CF-II M32 & M32A
Prepared for OOCL

TK 40299-2 (2-92)

The maintenance information in this manual covers unit models:

CF-II M32 (090.155)
CF-II M32A (090.170)

For further information refer to ...

Refrigeration Systems	**TK 5715**
X426 & X430 Compressor Overhaul	**TK 6875**
Tool Catalog	**TK 5955**
Parts Manual	**TK 40260**

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

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Recover Refrigerant

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

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

Safety Precautions

GENERAL PRACTICES

1. ALWAYS WEAR GOGGLES OR SAFETY GLASSES. Refrigerant liquid and battery acid can permanently damage the eyes (see First Aid).
2. Never close the compressor discharge valve with the unit in operation. Never operate the unit with the discharge valve closed.
3. Keep your hands, clothing and tools clear of the fans when the refrigeration unit is running. If it is necessary to run the refrigeration unit with covers removed, be very careful with tools or meters being used in the area.
4. Be sure gauge manifold hoses are in good condition. Never let them come in contact with a fan motor blade, or any hot surface.
5. Never apply heat to a sealed refrigeration system or container.
6. Fluorocarbon refrigerants, in the presence of an open flame or electrical arc, produce toxic gases that are severe respiratory irritants capable of causing death.
7. Be sure all mounting bolts are tight and are of 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, and holes drilled into the refrigeration system may release refrigerant.
9. Use caution when working around exposed coil fins. Painful laceration can be inflicted from the fins.
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, objectives of First Aid are to protect the frozen area from further injury, to warm the affected area rapidly and to maintain respiration.

1. Cover the frozen part.
2. Provide extra clothing and blankets.
3. Give the victim a warm drink (not alcohol).
4. Warm the frozen part quickly by immersing it in water that is warm, NOT HOT.
5. If warm water is not available or practical to use, wrap the affected part gently in a sheet and warm blankets.
6. If refrigerant contacts the eyes, flush them immediately with water.
7. Obtain medical assistance as soon as possible.

REFRIGERATION OIL

Avoid refrigeration oil contact with the eyes. Avoid prolonged or repeated contact of refrigeration oil with skin or clothing. Wash thoroughly after handling refrigeration oil to prevent irritation.

First Aid

In case of eye contact, immediately flush with plenty of water for at least 15 minutes. Wash skin with soap and water. Obtain medical assistance as soon as possible.

ELECTRICAL

Microprocessor Controller Calibration and Repair

When servicing the controller, it is necessary to ensure that electrostatic discharges to the controller are avoided. Potential differences considerably 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.

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. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
4. 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.
5. 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.

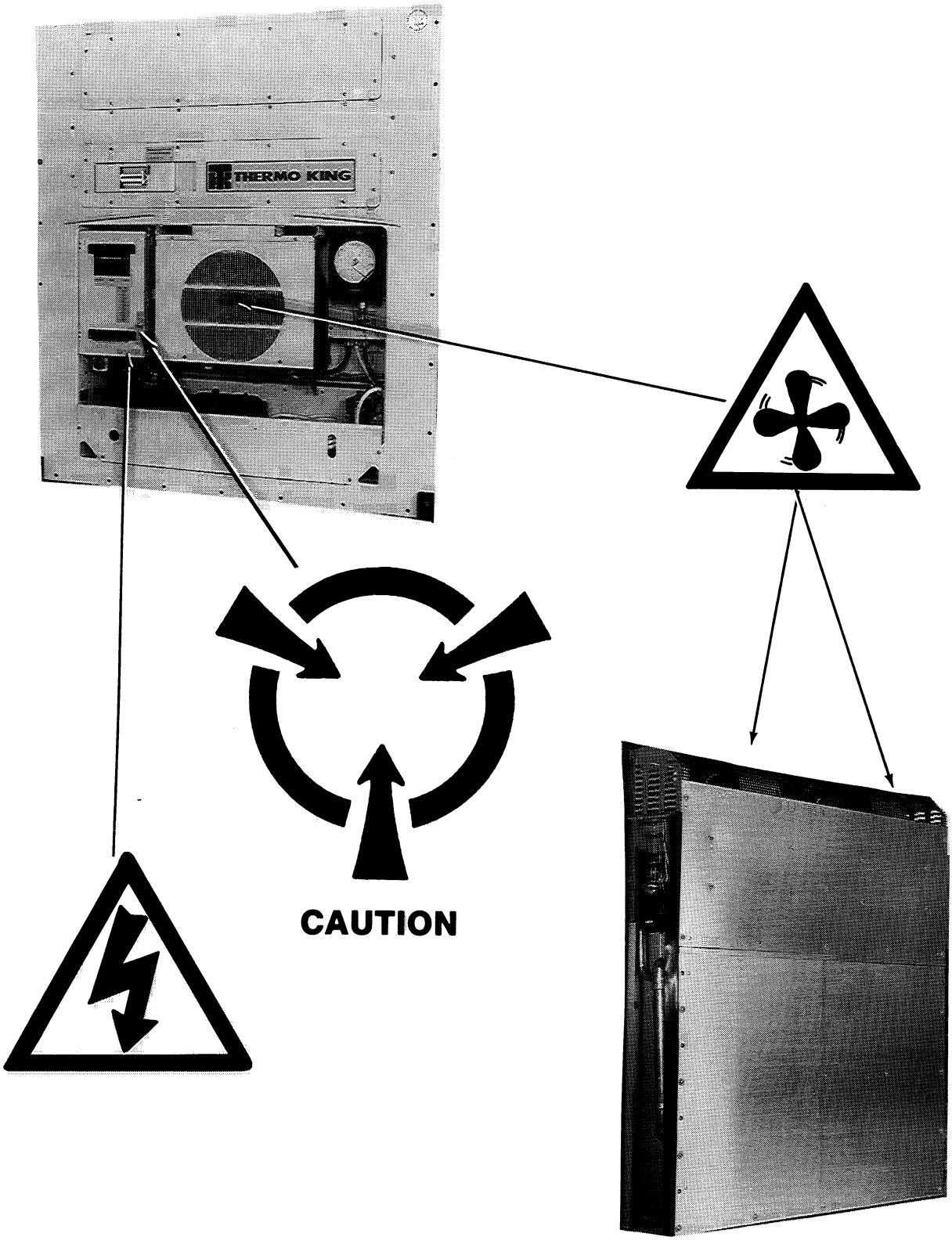
The source of shock must be immediately removed by either shutting down the power or removing the victim from the source. If it is not possible to shut off the power, the wire should be cut with either an insulated instrument (e.g., a wooden handled axe or cable cutters with heavy insulated handles) or 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 their body. After separating the victim and power source, check immediately for presence of 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 mouth-to-mouth resuscitation, but call for emergency medical assistance.

Low Voltage

Control circuits utilized by the refrigeration unit are low voltage (24V ac and 12V dc). 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.


THERMO KING
CAUTION

CF-II M32 and CF-II M32A Unit Comparison

The CF-II M32 and CF-II M32A are identical except for the following:

Unit Feature	CF-II M32	CF-II M32A
1. Improved copper tubing process treatment including pigmented gray color water borne lacquer finish on condenser side tubing.	No	Yes
2. Improved receiver tank process treatment.	No	Yes
3. Additional support bracket for suction line and modulation valve assembly	No	Yes
4. Compressor	X426 Compressor	X430 Compressor
Compressor part difference list:		
Compressor Assembly	102-327	102-380
Compressor Body	23-122	23-129
Piston	22-476	22-662
Bolt, Connecting Rod	55-1682	55-5062
Sleeve, Cylinder	22-297	22-656
Oil Pump Housing (new)	22-554	22-663
Oil Pump Housing (remanufactured)	822-554	822-663
Oil Pump Gasket	33-110	33-1549
O-ring, Pickup Tube	33-574	33-2205
Plug,-Metering Oil	22-763	22-123
Crankshaft	22-586	22-655
Seal Assembly, Crankshaft	22-746	22-378
Screw, Mounting Plate	55-2683	55-529
Nut, Valve Cage	55-5696	55-285
Plug, Pipe (Manifold)	55-3158	55-3364

Specifications

CF-II M32 Cooling Capacity

Full Cool Operation Net Cooling Capacity*

Return air to evaporator coil inlet	230V/460V, 3 Phase, 60 Hz Power					190V/380V, 3 Phase, 50 Hz Power				
	Net Cooling Capacity Btu/hr (Kcal/hr)		Power Consump** Amps		KW	Net Cooling Capacity Btu/hr (Kcal/hr)		Power Consump** Amps		KW
Full Cool Operation			**230V**	**460V**				**190V**	**380V**	
70 F (21.1 C)	45,000	(11,340)	36.4	18.2	12.0	38,000	(9,576)	38.0	20.0	9.8
35 F (1.7 C)	28,000	(7,056)	32.0	16.0	8.9	25,000	(6,300)	30.0	17.0	6.7
0 F (-17.8 C)	16,000	(4,032)	22.9	11.5	5.0	13,000	(3,503)	20.0	12.0	4.8

**System net cooling capacity with a 100 F (37.8 C) ambient air temperature.*

***Power consumption in the modulation mode decreases to a minimum of 4.5 kw on 230V power and 3.4 kw on 190V power*

CF-II M32A Cooling Capacity

Full Cool Operation Net Cooling Capacity*

Return air to evaporator coil inlet	230V/460V, 3 Phase, 60 Hz Power					190V/380V, 3 Phase, 50 Hz Power				
	Net Cooling Capacity Btu/hr (Kcal/hr)		Power Consump Amps		KW	Net Cooling Capacity Btu/hr (Kcal/hr)		Power Consump Amps		KW
Full Cool Operation			**230V**	**460V**				**190V**	**380V**	
70 F (21.1 C)	40,500	(10,200)	38.5	19.3	12.0	34,000	(8,568)	35.7	17.8	9.8
35 F (1.7 C)	32,000	(8,064)	35.9	18.0	8.9	28,000	(7,056)	33.2	16.6	6.7
0 F (-17.8 C)	18,000	(4,530)	24.7	12.4	5.0	15,000	(3,780)	23.2	11.6	4.8
Power Draw at Full Modulation			19.0	9.5	4.5			17.4	8.7	3.4

**System net cooling capacity with a 100 F (37.8 C) ambient air temperature.*

CF-II M32 & M32A

System Net Heating Capacity

Heater Type (location)	Quantity	230V/460V, 3 Phase, 60 Hz Power			190V/380V, 3 Phase, 50 Hz Power		
		Watts (total)	Heating Capacity Btu/hr (Kcal/hr)		Watts (total)	Heating Capacity 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 fan 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 fan motors and blowers are shut off.*

Evaporator Airflow

External Static Pressure (water column)	230V/460V, 3 Phase, 60 Hz Power		190V/380V, 3 Phase, 50 Hz Power	
	High Speed ft ^{3}/min (m^3/hr)	Low Speed ft ^{3}/min (m^3/hr)	High Speed ft ^{3}/min (m^3/hr)	Low Speed 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.: CF-II M32	Model X426
CF-II M32A	Model X430
Refrigerant Charge	14 lb. (6.35 Kg) R-12
Compressor Oil Capacity	4 qts 6 oz. (3.96 liter)
Compressor Oil Type (types may be mixed)	Synthetic Type 67-404 (recommended)
	Petroleum Type 67-426
High Pressure Cutout Switch: Cutout	300 $^{+25}_{-0}$ psi (2068 $^{+172}_{-0}$ kPa)
Cut-in	200 ±20 psi (1379 ±138 kPa)
Condenser Fan Speed Pressure Switch: Open	200 ±7 psi (1379 ±48 kPa)
Close	160 ±7 psi (1103 ±48 kPa)
Expansion Valve: Super Heat	6 F @0 F (3.4 C @-17.8 C)
High Pressure Relief Valve: Relief Pressure	500 ±50 psi (3447 ±345 kPa)
Reset	400 psi (2758 kPa)

Electrical System

Compressor Motor: Type	230-190V, 60/50 Hz, 3 Phase
Horsepower	10 hp — 60 Hz
	8.33 hp — 50 Hz
Rpm	1765 rpm — 60 Hz
	1465 rpm — 50 Hz
Full Load Amps	29.6 amps — 230V, 60 Hz
	29.4 amps — 190V, 50 Hz
Locked Rotor Amps	198 amps — 230V, 60 Hz
	180 amps — 190V, 50 Hz
Condenser Fan Motor: Type	230-190V/3 Ph/60-50 Hz
Horsepower	1.0 hp — 60 Hz High Speed
	0.25 hp — 60 Hz, Low Speed
Rpm	1725 — 60 Hz, High Speed
	1140 — 60 Hz, Low Speed
Full Load Amps	3.4 amps — 230V, 60 Hz, High Speed
	1.9 amps — 230V, 60 Hz, Low Speed
Locked Rotor Amps	23.6 amps — 230V, 60 Hz, High Speed
	11.2 amps — 230V, 60 Hz, Low Speed
Evaporator Blower Motors: Type	230-190V/3 Ph/60-50 Hz
Number	2
Horsepower	1.0 hp, High Speed
	0.25 hp, 60 Hz, Low Speed
Rpm	3450 — 60 Hz, High Speed
	1725 — 60 Hz, Low Speed
Full Load Amps	3.2 amps — 230V, 60 Hz, High Speed
	1.6 amps — 230V, 60 Hz, Low Speed
Locked Rotor Amps	23.0 amps — 230V, 60 Hz, High Speed
	9 amps — 230V, 60 Hz, Low Speed

Modulating Valve Solenoid: Current Draw	0 to 3 volts (0 to 0.4 amp) valve open 3 to 7.5 volts (0.4 to 1.0 amp) valve modulates to close Above 7.5 volts (1.0 amp) valve closed 1.5 amp maximum controller output to valve
Resistance	7.6 ohms
31-Day Recording Thermometer: Type	Partlow TRLW
Drive	Spring Wound

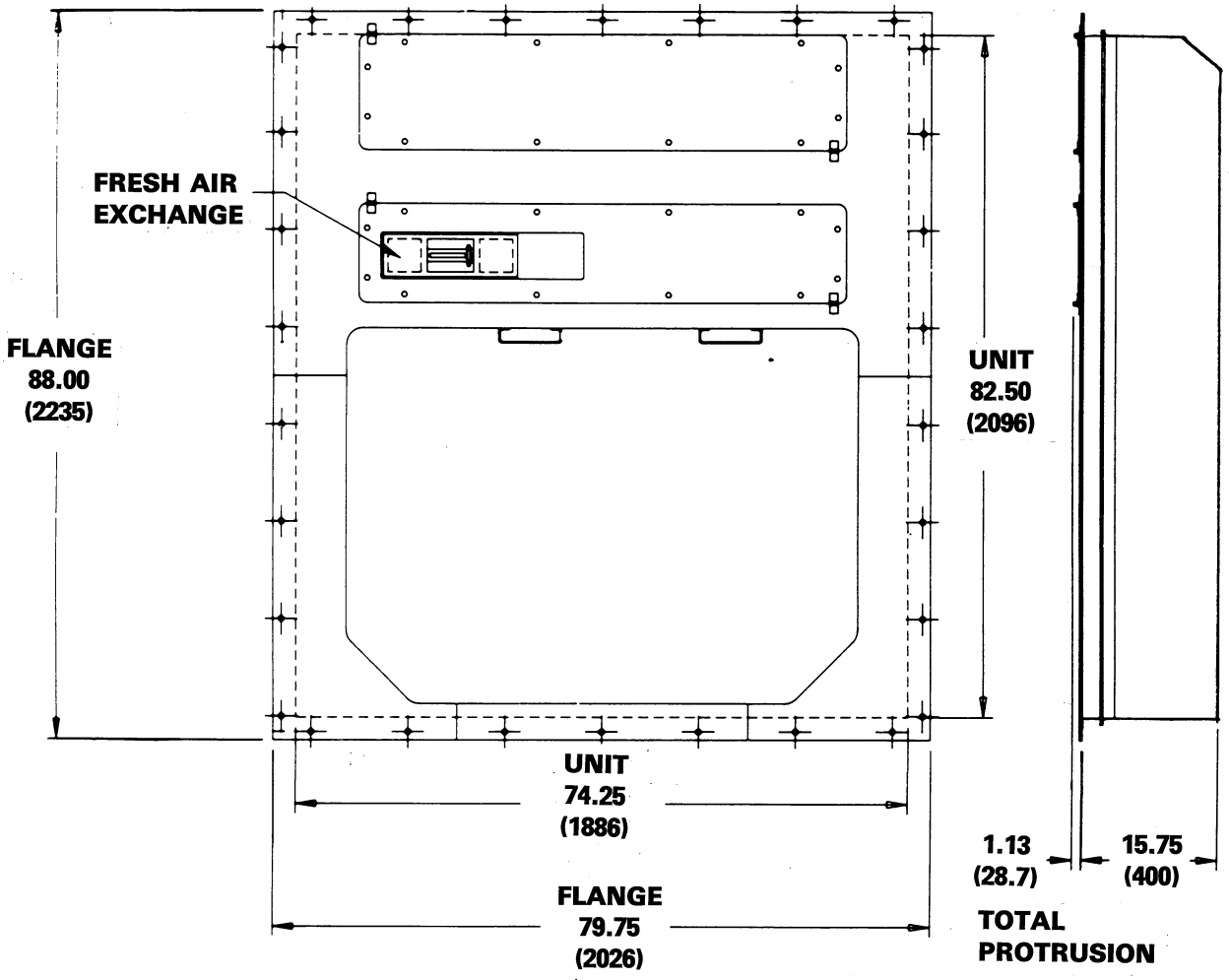
Thermoguard® Microprocessor "A"

Temperature Controller: Type	Electronic THERMOGUARD Microprocessor "A" with digital thermostat, thermometer and fault indicator monitor
Setpoint Range	-20.0 to +80.0 F (-30.0 to +30.0 C)
Digital Temperature Display	-40.0 to +99.9 F (-40.0 to +40.0 C)
Defrost Initiation: Coil Sensor	Coil must be below 45 F (7.2 C) to initiate defrost by demand, timer or manual switch
Demand Defrost: Return Air Above 24.0 F (-4.4 C)	Microprocessor initiates defrost based on the difference between the evaporator coil temperature and the return air temperature
Return Air Below 24.0 F (-4.4 C)	Microprocessor initiates defrost based on the difference between the discharge air temperature and the return air temperature
Internal Defrost Timer: Temperature Pulldown	4 hour intervals (factory programmed)
Temperature In-range	6 hour intervals
Defrost Termination: Coil Sensor	Terminates defrost with coil temperature above 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	Opens heater contactor at 100 F (38 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)	1235 lb. (561 Kg)

Unit Dimensions: Inches (Millimeters)



STANDARD HARDWARE TORQUE CHART

Screw Type - Grade	Screw Size-Thread													
	4-40	6-32	8-32	10-32	1/4-20	5/16-18	3/8-16	7/16-14	1/2-13	9/16-12	5/8-11	3/4-10	7/8-9	1.0-8
HH - GR 2	(4-7)	(7-10)	(15-20)	(25-30)	4-7	9-12	15-20	26-30	40-50	60-75	80-100	130-165	180-230	260-335
HH - GR 5	(6-9)	(12-16)	(25-30)	(40-45)	7-10	15-20	30-35	45-55	65-85	95-120	130-170	220-280	350-450	500-650
HH - GR 8					10-13	20-25	35-45	55-75	90-115	130-165	170-265	310-410	490-640	760-980
HH- Brass	(4-7)	(7-10)	(15-20)	(25-30)	4-7	9-12	15-20	26-30	40-50	60-75	80-100	130-165	180-230	260-335
HH- SS (1)	(6-9)	(12-16)	(25-30)	(40-45)	7-10	15-20	30-35	45-55	65-85	95-120	130-170	220-280	350-450	500-650
Phil H - SZN	(4-7)	(7-10)	(15-20)	(25-30)	4-7									
Phil H - SS (1)	(6-9)	(12-16)	(25-30)	(40-45)	7-10									
HHTC - SS (1)	(6-9)	(12-16)	(25-30)	(40-45)										
HHTC - SZN	(10-13)	(20-25)	(35-40)	(55-60)										
HHSM - SS (1)	(6-9)	(12-16)	(25-30)	(40-45)										
HHSM - SZN	(10-13)	(20-25)	(35-40)	(55-60)										
Allen - SS (1)	(6-9)	(12-16)	(25-30)	(40-45)	7-10	15-20	30-35	45-55	65-85					
Allen - Bl Ox	(15-18)	(25-30)	(50-60)	(75-85)	15-20	30-35	50-60	85-95	135-150					
Set - SS (1)	(4-7)	(7-10)	(15-20)	(25-30)	4-7	9-12								
Set - SZN	(6-9)	(12-16)	(25-30)	(40-45)	7-10	15-20								
Cagenut (2) - All	(4-7)	(7-10)	(5-20)	(25-30)	4-7	9-12								

Comments:
(1) Use Never Seize on all SS hardware
(2) Use lower valve torque (cage nut vs screw)

Torque in ft-lb (in-lb)
Torque, T = L x F
L - Length of lever
F - Force, in pounds

METRIC HARDWARE

Screw Type-Class	M6	M8	M10	M12	M14	M16	M18	M22
HH - CL 5.8	4-7	9-12	20-25	35-40	55-65	85-100	130-160	250-300
HH - CL 8.8	7-10	15-20	30-35	55-65	85-100	130-160	200-250	350-450
HH - CL 10.9	10-13	20-25	40-50	75-90	100-130	180-220	290-350	500-600
HH - CL 12.9	12-16	30-35	50-60	90-110	130-160	210-260	330-400	650-750
HH - SS (2)	7-10	15-20	30-35	55-65	85-100	130-160	200-250	350-450

COMMENTS:
Use Never Seize on all SS hardware

LEGEND
Torque in-ft (in.-lb)

BRS - Brass	HHTC- HH Thread Cutting
Bl Ox - Black Oxide (coated)	Phil H- Phillips Head
HH - Hex Head	SS - Stainless Steel
HHSM - HH Sheet Metal	SZN - Steel, Zinc-plated

COMPRESSOR TORQUE CHART

Location of Screw	Dia.	THREAD SIZE Pitch	Length	TORQUE In. lb	Ft. lb	Kgm	N·m	Part No.	Req.
Cylinder Head	3/8	16	2-1/2	275	23	3.18	31.8	55-1993	8
Cylinder Head	3/8	16	1-7/8	275	23	3.18	31.8	55-878	12
Check Valve Oil Return Assy.				24	2	.27	2.7	55-4281	1
Check Valve Oil Return Install.				326	28	3.8	38	22-566	5
Connecting Rod Nut	5/16	24		300	25	3.46	34.6	55-1681	8
Drive Bearing Plate	3/8	16	1-1/8	275	23	3.18	31.8	55-2306	9
Drive Coupling Mtg.	3/8	16	3		40/50	5.4/6.8	54-68	55-3546	1
Indicator Liquid								22-350	
Manifold	3/8	16	1-5/8	275	23	3.18	31.8	55-2306	4
Oil Drain Plug	5/8	18		450	37.5	5.08	50.8	55-4018	1
Oil Fill	1/2	13	1	450	37.5	5.08	50.8	55-1558	1
Oil Pick-up Tube Bracket	1/4	20	1/2	120	10	1.4	14.0	55-165	2
Oil Pressure Control	9/16	18		275	23	3.18	31.8	22-309	1
Oil Pump Housing	3/8	16	1-1/8	275	23	3.18	31.8	55-183	8
Oil Pump Cover	5/16	18	1-3/8	150	12	1.7	17.0	55-681	2
Oil Sump	3/8	16	1-1/4	275	23	3.18	31.8	55-1417	16
	3/8	16	3	275	23	3.18	31.8	55-4546	16
Piston Head Nut w/oil	5/16	24		130	11	1.52	15.2	55-318	4
Throttling Valve Body	3/8	16	1-1/8	275	23	3.18	31.8	55-2381	4
All other Bolts	5/16	18		150	12-1/2	1.7	17.0		A/R
All other Bolts	3/8	16		275	23	3.18	31.8		A/R

REFRIGERATION FLARE FITTINGS

Aluminum or Copper w/Brass Nut

TUBE	1/4	3/8	1/2	5/8	3/4
NUT (Thread)	(7/16)	(5/8)	(3/4)	(7/8)	(1-1/16)
Oiled	(12-15)	(25-30)	(25-30)	(35-40)	(45-50)
(1) Dry	(15-17)	(30-35)	(30-35)	(40-45)	(50-55)

COMMENTS:

(1) Refrigerant oil must be used on flare seat.

Torque in ft-lb (in-lb)

ELECTRICAL TERMINALS

Application	Screw Size #4	#6	#8	#10
General				
SZN, BRS, SS		(9-12)	(15-18)	(18-22)
Specials				
Toggle On/Off Switch		(7-11)		
Control Transformer			(9-12)	

Torque in ft-lb (in.-lb)

Service Guide

Inspect/Service these Items	Pre-Trip	Every 1,000 Hours	Annual/ Yearly
Electrical			
Check condenser fan and evaporator blower rotation.	●	●	●
Check defrost initiation and termination.	●	●	●
Check unit cycle sequence.	●	●	●
Check operation of protection shutdown circuits.		●	●
Check Microprocessor calibration.		●	●
Inspect electrical contacts.		●	●
Inspect wire harness for damaged wires or connections.		●	●
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.		●	●
Inspect and clean compressor drive motor housing		●	●
Grease compressor drive motor bearings.			*

* Although the motor bearings are sealed and do not require lubrication, Thermo King recommends adding grease to both bearing cavities every one to two years. Lubricating the bearings purges the old grease and contaminants (green water) from the grease cavities to maximize bearing life.

Unit Description

The Model CF-II M32 and M32A are an all-electric, one-piece, self-contained refrigeration units with bottom air discharge. The units are designed to cool and heat large containers for shipboard or overland transit. The units mount in the front wall of the container.

The CF-II M32 and M32A refrigeration units are equipped with two 60 ft. (18.3 m) power cords for operation on 460-380V/3PH/60-50 Hz power or 230-190V/3 PH/60- 50 Hz power. A 15 KVA autotransformer steps the 460-380V power down to 230-190V. The power cables are wired to a two-position power selector switch. The positions are identified as OFF, 220/230V AC and 380/460V AC. A power cable storage compartment is provided in the condenser section.

The units are equipped with 230-190V/3 Ph/60-50 Hz electric motors. An automatic phase correction system provides the proper electrical phase sequence for condenser fan and evaporator blower motor operation. The compressor can operate properly running in either direction.

Unit features include a Thermo King X426 compressor (CF-II M32), a Thermo King X430 compressor (CF-II M32A); two, two-speed evaporator blowers; an air exchange system; a two-speed condenser fan; sequential component start-up system; proportional-integral capacity control system; indicator lights; 31-day recording thermometer; remote monitor system; and THERMO-GUARD Microprocessor "A" temperature controller with discharge and return air temperature sensors and coil sensor to control, monitor and record unit operation.

Compressor

The CF-II M32 refrigeration unit includes a Thermo King X426 compressor while the CF-II M32A refrigeration unit includes the Thermo King X430 compressor. Both compressors feature a field repairable, four-cylinder, reciprocating "V" design. Each compressor is driven by a 10.0 horsepower, single speed electric motor with external overload protection.

Two-Speed Evaporator Blowers

Two, two-speed evaporator blowers provide high speed evaporator airflow at return air temperatures above 24.0 F (-4.4 C) for perishable cargo. At return air temperatures below 24.0 F (-4.4 C), the evaporator blowers run on low speed for forzen cargo.

Air Exchange System

The air exchange system removes harmful gases from containers carrying sensitive perishable commodities. The evaporator blowers draw in outside air through an air intake and discharge an equal amount of container air through an air outlet. An adjustable pre-calibrated vent door provides an air exchange rate of 0 to 150 cu ft/min (0 to 255 m^3/hr) at 0.5 in. (12.7 mm) water column external static pressure on high speed evaporator blower operation.

