then return to the standard display.

Marking Start of Trip (SSSS)

To indicate the start of the current trip in the microprocessor's data recording memory:

1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show "----".
3. Pressing the [UP] or [DOWN] arrow key, scroll to "SSSS".



4. Press the [SELECT] key while "SSSS" is shown on the display. The EDIT LED will begin to flash.
5. To mark the start of a trip, press the [ENTER] key. The display will continue to show "SSSS" for 3 seconds, and then return to the standard display.

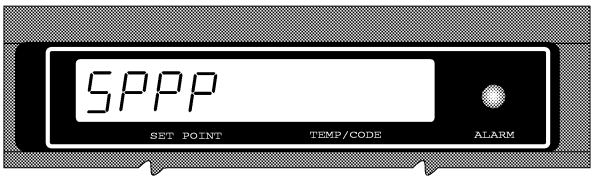
Pre-trip Test (SPPP or LPPP)

Short Pre-trip Test

A visual diagnostic check of the operating modes can be accomplished on a loaded or empty container by initiating a short pre-trip (SPPP) test cycle.

The short pre-trip test ("SPPP" in microprocessor MENU) automatically operates the unit on Cool with modulation valve closed (10 seconds), Cool with high speed evaporator blower, Cool with low speed evaporator blower, Cool with high speed evaporator blower, Modulation Cool, Null and Heat. The microprocessor operates the unit in each mode for approximately 30 seconds to verify unit functions.

The short pre-trip test cycle is initiated by pressing [SELECT] to enter the MENU. Then press the [UP] or [DOWN] arrow key to scroll to select SPPP.



With SPPP on the display, press [SELECT] and [ENTER] (the microprocessor will cycle the unit through the short pre-trip modes). The short pre-trip sequence is:

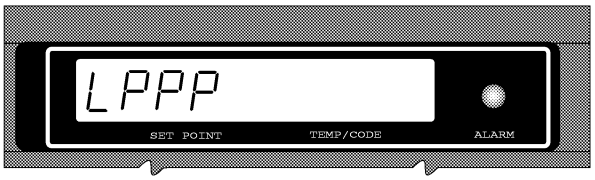
1. Initialization (Unit On LED lit): High Speed Evaporator Blowers, High Speed Condenser Fan and Modulation—10 seconds
2. Cool Mode (Cool LED lit):
   a. High Speed Evaporator Blowers, High Speed Condenser Fan, Compressor On—30 seconds
   b. Low Speed Evaporator Blowers, High Speed Condenser Fan, Compressor On—30 seconds
   c. High Speed Evaporator Blowers, High Speed Condenser Fan, Compressor On—30 seconds
3. Modulation Mode (Cool and Mod LEDs lit): High Speed Evaporator Blowers, High or Low Speed Condenser Fan, Compressor On, Suction Pressure Should Decrease as modulation valve energizes (closes).
4. Null Mode (Null LED lit): High Speed Evaporator Blowers, High or Low Speed Condenser Fan, Compressor Off.
5. Heat Mode (Heat LED lit): High Speed Evaporator Blowers, No Condenser Fan, Heaters On.

NOTE: Condenser fan is controlled by condenser fan pressure switch during the short pre-trip test.

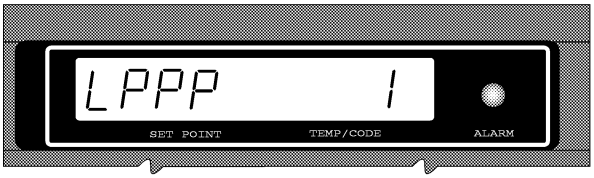
Long Pre-trip Test

A functional check of the operating modes can be accomplished on a loaded or empty container by initiating a Long Pre-trip (LPPP) test cycle.

The long pre-trip test cycle function (LPPP in microprocessor MENU) takes approximately 35 minutes to automatically performs five (5) basic tests. The long pre-trip test is initiated by entering the MENU and pressing the [UP] or [DOWN] arrow key to select LPPP.



With LPPP on the display, press [SELECT] and [ENTER]. LPPP 1 through LPPP 5 will be displayed as the unit operates in each of the 5 functional tests.



When the pre-trip tests are complete, the unit returns to normal operation. After successful completion of a Long Pre-trip (LPPP), a Start-of-Trip is automatically initiated by the microprocessor. If an alarm has occurred, the alarm light will flash. Press the [CODE] key to read alarm codes. Each test is conducted for a specific period of time. The tests and their duration time are:

1. HEATING CAPACITY TEST—6 minutes
2. DEFROST TEST—Terminates when evaporator coil temperature is 5 F (2.8 C) or greater than discharge air temperature (10 minute maximum test period)
3. COOLING CAPACITY TEST—HIGH SPEED EVAPORATOR BLOWERS—8.5 minutes
4. COOLING CAPACITY TEST—LOW SPEED evaporator BLOWERS—6 minutes
5. COOLING CONTROL TEST—3 minutes

Pre-trip Test Fault Indication

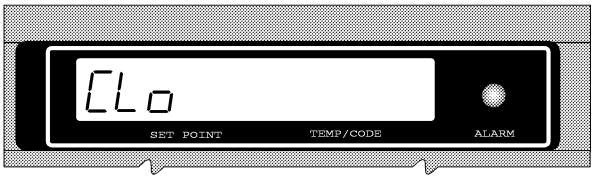
If a non-shutdown fault occurs during a pre-trip test cycle, the Alarm light will flash and the unit will continue to operate. After pre-trip is complete, press the [CODE] key to read the fault code recorded in the microprocessor memory.

If a shutdown fault occurs during the test cycle, the Alarm light will flash and the microprocessor will shut down all unit operation. Press the [CODE] key to read the fault code registered in the microprocessor memory.

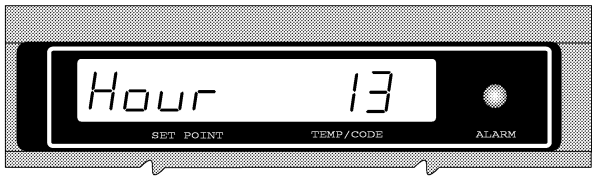
Reviewing Time and Date Recorded in the Microprocessor's Internal Clock (CLo)

A clock in the microprocessor automatically keeps track of the Hour, Minute, Day (Date), Month and Year. The clock can be set via a MicroPac™ microcomputer when the controller is installed or using the microprocessor keypad in guarded access Menu. To view the clock functions:

1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show "---".
3. Press the [UP] or [DOWN] arrow key to scroll to "CLo".



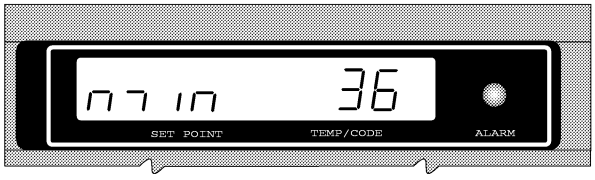
4. Press the [SELECT] key while "CLo" appears on the display. "Hour" will appear in the SETPOINT display while the hour setting ("13" for example) appears in the TEMP/CODE display.



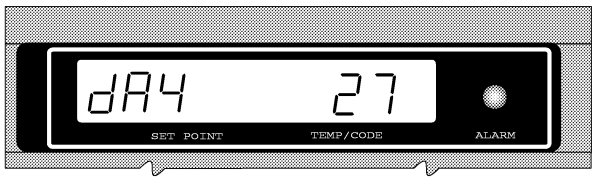
The hour setting is based on a 24 hour clock as shown below:

Time	Display	Time	Display
1 a.m.	1	1 p.m.	13
2 a.m.	2	2 p.m.	14
3 a.m.	3	3 p.m.	15
4 a.m.	4	4 p.m.	16
5 a.m.	5	5 p.m.	17
6 a.m.	6	6 p.m.	18
7 a.m.	7	7 p.m.	19
8 a.m.	8	8 p.m.	20
9 a.m.	9	9 p.m.	21
10 a.m.	10	10 p.m.	22
11 a.m.	11	11 p.m.	23
12 a.m.	12	12 midnight	24

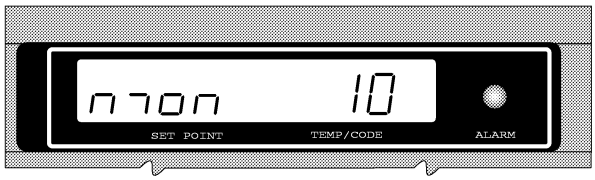
5. Press the [SELECT] key while "Hour" appears on the display. "min" will appear in the SETPOINT display while the minute setting ("36" for example) appears in the TEMP/CODE display.



6. Press the [SELECT] key again to display "dAY" in the SETPOINT display followed by the day setting ("27" for example).



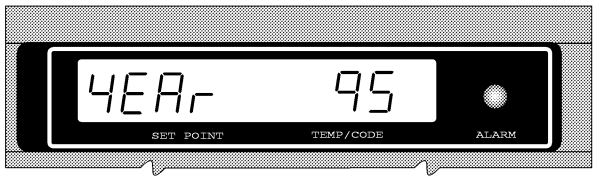
7. Press the [SELECT] key again to display "mon" in the SETPOINT display followed by the month setting ("10" for example).



The month setting is based on a number of the month as shown below.

Month	Display	Month	Display
January	1	July	7
February	2	August	8
March	3	September	9
April	4	October	10
May	5	November	11
June	6	December	12

Press the [SELECT] key again to display "YEAr" in the SETPOINT display followed by the last two digits of the year setting ("95" for example).



8. To exit the MENU, press the [CLEAR] key.

   NOTE: If no keys are pressed for 30 seconds, the microprocessor will exit the MENU mode automatically and the standard display will appear.

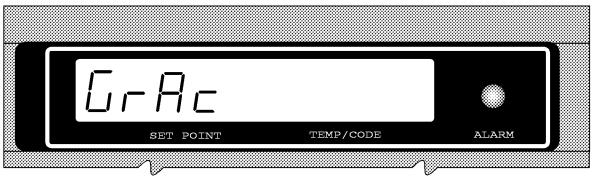
   NOTE: Clock time and date can be set in guarded access MENU.

Guarded Access Menu (GrAc)

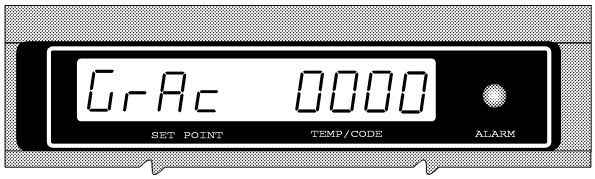
The microprocessor is factory programmed to match the configuration and operating requirements of the container refrigeration unit. Some of these programming functions are purposely protected in the guarded access menu. A special security code ("0007") must be entered to access the Guarded Access Menu. The Guarded Access Menu contains the following functions:

SETPOINT Display	TEMP/CODE Display Description
Cld	Set container identification number
CLo	Set time and date
Chr	Reset compressor ON hours
Cb	Configuration block selection

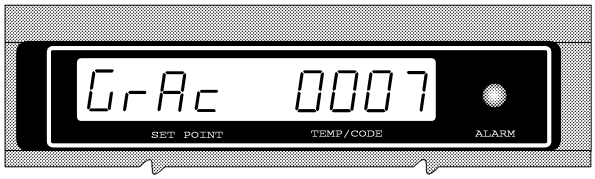
1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show "----".
3. Press the [UP] or [DOWN] arrow key to scroll to "GrAc".



4. Press the [SELECT] key with "GrAc" appearing in the SETPOINT display. "0000" will appear in the TEMP/CODE display. The fourth (left hand) digit flashes on and off.



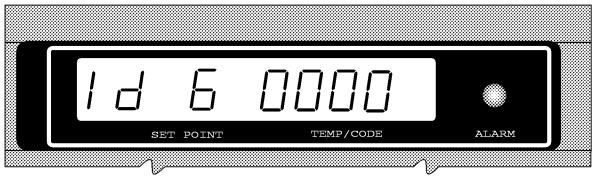
5. Press and release the [SELECT] key 3 times. The first "0" (right hand) digit should flash on and off.
6. Press the [UP] or [DOWN] arrow key to scroll the first digit to "7".



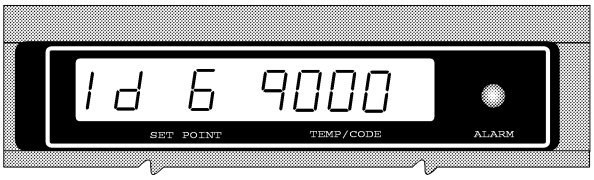
7. Then press [ENTER]. "Cld" will appear in the display as you enter the Guarded Access Menu.

Setting the Container Identification Number (Cld)

1. Enter the Guarded Access Menu (see "Entering the Guarded Access Menu" above).
2. With "Cld" appearing in the SETPOINT display, press the [SELECT] key. Id and the four digits of the current six digit container identification number will appear in the display. The sixth digit (left hand digit identified by the "6" that appears after Id in the display) flashes on and off.



3. To change this digit, press the [UP] or [DOWN] arrow key to scroll the sixth digit to the number you desire (0 to 9).



4. Press the [SELECT] key to move to the fifth digit in the container identification nubmer. Then repeat step 3.

5. Repeat step 4 until you have adjusted all six digits to the numbers you desire for the new container identification number.

6. Then press the [ENTER] key. The microprocessor will display "LOAd". The display then returns to "Cld".

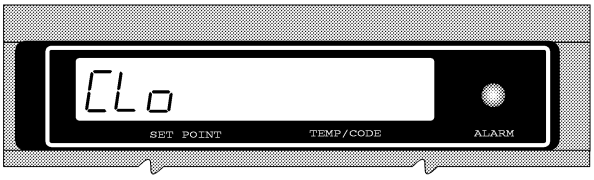
   NOTE: The display can show ONLY 4 of the six identification numbers at a time. The numbers scroll to right when you move to the second and then first digits.

Setting the Time and Date (CLo)

NOTE: Refer to "Reviewing Time and Date Recorded in the microprocessor Internal Clock (CLo)" under Menu Operating Instructions in this chapter for more information about the hour, day and month displays.

1. Enter the Guarded Access Menu (see "Entering the Guarded Access Menu" above).

2. With "Cld" appearing in the SET POINT display, press the [UP] arrow key. "CLo" will appear in the SETPOINT display.



3. Press the [SELECT] key while "CLo" appears on the display. "Hour" will appear in the SETPOINT display while the hour setting ("13" for example) appears in the TEMP/CODE display. To change the hour setting, press the [UP] or [DOWN] arrow key to scroll the new hour setting you desire (0 to 23).

4. When the hour setting is correct, press the [SELECT] key to move to the minute ("min") display. The minute setting ("36" for example) appears in the TEMP/CODE display. To change the minute setting, press the [UP] or [DOWN] arrow key to scroll the new minute setting you desire (0 to 59).

5. When the minute setting is correct, press the [SELECT] key to move to the day ("dAY") display. The day setting ("27" for example) appears in the TEMP/CODE display. To change the day setting, press the [UP] or [DOWN] arrow key to scroll the new day setting you desire (1 to 31).

6. When the day setting is correct, press the [SELECT] key to move to the month ("mon") display. The month setting ("10" for example) appears in the TEMP/CODE display. To change the month setting, press the [UP] or [DOWN] arrow key to scroll the new month setting you desire (1 to 12).

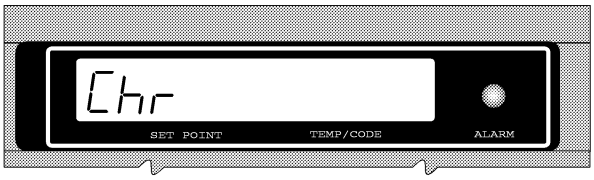
7. When the month setting is correct, press the [SELECT] key to move to the year ("YEAr") display. The year setting ("95" for example) appears in the TEMP/CODE display. To change the year setting, press the [UP] or

[DOWN] arrow key to s roll the new year setting you desire (00 to 99).

8. When all time and date settings are correct, press the [ENTER] key. The microprocessor will display "LOAd". The display then returns to "CLo".

Resetting the Compressor ON Hours (Chr)

1. Enter the Guarded Access Menu (see "Entering the Guarded Access Menu" above).
2. With "Cld" appearing in the SETPOINT display, press the [UP] arrow key until "Chr" appears in the SET-POINT display.



3. Press the [SELECT] key while "Chr" appears on the display. The current total compressor ON hours will appear in the TEMP/CODE display. The fifth digit (left hand digit) flashes on and off.

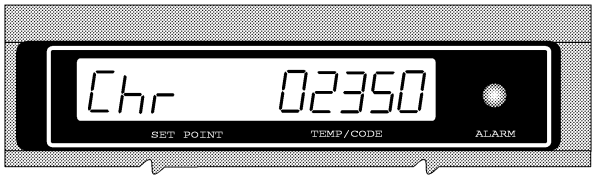
   If the controller is being replaced, the hours can be adjusted to match the old setting. With the fifth digit flashing:

   a. Press the [UP] or [DOWN] arrow key to adjust the digit to the correct old digit.

   b. Press the [SELECT] key to move to the next digit. Then repeat step a.

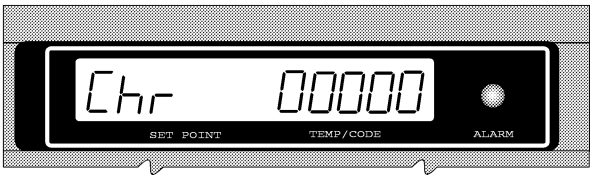
   c. Repeat step a. and step b. until the hours have been adjusted to the original setting.

   d. With the original setting appearing in the TEMP/CODE display, press the [ENTER] key. The microprocessor will display "LOAD". The display then returns to "CHR".



If the compressor is being repaired or replaced, the compressor ON hours can be reset to zero ("00000").

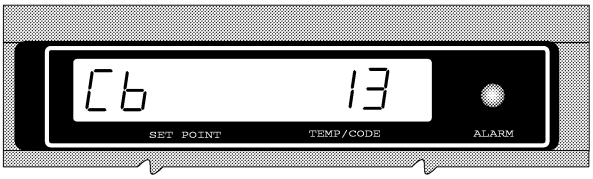
a. To reset the compressor ON hours to zero ("00000"), press the [UP] AND [DOWN] arrow keys at the same time. The TEMP/CODE display should clear to "00000".



b. With "00000" appearing in the TEMP/CODE display, press the [ENTER] key. The microprocessor will display "LOAd". The display then returns to "Chr".

Setting the Configuration Block Selection (Cb)

1. Enter the guarded access menu (see "Entering the Guarded Access Menu" above).
2. Press the [UP] or [DOWN] arrow key to scroll to the "Cb" display. Cb and a two digit configuration block number will appear in the display.



3. To change this two digit, press the [SELECT] key with "Cb" appearing in the SETPOINT display. The EDIT LED will flash.

4. Press the [UP] or [DOWN] arrow key to scroll to a new configuration block number setting.

   NOTE: The factory setting for the configuration block selection is "13" on the CF-II M53 and CF-II M53.1.

   CAUTION: Each configuration block selection is programmed for a specific unit and cooling application. Changing the configuration block to a selection that is different from the original factory setting may cause inaccurate temperature control and erratic unit/microprocessor operation. Consult a Thermo King factory representative before selecting a configuration block selection different from the original factory setting.

5. To enter the new configuration block setting that appears in the microprocessor TEMP/CODE display, press the [ENTER] key. The microprocessor will display "LOAd" for 3 seconds. The microprocessor then displays an "S" in the SETPOINT display.

6. Turn the unit On-Off switch to OFF to reboot the microprocessor using the new configuration block setting. Turn the On-Off switch to ON. After unit start-up, the microprocessor will return to display the current setpoint and controlling air sensor temperatures.

7. To verify that the correct configuration block setting was loaded, press the [ENTER] key. The microprocessor will display the application software version, configuration block version and boot block software version currently stored in the microprocessor memory (see "Reviewing Application Software Version" for more information).

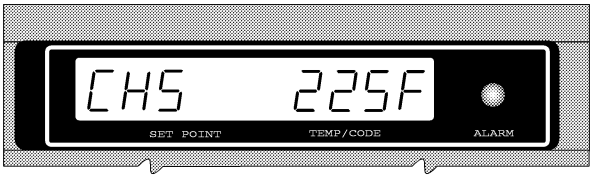
Reviewing Compressor Discharge Gas Temperature (CHS) and Calibration

A temperature sensor in the compressor head senses the compressor temperature and sends a signal to the Microprocessor. To view the compressor temperature:

1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.

2. Press the [SELECT] key to enter the MENU. The display will show "---".

3. Press the [UP] or [DOWN] arrow key to scroll to "CHS". The three digit number following CHS is the compressor temperature. The temperature unit (F or C) appears after the number.



   NOTE: Pressing the [ENTER] key will hold current MENU display in the screen display for 5 minutes.

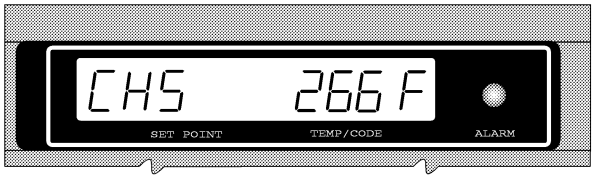
4. To exit the MENU, press the [CLEAR] key.

   NOTE: If no keys are pressed for 30 seconds, the microprocessor will exit the MENU mode automatically and the standard display will appear.

Calibration (CHS)

New and remanufactured microprocessors that are installed in the field must be calibrated to provide proper compressor head (discharge) temperature sensing. To calibrate the microprocessor compressor discharge gas temperature sensor (CHS) channel:

1. Disconnect the compressor discharge gas temperature sensor leads from the front of the microprocessor printed circuit board.
2. Install a 2.74 K ± 1% ohm resistor across the terminals labeled "COMP DISCH TEMP".
3. Press the [SELECT] key to enter the MENU (----).
4. Then press the [UP] arrow key to view CHS in the SET POINT display.
5. Press the [SELECT] key to enter Calibration mode. SETPOINT display will show [CCHS]. Wait 10 to 15 seconds for the TEMP/CODE display to stabilize.
6. Press both the [UP] and [DOWN] arrow keys at the same time and hold. The EDIT LED will flash. While holding (pressing the [UP] and [DOWN] keys), press the [ENTER] key. The SETPOINT display will display "LOAd".
7. The TEMP/CODE display should read 265 to 267 F (129.4 to 130.6 C).

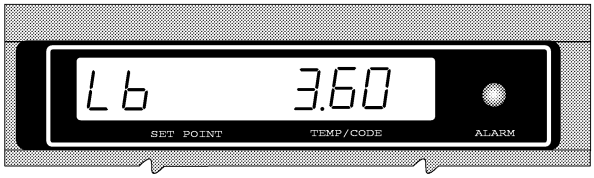


8. Remove the resistor and reattach the compressor discharge temperature sensor leads to the "COMP DISCH TEMP" terminals. The calibration procedure is complete.

Reviewing Battery Voltage (Lb)

A microprocessor contains a 3.6 Volt lithium battery (on back of microprocessor board) to provide power to the internal clock. Minimum battery voltage is 3.3 Volts. To view the battery voltage:

1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show "---".
3. Press the [UP] or [DOWN] arrow key to scroll to "Lb". The three digit number following Lb is the battery voltage.



NOTE: Pressing the [ENTER] key will hold current MENU display in the screen display for 5 minutes.

4. To exit the MENU, press the [CLEAR] key.

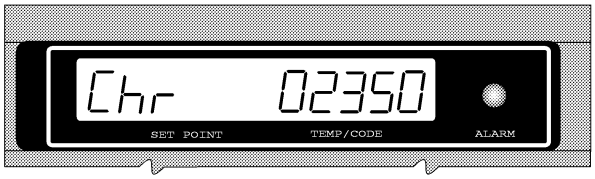
NOTE: If no keys are pressed for 30 seconds, the microprocessor will exit the MENU mode automatically and the standard display will appear.

Reviewing Compressor ON Hours (Chr)

An hourmeter in the microprocessor automatically keeps track of the compressor ON hours. In the guarded access MENU, the hourmeter can be reset to zero (00000) if the compressor is repaired or replaced; or set to equal the duty hours on existing compressor if the microprocessor is repaired or replaced. To view the hourmeter:

1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show "----".

3. Press the [UP] or [DOWN] arrow key to scroll to "Chr".



4. To exit the MENU, press the [CLEAR] key.

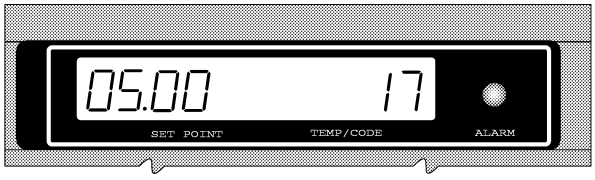
NOTE: If no keys are pressed for 30 seconds, the microprocessor will exit the MENU mode automatically and the standard display will appear.

NOTE: The hourmeter can be set in guarded access MENU.

Reviewing Application Software Version

The application software version, configuration block version and boot block software version are stored in the microprocessor memory. To view the software version installed on the microprocessor:

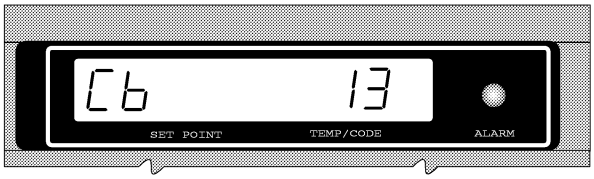
1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [ENTER] key once. The display will show the application software version for 2 seconds (in following format: 05.00 17).



NOTE: CF-II M53.1 will show software version 05.00.19.

3. The display then shows the configuration block version (e.g. Cb 13) for two seconds.

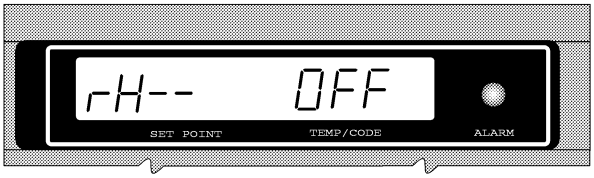
NOTE: The correct configuration block version must be loaded for the unit to operate properly. See "Setting the Configuration Block Selection", page 51.



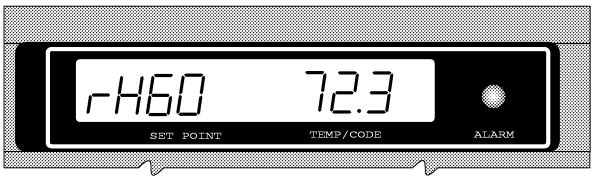
4. The display then shows the boot block software version (e.g. 01.03 01) for two seconds and then returns to the standard display (e.g. setpoint temperature and container temperature).

Turning the Dehumidification System ON and Adjusting the Relative Humidity Setpoint

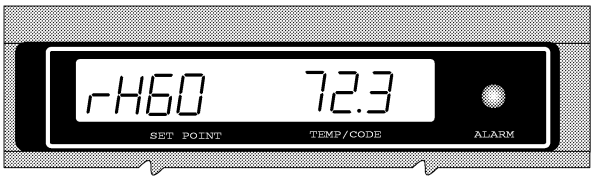
1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show "----"
3. Press the [UP] or [DOWN] arrow key to scroll to "rH". The display will show:
   - "rH---- OFF" when the dehumidification system is OFF.



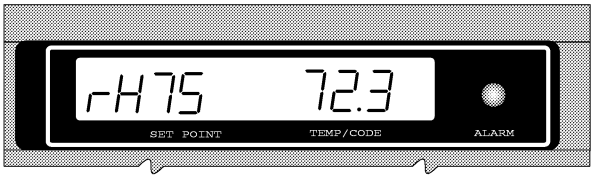
- "rH60 72.3" when the dehumidification system is ON. The two digit number (e.g. "60") immediately after "rH" is the current relative humidity setpoint (in percent). The three digit number in the right TEMP/CODE display (e.g. "72.3") is the current container relative humidity.



4. If the dehumidification is OFF, press the [SELECT] key. the EDIT LED will flash and the display will change to show the current relative humidity setpoint (e.g. "60") immediately after "rH" and the current container relative humidity (e.g. "72.3").



5. To change the relative humidity setpoint, press the [UP] or [DOWN] arrow key within 3 seconds to scroll to the new 2 digit setting (in percent).



6. To enter the relative humidity setpoint that appears in the SETPOINT display and activate the dehumidification system, press the [ENTER] key. the microprocessor will display "LOAd" for 3 seconds.

7. The microprocessor returns to the standard display. The SETPOINT decimal point will flash ON and OFF to indicate the dehumidification mode is active.

8. To verify the new relative humidity setpoint:

   a. Press the [SELECT] key to enter the MENU. The display will show "----".

   b. Press the [UP] or [DOWN] arrow key to scroll to "rH" in menu.\

   c. The display will show the new setpoint and current container relative humidity (e.g. "rH75 72.3").

GENERAL SAFETY PRECAUTIONS FOR SERVICING UNITS OR CONTAINERS

The THERMOGUARD µP-A+ Microprocessor, like all solid-state integrated circuits in use today, requires special precautions in handling to avoid damaging sensitive integrated circuit components. While integrated circuits are highly reliable and immune to many environmental extremes, electrostatic discharge (commonly created by static electricity) and handling can damage or destroy them.

Precautions must be taken when servicing units and containers using a THERMOGUARD µP-A+ Microprocessor to ensure that the microprocessor and other sensitive components are not damaged or destroyed. 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 microprocessor. The second cause results from electric welding on the unit and container chassis without taking precautionary steps.

Controller Repair

When servicing the microprocessor, 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 microprocessor 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 with the lead end connected to the microprocessor'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 microprocessor 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 the chassis ground leads connected to the microprocessor's "GRND" terminals (wires labeled "CH"). Secure these leads to prevent them from contacting the microprocessor.
3. If the unit is equipped with an Integrated Remote Monitor Unit (IRMU), the cable that plugs into the microprocessor's serial port receptacle should be disconnected. Also the IRMU circuit board should be disconnected at the two terminal blocks (high voltage and data connections).
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.

REPAIR

CAUTION: The THERMOGUARD µP-A+ Microprocessor is not field repairable except as described in the following procedure. Contact your local Thermo King dealer for information about our microprocessor remanufacturing program.

External Cause Check

The THERMOGUARD µP-A+ Microprocessor continuously monitors a wide variety of unit functions including the return and discharge air temperatures, evaporator coil temperature, compressor discharge temperature sensor,

compressor discharge high pressure switch, condenser fan pressure switch, current sensor, and manual defrost switch to control unit operation. Before assuming the microprocessor is malfunctioning, eliminate any possibility that the problem is caused by failure of components other than the microprocessor. The failure may be due to any of the following:

1. Poor contact between male and female connector plugs (loose connection).
2. Defective wire harness (broken wires, loose connections).
3. External electrical causes such as low or high line voltage and faulty (open or stuck) relay contacts.
4. Malfunction of refrigeration components.

Sensor Check

1. Detach the discharge air sensor, return air sensor and evaporator coil sensor leads from terminal strip TB1 on the front panel of the microprocessor printed circuit board.
2. Check the resistance of each sensor with an ohmmeter, capable of reading at least 4,000 ohms. The resistance of each sensor should be between 2,750 and 3,975 ohms. Sensors outside of this range are faulty and must be replaced. For a more accurate check, the sensor resistance should be 3,266 ohms at 32 F (0 C) and 3,450 ohms at 70 F (21.1 C).

Air and Coil Sensor Resistance vs Temperature

Temperature °F	Temperature (°C)	Nominal Resistance (Ohms)
-20.0	(-28.9)	3,011.56
-15.0	(-26.1)	3,036.17
-10.0	(-23.3)	3,060.75
-5.0	(-20.6)	3,085.3
0.0	(-17.8)	3,109.81
5.0	(-15.0)	3,134.3
10.0	(-12.2)	3,158.75
15.0	(-9.5)	3,183.18
20.0	(-6.7)	3,207.57
25.0	(-3.9)	3,231.94
30.0	(-1.1)	3,256.27
32.0	(0.0)	3,266.
35.0	(1.7)	3,280.58
40.0	(4.4)	3,304.86
45.0	(7.2)	3,329.1
50.0	(10.0)	3,353.32
55.0	(12.8)	3,377.51
60.0	(15.6)	3,401.67
65.0	(18.3)	3,425.8
70.0	(21.1)	3,449.9
75.0	(23.9)	3,473.97
80.0	(26.7)	3,498.01

Microprocessor Relays K1 through K9

Control Relays K1 through K9 are identical and interchangeable. These relays are single-pole, single-throw normally open 12 Vdc relays.

When the relay is not energized, there is no continuity (open circuit or infinite resistance) between pin 30 and 87 (pin numbers are adjacent to the pins). Power is supplied to pin 86 continuously. When negative (ground) is applied to pin 85, the relay will energize. When the relay is energized, there will be continuity (short circuit or zero resistance) between pin 30 and pin 87.

The microprocessor printed circuit board contains identifying labels beside the relays. The following eight control relays are used:

Relay K1

If relay K1 fails in the open position, the liquid injection valve will not open to cool the compressor on high compressor temperature (fault code 82). If relay K1 fails in the closed position, the liquid injection valve will be energized continuously. Injecting liquid refrigerant continuously into the suction cavity of the compressor will reduce the unit cooling capacity.

Relay K2

If relay K2 fails in the open position, the liquid line solenoid will not open and the unit will not cool. If relay K2 fails in the closed position, the unit will not pump down when the unit shifts to the Null mode. Fault code 40 (Pump Down Terminated on Time Limit) will be registered in the microprocessor memory.

Relay K3

If relay K3 fails in the open position, the evaporator blowers will not operate on high speed. If relay K3 fails in the closed position, the evaporator blowers will operate continuously on high speed.

Relay K4

If relay K4 fails in the open position, the evaporator blowers will not operate on low speed. If relay K4 fails in the closed position, the evaporator blowers will operate continuously on low speed.

Relay K5

If relay K5 fails in the open position, the condenser fan will not operate on high speed. If relay K5 fails in the closed position, the condenser fan will operate continuously on high speed.

Relay K7

If relay K7 fails in the open position, the compressor will not operate. If relay K7 fails in the closed position, the compressor will operate continuously.

Relay K8

If relay K8 fails in the open position, the suction line solenoid will not open, reducing the unit cooling capacity. If relay K8 fails in the closed position, the suction line solenoid will remain open (energized), and the unit will continue to operate at full cooling (closing modulation valve will not reduce unit capacity).

Relay K9

If relay K9 fails in the open position, the electric heaters will not energize for Heat or Defrost. If relay K9 fails in the closed position, the heaters will be energized continuously.

Replacement Relays

The printed circuit board also contains one (1) additional relay that may be used as a spare. The relay is not used or needed by the microprocessor to operate this unit. The circuit board relay is not used because the unit does not contain an electrical device or valve to receive an output signal from the microprocessor. All nine relays are identical and interchangeable. The following relay can be used for replacement should any of the other relays fail.

The spare relay is labeled:

- Relay K6

Testing Relays K1 through K9

Equipment required:

- 12 Volt Battery
- Ohmmeter
- 2 Jumper Wires

Since Relays K1 through K9 are identical and interchangeable, they may all be checked using the following procedure:

1. Carefully remove the relay from the printed circuit board by gently prying between the base of the relay and the top of the socket with a screwdriver.
2. Using an ohmmeter set on the Rx1 scale, test the continuity between pins 30 and 87 on the relay (pin numbers are adjacent to the pins). There should be no continuity (open circuit or infinite resistance).
3. Using two jumper wires, carefully connect pins 85 and 86 of the relay to the terminals of a 12 volt battery (- and + polarity is not important). The relay will energize. Proceed to next step.
4. With the relay energized, use an ohmmeter set on the Rx1 scale and test the continuity between relay pins 30 and 87. There should be continuity (short circuit or zero resistance).
5. Disconnect both jumper wires and the relay will de-energize.

If the relays pass these tests, they may be considered good.

Alarm Indicator Light

The red Alarm indicator light on the front of the microprocessor is replaceable. The bulb is completely encapsulated in red plastic. To remove the bulb, turn the red plastic cap counterclockwise to unscrew the light. Remove the defective bulb from the red plastic cap and install a new bulb in the cap. Make sure an O-ring is installed around the base of the bulb before installing in the socket. Screw bulb down clockwise until it is finger tight.

FAULT INDICATION DIAGNOSIS

The following fault indicator functions will be held in microprocessor memory and displayed on the temperature readout display when the Alarm [CODE] key is manually depressed. Some functions are alarm only and some will shut down unit operation.

Please write down each fault code as it is displayed. When all codes have been displayed, press the [CLEAR] key (with the number 1 alarm in the TEMP/CODE display) to erase all alarm codes from the display.

CAUTION: Some unit malfunctions will cause an Alarm and unit shutdown condition. When the [CLEAR] key is pressed (with the number 1 alarm in the TEMP/CODE display), the unit will start automatically.

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
00	**No Fault**	None	None	None
02	**Coil Sensor**	Displays alarm. Switches to return air sensor for defrost initiation. Defrost is then initiated every 6 hours and automatically terminates after 30 minutes.	Open sensor lead Shorted sensor Defective sensor Defective microprocessor	Test for continuity Test for ground Test resistance Replace microprocessor
03	**Return Air Sensor Fault**	**Alarm:** At setpoints below 24 F (-4.4 C), the microprocessor displays discharge air temperature and continues unit operation using discharge air sensor temperature plus 8 F (4.5 C). Also, if both the discharge and return air sensors are disabled and the setpoint is below 24 F (-4.4 C), the unit will continue to operate on Cool. **Alarm and Unit Shutdown:** If the microprocessor recorded an earlier discharge air sensor fault (both the sensors now disabled) and the setpoint is above 24 F (-4.4 C), the microprocessor will stop unit operation.	Open sensor lead Shorted sensor Defective sensor Defective microprocessor	Test for continuity Test for ground Test resistance Replace microprocessor

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
04	**Discharge Air Sensor Fault**	**Alarm:** At setpoints above 24 F (-4.4 C), the microprocessor displays return air temperature when selected and continues unit operation using the return air temperature minus 2.5 F (1.4 C). Also, if both the discharge and return air sensors are disabled and the setpoint is below 24 F (-4.4 C), the unit will continue to operate on Cool. **Alarm and Unit Shutdown:** If the microprocessor recorded an earlier return air sensor fault (both sensors now disabled), and the setpoint is above 24 F (-4.4 C), the microprocessor will stop unit operation.	Open sensor lead	Test for continuity
			Shorted sensor lead	Test for ground
			Defective sensor	Test resistance
			Defective microprocessor	Replace microprocessor
05 **06** **07**	**Spare 1 Sensor, or Spare 2 Sensor, or Spare 3 Sensor***	Microprocessor displays alarm light but no other action is taken.	Open sensor lead	Test for continuity
			Shorted sensor lead	Test for ground
			Defective sensor	Test resistance
			Defective microprocessor	Replace microprocessor
			Controller set for six (6) sensor record and spare (USDA) sensors are missing	Load a new header with two (2) sensor recording

**** NOTE: Loading a header from a MicroPac Microcomputer with six (6) sensor recording selected will cause control to check the spare sensors. If any spare sensor (USDA or Cold sensor) is not installed, alarm will not clear. To clear alarm, enter a header with two (2) sensor recording selected.***

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
09	**Evaporator Over Temperature**	**Alarm:** Microprocessor de-energizes heater contactor.	Defective heater rods	Inspect heater rods
			Defective evaporator coil sensor	Test sensor
			Defective microprocessor	Replace microprocessor
			Lack of evaporator airflow	Motor defective, loose fan wheel hub or blocked air stream
10	**High Refrigerant Pressure**	**Alarm:** Microprocessor immediately shuts down compressor and evaporator blowers while the condenser fan operates on high speed. After the HPCO switch resets, the condenser fan continues to operate for 1 minute. Then the compressor and evaporator blowers restart and operate until high refrigerant pressure occurs again.	Dirty or restricted condenser coil	Inspect condenser coil
			Condenser fan not operating	Check and correct condenser fan motor, condenser fan contactor or microprocessor
			Condenser fan grille damaged or missing	Repair or replace grille
			Defective HPCO switch	Test HPCO switch
			Open in R51A, R51, R2E, R2H, or R2K wires	Check wires for continuity
			Defective CB3	Replace circuit breaker
			Defective On-Off switch	Replace switch
			Defective microprocessor	Replace microprocessor
			Refrigerant overcharge	Purge system
			Air in refrigeration system	Evacuate and recharge

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
11	**Temperature Out-of-range**	**Alarm:** Control sensor temperature more than 4 F (2.2 C) above setpoint. ***NOTE: Microprocessor will not record an out-of-range alarm until the return air temperature is in-range first.*** ***NOTE: The microprocessor does not respond to an out-of-range alarm for 1 hour on rising temperature or 3 hours after the termination of a defrost cycle.***	Shortage of refrigerant	Check refrigerant charge
			Defective compressor, condenser fan, evaporator blower, or heater contactor	Inspect contactors
			Defective compressor, condenser fan, evaporator blower or heater relay	Test relays
			Compressor inefficient	Check valves and pistons
			Partial obstruction in low side of refrigeration system	Locate obstruction and repair
			Iced or dirty evaporator coil	Inspect/defrost evaporator coil
			Expansion valve or screen plugged	Check expansion valve and screen
			Plugged filter drier	Check filter drier
			Defective modulation valve	Replace modulation valve
			Poor fitting container doors	Inspect doors
			Defective microprocessor	Replace microprocessor

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
14	**Defrost Terminated on Time Limit**	**Alarm:** Microprocessor terminates defrost cycle after 45 minutes.	Defective heater rods	Inspect rods
			Defective heater contactor	Inspect contactor
			Defective Heater relay (K9)	Test relay
			Defective coil sensor	Check sensor
			Evaporator blower motor contacts frozen	Inspect contacts
			Defective microprocessor	Replace microprocessor
15	**Controller Out of Calibration**	**Alarm:** Microprocessor between 6 and 10 F (3.4 and 5.6 C) out of calibration. **Alarm:** Microprocessor more than 10 F (5.6 C) out of calibration at setpoints below 24 F (-4.4 C). **Alarm and Shutdown:** Microprocessor more than 10 F (5.6 C) out of calibration at setpoints above 24 F (-4.4 C).	Defective microprocessor. (Also generated if calibration of a sensor that is not within 6 F of 32 F [3.4 C of 0 C] is attempted)	Replace microprocessor (or replace defective sensor and recalibrate sensors)
36	**Low Refrigerant/Compressor Motor Shutdown**	Does not apply to this unit.	Does not apply	Does not apply
38	**Check Lithium Battery**	Time of day clock stops or is inaccurate.	Weak or dead battery	Check. Battery usually requires replacement. Check time of day after replacement. May be set with MicroPac™ or microprocessor keypad (Guarded Access menu)

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
39	**E2PROM Failure**	**Alarm:** Controller goes to default for all variables which are affected.	Damaged or failed memory chip	None
			Electrostatic Discharge	Flash memory requires re-programming
40	**Pump Down Terminated on Time Limit**	**Alarm:** Microprocessor terminates pump down cycle and shifts unit to next operating mode. ***NOTE: The Microprocessor does not respond to a pump down terminated on time limit alarm for 2 minutes after liquid line solenoid de-energizes (closes).***	Defective liquid line solenoid valve	Inspect solenoid valve
			Defective low pressure cutout (LPCO) switch	Test LPCO switch
			Open in CSP wires	Check wires for continuity
			Compressor inefficient	Repair or replace compressor
42	**Programming Fault**	**Alarm:** Microprocessor defaults to previous value.	User error in programming a new value into microprocessor memory	Repeat programming steps and clear alarm code
44	**Low Voltage**	**Alarm and Shutdown:** Microprocessor tried to start unit 6 times consecutively and each time the voltage drop was too low, so microprocessor aborted startup.	Low voltage supply—excessive current draw by a motor, defective control transformer	Check voltage and current when starting
80	**Spare 4 Sensor**	Does not apply to this unit.	Does not apply to this unit	Does not apply to this unit
81	**Compressor Temperature Sensor Faulty**	**Alarm:** Microprocessor energizes the liquid injection valve continuously when the compressor is operating.	Open sensor lead	Test for continuity
			Shorted sensor lead	Test for ground
			Defective sensor	Test resistance
			Defective microprocessor	Replace microprocessor
			Expansion valve flooding evaporator coil	Adjust expansion valve feeler bulb

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
82	**High Compressor Temperature**	**Alarm:** Microprocessor immediately shuts down compressor and evaporator blowers while the condenser fan operates on high speed.	High compressor temperature	Allow compressor to cool down. Unit should restart automatically. Check liquid injection system
		After the compressor high discharge gas temperature switch resets, the condenser fan continues to operate for 1 minute. Then the compressor and evaporator blowers restart and operate until high compressor temperature occurs again.	Defective compressor discharge gas temperature sensor	Check for fault code 81. Test sensor resistance
			Open or shorted compressor discharge gas temperature sensor	Check for fault code 81. Test for ground or short
			Defective liquid injection valve	Test valve
			Open in LL or R51 wire	Check wires for continuity
			Defective K1 relay	Check K1 relay
			Low refrigerant charge	Check and add refrigerant as needed
			Defective microprocessor	Replace microprocessor
88	**Controller Failure**	**Alarm:** Self-checking feature locates malfunction in microprocessor.	Circuit or component failure	Replace microprocessor

LONG PRE-TRIP FAULT CODES

The microprocessor indicates an alarm for the following fault codes. Refer to the proper diagnostic section of this manual for further information on diagnosing mechanical, electrical and refrigeration problems. Refer to proper wiring and schematic diagrams as required.

Fault Code	Fault	Possible Cause	Test Procedure
50	**Comp motor current—Off fail**	Compressor current when there should not be compressor current (heat/defrost)	Check contactor. Repair or replace
		Compressor contactor welded	Repair or replace
		Microprocessor turning the compressor on in heat/defrost	Check microprocessor for proper operation
		Current transformer bad	Check current transformer
51	**Compressor motor current—Cool Fail**	Compressor current is too high when compressor is on	Check compressor motor
		Motor failure	Repair or replace
		Current transformer bad	Check current transformer
		Incorrect number of power lead loops through current sensor	Check loops per wiring diagram
		Microprocessor faulty	Check microprocessor
52	**Modulation control failure**	Circuit breaker faulty	Check circuit breaker for proper operation
		Modulation valve does not energize (modulate)	Check microprocessor for proper operation
		Wiring faulty	Check wiring between microprocessor, circuit breaker and modulation valve

Fault Code	Fault	Possible Cause	Test Procedure
53	**Heating capacity failure**	Heater failure	Check heaters
		Evaporator blower motor failure	Check evaporator blower motors
		Heater or evaporator blower motor contactor defective	Check contactors
		Wiring faulty	Check wiring
54	**Defrost capacity failure**	Heater failure	Check heater
		Heater contactor defective	Check contactor
		Wiring faulty	Check wiring
55	**Cool capacity (High Fan)—Fail**	Compressor failure	Check compressor
		Evaporator blower rotation inoperative or incorrect	Check evaporator blowers
		Incorrect refrigerant level	Check refrigerant level
		Compressor or evaporator blower motor contactor malfunction	Check contactors
		Compressor or evaporator blower motor wiring faulty	Check wiring
56	**Cool capacity (Low Fan)—Fail**	Same as for High Fan	Same as for High Fan
57	**Fan rotation failure**	Evaporator blower motor failure	Check motor and bearings
		Evaporator blower motor contactor malfunction	Check contactor
		Evaporator blower motor wiring faulty	Check wiring

EMERGENCY MICROPROCESSOR BYPASS PROCEDURE

In the event of an emergency situation when a microprocessor is defective and a replacement is not available, the following procedure may be used to manually control the unit:

NOTE: It may be necessary to partially close (manually) the receiver tank outlet valve to regulate the flow of refrigerant.

WARNING: High voltage (460/380 volts) is present on the contactors and relays on the high voltage tray. To prevent dangerous electrical shock, disconnect the system power whenever possible when working in this area.

1. Switch circuit breakers CB2 and CB6 (located in the control box) to OFF position.
2. Turn the On-Off switch to the OFF position.
3. On the back of the microprocessor, find two terminal boards oriented vertically near the microprocessor control relays. The terminals on the boards are grouped in pairs and labeled by control function.
4. To activate a function, simply place a jumper (without disturbing any of the normal wiring) between the pair of (two) labeled terminals. For example, to activate high speed evaporator blowers, place a jumper between the fifth and sixth terminals down from the top (labeled EVAP FAN HIGH) of the upper terminal board.

   CAUTION: The microprocessor MUST be OFF (CB2 and CB6 in OFF) during use of Emergency Bypass procedure or additional damage to the unit components may occur.

   NOTE: Mode light functions will NOT be correct when this emergency microprocessor bypass procedure is in use.

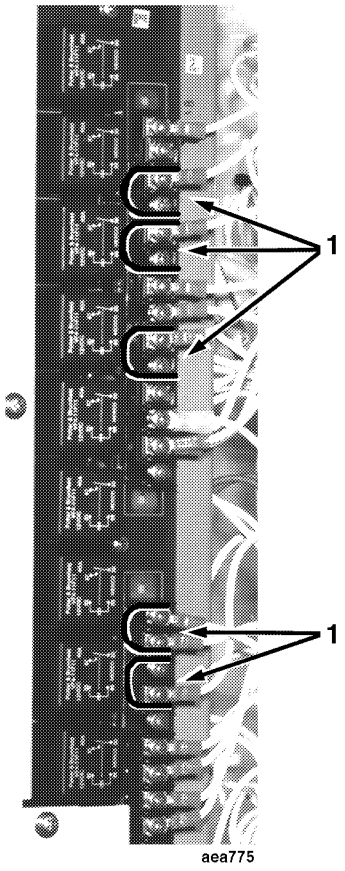
   NOTE: If emergency bypass procedures are used under high ambient and high container (load) temperature conditions, a compressor motor shutdown may occur (indicating the compressor motor internal overload protector has tripped). Wait a few minutes to allow the overload protector to cool.

   The unit is equipped with a suction modulation capacity control system to control system cooling capacity and limit compressor motor current draw. If the unit shuts down due to the overload protector tripping during emergency bypass procedure operation, restrict refrigerant flow to the compressor using the receiver tank outlet valve. Manually close the valve and then open the valve 1/4 turn. Restart the unit. Check compressor motor current draw. The motor should draw 14 to 15 amps. Adjust the receiver tank outlet valve slightly if necessary to raise or lower draw to 14 to 15 amps.
5. In emergency situations, different products and load conditions will require different cooling modes. Refer to the following guidelines to select which unit functions to activate with jumper wires:

a. Fresh Loads—Pulldown

To activate Cool with high speed evaporator blower operation, place a jumper between the two terminal screws of the following control functions:

LIQ LINE
EVAP FAN HIGH
COND FAN HIGH
COMP HIGH
COMP LOW (Suction Line Solenoid)



1	Jumpers

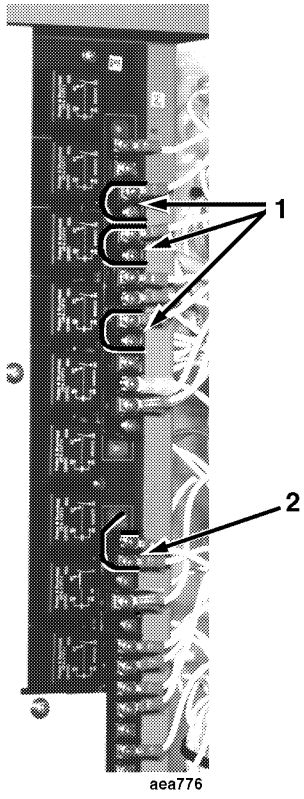
Jumper Locations for Fresh Loads During Pulldown

a. Fresh Loads—Holding Temperature

To hold fresh loads, manually cycle the unit on and off the Cool mode. Place a jumper wire between the two terminal screws of the following control functions:

LIQ LINE
EVAP FAN HIGH
COND FAN HIGH
COMP HIGH

NOTE: The jumper wire between the COMP HIGH terminals should contain a switch (single-pole, single-throw) so the unit can be manually switched to Null mode. Opening the switch will stop the compressor.



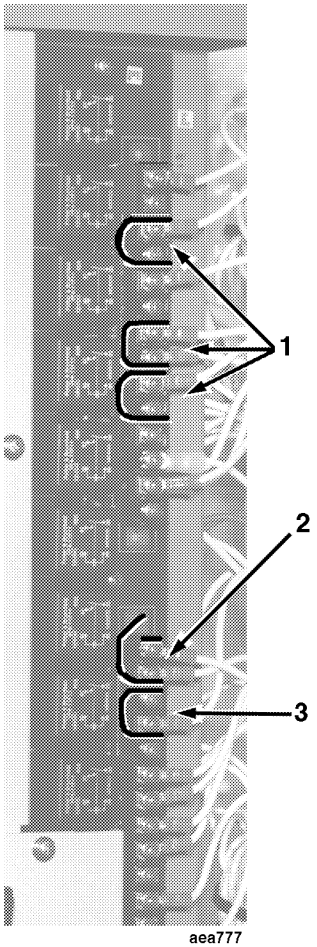
1	Jumpers
2	Jumper with Manual Switch

Jumper Locations For Holding Fresh Loads by Manually Cycling Compressor On and Off

a. Frozen Loads

To activate Cool with low speed evaporator blowers, place a jumper between the two terminal screws of the following control functions:
LIQ LINE
EVAP FAN LOW
COND FAN HIGH
COMP HIGH
COMP LOW (Suction Line Solenoid)

NOTE: The jumper wire between the COMP HIGH terminals should contain a switch (single-pole, single-throw) so the unit can be manually switched to Null mode. Opening the switch will stop the compressor.



1	Jumpers
2	Jumper with Manual Switch
3	Jumper

Jumper Locations For Frozen Loads

UNIT WIRING

Inspect unit wiring, wire harnesses, and the microprocessor printed circuit board during pre-trip inspection and every 1,000 operating hours to protect against unit malfunctions due to open or short circuits. Look for loose, chaffed or broken wires on the unit; open or short circuits and damaged components on the microprocessor printed circuit board.

Inspect relay contacts and electrical contactor points for pitting or corrosion every 1,000 operating hours. Repair or replace as necessary.

DEFROST SYSTEM

The unit should be operated through a defrost cycle during Unit Pre-Load Operation and every 1,000 operating hours to test defrost system components. To check the defrost cycle, operate the unit on cooling and adjust the temperature setpoint to drop the evaporator coil temperature below 45 F (7.2 C). Press the manual defrost switch. The unit should shift from the cooling cycle to the defrost cycle.

If the unit continues on cooling, double check the evaporator coil temperature and refer to the "Defrost Cycle Checkout Procedure".

NOTE: After a defrost cycle, the microprocessor performs a compressor bump start when cooling is required. See "Sequential Component Startup System" in Unit Description for more detail.

Defrost Components

Manual Defrost Switch

The manual defrost switch is located on the side of the control box. Pressing the manual defrost switch initiates a defrost cycle when the evaporator coil sensor temperature is below 45 F (7.2 C).

Evaporator Coil Sensor

The evaporator coil sensor is mounted in the evaporator and senses the evaporator coil temperature to control defrost. If the evaporator coil temperature is below 45 F (7.2 C), a defrost cycle may be initiated by the microprocessor or manual defrost switch. The microprocessor terminates the defrost cycle when the evaporator coil temperature rises to 75 F (23.9 C).

Microprocessor Temperature Controller

The microprocessor will automatically initiate defrost using the "demand defrost" algorithm or using an internal defrost timer. The configuration block selection for this unit sets the dFln to "12H" (12 hour defrost timer interval).

NOTE: To change the automatic defrost setting, see "Setting Automatic Defrost Interval" in the Microprocessor Operation and Diagnosis chapter.

NOTE: Demand defrost (dd) always remains active (on) when an hourly defrost interval is selected. Defrost can be initiated by either the timer or demand defrost ("as needed") function.

Defrost Interval

When the Automatic Defrost Interval is set to an hourly interval setting (01 H to 48 H), an internal defrost timer in the microprocessor automatically places the unit on timed defrost intervals. If "12 H" appears in the TEMP/CODE display, the microprocessor will initiate a defrost cycle every 12 hours when the container temperature is in-range. The time interval begins at the completion of a defrost cycle.

If the Automatic Defrost Interval is set to Demand Defrost (dd) instead of an hourly setting, the microprocessor will initiate Demand Defrost on an "as needed" basis when the following conditions are met (determined by the load):

- **Frozen Loads**—The evaporator blowers operate in low speed when return air temperature is less than 24 F (-4.4 C). When temperature differential between Discharge Air Temperature and Return Air Temperature becomes too large (this condition exists for 15 minutes); and/or the coil sensor reaches a pre-determined temperature (this condition exists for 5 minutes); and no defrost has occurred for 90 minutes, the unit shifts to defrost.
- **Chill Loads**—The evaporator blowers operate on high speed when the return air temperature is above 24 F (-4.4 C). Defrost is initiated when the coil sensor temperature is less than the return air temperature for a period of 15 minutes and 90 minutes have elapsed since last defrost.

Automatic Defrost Termination by Evaporator Coil Sensor

When the evaporator coil sensor temperature rises to 75 F (23.9 C), the microprocessor terminates defrost.

Automatic Defrost Termination by Interval Timer

An interval timer in the microprocessor will terminate defrost after 45 minutes if the evaporator coil sensor temperature has not risen to 75 F (23.9 C). The interval timer will terminate a defrost cycle initiated by either the manual defrost switch or microprocessor.

NOTE: If the evaporator coil sensor fails during the defrost mode, the microprocessor will terminate defrost after 30 minutes. An alarm code will be generated if this occurs.

Defrost Cycle

The defrost cycle may be initiated by the manual defrost switch or the microprocessor when the evaporator coil temperature is below 45 F (7.2 C). Immediately upon initiating defrost, the defrost LED will illuminate and the liquid line solenoid valve de-energizes (closes). The evaporator blowers stop. The compressor and condenser fan stop when the pump down cycle is complete. The heater contactor energizes to supply current to the heaters when the compressor and condenser fan stop.

NOTE: The unit will not defrost during normal unit operation unless the defrost cycle is initiated while the evaporator coil temperature is below 45 F (7.2 C).

When the frost has melted and the evaporator coil temperature reaches 75 C (23.9 C), the defrost cycle should terminate. Immediately, the defrost LED will go out, and the condenser fan and evaporator blower motors should start. The compressor should start 5 seconds after the fan motors start.

NOTE: The microprocessor performs a compressor bump start after a defrost cycle.

Defrost Cycle Checkout Procedure

To check the defrost cycle, operate the unit on cooling until the evaporator coil temperature is below 45 F (7.2 C). Operate the manual defrost switch. If the unit continues to operate on cooling, proceed to "Unit Does Not Defrost".

If the unit shifts to defrost but the evaporator temperature fails to rise, proceed to "Defrost Terminated on Time Limit".

Unit Does Not Defrost

If the unit continues on cooling, proceed to the following steps:

1. Check the Evaporator Coil Sensor:

   If the evaporator coil sensor fails, the Alarm light will flash and the microprocessor will initiate a defrost cycle every 6 hours and automatically terminates defrost after 30 minutes. A faulty evaporator coil sensor is reported on the fault indication readout display as Code 02 when the Alarm [CODE] key is depressed. Test the evaporator coil sensor to determine if the sensor is faulty (see "Sensor Check" under Microprocessor Repair in the Electrical Maintenance section).

2. Check the Evaporator Temperature:

   Make sure the evaporator temperature is actually below 45 F (7.2 C) if the unit will not defrost. Use the thermistor lead in the unit control box to check the evaporator return air temperature. The evaporator return air temperature should be 40 F (4.4 C) or less.

3. Check the Manual Defrost Switch and DEFR wire:

   If the unit will not defrost, no Alarm signal is displayed and the evaporator return air temperature is below 40 F (4.4 C), place a jumper wire from the DEFR wire to ground at the DEFR terminal on the front of the microprocessor printed circuit board. If the unit shifts to defrost, the manual defrost switch is defective or there is an open in the DEFR or CH (ground) wires to the switch. Repair or replace the defective switch or wire.

   CAUTION: Do not forget to remove jumper wires from the unit after checking or testing unit components.

Defrost Terminated on Time Limit (Alarm Light Blinking—Fault Code 14)

If the unit shifts to Defrost but the evaporator temperature fails to rise, an interval timer in the microprocessor will automatically terminate defrost after 45 minutes. Defrost cycle termination by the interval timer results in a fault indication alarm. The Alarm light flashes and fault Code 14 is displayed on the right hand digital readout when the Alarm [CODE] key is depressed. If the evaporator temperature fails to rise, proceed to the following steps:

1. Check the Evaporator Coil Temperature:

   Check to see if the evaporator temperature is above 75 F (23.9 C) if the unit will not come out of defrost. Use the coil sensor temperature readout or the thermistor lead in the unit control box to check the evaporator temperature. If the evaporator temperature does not rise enough to bring the unit out of defrost, some of the heater rods, the heater contactor, or HTR or R51 wires to the heater contactor may be defective.

2. Check for Additional Fault Indication Codes:

   If the interval timer terminates defrost, press the Alarm [CODE] key to view and record any additional faults.

   A Code 09 (Evaporator Over Temperature) fault would cause the microprocessor to de-energize the electric heater contactor due to the coil sensor high temperature. Check for a defective electric heater rod (hot spots) or a defective coil sensor.

   A Code 02 (Coil Sensor) Fault indicates a faulty evaporator coil sensor. If the evaporator coil sensor fails during defrost, the microprocessor interval timer automatically terminates defrost in 30 minutes instead of 45 minutes. To test the evaporator coil sensor, see "Sensor Check" under microprocessor Repair in the Electrical Maintenance chapter. Replace a defective evaporator coil sensor.

3. Check Compressor and Evaporator Blower Contactors and the Microprocessor Relays:

   When the unit shifts to defrost, the compressor and evaporator blowers should stop after pump down is complete. If the compressor or evaporator blowers fail to stop after pump down, check for a defective compressor contactor or evaporator blower motor contactor, a defective compressor contactor relay or evaporator blower motor contactor relay, or a defective microprocessor.

Microprocessor Internal Defrost Timer Checkout

To test the microprocessor internal defrost timer, operate the unit in cooling until the evaporator coil sensor temperature is below 45 F (7.2 C). Connect a jumper wire from the "Short Time" terminal on terminal strip TB2 on the front of the microprocessor printed circuit board to a GRND (ground) terminal. The microprocessor will initiate the defrost mode and then terminate defrost.

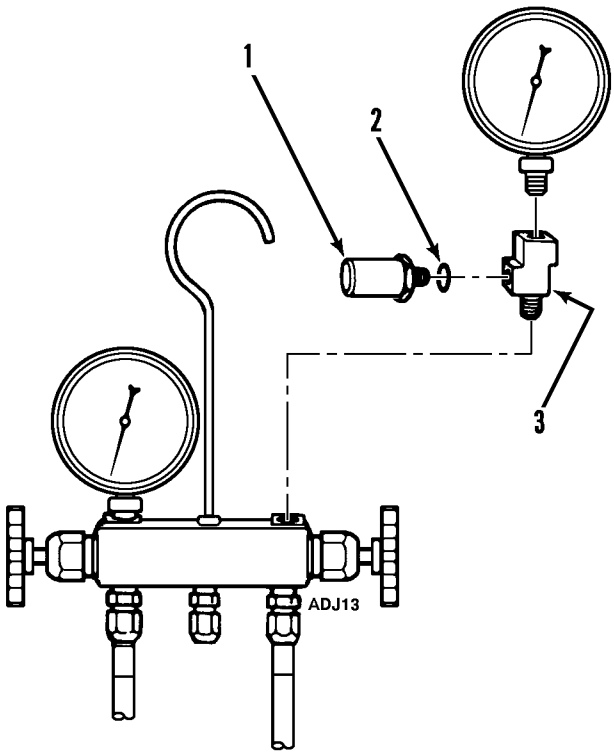
Initiation will occur from 0 to 60 seconds after applying the jumper, and termination will occur 60 seconds later. Remove jumper from terminal strip.

CAUTION: Do not forget to remove jumper wires from the unit after checking or testing unit components.

NOTE: The unit must be in Cool mode to initiate "short time" defrost cycle.

HIGH PRESSURE CUTOUT

The high pressure cutout is located on the compressor discharge manifold. If the discharge pressure rises above 350 ± 10 psig (2415 ± 69 kPa), the switch opens the R51A circuit. The microprocessor Alarm light will flash, and the compressor and evaporator blowers will turn off immediately. The condenser fan will continue to operate on high speed. Pressing the Alarm [CODE] key on the microprocessor will cause Code 10 (High Refrigerant Pressure/TEMP) to appear on the right hand display. To test the switch, rework a gauge manifold per "High Pressure Cutout Manifold" illustration.



1	Relief Valve (66-6543)
2	O-ring (33-1015)
3	Adapter Tee Weather Head (No. 552X3)

High Pressure Cutout Manifold

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 900 psig (6024 kPa) working pressure rating.

2. Adjust temperature setpoint well below the control sensor temperature so that the unit will operate in Cool mode.

3. Raise the discharge pressure of the compressor by blocking the condenser coil airflow. Temporarily cover the compressor compartment, control box, and Integrated Remote Monitoring Unit box with cardboard to reduce condenser coil airflow. This should increase the discharge pressure enough to cause the switch to open.

   NOTE: The discharge pressure should never be allowed to exceed 400 psig (2758 kPa).

4. Failure of the HPCO system to stop compressor operation should be investigated first by checking the control circuit operation, and secondly by HPCO switch replacement.

   To check control circuit operation, disconnect the electrical leads to the HPCO switch (disable power while removing leads). The Alarm light should flash and the compressor and evaporator blowers should turn off immediately. The condenser fan should operate on high speed. This indicates the control circuit and microprocessor are operating properly. Therefore, the HPCO is defective and must be replaced.

   Be sure to remove the cardboard installed in step 3.

   NOTE: To clear the HPCO alarm, press the Alarm [CODE] key on the microprocessor. With CODE 10 displayed on the right hand readout, press the CLEAR key. The Alarm light will stop flashing and the unit will start.

   WARNING: When the CLEAR key is pressed, the unit will start automatically.

   WARNING: The condenser fan continues to operate during compressor shutdown on high pressure cutout.

ELECTRICAL CONTACTORS AND RELAYS

Maintenance consists of replacing a relay. The coil of the phase selection contactors can also be replaced if the coil is shorted (burned out) or open (broken wire). Points on the phase selection contactor are also replaceable as a set.

Phase Selection Contactor Repair

Point Replacement

1. Disconnect the power cord from the unit.
2. Remove high voltage wires from contactor. Note and record positions of wires on contactor (label wire and contactor terminal).
3. Remove low voltage wires from the coil. Note and record positions of wires on coil (label wire and coil terminal).
4. Remove contactor from the unit.
5. Remove the screws that mount the bridge contacts and the terminal contacts.
6. Install point kit set.
7. Replace contactor in the unit and install the power cord wires.
8. Reconnect the power cord to the unit.
9. Operate the unit and check contactor for proper operation.

Coil Replacement

1. Follow steps 1 through 4 in Point Replacement.
2. Remove the screws which mount the base to the contactor.
3. Slide out the coil and remove the brass tube from the coil.
4. Insert the brass tube inside the new coil.
5. Slide the coil into the contactor assembly.
6. Replace the mounting plate and screws.

7. Install contactor assembly in the unit and connect wires.
8. Reconnect the power cord to the unit.
9. Operate the unit and check contactor for proper operation.

24 Vac Coil Contactors

Replacement

NOTE: If the points are worn or damaged, replace the entire contactor. There are no repairable parts.

1. Disconnect the power cord from the unit.
2. Remove the high voltage wires from contactor. Note and record positions of wires on contactor (label wires and contactor terminal).
3. Remove the low voltage wires from the coil. Note and record the positions of wires on coil (label wires and coil terminals).
4. Remove contactor from the unit.
5. Remove mechanical interlock if necessary.
6. Replace contactor in the unit and connect wires.
7. Reconnect the power cord to the unit.
8. Operate the unit and check contactor for proper operation.

CONDENSER FAN AND EVAPORATOR BLOWER ROTATION

CAUTION: When adjusting the microprocessor temperature setpoint to check fan rotation, be sure to return the microprocessor to the setpoint indicated on the shipping manifest.

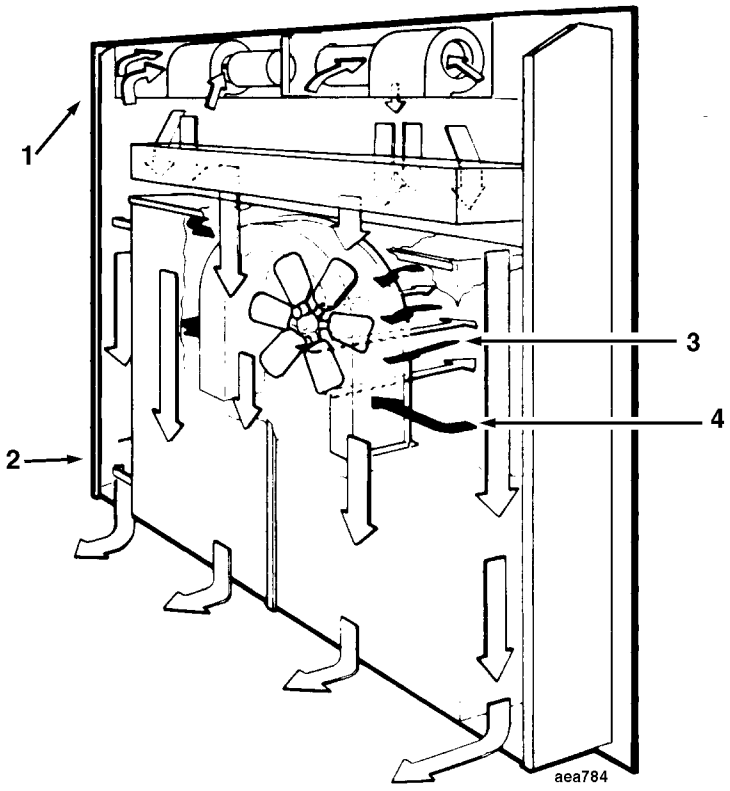
Condenser Fan

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 Blowers

Visually inspect the evaporator blower blades for proper rotation. Arrows placed on the motor housings and stamped in the blower wheel blades point in the direction of proper wheel rotation for easy reference.



Unit Airflow

1	Evaporator Air In (Top)
2	Evaporator Air Out (Bottom)
3	Condenser Air Out (Straight from Fan)
4	Condenser Air In (Compressor Compartment)

NOTE: Check both High and Low Speed evaporator blower rotation by adjusting the microprocessor temperature setpoint to operate the unit with the container return air temperature both above and below 24 F (-4.4 C).

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

NOTE: Evaporator blower 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.

Condenser Fan and Evaporator Blowers (and Compressor) Rotate Backwards

If both condenser fan and evaporator blowers are rotating incorrectly, the phase sequence selector is probably wired wrong or broken. First check the unit wiring against the unit wiring diagram. Check the phase selection contactor output leads L1A, L2A, and L3A and the phase selector circuit coil leads Brown, Orange, Blue and Red. Check phase sensing leads Purple, Yellow and Gray. Also check the unit wiring at the evaporator blower and condenser fan motor junction boxes to be sure the power cord leads have not been reversed.

If the phase sequence selector wiring agrees with the unit wiring diagram, the phase sequence selector is malfunctioning. The two phase selection contactors are physically interlocked so that only one contactor can pull in at a time. The phase sequence selector can fail with both contactors open (no line voltage to L1A, L2A, L3A), or with the same contactor pulling in all the time.

Since both condenser fan and evaporator blowers are rotating incorrectly, determine which contactor is closed with a test light or by visual inspection. Probe the test light across the coils of the contactors. The coils operate on 110 Vdc supplied through the phase selector circuit. To confirm the phase sequence selector has failed, reverse any two incoming power cord leads at the Phase Selection Contactors (disconnect power supply before reversing leads). If the same contactor closes when power is restored, replace the phase sequence selector.

COMPRESSOR LIQUID INJECTION SYSTEM

The compressor refrigerant injection system injects refrigerant vapor into the compressor suction cavity to protect the compressor from excessively high operating temperatures. The liquid injection system includes a liquid injection valve (24 Vac) mounted on the compressor, and a temperature sensor. The temperature sensor is mounted in the compressor head to sense refrigerant temperature. If the refrigerant temperature rises to 280 F (137.8 C), the microprocessor energizes the liquid injection valve. Cold refrigerant vapor is then injected into the compressor suction cavity through a metered orifice to cool the compressor. This causes frost to appear on the injection valve outlet tube that enters the compressor. When the refrigerant temperature drops to 270 F (132.2 C), the microprocessor de-energizes the liquid injection valve to stop injection.

NOTE: The liquid injection valve may be energized (injecting) whenever the modulation valve is closed 50% or more.

If the refrigerant temperature rises to 298 F (147.8 C), the microprocessor de-energizes the compressor contactor to stop the compressor. The unit microprocessor alarm light will flash and alarm code 82 (High Compressor Temperature) will be displayed when the [CODE] key is pressed. The condenser fan continues to operate on high speed. The microprocessor checks the compressor discharge temperature every 30 seconds. When the compressor discharge temperature drops below 298 F (147.8 C), the condenser fan operates for one additional minute before the microprocessor returns the unit to normal operation.

NOTE: All indicator mode lights (except the Power On light) are OFF during unit operation on High Compressor Temperature alarm [CODE 82]. The In-range LED will also remain ON if the controlling air sensor temperature is within 3 F (1.7 C) of setpoint.

The liquid injection system can fail if:

1. Injection valve does NOT inject refrigerant into the compressor.
2. Injection valve CONTINUALLY injects refrigerant into the compressor, or
3. Injection valve CYCLES ON and OFF.

   NOTE: A failed sensor generates microprocessor alarm code 81 and causes the microprocessor to energize the liquid injection valve for CONTINUOUS refrigerant injection.

Injection Valve Does NOT Inject Refrigerant Into the Compressor

When the liquid injection system injects refrigerant vapor into the suction cavity of the compressor, frost may appear on the outlet tube of the injection valve. If no frost appears but the compressor repeatedly shuts down on alarm code 82 (High Compressor Temperature) in high ambient conditions, perform the following checks:

1. Turn circuit breakers CB2, CB3 and CB6 to the OFF position to de-energize the microprocessor.

2. Disconnect the sensor from the microprocessor and connect a 1.7 K ohm ± 10% resistor to the terminals of the microprocessor (this simulates high compressor discharge temperature). Now turn CB2, CB3 and CB6 to ON position to energize the microprocessor and operate the compressor. The injection valve should begin injecting and frost should form on the outlet tube of the injection valve.

   If frost forms, go to Step 5, otherwise go to Step 3.

3. If frost does NOT form in Step 2, check to see if there is 24 Vac control voltage at the coil of the injection valve (wire leads L1 and R51). If control voltage is not present, check to be sure microprocessor relay K1 is energized. If the relay is energized, check for power on the R2K wire at the microprocessor. If relay K1 is not energized, replace the microprocessor.

4. If correct control voltage is present, make sure the ball in the bottom sight glass of the receiver tank is floating (indicating an adequate supply of refrigerant). If the ball is floating and frost still does not form, replace the injection valve.

5. If the injection valve operates properly using the 1.7 K ohm resistor, check for a defective sensor. See step 6 under "Injection Valve Continually Injects Liquid Into the Compressor".

Injection Valve CONTINUALLY Injects Refrigerant Into the Compressor (Including COOL Mode)

NOTE: During normal unit operation, the microprocessor energizes the liquid injection valve continuously when the modulation valve closes 50% or more (70% on temperature pull-down).

1. Make sure the ball in the bottom sight glass of the receiver tank is floating (indicating an adequate supply of refrigerant). Turn circuit breakers CB2, CB3 and CB6 to the OFF position to de-energize the system.

2. With the system de-energized, disconnect the sensor from the microprocessor and connect a 40.0 K ohm or greater resistor to the terminals of the microprocessor (this simulates very low compressor discharge temperature). Turn CB2, CB3 and CB6 to ON to energize the microprocessor and operate the compressor. The frosting should stop.

   If frosting stops, go to Step 4, otherwise go to Step 3.

3. If frosting does not stop (40.0 K ohm resistor installed), turn CB2, CB3 and CB6 OFF to de-energize the system. Disconnect voltage to the injection valve, then turn CB2, CB3 and CB6 ON and restart the compressor.

   If frosting still does NOT STOP, replace the injection valve (valve is stuck open). If frosting now STOPS, check the K1 relay; R2K, LL and R51 circuits; and the microprocessor (injection valve is being energized continuously).

4. If frosting stops (40.0 K ohm or greater resistor installed), check the system for high suction and/or condensing temperatures before proceeding. The higher the condensing and suction temperatures are, the more injection is required to lower the discharge temperature.

   If suction and condensing temperatures appear normal, perform a compressor pump down test. Close the receiver tank outlet valve and pump the low side down to 2 to 3 psig (14 to 21 kPa). Stop the compressor and wait one minute. The pump down should hold and the pressure should not rise.

   If the suction pressure rises, go to Step 5. If the suction pressure does not rise, go to Step 6.

5. If the suction pressure rises, the receiver tank outlet valve may not be entirely closed, or the valve plate or valve plate gasket may have been damaged. Damage to

the valve plate or its gasket can cause discharge gas to be introduced to the suction cavity, resulting in an artificially high suction temperature. The artificial high suction temperature, in turn, causes an earlier-than-required liquid injection. Replace the compressor valve plate and gaskets if required.

6. If the suction pressure does not rise, the sensor is calling for injection when it is not required and should be replaced. To confirm the sensor is defective, check the resistance of the sensor at room temperature (60 to 100 F [15.6 to 37.8 C]).

   Required equipment: A calibrated digital thermometer (1% full scale accuracy), a calibrated digital ohmmeter (1% full scale accuracy), electrical tape and piping insulation.

   a. Place the digital thermometer probe and the metal end of the sensor together and wrap with electrical tape. The end of the probe must touch the metal end of the sensor.

   b. Wrap the probe and sensor with piping insulation to protect them from air currents. The insulating material should be tightly wrapped around the probe-sensor bulbs and secured with wire or tie-wraps if necessary. There should be no free air movement over the metal part of the taped probe-sensor bulbs.

   c. Connect the digital ohmmeter to the two pins on the plug of the sensor. Make sure there is a good connection. Do not take a sensor resistance measurement until there is no change in the ohmmeter display.

   d. Measure the temperature of the thermometer sensor. The sensor resistance reading should be within ± 5% of the resistance value for the corresponding thermometer temperature in the table below. Interpolate between temperatures to obtain a calculated sensor resistance.

Sensor Temperature (°F)	Sensor Resistance (Ohms)
59.0	141426
60.8	135000
62.6	128907
64.4	123129
66.2	117639
68.0	112437
69.8	107478
71.6	102762
73.4	98289
75.2	94041
77.0	90000
78.8	86139
80.6	82476
82.4	78984
84.2	75663
86.0	72504
87.8	69480
89.6	66609
91.4	63864
93.2	61254
95.0	58770
96.8	56394
98.6	54126
100.4	51966
102.2	49914
104.0	47943
105.8	46053
107.6	44262
109.4	42543
282.2	2166
292.1	1903
310.1	1477

Injection Valve CYCLES ON and OFF

Injecting refrigerant vapor into the compressor suction cavity lowers the discharge temperature sensed by the sensor. When the discharge temperature drops 10 F (5.6 C), the module de-energizes (closes) the injection valve. Cycling of the injection valve in normal or low ambient temperatures is

generally caused by a defective sensor or sensor harness. Check sensor resistance before replacing the sensor.

LOW PRESSURE CUTOUT

The low pressure cutout (LPCO) switch is located on the suction line upstream of the modulation valve in the compressor compartment. If the suction pressure drops below 5 to 17 in. Hg vacuum (-16.9 to -57 kPa) during a compressor pump down cycle, the switch opens the CSP circuit to the microprocessor's compressor suction pressure inputs.

NOTE: The compressor pump down cycle is terminated after 30 seconds at setpoints below 17 F (-8.3 C).

If the LPCO switch fails to open within two minutes after a pump down cycle begins, the microprocessor displays an alarm light, and shifts the unit to the next operating mode. Pressing the Alarm [CODE] key on the microprocessor will cause Code 40 (Pump Down Terminated on Time Limit) to appear on the display.