Two-Speed Condenser Fan

A two-speed condenser fan changes the rate of heat rejection from the air-cooled condenser coil to meet system demands and reduce noise level during Modulation. Low speed condenser fan operation is locked out during the full Cool mode.

When the compressor discharge pressure rises above 200 $\pm$7 psi (1379 $\pm$48 kPa), the condenser fan pressure switch opens and places the condenser fan motor on high speed. If the discharge pressure falls below 160 $\pm$7 psi (1103 $\pm$48 kPa), the switch closes. If the condenser fan pressure switch closes with the unit in Modulation, the Microprocessor places the condenser fan on low speed.

Sequential Component Start-up System

A sequence start of the required loads occurs during initial start-up of the Microprocessor Controller and when a control mode shift requires the compressor to start.

On initial Microprocessor start-up (unit On/Off switch in the On position), a one second delay occurs. The alarm light will flash to test the alarm light circuit before the display lights fill with 8's (88888 8888). Five seconds later, the setpoint and sensor temperature will be displayed, and the condenser fan and evaporator blower motors start.

The compressor motor starts three seconds after the fan motors start. During normal operation, the Microprocessor provides a three second delay in compressor startup whenever a mode shift requires compressor operation.

Proportional-integral Capacity Control System

At Microprocessor setpoints above 24.0 F (-4.4 C), a proportional-integral capacity control system uses a direct acting modulation solenoid valve to provide accurate control of the container temperature in direct response to load demand. The modulation valve is installed in the suction line and controls the amount of refrigerant returning to the compressor. The valve opens and closes in response to a Microprocessor output signal. The Microprocessor generates the output signal based on a control differential that is generated by considering the evaporator discharge air temperature, evaporator return air temperature, the Microprocessor setpoint and the rate of temperature pulldown.

Indicator Lights

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

The In-range LED is on when the return air sensor temperature is within (above or below) 3.0 F (1.7 C) of the Microprocessor setpoint. The Microprocessor inhibits the out-of-range alarm for 45 minutes during Defrost.

NOTE: The Microprocessor will not respond to an out-of-range condition for 45 minutes after the termination of a defrost cycle.

Recording Thermometer

A 31-day Partlow recording thermometer permanently records the temperature of the container on a pressure sensitive, eight inch, calibrated chart.

Remote Monitor Connector

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

THERMOGUARD Microprocessor "A" Temperature Controller

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

Two four-digit vacuum fluorescent displays indicate setpoint, discharge air, return air and coil sensor temperature; and fault indication. An alarm light adjacent to the fluorescent displays alerts personnel to a fault condition.

Setpoint input, temperature sensor display selection, and fault code indication are selected via an easy-to-operate keypad located at the bottom of the Microprocessor.

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 for setpoint adjustment, air temperature sensor selection, or alarm code display.

Controls all unit functions

The THERMOGUARD Microprocessor "A" automatically controls all unit functions including maximum power consumption, modulation valve position, evaporator blower motor speed, condenser fan motor operation, compressor operation, evaporator heaters, automatic defrost, and all indicator functions.

Data Recording

The THERMOGUARD Microprocessor Temperature Controller 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 up to 80 days.

Trip data can be retrieved (but not erased) from the Microprocessor memory using the THERMOGUARD MiniPac™ portable microcomputer. The microcomputer is connected to the built-in serial communications port on the front of the Microprocessor. A brief graphical or tabular report can be displayed on the MiniPac™ 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 MiniPac portable microcomputer. Identification data may include the date, container serial number, operator identification, point of origin, product, setpoint and other information up to a total of 80 characters (numerals or alphabetical letters).

Short Pre-trip Check

A basic pre-trip function cycles the unit through the cooling and heating operating modes. To initiate a Short pre-trip, enter the program menu by pressing the [SELECT] key. Then press the [UP] and [DOWN] arrow keys to scroll through the menu until you reach SPPP. Press the [SELECT] key and then the [ENTER] key. The unit operates in each mode for a fixed length of time. Any faults encountered during the pre-trip check will be noted and registered in the Microprocessor's fault indication memory.

NOTE: See "Pre-load Operation" under Operating Instructions for additional details on Microprocessor operation.

Long Pre-trip Check

The THERMOGUARD Microprocessor "A" performs five basic tests in preparation for extended trips. To initiate a Long Pre-trip, enter the program menu by pressing the [SELECT] key. Then press the [UP] and [DOWN] arrow keys to scroll through the menu until you reach LPPP. Press [SELECT] and then [ENTER]. LPPP 1 through LPPP 5 will be displayed as the unit operates in each of the five functional tests. Each test is conducted for a specific period of time. Any faults encountered will

be noted in the Microprocessor's fault indication memory. The tests with their time duration are:

1. HEATING CAPACITY TEST—6 minutes
2. DEFROST TEST—Within 10 minutes or 5.0 F (2.8 C) rise in temperature
3. COOLING CAPACITY TEST—HIGH SPEED EVAPORATOR FANS—8.5 minutes
4. COOLING CAPACITY TEST—LOW SPEED FANS—6 minutes
5. COOLING CAPACITY CONTROL TEST—3 minutes

NOTE: See "Pre-load Operation" under Operating Instructions for additional details on Microprocessor operation.

Fault Indication

The THERMOGUARD Microprocessor "A" fault indication monitor simplifies unit diagnosis and troubleshooting procedures. If a refrigeration system or Microprocessor fault occurs, the Alarm light blinks on and off. 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.

The codes are called to the display via keypad input and identify the following conditions:

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 R12/COMP MOTOR SHUTDOWN
38 CHECK LITHIUM BATTERY
39 E2PROM FAILURE
40 PUMPDOWN TERMINATED ON TIME LIMIT
42 PROGRAMMING FAULT
44 LOW VOLTAGE
88 CONTROLLER FAILURE

LONG 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

Power Monitor

A current transformer senses the compressor current draw and sends an input signal to the Microprocessor. When the current exceeds a predetermined threshold, the Microprocessor limits unit power consumption by sending an output signal to the modulation valve. The modulation valve closes and opens in response to the Microprocessor signal to restrict the flow of refrigerant to the compressor to limit the compressor drive motor current draw to the pre-selected threshold.

SEQUENCE OF OPERATION

Initial Unit Start-up

When the unit is turned on, the SETPOINT and TEMP/CODE displays fill with 8's after a one second display. Five seconds later, the setpoint and return air sensor temperature will be displayed. The Microprocessor relays and unit loads (except compressor contactor relay) will be energized when the setpoint and sensor temperature are displayed. If the Microprocessor calls for cooling, the compressor motor will start three seconds later (see description of "Sequential Component Start-up System," under Unit Description for more details).

NOTE: When the compressor is off, the modulation valve is closed. If the container temperature requires compressor start-up, the modulation valve opens gradually during a two minute interval until the valve is fully open or reaches the proper position based on the output signal from the Microprocessor Controller.

Microprocessor Setpoint Above 24.0 F (-4.4 C)

At setpoints above 24.0 F (-4.4 C), the Microprocessor operates the unit on Cool, Modulation Cool, Null, Heat and Defrost.

After unit start-up, the Microprocessor regulates the compressor, condenser fan motor, modulation valve, electric heaters and mode indicator LEDs based on a control temperature differential. The control temperature differential is calculated by the Microprocessor based on the resistance of the return air sensor, the resistance of the discharge air sensor, the pulldown rate, and the setpoint. Because the digital readout on the Microprocessor displays the actual return air sensor temperature, service personnel will observe unit operating mode changes at variable return air sensor temperature readings.

Evaporator blower motor speed, the In-range LED and the Out-of-Range Alarm are regulated by the Microprocessor based on actual return air temperature. At return air temperatures above 24.0 F (-4.4 C), the Microprocessor operates the evaporator blowers on high speed.

The condenser fan speed is determined by the compressor discharge pressure during Modulation Cool operation. The condenser fan operates on low speed if the compressor discharge pressure falls below 160 ±7 psi (1103 ±48 kPa). If the discharge pressure rises above 200 ±7 psi (1379 ±48 kPa), the condenser fan pressure switch opens, shifting the condenser fan to high speed operation.

Cool

If the control temperature differential is more than 18.0 F (10.0 C) above the Microprocessor setpoint, the unit will operate on Cool. The Microprocessor de-energizes (opens) the modulation valve, shifting the unit to Cool.

NOTE: Power monitor is active whenever the compressor is operating.

Modulation Cool

When the control temperature differential is less than 18.0 F (10.0 C) above setpoint, the Microprocessor energizes 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 modulation valve is full open at 18.0 F (10.0 C) above setpoint and closed at 1.0 F (0.6 C) above setpoint.

Although the Microprocessor drives the valve to the closed position, a small orifice in the valve remains open. This opening permits a small amount of refrigerant to return to the compressor for compressor oil return and heat rejection. The modulation valve remains closed from 1.0 F (0.6 C) above setpoint to setpoint.

In-range LED

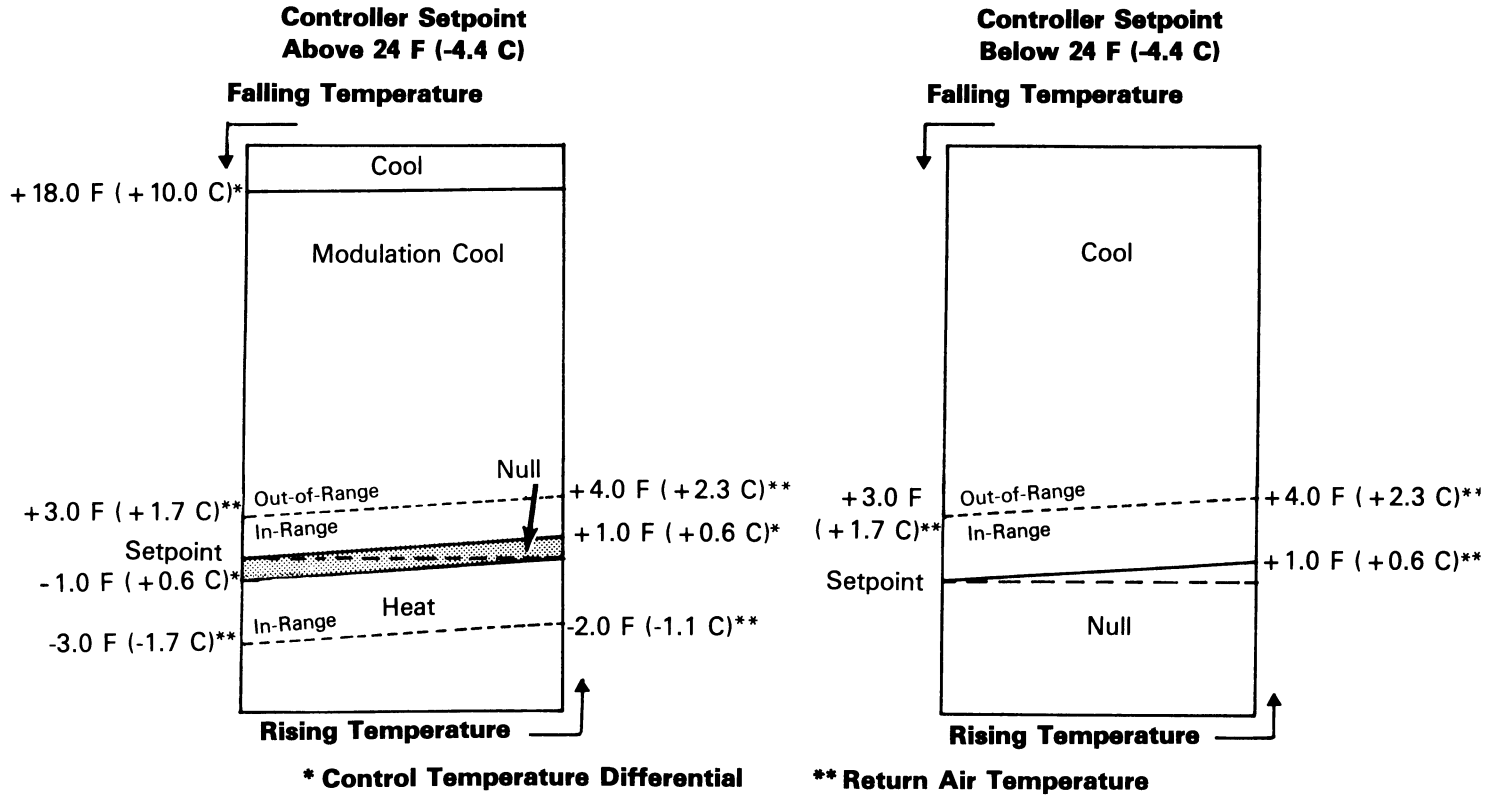
When the return air temperature drops within 3.0 F (1.7 C) of setpoint, the Microprocessor energizes the In-range LED. In-range LED operation is not affected by the pulldown rate.

Null

When the control temperature differential decreases to zero (container temperature at setpoint), the Microprocessor de-energizes the compressor motor contactor and condenser fan contactor. The compressor motor and condenser fan motor stop, placing the unit in the Null mode (the evaporator blowers continue to run).

NOTE: The Microprocessor control algorithm also limits the length of time the discharge air temperature may stay below setpoint. If the discharge air temperature decreases below setpoint, the Microprocessor may shift the unit to Null with the return air temperature well above setpoint.

Thermoguard Microprocessor "A" Control Sequence



Heat

If the control temperature differential decreases to 1.0 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.

Out-of-range Alarm

If the return air temperature decreases to 3.0 F (1.7 C) below setpoint, the Microprocessor energizes the Alarm LED and shuts down unit operation to protect the load. The Microprocessor also de-energizes the In-range LED after 15 minutes. Fault Code 11, temperature-out-of-range, will be displayed on the digital temperature readout when the Alarm [CODE] key is manually depressed.

NOTE: The Microprocessor will not respond to a temperature out-of-range condition for 15 minutes to prevent nuisance alarms.

Rising Temperature

On rising temperature, the Microprocessor will energize the In-range LED when the return air temperature increases to 2.0 F (1.1 C) below setpoint.

The unit will operate in the Heat mode until the control temperature differential increases to setpoint. At setpoint, the Microprocessor de-energizes the heater contactor, returning the unit to the Null mode. The unit will remain in Null until the control temperature differential decreases below zero (setpoint) or increases to 1.0 F (0.6 C) above setpoint.

If the control temperature differential increases to 1.0 F (0.6 C) above setpoint, the Microprocessor will start the condenser fan motor and energize the modulation valve. The compressor motor will start three seconds later, placing the unit on Modulation Cool. The unit will remain in Modulation Cool until the control temperature differential increases to 18.0 F (10.0 C) above setpoint or decreases to zero (setpoint).

If the control temperature differential increases to more than 18.0 F (10.0 C) above setpoint, the Microprocessor de-energizes the modulation valve. With the modulation valve open, the unit operates on Cool. The unit will remain in Cool until the control temperature differential decreases to 18.0 F (10.0 C) above setpoint.

OPERATING MODE CONTROL SEQUENCE

	Controller Setpoint Above 24.0 F (-4.4 C)					Controller Setpoint Below 24.0 F (-4.4 C)		
Unit Function	Cool[1]	Mod. Cool	Null	Heat	Defr	Cool[1]	Null	Defrost
High Speed Evaporator Blowers	●	●	●	●		●[2]		
Low Speed Evaporator Blowers						●[2]	●	
Control Temperature Differential[3]	●	●	●	●	●			
Return Air Sensor Control						●	●	●
Compressor Operation[4]	●	●				●		
High Speed Condenser Fan Operation[5]	●	●[5]				●		
Low Speed Condenser Fan Operation[5]		●[5]						
Modulation Valve Closed			●	●	●		●	●
Modulating Valve Open	●					●		
Modulating Valve Modulating[1] (energized)	●[1]	●				●[1]		
Electric Heaters "On"				●	●			●

[1] *When a cooling mode requires compressor start-up, the compressor starts and operates in Modulation Cool for two minutes. The Microprocessor then operates the unit in the proper mode based on the setpoint temperature. Also, 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] *Evaporator blower speed is controlled by the evaporator return air sensor temperature. At return air temperatures above 24.0 F (-4.4 C), the evaporator blowers operate on high speed. At return air temperatures below 24.0 F (-4.4 C), the Microprocessor shifts the evaporator blowers to low speed. The evaporator blowers always start in high speed.*

[3] *The control temperature differential is calculated by the Microprocessor based on the resistance of the discharge and return air sensors, the pulldown rate and the setpoint.*

[4] *Three (3) second delay on initial unit start-up or unit shift to a cooling mode requiring compressor start-up.*

[5] *Condenser fan operation is controlled by the condenser fan pressure switch.*

Microprocessor Setpoint Below 24.0 F (-4.4 C)

When the Microprocessor setpoint is set below 24.0 F (-4.4 C), the Modulation Cool and Heat modes are locked out. The Microprocessor operates the unit on the Cool, Null and Defrost modes using only the return air sensor temperature to determine operating mode switch points.

The evaporator blower motor speed is regulated by the Microprocessor based on the return air sensor temperature. At return air temperatures above 24.0 F (-4.4 C), the Microprocessor operates the evaporator blowers on high speed.

When the return air temperature decreases to 24.0 F (-4.4 C), the Microprocessor shifts the evaporator blowers to low speed.

Cool

If the return air temperature is above the Microprocessor setpoint on unit start-up, the unit operates on Cool. The Microprocessor energizes the evaporator blower high speed contactor and the condenser fan contactor to start the fans when the setpoint and sensor temperature are displayed. The evaporator blowers operate on high speed until the container return air temperature decreases below 24.0 F (-4.4 C).

The Microprocessor energizes the compressor motor contactor three seconds after the fan motors start. The unit will operate in Cool until the evaporator return air temperature decreases to setpoint.

NOTE: Power monitor is active whenever compressor is operating.

In-range LED

When the return air temperature decreases to 3.0 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 compressor motor and condenser fan motor contactors. The compressor and condenser fan stop, placing the unit in the Null mode (the evaporator blowers continue to run). The unit remains in the Null mode until the return air temperature increases to 1.0 F (0.6 C) above the setpoint temperature.

Rising Temperature

If the return air temperature increases to 1.0 F (0.6 C) above setpoint, the Microprocessor energizes the condenser fan contactor to start the condenser fan. The Microprocessor energizes the compressor motor contactor three seconds later, placing the unit in Cool mode. The unit will operate on Cool until the return air temperature decreases to setpoint.

If the return air temperature increases to 4.0 F (2.3 C) above setpoint after energizing the in-range LED, the Microprocessor will de-energize the in-range LED. If the return air temperature remains out-of-range (more than 3.0 F [1.7 C] above setpoint) for 15 minutes, the Microprocessor will energize the Alarm LED. Fault code 11, temperature out-of-range, will be displayed on the digital temperature/setpoint readout when the Alarm [CODE] key is manually depressed.

UNIT FEATURES

- 230-190V/3 Ph/60-50 Hz, 60 ft (18.3 m) Power Cord
- 15 KVA Auto Transformer and 460-380V/3 Ph/ 60-50 Hz, 60 ft (18.3 m) Power Cord
- THERMOGUARD Microprocessor "A" Temperature Controller with data recording feature and real time clock
- Compressor: Model X426 (CF-II M32)
  Model X430 (CF-II M32A)
- 10 Horsepower Compressor Drive Motor
- Automatic Phase Selection
- Two-Speed Evaporator Blower Motors
- Two-Speed Condenser Fan
- Fresh Air Exchange System
- Modulation Valve
- Power Limit Current Sensor
- Mode Indicators (LEDs)
- Bottom Evaporator Air Discharge
- Demand Defrost is Backed up by an Interval Defrost Timer with a 4-hour Defrost interval on temperature pulldown and 6-hour interval when the container air temperature is In-range
- 31-Day Recording Thermometer
- Thermistor Lead (for return air temperature verification)
- 24V ac Control Circuit for Contactors and Remote Monitor Signals
- 12V dc Control Circuit for Mode Indicator LEDs
- Compound Gauge
- Receiver Tank with Two Moisture Indicating Sight Glasses for Refrigerant Charge Inspection
- Schrader Service Valves (discharge, suction and receiver tank)
- Remote Monitor Connector

PROTECTION FEATURES

- 40 Ampere Circuit Breaker Main Power Protection
- 5 Ampere Circuit Breaker Protection in the Microprocessor Relay Power Circuit (Manual Reset)
- 3 Ampere Circuit Breaker Protection in Mode Indicator LED Circuit (Manual Reset)
- 1.5 Ampere Circuit Breaker Protection in Modulation Valve Output Circuit (Manual Reset)
- 3 Ampere Circuit Breaker Protection in Microprocessor Power Input Circuit (Manual Reset)
- 3 Ampere Circuit Breaker Protection in the Remote Battery Circuit (Manual Reset)
- 1 Ampere Circuit Breaker Protection in Remote Monitor Circuit (Manual Reset)
- Refrigerant High Pressure Cutout Switch
- Refrigerant High Pressure Relief Valve
- Evaporator Over Temperature Protection (Coil Sensor)
- Internal Overload Protection for Condenser Fan Motor and Evaporator Blower Motors
- External Overload Protection for the Compressor Drive Motor

OPERATING MODES

Microprocessor Setpoint Above 24.0 F (-4.4 C)

- Temperature Control by Temperature Differential Based on the Discharge and Return Air Sensor Temperatures, Setpoint and the Pulldown Rate
- High Speed Evaporator Blower Operation
- Cool
- Modulation Cool
- Null (compressor stops, evaporator blowers run)
- Heat (resistance heaters)
- Defrost (resistance heaters)

Microprocessor Setpoint Below 24.0 F (-4.4 C)

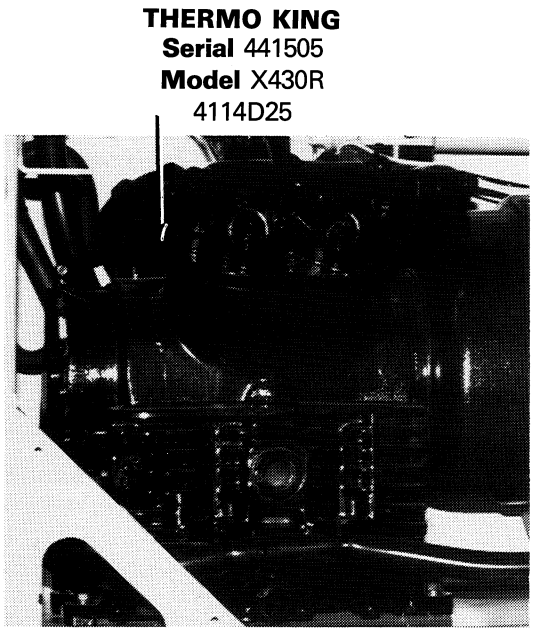
- Temperature Control by Return Air Sensor
- Low Speed Evaporator Blower Operation (when container return air sensor temperature drops below 24.0 F [-4.4 C])
- Cool
- Null (compressor stops, evaporator blowers run)
- Defrost (resistance heaters)

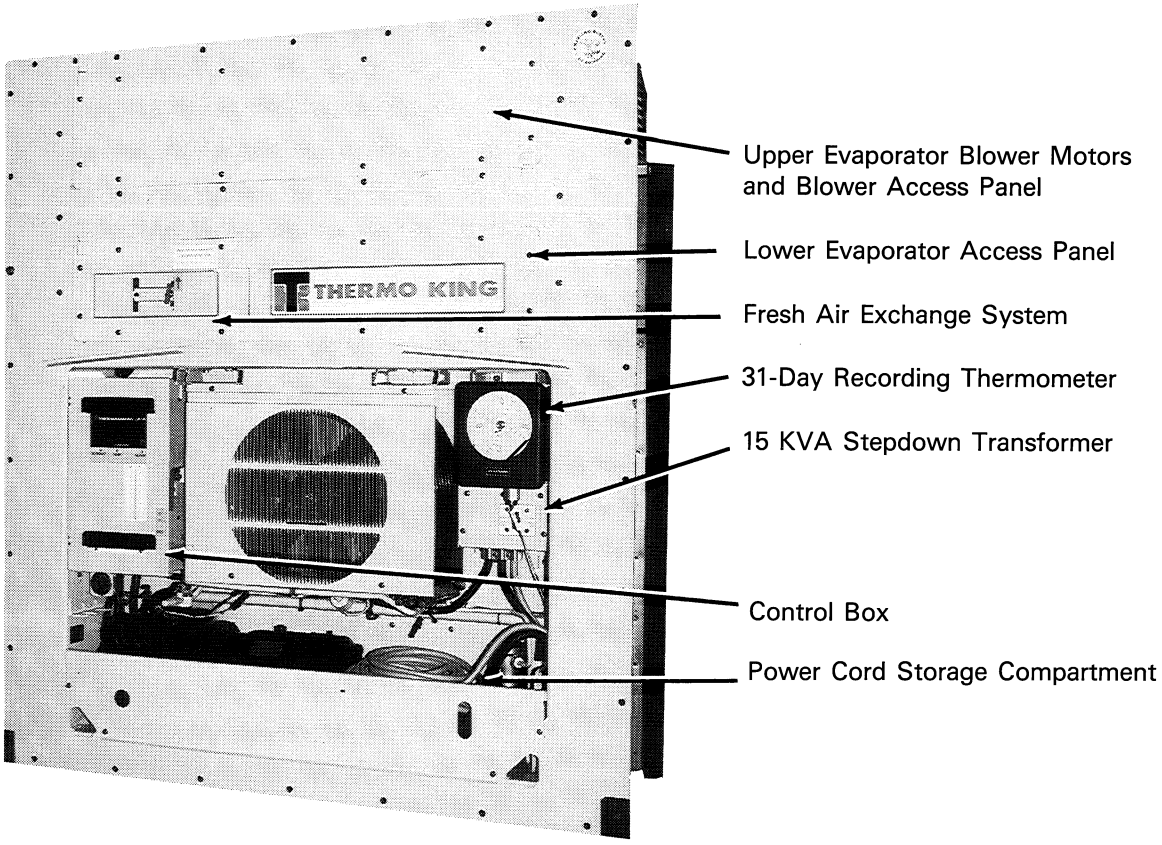
SERIAL NUMBER LOCATIONS

Electric Motors: Nameplate attached to motor housing.

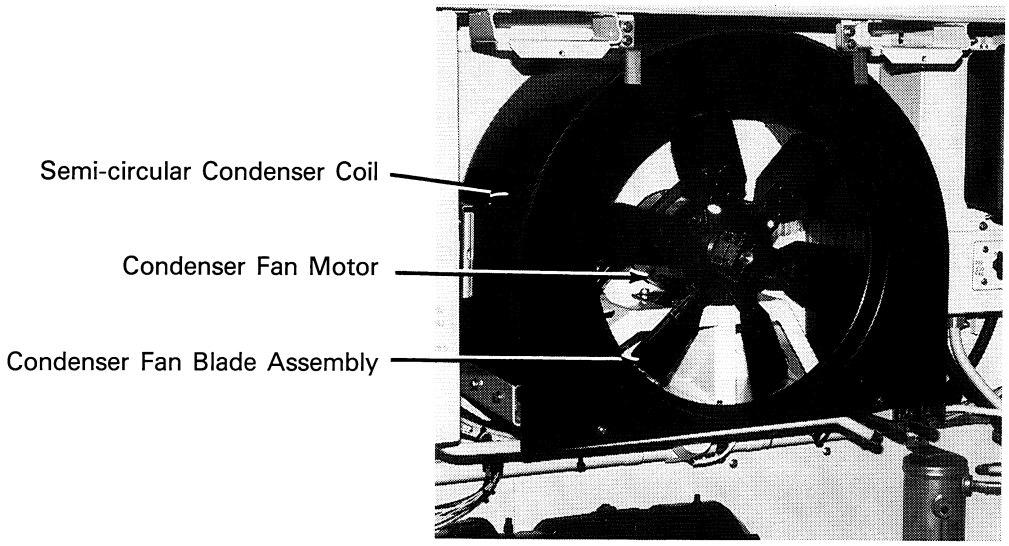
Compressor: Stamped on end above oil pump.

Unit Nameplate: Nameplate on unit frame next to the compressor.

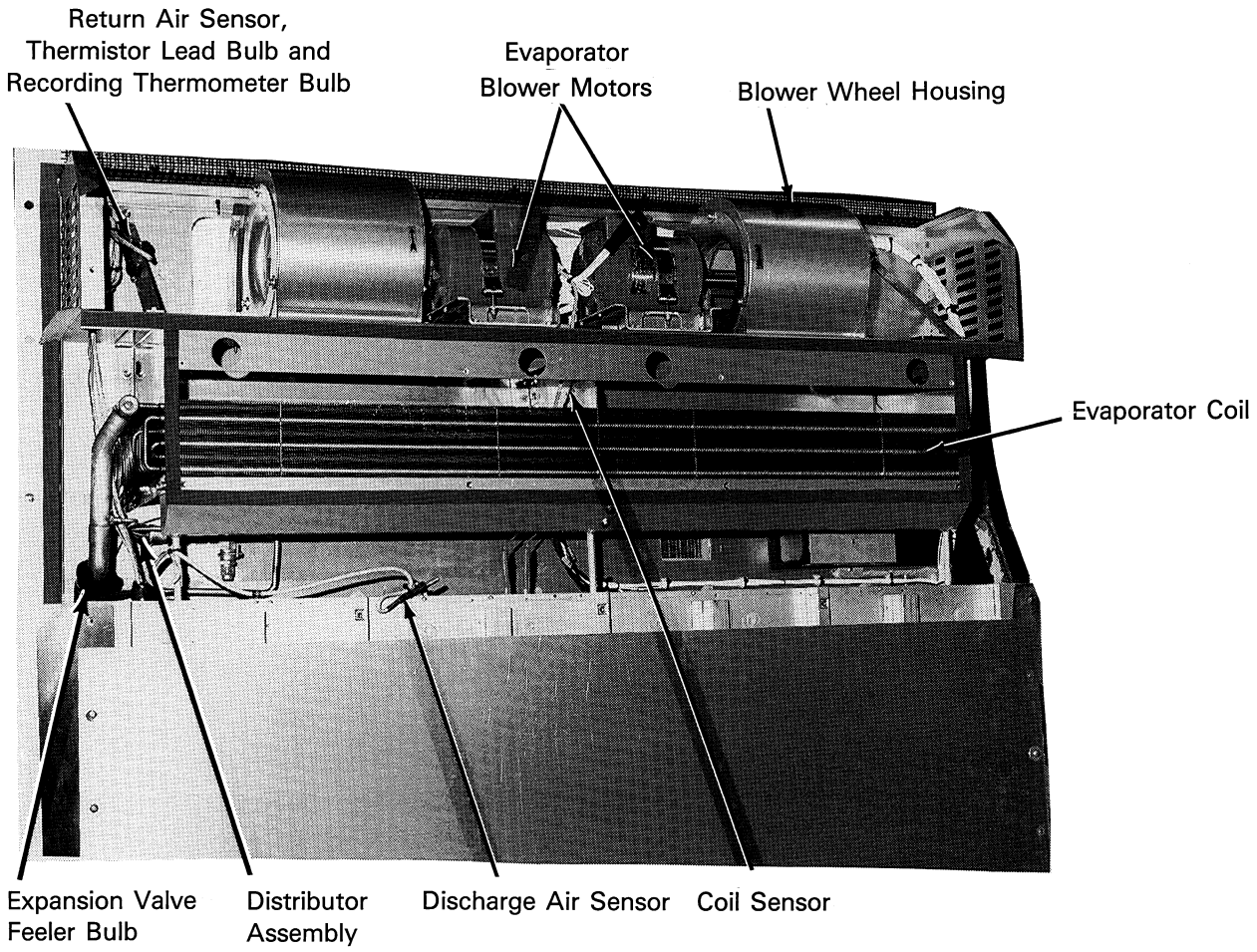




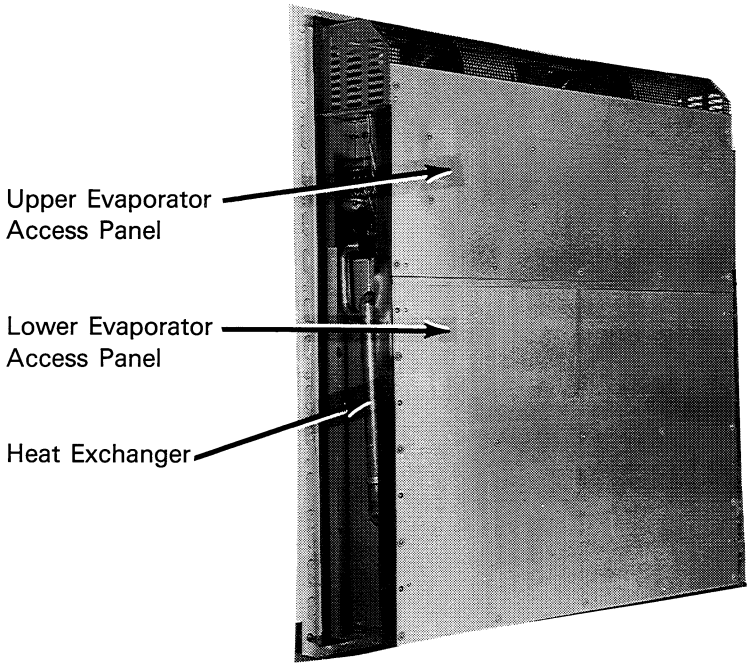
Front View



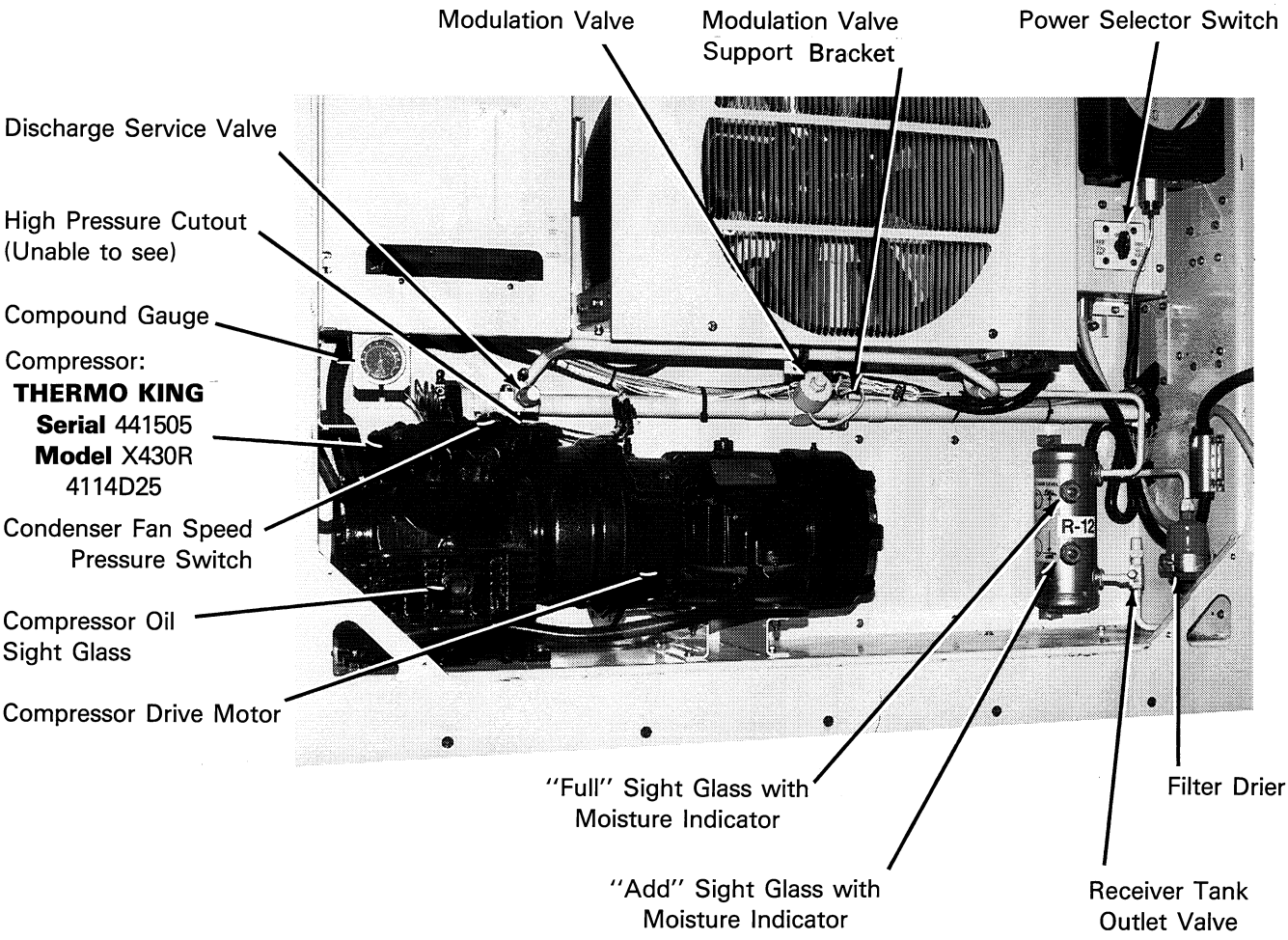
Condenser Fan Section



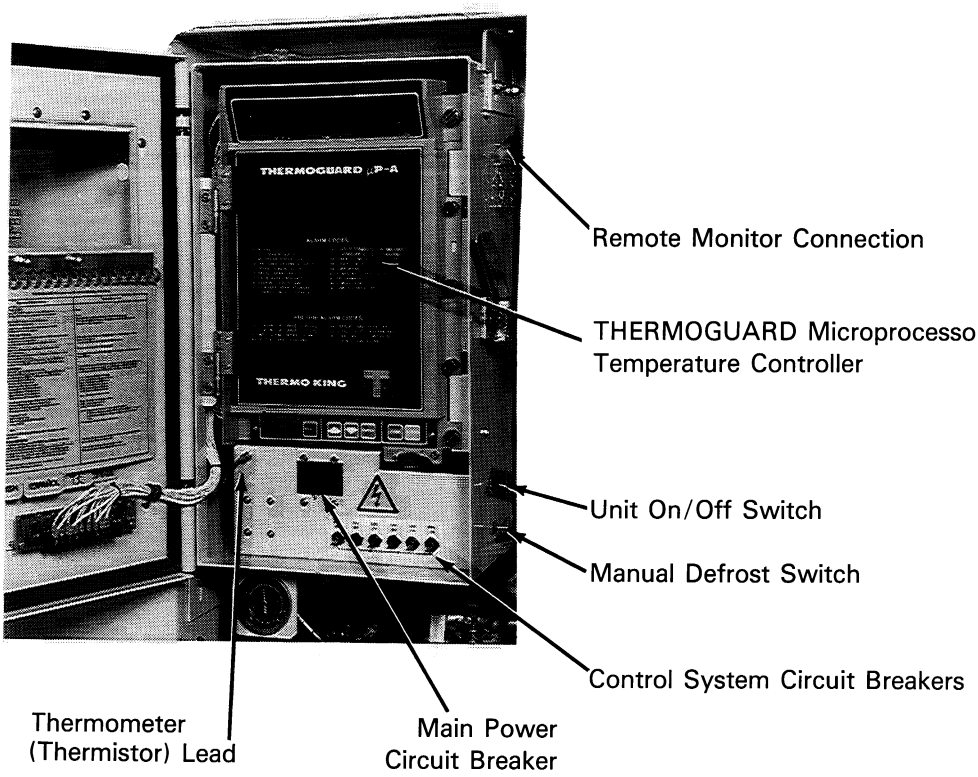
Evaporator Section Back View



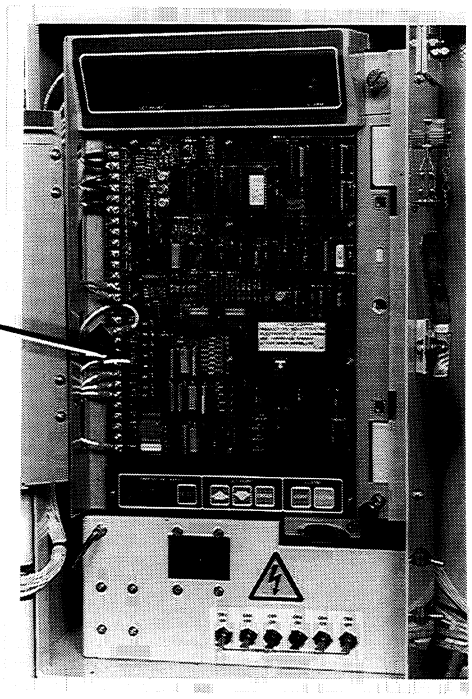
Back View



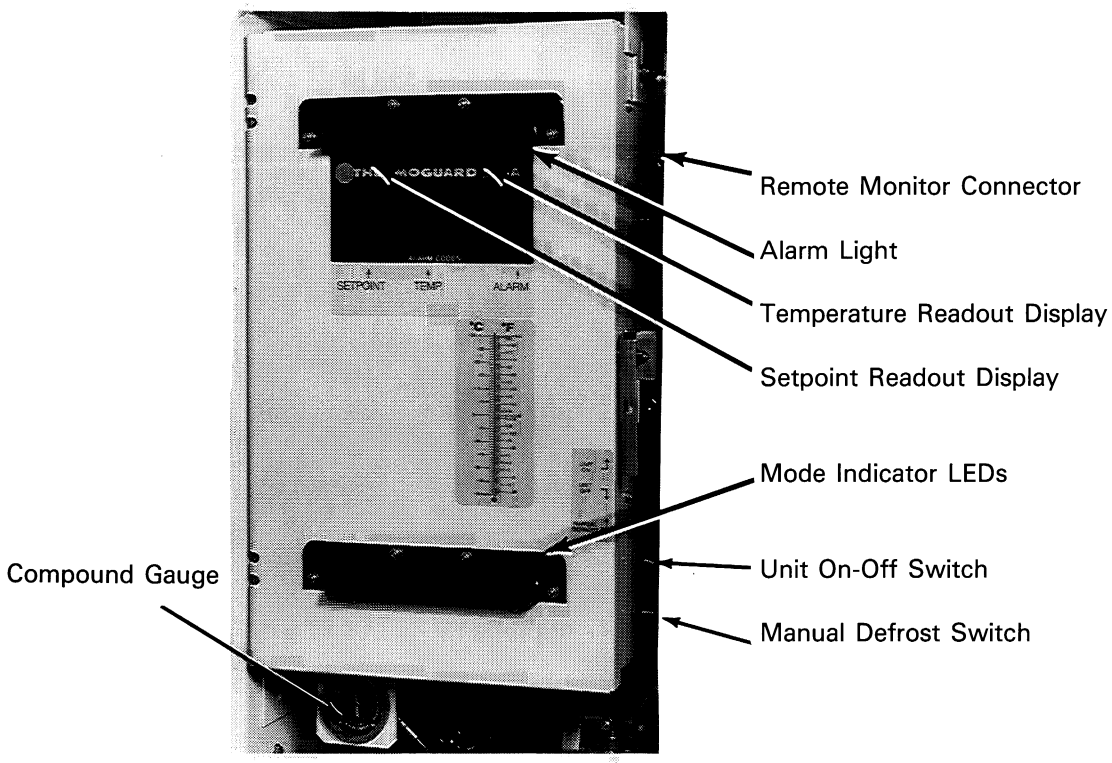
Compressor Compartment



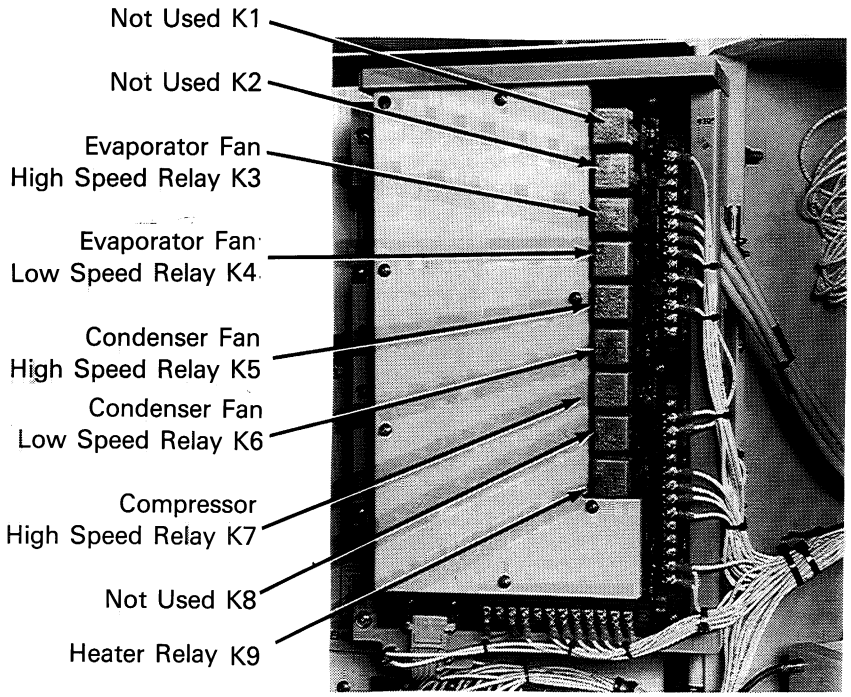
Control Box



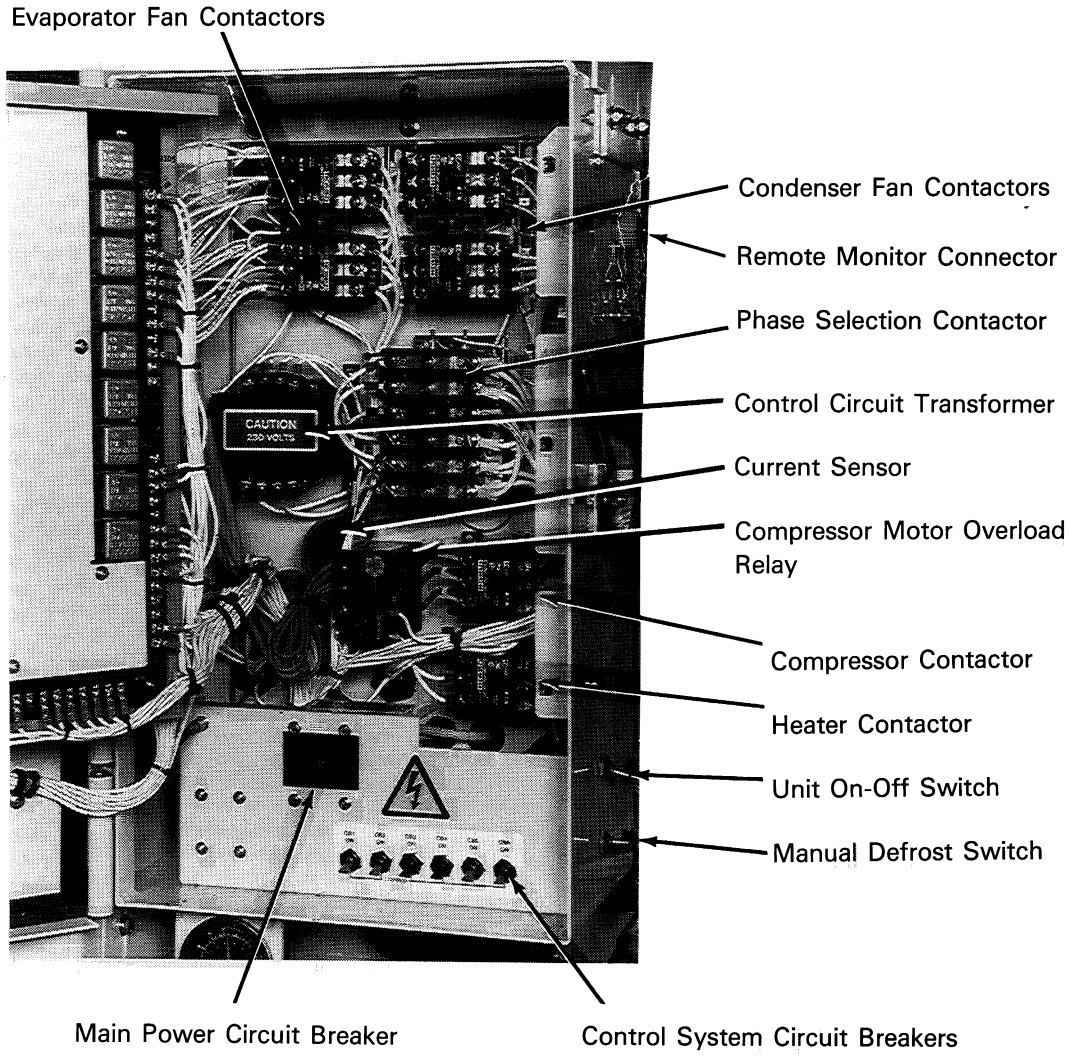
Microprocessor in Unit Control Box



Control Box



Microprocessor Board

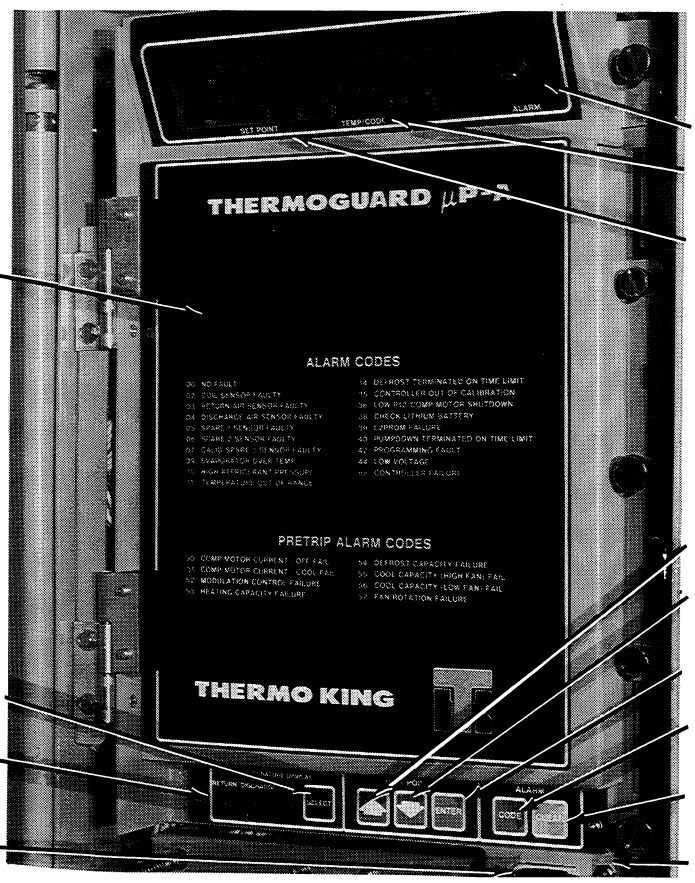


High Voltage Tray

Operating Instructions

THERMOGUARD Microprocessor "A" Controller Operating Instructions

Operator/User Action	System Response
1. STARTING THE UNIT:	
● Check that the unit 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 3 seconds for the unit to start	The unit will start and display the previous setpoint and the present return air sensor temperature.
NOTE: If unit does not start, repeat the above steps. If it still won't start, refer to maintenance manual.	
2. ENTERING THE SETPOINT:	
NOTE: Switch the setpoint enable switch to ON or connect 12 volt battery to battery jack if power source is not available.)	(The Controller will be powered by the battery permitting operation of items 2 through 4.)
● Select the desired setpoint temperature using the [UP] and [DOWN] arrow keys	The setpoint temperature display 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.	



Alarm Light

Temperature Readout Display

Setpoint Readout Display

THERMOGUARD Microprocessor Temperature Controller

Setpoint Increase Key

Setpoint Decrease Key

Setpoint Enter Key

Select Key

Alarm Code Key

Temperature Display Indicator Lights

Alarm Clear Key

Serial Connector for Data Retrieval

12 V dc Remote Battery Pack Receptacle

Operator/User Action	System Response
3. MENU SELECTION:	
● Press the [SELECT] key to enter the menu list.....	If [SELECT] is pressed while the temperatures are being displayed, the unit will go to the calibration mode. To calibrate, press the [UP] and [DOWN] arrow keys together. The edit LED will now flash, then press [ENTER].
● Use the [UP] and [DOWN] arrow keys to scroll through the menu. To change a variable, press [SELECT] while viewing that variable.	
● The menu consists of the following:	
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
cur Compressor Drive Motor Current Current at 230 V ac reads actual. For 460 V ac units the current is half the number displayed. (Divide reading by 2.)	Scur Select a new current limit
PcCA Percent Capacity (Percent Modulation)	
Ldur Number of Data Logs Using Battery Power after Primary Power is Turned Off	Ldur Select a new data log number.
dSPL Degrees F or C	dSPL Select degrees C or F
SSSS Mark Start of Trip	SSSS Mark Start of Trip
SPPP Short Pretrip (Mode Verification)	SPPP The unit will function in each mode of operation. P 0 will be displayed until ENTER is pressed, then P1 through P5 as the unit operates in each of 5 functional tests.
LPPP Long Pretrip	
---- Exit	The display will return to normal operation
NOTE: The controller will time out of this mode in 30 seconds after the last switch is pressed.	
4. ALARM CONDITIONS:	
● If alarm light is flashing, press the [CODE] key to change the Temp/Code display to indicate the alarm codes	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.
● 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 memory.	
NOTE: Some alarm codes will shut unit off. *CAUTION: Unit will automatically start if [CLEAR] key is pressed.*	

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 R12/COMP MOTOR SHUTDOWN
38 CHECK LITHIUM BATTERY
39 E2PROM FAILURE
40 PUMPDOWN TERMINATED ON TIME LIMIT
42 PROGRAMMING FAULT
44 LOW VOLTAGE
88 CONTROLLER FAILURE

LONG PRETRIP 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

UNIT CONTROLS

1. POWER SELECTION SWITCH. The power selection switch allows the shipper to select the unit power cord to match the power supply. The unit is equipped with a 230-220V/3 Ph/60-50 Hz power cord and a 460-380V/3 Ph/60-50 Hz power cord.
2. 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. Unit will not operate.
3. MANUAL DEFROST SWITCH. Unit can be placed on defrost by depressing the manual defrost switch. If the evaporator coil temperature is below 45.0 F (7.2 C), the unit will defrost. Otherwise the unit will continue normal operation.
4. THERMOGUARD MICROPROCESSOR "A". 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 performance tests.
5. CONDENSER FAN PRESSURE SWITCH. When the condenser head pressure rises above 200 ±7 psi (1379 ±48 kPa), the condenser fan pressure switch opens, signaling the Microprocessor to place the condenser fan on high speed. When the condenser head pressure falls below 160 ±7 psi (1103 ±48 kPa), the condenser fan pressure switch closes, signaling the Microprocessor to place the condenser fan on low speed if the unit is operating in Modulation Cool.

UNIT INSTRUMENTS

1. MODE INDICATOR LEDs signal the following:

   Designation

   - Unit On
   - Power Limit
   - Cool
   - Modulation
   - Temp-in-Range
   - Null
   - Heat
   - Defrost

   The In-range LED lights when the return air temperature is within 3.0 F (1.7 C) above or 3.0 F (1.7 C) below the Microprocessor setpoint. The Microprocessor inhibits the out-of-range alarm for 45 minutes during defrost.

   NOTE: The Microprocessor will not respond to an out-of-range condition for 45 minutes after the termination of a defrost cycle or for 15 minutes during normal operation to avoid nuisance alarms.
2. RECEIVER TANK SIGHT GLASSES. The receiver tank contains two sight glasses to indicate the level of refrigerant in the tank for checking the refrigerant charge.