NOTE: The low pressure cutout switch on this unit does NOT cause the microprocessor to stop unit operation due to low refrigerant charge. Automatic unit shutdown on a low refrigerant charge is an option.

To test the LPCO switch:

1. Install a gauge manifold on the compressor suction line.
2. Adjust temperature setpoint to 0.5 F (0.3 C) below the control sensor temperature so that the unit will shift to Null.
3. Observe the reading on the compound gauge. The suction pressure should decrease, indicating that the liquid line solenoid valve has closed (de-energized). When the compound gauge reads 5 to 17 in. vacuum (-17 to -57 kPa), the compressor should stop.

   NOTE: To clear the LPCO alarm, press the Alarm [CODE] key on the microprocessor. With CODE 40 displayed on the right hand readout (as the number 1 alarm), press the [CLEAR] key. The Alarm light will stop flashing.

4. Failure of the LPCO system to stop compressor operation should be investigated first by checking the control circuit operation, and secondly by low pressure cutout switch replacement.

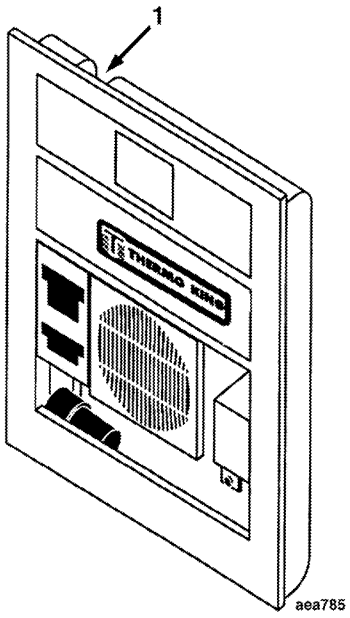
   To check control circuit operation, disconnect the electrical leads to the LPCO switch (disable power while removing leads). Restart the unit in the Cool mode. Adjust the setpoint to 0.5 F (0.3 C) below the control sensor temperature. When the unit shifts to Null, the compressor should stop immediately. The condenser fan should operate for approximately two minutes and then stop. This indicates the LPCO control circuit and microprocessor are operating properly. Therefore the LPCO switch is defective and must be replaced.

   NOTE: Be sure to return the microprocessor to the setpoint indicated on the shipping manifest.

USDA COLD TREATMENT TEMPERATURE RECORDING

The THERMOGUARD µp-A+ controller includes provisions for the use of three sensors approved for monitoring in-transit Cold Treatment shipments under USDA requirements. 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.

The sensor inputs are pre-wired from the spare 1, 2, and 3 terminals on the microprocessor to a connector located in the upper evaporator section of the unit on the compressor side. The connector is accessible form inside the container at the rear of the unit through a cutout in the evaporator screen.



1	Cold Treatment Sensor Connection

Cold Treatment Temperature Recording

The sensors used are special 1/4 in. diameter sensors as required by USDA regulations. The three sensors pre-wired to the required connector are available as an assembly from Thermo King. See the parts manual for part numbers.

Sensor Activation

In order to utilize the sensors they must be software activated using a MicroPac™ microcomputer.

NOTE: The USDA sensors will be identified as follows in the left hand display:

Cold Sensor 1	***SP1 (Spare 1)***
Cold Sensor 2	***SP2 (Spare 2)***
Cold Sensor 3	***SP3 (Spare 3)***

NOTE: The heading "Cold" can be changed to display any code (e.g., USDA). Make the change in your MicroPac under No. 4, initialize, then No. 8, Enter.

To Activate USDA Temperature Recording, Select Six Sensor Recording:

1. Connect a MicroPac microcomputer to the unit.
2. Change to [SIX SENSOR RECORDING] using the initialization menu.
3. Select [SET HEADER] from the menu.
4. Send the header to the unit.

   NOTE: Even though six sensor record is selected, only five sensors will be recorded as follows: return air, discharge air, cold 1, Cold 2 and Cold 3.

   NOTE: If the six sensor record is activated but the USDA sensors are not installed, alarm codes 05, 06 and 07 will be activated and can not be cleared unless the sensors are de-activated by selecting two sensor operation using a MicroPac microcomputer or PC-PAC software and loading a new header; or attaching the USDA sensors.

To De-activate USDA Temperature Recording, Select Two Sensor Recording:

1. Connect a MicroPac microcomputer to the unit.
2. Change to [TWO SENSOR RECORDING] from the initialization menu.
3. Select [SET HEADER] from the menu.
4. Send the header to the unit.

Sensor Calibration

Calibration of the sensors should be verified as required by USDA officials. This is accomplished by means of a three step process.

- The sensors (three) are immersed in an ice water bath to stabilize their temperature at 32.0 ± 0.1 F (0.0 ± 0.1 C).

- The controller display is checked to verify that the sensors are calibrated to read 32.0 F ± 0.0 F (0.0 C ± 0.1 C).
- Calibrate any sensor that does not display 32.0 F ± 0.1 F (0.0 ± 0.1 C).

NOTE: The sensors must be software activated before proceeding. To activate the sensors, see "Sensor Activation" in this manual section.

Ice Bath Preparation

1. The ice bath should consist 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. The container must be filled with ice to the bottom of the container.
2. Stir the ice bath briskly for one minute before proceeding.
3. Insert all three sensors into the ice bath. The sensors should not be allowed to touch the sides of the container during the test.
4. Allow the sensors to stabilize in the bath for five minutes. Stir the bath several times during the five minute wait.

Calibration Check

1. After the sensor temperatures have stabilized (five minute wait), monitor all three sensor temperatures with the controller.

   NOTE: The USDA sensors will be identified as follows in the left hand display:

Cold Sensor 1	***SP1 (Spare 1)***
Cold Sensor 2	***SP2 (Spare 2)***
Cold Sensor 3	***SP3 (Spare 3)***

2. Press the [SELECT] key to enter the menu. Use the [UP] and [DOWN] arrow keys to examine each sensor. Verify that the temperature reading on the right display has stabilized.
3. The temperature of each sensor should be displayed as 32.0 F ± 0.1 F (0.0 ± 0.1 C). If not, the sensor must be calibrated.

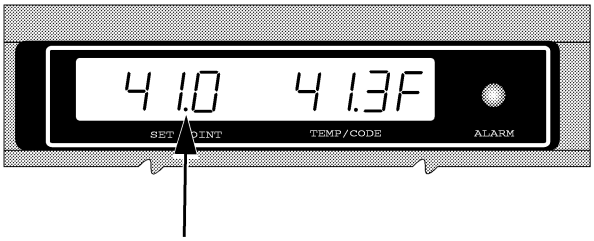
Calibration Procedure

1. Press the [SELECT] key to enter the menu. Use the [UP] and [DOWN] arrow keys to examine each sensor. Verify that the temperature reading on the right display has stabilized.
2. Press the [UP] or [DOWN] arrow key to select sensor 1 (SP1).
3. Press the [SELECT] key to enter Calibration. Left display will show [SP1].
4. Press and hold both the [UP] and [DOWN] arrow keys. Then press the [ENTER] key while still holding both arrow keys. The sensor is now calibrated.
5. Press the [DOWN] arrow key to select [SP2}. Repeat steps 3 and 4 to calibrate sensor 2.
6. Press the [DOWN] arrow key to select [SP3]. Repeat steps 3 and 4 to calibrate sensor 3.
7. Recheck the readings of all three sensors. They should be displayed as 32.0 F ± 0.1 F (0.0 ± 0.1 C). If they are not, repeat the calibration procedure.
8. Remove the sensors from the ice bath and install as required by the local USDA office.

DEHUMIDIFICATION CONTROL SYSTEM

The dehumidification mode is activated by selecting the "rH" screen from the microprocessor menu, pressing the [SELECT] key and then pressing the [ENTER] key. When the microprocessor display returns to the standard screen, the SETPOINT decimal point will flash ON and OFF to indicate the dehumidification mode is active. The humidity

system remains active until it is turned OFF from "rH" screen in the microprocessor menu. Turning the microprocessor or unit power OFF does NOT affect the dehumidification system settings. However, if the unit or microprocessor remains OFF for 7 days, the dehumidification mode will default to OFF.



Setpoint Decimal Point Flashed ON and OFF When Dehumidification Mode is Active (On)

The dehumidification system lowers the relative humidity in the container by energizing the evaporator heaters, thereby increasing the cooling load on the evaporator coil. This causes the evaporator coil temperature to decrease and condenser more water out of the evaporator air. The relative humidity setpoint is adjustable between 60% to 100% (factory default setting = 75%). the humidity setpoint is adjusted from the "rH" screen in the microprocessor menu.

When the dehumidification mode is ON (setpoint decimal point flashing), the microprocessor will energize the electric heaters when the following conditions are satisfied:

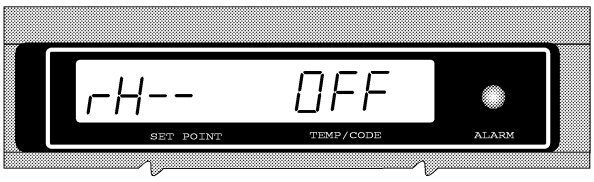
- Fresh Load: Microprocessor temperature setpoint is above 24 F (-4.4 C).
- Unit has completed initial temperature pulldown, placing the unit in Modulation Cool
- Compressor current draw is less than 12.0 amps (microprocessor display = 24)
- Container relative humidity is more than 2% above the humidity setpoint

A humidity sensor mounted in the return air section senses the container relative humidity and sends an input signal to the microprocessor. to prevent rapid cycling of the electric heaters ON and OFF, the microprocessor keeps the heaters ON for a minimum of 3 minutes. When the heaters turn OFF, the microprocessor also keeps the heaters OFF for a minimum of 3 minutes. The heaters remain energized until the container relative humidity decreases to setpoint or one of the following conditions occurs:

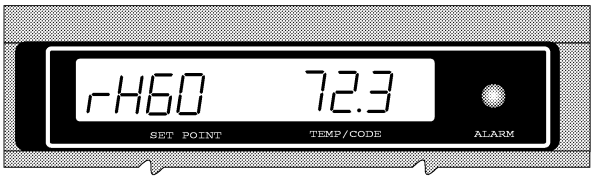
- If the container temperature goes out of range for 5 minutes or more, the microprocessor turns the electric heaters OFF.
- If the compressor current draw exceeds 13.0 amps (microprocessor display = 26), the microprocessor turns the electric heaters OFF immediately.
- If an evaporator over temperature alarm (code 09) occurs, the microprocessor turns the heaters OFF immediately.
- If an evaporator coil sensor alarm (code 02) occurs, the microprocessor turns the heaters OFF immediately.

Viewing the Relative Humidity Setpoint and Current Container Relative Humidity

1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show "----".
3. Press the [UP] or [DOWN] arrow key to scroll to "rH". The display will show:
   - "rH---- OFF" when the dehumidification system is OFF.



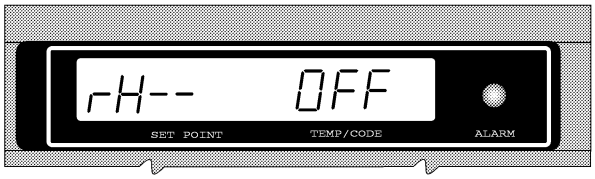
- A two digit number (e.g. “60”) immediately after “rH” when the dehumidification system is ON. This is the current relative humidity setpoint (in percent).
- A three digit number in the right TEMP/CODE display (e.g. “72.3”) when the dehumidification system is ON. This is the current container relative humidity.



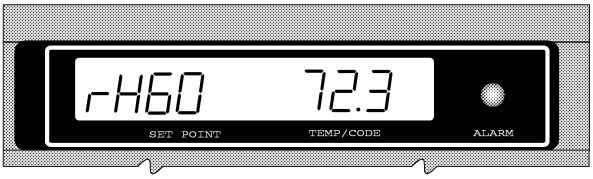
NOTE: Press the [CLEAR] key to return the microprocessor to the standard display.

Turning the Dehumidification System ON and Adjusting the Relative Humidity Setpoint

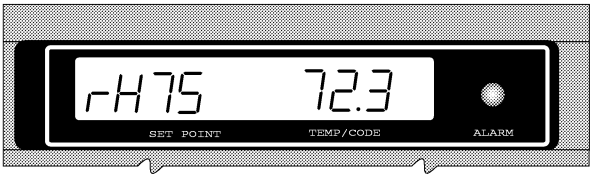
1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show “----”
3. Press the [UP] or [DOWN] arrow key to scroll to “rH-- OFF”.



4. Press the [SELECT] key. the EDIT LED will flash and the display will change to show the current relative humidity setpoint (e.g. “60”) immediately after “rH” and the current container relative humidity (e.g. “72.3”).



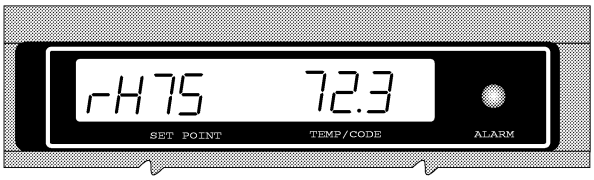
5. To change the relative humidity setpoint, press the [UP] or [DOWN] arrow key within 3 seconds to scroll to the new 2 digit setting (in percent).



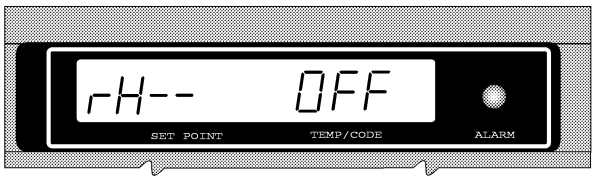
6. To enter the relative humidity setpoint that appears in the SETPOINT display and activate the dehumidification system, press the [ENTER] key. the microprocessor will display “LOAd” for 3 seconds.
7. The microprocessor returns to the standard display. The SETPOINT decimal point will flash ON and OFF to indicate the dehumidification mode is active.
8. To verify the new relative humidity setpoint:
   a. Press the [SELECT] key to enter the MENU. The display will show “----”.
   b. Press the [UP] or [DOWN] arrow key to scroll to “rH” in menu.\
   c. The display will show the new setpoint and current container relative humidity (e.g. “rH75 72.3”).

Turning the Dehumidification System OFF

1. Turn the unit On-Off switch ON or operate the microprocessor using battery power.
2. Press the [SELECT] key to enter the MENU. The display will show "----".
3. Press the [UP] or [DOWN] arrow key to scroll to "rH" menu. When the dehumidification system is ON, the SETPOINT decimal point flashes and the display will show the current relative humidity setpoint and current container relative humidity (e.g. "rH75 72.3").



4. Press the [SELECT] key. The EDIT LED will flash but the display does NOT change.
5. Press the [SELECT] key again. The display will show "rH-- OFF".



6. To turn the dehumidification system OFF, press the [ENTER] key. The display will show "LOAd" for 3 seconds. The microprocessor then returns to the standard display. The SETPOINT decimal point will NOT flash when dehumidification mode is inactive (OFF).

HUMIDITY SENSOR DIAGNOSIS

A defective humidity sensor can be detected by checking the resistance between the sensor leads. Disconnect the sensor harness from the terminals on the microprocessor printed circuit board and check the resistance with an ohmmeter. Resistance should be between 3109 ohms (0% relative humidity) and 3600 ohms (100% relative humidity). For a more accurate check, sensor resistance is 3353 ohms at 50% relative humidity and varies 5 ohms per 1 percent change in relative humidity. If resistance is out-of-range, the sensor is defective and must be replaced.

Calibration of Microprocessor Dehumidification System Input Circuit

The calibration of the dehumidification system should be checked (recalibrated) annually or whenever the microprocessor is replaced.

1. With the unit On-Off switch OFF, remove the humidity sensor leads (HSEN and SCOMH wires) from the microprocessor terminal strip.
2. Place a 3266 ± 0.5 ohm resistor across the "Spare AI4" and "COMMON" terminals on the microprocessor circuit board.
3. Turn control circuit breaker CB3 OFF. Then turn unit On-Off switch ON.
4. Press the [SELECT] key to enter the MENU. the display will show "----".
5. Press the [UP] or [DOWN] arrow key to scroll to "SP4" screen in the menu.
6. Press the [SELECT] key to enter the calibration mode. SETPOINT display will show [C SP]. The microprocessor will stay in this mode up to 15 minutes. To return to the standard display and exit calibration, press the [CLEAR] key.
7. To calibrate the controller, press both the [UP] and [DOWN] arrow keys at the same time and hold. the EDIT LED will flash. While holding (pressing the [UP] and [DOWN] keys), press the [ENTER] key. The SETPOINT display will show "LOAd".

8. When the microprocessor returns to the standard display, the TEMP/CODE display must show 32.0 F ± 0.1 F (0.0 C ± 0.1 C). If not, repeat the calibration procedure.

9. Remove the resistor and reconnect the humidity sensor leads to the terminals on the microprocessor printed circuit board. Turn circuit breaker CB3 ON.

Refrigeration Maintenance

CAUTION: When servicing Thermo King R-134a 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-134a refrigerant and Polyol Ester based compressor oils. Residual non-HFC refrigerants or non-Ester based oils will contaminate HFC systems.

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.

SERVICE TOOLS

When servicing R-134a refrigeration systems, use only those tools (i.e., vacuum pump, gauge hoses, gauge manifold set) certified for and dedicated to R-134a refrigerant and Ester based compressor oils. Residual non-HFC refrigerants or non-Ester based oils will contaminate HFC systems.

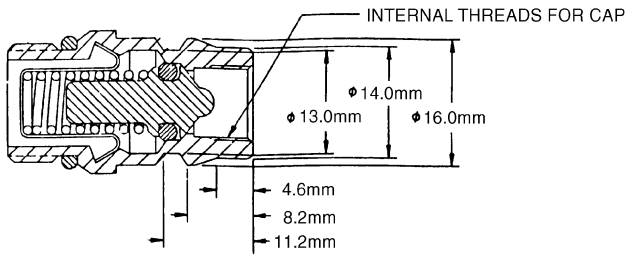
Unit Service Fittings—Special fittings are used on R-134a systems to prevent mixing of non-HFC refrigerants in R-134a units. These fittings are located in three places on CF-II refrigeration systems:

- Low side near the compressor suction adapter,
- High side near the compressor discharge manifold,
- High side near the receiver tank.

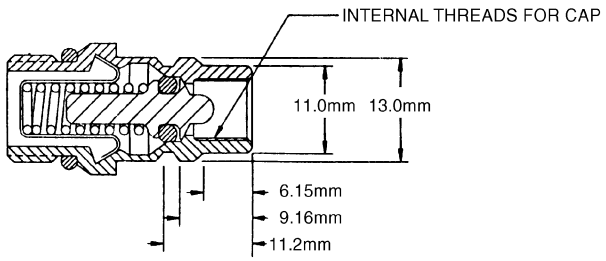
Leak Detection—Leaks can be detected with the use of soap bubbles and with Halogen leak detectors such as model H10G, TK P/N 204-712 or model H10N, TK P/N 204-756 (portable).

Gauge Manifold Set—A new gauge manifold set (TK P/N 204-758) should be dedicated for use with R-134a only. Gauge hoses should also be dedicated to R-134a.

Vacuum Pump—A two-, three- or five-stage pump (TK P/N 204-725) 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 (TK P/N 204-725) 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.

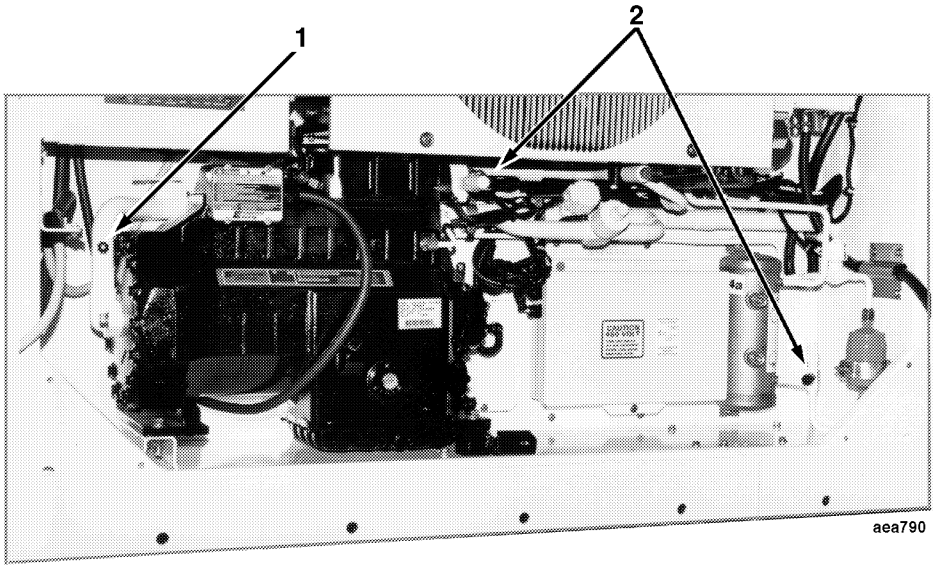


High-pressure Fitting



Low-pressure Fitting

Service Fittings Specifications



1	Low Pressure Fitting
2	High Pressure Fittings

Typical Service Fitting Locations—All Three (3) Connections Must Be Used To Completely Remove Refrigerant Charge

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-134a systems.

Refrigerant Recovery—Use only refrigerant recovery equipment approved for and dedicated to R-134a recovery.

Compressor Oil Acid Test—Perform an oil acid test whenever a unit has a substantial refrigerant loss, a noisy compressor or dark/dirty oil.

COMPRESSOR DISCHARGE SERVICE VALVE

The discharge valve isolates the compressor from the high side of the refrigeration system for system diagnosis, service and repair.

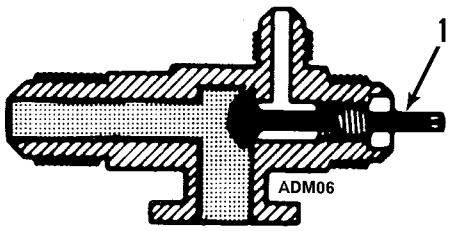
NOTE: The only maintenance possible on the discharge service valve is to periodically tighten the packing nut or to replace the packing. The valves are a permanently assembled unit and must be replaced in total if defective.

BACK SEATED—normal operation position.

OPEN TO SERVICE PORT—position for servicing.

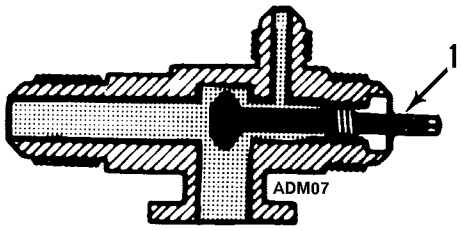
FRONT SEATED—to check or remove compressor.

WARNING: Do not start unit with discharge valve in FRONT SEATED position



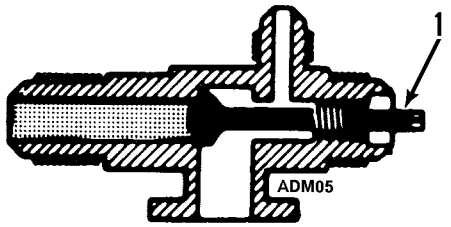
1	Full Counterclockwise

Service Valve Back Seated



1	1/2 Turn In

Service Valve Open to Port



1	Full Clockwise

Service Valve Front Seated

GAUGE MANIFOLD SET (WITH LOW LOSS FITTINGS) ATTACHMENT AND PURGING

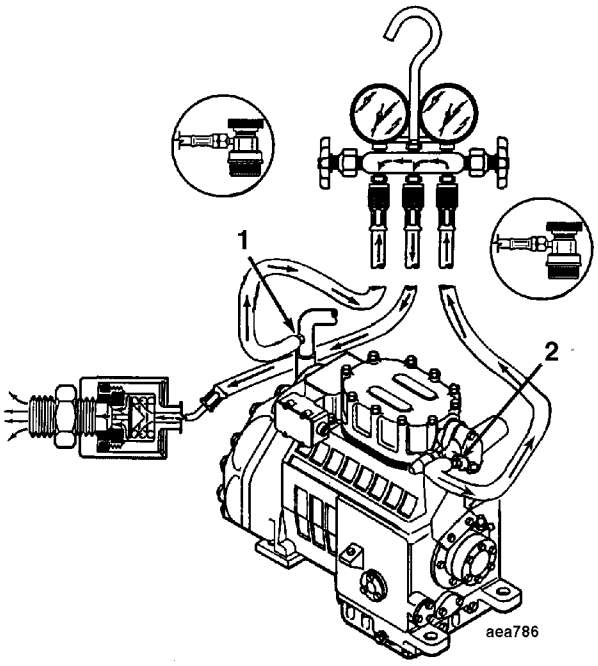
Thermo King recommends the use of access valves or self-sealing, quick disconnect fittings whenever possible to limit the loss of refrigerant into the atmosphere. A separate gauge manifold set with low loss fittings (TK P/N 204-758) should be dedicated for use with R-134a only. Gauge hoses should also be dedicated to R-134a.

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

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 when removed from the unit.

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 re-use the caps and sealing washers on 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.



1	Suction Connection
2	Discharge Connection

Purging Gauge Manifold

5. With 10 psig (69 kPa) 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.

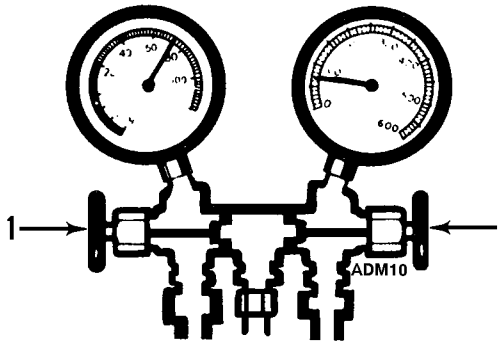
8. Attach high side hose (pressure gauge) to the discharge service line port.

9. Open the discharge service manifold hand valve fully. Then rotate the discharge hose fitting hand wheel clockwise to open (depress) the 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.

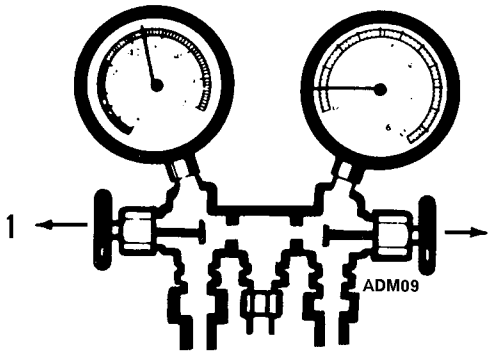
11. Close the discharge service manifold hand valve fully to the center port. You are now ready to use the gauge manifold to check system pressures or perform MOST service procedures.

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	Close Hand Valves

Closed To Center Port



1	Open Hand Valves

Open to Center Port

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 the 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. Close the receiver tank outlet valve and pump down the low side. Then turn the unit OFF.
3. Rotate the discharge fitting hand wheel clockwise to depress port valve stem to equalize pressure between 1 and 3 psig (7 to 21 kPa).
4. Rotate both coupler hand wheels counterclockwise to close (seal) valve port stems to the high and low hoses.
5. Then remove the gauge line from the suction service fitting and cap the service port.
6. Remove the gauge line from the discharge service fitting and cap the service port.
7. Back seat the receiver tank outlet valve and cap the valve stem.
8. Secure all manifold lines to manifold hose anchors when the manifold is not in use.

SYSTEM SUCTION PRESSURES

Normal refrigeration system suction pressures at the compressor are shown in the table below.

NORMAL R-134a SYSTEM SUCTION PRESSURES (3D Compressor with Power Monitor)

Container Temperature	Operating Mode	Ambient Temperature	Suction Pressure
70 F (21.1 C)	COOL	80-100 F (26.7-37.8 C)	16 to 20 psig (110.3 to 137.9 kPa)
		60-80 F (15.6-26.7 C)	14 to 18 psig (96.5 to 124.1 kPa)
	MODULATION	80-100 F (26.7-37.8 C)	*
	COOL	60-80 F (15.6-26.7 C)	*
35 F (1.7 C)	COOL	80-100 F (26.7-37.8 C)	7 to 11 psig (48.3 to 75.8 kPa)
		60-80 F (15.6-26.7 C)	6 to 10 psig (41.4 to 68.9 kPa)
	MODULATION	80-100 F (26.7-37.8 C)	*
	COOL	60-80 F (15.6-26.7 C)	*
0 F (-17.8 C)	COOL	80-100 F (26.7-37.8 C)	9” to 5” Hg vacuum (-30.42 to -16.90 kPa)
		60-80 F (15.6-26.7 C)	11” to 7” Hg vacuum (-37.18 to -23.66 kPa)
-20 F (-28.9 C)	COOL	80-100 F (26.7-37.8 C)	14” to 10” Hg vacuum (-47.32 to 33.80 kPa)
		60-80 F (15.6-26.7 C)	15” to 11” Hg vacuum (-50.70 to 37.18 kPa)

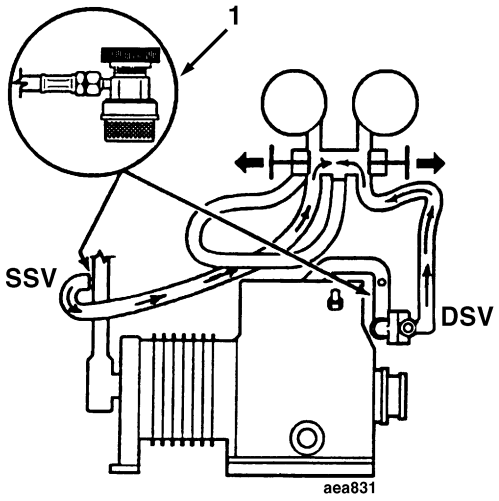
Suction pressure in MODULATION COOL mode will vary between 10 in. Hg vacuum (-33.8 kPa) and 20 psig (137.9 kPa), depending on the value of the control temperature differential.

GAUGE MANIFOLD VALVE POSITIONS

The gauges indicate low and high side pressures.

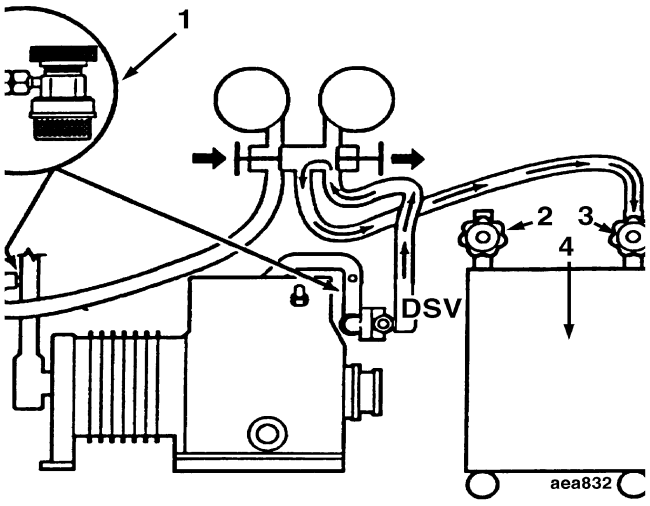
Operate one or both hand valves to perform the different service operations.

NOTE: It will be necessary to operate the compressor with the suction pressure below a 5 in. vacuum (-17 kPa) in some troubleshooting and service procedures. In these cases, it will be necessary to place a jumper across the low pressure cutout to prevent the unit from shutting down.



1	Self-sealing Quick Disconnect Access Valves

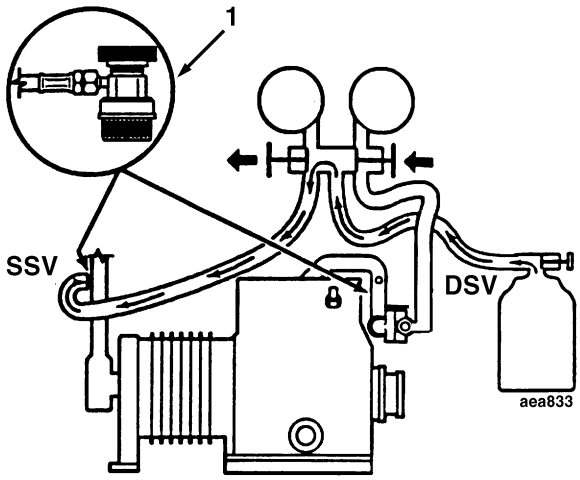
Balancing the Pressure



1	Self-sealing Quick Disconnect Access Valves
2	Out
3	In
4	Reclaimer

Removing Refrigerant—To Remove up to 5 lb (2.3 kg) of Refrigerant from an overcharged Unit ONLY

NOTE: To remove entire refrigerant charge, use 3-point connection to suction valve, discharge valve and receiver tank outlet valve service fittings as shown on page 101. Because this unit is equipped with a discharge pressure regulator and a discharge check valve, refrigerant will remain trapped in the condenser coil if connections are made to the suction and discharge service valves ONLY.



1	Self-sealing Quick Disconnect Access Valves

Charging the System

CHECKING COMPRESSOR OIL

CAUTION: Use ONLY Polyol Ester based refrigeration compressor oil, TK P/N 203-433.

DO NOT use Polyol Ester based oil in other Thermo King units.

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

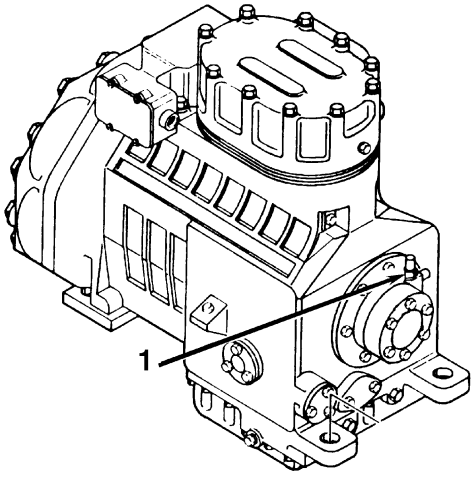
Rubber gloves are recommended when handling Ester based compressor oil.

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 50 F (10 C)

Install gauge manifold on the compressor. Operate the unit on COOL with a 20 psig (138 kPa) minimum suction pressure and a 100 psig (689 kPa) 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 Here at Oil Pump Fitting

Adjusting Compressor Oil Level

To check compressor oil level with an ambient air temperature below 50 F (10 C)

With the evaporator temperature below 45 F (7.2 C), press the Manual Defrost switch 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. Install gauge manifold set (refer to "Gauge Manifold Set Attachment and Purging"). Pump the compressor down (refer to "Low Side Pump Down").
2. After stopping the compressor—adjust the low side pressure using the service gauge set to 3 psig (21 kPa) inside the compressor. (Pressure measured at the suction line service port.)
3. Remove the cap from oil pressure fitting on top of oil pump.
4. Using a commercial hand pump, force oil in through the oil pressure fitting. Slowly add oil and allow 5 to 10 minutes for the oil to flow down through the compressor into the sump. Add Polyol Ester oil, TK PN 203-433 ONLY!
5. When the compressor oil sight glass is 1/2 to 3/4 full, remove hand pump and replace the cap on the oil pressure fitting.
6. Open the receiver tank outlet valve and operate the unit. Recheck the refrigerant charge level and the oil level before returning the unit to service.

Removing Excess Compressor Oil

1. Install an access valve actuator on the oil pressure fitting on oil pump housing.
2. Operate the unit and 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 access valve and replace the cap on the oil pressure fitting.
4. Operate the unit and recheck the refrigerant charge level and the oil level before returning the unit to service.

REFRIGERANT LEAK TEST PROCEDURE

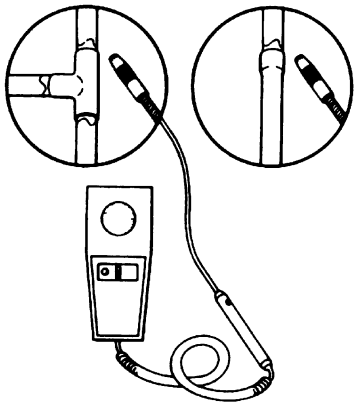
Use a reliable Halogen leak detector such as model H10G, TK P/N 204-712 or 204-756 (portable), to leak test the refrigeration system. Inspect carefully for signs of compressor oil leakage which is the first sign of a leak in the refrigeration system.

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 50 psig (345 kPa) 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.



Testing for Refrigerant Leaks

6. Close both hand valves on the 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 200 psig (1379 kPa). See "Using Pressurized Nitrogen" in this manual chapter.

   CAUTION: Nitrogen (N_2) is under 2200 psig (15169 kPa) pressure in a full cylinder at 70 F (21 C). DO NOT use oxygen, acetylene or any other type of pressurized gas in the system.
9. Pressurize the system with nitrogen to 200 psig (1379 kPa).
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.

LOW SIDE PUMP DOWN

1. Install the gauge manifold on the compressor.
2. Set the microprocessor setpoint temperature well below the return air temperature and operate the unit in the Cool mode until the temperature stabilizes (at least 5 minutes).
3. Close the receiver tank outlet valve. Allow the unit to operate until it reaches 5 to 11 in. vacuum (-17 to -37 kPa) on the suction pressure gauge (approximately 10 minutes). Then shut the unit down manually with the On-Off switch.

   NOTE: This unit is equipped with a low pressure cutout switch. The low pressure cutout switch may shut down the unit automatically.

   CAUTION: Never open the low side to the atmosphere while it is in a vacuum because air and moisture will be drawn in and contaminate the refrigerant system.
4. To place the unit back in service, open the receiver tank outlet valve and turn the On-Off switch ON.

REFRIGERANT CHARGE

The refrigerant charge should be checked 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. The unit is charged with 14 lb (6.35 kg) R-134a refrigerant at the factory. The refrigerant charge can be checked by inspecting the receiver tank sight glasses.

NOTE: See "Receiver Tank Sight Glasses" under Unit Instruments in the Operating Instructions chapter for

information about checking the moisture indicator in the sight glass.

Checking the Refrigerant Charge

1. Inspect the BOTTOM receiver tank sight glass (labeled "Add") with the unit operating in COOL or MODULATION COOL. If the ball FLOATS in the BOTTOM receiver tank sight glass, the R-134a charge level is correct.

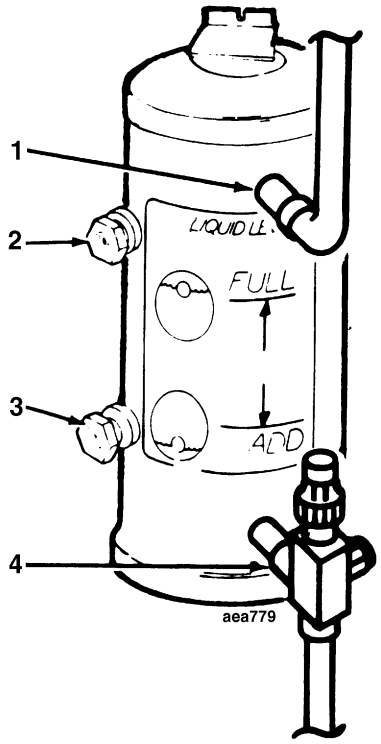
2. If the ball is NOT FLOATING in the BOTTOM sight glass, the unit MAY be low on R-134a charge. Adjust the microprocessor setpoint to operate the unit on COOL. Operate the unit on COOL for 5 minutes. If the ball floats in the BOTTOM receiver tank sight glass, the R-134a charge level is correct.

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

3. If the ball in the BOTTOM receiver tank sight glass does NOT FLOAT after operating the unit on COOL for 5 minutes, the unit is low on R-134a charge. With the unit operating on COOL, add R-134a until the ball in the BOTTOM receiver tank sight glass FLOATS in the sight glass.

   NOTE: Inspect the unit for refrigerant leaks with a reliable leak detector if the unit is low on R-134a charge.

4. If the ball in the TOP sight glass is FLOATING after operating the unit on COOL for 5 minutes, the unit is overcharged. Remove refrigerant until the TOP ball is not floating.



1	Inlet Tube
2	"Full" Sight Glass with Moisture Indicator
3	"Add" Sight Glass with Moisture Indicator
4	Receiver Tank Outlet Valve

Receiver Tank

EVACUATION AND CLEANUP OF THE REFRIGERATION SYSTEM

Contamination

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. If the compressor oil shows an acid condition, change the oil, the compressor bypass 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 5 to 10 inch vacuum that is dependent upon the recovery equipment used).