   A moisture indicator around the circumference of each sight glass changes color to indicate the level of moisture in the system. Check the color of the indicator against the color decal on the sight glass. The dry eye in the sight glass is GREEN when the system is dry and YELLOW when the system is wet (contains excessive moisture).
3. COMPRESSOR OIL SIGHT GLASS. A compressor oil sight glass indicates the relative level of compressor oil in the compressor sump.
4. COMPOUND GAUGE. A compound gauge indicates the refrigerant pressure in the suction line returning to the compressor. See "Normal Refrigeration System Suction Pressure Readings" table for normal suction pressure readings.
5. THERMISTOR LEAD. A thermistor lead is located in the unit control box. The bulb of the thermistor lead is attached to the return air sensor in the evaporator section for return air temperature verification.
6. 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.
7. REMOTE MONITOR RECEPTACLE. A female receptacle is provided on the side of the control box for connecting the ship's 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 container temperature is within 3.0 F (1.7 C) above or below the Microprocessor setpoint.

NORMAL R-12 SUCTION PRESSURES (X430 and X426 Compressors with Power Monitor)

Container Temperature	Operating Mode	Ambient Temperature	Suction Pressure X426 Compressor	Suction Pressure X430 Compressor
70 F (21.1 C)	COOL	80-100 F (26.7-37.8 C)	22 to 34 psig (151.7 to 234.4 kPa)	13 to 17 psig (89.6 to 117.2 kPa)
		60-80 F (15.6-26.7 C)	14 to 22 psig (96.5 to 151.7 kPa)	11 to 15 psig (75.8 to 103.4 kPa)
	MODULATION COOL	80-100 F (26.7-37.8 C)	*	*
		60-80 F (15.6-26.7 C)	*	*
35 F (1.7 C)	COOL	80-100 F (26.7-37.8 C)	11 to 13 psig (75.8 to 89.6 kPa)	10 to 12 psig (68.9 to 82.7 kPa)
		60-80 F (15.6-26.7 C)	10 to 12 psig (68.9 to 82.7 kPa)	9 to 11 psig (62.1 to 75.8 kPa)
	MODULATION COOL	80-100 F (26.7-37.8 C)	*	*
		60-80 F (15.6-26.7 C)	*	*
0 F (-17.8 C)	COOL	80-100 F (26.7-37.8 C)	2" Hg vaccum to 2 psi (-6.76 to 13.8 kPa)	4" Hg vacuum to 0 psig (-13.52 to 0 kPa)
		60-80 F (15.6-26.7 C)	4" Hg vacuum to 0 psig (-13.52 to 0 kPa)	6" to 2" Hg vacuum (-20.28 to -6.76 kPa)
-20 F (-28.9 C)	COOL	80-100 F (26.7-37.8 C)	6" to 2" Hg vacuum (-20.28 to -6.76 kPa)	11" to 7" Hg vacuum (-37.18 to -23.66 kPa)
		60-80 F (15.6-26.7 C)	9" to 3" Hg vacuum (-30.42 to -10.14 kPa)	12" to 8" Hg vacuum (-40.56 to -27.04 kPa)

*Suction pressure in MODULATION COOL mode will vary between 10" Hg vacuum (-33.8 kPa) and 34 psig (234.4 kPa) for X426 compressor or 17 psig (117.2 kPa) for X430 compressor, depending on the value of the control temperature differential.

UNIT PROTECTION DEVICES

1. CIRCUIT BREAKERS. A 40 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 also protect the control circuits. A 5 amp circuit breaker protects the contactor output circuit, a 3 amp circuit breaker protects the Microprocessor power input circuit, a 1.5 amp circuit breaker protects the modulation signal output circuit, a 3 amp circuit breaker protects the mode indicator LED circuit, and a 3 amp circuit breaker protects the remote battery circuit. A 1 amp manual reset circuit breaker protects the remote monitor system.

2. EVAPORATOR OVER TEMPERATURE PROTECTION. An evaporator coil sensor monitors coil temperature. When coil sensor temperature reaches 100 F (38.0 C) a signal is sent to the Microprocessor, de-energizing the heater contactor to shut 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.

3. HIGH PRESSURE CUTOUT SWITCH. The refrigerant high pressure cutout opens, interrupting 24V ac control power to the Microprocessor relays and contactors, stopping compressor and fan motor operation if the compressor discharge pressure rises above 300 psi (2067 kPa). Fault code 10 (high refrigerant pressure) is displayed on the digital temperature readout when the Alarm [CODE] key is manually depressed. The switch closes when the pressure drops back to 200 ±20 psi (1379 ±138 kPa).

4. HIGH PRESSURE RELIEF VALVE. A high pressure relief valve is installed in the refrigerant piping system to avoid excessive pressure buildup within the refrigeration system from extraordinary and unforeseen circumstances. The valve is a spring-loaded piston that lifts when refrigerant pressure exceeds 500 ±50 psi (3447 ±347 kPa). The valve will reset when this pressure drops to 400 psi (2758 kPa). The valve could possibly leak refrigerant after it has relieved excess pressure. Tapping the valve lightly may help the valve reseat and seal properly. The valve is non-repairable and requires no adjust-

ment. 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.

5. OVERLOAD PROTECTION. The condenser fan motor and evaporator blower motors include an internal type overload protection with automatic reset. An overload relay located in the unit control box provides the compressor drive motor with overload protection.

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

PRE-TRIP INSPECTION

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

1. Visually check unit for physical damage.
2. Check electrical connections in unit control box, making sure they are fastened securely.
3. Check conditions of wires and terminals. Repair or replace if necessary.
4. Check refrigeration system for leaks. Inspect for evidence of oil leaks at all points and connections.
5. Check 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 grille if necessary.

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

6. Check mounting bolts on unit, compressor and fan motors. Tighten if necessary.
7. Clean defrost drains.
8. Install a new chart on the recording thermometer.
9. Observe unit for proper operation and functions during pre-load operation.

POWER SELECTION

The CF-II M32 and CF-II M32A refrigeration units are designed to operate on 230/190V, 3 Phase, 60-50 Hz or 460-380V, 3 Phase, 60-50 Hz electric power from a 4-wire power source. To operate the refrigeration unit, plug the 230/190V or 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 Microprocessor "A" Temperature Controller, the following conditions must exist:

- The container must be empty with rear doors closed.
- The internal container temperature (return air temperature on Microprocessor display) must be less than 70.0 F (21.0 C) and no more than 10.0 F (5.5 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 35.0 F (1.7 C). Manually defrost the unit before starting pre-trip checks.

1. Connect unit to 230/190V, 3 phase, 60-50 Hz or 460-380V, 3 Phase, 60-50 Hz power source. Turn the power selection switch to the proper power supply voltage.
2. Turn power supply ON-OFF switch to ON.
3. Turn the refrigeration unit On-Off switch to ON position. After a one-second delay, the Setpoint and Temp/Code display lights should fill with 8's. Five seconds later, the Setpoint and return air temperature are displayed.

   As the Setpoint and 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 return air sensor temperature.

   The compressor motor will start three (3) seconds after the fan motors start.

NOTE: If the unit doesn't 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 direction of condenser airflow (see "Condenser Fan and Evaporator Fan Rotation" in the Electrical Maintenance section of this manual).

6. Check direction of evaporator airflow (see "Condenser Fan and Evaporator Fan Rotation" in the Electrical Maintenance section of this manual).

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

   Initiate data log recording and start of trip by pressing the [SELECT] key to enter the MENU. Press the [UP] and [DOWN] arrow keys 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 present return air sensor temperature.

8. Go to 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 sensor used for setpoint temperature control.
   b. dA—displays discharge air temperature for 30 seconds regardless of sensor used for setpoint temperature control.
   c. COIL—displays evaporator coil sensor temperature reading for 30 seconds. The evaporator coil temperature is used for defrost cycle control and evporator over temperature protection.

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

9. Check unit modes while the unit pre-cools by selecting MENU. Press the [UP] and [DOWN] arrow keys to scroll through the MENU. You may perform an automatic Short Pre-trip (SPPP) or Long Pre-trip (LPPP) test. With the TEMP/CODE display indicating LPPP (for Long Pre-trip) or SPPP (for Short Pre-trip), press [SELECT] and [ENTER]. The unit will operate in the pre-trip test mode selected and then return to normal operation.

   Observe unit for proper operation and functions during pre-trip. 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 MiniPac™ portable microcomputer.

   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.

10. The Microprocessor will automatically initiate defrost if the coil sensor temperature is below 45.0 F (7.2 C). The unit will terminate Defrost automatically when the coil temperature reaches 75.0 F (23.9 C).

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

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

13. Wind the chart drive on the recording thermometer.

LOADING PROCEDURE

1. Be sure unit ON-OFF switch is OFF before opening the container doors. (Unit may be running 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. Be 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 ten (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 THERMOGUARD MiniPac™ portable microcomputer (see instructions of THERMOGUARD MiniPac™ portable microcomputer).
5. One-half hour after loading, defrost the unit by momentarily pressing the Manual Defrost switch. If the evaporator coil temperature is below 45.0 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 position. Never attempt to start or stop the refrigeration unit with the unit power cable.

1. Connect the unit to the proper 230/190V, 60-50 Hz or 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 ON position and check for correct 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 ten (10) seconds, the Microprocessor will default to the previous setpoint. If this occurs, repeat step 4.

POST TRIP PROCEDURE

Trip data recorded by the THERMOGUARD Microprocessor "A" Data Logger may be down loaded to the THERMOGUARD MiniPac portable microcomputer via the communications port on the front of the Microprocessor. (See instructions on the THERMOGUARD MiniPac portable microcomputer.)

Electrical Maintenance

UNIT WIRING

Inspect unit wiring, wire harnesses, and the Microprocessor Temperature Controller printed circuit board 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.

THERMOGUARD MICROPROCESSOR "A" TEMPERATURE CONTROLLER

Description

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

1. Two digital displays on front panel:
   a. Three digits (numerical tens, ones and tenths position), a C for Celsius or F for Fahrenheit, and a minus (-) sign for temperature setpoint display.
   b. Four digits (numerical tens, ones and tenths position) and a minus sign for sensor temperature display (selectable).
   c. Two digit fault indication code (selectable) for No Fault, 18 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 R12/COMP MOTOR SHUTDOWN
38 CHECK LITHIUM BATTERY
39 E2PROM FAILURE
40 PUMPDOWN TERMINATED ON TIME LIMIT
42 PROGRAMMING FAULT
44 LOW VOLTAGE FAULT
88 CONTROLLER FAILURE

LONG 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.
3. Alarm indicator output terminals for remote location monitor.
4. Key pads to:
   a. Select fault code readout on digital display.
   b. Clear fault code from digital display.
   c. Select menu items for display.
   d. Increase temperature setpoint.
   e. Decrease temperature setpoint.
   f. Enter temperature setpoint into memory of Microprocessor.
5. Mode light output terminals.
6. Replaceable return air, discharge air and evaporator coil temperature sensors.
7. Unit function output relay terminals including modulation output circuits.
8. Defrost cycle control.
9. Internal self-checking/diagnostic capability.
10. Pre-trip test capability.
11. Data recording capability with retrieval via computer.

General Theory of Operation

The THERMOGUARD Microprocessor "A" Temperature Controller 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, manual defrost switch, condenser fan pressure switch and current sensor to control unit operation.

Output signals from the Microprocessor automatically regulate all unit functions including the compressor, condenser fan motor speed, evaporator blower motor speed, modulation 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.

At setpoints above 24 F (-4.4 C), the Microprocessor controls unit operation based on the control temperature differential. The Microprocessor calculates the control temperature differential based on the setpoint temperature, discharge and return air sensor temperatures, and the pulldown rate. If either the discharge or return air sensor fails, the temperature of the failed sensor is calculated by the Microprocessor based on the operating mode and temperature of the good sensor. If both sensors fail, the Microprocessor will immediately shut down unit operation.

At setpoints below 24 F (-4.4 C), the Microprocessor controls unit operation based on the return air sensor 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 a discharge air sensor installed in the evaporator. If the discharge air sensor also fails, the Microprocessor will operate the unit continuously on Cool.

THERMOGUARD Microprocessor Temperature Controller circuit protection is provided by an 5 ampere circuit breaker in the input circuit to the Microprocessor relays, a 3 ampere circuit breaker in the Microprocessor power input circuit, a 1.5 ampere circuit breaker in the modulation output signal circuit, and a 3 ampere circuit breaker in the mode indicator LED circuit.

THERMOGUARD Microprocessor "A" Temperature Controller Power Specifications

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

Current: Control devices — 2.0 amperes maximum with relay energized. Status indicator LEDs — 0.5 ampere maximum. Modulation valve signal — 1.0 ampere maximum.

Pretrip Test

A functional check of the operating modes can be accomplished on a loaded or empty container by initiating a short or long pretrip test cycle.

Short Pretrip Test

The short pretrip test (SPPP in Microprocessor MENU) automatically operates the unit on Cool (high speed and low speed evaporator fan), Modulation Cool, Null and Heat. The Microprocessor operates the unit in each mode for approximately 30 seconds to verify unit functions.

The short pretrip test cycle is initiated by going to the MENU and pressing the [UP] or [DOWN] arrow key to select SPPP. Then press [SELECT] and [ENTER] (the Microprocessor will operate the unit in the Cool mode).

Long Pretrip Test

The long pretrip test cycle function (LPPP in Microprocessor MENU) automatically performs five basic tests. The long pretrip test is initiated by going to the MENU and pressing the [UP] or [DOWN] arrow key to select LPPP. Then press [SELECT] and [ENTER]. LPPP 1 through LPPP 5 will be displayed as the unit operates in each of the five fuctional tests. Each test is conducted for a specific period of time. The tests and their duration time are:

- HEATING CAPACITY TEST — 6 minutes
- DEFROST TEST — Within 10 minutes or 5.0 F (2.7 C) rise in temperature
- COOLING CAPACITY TEST — HIGH SPEED EVAPORATOR FANS — 8.5 minutes
- COOLING CAPACITY TEST — LOW SPEED EVAPORATOR FANS — 6 minutes
- COOLING CONTROL TEST — 3 minutes

Pretrip Test Fault Indication

If a non-shutdown fault occurs during a pretrip test cycle, the Alarm light will light and the unit will continue to operate. Depress 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 light and the Microprocessor will shut down all unit operation. Depress the [CODE] key to read the fault code registered in the Microprocessor memory.

General Safety Precautions for Servicing Units Equipped with THERMOGUARD Microprocessor "A" Controller

The THERMOGUARD Microprocessor Temperature Controller, 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 (comonly created by static electricity) and handling can damage or destroy them.

Precautions must be taken when servicing units and containers using a THERMOGUARD Microprocessor Temperature Controller 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 Calibration or Repair

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

1. Disconnect all power to 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 proof 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 a Remote Monitor Unit (RMU), the cable that plugs into the Microprocessor's serial port receptacle should be disconnected. Also the RMU should be disconnected at the two terminal blocks.
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.

Calibration

NOTE: Extreme care must be exercised when calibrating to follow the exact procedures as specified — especially ICE BATH preparation.

The Microprocessor calibration should be checked every 1,000 operating hours to verify accuracy. Switch point differentials are permanently fixed and can not be adjusted. Calibration may be checked by using an ice bath (see "Ice Bath Preparation").

The calibration procedure sets the Microprocessor to a 32.0 F (0.0 C) reference point. During calibration, the Microprocessor stores one number as an offset for the calibration of all sensors. The numbers that can be stored range from -6 to +6. This calibration procedure makes calibration correct at 32.0 ± .1 F (0.0 ± .05 C). When calibration is complete the range for the sensors become 31.9 to 32.1 F (-.06 to +.06 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 32.0 F (0.0 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 ±0.1 F (0.0 ±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. The return air [rA on Menu] sensor and discharge air [dA on Menu] sensor temperature can both be monitored by alternating pressing the [UP] and [DOWN] arrows while 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 preceeding "Calibration Checking Procedure," calibrate the Microprocessor.

1. Press the [SELECT] key to enter the Menu. Then use the [UP] or [DOWN] arrows to select the desired sensor [rA]. Verify that the temperature reading on the right display is stabilized.

2. Press the [SELECT] key to enter Calibration. Display will show [C rA] sensor. Press both [UP] and [DOWN] arrows at the same time then press [ENTER].

3. Press the [UP] arrow key again to select the Discharge Sensor [dA]. Again verify that the temperature on the right display is stabilized. Repeat step 2.

4. With the discharge and return air sensors still in the ice bath, check the temperature. The temperature displayed on the Temperature Code display must be 32 ±0.1 F (0.0 ±0.1 C) in the DISCHARGE and RETURN air modes. If not, recheck the temperature of the ice bath and repeat the calibrate procedure.

   NOTE: The evaporator coil sensor may also be calibrated periodically using the previous procedure but pressing the [UP] or [DOWN] arrow key to select the COIL on the Menu.

5. Remove sensors from the ice bath and install in the evaporator section, returning the Microprocessor to normal operation.

THERMOGUARD Microprocessor Temperature Controller Repair

CAUTION: The THERMOGUARD Microprocessor Temperature Controller is not field repairable except as described in the following procedure. Return a faulty Microprocessor to Thermo King for refurbishing or replacement.

External Cause Check

The THERMOGUARD Microprocessor Temperature Controller continuously monitors a wide variety of unit functions including the return and discharge air temperatures, evaporator coil temperature, compressor discharge 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.
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 a 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 32.0 F (0.0 C) and 3,450 ohms at 70.0 F (21.1 C).

Air and Coil Sensor Resistance vs Temperature

Temperature °F (°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

Temperature °F (°C)	Nominal Resistance (ohms)
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 12V dc relays.

When the relay is not energized, there is no continuity (open circuit or infinite resistance) between pin 30 and 87 or pin 30 and pin 87B (pin numbers are adjacent to the pins). When positive +12V dc power is applied to pin 86 and 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 and pin 30 and pin 87B.

The Microprocessor printed circuit board contains identifying labels beside the relays. The CF-II M32 and M32A use only six of the relays to control unit functions. The following six control relays are used:

Relay K3

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

Relay K4

If relay K4 fails in the open position, the evaporator fans will not operate on low speed. If relay K4 fails in the closed position, the evaporator fans 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 K6

If relay K6 fails in the open position, the condenser fan will not operate on low speed. If relay K6 fails in the closed position, the condenser fan will operate continuously on low speed.

Relay K7

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

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 three (3) additional relays that may be used as spares. These relays are not used or needed by the Microprocessor to operate CF-II M32 and M32A units. These circuit board relays are not used because the CF-II M32 and M32A do not contain an electrical device or valve to receive an output signal from the Microprocessor. All nine relays are identical and interchangeable. The following three (3) relays can be used as replacements should any of the other relays fail.

These three spare relays are labeled:

- Relay K1
- Relay K2
- Relay K8

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 the 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 the previous 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 cup counterclockwise to unscrew the light. Remove the defective bulb from the red plastic cap and install a new bulb in the cap. Be 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 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, 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	Open sensor lead	Test for continuity
		Switches to return air sensor for defrost initiation, then times out of defrost after 30 minutes	Shorted sensor	Test for ground
			Defective sensor	Test resistance
			Defective Microprocessor	Replace Microprocesso
03	Return Air Sensor Fault	Alarm — Microprocessor displays discharge air temperature and continues unit operation using calculated control differential	Open sensor lead	Test for continuity
			Defective sensor	Test resistance
			Defective Microprocessor	Replace Microprocesso
		Alarm & Unit Shutdown — If the Microprocessor recorded an earlier discharge air sensor fault (both sensors now disabled), the Microprocessor will stop unit operation		
04	Discharge Air Sensor Fault	Alarm — Microprocessor displays calculated discharge air temperature when selected and continues unit operation using calculated control differential	Open Sensor lead	Test for continuity
			Shorted sensor lead	Test for ground
			Defective sensor	Test resistance
			Defective Microprocessor	Repalce Microprocesso
		If the Microprocessor recorded an earlier return air sensor fault (both sensors now disabled), the Microprocessor will stop unit operation		

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
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 Microprocesso
			Controller set for six (6) sensor record and no sensor	Load a new header wit two (2) sensor recordin
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 Microprocesso
			Lack of evaporator airflow	Motor defective, loose fan blade hub or blocke air stream
10	High Refrigerant Pressure	Alarm & Shutdown—Micro-processor immediately shuts down all loads	Dirty or restricted condenser coil	Inspect condenser coil
			Condenser fan not running	Check and correct condenser fan motor, condenser fan contacto or Microprocessor
			Condenser fan grille damaged or missing	Repair or replace grille
			Defective HPCO switch	Test HPCO switch
			Open in HPCO, R51A or R51 wires	Check wires for continuity
			Defective Microprocessor	Replace Microprocesso
			Refrigerant overcharge	Purge system
			Air in refrigeration system	Evacuate and recharge

NOTE: Loading a header from the Mini Pac microcomputer with six (6) sensor recording selected will cause control to check the spare sensors. If any spare sensor is removed, alarm will not clear.

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
11	Temperature Out-of-range	Alarm—Control sensor temperature more than 3 F (1.7 C) above setpoint	Shortage of refrigerant	Check refrigerant charg
			Defective compressor, condenser fan, evaporator fan, or heater contactor	Inspect contactors
	NOTE: Microprocessor will not record an out-of-range alarm until the return air temperature in in-range first.	Alarm & Shutdown—Control sensor temperature drops more than 3 F (1.7 C) below setpoint at Microprocessor setpoints above 24 F (-4.4 C)	Defective compressor, condenser fan, evaporator fan or heater relay	Test relays
			Compressor inefficient	Check valves and pistor
			Partial obstruction in low side of refrigeration system	Locate obstruction and repair
			Iced or dirty evaporator coil	Inspect defrost evaporator coil
			Refrigerant shortage	Check refrigerant charg
			Expansion valve or screen plugged	Check expansion valve and screen
			Plugged filter drier	Check filter drier
			Poor fitting container doors	Inspect doors
			Microprocessor Controller defective	Replace Microprocessor
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 fan contacts frozen	Inspect contacts
			Defective Microprocessor	Replace Microprocessor

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
15	Microprocessor Out of Calibration	Alarm—Microprocessor between 6 and 10 F (3.3 to 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 & Shutdown—Microprocessor more than 10 F (4.6 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 is attempted	Replace Microprocessor
36	Low R12/ Compressor Motor Shutdown	Alarm & Shutdown—If the Compressor motor overload trips, the compressor oil pressure input will go low, and the Microprocessor will time out two minutes later (five minutes on initial startup). The Microprocessor then displays the Alarm light and shuts down unit operation	Overload relay tripped due to high motor current Defective overload relay	Repair or replace motor Replace overload relay
38	Check Lithium Battery	Time of day clocks stops or is inaccurate	Weak or dead battery	None. Battery usually requires replacement. Check time of day after replacement. Time must be set with Mini Pac microcomputer
39	E2PROM Failure	Alarm—Controller goes to default for all variables which are affected	Damaged or failed memory chip Electrostatic discharge	None Requires replacement
40	Pump Down terminated on time limit	Not used on this application	Does not apply	Does not apply
42	Programming Fault	Alarm—Microprocessor defaults to previous value	User error in programming a new value into Microprocessor memory	Clear the alarm code an repeat programming steps

Fault Code	Fault	Microprocessor Action	Possible Cause	Test Procedure
44	Low Voltage Alarm	Alarm & Shutdown—Microprocessor tried to start unit six (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
88	Microprocessor Faulty	Alarm—Self-checking feature locates malfunction in Microprocessor	Circuit or component failure	Replace Microprocessor

Pre-Trip Fault Codes

The Microprocessor indicates an alarm for the following fault codes. Refer to Mechanical Diagnosis or Refrigeration Diagnosis sections of this manual for further inforamtion 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 shouldn't 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—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 thorugh current sensor	Check number of loops per wiring diagram
		Microprocessor faulty	Check Microprocessor
52	Modulation capacity failure	Modulation valve, circuit breaker, or Microprocessor wiring faulty	Check circuit breaker for proper operation
			Check Microprocessor for proper operation
			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 fan motor failure	Check evaporator fan motors
		Contactors bad	Check contactors
		Wiring faulty	Check wiring
54	Defrost capacity failure	Heater failure	Check heater
		Heater contactor bad	Check contactor
		Wiring faulty	Check wiring
55	Cool capacity (High Fan)—Fail	Compressor failure	Check compressor
		Compressor drive motor faulty	Check compressor drive motor
		Evaporator fan rotation inoperative or incorrect	Check evaporator fans
		Incorrect refrigerant level	Check refrigerant level
		Contactor malfunction	Check contactor
		Wiring faulty	Check wiring
56	Cool capacity (low fan)—Fail	Same as for high fan	Same as for high fan
57	Fan rotation failure	Fan motor failure	Check fan motor and bearings
		Contactor malfunction	Check contactor
		Incorrect or damaged wiring	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 manually partially close the receiver tank outlet valve to regulate the flow of refrigerant.

1. Switch circuit breakers CB2 and CB6 (located in the control box) to OFF position.
2. 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.
3. 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 fans, place a jumper between the fifth and sixth terminals down from the top (labeled EVAP FAN HIGH) of the upper terminal board.

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

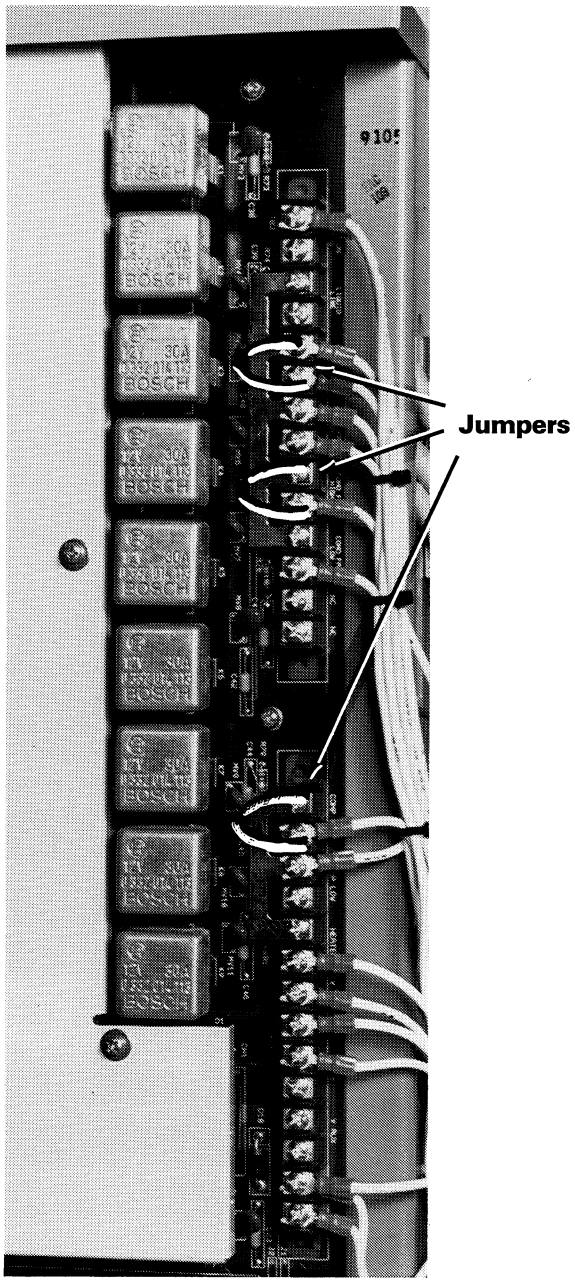
   NOTE: If emergency bypass procedures are used, under high ambient and high container (load) temperature conditions, a compressor motor shutdown may occur. Fault code 36 will be displayed on the temperature readout display when the [CODE] key is depressed, indicating the compressor motor overload relay has tripped. Wait a few minutes to allow the overload protector to cool. Then press the [CLEAR] key to erase the alarm code from the display and restart the unit.