2. Break vacuum with refrigerant and equalize system pressure to 0 psig (0 kPa). Replace the liquid line filter drier.

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 on the diagram on the following page. Connect evacuation hoses to the compressor suction and discharge service lines and the receiver tank outlet valve.

   NOTE: A three (3) point connection of evacuation station to the unit is required to remove the entire refrigerant charge from the unit. Because this unit is equipped with a discharge pressure regulator and discharge check valve, refrigerant will be trapped in the condenser coil if evacuation connections are made to the suction and discharge service valves ONLY.

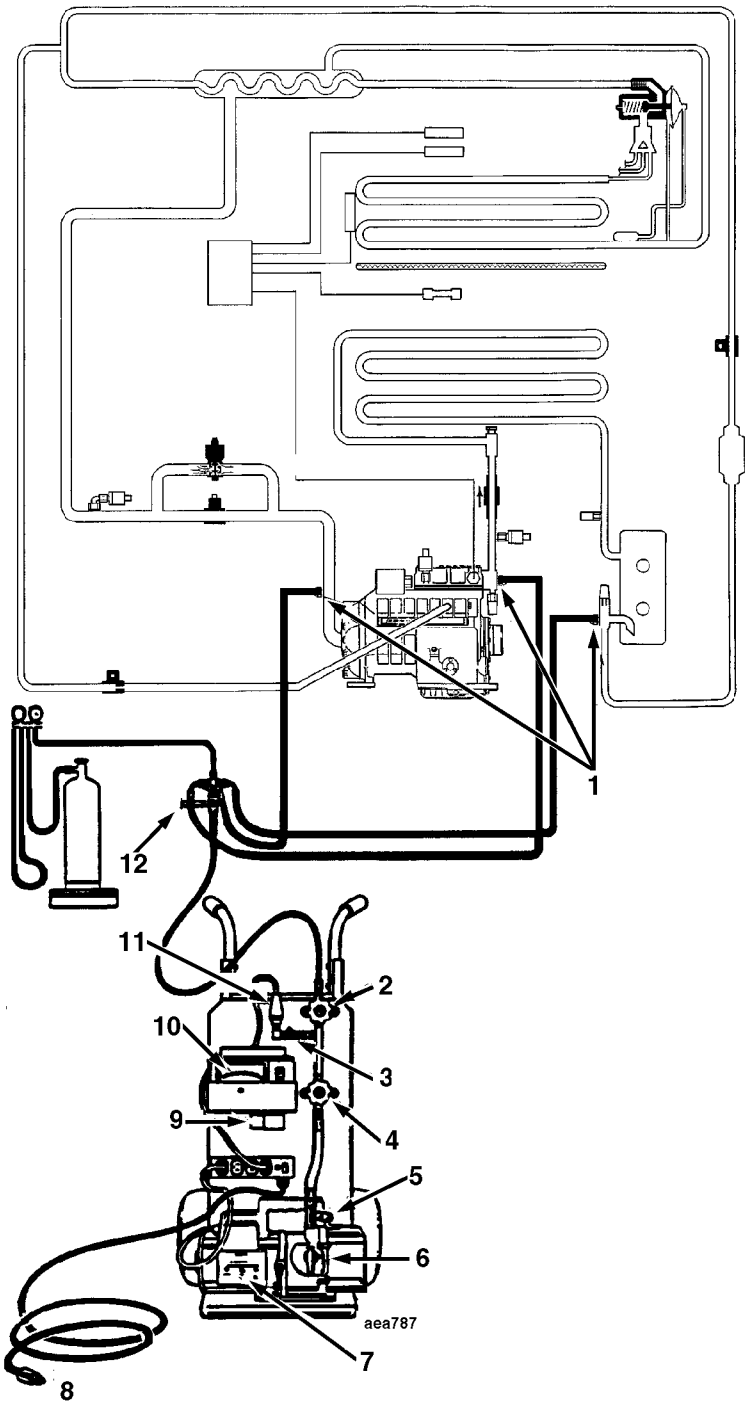
5. Mid-seat the receiver tank outlet valve.

6. Replace valve stem cap on the receiver tank outlet valve.

7. 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.

8. 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.

9. 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.



1	Special Self-sealing, Quick Connect Couplers are Required for R-134 Units	7	Two Stage Vacuum Pump
2	V3	8	To 220 Vac Power
3	V2	9	Calibration Standard
4	V1	10	Micron Meter
5	Gas Ballast Valve	11	Sensor
6	ISO Valve	12	V4

Evacuation Station and Unit Hookup

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 counter-clockwise). 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.

2. If the vacuum level appears to stall above 500 microns, back seat the discharge service valve and observe the Micron Meter.

   - A drop in pressure indicates that the compressor oil is out-gassing and further evacuation is necessary.
   - An increase in pressure indicates that a leak exists or there is moisture in the system. Perform a "Pressure Rise Test" and evaluate.

3. Close valve V1 when the desired vacuum level has been reached.

4. Wait five minutes and read the Micron Meter.

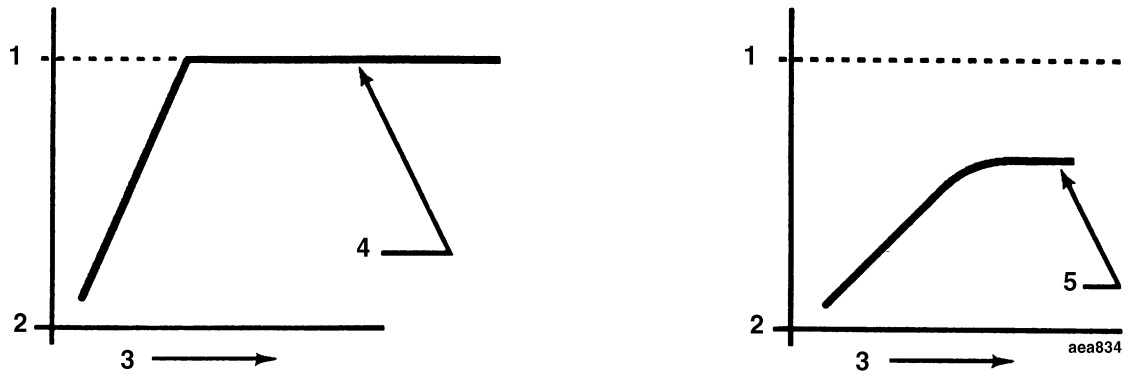
   - A system that is leak free and dry will remain below 2000 microns for five minutes.
   - A system that rises above 2000 microns but stabilizes below atmospheric pressure is probably contaminated with moisture or has refrigerant out-gassing from the compressor oil. Additional evacuation is required.
   - A system that continues to rise without stabilizing has a leak and must be repaired.

5. If the vacuum level remained below 2000 microns for five minutes, the unit is ready to charge.

Pressure Rise Test

1. 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" on page 103).



1	Atmospheric Pressure
2	Absolute Vacuum
3	Time
4	Vacuum Level Stabilizes at Atmospheric Pressure
5	Vacuum Level Stabilizes Below Atmosphere Pressure

Pressure Rise Test Evaluation

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 "Pressure Rise Test Evaluation" on page 103).

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.

- how large the system is
- the amount of moisture contained in the system
- the 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 1/4 inch diameter hose as it does through a 1/2 inch diameter hose. It takes twice as long to pull a vacuum through a 6 foot long hose as it does through a 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.

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.

Unit Charging (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 and receiver outlet valves remain mid-seated.
5. Connect the refrigerant tank with gauge manifold to the evacuation station (see "Evacuation Station and Unit Hookup" on page 101).
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 (described in the following steps, "Evacuation Station Removal"). Complete charging a partially charged unit will be done in the section below, "Final Charging Procedure for Partially Charged Units."

Evacuation Station Removal

1. Back seat the receiver outlet and discharge service valves.
2. Close the refrigerant tank hand valve.
3. Operate the unit in cool mode.
4. Open the hand valve at the gauge manifold and read suction pressure.
5. Front seat the suction service valve and pump down the system to 3 to 5 psig (21 to 35 kPa).
6. Back seat the suction service valve.
7. Remove the hoses from the receiver outlet and discharge service valves.
8. Cap the receiver outlet service port and valve stem.
9. Install a gauge manifold set.
   - If the unit is fully charged, perform a functional check out.
   - If the unit has a partial charge, complete the charging process as described below.

Final Charging Procedure for Partially Charged Units

1. Connect the gauge manifold to the suction line and discharge line service ports. Be sure to purge the air from the lines (see "Gauge Manifold Set Attachment and Purging" in the Refrigeration Maintenance chapter of this manual).
2. Back seat and crack the discharge service valve.
3. Connect a refrigerant tank to the gauge manifold service line.
4. Set the refrigerant tank for vapor charging. Open the refrigerant tank hand valve.
5. Start and operate the unit in the COOL mode.
6. Observe the suction pressure and slowly open the gauge manifold low pressure hand valve to allow refrigerant vapor to flow to the compressor suction line.

7. Control the refrigerant flow so that suction pressure increases approximately 25 psig (172 kPa).
8. Close the hand valve on the refrigerant tank when the correct amount of refrigerant has been added (the bottom receiver tank ball floats at the top of the sight glass).
9. Operate the unit and perform a functional check out.
10. Remove the gauge manifold set.
11. Cap all service ports and valve stems.

CAUTION: If the microprocessor temperature setpoint was lowered to force COOL operation, be sure to return the microprocessor to the setpoint indicated on the shipping manifest.

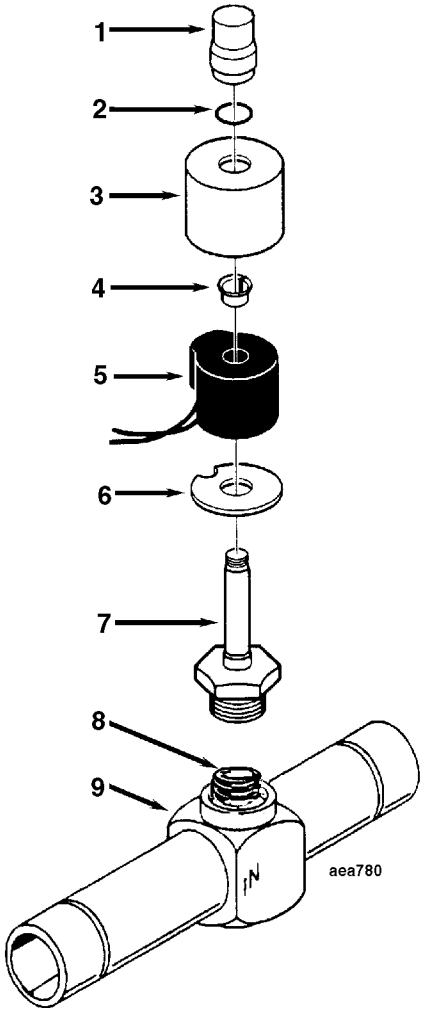
MODULATION VALVE

The modulation valve is used to control the flow of refrigerant to the compressor when the unit is operating in the Modulation mode. As the return air temperature approaches setpoint, the microprocessor sends an electrical signal to the coil of the valve. The armature overcomes the spring tension and the valve closes a precise amount. This throttles the suction gas returning to the compressor and reduces cooling capacity. As the signal is increased, the valve closes an additional amount. Due to valve design, the flow of refrigerant gas exerts no opening or closing forces on the valve spool allowing very precise operation.

Service of the modulation valve includes replacement of the coil, replacement of the enclosing tube assembly or replacement of the complete valve.

Tools Required:

- Digital Multimeter (P/N 204-615)
- Modulation Valve Coil (P/N 44-5175) or Modulation Valve Repair Kit (P/N 60-203) (kit includes coil)
- Scissors (with duct tape), pocket knife or other thin-pointed instrument
- Adjustable Wrench
- 1.5 inch Wrench
- Torque Wrench



1	Top Nut
2	O-ring
3	Coil Housing
4	Coil Sleeve
5	Coil
6	Bottom Plate
7	Enclosure Tube
8	Closing Spring
9	Valve Body

Modulation Valve

Coil Checkout Procedure

1. Unplug the modulation valve coil lead wire harness.
2. Using a FLUKE multimeter, test each lead resistance to ground. Low resistance indicates a short is present. Repair or replace any damaged or exposed wires.
3. Then check the coil resistance. If the coil resistance is below 5 ohms, replace the coil (good coils have a resistance of 7.6 ohms at 77 F (25 C) or 6.9 ohms at 40 F (4.4 C).

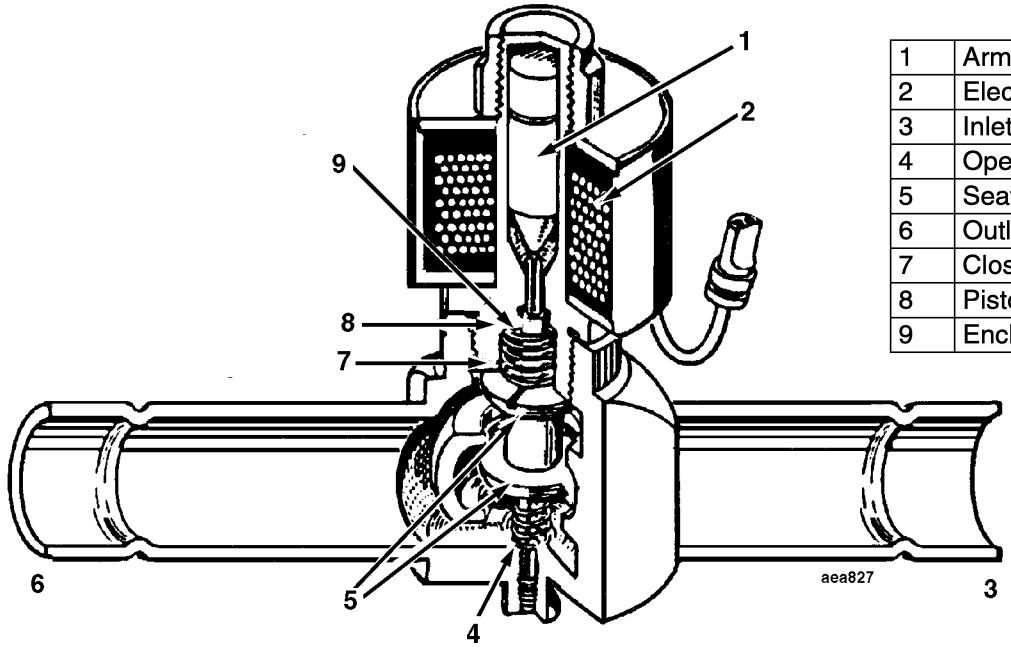
   NOTE: The ohmmeter will display a higher coil resistance if the modulation valve was energized for a long period of time just prior to testing the coil resistance.
4. To return the unit to service, plug the modulation valve lead connector into the unit wire harness.

Enclosure Tube Replacement

CAUTION: When replacing the enclosing tube assembly, DO NOT remove the valve piston, top return spring or bottom return spring from the valve body. These components must be factory installed and adjusted to ensure proper valve operation.

If the modulation fails to operate properly, remove the coil housing and inspect the solenoid coil sleeve and enclosure tube assembly for rust or corrosion. Rust or corrosion can damage the enclosure tube, preventing the piston inside the tube from opening and closing the valve properly. If the solenoid coil sleeve is badly corroded, replace the entire enclosure tube and coil assembly.

1. To replace enclosure tube and coil assembly, unplug the coil lead wire harness.
2. Connect the unit's main power cable to the main power source and switch the refrigeration unit's On-Off switch to ON. Close the receiver tank outlet valve and pump down the low side to 10 inch Hg vacuum (-33.8 kPa).



1	Armature
2	Electric Coil
3	Inlet
4	Opening Spring
5	Seats
6	Outlet
7	Closing Spring
8	Piston
9	Enclosure Tube

Modulation Valve Assembly

3. Turn the unit On-Off switch to OFF. Then disconnect the main power cable from the main power source again. Close (front seat) the discharge service valve. Break the vacuum with nitrogen between 1 and 3 psig (7 and 21 kPa).

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

4. Remove the coil, coil sleeve and bottom housing plate from the enclosure tube.

5. Place a 1.5 inch wrench on the enclosure tube hex fitting and loosen enclosure tube one-half turn.

6. Hold scissors or other thin-pointed instrument in one hand while you unscrew enclosure tube using other hand. After approximately five full turns, the enclosure tube threads should be free of the modulation valve body. Lift enclosure tube slightly and retain valve piston in valve body by carefully inserting scissors through top return spring above boss on piston.

7. Hold valve piston in valve body with scissors while you finish removing the enclosure tube. Immediately insert new enclosure tube carefully over piston top. When you are ready to thread new enclosure tube into valve body, remove scissors from piston boss and top spring.

   NOTE: If the piston is removed from its bottom seat in the valve body, the entire modulation valve must be replaced to ensure proper operation of the modulation valve. Attempting to reseat the piston in the bottom of the valve body will damage the bottom return spring and the valve will no longer operate properly.

8. Thread new enclosure tube into valve body until it is hand tight. Then tighten 1/6 turn more with a 1.5 inch wrench.

9. Place new bottom coil housing plate over enclosure tube.

10. Place new coil and coil sleeve on enclosure tube.

11. Place new outer and top coil housing plates over enclosure.

12. Place new o-ring and coil nut on enclosure tube and torque to 3 ft-lb (4.1 N·m). Plug coil wire harness into unit wire harness.

13. Evacuate the low side.

14. Open the discharge valve. Then open the receiver tank outlet valve.

15. Verify that all personnel are clear and connect main power plug to power supply. Place the unit back in service.

Modulation Valve Replacement

If the valve body is damaged, replace the entire modulation valve.

1. Connect the unit's main power cable to the main power source and switch the refrigeration unit's On-Off switch to ON.

2. Close receiver tank outlet valve and pump down the low side to 10 inch Hg vacuum (-33.8 kPa).

3. Turn the unit On-Off switch to OFF. Then disconnect the main power cable from the main power source. Close (front seat) the discharge service valve. Break the vacuum with nitrogen between 1 and 3 psig (7 and 21 kPa).

   CAUTION: Any time the discharger valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.

4. Unplug the coil wire harness leads from the unit wire harness.

5. Unbolt the suction line flange assembly from the compressor suction adapter.

6. Unsolder the compressor side modulation valve and suction line solenoid joints from the suction line. Unsolder and remove modulation valve.

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

7. Clean the tubes for soldering. Position the new valve in position in the suction line.

8. Bolt the suction line flange assembly to the compressor suction adapter using new O-ring coated with compressor oil. Torque bolts to 41.7 ft-lb (56.5 N·m).

9. Solder both modulation valve and suction line solenoid connections.

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

10. Pressurize the low side and test for refrigerant leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).

    NOTE: If pressurizing with nitrogen, front seat the discharge valve to prevent nitrogen from entering the refrigerant charge.

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

11. If no leaks are found, evacuate the low side and recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).

12. Plug the coil wire harness into the unit wire harness.

13. Open the discharge valve. Then open the receiver tank outlet valve.

14. Verify that all personnel are clear and connect main power plug to power supply. Start the unit and check the refrigerant charge. Add refrigerant as required.

REFRIGERANT RECOVERY

Caution: Use only refrigerant recovery equipment approved for and dedicated to R-134a 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.

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 psig (0 kPa) pressure.

Liquid Recovery

1. Install a gauge manifold's low-pressure line to the Schrader suction service valve in the suction line (near modulation valve). Attach the manifold's high-pressure line to receiver tank outlet valve service port.

Attach the service line to the recovery machine and purge the lines.

2. Operate the unit and build discharge pressures to approximately 200 psig (1379 kPa).
3. Close the receiver tank outlet valve and pump down the low-pressure side of the system.
4. Stop the unit.
5. Set the recovery machine for liquid recovery and turn it ON.
6. Open (back seat) the gauge manifold's high-pressure hand valve.
7. Operate the recovery machine until the unit system pressures reach approximately 0 psig (0 kPa).

R-134a Pressure-Temperature Relationship

°F	ºC	PSIG	kPa
-30.0	-34.4	9.7*	-32.8
-25.0	-31.7	6.8*	-23.0
-20.0	-28.9	3.6*	-12.2
-15.0	-26.1	0.0	0.0
-10.0	-23.3	2.0	13.8
-5.0	-20.6	4.1	28.3
0.0	-17.8	6.5	44.8
5.0	-15.0	9.1	62.7
10.0	-12.2	12.0	82.7
15.0	-9.4	15.1	104.1
20.0	-6.7	18.4	126.8
25.0	-3.9	22.1	152.4
30.0	-1.1	26.1	179.9
35.0	1.7	30.4	209.6
40.0	4.4	35.0	241.3
45.0	7.2	40.0	275.8
50.0	10.0	45.4	312.9
55.0	12.8	51.2	353.0
60.0	15.6	57.4	395.7

R-134a Pressure-Temperature Relationship (continued)

°F	ºC	PSIG	kPa
65.0	18.3	64.0	441.3
70.0	21.1	71.1	490.2
75.0	23.9	78.6	541.9
80.0	26.7	86.7	597.7
85.0	29.4	95.2	656.3
90.0	32.2	104.3	719.0
95.0	35.0	113.9	785.2
100.0	37.8	124.1	855.5
105.0	40.6	134.9	930.0
110.0	43.3	146.3	1008.6
115.0	46.1	158.4	1092.0
120.0	48.9	171.1	1179.6

*Vacuum (Inches Hg)

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 2200 psig (15170 kPa), or greater. Pressure is for full cylinder at 70 F (21 C). DO NOT use Oxygen (O_2), acteylene 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).

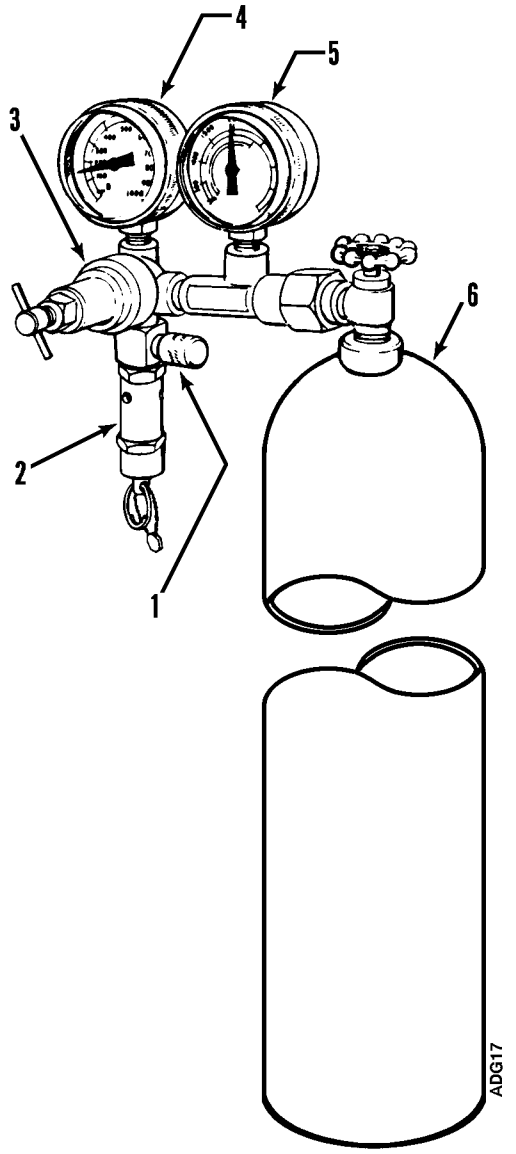
2. Close both hand valves on the gauge manifold (front seated).

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:

Procedure	Maximum Pressure	
Leak Testing	150-175 psig	1034-1206 kPa
Purging Dehydration	10-20 psig	69-138 kPa
Soldering	5 psig	35 kPa



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

Typical Pressurized Gas Bottle with Pressure Regulator and Gauges

CAUTION: When servicing Thermo King R-134a 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-134a refrigerant and Polyol Ester based compressor oils. Residual non-HFC refrigerants or non-Ester based oils will contaminate HFC systems.

NOTE: It is generally good practice to replace the filter drier whenever the high side is opened or when the low side is opened for an extended period of time. Refer to the Refrigeration Manual (Thermo King Manual number TK 5715) for system cleanup after a compressor failure or repair or replacement of basic components.

COMPRESSOR

Removal

1. Remove the compressor compartment grille. Close the receiver outlet valve and pump down the low side to 10 inch Hg vacuum (-33.8 kPa). Break the vacuum with nitrogen between 1 and 3 psig (7 and 21 kPa).

   NOTE: If the compressor does not operate, reclaim the refrigerant charge.

2. Front seat the discharge valve.

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

3. Remove discharge service valve, suction line and liquid injection valve line from the compressor.

4. Disconnect the wire connector for the high pressure cutout switch, condenser pressure switch, and liquid injection temperature sensor.

5. Remove the three-phase electric power connection.

6. Remove the compressor mounting tray bolts and nuts.

7. Slide the compressor from the unit.

8. Keep the compressor ports covered to prevent dust, dirt, etc., from falling into the compressor.

   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.

Installation

1. Slide the compressor into the unit. Install mounting bolts, washers and nuts, and tighten.

2. Bolt the suction line to the compressor using a new O-ring coated with compressor oil. Bolt the discharge valve to the compressor with a new gasket coated with compressor oil. Install liquid injection valve and connect liquid injection line to the compressor.

3. Apply refrigerant locktite to the threads of the switches. Install the switches. Connect the wire connectors for the condenser fan pressure switch, high pressure cutout switch, and liquid injection temperature sensor. Connect liquid injection line to compressor body.

4. Connect three-phase electric power to the compressor.

5. Pressurize the compressor with refrigerant gas (same gas as that used in the system). Check for refrigerant leaks around the compressor assembly and gasket connections.

6. If no leaks are found, recover the refrigerant used for the leak test (see “Refrigerant Recovery” in the Refrigeration Maintenance chapter of this manual). Because

this refrigerant gas will contain some air, place it in a contaminated refrigerant bottle to be reclaimed later.

7. After all pressure is removed from the low side and compressor, hook up your evacuation equipment.
8. Evacuate the low side and compressor (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
9. Back seat the discharge service valve and open the receiver outlet valve fully.
10. Operate the unit at least thirty minutes and then inspect the oil level in the compressor. Add or remove oil if necessary.
11. Check the refrigerant charge and add refrigerant if needed.

CONDENSER COIL

Removal

1. Recover the refrigerant charge from the unit (do NOT vent refrigerant to the atmosphere).
2. Remove the condenser fan grille, condenser fan blade and condenser fan shroud.
3. Remove the condenser coil support brackets from the top of 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 the Refrigerant Maintenance chapter of this manual).

4. Pressurize the system and test for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
5. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
6. Then evacuate the system (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
7. Replace the condenser coil support brackets, condenser fan shroud and condenser fan grille.
8. Recharge the unit with R-134a refrigerant and check the compressor oil level. Add oil if necessary.

DEHYDRATOR (FILTER DRIER)

Removal

1. Close the receiver tank outlet valve and pump down the low side. Open the outlet valve slightly to equalize the pressure between 1 and 3 psig (7 and 21 kPa).
2. Place the new filter-drier near the unit for immediate installation.
3. Using two wrenches, "crack" both filter-drier line mountings. 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.

NOTE: Perform the following four procedures as quickly as possible to prevent contamination.

6. Remove the old filter-drier from the line.

Installation

1. Remove the sealing caps from the new filter-drier.
2. Apply clean compressor oil to filter-drier threads.
3. Assemble new filter-drier to lines. Finger tighten filter-drier mounting nuts.

   NOTE: Ensure arrow on filter-drier points in the direction of refrigerant flow. To prevent installation of the dehydrator with the filter at the wrong end, "IN" is printed on the inlet fitting.
4. Reinstall filter-drier clamping brackets, nut and bolts. Tighten the bolts.
5. Tighten the filter-drier inlet line mounting nut.
6. Open the receiver tank outlet valve on the inlet side of the filter-drier slowly to release a small amount of refrigerant from the receiver tank to purge the air through the drier. Then tighten the filter-drier outlet flare nut.

   NOTE: When removing or replacing the flare nuts on the dehydrator, always hold the body of the dehydrator near the flare fittings to prevent twisting the tubing when the flare nuts are being loosened or tightened.
7. Back seat (open) the receiver tank outlet valve on the inlet side of the filter-drier.
8. Test the filter-drier for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
9. If no leaks are found, place the unit in operation.

EXPANSION VALVE POWER ASSEMBLY

Removal

1. Close the receiver tank outlet valve and pump down the low side to 10 inch Hg vacuum (-33.8 kPa). Break the vacuum with nitrogen between 1 and 3 psig (7 and 21 kPa). Remove lower evaporator access panel from the front of the unit.
2. Remove insulating tape and unclamp feeler bulb from the suction line. Note the position of the feeler bulb on the side of the suction line.

   NOTE: Expansion valve power head and cage can be replaced without unsoldering valve body.

Installation

1. Replace internal components of the expansion valve. Place a new cage in the bottom of the valve. Place a new power head in top of valve.
2. 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.
3. Pressurize the low side and test for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
4. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
5. Then evacuate the low side (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
6. Install the lower evaporator access panel on the front of the unit.
7. Open the receiver tank outlet valve and place the unit in operation.
8. Operate the unit and note the suction pressure and container temperature to see that the expansion valve is properly installed and that the feeler bulb is properly located.

HEAT EXCHANGER

Removal

1. Close the receiver tank outlet valve and pump down the low side to 10 inch Hg vacuum (-33.8 kPa). Break the vacuum with nitrogen between 1 and 3 psig (7 and 21 kPa).
2. Remove the "U" mounting clamps that hold the heat exchanger assembly to the wall of the evaporator section.
3. Unbolt and remove the suction line fitting from the compressor body.
4. Remove suction line and modulation valve mounting brackets.
5. Heat and unsolder the suction line connection between the heat exchanger first.
6. Heat and unsolder the liquid line connection to filter drier tube in condenser section.
7. Note the position of the feeler bulb on the side of the suction line elbow. Untape and remove the feeler bulb from the suction line elbow.
8. Heat and unsolder the liquid line elbow connection to the evaporator coil.
9. Unsolder the suction line connection to the evaporator coil before the feeler bulb location.
10. 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. Bolt suction line fitting to compressor using new O-ring coated with compressor oil.
4. Solder the suction line connection in the evaporator section to the evaporator coil.

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

   NOTE: If pressurizing with nitrogen, front seat the discharge valve to prevent nitrogen from entering the refrigerant charge.

   CAUTION: Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.
5. Solder the liquid line connection to the evaporator coil.
6. Solder the suction line connection to the heat exchanger in the condenser section.
7. Solder the liquid line connection to the filter drier tube in the condenser section.
8. Pressurize the low side and check for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
9. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
10. Then evacuate the low side (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
11. Clean the suction line to a bright polished condition. Install the 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.
12. Open the receiver tank outlet valve and place the unit in operation. Operate the unit and note suction pressure

and container temperature to see that the feeler bulb is properly installed.

STAINLESS STEEL RECEIVER TANK

Removal

1. Recover the refrigerant charge from the unit (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
2. Unsolder the outlet valve on the liquid outlet line.
3. Unsolder the liquid line inlet connection.
4. Loosen the mounting nuts and remove the tank.
5. Remove the outlet valve from the receiver tank.

Installation

1. Install a new tank in the unit and tighten the mounting bolts.
2. Solder both the inlet line and outlet valve with high temperature silver solder (30% silver).

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

   NOTE: If pressurizing with nitrogen, front seat the discharge valve to prevent nitrogen from entering the refrigerant charge.

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

3. Pressurize the refrigeration system and check for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
4. Then evacuate the system (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
5. Recharge the unit (see "Refrigerant Charge" in the Refrigeration Maintenance chapter of this manual).

EVAPORATOR COIL

Removal

1. Close the receiver tank outlet valve and pump down the low side to 10 inch Hg vacuum (-33.8 kPa). Break the vacuum with nitrogen between 1 and 3 psig (7 and 21 kPa).
2. Remove the upper evaporator access panel on the rear of the unit.
3. Remove the evaporator coil temperature sensor from the bracket in the coil assembly.
4. Unbolt and remove the evaporator drain pan from the unit.
5. Remove insulating tape and unclamp expansion valve feeler bulb from the suction line. Note the position of feeler bulb on the suction line.
6. Unsolder and remove expansion valve from the distributor line.
7. Unsolder the equalizer line from the evaporator suction header.
8. Remove the electric heater coils from the bottom of the evaporator coil.
9. Unsolder the suction line from the evaporator coil at the horizontal joint near the feeler bulb location.
10. Unbolt and remove the evaporator coil assembly from the unit.

Installation

1. Clean the tubes for soldering.
2. Slide the evaporator coil assembly into the unit and bolt in place.
3. Solder the suction line connection to the heat exchanger.

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

   NOTE: If pressurizing with nitrogen, front seat the discharge valve to prevent nitrogen from entering the refrigerant charge.

   CAUTION: Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.
4. Install the electric heater coils on the evaporator coil with the mounting brackets.
5. Solder the expansion valve power assembly to the distributor line.
6. Solder the equalizer line to the suction line elbow and expansion valve. Install "U" bolt mounting bracket on the expansion valve and tighten.
7. Pressurize the low side and test for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
8. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
9. Then evacuate the low side (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
10. Clean the suction line to a bright polished condition. Install the feeler bulb clamps and feeler bulb 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. Wrap with insulating tape.
11. Place the evaporator coil drain pan in the unit and bolt in place.
12. Install the evaporator coil temperature sensor in mounting bracket in the coil support frame.
13. Reinstall the upper rear access panel.
14. Open the refrigeration valves and place the unit in operation.
15. Check the refrigerant and compressor oil charge and add refrigerant or compressor oil if needed. Note the suction pressure and container temperature to see that the feeler bulb is properly installed.

HIGH PRESSURE CUTOUT SWITCH OR CONDENSER FAN SPEED PRESSURE SWITCH

Removal

1. Close the receiver tank outlet valve and pump down the low side. Open the outlet valve slightly to equalize the pressure between 1 and 3 psig (7 and 21 kPa).
2. Front seat the discharge service valve.

   CAUTION: Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start-up.
3. Purge the high pressure from the compressor head through the service port on the discharge line.
4. Disconnect the leads from the wire harness and remove the switch from the compressor discharge manifold.

Installation

1. Apply a refrigeration locktite (sealant) to the threads of the switch.
2. Install and tighten the switch. Connect the leads to the wire harness.
3. Open discharge service valve slightly to pressurize the compressor head and tube assembly. Check for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual). Front seat the discharge service valve.
4. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
5. Open the receiver tank outlet and compressor discharge service valves and place the unit in operation.

MODULATION VALVE

NOTE: See "Modulation Valve" in the Refrigeration Maintenance chapter of this manual.

LIQUID INJECTION VALVE (COMPRESSOR)

Removal

1. Close the receiver tank outlet valve and pump down the low side to 10 inch Hg vacuum (-33.8 kPa). Break the vacuum with nitrogen between 1 and 3 psig (7 and 21 kPa).
2. Disconnect the unit power source from the unit. Disconnect the electrical connections to the liquid injection valve.

   NOTE: In most cases, only the coil requires replacement. No other repair is possible on the liquid injection valve.
3. Unsolder the liquid line valve from the liquid line. Unscrew fitting from the compressor body.
4. Unbolt and remove the valve from the unit.

Installation

1. Clean the tubes for soldering.
2. Place the new valve in position. Screw fitting into the compressor body.
3. Solder the connection in the liquid line.

   CAUTION: Use a heat sink or wrap the valve with wet rags to prevent damage to the new valve.
4. Pressurize the low side with refrigerant and check for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
5. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
6. Then evacuate the low side (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
7. Reconnect the electrical wires from the valve.
8. Open the receiver tank outlet valve and place the unit in operation. Check the refrigerant charge and add refrigerant as required.

LOW PRESSURE CUTOUT SWITCH

Removal

1. Close the receiver tank outlet valve and pump down the low side. Equalize the pressure between 1 and 3 psig (7 and 21 kPa).
2. Remove the switch from the suction line and disconnect leads from the wire harness.

Installation

1. Apply compressor oil to the threads of the new switch.
2. Install and tighten the switch. Connect leads to the wire harness.
3. Release refrigerant from the receiver tank to pressurize the low side and test for leaks.
4. If no leaks are found, open the receiver tank outlet valve and place the unit in operation.

LIQUID LINE SOLENOID VALVE (REFRIGERATION SYSTEM)

Removal

1. Close the receiver tank outlet valve and pump down the low side to 10 inch Hg vacuum (-33.8 kPa). Break the vacuum with nitrogen between 1 and 3 psig (7 and 21 kPa).
2. Turn the unit On-Off switch OFF. Disconnect electrical connections to liquid line solenoid.

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

3. Disconnect outlet flare connection on dehydrator (filter drier).
4. Unsolder the liquid line solenoid valve from the liquid 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 valve with wet rags to prevent damage to the new valve.

3. Install and tighten the dehydrator outlet line flare nut on the liquid line. Hold the dehydrator with a back-up wrench on the hex behind the flare fitting.
4. Release a small amount of refrigerant from the receiver tank to pressurize the liquid line. Check for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
5. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
6. Then evacuate the low side (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
7. Reconnect the electrical wires to the valve.
8. Open the receiver tank outlet valve and place the unit in operation. Check the refrigerant charge and add refrigerant as required.

SUCTION LINE SOLENOID VALVE

Removal

1. Close the receiver tank outlet valve and pump down the low side to 10 inch Hg vacuum (-33.8 kPa). Break the vacuum with nitrogen between 1 and 3 psig (7 and 21 kPa).
2. Turn the unit On-Off switch OFF. Disconnect electrical connections to suction line solenoid and modulation valve.

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

3. Remove suction line solenoid and modulation valve mounting hardware.
4. Unbolt suction service valve from compressor body.

5. Unsolder suction line solenoid and modulation valve assembly from heat exchanger suction line connection in power cord storage compartment.
6. Unsolder the suction line solenoid valve from the modulation valve assembly.

Installation

1. Clean the tubes for soldering.
2. Place the new suction line valve in position and solder the connections to the modulation valve assembly.

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

3. Place suction line solenoid and modulation valve assembly in unit. Install and tighten the suction line solenoid and modulation valve mounting hardware.
4. Bolt suction service valve to compressor body using a new gasket soaked in compressor oil.
5. Solder suction line connection to suction line solenoid and modulation valve assembly in condenser section.
6. Release a small amount of refrigerant from the receiver tank to pressurize the liquid line. Check for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
7. If no leaks are found, recover the leak test gas (see "Refrigeration Maintenance chapter of this manual).
8. Then evacuate the low side (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
9. Reconnect the electrical wires to the valves.
10. Open the receiver tank outlet valve and place the unit in operation. Check the refrigerant charge and add refrigerant as required.

DISCHARGE PRESSURE REGULATING VALVE

Removal

1. Recover the refrigerant charge from the unit (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
2. Remove the discharge pressure regulating valve mounting bracket.
3. Unsolder valve inlet and outlet connections in the discharge line.

   NOTE: Use a heat sink or wrap lines with wet rags to protect the check valve and condenser coil header connection.

Installation

1. Clean the tubes for soldering.
2. Position new discharge pressure regulating valve in discharge line.
3. Solder inlet and outlet connections.

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

4. Pressurize the system and test for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
5. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
6. Then evacuate the system (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
7. Replace the valve support bracket.

8. Recharge the unit with R-134a refrigerant and check the compressor oil level. Add oil if necessary.

DISCHARGE LINE CHECK VALVE

Removal

1. Recover the refrigerant charge from the unit (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
2. Remove the discharge pressure regulating valve mounting bracket.
3. Unsolder check valve inlet and outlet connections in the discharge line.

   NOTE: Use a heat sink or wrap lines with wet rags to protect the discharge pressure regulating valve and suction service valve.

Installation

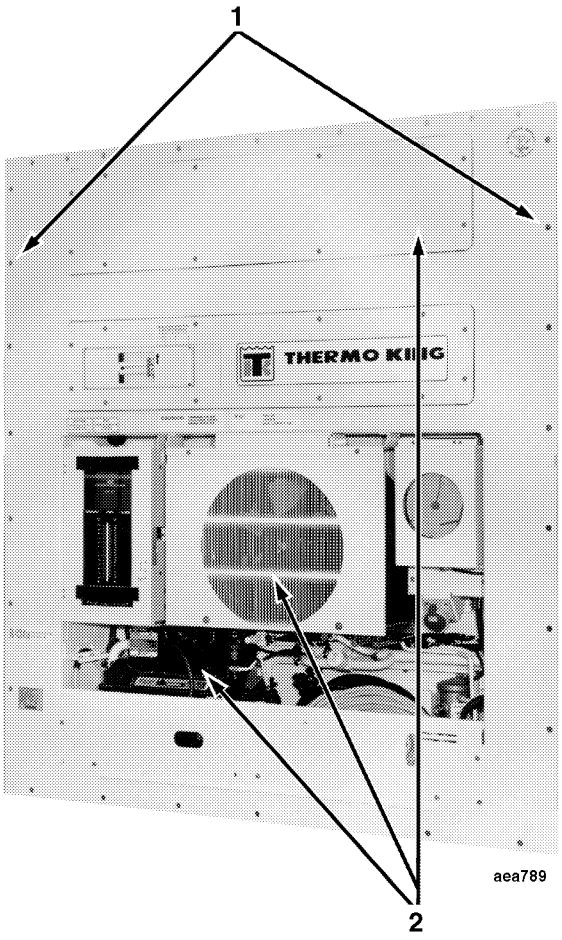
1. Clean the tubes for soldering.
2. Position new check valve in discharge line.
3. Solder inlet and outlet connections.

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

4. Pressurize the system and test for leaks (see "Refrigerant Leak Test Procedure" in the Refrigeration Maintenance chapter of this manual).
5. If no leaks are found, recover the leak test gas (see "Refrigerant Recovery" in the Refrigeration Maintenance chapter of this manual).
6. Then evacuate the system (see "Evacuation and Cleanup of the Refrigeration System" in the Refrigeration Maintenance chapter of this manual).
7. Replace the discharge pressure regulating valve support bracket.
8. Recharge the unit with R-134a refrigerant and check the compressor oil level. Add oil if necessary.

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 150 ft-lb (204.4 N•m). Compressor and fan motor mounting bolts should be tightened to a torque value of 15 to 20 ft-lb (20.3 to 21.1 N•m).



1	Tighten Unit Mounting Bolts
2	Tighten Compressor and Fan Motor Mounting Bolts

Mounting Bolts

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.

CONDENSER COIL

Clean the condenser coil by blowing low pressure compressed air 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 must not be high enough to damage coil fins.

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.

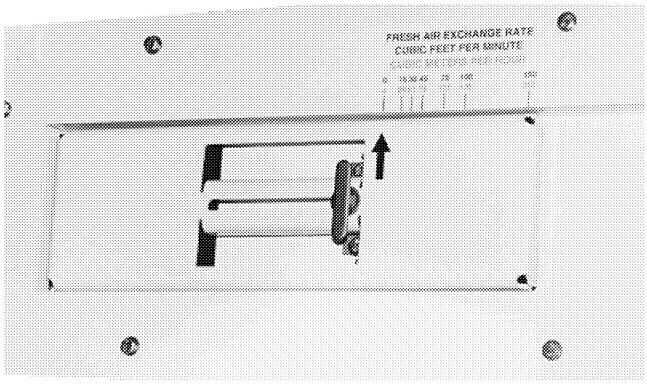
CAUTION: Air pressure must not be high enough to damage coil fins.

DEFROST DRAINS

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

FRESH AIR EXCHANGE SYSTEM

The fresh air exchange system has an adjustable vent door that is precalibrated for air exchange rates of 0, 15, 30, 45, 75, 100 and 150 cu ft/min. (0, 25, 51, 76, 127, 170 and 255 m^3/hr). The evaporator blowers draw in outside air through an air intake and discharge an equal amount of container air through an air outlet.



Fresh Air Vent Door

EVAPORATOR BLOWER WHEEL LOCATION AND INSTALLATION

Model CF-II refrigeration systems use a backward inclined blower wheel, different from typical forward curved wheels. The blower blades on a backward inclined blower wheel are tilted away from the direction of blower rotation. Instead of scooping air like a forward curved blade, the backward inclined blade compressors and pushes the air out the discharge opening with a slapping action.

The evaporator blower motors may be removed by removing the screw that fastens the motor mounting strap to the support bracket. unbolt and remove the access panel and blower housing plate from the blower housing. Unbolt both inlet rings from the blower housing.

To remove the blower wheel and motor assembly through the front service access opening:

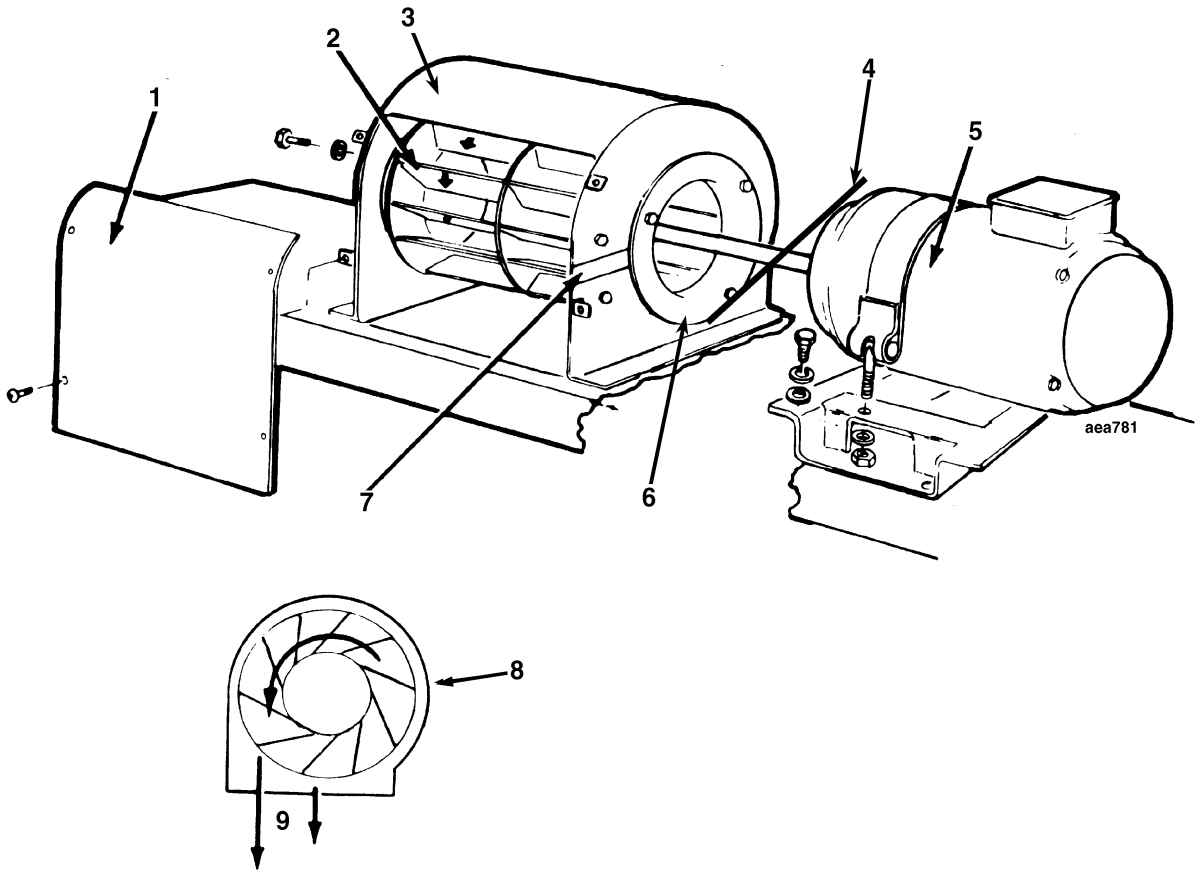
1. Unbolt the inside inlet ring. Tilt the inlet ring between the motor and the blower housing at a 45° angle.
2. Remove the fan motor mounting strap.
3. slide the motor towards the back of the blower compartment and rotate the blower wheel forward as the motor shaft slides through the slot in the blower housing.
4. Slide the assembly forward through the service access opening.
5. Remove the blower wheel and inlet ring from the motor shaft.

Whenever the evaporator blower wheel and motor are removed from the evaporator assembly, care must be taken to make sure they are properly reassembled. Arrows stamped in the blower wheel blades point in the direction of wheel rotation for easy reference during blower reassembly. Always install blower wheel in the blower housing with the arrows (stamped in the blower wheel blade) pointing in the direction of wheel rotation.

Place the inlet ring on the shaft of the replacement motor. place the inlet ring and motor assembly in the evaporator section (reverse the removal procedure). Install and tighten the motor assembly strap.

Install and center the blower wheel in the blower housing. The blower wheel must overlap both rings equally. Tighten the blower wheel motor hub not he motor shaft.

Then center the inlet rings inside the blower wheel inlets. The inlet rings must be positioned so the space between the inlet rings and the blower inlet is equal around the entire ring. tighten the inlet ring mounting hardware. Reinstall blower housing plate and acce3ss panel using mounting hardware.



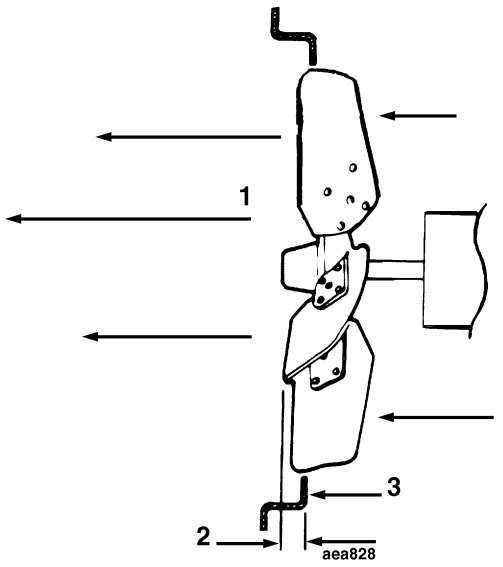
1	Access Panel
2	Blower Wheel
3	Blower Housing
4	Inlet Ring Position During Motor and Blower Wheel Removal and Installation
5	Fan Motor
6	Inlet Ring
7	Blower Housing Plate
8	Proper installation of the evaporator blower wheel when viewing blower assembly from the front of the unit—arrows stamped on the fan blades point in the proper direction of rotation.
9	Air Discharge

Evaporator Blower Wheel Location

CONDENSER FAN LOCATION

Place the condenser fan blade on the motor shaft with the hub located on the outside of the blade for proper airflow direction.

When mounting the condenser fan blade and hub assembly on the fanshaft, position the assembly in the orifice with 30% to 35% of the blade width to the air discharge side for proper fan performance.



1	Air Flow
2	35 Percent of Blade Width to Air Discharge Side
3	Orifice

Fan Blade Position in Orifice

RECORDING THERMOMETER CALIBRATION AND OPERATION (SAGINOMIYA SKM)

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

Battery

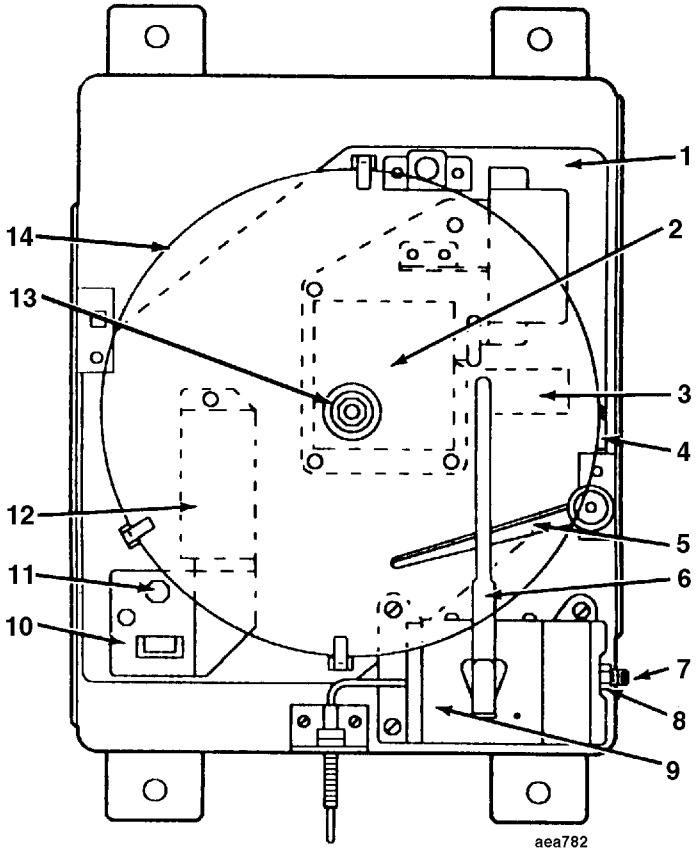
The recording chart is driven by a battery-powered quartz motor and reducing gear. The battery charge should be checked during unit pre-trip inspection or once a month.

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.

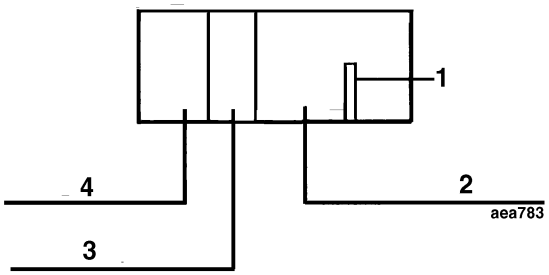


Saginomiya SKM

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

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.



1	Pointer
2	Blue Zone
3	White Zone
4	Red Zone

Battery Voltage Indicator

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 setscrews 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 the three hold-down flanges.
3. Replace the chart nut loosely and rotate the chart so that the correct date and time are indicated by the arrow on the time scale plate. Firmly 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

NOTE: The calibration of the recording thermometer may also be checked periodically using an electronic thermometer or the digital readout on the microprocessor controller.

When checking recording thermometer calibration:

1. Use an accurate test instrument like the Simpson Temperature Gauge (TK P/N 204-135) or equivalent.
2. Remove the recording thermometer sensing bulb from the evaporator section.

3. Prepare an ice water bath. The ice water bath consists of an insulated container full of ice made from distilled water with enough distilled water to cover the top of the ice. A properly filled ice water bath must be completely filled with ice all the way to the bottom of the container. Stir the ice water bath briskly for 3 minutes to bring the temperature to 32 F (0 C).
4. Place the recording thermometer sensing bulb and the test instrument thermistor lead bulb in the ice water bath. Wait for 2 minutes to allow the sensor temperatures to stabilize.
5. After the sensor temperatures have stabilized, compare the readings of the test instrument (Simpson Temperature Gauge) with the recording stylus of the recording thermometer. Record the readings of both instruments.
6. If the average difference is 1 F (0.6 C) or less, DO NOT attempt to recalibrate.
7. Remove the recording thermometer sensing bulb and the thermistor lead bulb from the ice water bath. Replace the recording thermometer sensing bulb in the evaporator section.

If the recording thermometer requires calibration:

1. Loosen the lock screw with a Phillips screwdriver.
2. Adjust the calibration by turning the setting screw with a 7 mm wrench. With the pen in recording position (lowered against chart), rotate the setting screw clockwise until the recording pen temperature reading is 4 to 6 degrees F (2 to 3 degrees C) higher than the temperature reading of the test instrument.

   NOTE: Turning the setting screw one complete revolution (360°) changes the temperature reading of the pen by approximately 9 degrees F (5 degrees C).
3. Then rotate the setting screw counterclockwise to lower the recording pen temperature reading until the pen reading agrees with the test instrument temperature reading.
4. Retighten the lock screw.

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. Install a new power element assembly. Install and securely tighten five mounting screws.
5. Replace the recording platen, recording chart and chart nut. Lower the recording pen.
6. After the temperature of the new sensing bulb has "settled out", check the calibration of the new power element assembly. If the average difference of the recording pen temperature reading and the test instrument is more than 1 degree F (0.5 degree C), recalibrate the recorder.

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 and 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 running (flywheel revolving).
7. Replace the recording platen, recording chart and chart nut. Lower the recording pen.

CONDITION	POSSIBLE CAUSE	REMEDY
Compressor does not operate—no amperage draw.	Microprocessor on—8 second time delay still timing.	Wait full 8 seconds.
	No power to unit.	Locate fault and repair: power source, power plug, CB2 circuit breaker to microprocessor, motor contactor, motor terminals, motor.
	Open in 12 Vdc or 24 Vac control circuit.	Check circuit breakers and On-Off switch. Repair as required.
	Container temperature does not demand unit operation.	Adjust microprocessor setpoint.
	Compressor contactor inoperative.	Replace compressor contactor.
	Defective compressor contactor relay.	Replace compressor contactor relay.
	No output signal from microprocessor.	Replace microprocessor.
	Unit on defrost.	Turn unit On-Off switch OFF and then ON again.
	Defective liquid line solenoid valve.	Replace liquid line solenoid valve.
	Defective low pressure cutout switch.	Replace low pressure cutout switch.
	Defective high pressure cutout switch.	Replace high pressure cutout switch.
	High condenser head pressure causing high pressure cutout.	Check refrigeration system and correct fault.
	Defective compressor.	Replace compressor.
	Microprocessor unit shut down on High Compressor Temperature (fault code 82).	Let compressor cool and microprocessor will reset automatically. Check liquid injection valve and compressor temperature sensor for correction position.

CONDITION	POSSIBLE CAUSE	REMEDY
Compressor does not operate—excessive amperage draw or intermittent cycling on overload ***NOTE: The microprocessor performs a compressor bump start after a heat or defrost cycle or when the unit has been off for more than 8 hours. See "Sequence of Operation" in Thermoguard µP-A+ Microprocessor Temperature Controller chapter for further detail.***	Piston stuck.	Remove compressor head. Look for broken valve and jammed parts.
	Frozen compressor bearings.	Repair or replace compressor.
	Improperly wired.	Check and correct wiring against wiring diagram.
	Low line voltage.	Check line voltage—determine location of voltage drop.
	High head pressure.	Eliminate cause of high head pressure.
	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.
	Stator winding grounded.	Test for grounded winding. If grounded, replace compressor.
	Seized bearings on compressor.	Replace compressor.
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	Microprocessor out of calibration.	Recalibrate (see "Calibration Procedure" in Electrical Maintenance section) or replace microprocessor.
	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.

CONDITION	POSSIBLE CAUSE	REMEDY
Noisy unit	Insufficient compressor oil.	Add oil to proper level.
	Loose mounting bolts.	Tighten mounting bolts.
	Oil slugging or refrigerant flooding back.	Add oil or refrigerant charge. Check expansion valve adjustment.
	Worn fan motor bearings.	Replace bearings or motor.
	Faulty compressor.	Repair or replace compressor.
Condenser fan motor does not operate	Unit in Null, Heat or Defrost.	Check indicator lights. If unit is in Null, Heat or Defrost, unit operation is normal (no remedy required).
	Unit in Cool or Modulation.	Check cargo temperature and condenser pressure. If condenser (high) head pressure is below 200 ± 7 psig (1379 ± 48 kPa), the condenser fan pressure switch is closed and unit operation is normal (no remedy required).
	Loose line connection.	Tighten connections.
	Defective motor.	Replace motor.
	Defective high speed condenser fan contactor.	Replace defective contactor.
	Defective high speed condenser fan contactor relay.	Replace defective contactor relay.
	No high speed condenser fan output signal from microprocessor.	Replace microprocessor.
Evaporator blower motor(s) does not operate	Unit on defrost.	Check operating mode status indicators.
	Loose line connection.	Tighten connections.
	Defective motor.	Replace motor.
	Defective low or high speed evaporator blower contactor.	Replace defective contactor.
	Defective low or high speed evaporator blower contactor relay.	Replace defective contactor relay.
	No low or high speed evaporator blower output signal from microprocessor.	Replace microprocessor.
Status indicator LEDs will not light	Circuit breaker CB5 tripped.	Check circuit for cause of overload and repair.
	LED circuit board defective.	Replace LED circuit board.
	Microprocessor defective.	Replace microprocessor.

Refrigeration Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Unit operating in a vacuum.	Shortage of refrigerant.	Repair leak and recharge.
NOTE: When the unit is in Modulation Cool or when the unit is in Full Cool and the container temperature is approximately 0 F (-17.8 C) or below, the suction pressure will be less than 0 psig (0 kPa) (in a vacuum) during normal operation.	Compressor motor contacts frozen.	Clean points or replace contactor.
	Compressor motor contactor relay defective.	Replace defective relay.
	Compressor inefficient.	Check valves and pistons.
	Defective liquid line solenoid valve.	Repair or replace liquid line valve.
	Partial obstruction in low side of refrigeration system.	Locate obstruction and repair.
	Iced or plugged evaporator coil.	Defrost or clean evaporator coil.
	Expansion valve screen partially closed by ice, dirt or wax.	Clean or replace screen.
	Expansion valve power element lost its charge.	Replace power element.
	Defective container insulation.	Correct or replace container insulation.
	Poor fitting container doors.	Repair or replace doors.
	Partial obstruction in dehydrator or high side.	Locate obstruction and repair.
	Service gauge out of calibration.	Replace service gauge.
	Modulation valve stuck closed or defective.	Repair or replace modulation valve.
	Microprocessor out of calibration or defective.	Recalibrate (see “Calibration Procedure” in Electrical Maintenance chapter) or replace microprocessor
	Expansion valve feeler bulb improperly mounted or making poor contact	Correct feeler bulb installation.

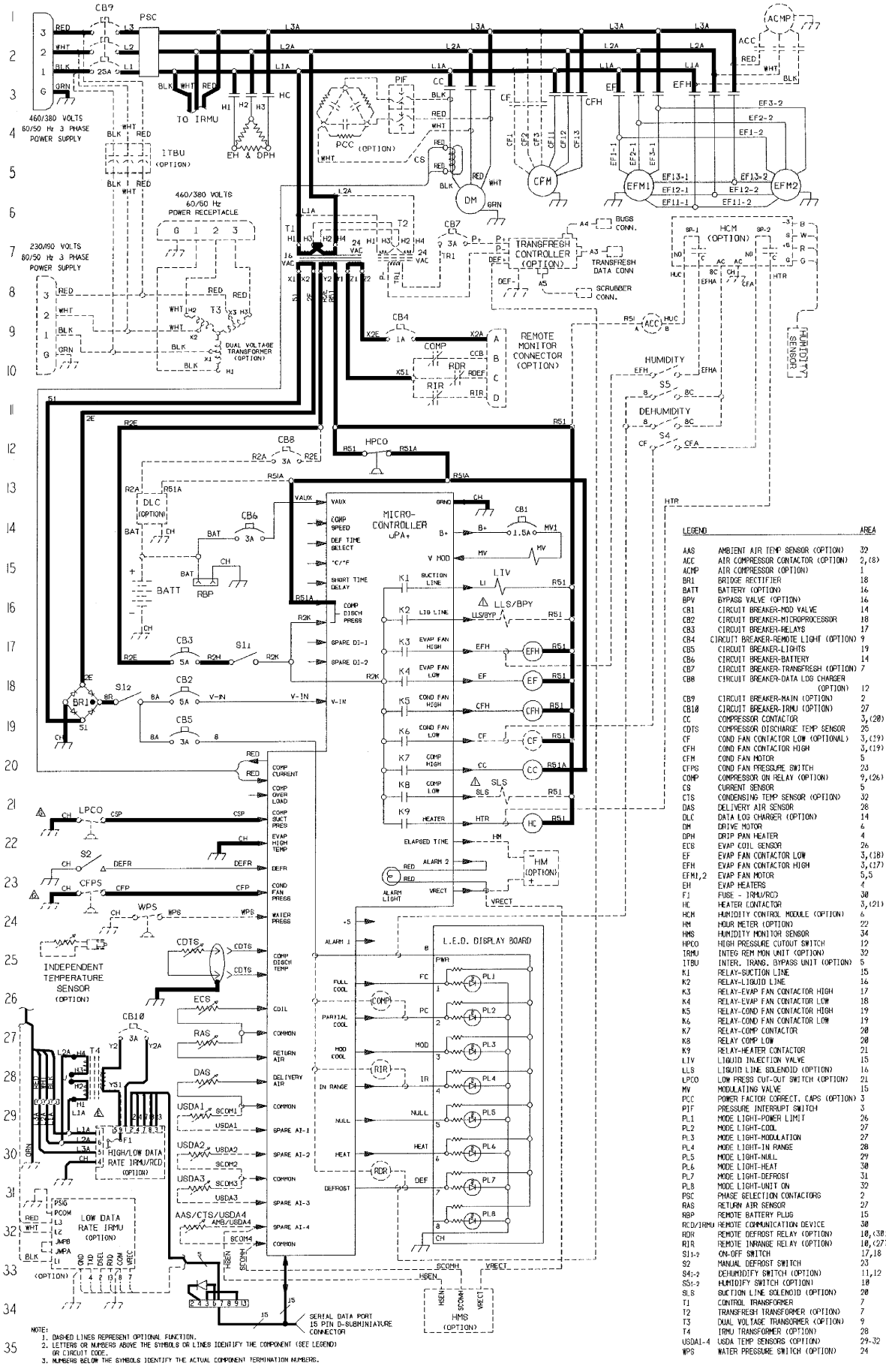
CONDITION	POSSIBLE CAUSE	REMEDY
Load temperature too high (unit not cooling).	Compressor does not operate.	See “Mechanical Diagnosis”.
	Shortage of refrigerant.	Repair leak and recharge.
	Overcharge of refrigerant.	Purge system.
	Air in refrigeration system.	Evacuate and recharge.
	Liquid injection valve open.	Check liquid injection valve circuit and compressor discharge temperature sensor operation.
	Microprocessor out of calibration or defective.	Recalibrate (see “Calibration Procedure” in Electrical Maintenance chapter) or replace microprocessor.
	Microprocessor setpoint too high.	Adjust microprocessor setpoint.
	Expansion valve screen plugged.	Clean or replace screen.
	Too much compressor oil in system.	Remove compressor oil from compressor.
	Compressor inefficient.	Check valves and pistons.
	Expansion valve open too much.	Adjust or replace valve.
	Iced or dirty evaporator coil.	Defrost or clean evaporator coil.
	Restricted lines on high side.	Clear restriction.
	Plugged dehydrator.	Change dehydrator.
	Suction line solenoid defective.	Repair or replace suction line solenoid.
	Modulation valve defective.	Repair or replace modulation valve.
	Condenser coil dirty or airflow restricted.	Clean condenser coil, clear restriction, or repair or replace fan motor or condenser fan blade.
	Defective condenser fan pressure switch.	Replace switch.
	Expansion valve power element lost its charge.	Replace power element.
	Expansion valve feeler bulb improperly mounted or making poor contact.	Correct feeler bulb installation.

CONDITION	POSSIBLE CAUSE	REMEDY
Head pressure too low	Shortage of refrigerant.	Repair leak and recharge.
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 2.5 to 3 F [1.4 to 1.7 C] of setpoint or in Power Limit mode.	Compressor suction or discharge valve inefficient.	Clean or replace leaking valve plates.
	Low ambient air temperature.	No remedy.
	Discharge pressure regulating valve defective or out of adjustment.	Adjust or replace valve.
	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.
	Defective condenser fan pressure switch.	Replace switch.
	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 dehydrator or clear restriction.
	Discharge pressure regulating valve defective or out of adjustment.	Adjust or replace valve.
	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.

CONDITION	POSSIBLE CAUSE	REMEDY
Rapid cycling between Cool, Null and Heat modes	Air short cycling through evaporator.	Check and correct cargo load.
	Microprocessor out of calibration.	Recalibrate (see "Calibration Procedure" in Electrical Maintenance chapter) or replace microprocessor.
	Short cycling.	See "Unit short cycles" under Mechanical Diagnosis.
Hot liquid line	Shortage of refrigerant.	Repair or recharge.
	Expansion valve open too wide.	Adjust or replace expansion valve.
Frosted liquid line	Receiver tank outlet valve partially closed or restricted.	Open valve or remove restriction.
	Restricted dehydrator.	Replace dehydrator.
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 microprocessor and evaporator coil sensor.
	Evaporator blower does not operate.	See "Evaporator blower motor does not operate" under Mechanical Diagnosis.
	Liquid injection valve open.	Normal with high compressor discharge temperature, no 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 dehydrator.
High suction pressure	Overcharge of refrigerant.	Purge system.
	Expansion valve open too much.	Adjust or replace valve.
	Microprocessor out of calibration or defective.	Recalibrate (see "Calibration Procedure" in Electrical Maintenance chapter) or replace microprocessor.
	Service gauge out of calibration.	Adjust or replace service gauge.

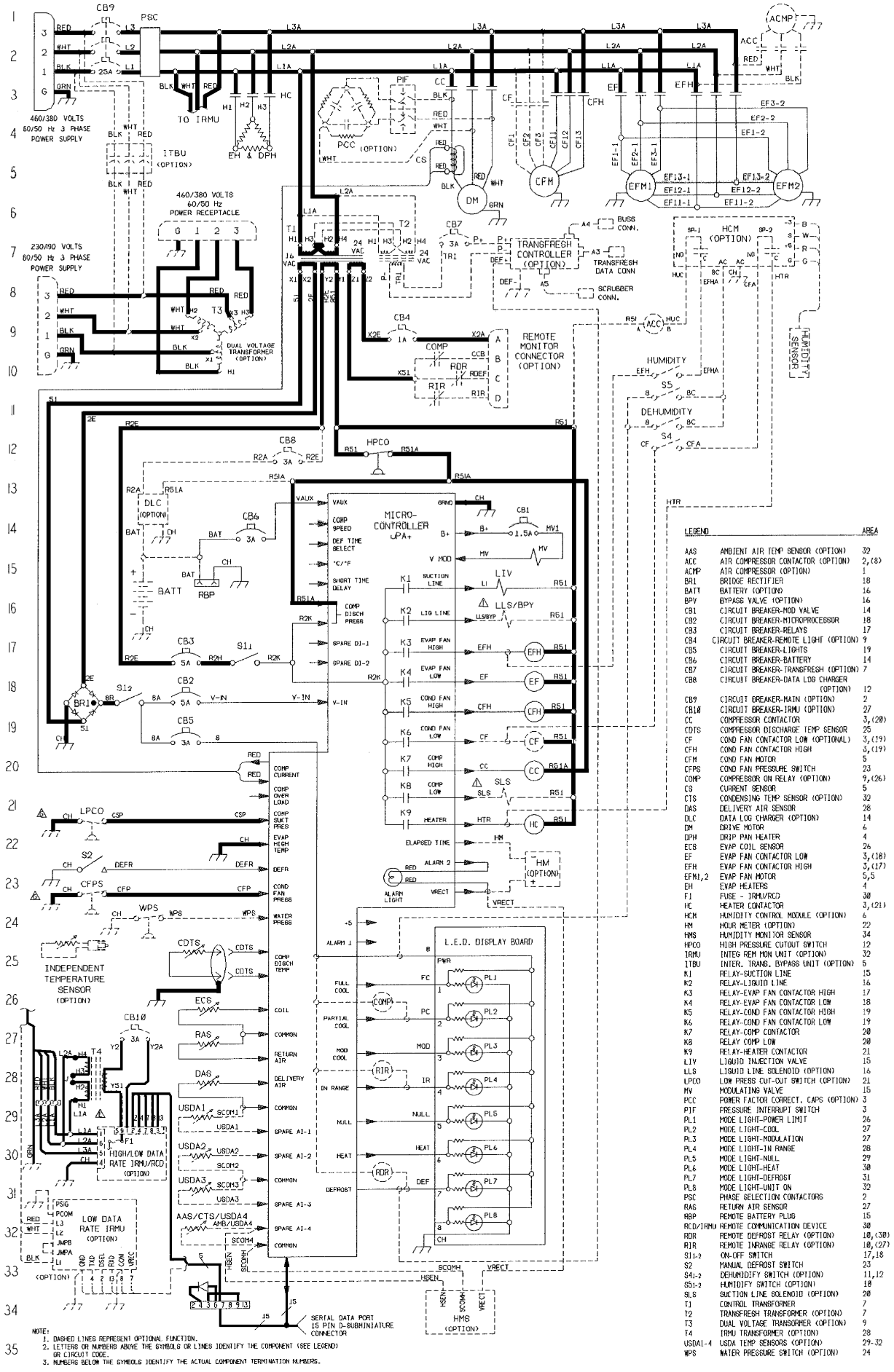
CONDITION	POSSIBLE CAUSE	REMEDY
Low suction pressure	Shortage of refrigerant.	Repair leak and recharge.
NOTE: This unit has a suction modulation capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is on Modulation Cool (control temperature within 2.5 to 3 F [1.4 to 1.7 C] of setpoint or in Power Limit mode.	Low ambient air temperature.	No remedy.
	Iced or dirty evaporator coil.	Defrost or clean evaporator coil.
	Expansion valve closed too much.	Adjust or replace valve.
	Restricted lines.	Locate and clear restriction.
	Plugged dehydrator.	Replace dehydrator.
	Evaporator blowers off.	Check evaporator blower motors and control circuit and correct fault.
	Microprocessor out of calibration.	Recalibrate (see “Calibration Procedure” in Electrical Maintenance section) or replace microprocessor.
	Service gauge out of calibration.	Adjust or replace gauge.

460/380 Vac Power Supply to Unit



LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PFC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S1:1-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4:1-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S5:1-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

230/190 Vac Power Supply to Unit (CF-II M53 Only)



LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,8
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S1,1-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4,1-2	DEHUMIDIFY SWITCH (OPTION)	11,12
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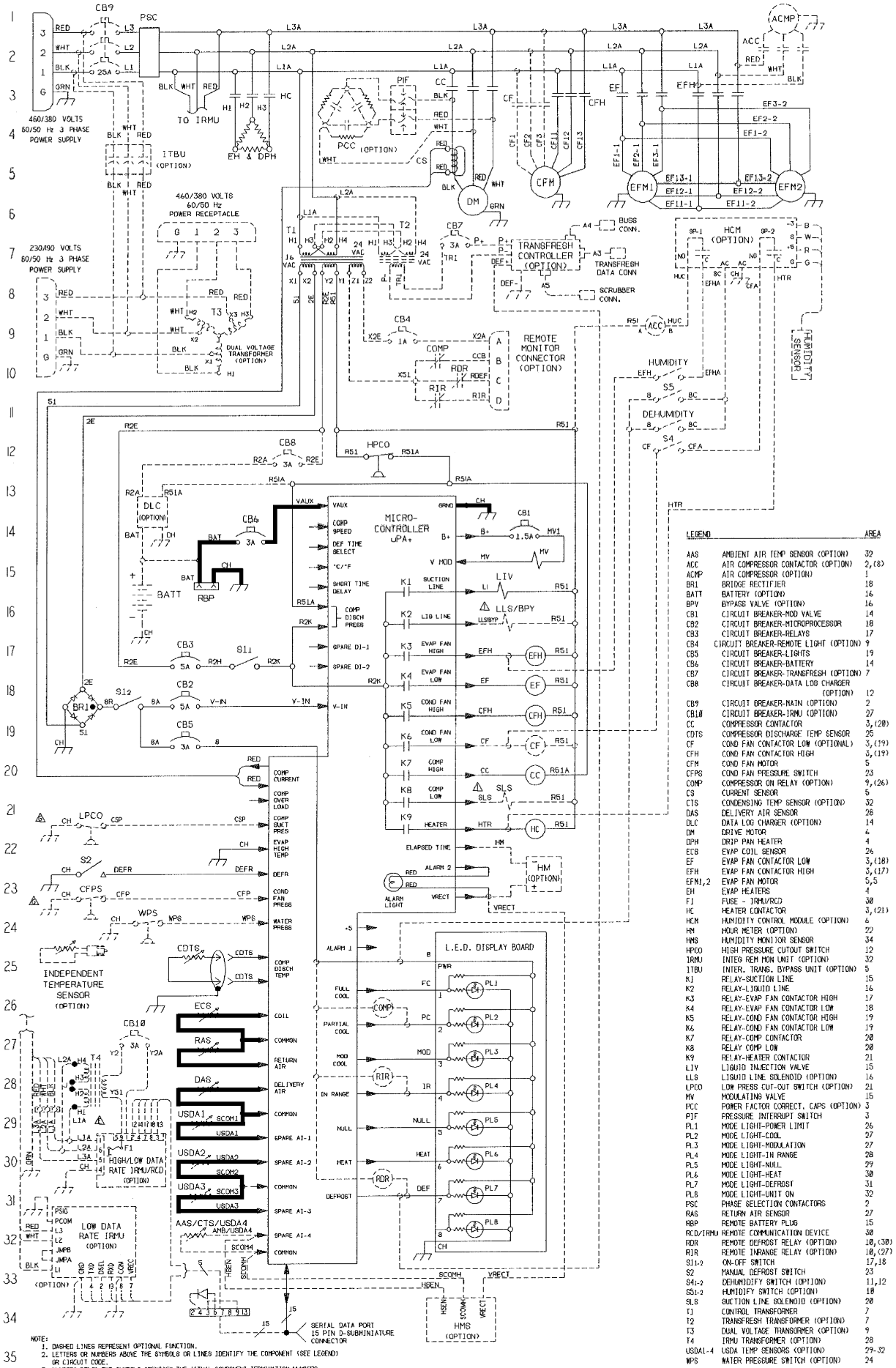
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