   The CF-II M32 and M32A are 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 relay tripping during emergency bypass procedure operation, restrict refrigerant flow to the compressor using the receiver tank outlet valve. Close the valve and then open the valve 1/4 turn. Restart the unit. Check compressor motor current draw. The motor should draw 28-30 amps. Adjust the suction service valve slightly if necessary to achieve a 28-30 amp draw on the compressor motor.
4. 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:

      EVAP FAN HIGH
      COND FAN HIGH
      COMP HIGH



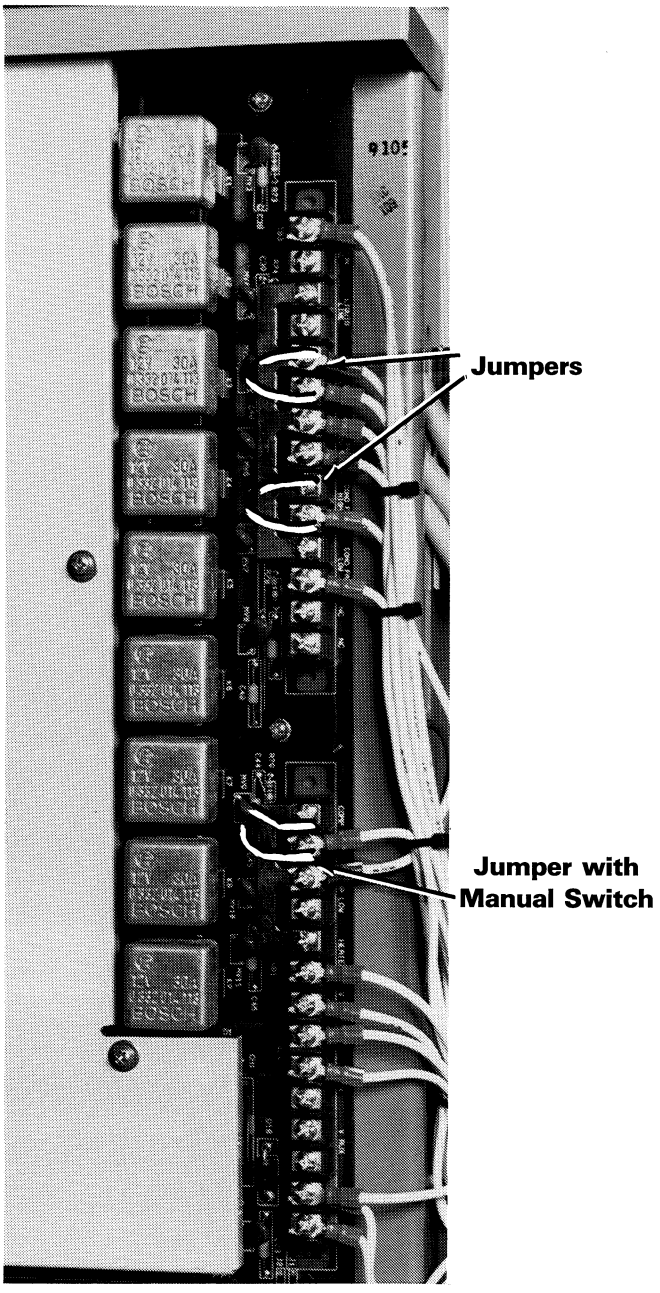
Jumper Locations for Fresh Loads During Pulldown

b. Fresh Loads—Holding Temperature

To hold fresh loads on containers equipped with the CF-II M32 and M32A, manually cycle the unit on and off the Cool mode. Place a jumper wire between the two terminal screws of the following control functions:

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.



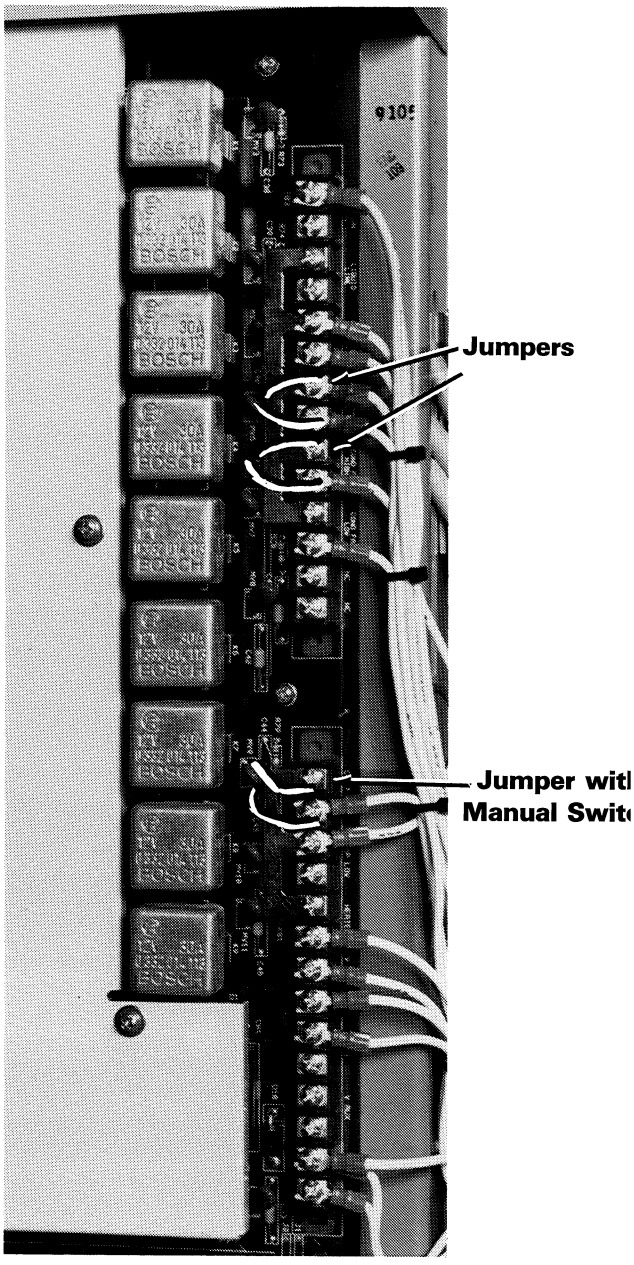
Jumper Locations for Holding Fresh Loads by Manually Cycling Compressor On and Off

c. Frozen Loads

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

EVAP FAN LOW
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 the Null mode. Opening the switch will stop the compressor.



Jumper Locations for Frozen Loads

DEFROST SYSTEM

The unit should be run 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, run 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".

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

Demand Defrost

In addition to timed defrost, the Microprocessor will initiate Demand Defrost on an "as needed" basis when the following conditions are met as dtermined by the load:

Frozen Loads—Evaporator blowers run 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 Tepmerature becomes too large, and this condition exists for 15 minutes, and no defrost has occurred for 90 minutes—the unit shifts to defrost.

Chill Loads—Evaporator blowers are running 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 has elapsed since the last defrost.

NOTE: The internal defrost timer still operates. The timer is automatically reset to the programmed setting (4 or 6 hours) after any defrost.

Automatic Defrost Initiation by Internal Defrost Timer

In addition to demand defrost, an internal defrost timer in the Microprocessor automatically places the unit on defrost on 4-hour intervals on temperature pull down and 6- hour intervals when the container temperature is in-range. The time interval begins at the completion of a defrost cycle.

NOTE: If the control air sensor temperature goes out of range during unit operation, defrost cycles again are initiated on the 4-hour temperature pull down interval. Even if the control air sensor temperature returns to in-range in just 2-3 minutes, the next defrost period will be initiated based on the 4-hour pull down defrost interval. The defrost interval will then return to the 6-hour in-range defrost interval as long as the return air sensor temperature remains in-range. However, the Microprocessor will not respond to an out-of-range condition for 45 minutes after the termination of a defrost cycle.

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.

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 compressor motor, condenser fan and evaporator blowers will stop. The defrost LED will turn on and the heater contactor will energize and supply current to the heaters.

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 F (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 motor should start 3 seconds after the fan motors start.

Defrost Cycle Checkout Procedure

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

To check the defrost cycle, run 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 evaporator coil sensor fails, the Alarm light will flash and the Microprocessor will not initiate a defrost cycle. 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:

   Be 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 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 sensing high temperature. Check for a defective electric heater rod (hot spots), a defective sensor.

   A Code 02 (Coil Sensor) Fault could indicate 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 section. Replace a defective evaporator coil sensor.

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

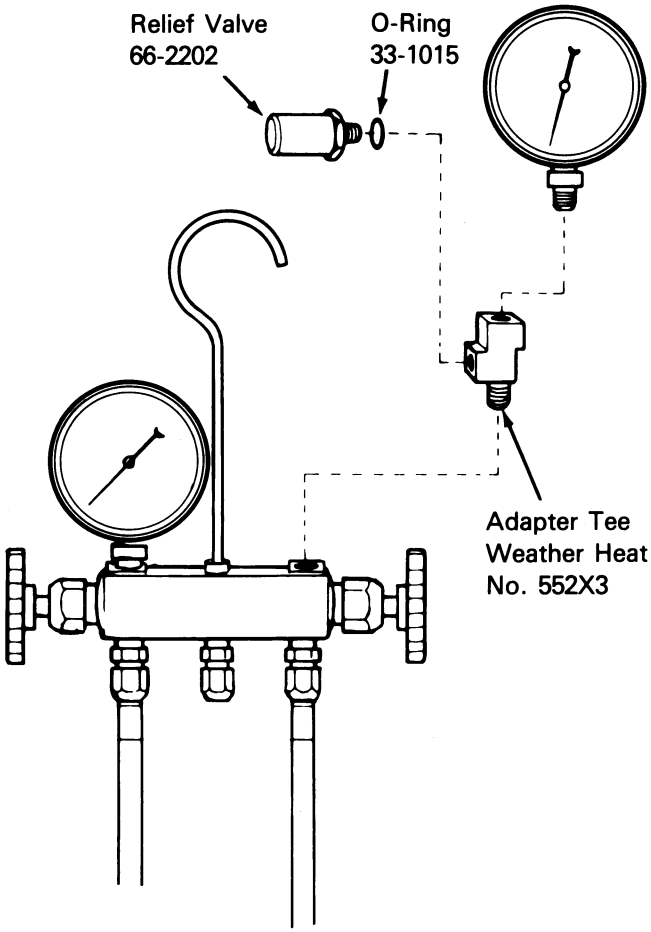
   When the unit shifts to defrost, the compressor, condenser fan and evaporator blowers should stop immediately. If the compressor motor or evaporator blowers fail to stop, check for a defective compressor motor contactor or evaporator blower motor contactor, a defective compressor motor contactor relay or evaporator blower motor contactor relay, or a defective Microprocessor.

Microprocessor Internal Defrost Timer Checkout

To test the Microprocessor internal defrost timer, run the unit on 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 0-60 seconds after applying the jumper, and termination will occur 60 seconds later. Remove jumper from terminal strip.

HIGH PRESSURE CUTOUT

The high pressure cutout is located on the compressor discharge manifold. If the discharge pressure rises above 300 psi (2,068 kPa), the switch opens the R51A circuit. The unit will display an Alarm light, and the compressor and all other loads will turn off immediately. Pressing the Alarm [CODE] key on the Microprocessor will cause Code 10 (High Refrigerant Pressure) to appear on the right hand display. To test the switch, rework a gauge manifold per "High Pressure Cutout Manifold" illustration.



High Pressure Cutout Manifold

1. Connect the manifold gauge to the compressor discharge service valve with a heavy duty, black jacketed thick wall #HCA 144 hose with 900 psi (6,024 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 recording thermometer 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 psi (2,758 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 light and the compressor and all unit loads should turn off immediately. 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: Before the unit can be restarted after shutdown on HPCO, 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 go out, and the unit can be restarted.

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

ELECTRICAL CONTACTORS AND RELAYS

Maintenance consists of replacing a relay. The coil of a contactor 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 power cord from 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 which mount the bridge contacts and the terminal contacts.
6. Install point kit set.
7. Replace contactor in unit and install power cord wires.
8. Reconnect power cord to unit.
9. Operate 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 unit and connect wires.
8. Reconnect power cord to unit.
9. Operate unit and check contactor for proper operation.

24V ac Coil Contactors

Coil Replacement

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

1. Disconnect power cord from unit.
2. Remove 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 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 unit and connect wires.
7. Reconnect power cord to 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.

NOTE: Check for both High and Low Speed condenser fan operation. The unit should be in the Full Cool mode to check High Speed condenser fan operation. Shift the unit to high speed condenser fan operation by adjusting the Microprocessor temperature set point more than 18 F (10.5 C) below the return air temperature.

If the condenser fan is rotating backwards on one or both fan speeds, 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.

NOTE: Condenser fan wires CF1, CF2 and CF3 are used on Low Speed fan operation. Wires CF11, CF12 and CF13 are used on High Speed fan operation.

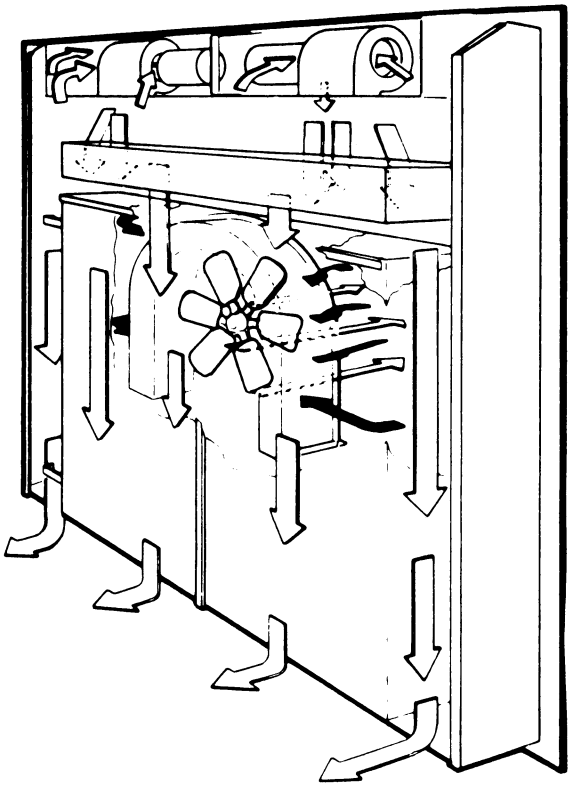
Evaporator Blowers

Visually inspect the evaporator blower wheels 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.

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 fan motor speeds, refer to the unit wiring diagram to correct fan motor wiring at the blower motor junction box or evaporator blower contactor (disconnect power supply before reversing leads). (DO NOT move the ground wire which is labelled CH.)

NOTE: Evaporator fan motor wires EF1, EF2 and EF3 are used on LOW SPEED fan operation. Wires EF11, EF12 and EF13 are used on HIGH SPEED fan operation.



Unit Air Flow

Condenser Fan and Evaporator Blowers 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.

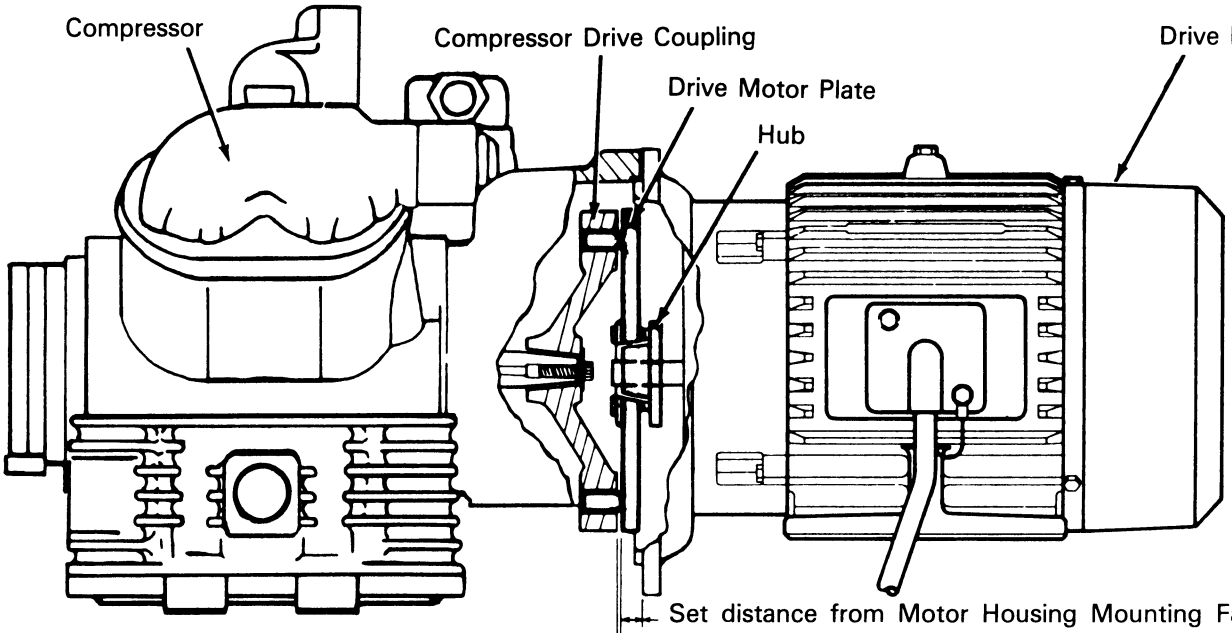
Since both condenser fan and evaporator blowers are rotating incorrectly, determine which contactor is closed with a test light or by visual inspeciton. Probe the test light across the coils of the contactors. The coils operate on 110V dc supplied through the phase selector circuit. To confirm the phase 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 DRIVE MOTOR

When repairing or replacing the compressor drive motor, the motor and compressor drive coupling must be carefully aligned and assembled to provide a minimum clearance of .020 in. (0.5 mm) between the motor drive plate and the compressor drive plate.

Drive Motor Installation:

1. Inspect compressor drive plate coupling on compressor drive shaft. Check torque on drive plate mounting screw. Torque should be 40-45 ft lb (54-61 N·m).
2. Install drive motor coupling assembly on motor shaft. Apply Never Seize lubricant to motor shaft and slide hub onto motor shaft with tapered shaft facing outward.
3. Slide drive plate onto motor shaft with pins on plate facing outward. Align mounting holes of plate with hub and install mounting screws. Screws should be finger tightened.
4. When the electric drive motor and compressor are



bolted together, there must be a minimum clearance of .020 in. (0.5 mm) between the motor drive plate and the compressor drive plate. To help establish this minimum clearance, measure the distance from the mounting face of the motor housing to the outer face of the drive motor plate. The distance should be 0.66 in. (16.8 mm). Slide the drive plate and hub assembly on the motor shaft until this distance is achieved. Carefully torque the mounting screws on the drive plate and hub assembly in alternate steps to 10 ft lb (14 N·m).

5. Slide electric drive motor into the unit.
6. Align pins on the motor drive plate with the holes in the compressor drive plate. Slide electric motor and compressor together.
7. Align the motor housing with the compressor housing and install mounting screws. Torque mounting screws to 33 ft lb (45 N·m).
8. Check clearance between the motor drive plate the compressor drive plate. Using a feeler gauge, check for .020 (0.5 mm) minimum clearance. Insert the feeler gauge between the drive plates through the bottom of the compressor drive housing. A clearance of .020 to .080 in. (0.5 to 2.0 mm) is acceptable. Rotate the drive coupling by hand and check drive plate clearance at two other points around the circumference of the coupling.
9. If the clearance between the motor drive plate and the compressor drive plate is less than .020 in. (0.5 mm), disassemble the electric motor from the compressor and adjust the position of the drive plate and hub assembly on the electric motor shaft.

   To adjust drive plate and hub assembly position, measure the distance from the mounting face of the motor housing to the outer face of the drive motor plate. Loosen the mounting screws on the motor drive plate. Slide the plate and hub assembly on the motor shaft .020 in. (0.5 mm) toward the motor. Tighten the plate to hub mounting screws alternately in steps to 10 ft lb (14 N·m). Reassemble drive motor to compressor repeating steps 4 through 6.
10. Position compressor and electric motor assembly on mounting base in unit. Install and tighten mounting hardware.

Refrigeration Maintenance

REFRIGERANT LEAKS

Use a reliable leak detector (i.e., electronic detector or Halide torch) 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.

CHECKING COMPRESSOR OIL

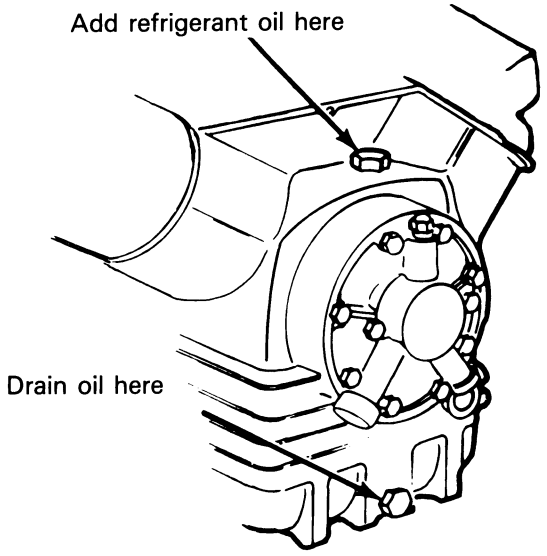
The compressor oil should be checked when there is evidence of oil loss (oil leaks) or when components in the refrigeration system have been removed for service or replacement.

To check compressor oil level with an ambient air temperature above 50.0 F (10.0 C):

Install gauge manifold on the compressor. Operate the unit on COOL with a 20 psi (138 kPa) minimum suction pressure and a 100 psi (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 1/4 to 1/2 up in the sight glass.

To check compressor oil level with an ambient air temperature below 50.0 F (10.0 C):

With the evaporator temperature below 45.0 F (7.2 C), press the Manual Defrost switch to run the unit through a complete DEFROST CYCLE. After completing the defrost cycle, run the unit on COOL for a few minutes. After 2 to 3 minutes, observe the oil level. The oil should be 1/4 to 1/2 up in the sight glass.



Compressor Oil Fill and Drain Plugs

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

NOTE: Use refrigeration compressor oil ONLY, petroleum type, TK Part No. 67-426; or synthetic type (recommended), TK Part No. 67-404. Types may be mixed.

LOW SIDE PUMP DOWN

1. Set the Microprocessor setpoint temperature well below the return air temperature and run the unit in the Cool mode until the temperature stabilizes (at least 5 minutes).
2. Close the receiver tank outlet valve. Allow the unit to run until it reaches 15 to 20 in. vacuum (-51 to -68 kPa) on the compound gauge (approximately 10 minutes). Then shut the unit down manually with the ON-OFF switch.

   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.
3. To place the unit back in service, open the receiver tank outlet valve and turn 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 Model CF-II M32 and M32A units hold a full charge of 14 lb (6.35 kg) R-12. The refrigerant charge can be checked by inspecting the receiver tank sight glasses.

Checking the Refrigerant Charge

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

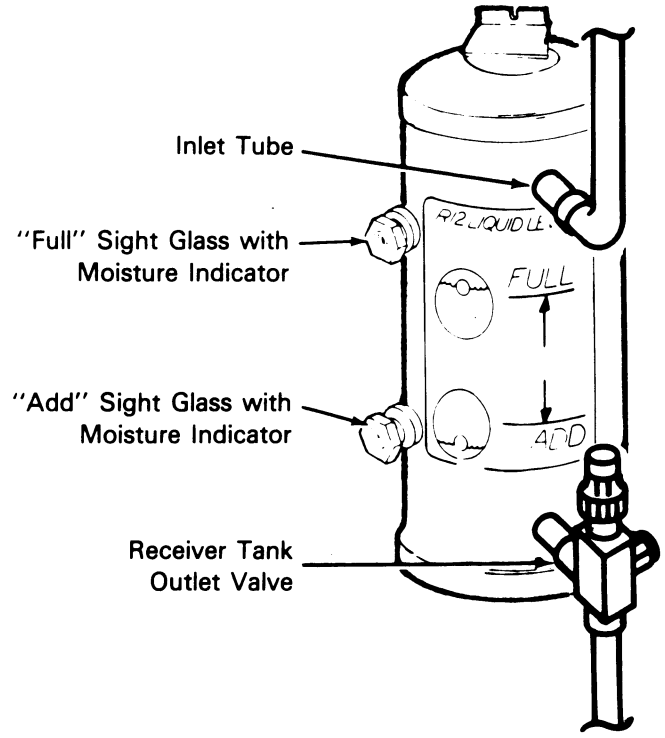
1. Inspect the BOTTOM receiver tank sight glass (labeled "Add") with the unit operating in COOL or MODULATION COOL. If the ball floats in the BOTTOM receiver tank sight glass, the R-12 charge level is correct.

2. If the ball is NOT floating in the BOTTOM sight glass, the unit MAY be low on R-12 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-12 charge level is correct.

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-12 charge. With the unit operating on COOL, add R-12 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-12 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.



Receiver Tank

MODULATION VALVE

The suction line modulation valve requires no maintenance. Service of the modulation valve includes replacement of the coil or replacement of the entire valve. When replacing the modulation valve assembly, be sure the screen in the assembly is properly installed. The screen should be upstream of the modulation valve.

COMPOUND PRESSURE GAUGE

The suction pressure at the compressor is shown on the compound pressure gauge. The compound gauge monitors the low side of the refrigeration system and indicates the expansion valve is working.

The compound pressure gauge should be checked occasionally by comparing it with a gauge of known accuracy.

To check the compound gauge with a gauge of known accuracy, install the check gauge on the suction service valve fitting. Operate the unit on COOL. The gauge pressure readings should be the same.

If the compound gauge is out of calibration, replace the compound gauge.

REFRIGERANT 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 both the suction and discharge service valves.
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 psi (0 kPa) pressure.

Liquid Recovery

1. Install a gauge manifold's low-pressure line to the compressor to the throttling valve or suction ser-

vice valve. Attach the manifold's high-pressure line to the 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 psi (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 psi (0 kPa).

Refrigeration Service Operations

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 TK5715) 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. Equalize pressure to slightly positive.
2. Front seat the discharge valve.

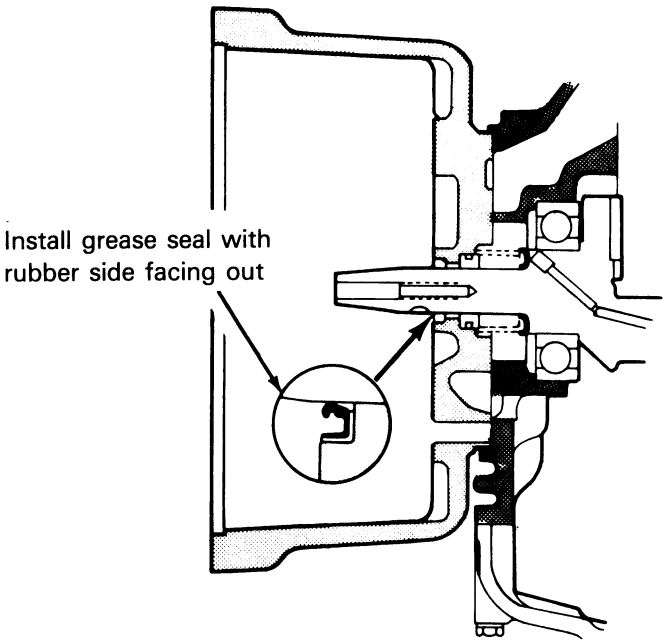
   CAUTION: Any time the discharge valve is front seated, disconnect the unit power source to prevent accidental compressor start up.
3. Remove discharge valve and suction line from compressor.
4. Disconnect the wire connector for the condenser fan pressure switch and high pressure cutout switch.
5. Disconnect the compound gauge line from compressor.
6. Remove electric motor and compressor mounting tray bolts and nuts.
7. Remove mounting bolts from compressor drive motor housing and separate compressor drive motor from compressor.
8. Slide the compressor from the unit.
9. 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:

NOTE: When replacing the compressor crankshaft grease seal, install new seal with rubber side facing out.

1. Install compressor drive coupling on compressor drive shaft with spacer and mounting screw. Tighten mounting screw to 40-45 ft lb (15-61 N·m).
2. Inspect the compressor drive motor coupling assembly. Check torque on drive motor plate to hub mounting screws. Torque should be 10 ft lb (14 N·m).



Crankshaft Grease Seal

NOTE: When the electric drive motor and compressor are bolted together, there must be a minimum clearance of .020 in. (0.5 mm) between the motor drive plate and the compressor drive plate. To help establish this minimum clearance, measure the distance from the mounting face of the motor housing to the outer face of the drive motor plate. The distance should be 0.66 in. (16.8 mm).

3. Slide compressor into the unit.
4. Align pins on the motor drive plate with the holes in the compressor drive plate. Slide electric motor and compressor together.
5. Align the motor housing with the compressor housing and install mounting screws. Torque mounting screws to 33 ft lb (45 N·m).
6. Check clearance between the motor drive plate and the compressor drive plate. Using a feeler gauge, check for 0.020 (0.5 mm) minimum clearance. Insert the feeler gauge between the drive plates through the bottom of the compressor drive housing. A clearance of .020 to .080 in. (0.5 to 2.0 mm) is acceptable. Rotate the drive coupling by hand and check drive plate clearance at two other points around the circumference of the coupling.

7. If the clearance between the motor drive plate and the compressor drive plate is less than .020 in. (0.5 mm), disassemble the electric motor from the compressor and adjust the position of the drive plate and hub assembly on the electric motor shaft.

   To adjust drive plate and hub assembly position, measure the distance from the mounting face of the motor housing to the outer face of the drive motor plate. Loosen the mounting screws on the motor drive plate. Slide the plate and hub assembly on the motor shaft .020 in. (0.5 mm) toward the motor. Tighten the plate to hub mounting screws alternately in steps to 10 ft lb (14 N·m). Reassemble drive motor to compressor repeating steps 4 through 6.

8. Position compressor and electric motor assembly on mounting base in unit. Install and tighten mounting hardware.

9. Bolt the suction line to the compressor using new O-rings coated with compresssor oil. Bolt the discharge valve to the compressor with a new gasket soaked in compressor oil. Reconnect the compound gauge line to the compressor suction valve fitting.

10. Apply refrigerant locktite to the threads of the switches. Connect the high pressure cutout switch and the condenser fan pressure switch to the compressor.

11. Pressurize the compressor and check for refrigerant leaks. If no leaks are found, evacuate the low side and compressor.

12. Back seat the discharge service valve. Open the receiver outlet valve fully.

13. Operate the unit at least thirty minutes and then inspect the oil level in the compressor. Add or remove oil if necessary.

14. Check the refrigerant charge and add refrigerant if needed.

CONDENSER COIL

Removal:

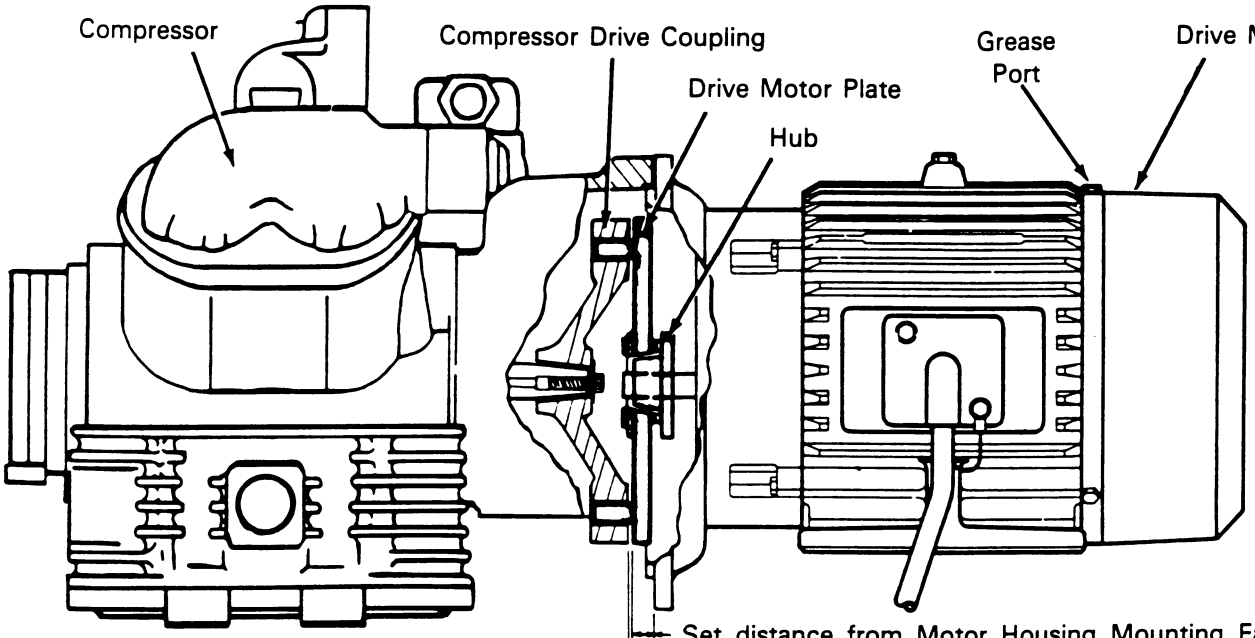
1. Remove the refrigerant charge from the unit.

2. Remove condenser fan grille, condenser fan blade and condenser fan shroud.

3. Remove condenser coil support brackets from top of coil.

4. Unsolder the coil inlet and liquid line connections.

5. Support coil and unbolt condenser coil mounting brackets. Slide coil from unit.



Installation:

1. Clean tubes for soldering.
2. Slide coil into unit and install bolts in mounting brackets.
3. Solder inlet line and liquid line connections.
4. Pressurize the system and test for leaks.
5. If no leaks are found, evacuate the system.
6. Replace condenser coil support brackets, condenser fan shroud and condenser fan grille.
7. Recharge the unit with R-12 refrigerant and check compressor oil level. Add oil if necessary.

DEHYDRATOR (FILTER DRIER)

Removal:

1. Close the receiver tank outlet valve and pump down the low side. Equalize the pressure to slightly positive.
2. Disconnect the flare nuts at the ends of the drier.
3. Remove the drier.

Installation:

1. Install the new drier and tighten nut on mounting bracket (inlet end of drier is labeled "IN").
2. Install and tighten the inlet flare nut. Hold the drier with a back-up wrench on the hex behind the flare fitting.
3. Release a small amount of refrigerant from the receiver tank to purge the air through the drier. Then tighten the outlet flare nut.
4. Release refrigerant from the receiver tank to pressurize the system and inspect for leaks.
5. If no leaks are found, open the refrigeration valves and place the unit in operation.

EXPANSION VALVE POWER ASSEMBLY

Removal:

1. Close receiver tank outlet valve and pump down the low side. Equalize the pressure to slightly positive. Remove lower evaporator access panel from front of unit.
2. Remove insulating tape and unclamp feeler bulb from suction line. Note position of feeler bulb on side of suction line.
3. Disconnect the equalizer line from expansion valve.
4. Remove U-bolt from expansion valve. Disconnect liquid inlet line from expansion valve.
5. Unsolder expansion valve from distributor line.

Installation:

1. Polish end connections and ensure no burs are present before soldering. Solder expansion valve into distributor line. Install U-bolt and secure expansion valve to mounting bracket. Connect the liquid line.
2. Connect equalizer line to expansion valve.
3. Clean suction line to bright polished condition. Install the feeler bulb 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.
4. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.

   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. Install lower evaporator access panel on the front of the unit.
6. Open the receiver tank outlet valve, and place the unit in operation.
7. Operate unit and note 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 receiver tank outlet valve and pump down the low side. Equalize the pressure to slightly positive.
2. Loosen the suction flange connection to the compressor suction adapter. Heat and unsolder the suction line connection above the receiver tank from the heat exchanger first.
3. Heat and unsolder the liquid line connection to filter drier tube in condenser section.
4. Remove the "U" mounting clamps that hold assembly to the wall of the evaporator section.
5. Disconnect equalizer line from suction line elbow.
6. Note the position of the feeler bulb on the side of the suction line elbow. Untape and remove feeler bulb from suction line elbow.

7. Heat and unsolder the liquid line elbow connection to the evaporator coil.
8. Unsolder the suction line connection to the evaporator coil below the equalizer line fitting.
9. Lift heat exchanger assembly from unit.

Installation:

1. Clean tubes for soldering.
2. Place heat exchanger assembly in unit and install mounting hardware.
3. Solder the suction line connection in the evaporator section to the evaporator coil.
4. Solder the liquid line connection to the evaporator coil.
5. Connect equalizer line to suction line.
6. Connect the suction line connection to the heat exchanger in the condenser section. Install and tighten the suction line flange connection to the compressor suction adapter using a new O-ring coated with compressor oil.
7. Solder liquid line connection to filter drier tube in condenser section.
8. Pressurize the low side and check for leaks. If no leaks are found, evacuate the low side.

   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.
9. Clean suction line to 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.
10. Open the receiver tank outlet valve and place unit in operation. Operate unit and note suction pressure and container temperature to see that the feeler bulb is properly installed.

STAINLESS STEEL RECEIVER TANK

Removal:

1. Remove the refrigerant charge from unit.
2. Unsolder outlet valve on the liquid outlet line.
3. Unsolder liquid line inlet connection.
4. Loosen mounting nuts and remove tank.
5. Remove outlet valve from receiver tank.

Installation:

1. Install new tank in unit and tighten mounting bolts.
2. Solder both inlet line and outlet valve with high temperature silver solder (30% silver).
3. Pressurize the refrigeration system and check for leaks. If no leaks are found, evacuate the refrigeration system.
4. Recharge the unit.

EVAPORATOR COIL

Removal:

1. Close the receiver tank outlet valve and pump down the low side. Equalize the pressure to slightly positive.
2. Remove upper evaporator access panel on the rear of the unit.
3. Remove 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 suction line. Note position of feeler bulb on suction line. Unsolder equalizer line from suction line.
6. Unsolder and remove expansion valve from distributor line.
7. Remove electric heater coils from bottom of evaporator coil.
8. Unsolder the suction line from the evaporator coil at the horizontal joint near the feeler bulb location.
9. Unbolt and remove evaporator coil assembly from unit.

Installation:

1. Clean tubes for soldering.
2. Slide evaporator coil assembly into unit and bolt in place.
3. Solder suction line connection to the heat exchanger.
4. Install electric heater coils on evaporator coil with mounting brackets.
5. Solder expansion valve power assembly to the distributor line.

6. Solder equalizer line to suction line elbow and expansion valve. Install "U" bolt mounting bracket on expansion valve and tighten.

7. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.

   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.

8. Clean suction line to bright polished condition. Install feeler bulb clamps and feeler bulb on suction line. Locate bulb on the side of 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.

9. Place evaporator coil drain pan in unit and bolt in place.

10. Install evaporator coil temperature sensor in mounting bracket in coil support frame.

11. Reinstall upper rear access panel.

12. Open the refrigeration valves and place the unit in operation.

13. Check the refrigerant and compressor oil charge and add refrigerant or compressor oil if needed. Note 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. Equalize the pressure to slightly positive.

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. Remove switch from compressor discharge manifold and disconnect leads from wire harness.

Installation:

1. Apply a refrigeration locktite (sealant) to the threads of the switch.

2. Install and tighten switch. Connect leads to wire harness.

3. Release refrigerant from the receiver tank to pressurize the system and test for leaks.

4. If no leaks are found, evacuate system. Open the receiver tank outlet and compressor discharge service valves and place the unit in operation.

MODULATION VALVE

Removal:

1. Close the receiver tank outlet valve and pump down the low side. Equalize the pressure to slightly positive.

2. Disconnect modulation valve leads from wire harness.

   NOTE: In most cases, only the coil requires replacement. No other repair is possible on the modulation valve.

3. Unbolt the suction line flange assembly from the compressor suction adapter. CF-II M32A units: Unbolt support bracket from suction line and modulation valve assembly.

4. Unsolder the modulation valve joints from the suction line.

Installation:

1. Clean tubes for soldering. Bolt suction line flange assembly to compressor suction adapter.

2. Place new valve in position in the suction line.

3. Solder both modulation valve suction line connections.

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

4. CF-II M32A units: Install support bracket on suction line near modulation valve.

5. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.

   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.

6. Reconnect electrical wires to valves.

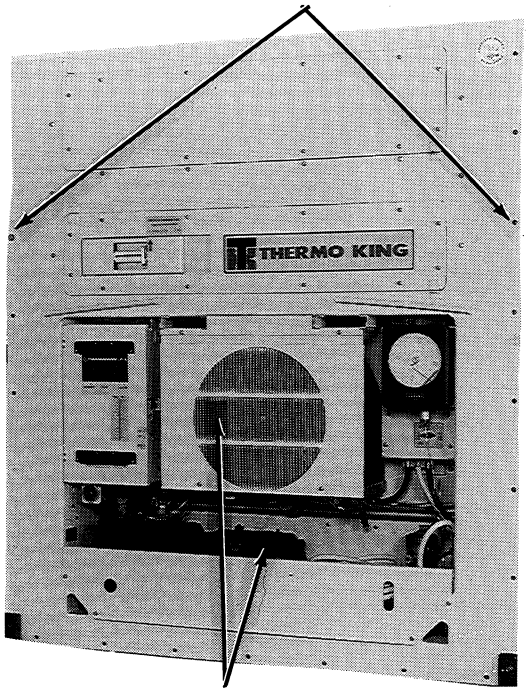
7. Open the receiver tank outlet valve and place the unit in operation. Check refrigerant charge and add refrigerant as required.

Structural Maintenance

MOUNTING BOLTS

Check and tighten all unit, compressor, and fan motor mounting bolts 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).

Tighten Unit Mounting Bolts



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.

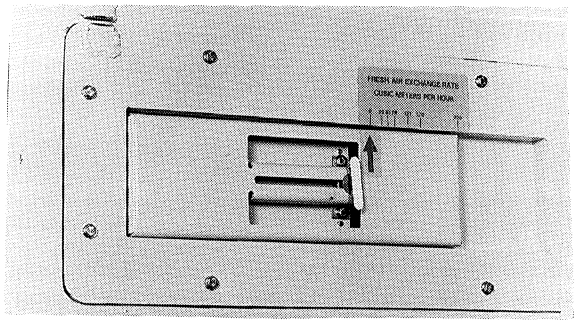
CAUTION: Air pressure must not be high enough to damage coil fins.

DEFROST DRAINS

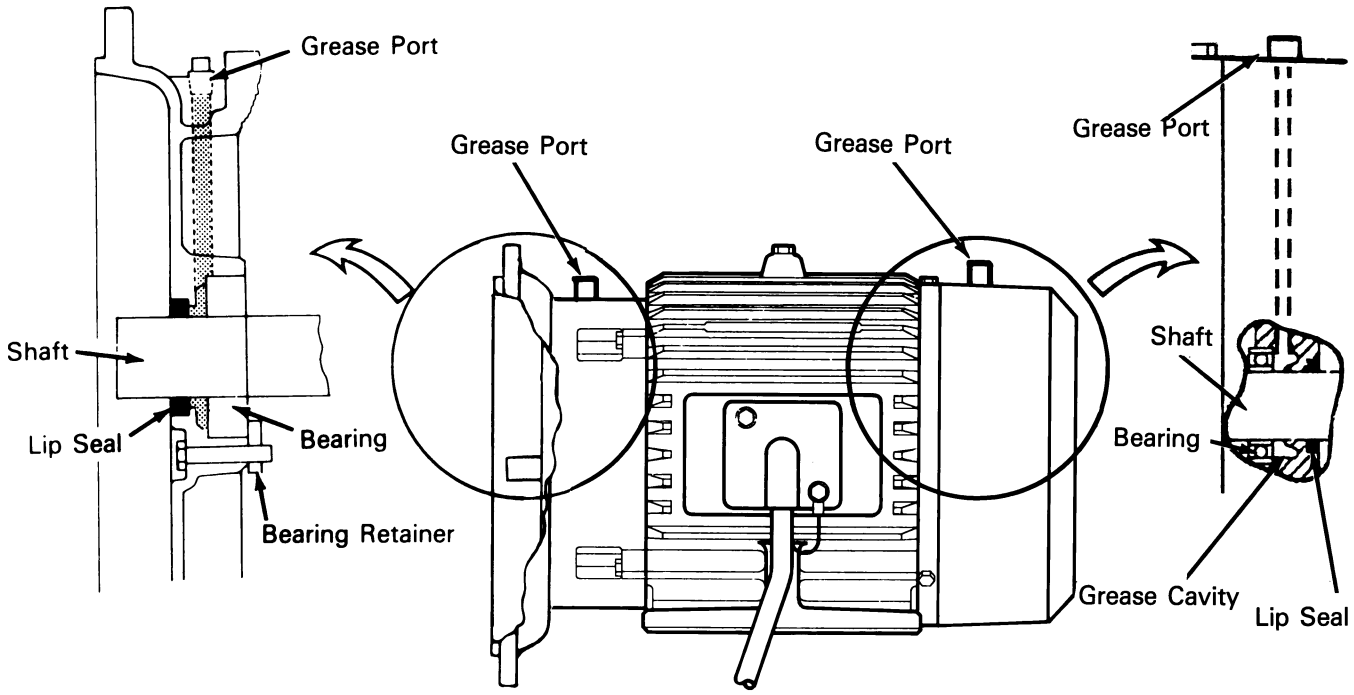
Clean the defrost drains every 1,000 operating hours to be sure the lines remain open.

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).



Fresh Air Vent Door



Compressor Drive Motor Grease Cavities

COMPRESSOR DRIVE MOTOR

The compressor drive motor is furnished with sealed bearings. Therefore the bearings do not require service (repacking) or lubrication. However, a grease cavity has been provided on the outboard side of each bearing. This grease cavity helps prevent contaminants from reaching the bearing.

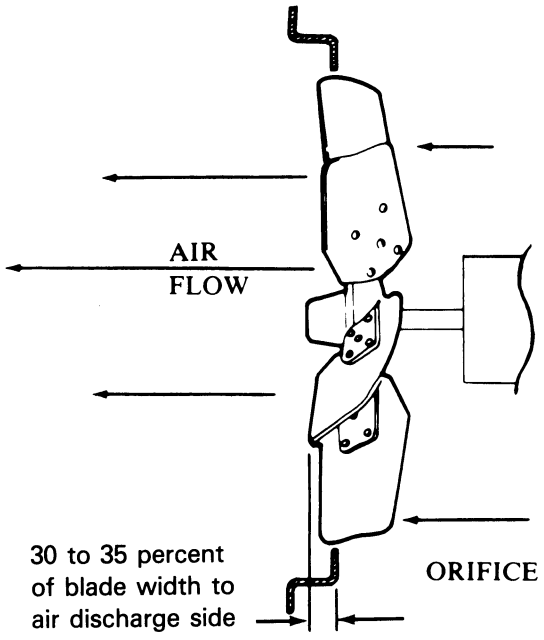
While the motor bearings do not require lubrication, Thermo King recommends adding grease to both bearing cavities every one to two years to maximize bearing life. Lubricating the cavities purges the old grease and contaminants from the cavity. The time interval between lubrication depends on the amount of contaminants (green water) reaching the motor. Use Mobil 28 or equivalent grade grease. Remove plugs from grease ports to lubricate the grease cavity.

Adding lubrication to the bearings forces excess grease out through the lip seal on the shaft. The shaft seal is installed so that pressure from inside the grease cavity will lift the seal and allow excess grease to flow out.

CONDENSER FAN LOCATION

Place 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.



Fan Blade Position in Orifice

EVAPORATOR BLOWER WHEEL LOCATION AND INSTALLATION

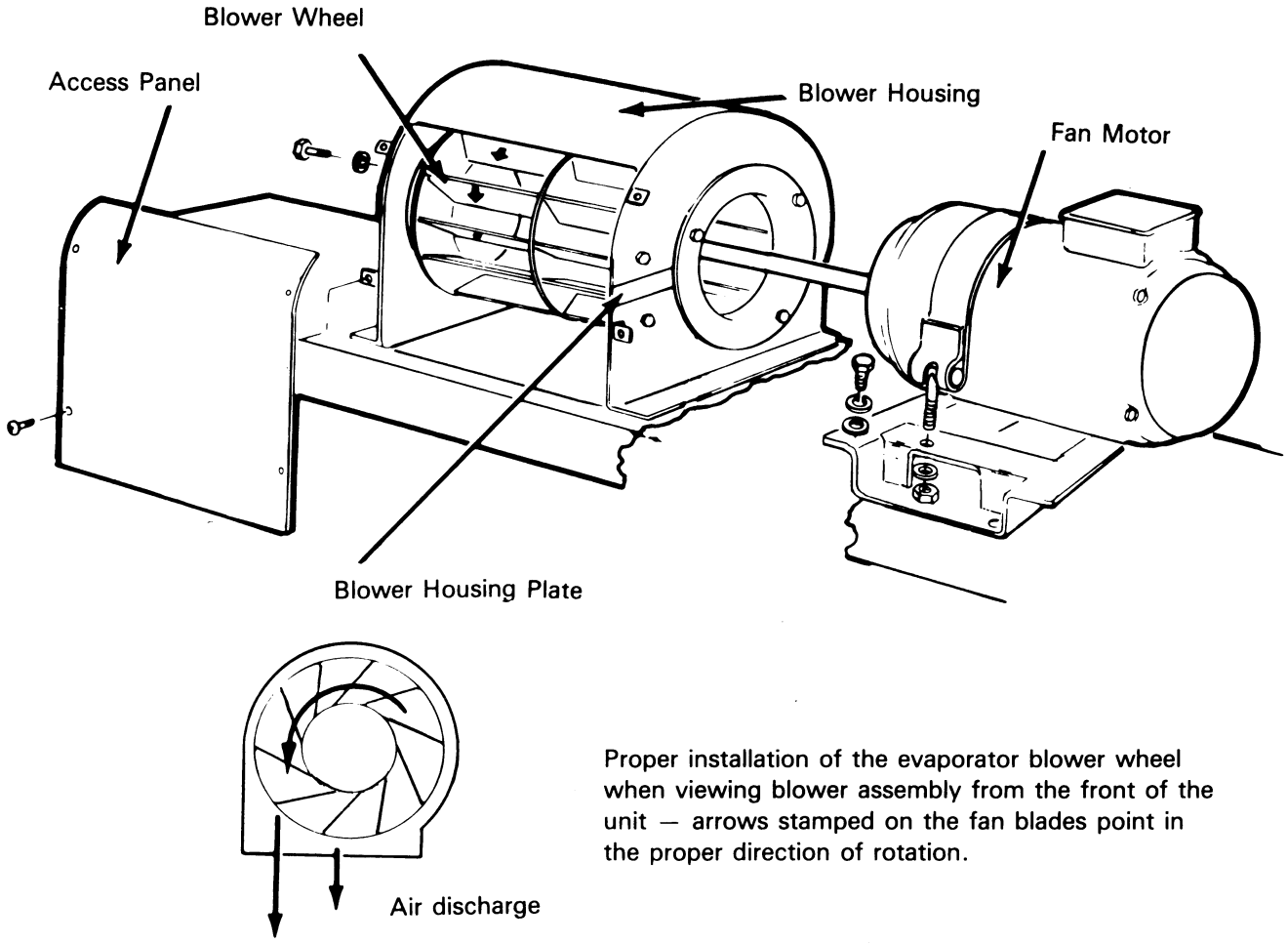
Model CF-II refrigeration systems use a backward inclined blower wheel that is different from typical forward curved wheels. The blower blades on a backward inclined blower wheel are tilted away from the direction of blower rotation. Instead of scooping air like a forward curved blade, the backward inclined blade compresses and pushes the air out the discharge opening with a slapping action.

The evaporator blower motors may be removed by loosening 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 the inlet ring on the fan motor end of the blower housing. Remove blower wheel, inlet ring and fan motor assembly from the evaporator. Remove the blower wheel and inlet ring from the motor shaft.

Whenever the evaporator blower wheels and motors 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 and blower wheel on the shaft of the replacement motor. Before tightening the blower wheel hub mounting screw, place the blower wheel and motor assembly in the evaporator section. Install and tighten the motor assembly strap. Center the blower wheel in the blower housing. The blower wheel must overlap both rings equally. Tighten the blower wheel motor hub on the 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 access panel using mounting hardware.



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.

Evaporator Blower Wheel Location

RECORDING THERMOMETER CALIBRATION AND OPERATION (TRLW)

The recording thermometer should be inspected and cleaned to ensure that the stylus produces smooth clean lines and records accurate temperature readings. The chart drive motor is spring wound.

1. Marking system.

   To change the charts, remove the knurled knob from the drive shaft and remove the chart. When placing a new chart on the shaft, make sure the edges of the chart are under the four clips. Check the time indicated by the stylus on the chart and tighten the drive shaft knob. Clean the stylus occasionally to ensure smooth clean lines.

   In order to operate the stylus with the door open for the purpose of checking or zeroing the control, the lifter arm can be locked in this lowered position by pushing down on the lifter arm shaft and rotating the arm on its pivot point. If the lifter arm does not retract away from the stylus when the door is closed, reposition the arm on the shaft by loosening the Allen screw on the lifter arm.

   If there is insufficient pressure on the stylus to mark the chart, carefully grip the pivot end of the stylus arm where it is riveted to the stamping with a pair of long-nosed pliers. Bend the stamping toward the instrument.

   Care must be used not to bend the stylus arm, but only the stamping to which it is attached.

   After adjustment of the stylus, check the calibration of the thermometer and recalibrate if necessary.

   NOTE: The stylus line will be improved under operating conditions over the line drawn under the manual test conditions due to the much slower operating movement of the chart during actual operation.

   Periodically wipe the chart platen with a clean, damp cloth to remove material transferred from the back of the chart to the platen by the pressure of the stylus.

2. Checking the calibration.

   NOTE: The calibration of the recording thermometer may also be checked periodically while the container is in transit. Plug the return air thermistor lead located in the unit control box into an electronic thermometer. Compare the return air temperature reading on the recording thermometer with the reading on the electronic thermometer.

   When checking the calibration:

   a. Use an accurate test instrument like the Simpson Temperature Gauge (TK Part Number 204-135) or equivalent.

   b. Plug the return air thermistor lead located in the unit control box into the electronic thermometer.

   c. Remove the recording thermometer sensing bulb and the return air thermistor lead bulb from evaporator section.

   d. 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 32.0 F (0.0 C).

   e. Place the recording thermometer sensing bulb and the return air thermistor lead bulb in the ice water bath. Wait for 2 minutes to allow the sensor temperatures to stabilize.

   f. 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.

   g. If the average difference is 1.0 F (0.6 C) or less, DO NOT attempt to recalibrate.

   h. Remove the recording thermometer sensing bulb and the return air thermistor lead bulb from the ice water bath. Replace the recording thermometer sensing bulb and the return air thermistor lead bulb in the evaporator section.