External 12 Vdc Battery Power



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ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
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CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
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CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
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HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
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K9	RELAY-HEATER CONTACTOR	21
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LLS	LIQUID LINE SOLENOID (OPTION)	16
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MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
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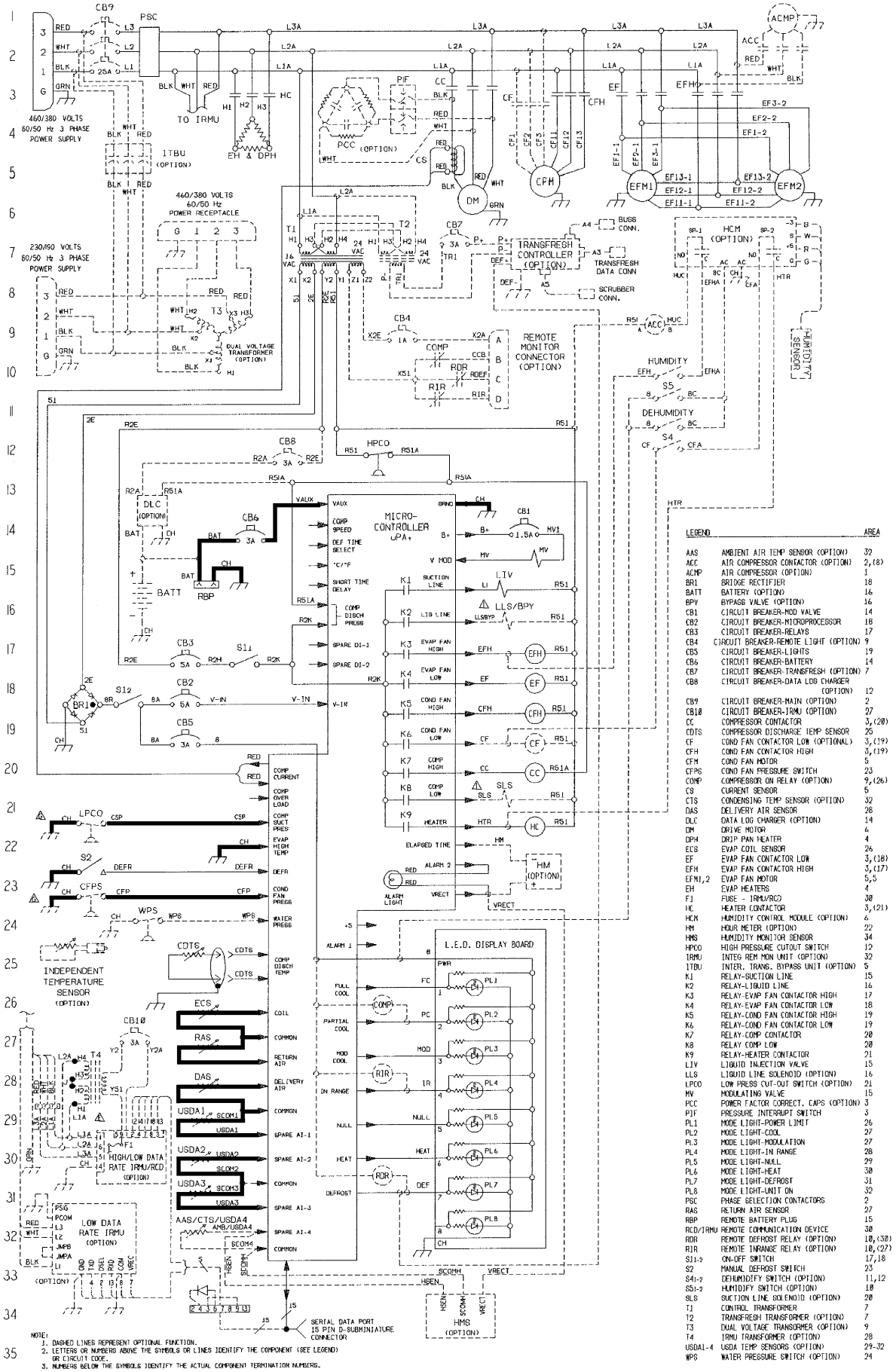
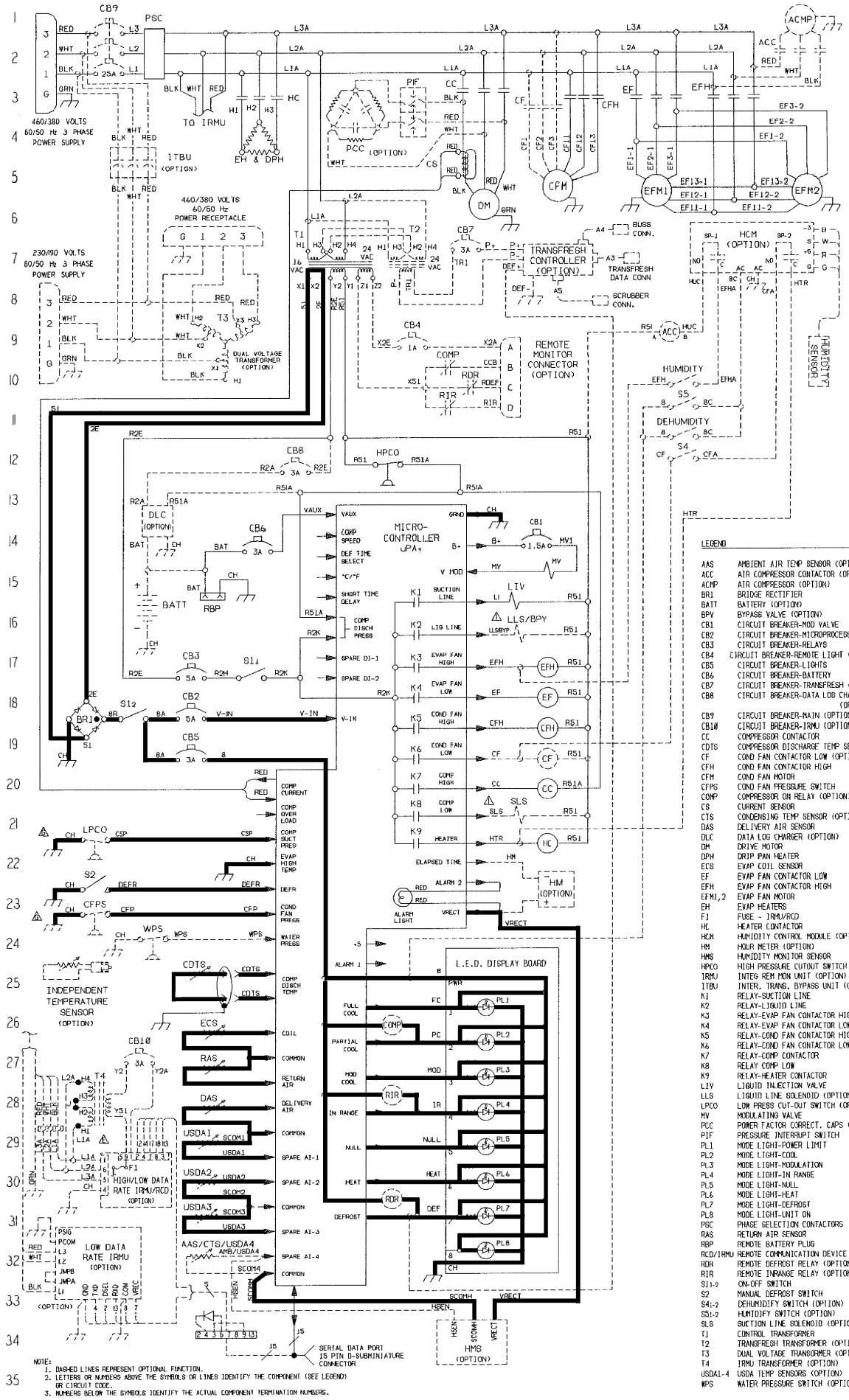
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S41-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S51-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

Microprocessor Awakened from Sleep Mode (Press [SELECT] key when external power is disconnected from unit)



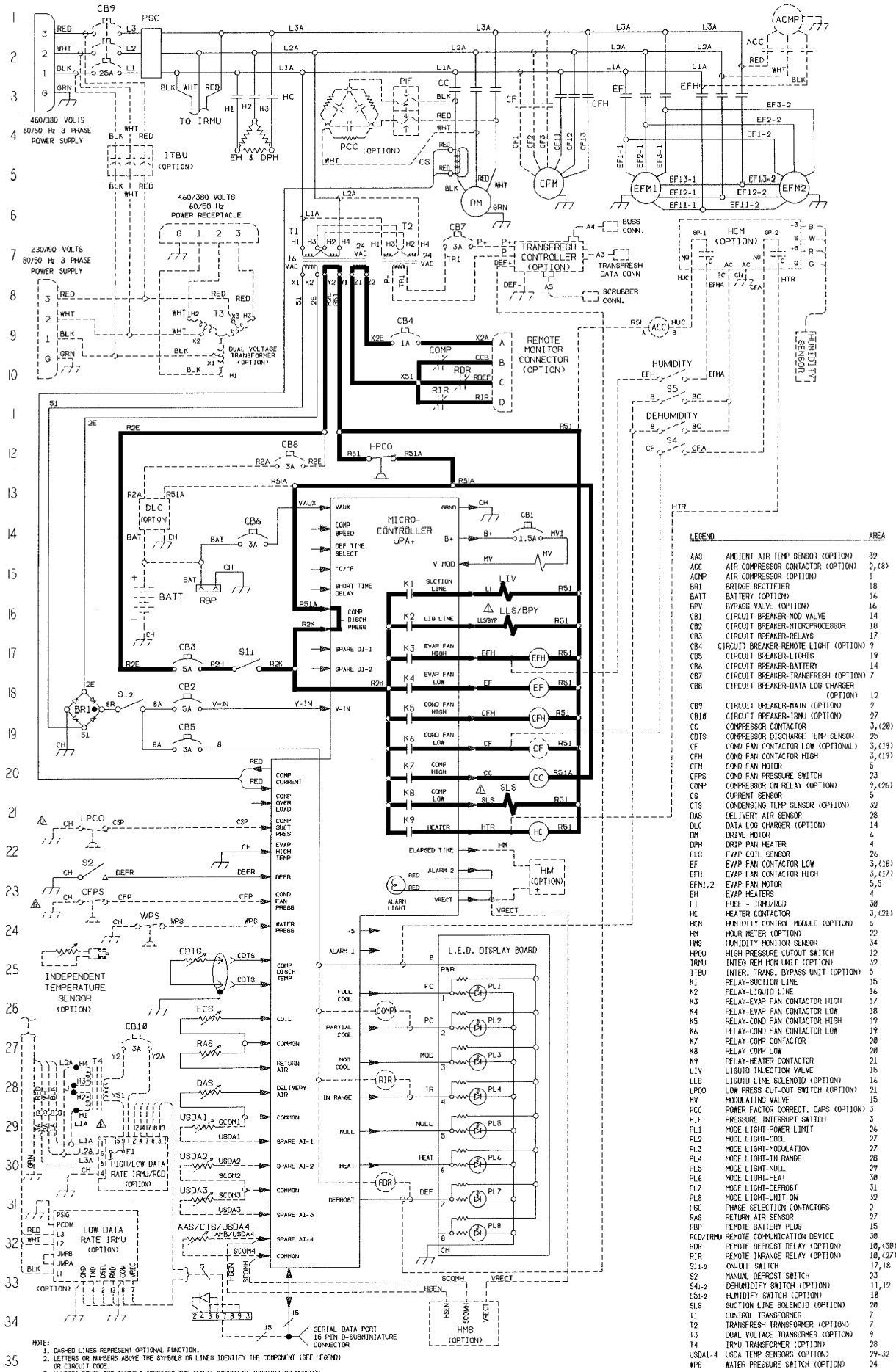
LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTER-REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S1[1-2]	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4[1-2]	DEHUMIDIFY SWITCH (OPTION)	11,12
S5[1-2]	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

12.5 Vdc Control Circuit



LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4(1-2)	DEHUMIDIFY SWITCH (OPTION)	11,12
S5(1-2)	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

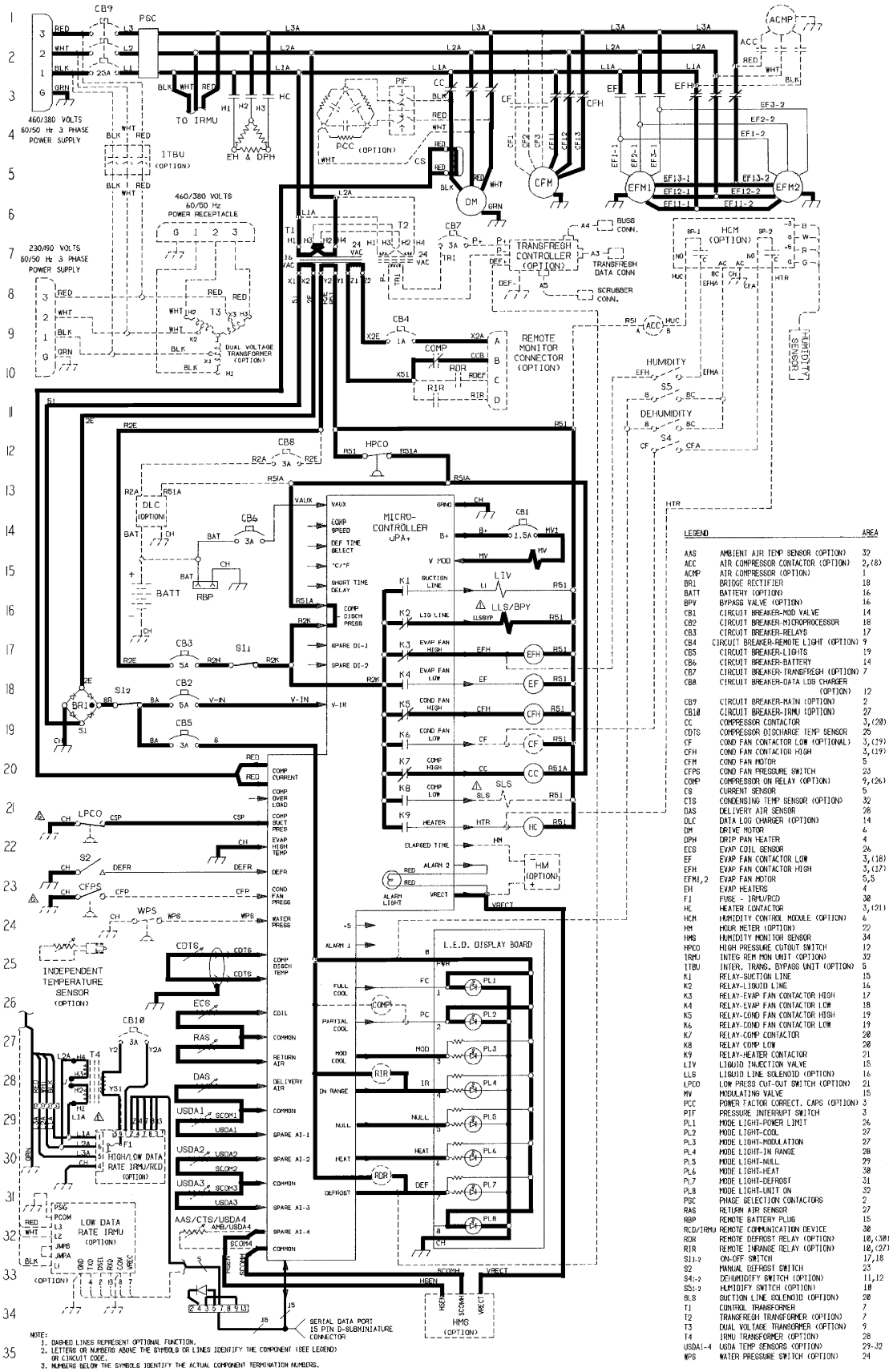
24 Vac Control Circuit



LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4;-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S5;-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

NOTE:
1. DASHED LINES REPRESENT OPTIONAL FUNCTION.
2. LETTERS OR NUMBERS ABOVE THE SYMBOLS OR LINES IDENTIFY THE COMPONENT (SEE LEGEND) OR CIRCUIT CODE.
3. NUMBERS BELOW THE SYMBOLS IDENTIFY THE ACTUAL COMPONENT TERMINATION NUMBERS.

Cool Mode—Setpoint above 24 F (-4.4 C), high speed condenser fan[1], power monitor limiting unit power consumption, humidity below controller setpoint (dehumidification ON), temperature out-of-range.

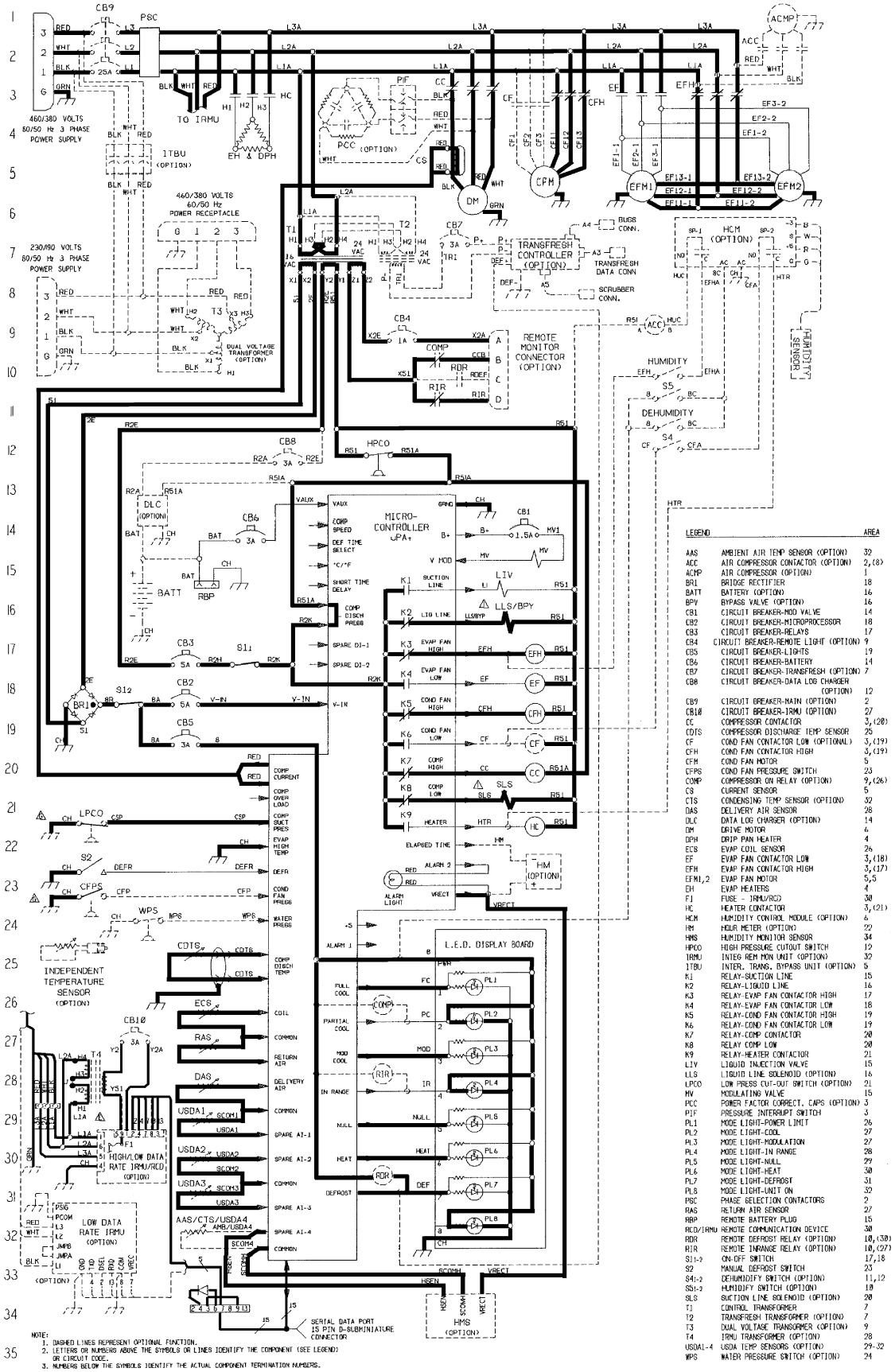


LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-1RMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(29)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	26
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - 1RMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
1RMU	INTEG REM MON UNIT (OPTION)	32
1TBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/1RMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S5-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSORMER (OPTION)	9
T4	1RMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

[1] **Condenser fan will stop if condenser head pressure drops below 160 ±7 psig (1103 ± 48 kPa).**

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

Cool Mode—Setpoint above 24 F (-4.4 C), high speed condenser fan[1], humidity below controller setpoint (dehumidification ON), temperature in-range.

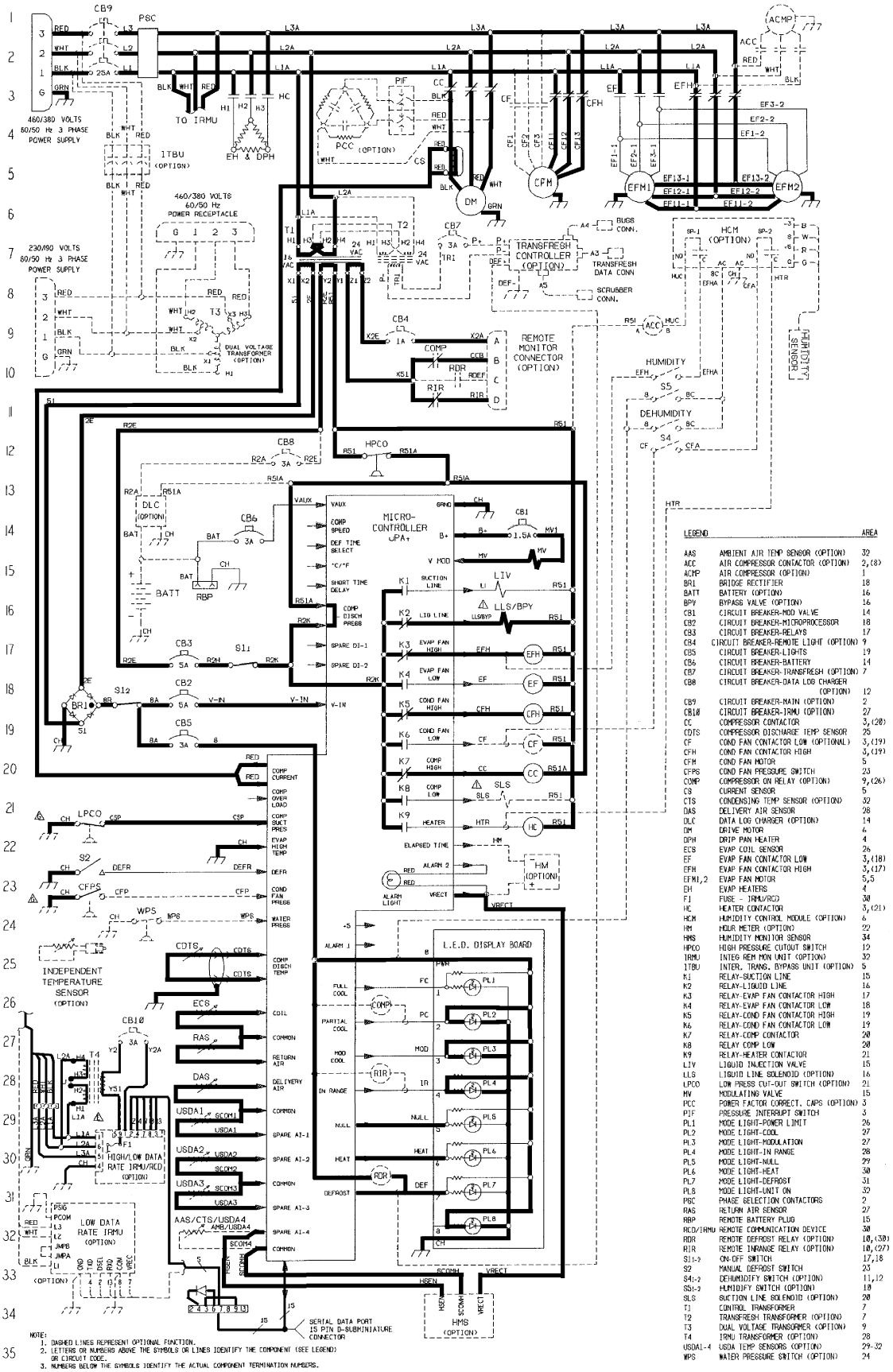


LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
1TBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S1:1-9	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4:1-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S5:1-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

[1] **Condenser fan will stop if condenser head pressure drops below 160 ±7 psig (1103 ± 48 kPa).**

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

Modulated Cool Mode—Setpoint above 24 F (-4.4 C), high speed condenser fan[1], liquid injection valve closed, humidity below controller setpoint (dehumidification ON).

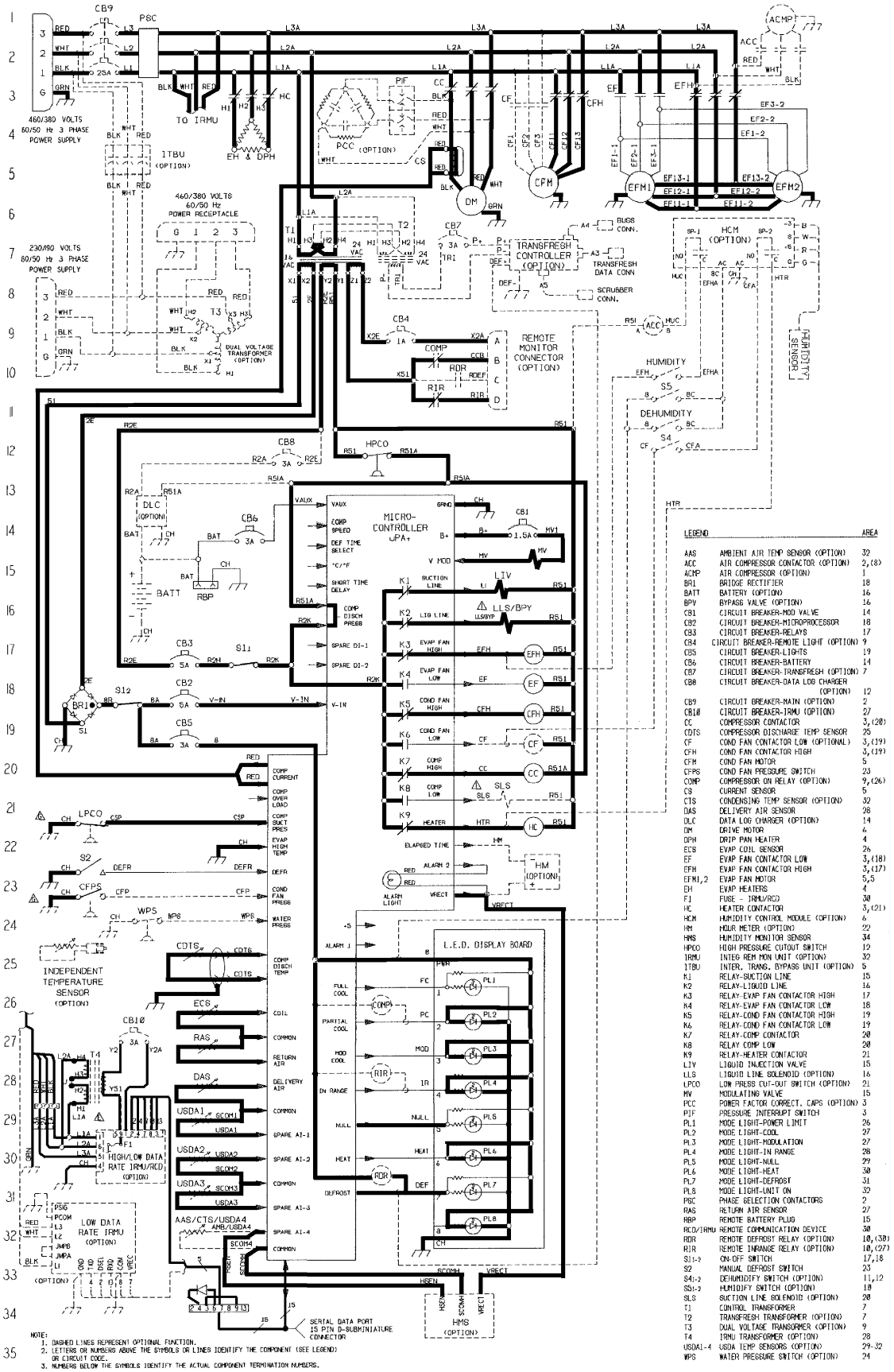


LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
1TBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S1:1-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4:1-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S5:1-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

[1] **Condenser fan will stop if condenser head pressure drops below 160 ±7 psig (1103 ± 48 kPa).**

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

Modulated Cool Mode—Setpoint above 24 F (-4.4 C), condenser fan OFF[1], liquid injection valve open (injecting)[2], humidity 3% above controller setpoint (dehumidification ON).



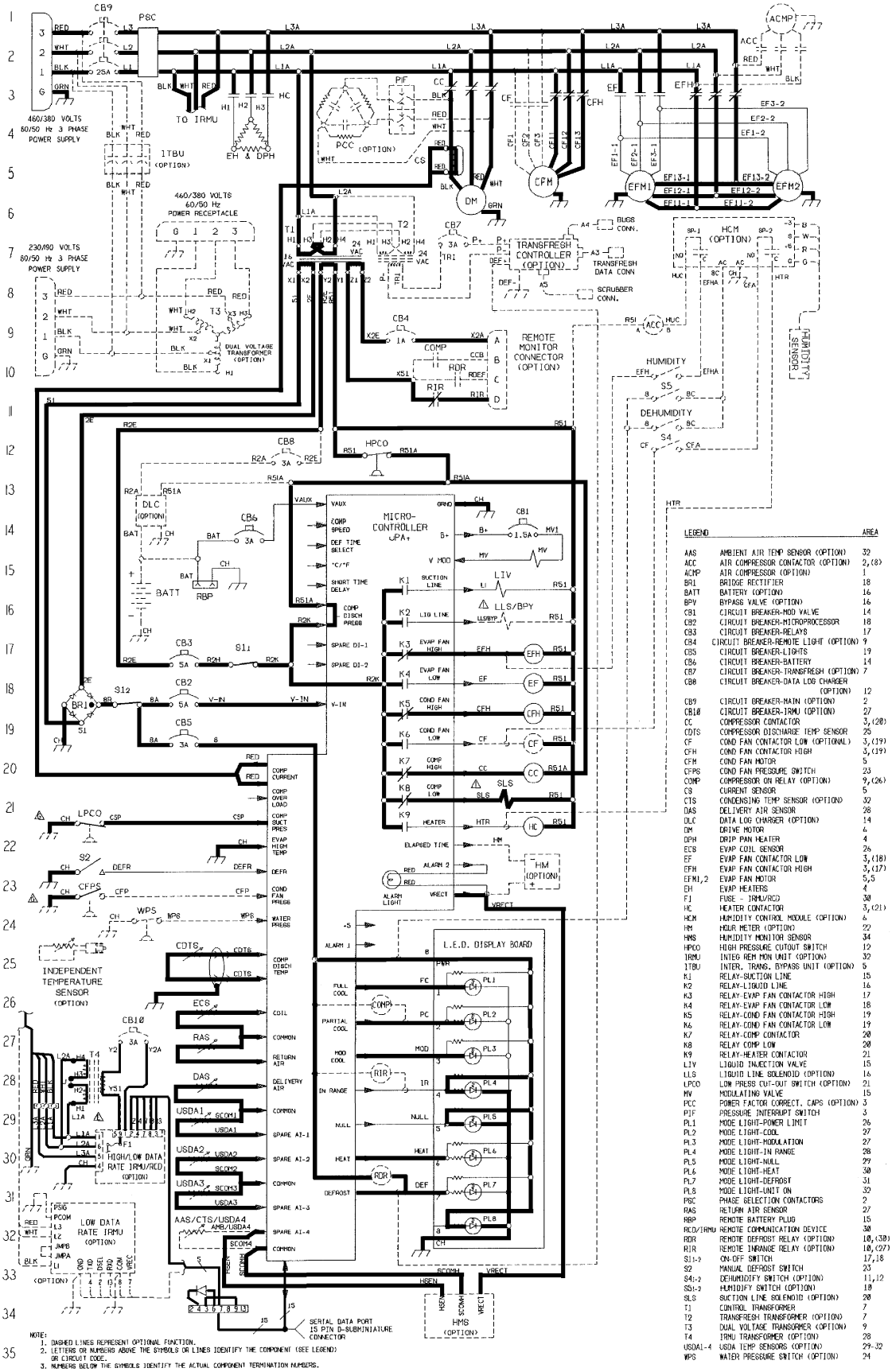
LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	24
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-3	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4:1-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S5:1-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

[1] **Condenser fan will stop if condenser head pressure drops below 160 ±7 psig (1103 ± 48 kPa).**

[2] **The microprocessor energizes (opens) the liquid injection valve when the modulation valve closes 50 percent or more.**

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

Null Mode—Setpoint above 24 F (-4.4 C) during compressor pump down, high speed condenser fan[1].

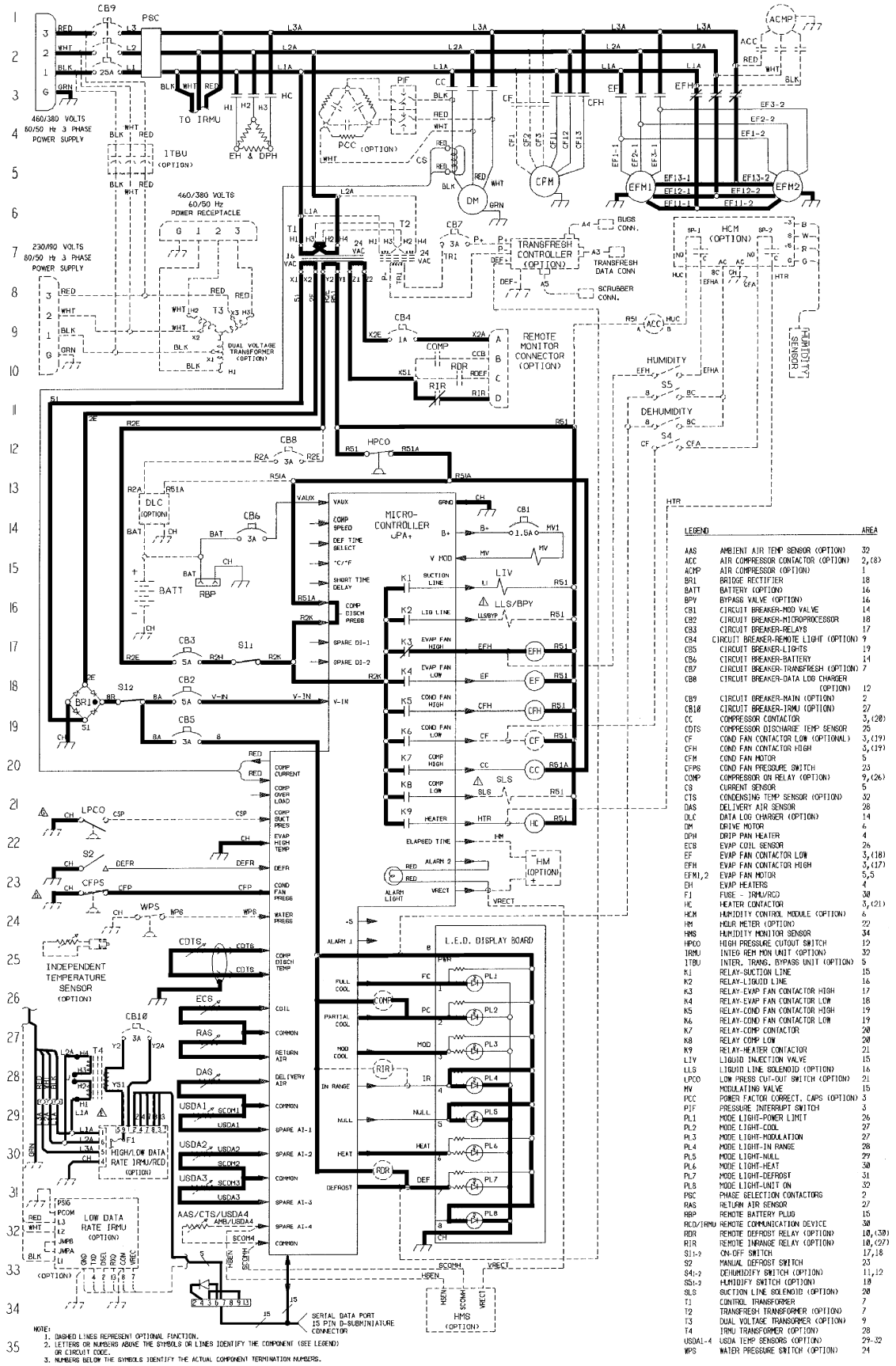


LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S41-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S51-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

[1] **The microprocessor opens the modulation valve fully and then opens (energizes) the suction line solenoid valve. The condenser fan operates for two minutes during Null or until the condenser head pressure drops below 160 ±7 psig (1103 ± 48 kPa).**

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

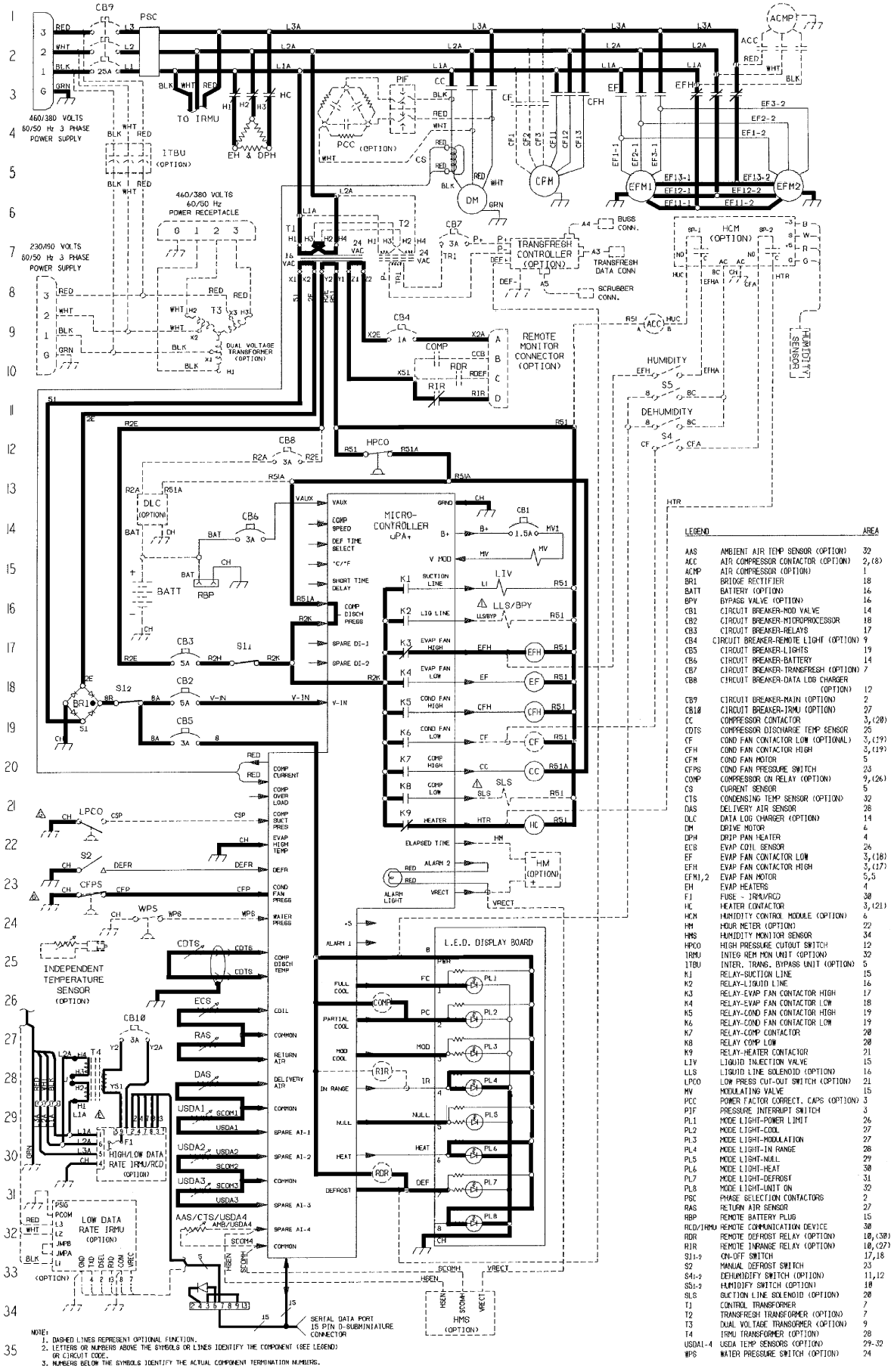
Null Mode—Setpoint Above 24 F (-4.4 C) after compressor pump down[1].



[1] **Condenser fan operates for two minutes during Null or until the condenser head pressure drops below 160 ±7 psig (1103 ± 48 kPa).**

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

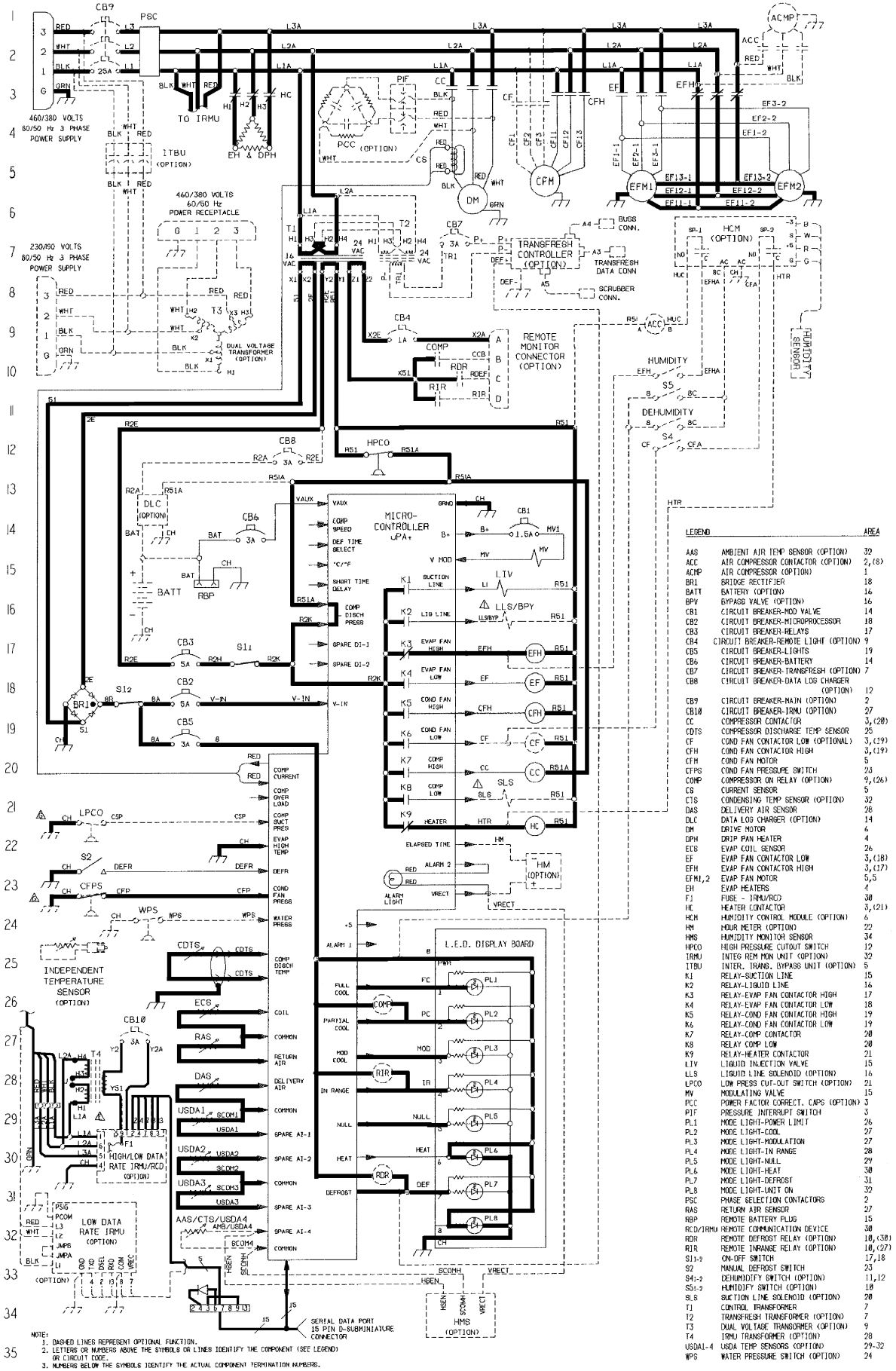
Heat Mode—Setpoint above 24 F (-4.4 C) temperature in-range.



LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S41-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S51-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

Heat Mode—Setpoint above 24 F (-4.4 C) temperature out-of-range.

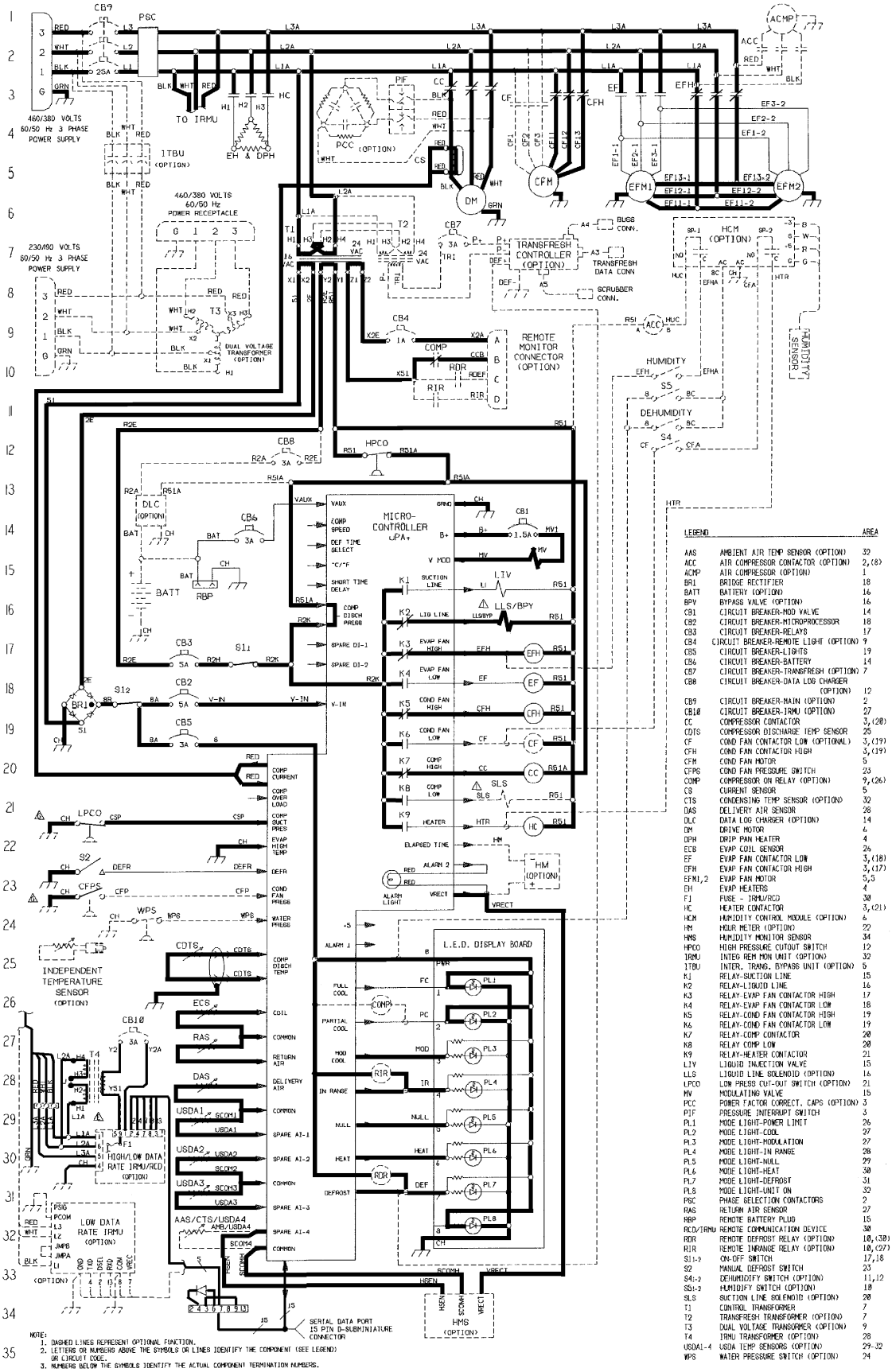


LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. (BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-9	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S51-3	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

NOTE:
1. DASHED LINES REPRESENT OPTIONAL FUNCTION.
2. LETTERS OR NUMBERS ABOVE THE SYMBOLS OR LINES IDENTIFY THE COMPONENT (SEE LEGEND) OR CIRCUIT CODE.
3. NUMBERS BELOW THE SYMBOLS IDENTIFY THE ACTUAL COMPONENT TERMINATION NUMBERS.

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

Cool Mode—Setpoint below 24 F (-4.4 C), high speed condenser fan[1], container return air temperature above 24 F (-4.4 C), temperature out-of-range, power monitor limiting unit power consumption.

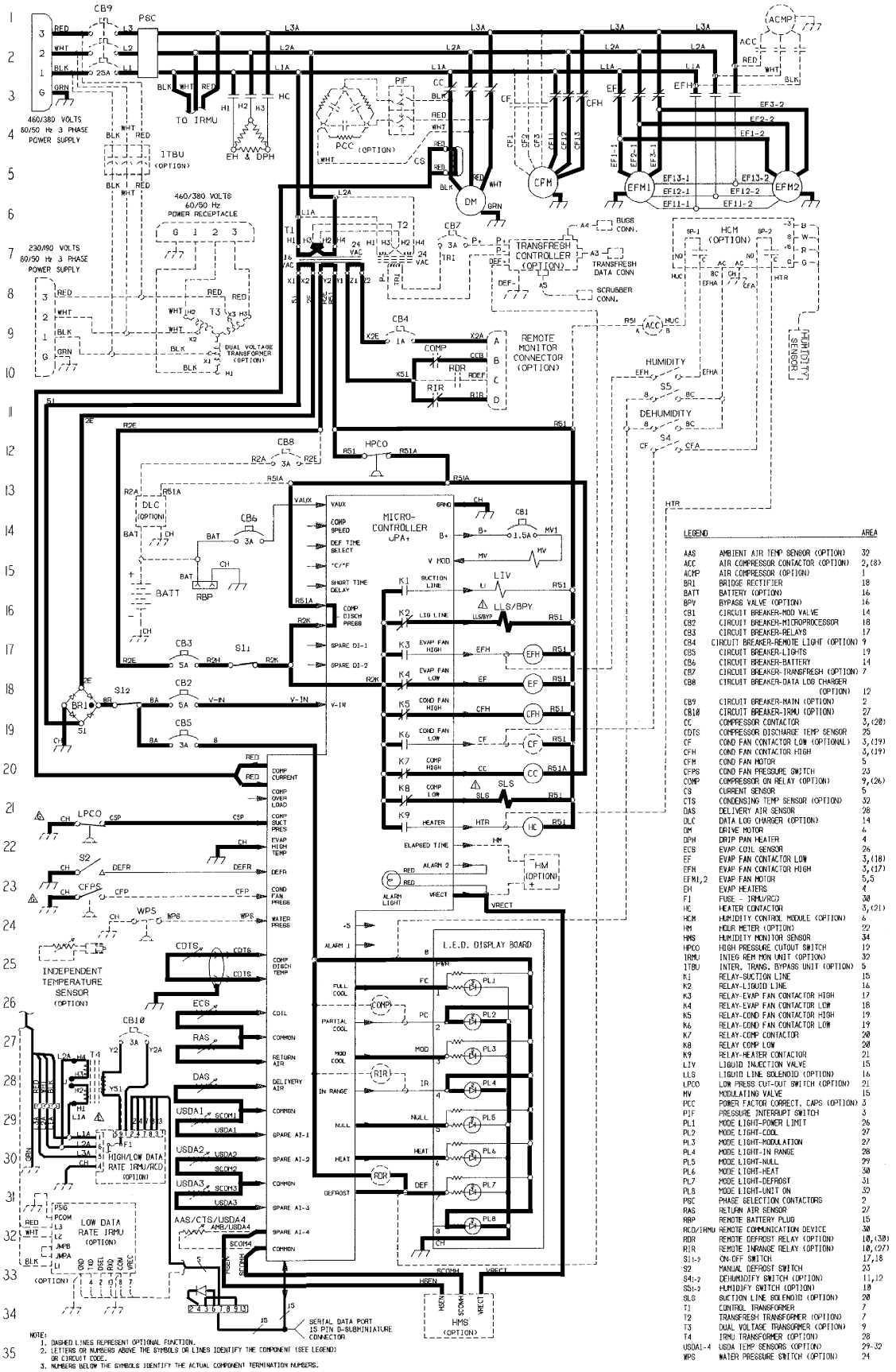


LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - 1RMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
1TBU	INTER. TRANS. BYPASS UNIT (OPTION)	6
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
L1V	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S41-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S51-3	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

[1] **Condenser fan will stop if condenser head pressure drops below 160 ±7 psig (1103 ± 48 kPa).**

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

Cool Mode—Setpoint below 24 F (-4.4 C), high speed condenser fan[1], container return air temperature below 24 F (-4.4 C), temperature in-range, liquid injection valve closed.

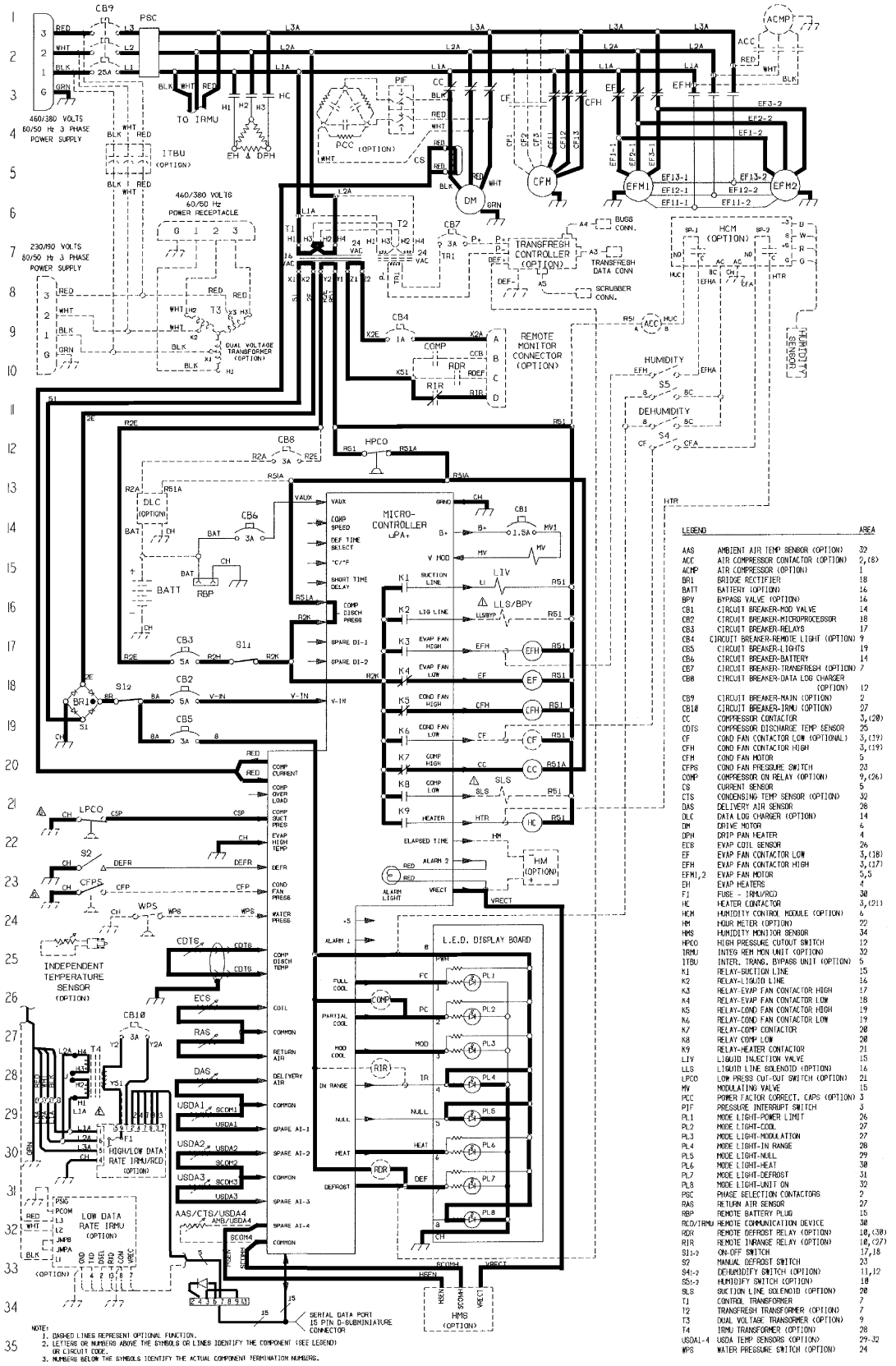


LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
1TBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PJF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	18,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	18,(27)
S1:1-3	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S4:1-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S5:1-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

[1] **Condenser fan will stop if condenser head pressure drops below 160 ±7 psig (1103 ± 48 kPa).**

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

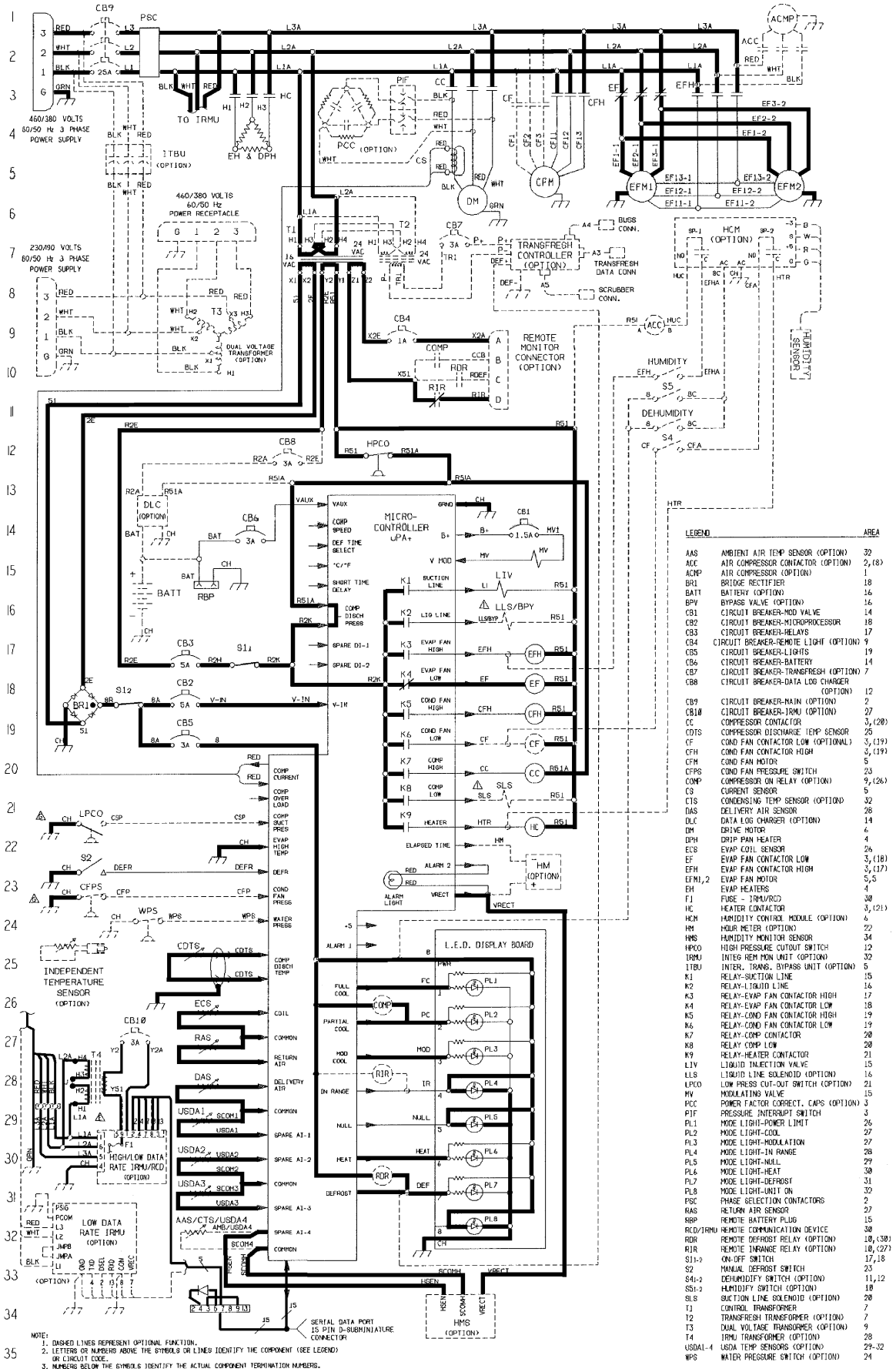
Null Mode—Setpoint below 24 F (-4.4 C) during compressor pump down[1].



[1] **The microprocessor opens the modulation valve fully and then opens (energizes) the suction line solenoid valve. At return air temperatures below 17 F (-8.4 C), the microprocessor operates the unit on pump down for 30 seconds and then stops the compressor. The condenser fan operates for two minutes during Null or until the condenser head pressure drops below 160 ±7 psig (1103 ± 48 kPa).**

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

Null Mode—Setpoint below 24 F (-4.4 C) after compressor pump down[1].

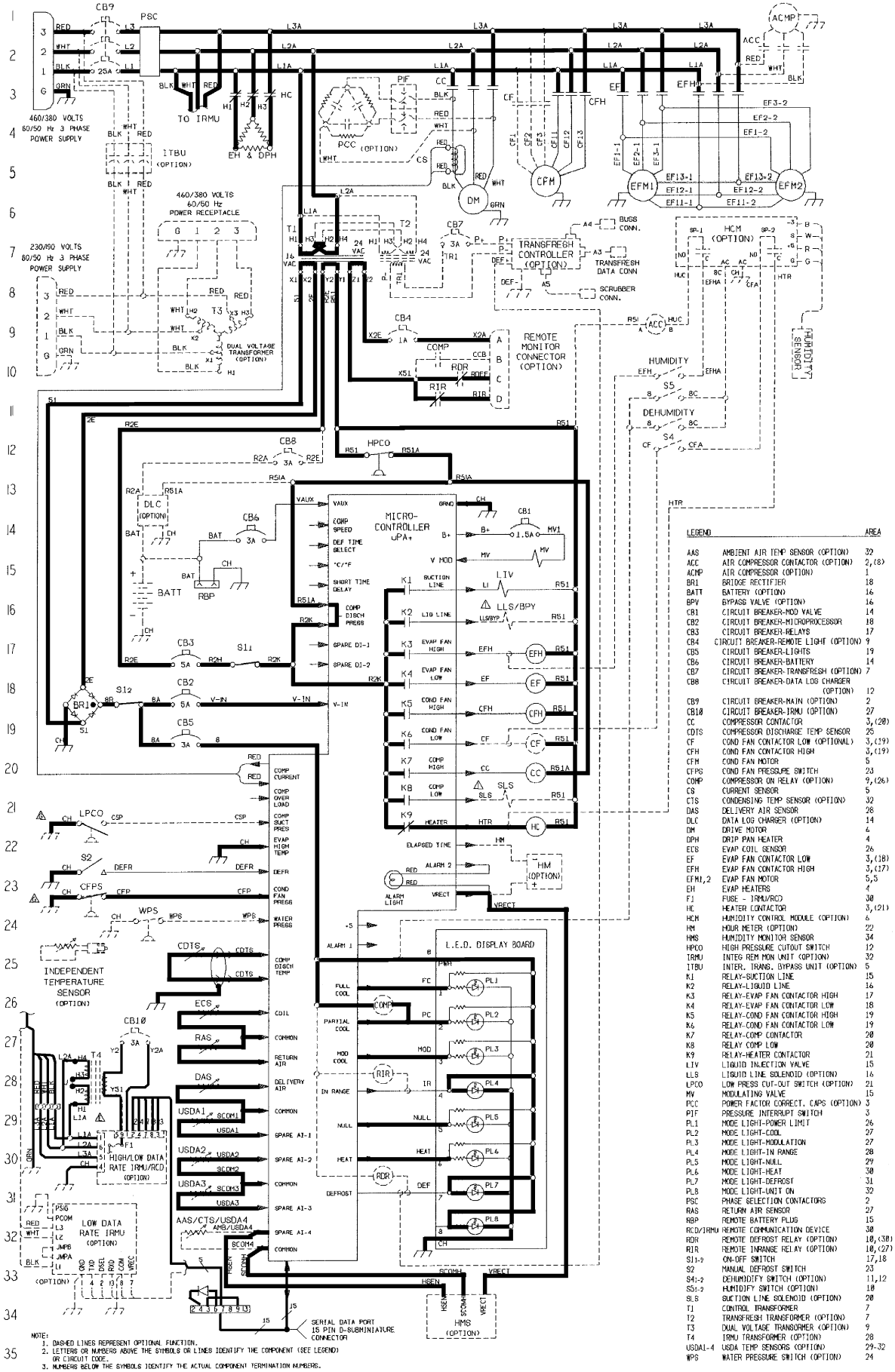


LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,6
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S41-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S51-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

[1] **Condenser fan operates for two minutes during Null or until the condenser head pressure drops below 160 ±7 psig (1103 ± 48 kPa).**

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

Defrost Mode—Microprocessor defrost override timer maintaining in-range signal.



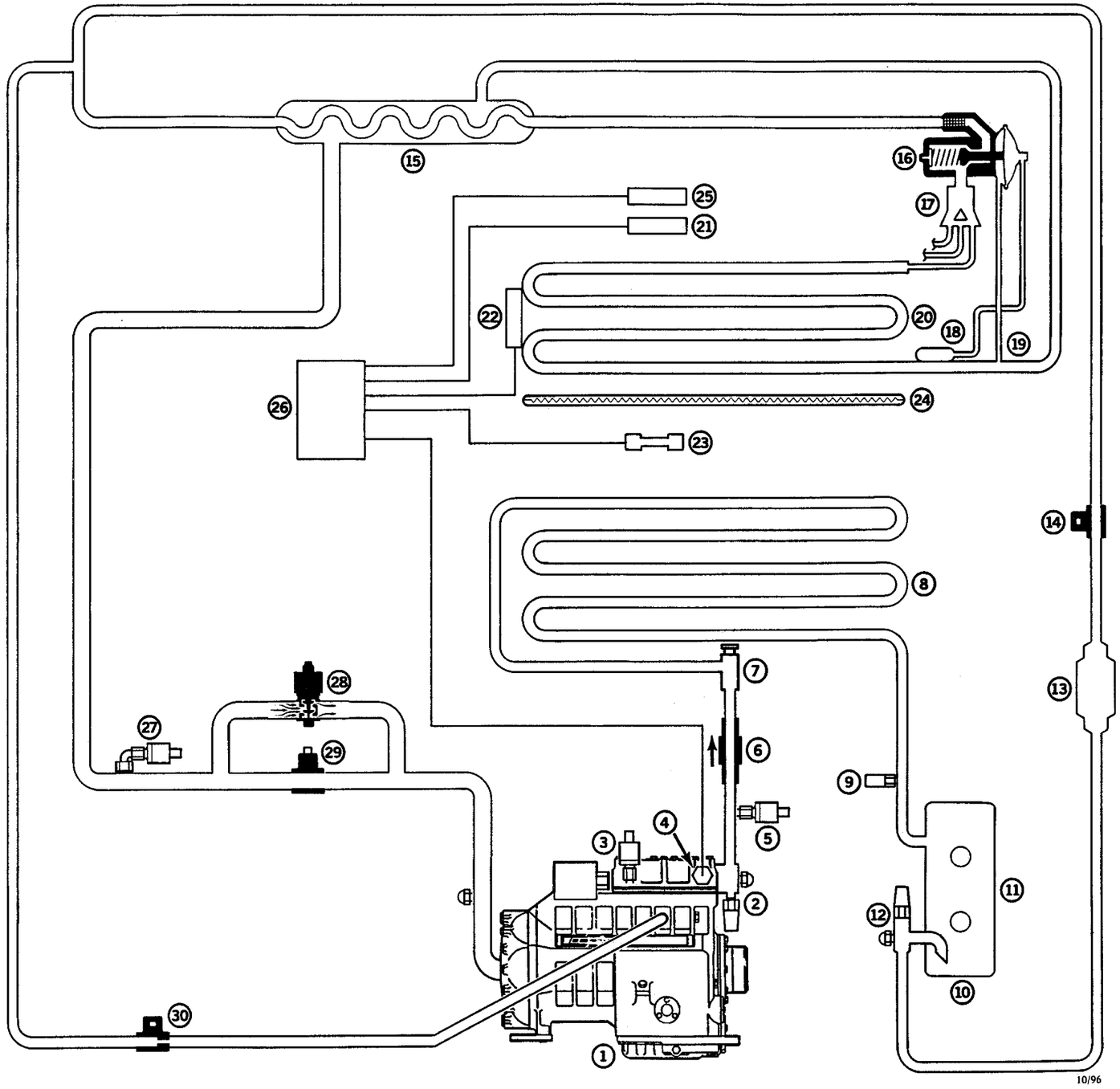
LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(28)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	6
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LTV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S41-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S51-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24

NOTE: Mode indicator light lines are grounded to turn LEDs OFF and float to about 2/3 of V-IN when LED is ON.

CF-II M53, M53.1

Refrigeration System Components

1. Compressor
2. Discharge Service Valve (DSV)
3. High Pressure Cutout Switch (HPCO)
4. Compressor Head Discharge Temperature Sensor (CDTS)
5. Condenser Fan Pressure Switch (CFPS)
6. Condenser Check Valve (CCV)
7. Discharge Pressure Regulator Valve (DPRV)
8. Condenser Coil
9. High Pressure Relief Valve
10. Receiver Tank
11. Sight Glass
12. Receiver Tank Outlet Valve
13. Filter Drier
14. Liquid Line Solenoid (LSS)
15. Heat Exchanger
16. Expansion Valve (TXV)
17. Distributor
18. TXV Power Element
19. Equalizer Line
20. Evaporator Coil
21. Return Air Sensor
22. Coil Sensor
23. Discharge/Supply Air Sensor (Squashed)
24. Electric Heaters
25. Humidity Sensor
26. Controller
27. Low Pressure Cutout Switch (LPCO)
28. Modulation Valve (MV)
29. Suction Line Solenoid (SLS)
30. Liquid Injection Valve w/Restrictor (LIV)



Flow and Pressure Diagram

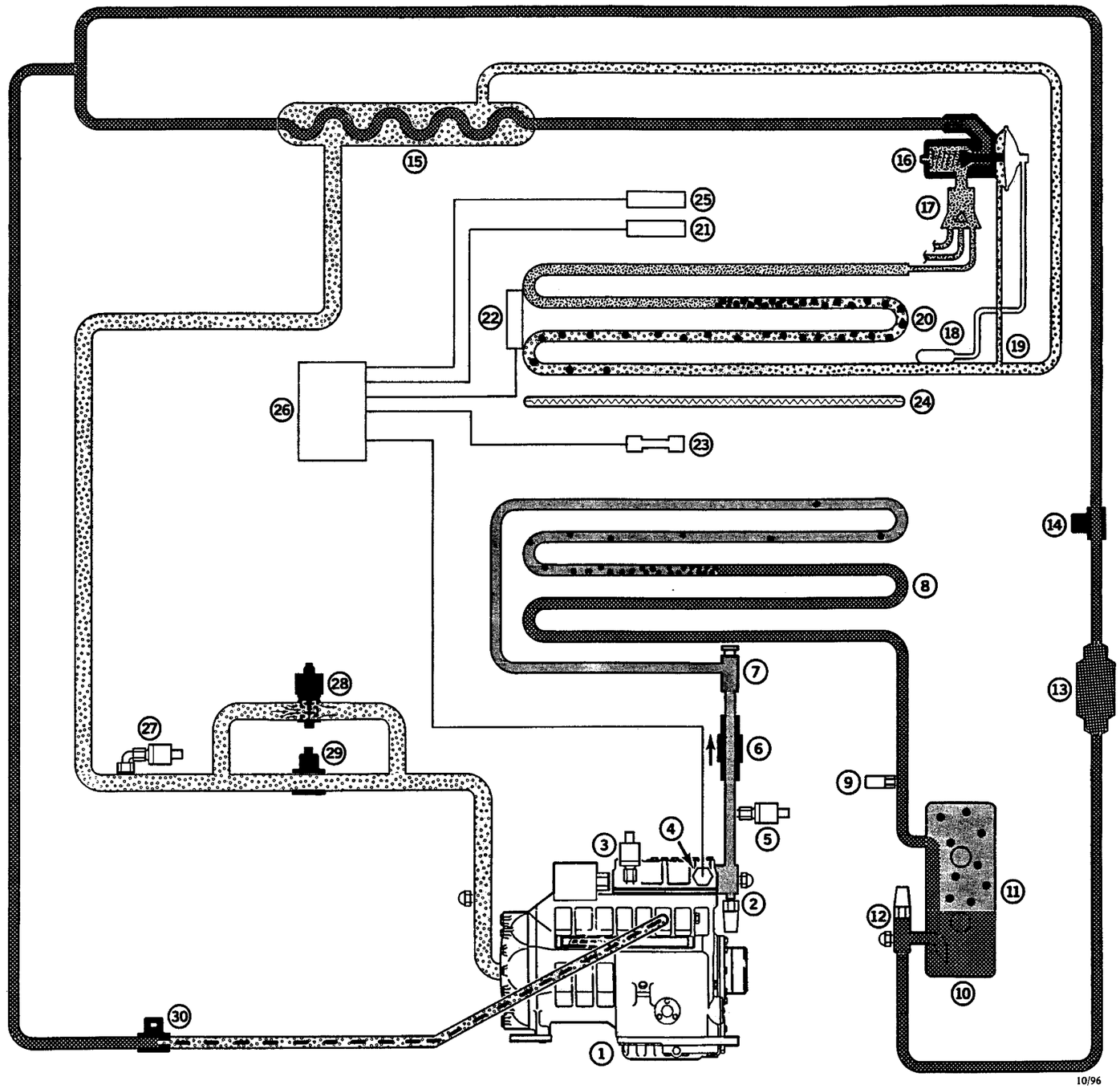
CF-II M53, M53.1

Full Cool

1. **Compressor**
   Compressor operation has a three (3) second delay on initial unit start-up or when the unit shifts to a cooling mode requiring compressor start up.
3. **High Pressure Cutout Switch (HPCO)**
   Is a normally CLOSED switch.
   It OPENS (cut-out) when pressure is 350 ± 10 PSIG (2415 ± 69 kPa).
   It CLOSES (cut-in) when pressure is 240 ± 10 PSIG (1656 ± 69 kPa).
5. **Condenser Fan Pressure Switch (CFPS)**
   Is a normally CLOSED switch.
   It OPENS at 200 ± 7 PSIG (1379 ± 48 kPa).
   It CLOSES at 160 ± 7 PSIG (1103 ± 48 kPa).
6. **Condenser Check Valve (CCV)**
   The check valve prevents reverse of liquid refrigerant flow back into the compressor in the off cycle.
7. **Discharge Pressure Regulator Valve (DPRV)**
   The Discharge Pressure Regulator Valve maintains compressor discharge pressure at 70 PSIG (483 kPa) into the compressor.
9. **High Pressure Relief Valve**
   OPENS at 500 ± 15 PSIG (3447 +345/-104 kPa).
   Reset (CLOSES) at 400 PSIG (2758 kPa).
26. **Controller**
    THERMOGUARD µP-A+ with digital thermostat, thermometer and fault indicator monitor.

Null Mode Operation

During Null Mode Operation, the compressor does not run. Condenser fan runs for 2 minutes and stops. Evaporator blowers are running (speed is controlled by the return air sensor temperature).



- High pressure gas
- High pressure liquid
- Low pressure gas
- Low pressure liquid
- Condensing high pressure gas
- Low pressure vaporizing liquid
- Liquid refrigerant injection

Flow and Pressure Diagram

CF-II M53, M53.1

Modulated Cool

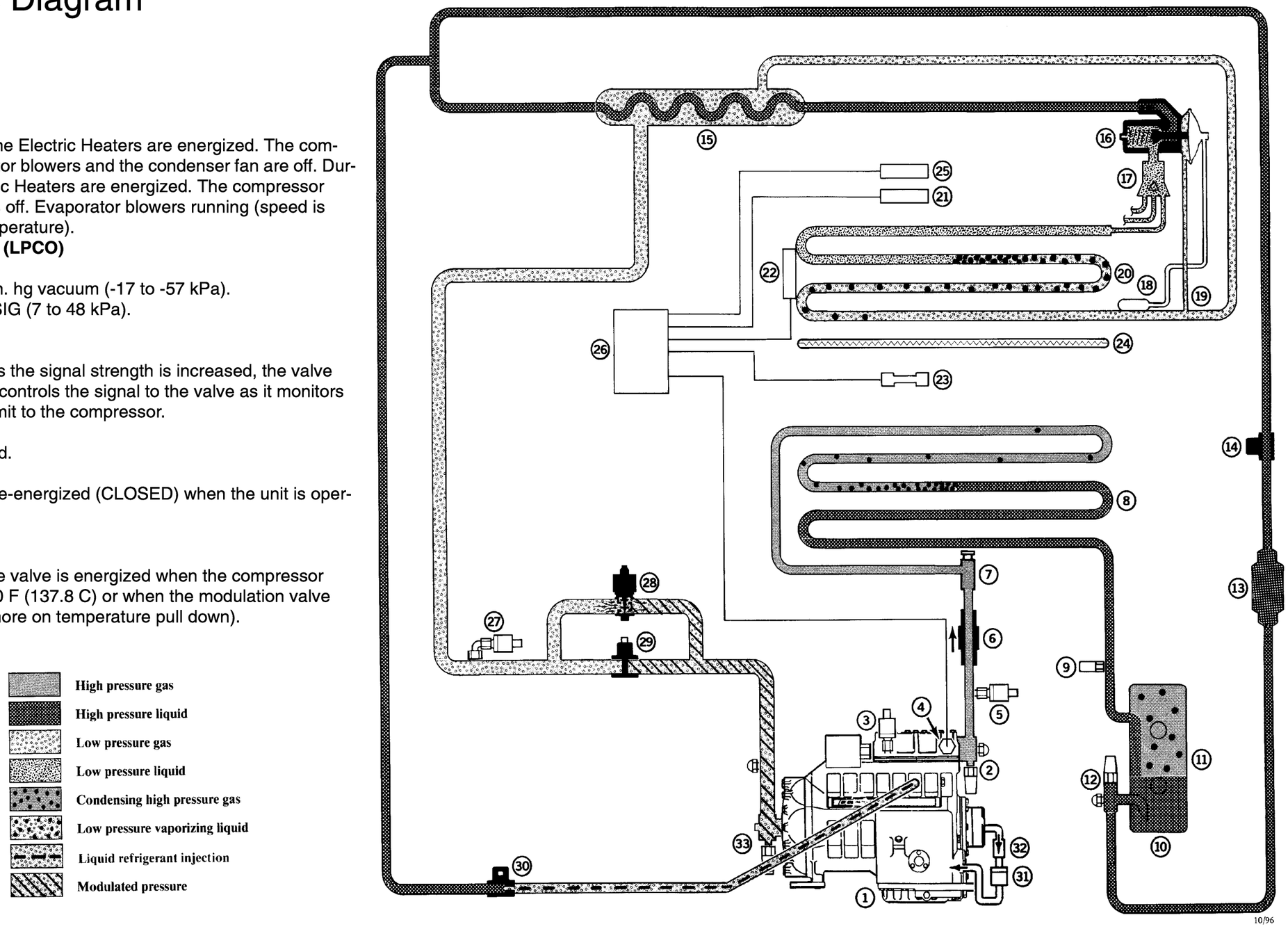
24. Electric Heaters
During DEFROST operation, the Electric Heaters are energized. The compressor does not run. Evaporator blowers and the condenser fan are off. During HEAT operation, the Electric Heaters are energized. The compressor does not run. Condenser fan is off. Evaporator blowers running (speed is controlled by the return air temperature).

27. Low Pressure Cutout Switch (LPCO)
Is a normally CLOSED switch.
It OPENS (cut-out) at 5 to 17 in. hg vacuum (-17 to -57 kPa).
It CLOSES (cut-in) at 1 to 7 PSIG (7 to 48 kPa).

28. Modulation Valve (MV)
Is a normally OPEN valve.
It CLOSES when energized. As the signal strength is increased, the valve CLOSES more. The controller controls the signal to the valve as it monitors the temperatures and power limit to the compressor.