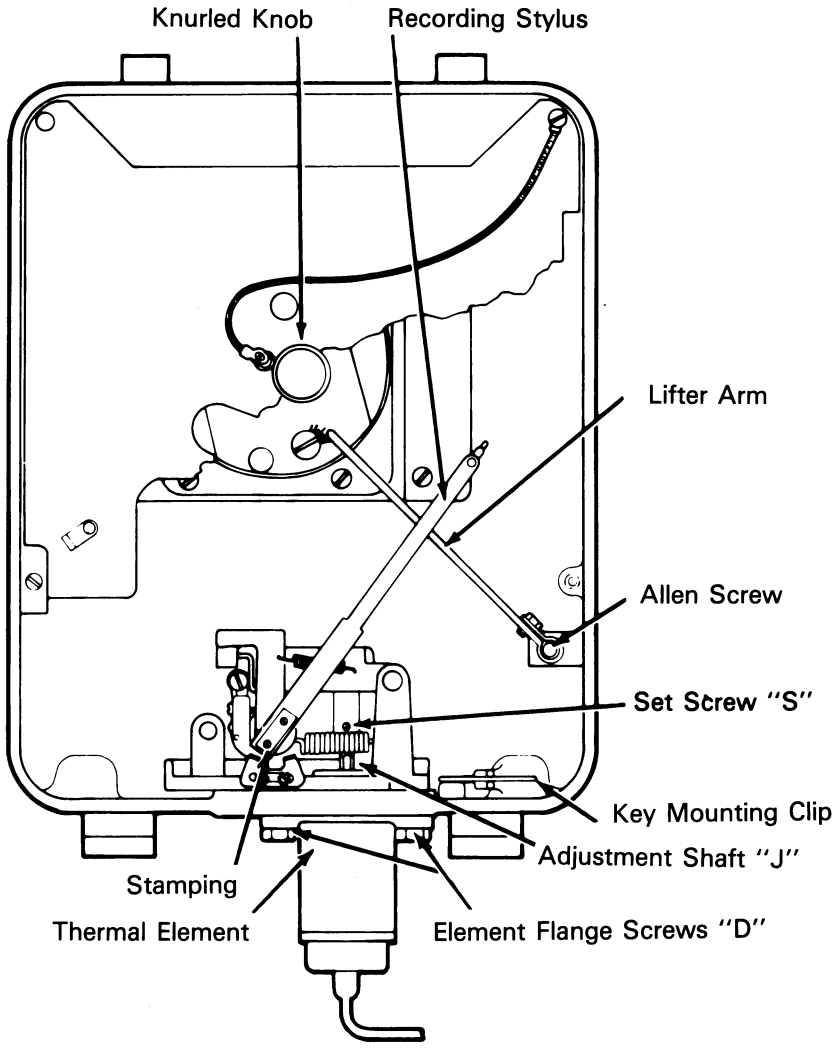
3. Recalibrating the Recorder.

   If the recorder needs recalibration:

   a. Stop the unit.

   b. Loosen the Allen setscrew (S) and adjust shaft (J) (with the wrench provided in the recorder box) until the recording stylus pointer is aligned to the temperature reading that agrees with the test instrument. If the readings were lower than the test instrument readings, the shaft must be turned to the left (clockwise). If the reading was higher than the test instrument reading, the shaft (J) must be turned to the right (counterclockwise).

   c. Retighten Allen setscrew (S).



Recording Thermometer

4. Element replacement.

   The recording thermometer's thermal element is field replaceable. To replace the element:

   a. Remove element flange screws (D) and withdraw the thermal element from the recorder case. Care must be taken not to bend the hex shaft which extends from the recorder case into the thermal element.

   b. Install a new thermal element in the recorder case. The capillary of the new thermal element may be bent, but DO NOT bend the bulb.

   c. Replace the element flange screws (D) and tighten securely.

   d. After the temperature has "settled out," check the calibration of the recorder, repeating Step 2, "Checking the Calibration." If calibration is necessary, repeat Step 3, "Recalibrating the Recorder."

Mechanical Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Compressor does not run — 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, 15 KVA auto transformer, power selector switch, main power circuit breaker, CB2 circuit breaker to Microprocessor, motor contactor, motor terminals, motor.
	Compressor motor overload relay tripped	Check for high head pressure, tight bearings, stuck pistons, clogged condenser coil or defective condenser fan motor
	Open in 12V dc or 24 ac control circuit	Check circuit breakers and On-Off switch. Repair as required.
	Overload relay defective.	Replace overload relay.
	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 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 drive motor.	Replace motor.
Compressor does not run — excessive amperage draw or intermittent cycling on overload	Piston stuck.	Remove compressor head. Look for broken valve and jammed parts.
	Frozen compressor or motor bearings.	Repair or replace compressor or motor.
	Shorted motor windings.	Repair or replace motor.

CONDITION	POSSIBLE CAUSE	REMEDY
Compressor does not run — excessive amperage draw or intermittent cycling on overload (continued)	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 motor winding.	Check motor stator connections. Check stator winding for continuity. If open, replace motor.
	Stator winding grounded.	Test for grounded winding. If grounded, replace motor.
	Tight 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 and condenser fan grille.
Noisy Unit	Insufficient compressor oil.	Add oil to proper level.
	Loose mounting bolts	Tighten mounting bolts.
	Oil slugging or refrigerant flooding back.	Adjust oil or refrigerant charge. Check expansion valve adjustment.
	Worn fan motor bearings.	Replace bearings or motor.
	Faulty compressor	Repair or replace compressor.

CONDITION	POSSIBLE CAUSE	REMEDY
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.
Condenser fan motor does not run	Unit on Null, Heat or Defrost.	Check indicator lights.
	Loose line connection.	Tighten connections.
	Defective motor.	Replace motor.
	Defective low or high speed condenser fan contactor.	Replace defective contactor.
	Defective low or high speed condenser fan contactor relay.	Replace defective contactor relay.
	No low speed or high speed condenser fan output signal from Microprocessor.	Replace Microprocessor.
Evaporator fan motor(s) does not run	Unit on defrost.	Check operating mode status indicators.
	Loose line connection.	Tighten connections.
	Defective motor.	Replace motor.
	Defective low speed or high speed evaporator fan contactor.	Replace defective contactor.
	Defective low speed or high speed evaporator fan contactor relay.	Replace defective relay.
	No low speed or high speed evaporator fan output signal from Microprocessor.	Replace Microprocessor.

Refrigeration Diagnosis

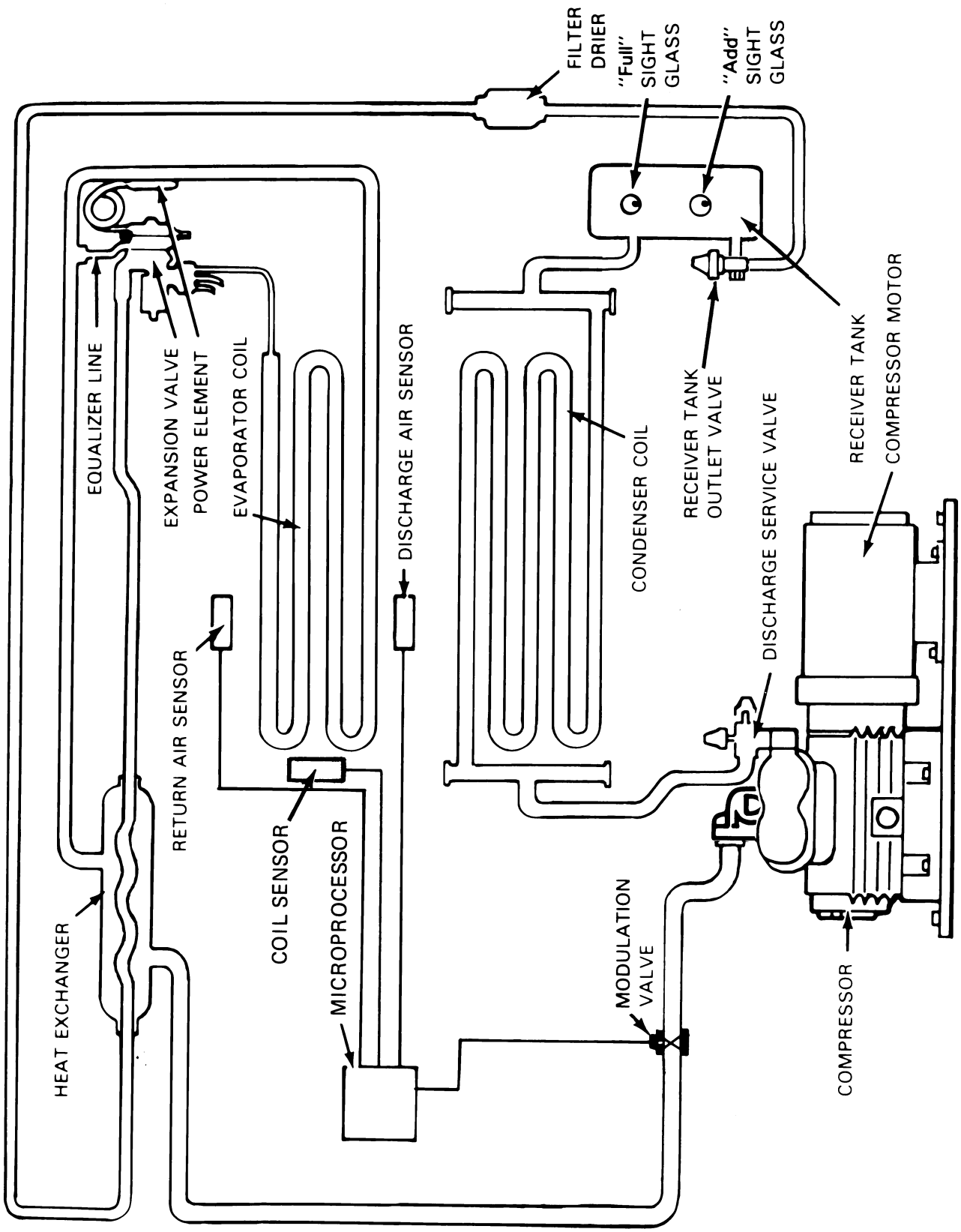
CONDITION	POSSIBLE CAUSE	REMEDY
Unit operating in a vacuum.	Shortage of refrigerant.	Repair leak and recharge.
	Compressor motor contacts frozen.	Clean points or replace contactor
	Compressor motor contactor relay defective.	Replace defective relay.
	Compressor inefficient.	Check valves and pistons.
	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.
	Compound gauge out of calibration.	Replace compound 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 section) or replace Microprocessor.
	Expansion valve feeler bulb improperly mounted or making poor contact.	Correct feeler bulb installation.
Load temperature too high (unit not cooling).	Compressor does not run	See "Mechanical Diagnosis".
	Shortage of refrigerant.	Repair leak and recharge.
	Overcharge of refrigerant.	Purge system.
	Air in refrigeration system.	Evacuate and recharge.

CONDITION	POSSIBLE CAUSE	REMEDY
Load temperature too high (unit not cooling) (continued).	Microprocessor out of calibration or defective.	Recalibrate (see "Calibration Procedure" in Electrical Maintenance section) or replace Microprocessor.
	Microprocessor set point too high.	Adjust Microprocessor set point.
	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.
	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.
Head pressure too low. *NOTE: This unit has a suction modulation capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is on Modulation Cool (control temperature within 18.0 F [10.8 C] above setpoint) or in Power Limit mode.*	Shortage of refrigerant.	Repair leak and recharge.
	Compressor suction or discharge valve inefficient.	Clean or replace leaking valve plates.
	Low ambient air temperature.	No remedy.
	Service gauge out of calibration.	Replace gauge.

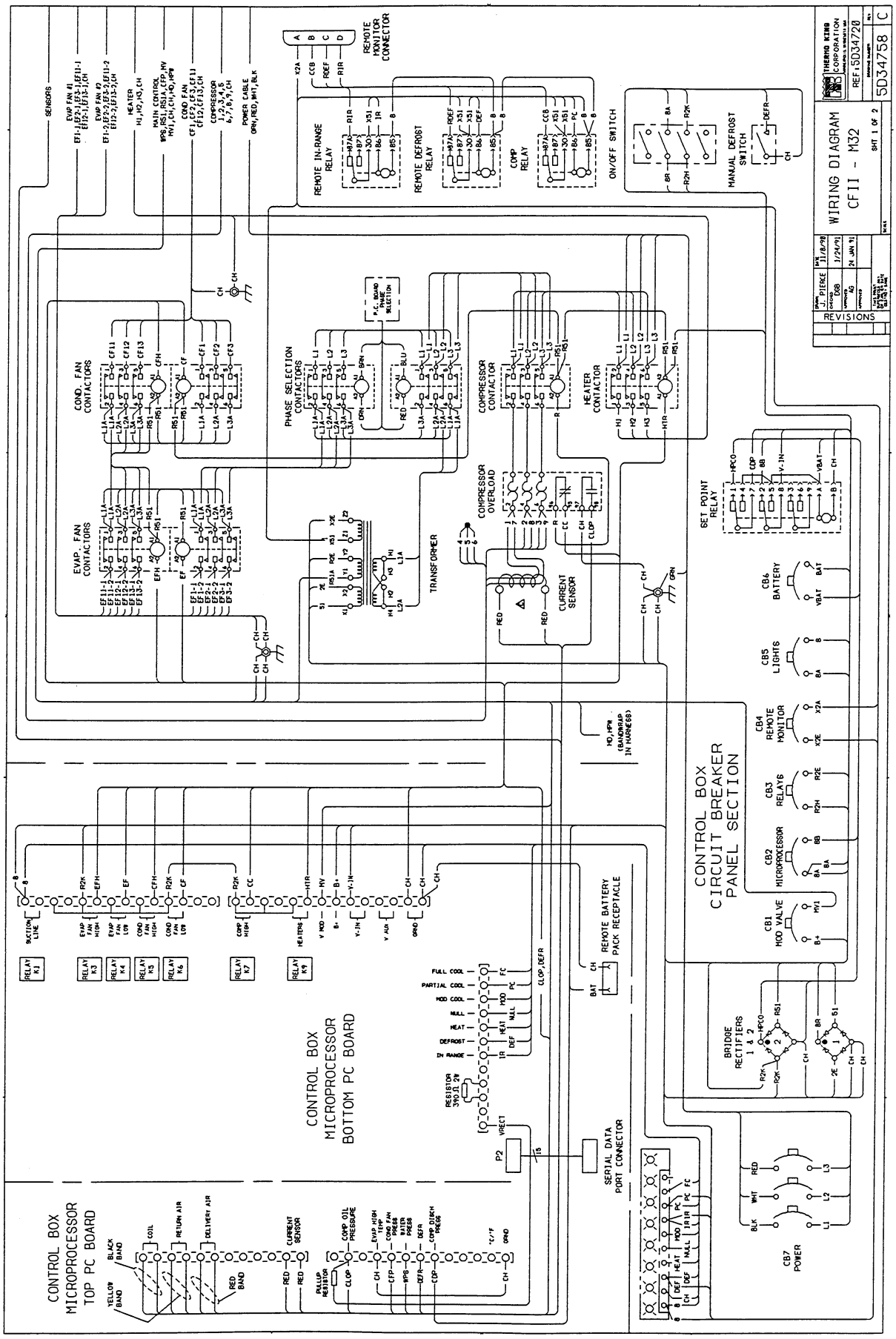
CONDITION	POSSIBLE CAUSE	REMEDY
Head pressure too high.	Refrigerant overcharge.	Purge system.
	Air in refrigeration system.	Evacuate and recharge.
	Dirty or restricted condenser coil.	Clean condenser coil.
	Defective condenser fan pressure switch.	Replace switch.
	Condenser fan not running.	See "Condenser fan motor does not run" 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.
	Defective service gauge.	Replace gauge.
Compressor loses oil.	Refrigerant leak.	Repair leak and recharge.
Compressor oil migrates to system.	Short cycling.	See "Unit Short Cycles" under Mechanical Diagnosis.
Rapid cycling between Cool, Null and Heat modes.	Air short cycling through evaporator.	Check and correct cargo load.
	Microprocessor out of calibration.	Recalibrate (see "Calibration Procedure" in Electrical Maintenance section) or replace Microprocessor.
	Short cycling.	See "Unit Short Cycles" under Mechanical Diagnosis.
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 fan does not operate.	See "Evaporator fan motor does not run" under Mechanical Diagnosis.

CONDITION	POSSIBLE CAUSE	REMEDY
Hot liquid line.	Shortage of refrigerant.	Repair and recharge.
	Expansion valve open too wide.	Adjust or replace expansion valve.
Frosted liquid line.	Receiver tank shut-off valve partially closed or restricted.	Open valve or remove restriction.
	Restricted dehydrator.	Replace dehydrator.
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 section) or replace Microprocessor.
	Compound gauge out of calibration.	Adjust or replace compound gauge.
Low suction pressure. *NOTE: This unit has a suction modulation capacity control system. Suction and discharge pressures may drop below expected normal readings when the unit is on Modulation Cool (Container temperature within 18.0 F [10.8 C] above setpoint) or in Power Limit mode.*	Shortage of refrigerant.	Repair leak and recharge.
	Low ambient 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 fans off.	Check evaporator fan motors and control circuit and correct fault.
	Microprocessor out of calibration.	Recalibrate (see "Calibration Procedure" in Electrical Maintenance section) or replace Microprocessor.
	Compound gauge out of calibration.	Adjust or replace gauge.

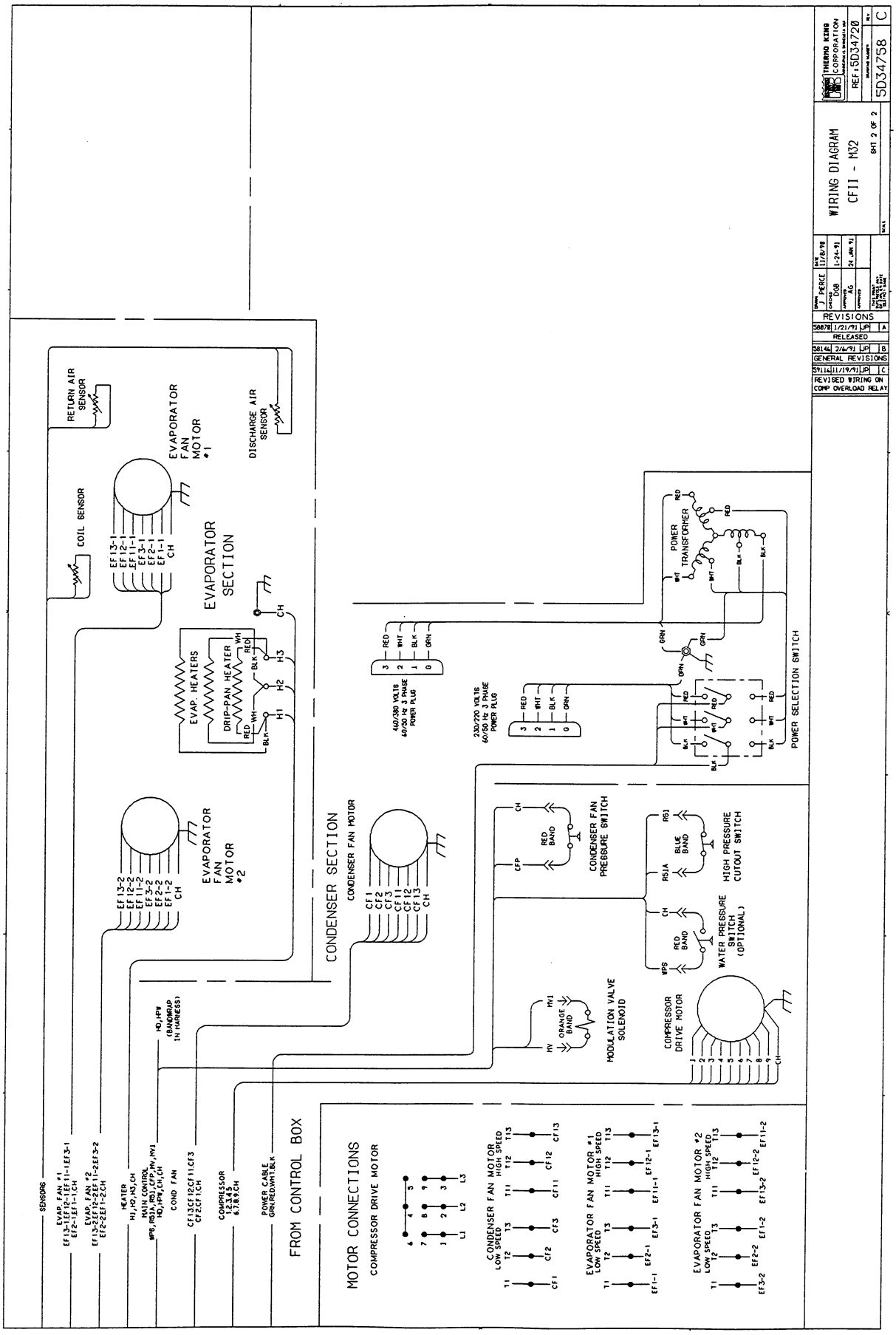
Refrigeration Diagram



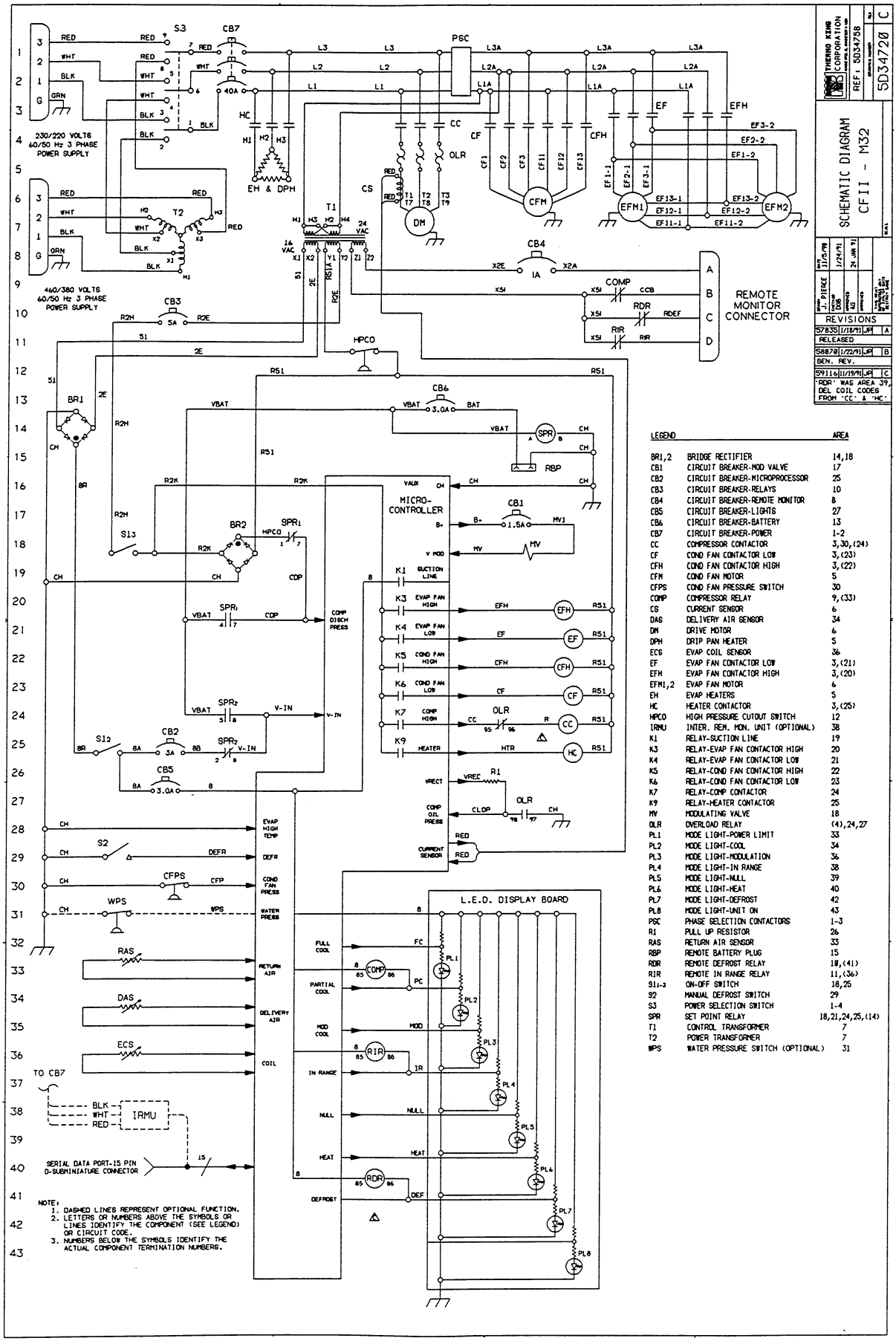
CF-II M32 & M32A Wiring Diagram — Sheet 1 of 2