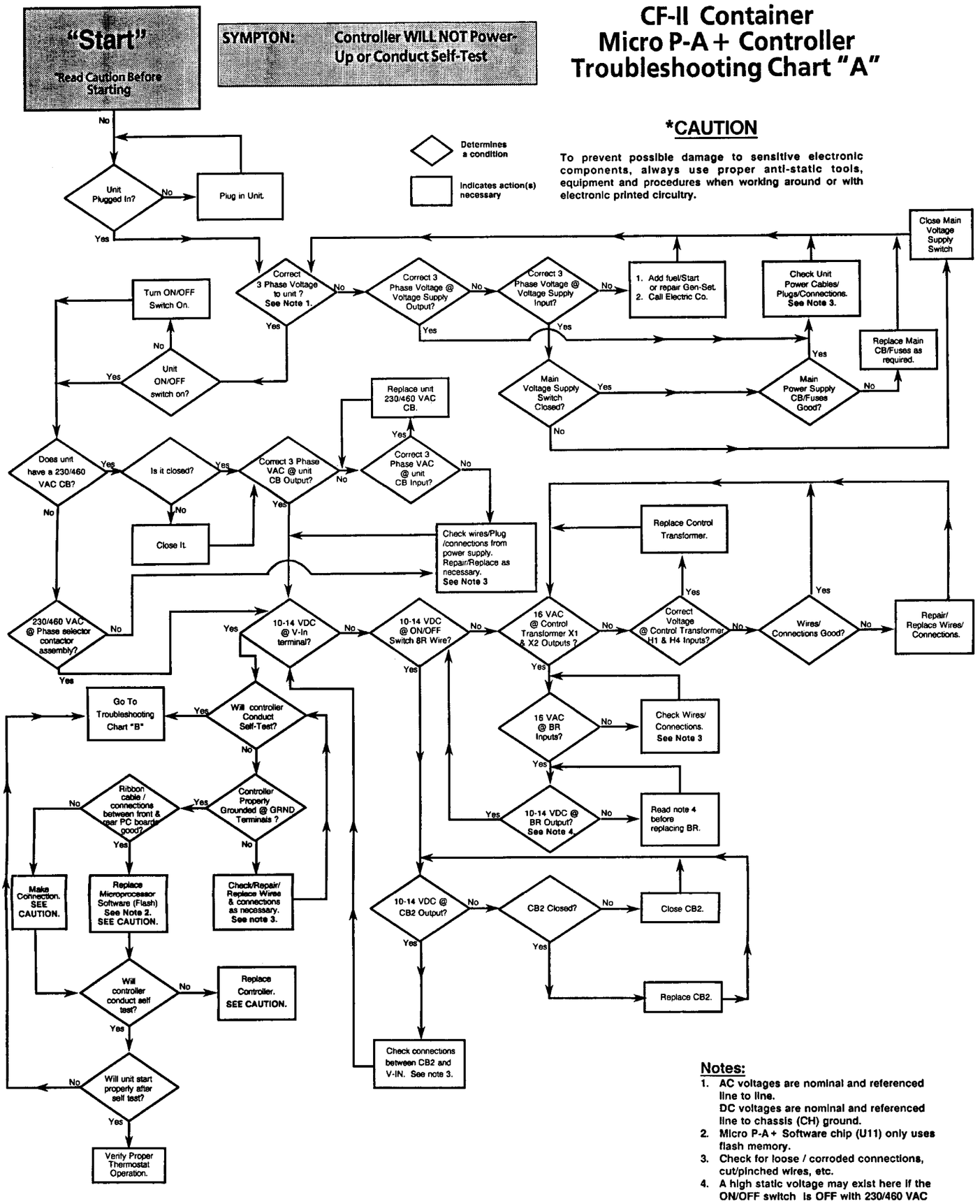
29. Suction Line Solenoid (SLS)
Is a normally CLOSED solenoid.
It OPENS when energized.
The Suction Line Solenoid is de-energized (CLOSED) when the unit is operating in modulation.

30. Liquid Injection Valve (LIV)
Is a normally CLOSED valve.
It OPENS when energized. The valve is energized when the compressor head temperature is above 280 F (137.8 C) or when the modulation valve closes 50% or more (70% or more on temperature pull down).



High pressure gas
High pressure liquid
Low pressure gas
Low pressure liquid
Condensing high pressure gas
Low pressure vaporizing liquid
Liquid refrigerant injection
Modulated pressure

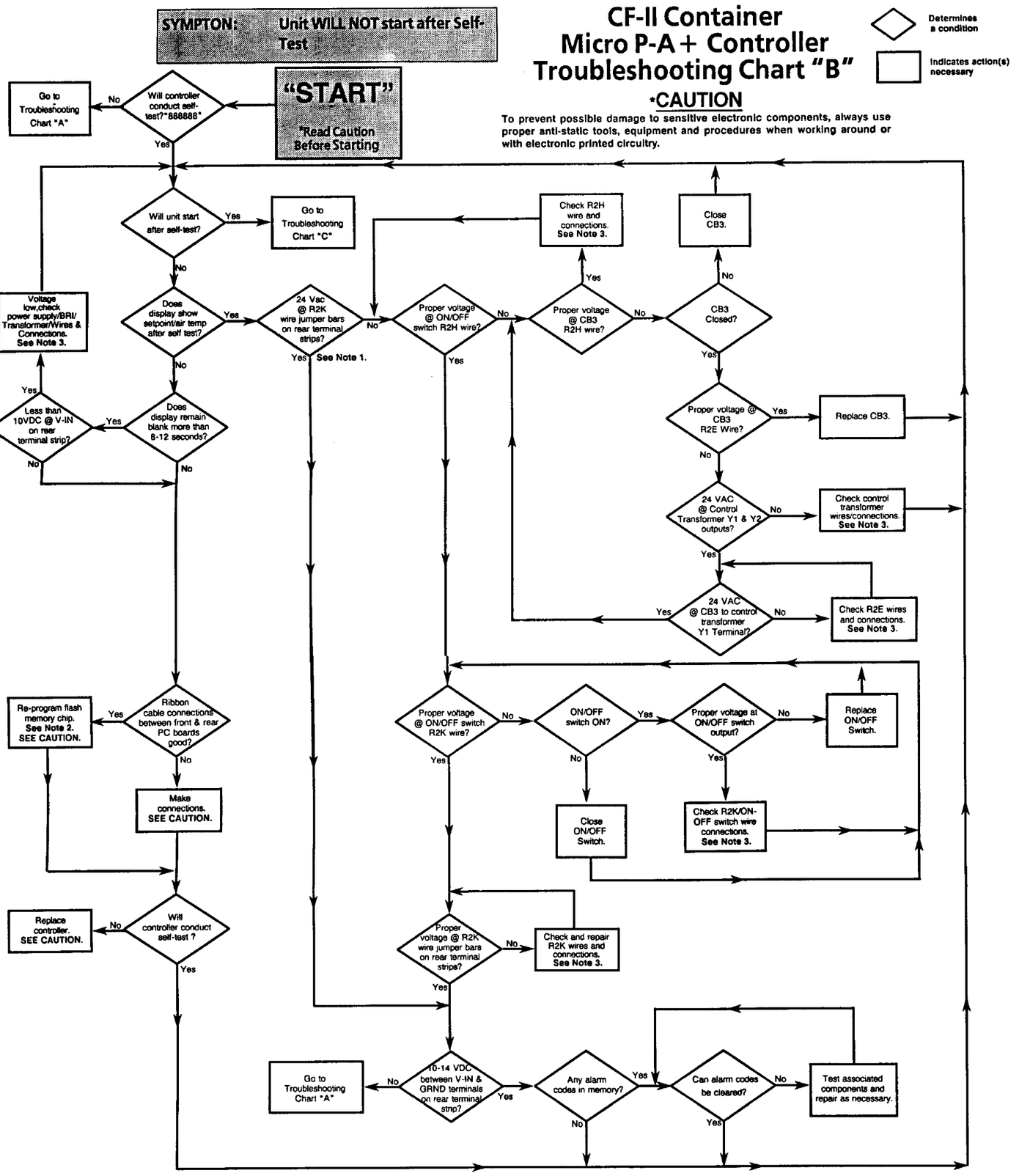
CF-II Container
Micro P-A+ Controller
Troubleshooting Chart "A"



Notes:

1. AC voltages are nominal and referenced line to line.
   DC voltages are nominal and referenced line to chassis (CH) ground.
2. Micro P-A+ Software chip (U11) only uses flash memory.
3. Check for loose / corroded connections, cut/pinched wires, etc.
4. A high static voltage may exist here if the ON/OFF switch is OFF with 230/460 VAC to unit.

CF-II Container Micro P-A+ Controller Troubleshooting Chart "B"



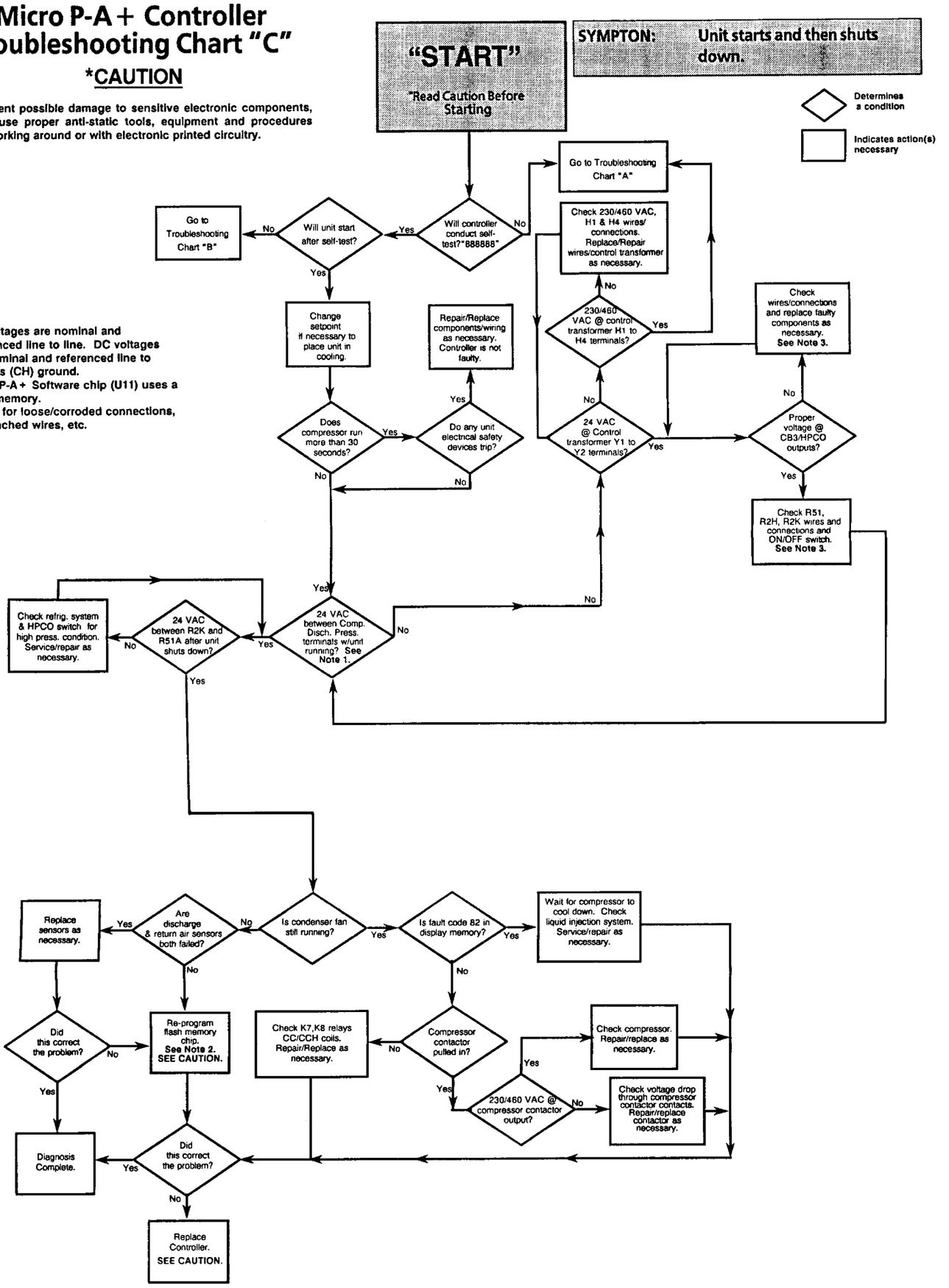
Notes:

1. AC voltages are nominal and referenced line to line.
   DC voltages are nominal and referenced line to chassis (CH) ground.
2. Micro P-A+ Software chip (U11) uses flash memory.
3. Check for loose/corroded connections, cut/pinched wires, etc.

CF-II Container
Micro P-A+ Controller
Troubleshooting Chart "C"

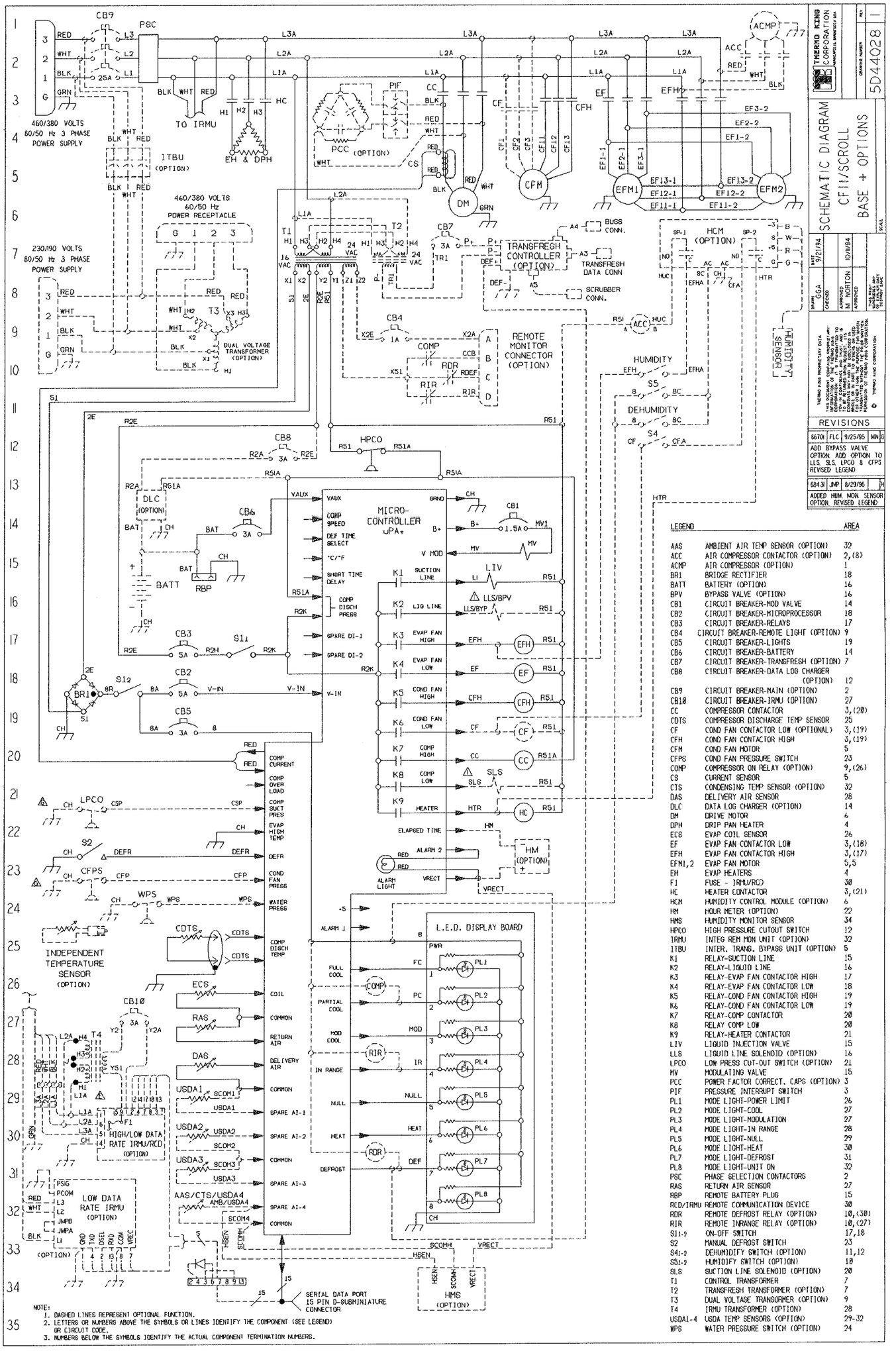
*CAUTION

To prevent possible damage to sensitive electronic components, always use proper anti-static tools, equipment and procedures when working around or with electronic printed circuitry.



Notes:

1. **AC voltages are nominal and referenced line to line. DC voltages are nominal and referenced line to chassis (CH) ground.**
2. **Micro P-A+ Software chip (U11) uses a flash memory.**
3. **Check for loose/corroded connections, cut/pinched wires, etc.**



THERMO KING CORPORATION
DRAWING NUMBER 5D44028
REV 1

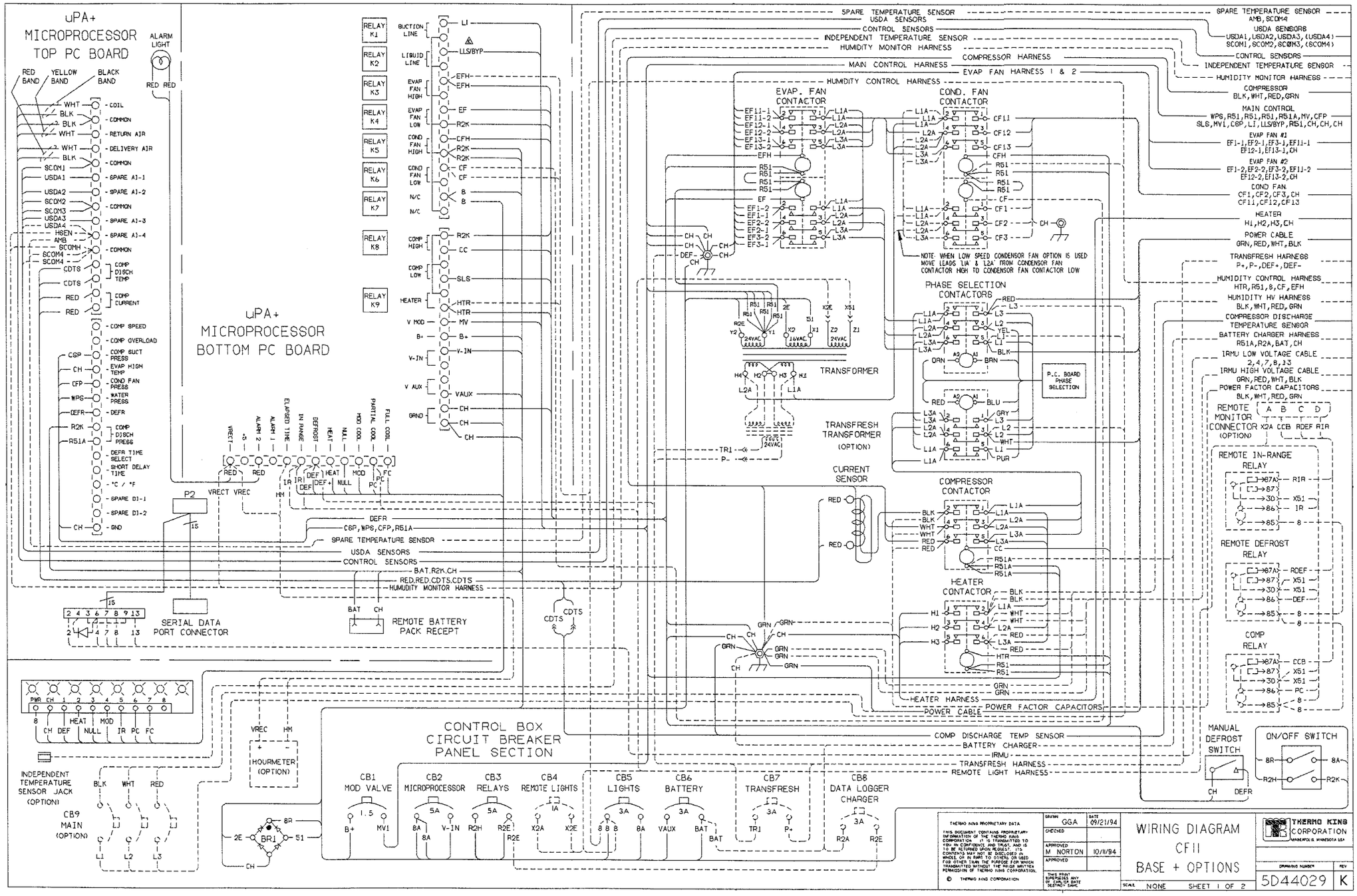
SCHEMATIC DIAGRAM
CF11/SCROLL
BASE + OPTIONS

DRAWN GGA 9/21/94
CHECKED
APPROVED M. NORTON 10/1/94
APPROVED

REVISIONS

6670	FLC	9/25/95	MN 6
ADD BYPASS VALVE OPTION ADD OPTION TO LLS SLS LPCO & CPFS REVISED LEGEND			
6843	JMP	8/29/96	H
ADDED HUM MON SENSOR OPTION, REVISED LEGEND			

LEGEND		AREA
AAS	AMBIENT AIR TEMP SENSOR (OPTION)	32
ACC	AIR COMPRESSOR CONTACTOR (OPTION)	2,(8)
ACMP	AIR COMPRESSOR (OPTION)	1
BR1	BRIDGE RECTIFIER	18
BATT	BATTERY (OPTION)	16
BPV	BYPASS VALVE (OPTION)	16
CB1	CIRCUIT BREAKER-MOD VALVE	14
CB2	CIRCUIT BREAKER-MICROPROCESSOR	18
CB3	CIRCUIT BREAKER-RELAYS	17
CB4	CIRCUIT BREAKER-REMOTE LIGHT (OPTION)	9
CB5	CIRCUIT BREAKER-LIGHTS	19
CB6	CIRCUIT BREAKER-BATTERY	14
CB7	CIRCUIT BREAKER-TRANSFRESH (OPTION)	7
CB8	CIRCUIT BREAKER-DATA LOG CHARGER (OPTION)	12
CB9	CIRCUIT BREAKER-MAIN (OPTION)	2
CB10	CIRCUIT BREAKER-IRMU (OPTION)	27
CC	COMPRESSOR CONTACTOR	3,(20)
CDTS	COMPRESSOR DISCHARGE TEMP SENSOR	25
CF	COND FAN CONTACTOR LOW (OPTIONAL)	3,(19)
CFH	COND FAN CONTACTOR HIGH	3,(19)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	23
COMP	COMPRESSOR ON RELAY (OPTION)	9,(26)
CS	CURRENT SENSOR	5
CTS	CONDENSING TEMP SENSOR (OPTION)	32
DAS	DELIVERY AIR SENSOR	28
DLC	DATA LOG CHARGER (OPTION)	14
DM	DRIVE MOTOR	4
DPH	DRIP PAN HEATER	4
ECS	EVAP COIL SENSOR	26
EF	EVAP FAN CONTACTOR LOW	3,(18)
EFH	EVAP FAN CONTACTOR HIGH	3,(17)
EFM1,2	EVAP FAN MOTOR	5,5
EH	EVAP HEATERS	4
F1	FUSE - IRMU/RCD	30
HC	HEATER CONTACTOR	3,(21)
HCM	HUMIDITY CONTROL MODULE (OPTION)	6
HM	HOUR METER (OPTION)	22
HMS	HUMIDITY MONITOR SENSOR	34
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTEG REM MON UNIT (OPTION)	32
ITBU	INTER. TRANS. BYPASS UNIT (OPTION)	5
K1	RELAY-SUCTION LINE	15
K2	RELAY-LIQUID LINE	16
K3	RELAY-EVAP FAN CONTACTOR HIGH	17
K4	RELAY-EVAP FAN CONTACTOR LOW	18
K5	RELAY-COND FAN CONTACTOR HIGH	19
K6	RELAY-COND FAN CONTACTOR LOW	19
K7	RELAY-COMP CONTACTOR	20
K8	RELAY COMP LOW	20
K9	RELAY-HEATER CONTACTOR	21
LIV	LIQUID INJECTION VALVE	15
LLS	LIQUID LINE SOLENOID (OPTION)	16
LPCO	LOW PRESS CUT-OUT SWITCH (OPTION)	21
MV	MODULATING VALVE	15
PCC	POWER FACTOR CORRECT. CAPS (OPTION)	3
PIF	PRESSURE INTERRUPT SWITCH	3
PL1	MODE LIGHT-POWER LIMIT	26
PL2	MODE LIGHT-COOL	27
PL3	MODE LIGHT-MODULATION	27
PL4	MODE LIGHT-IN RANGE	28
PL5	MODE LIGHT-NULL	29
PL6	MODE LIGHT-HEAT	30
PL7	MODE LIGHT-DEFROST	31
PL8	MODE LIGHT-UNIT ON	32
PSC	PHASE SELECTION CONTACTORS	2
RAS	RETURN AIR SENSOR	27
RBP	REMOTE BATTERY PLUG	15
RCD/IRMU	REMOTE COMMUNICATION DEVICE	30
RDR	REMOTE DEFROST RELAY (OPTION)	10,(30)
RIR	REMOTE INRANGE RELAY (OPTION)	10,(27)
S11-2	ON-OFF SWITCH	17,18
S2	MANUAL DEFROST SWITCH	23
S41-2	DEHUMIDIFY SWITCH (OPTION)	11,12
S51-2	HUMIDIFY SWITCH (OPTION)	10
SLS	SUCTION LINE SOLENOID (OPTION)	20
T1	CONTROL TRANSFORMER	7
T2	TRANSFRESH TRANSFORMER (OPTION)	7
T3	DUAL VOLTAGE TRANSFORMER (OPTION)	9
T4	IRMU TRANSFORMER (OPTION)	28
USDA1-4	USDA TEMP SENSORS (OPTION)	29-32
WPS	WATER PRESSURE SWITCH (OPTION)	24


uPA+
MICROPROCESSOR
TOP PC BOARD
ALARM LIGHT
RED BAND
YELLOW BAND
BLACK BAND
COIL
COMMON
RETURN AIR
DELIVERY AIR
COMMON
SPARE A1-1
SPARE A1-2
COMMON
SPARE A1-3
SPARE A1-4
COMMON
COMP DISCH TEMP
COMP CURRENT
COMP SPEED
COMP OVERLOAD
COMP SUCT PRESS
EVAP HIGH TEMP
COND FAN PRESS
WATER PRESS
DEFR
COMP DISCH PRESS
DEFR TIME SELECT
SHORT DELAY TIME
°C / °F
SPARE DI-1
SPARE DI-2
GND
uPA+
MICROPROCESSOR
BOTTOM PC BOARD
RELAY K1
RELAY K2
RELAY K3
RELAY K4
RELAY K5
RELAY K6
RELAY K7
RELAY K8
RELAY K9
SUCTION LINE
LIQUID LINE
EVAP FAN HIGH
EVAP FAN LOW
COND FAN HIGH
COND FAN LOW
COMP HIGH
COMP LOW
HEATER
V MOD
V AUX
GND
LI
LLS/BYP
EFH
EF
R2K
CFH
CF
B
N/C
CC
SLS
HTR
MV
B+
V-IN
VAUX
CH
VRECT
ALARM 2
ALARM 1
ELAPSED TIME
IN RANGE
DEFROST
HEAT
NULL
MOD COOL
PARTIAL COOL
FULL COOL
P2
SERIAL DATA PORT CONNECTOR
REMOTE BATTERY PACK RECEPT
SPARE TEMPERATURE SENSOR
USDA SENSORS
CONTROL SENSORS
INDEPENDENT TEMPERATURE SENSOR
HUMIDITY MONITOR HARNESS
COMPRESSOR HARNESS
MAIN CONTROL HARNESS
EVAP FAN HARNESS 1 & 2
HUMIDITY CONTROL HARNESS
EVAP. FAN CONTACTOR
COND. FAN CONTACTOR
NOTE: WHEN LOW SPEED CONDENSOR FAN OPTION IS USED MOVE LEADS L1A & L2A FROM CONDENSOR FAN CONTACTOR HIGH TO CONDENSOR FAN CONTACTOR LOW
PHASE SELECTION CONTACTORS
TRANSFORMER
TRANSFRESH TRANSFORMER (OPTION)
P.C. BOARD PHASE SELECTION
CURRENT SENSOR
COMPRESSOR CONTACTOR
HEATER CONTACTOR
SPARE TEMPERATURE SENSOR AMB, SCOM4
USDA SENSORS USDA1, USDA2, USDA3, (USDA4) SCOM1, SCOM2, SCOM3, (SCOM4)
CONTROL SENSORS
INDEPENDENT TEMPERATURE SENSOR
HUMIDITY MONITOR HARNESS
COMPRESSOR BLK, WHT, RED, GRN
MAIN CONTROL WPS, R51, R51, R51, R51A, MV, CFP SLS, MV1, C6P, LI, LLS/BYP, RS1, CH, CH, CH
EVAP FAN #1 EF1-1, EF2-1, EF3-1, EF11-1 EF12-1, EF13-1, CH
EVAP FAN #2 EF1-2, EF2-2, EF3-2, EF11-2 EF12-2, EF13-2, CH
COND FAN CF1, CF2, CF3, CH CF11, CF12, CF13
HEATER H1, H2, H3, CH
POWER CABLE GRN, RED, WHT, BLK
TRANSFRESH HARNESS P+, P-, DEF+, DEF-
HUMIDITY CONTROL HARNESS HTR, RS1, 8, CF, EFH
HUMIDITY HV HARNESS BLK, WHT, RED, GRN
COMPRESSOR DISCHARGE TEMPERATURE SENSOR
BATTERY CHARGER HARNESS R51A, R2A, BAT, CH
IRMU LOW VOLTAGE CABLE 2, 4, 7, 8, 13
IRMU HIGH VOLTAGE CABLE GRN, RED, WHT, BLK
POWER FACTOR CAPACITORS BLK, WHT, RED, GRN
REMOTE MONITOR CONNECTOR X2A CCB RDEF R1R (OPTION)
REMOTE IN-RANGE RELAY
REMOTE DEFROST RELAY
COMP RELAY
CONTROL BOX CIRCUIT BREAKER PANEL SECTION
CB1 MOD VALVE 1.5
CB2 MICROPROCESSOR 5A
CB3 RELAYS 5A
CB4 REMOTE LIGHTS 1A
CB5 LIGHTS 3A
CB6 BATTERY 3A
CB7 TRANSFRESH 3A
CB8 DATA LOGGER CHARGER 3A
CB9 MAIN (OPTION)
INDEPENDENT TEMPERATURE SENSOR JACK (OPTION)
HOURMETER (OPTION)
BR1
MANUAL DEFROST SWITCH
ON/OFF SWITCH
COMP DISCHARGE TEMP SENSOR
BATTERY CHARGER
IRMU
TRANSFRESH HARNESS
REMOTE LIGHT HARNESS
HEATER HARNESS
POWER CABLE
POWER FACTOR CAPACITORS
DEFR
CSP, WPS, CFP, RS1A
SPARE TEMPERATURE SENSOR
USDA SENSORS
CONTROL SENSORS
BAT, R2K, CH
RED, RED, CDTS, CDTS
HUMUDITY MONITOR HARNESS
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CF11
BASE + OPTIONS
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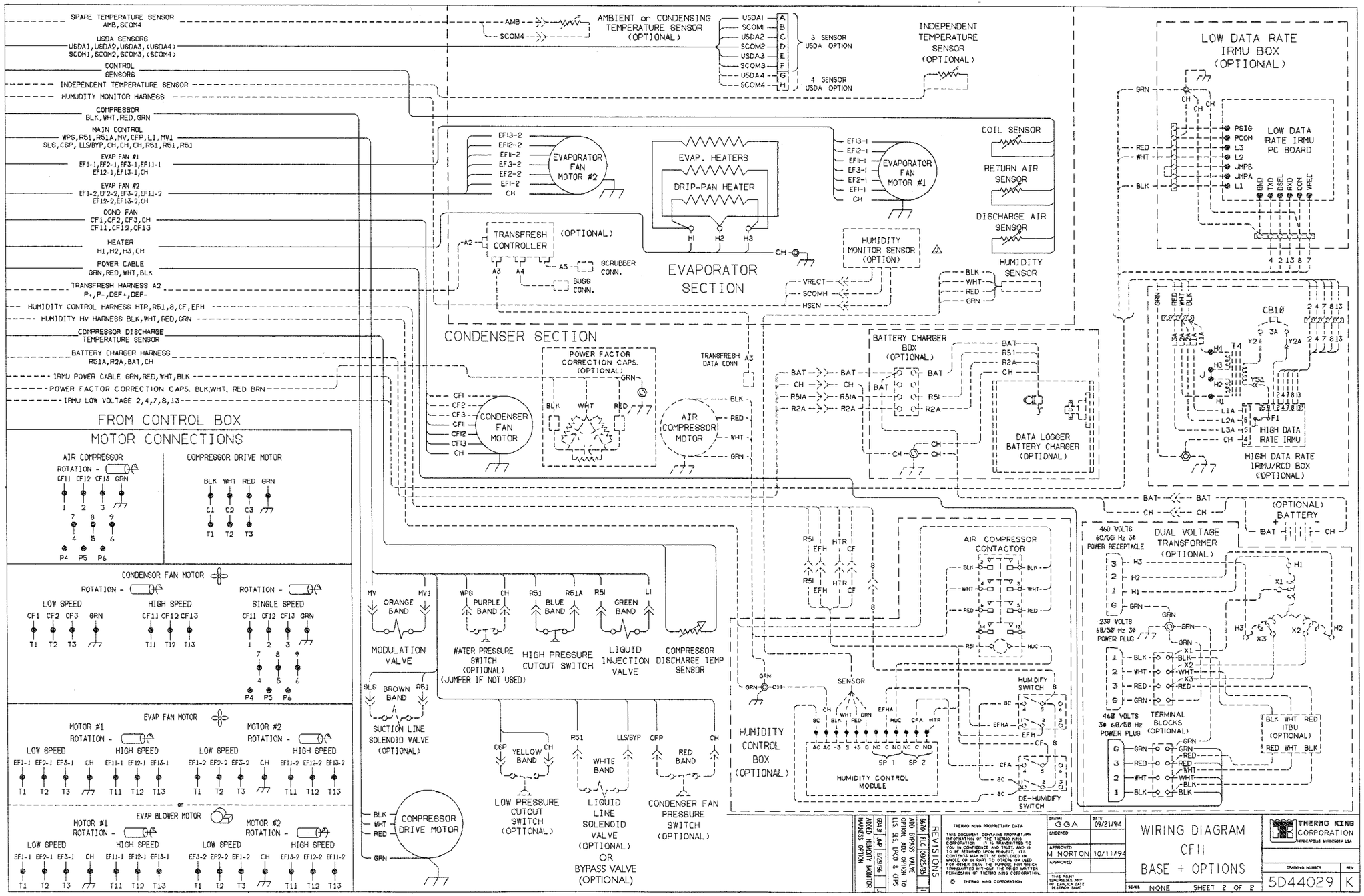
DRAWING NUMBER 5D44029
REV K


SPARE TEMPERATURE SENSOR AMB,SCOM4
USDA SENSORS USDA1,USDA2,USDA3,(USDA4) SCOM1,SCOM2,SCOM3,(SCOM4)
CONTROL SENSORS
INDEPENDENT TEMPERATURE SENSOR
HUMUDITY MONITOR HARNESS
COMPRESSOR BLK,WHT,RED,GRN
MAIN CONTROL WPS,RS1,RS1A,MV,CFP,LI,MV1 SLS,CSP, LLS/BYP,CH,CH,CH,RS1,RS1,RS1
EVAP FAN #1 EF1-1,EF2-1,EF3-1,EF11-1 EF12-1,EF13-1,CH
EVAP FAN #2 EF1-2,EF2-2,EF3-2,EF11-2 EF12-2,EF13-2,CH
COND FAN CF1,CF2,CF3,CH CF11,CF12,CF13
HEATER H1,H2,H3,CH
POWER CABLE GRN,RED,WHT,BLK
TRANSFRESH HARNESS A2 P+,P-,DEF+,DEF-
HUMIDITY CONTROL HARNESS HTR,RS1,8,CF,EFH
HUMIDITY HV HARNESS BLK,WHT,RED,GRN
COMPRESSOR DISCHARGE TEMPERATURE SENSOR
BATTERY CHARGER HARNESS RS1A,R2A,BAT,CH
IRMU POWER CABLE GRN,RED,WHT,BLK
POWER FACTOR CORRECTION CAPS. BLK,WHT, RED BRN
IRMU LOW VOLTAGE 2,4,7,8,13
FROM CONTROL BOX
MOTOR CONNECTIONS
AIR COMPRESSOR
ROTATION -
CF11 CF12 CF13 GRN
1 2 3 7 8 9 4 5 6
P4 P5 P6
COMPRESSOR DRIVE MOTOR
BLK WHT RED GRN
C1 C2 C3
T1 T2 T3
CONDENSOR FAN MOTOR
ROTATION -
LOW SPEED
CF1 CF2 CF3 GRN
T1 T2 T3
HIGH SPEED
CF11 CF12 CF13
T11 T12 T13
SINGLE SPEED
CF11 CF12 CF13 GRN
1 2 3 7 8 9 4 5 6
P4 P5 P6
EVAP FAN MOTOR
MOTOR #1
MOTOR #2
EF1-1 EF2-1 EF3-1 CH EF11-1 EF12-1 EF13-1
EF1-2 EF2-2 EF3-2 CH EF11-2 EF12-2 EF13-2
T1 T2 T3 T11 T12 T13
or
EVAP BLOWER MOTOR
AMB
SCOM4
AMBIENT or CONDENSING TEMPERATURE SENSOR (OPTIONAL)
USDA1 SCOM1 USDA2 SCOM2 USDA3 SCOM3 USDA4 SCOM4
A B C D E F G H
3 SENSOR USDA OPTION
4 SENSOR USDA OPTION
INDEPENDENT TEMPERATURE SENSOR (OPTIONAL)
EVAPORATOR SECTION
EVAPORATOR FAN MOTOR #2
EF13-2 EF12-2 EF11-2 EF3-2 EF2-2 EF1-2 CH
EVAP. HEATERS
DRIP-PAN HEATER
H1 H2 H3 CH
EVAPORATOR FAN MOTOR #1
EF13-1 EF12-1 EF11-1 EF3-1 EF2-1 EF1-1 CH
COIL SENSOR
RETURN AIR SENSOR
DISCHARGE AIR SENSOR
HUMIDITY SENSOR
BLK WHT RED GRN
TRANSFRESH CONTROLLER (OPTIONAL)
A2 A3 A4 A5
SCRUBBER CONN.
BUSS CONN.
HUMIDITY MONITOR SENSOR (OPTION)
VRECT SCOMH HSEN
CONDENSER SECTION
CONDENSER FAN MOTOR
CF1 CF2 CF3 CF11 CF12 CF13 CH
POWER FACTOR CORRECTION CAPS. (OPTIONAL)
BLK WHT RED GRN
TRANSFRESH DATA CONN A3
AIR COMPRESSOR MOTOR
BLK RED WHT GRN
BATTERY CHARGER BOX (OPTIONAL)
BAT R51 R2A CH R51A
DATA LOGGER BATTERY CHARGER (OPTIONAL)
LOW DATA RATE IRMU BOX (OPTIONAL)
GRN RED WHT BLK
CH
LOW DATA RATE IRMU PC BOARD
PSIG PCOM L3 L2 JMPB JMPA L1
GND TXD DSEL RXD COM VREC
4 2 13 8 7
CB10
3A
T4
Y2
Y2A
Y5
F1
HIGH DATA RATE IRMU
HIGH DATA RATE IRMU/RCD BOX (OPTIONAL)
MODULATION VALVE
MV MV1
ORANGE BAND
WATER PRESSURE SWITCH (OPTIONAL) (JUMPER IF NOT USED)
WPS PURPLE BAND CH
HIGH PRESSURE CUTOUT SWITCH
RS1 RS1A BLUE BAND
LIQUID INJECTION VALVE
RS1 LI GREEN BAND
COMPRESSOR DISCHARGE TEMP SENSOR
SUCTION LINE SOLENOID VALVE (OPTIONAL)
SLS BROWN BAND RS1
COMPRESSOR DRIVE MOTOR
BLK WHT RED GRN
LOW PRESSURE CUTOUT SWITCH (OPTIONAL)
CSP YELLOW BAND CH
LIQUID LINE SOLENOID VALVE (OPTIONAL) OR BYPASS VALVE (OPTIONAL)
RS1 LLS/BYP WHITE BAND
CONDENSER FAN PRESSURE SWITCH (OPTIONAL)
CFP RED BAND CH
AIR COMPRESSOR CONTACTOR
R5I EFH HTR CF
HUMIDITY CONTROL BOX (OPTIONAL)
SENSOR
HUMIDITY CONTROL MODULE
AC AC -3 S +5 G NC C NO NC C NO
SP 1 SP 2
HUMIDIFY SWITCH
DE-HUMIDIFY SWITCH
EFHA HUC CFA HTR
460 VOLTS 60/50 Hz 3Ø POWER RECEPTACLE
230 VOLTS 60/50 Hz 3Ø POWER PLUG
460 VOLTS 3Ø 60/50 Hz POWER PLUG
DUAL VOLTAGE TRANSFORMER (OPTIONAL)
H1 H2 H3 X1 X2 X3
TERMINAL BLOCKS (OPTIONAL)
BLK WHT RED ITBU (OPTIONAL)
(OPTIONAL) BATTERY
REVISIONS
6670 FIC 09/25/95 ADD BYPASS VALVE OPTION, ADD OPTION TO LLS, SLS, LPCO & CFPS
6843 AAP 8/29/96 ADDED HUMIDITY MONITOR HARNESS OPTION
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