CF-II M32 & M32A Wiring Diagram — Sheet 2 of 2

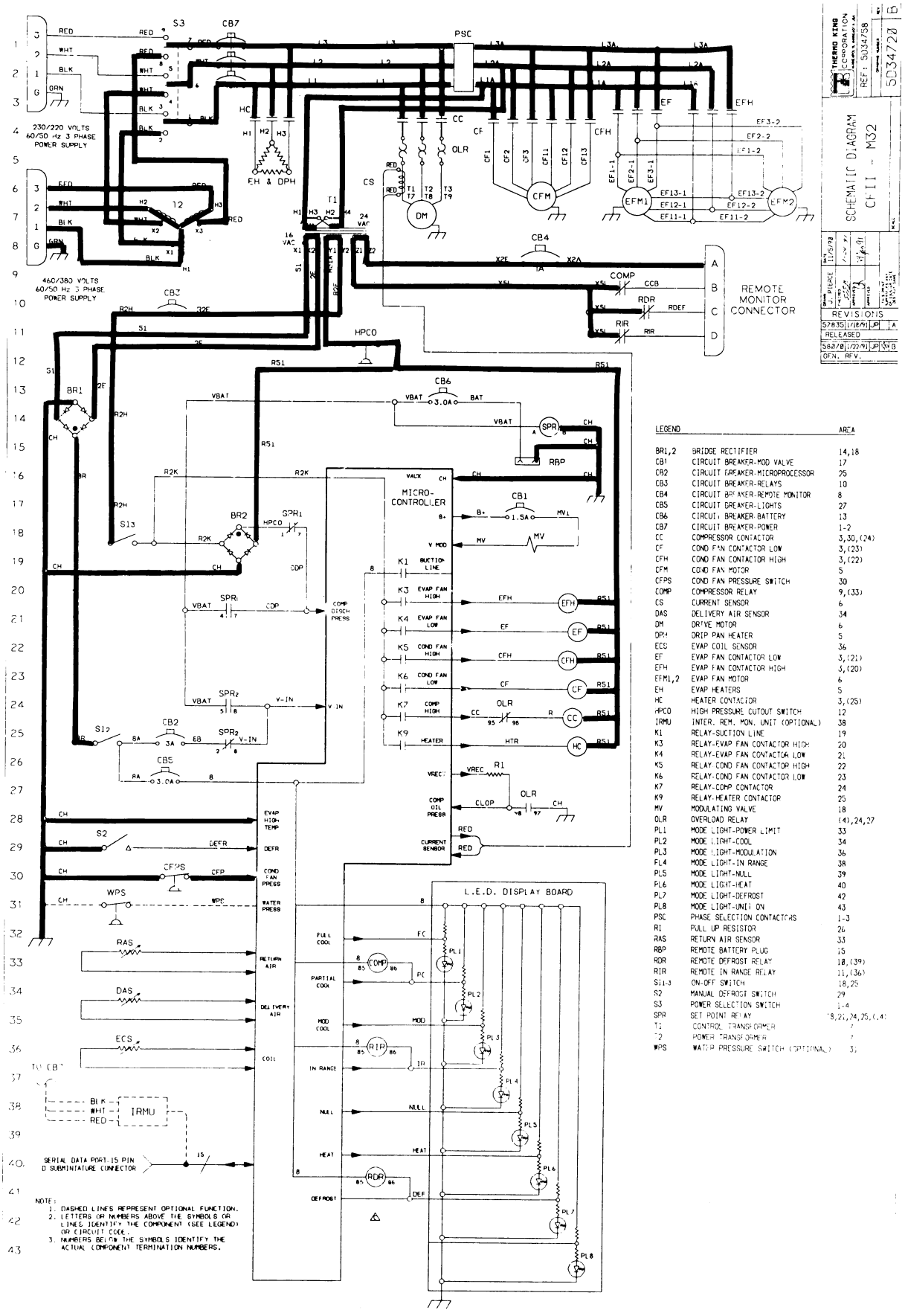


CF-II M32 and M32A Wiring Schematic



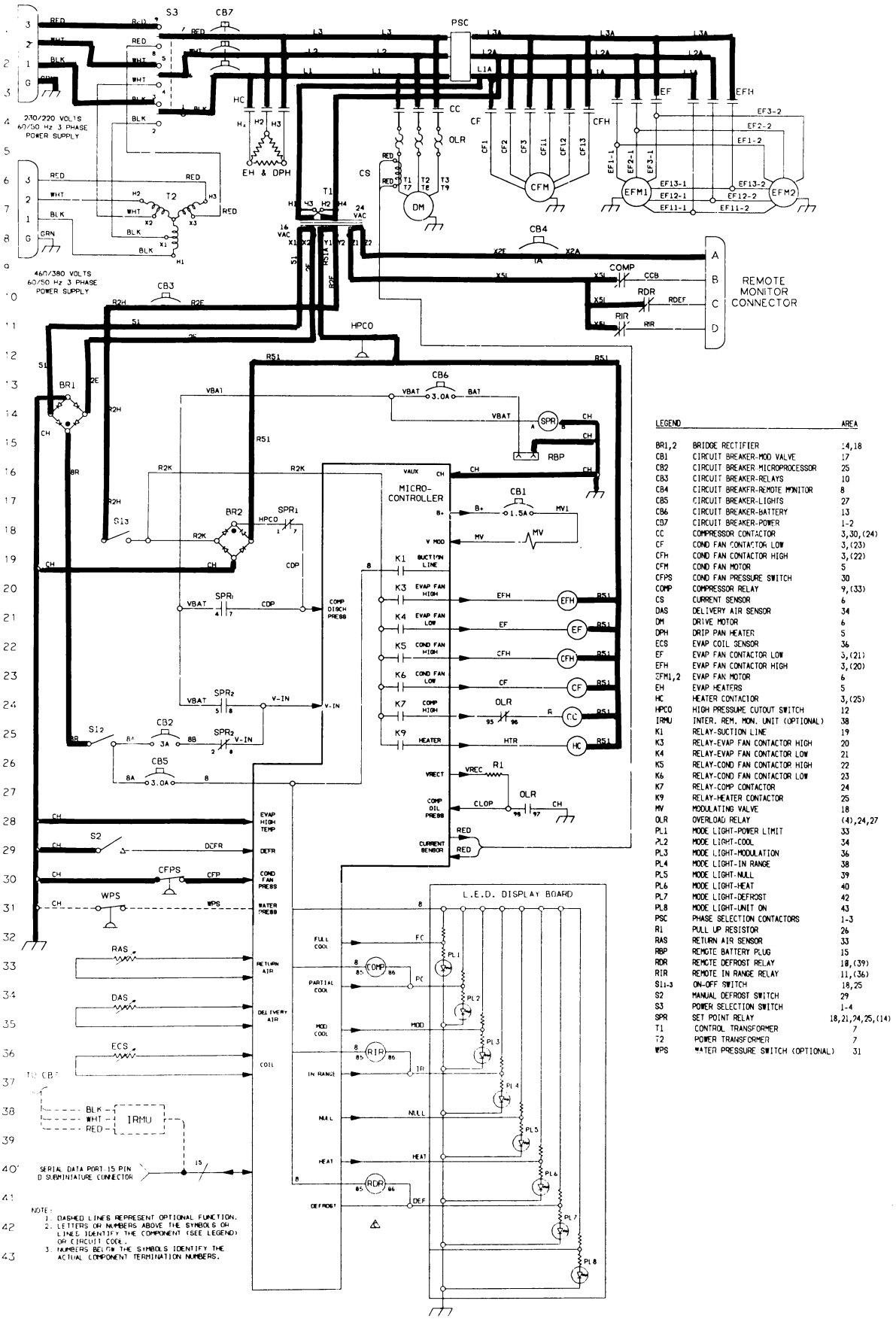
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTER. REM. MON. UNIT (OPTIONAL)	38
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
RI	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(41)
RIR	REMOTE IN RANGE RELAY	11,(36)
S11-3	ON-OFF SWITCH	18,25
S2	MANUAL DEFROST SWITCH	29
S3	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

460/380V AC Power Supply to Unit



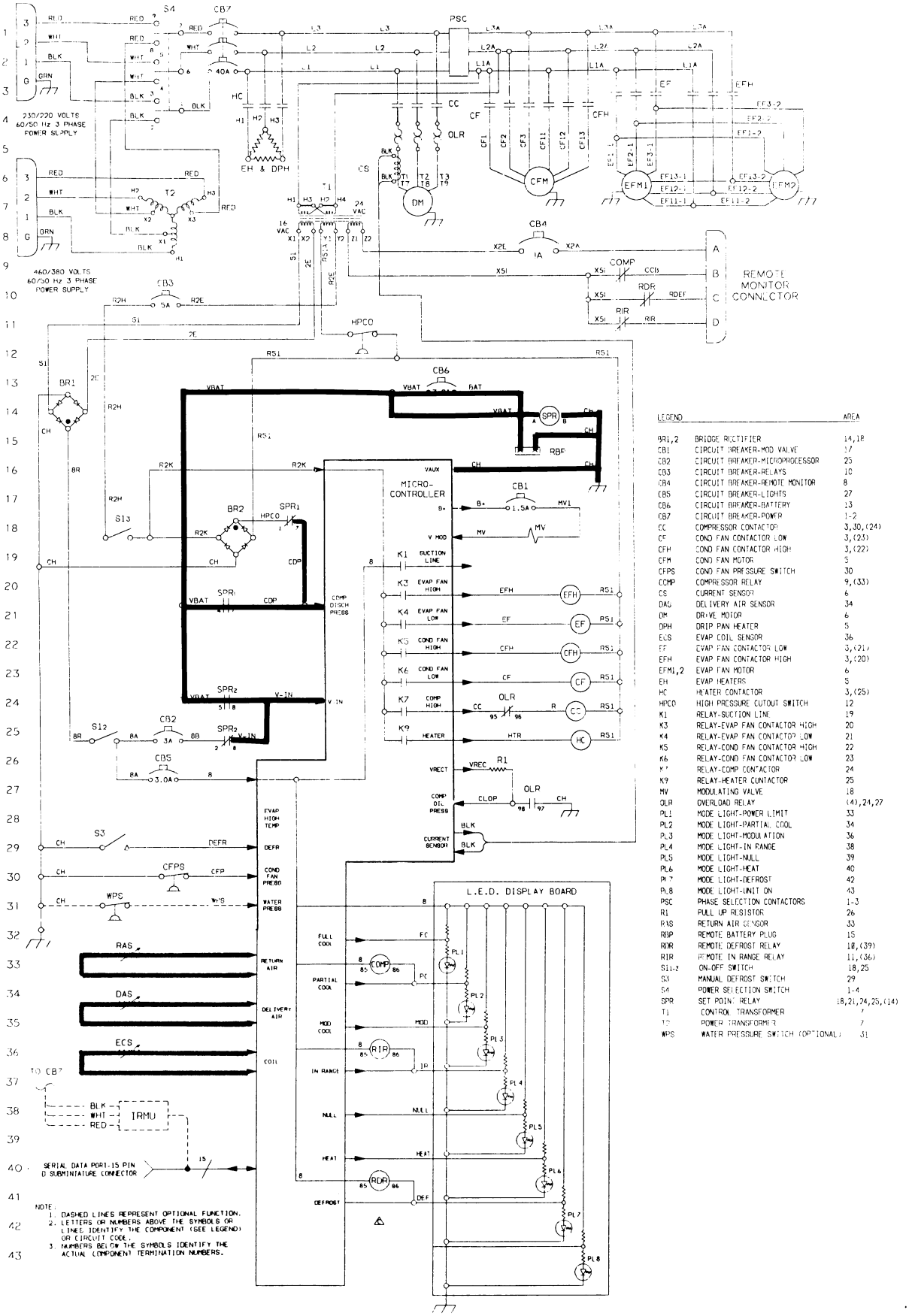
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTER. REM. MON. UNIT (OPTIONAL)	38
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S11-3	ON-OFF SWITCH	18,25
S2	MANUAL DEFROST SWITCH	29
S3	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(.4)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

230/190V AC Power Supply to Unit



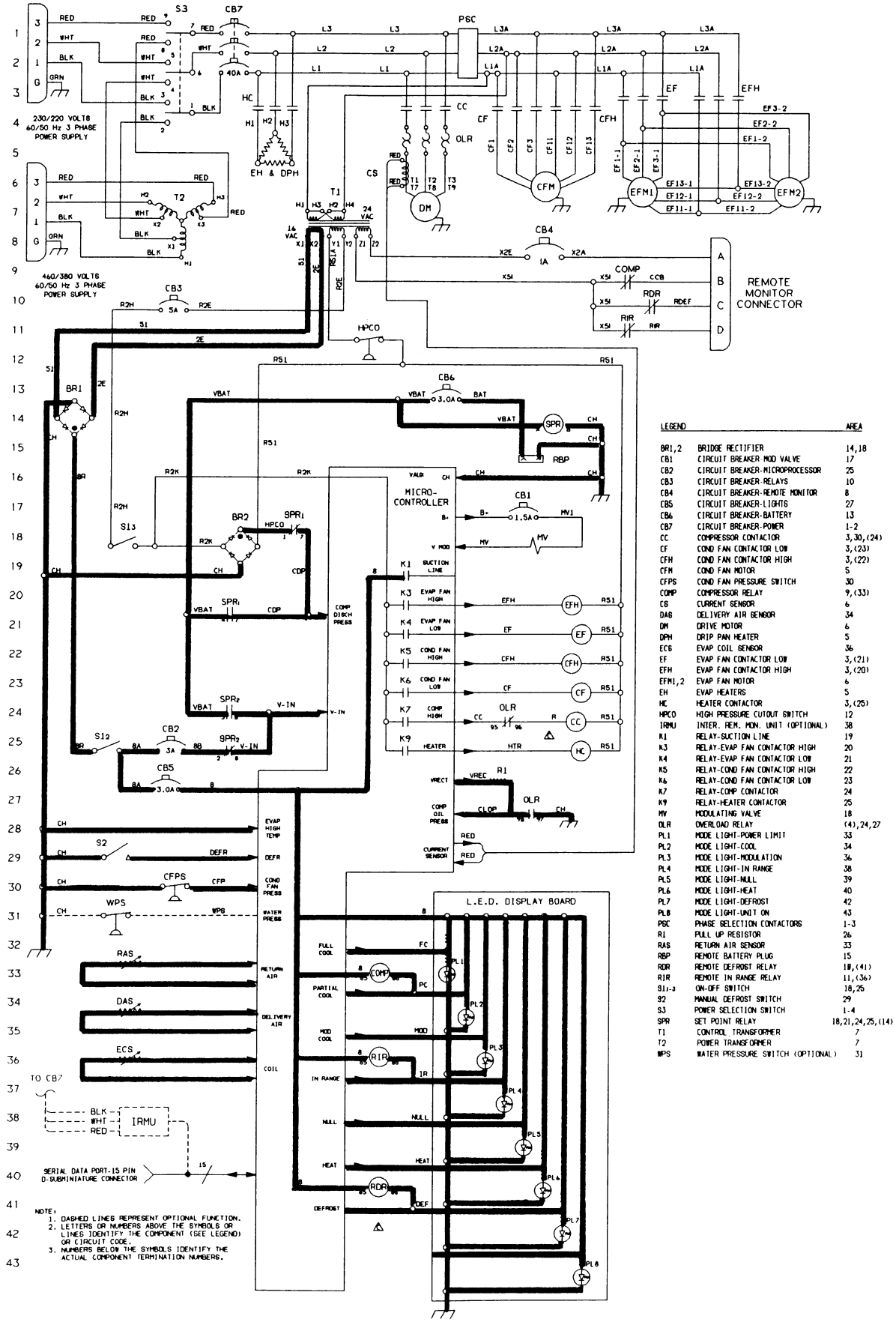
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTER. REM. MON. UNIT (OPTIONAL)	38
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	10,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1i-3	ON-OFF SWITCH	18,25
S2	MANUAL DEFROST SWITCH	29
S3	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

External 12V dc Battery Connection



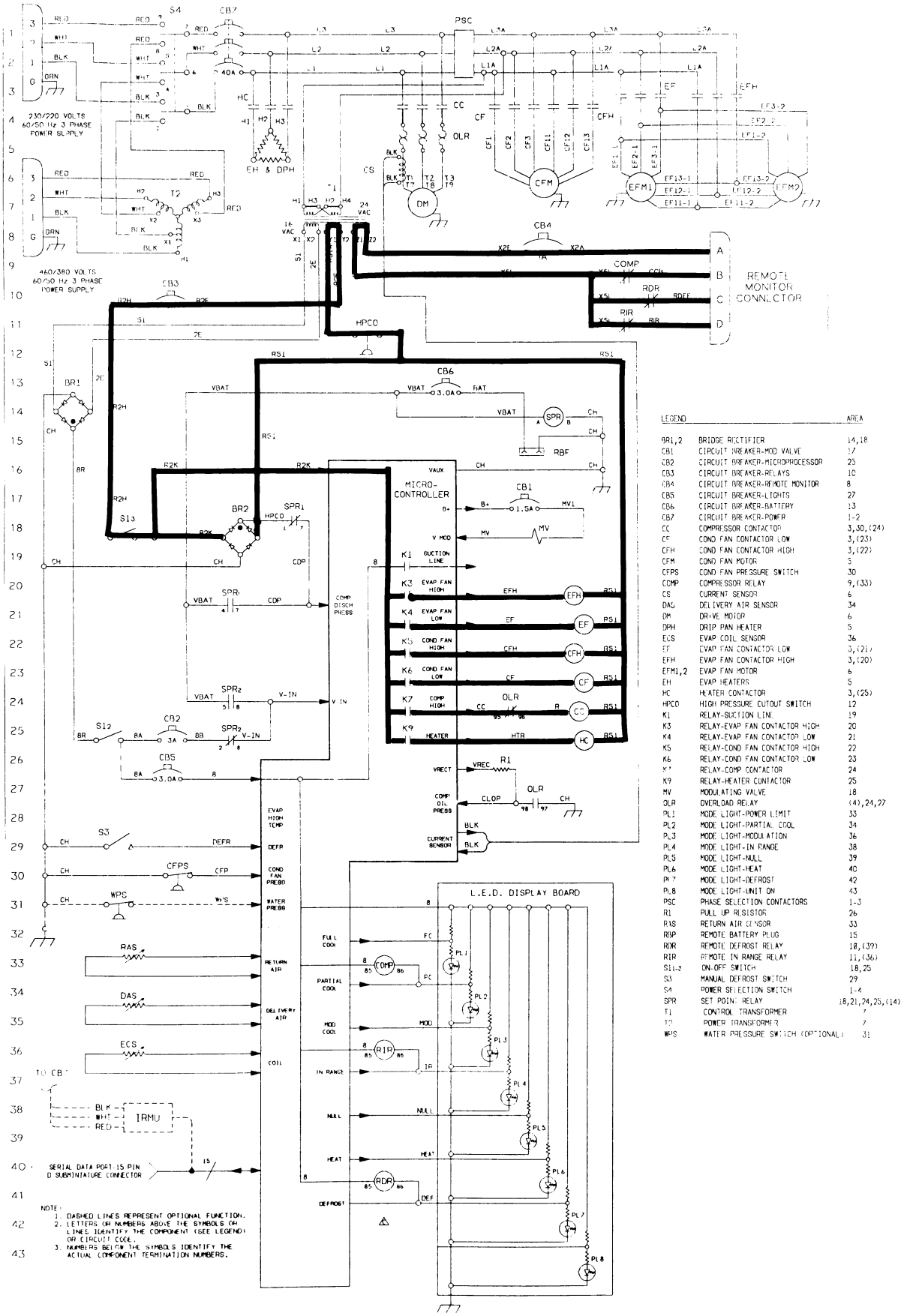
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	10,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S11-2	ON-OFF SWITCH	18,25
S3	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

12.5V dc Control Circuit



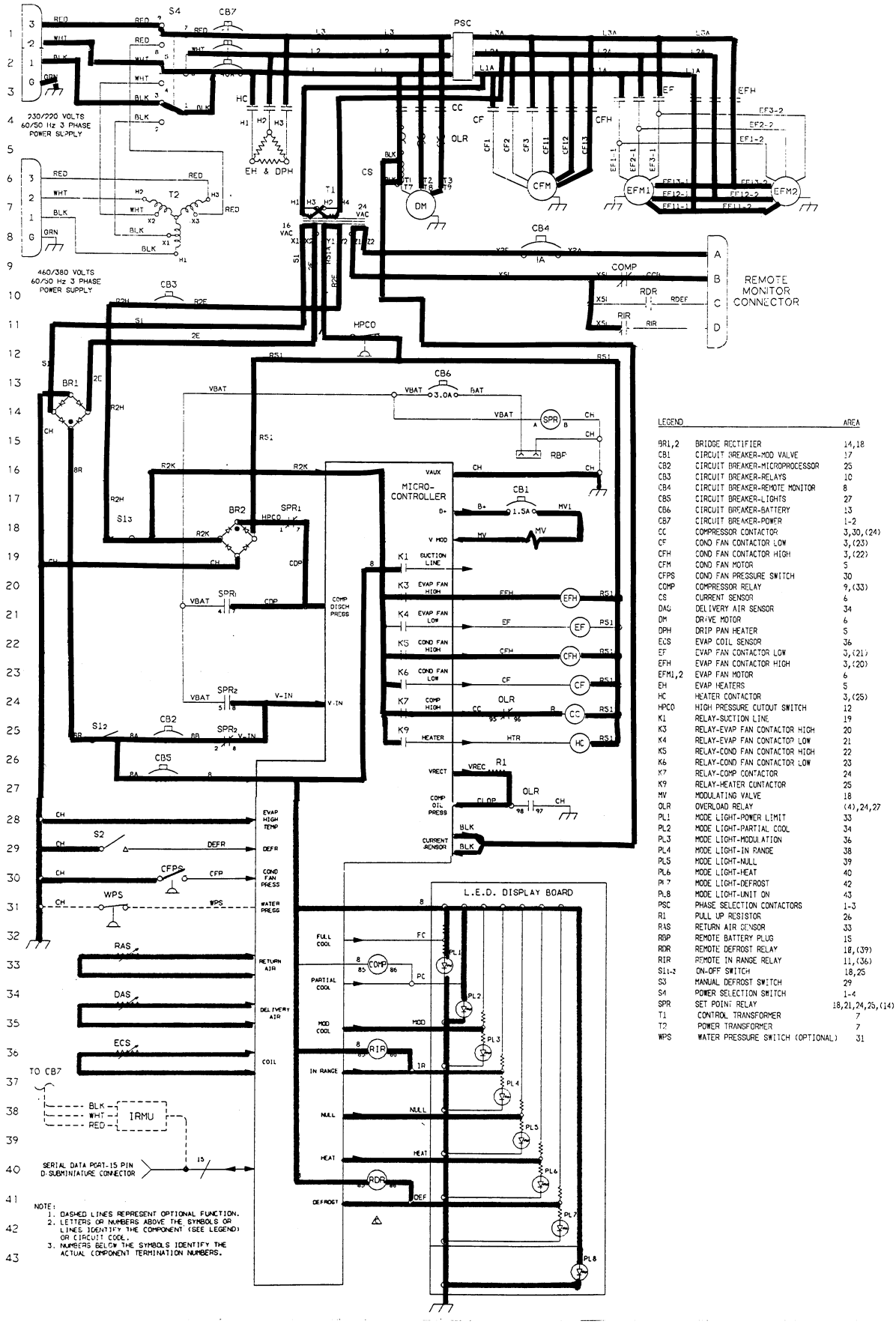
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTER. REM. MON. UNIT (OPTIONAL)	38
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(41)
RIR	REMOTE IN RANGE RELAY	11,(36)
S11-3	ON-OFF SWITCH	18,26
S2	MANUAL DEFROST SWITCH	29
S3	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

24V ac Control Circuit



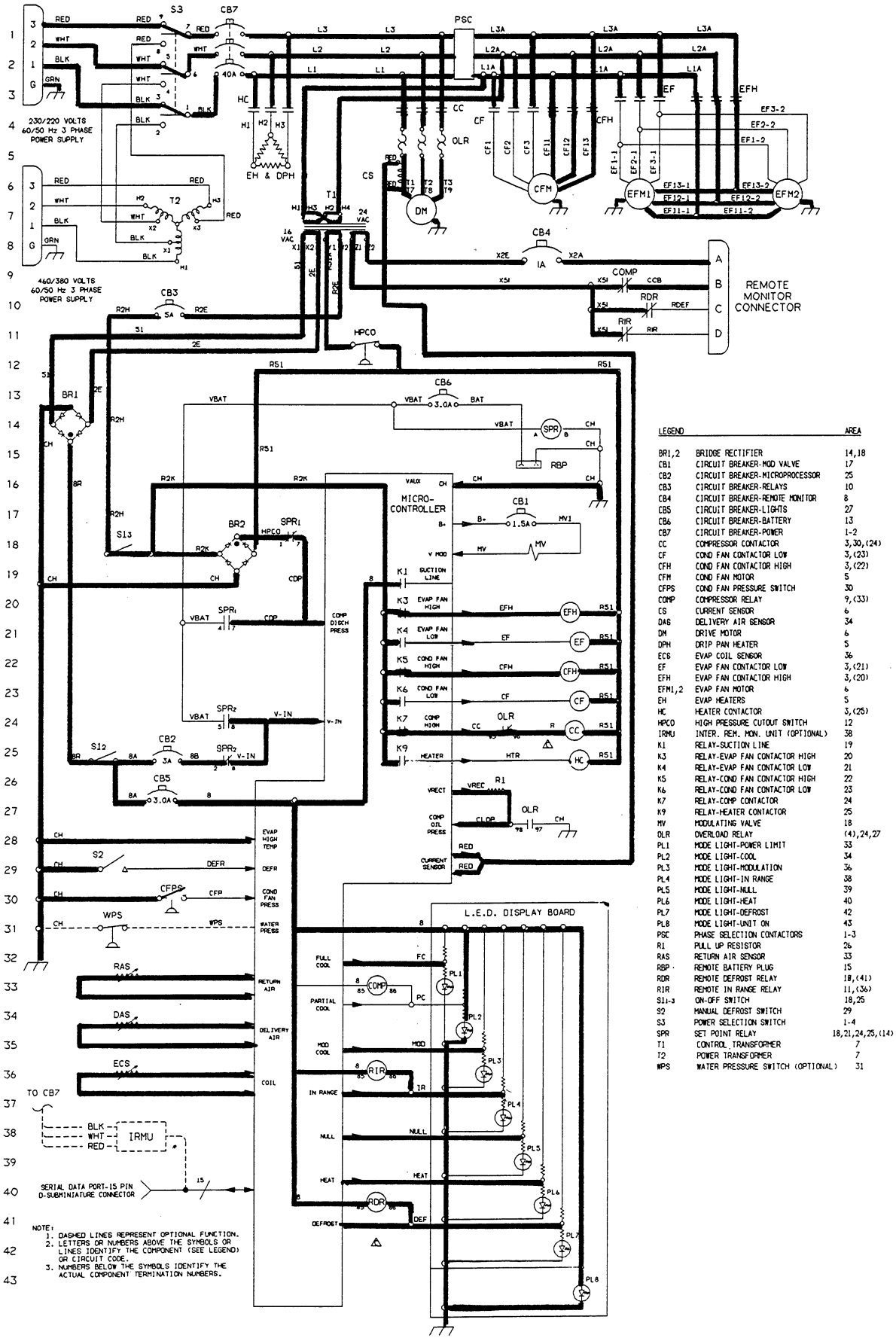
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S11-2	ON-OFF SWITCH	18,25
S3	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Cool Mode—Setpoint above 24 F (-4.4 C), power monitor limiting unit power consumption.



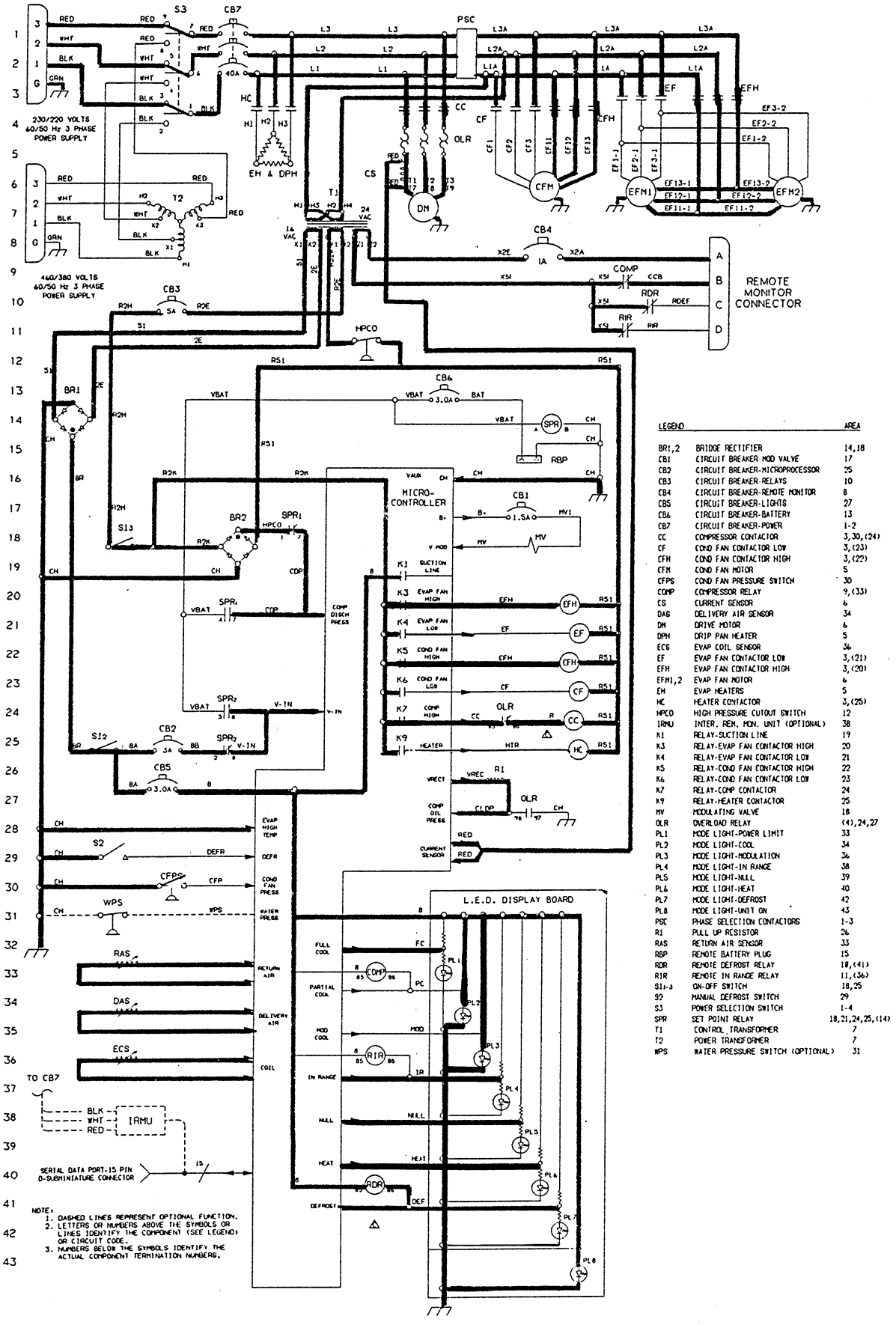
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1-2	ON-OFF SWITCH	18,25
S3	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Cool Mode—Setpoint above 24 F (-4.4 C).



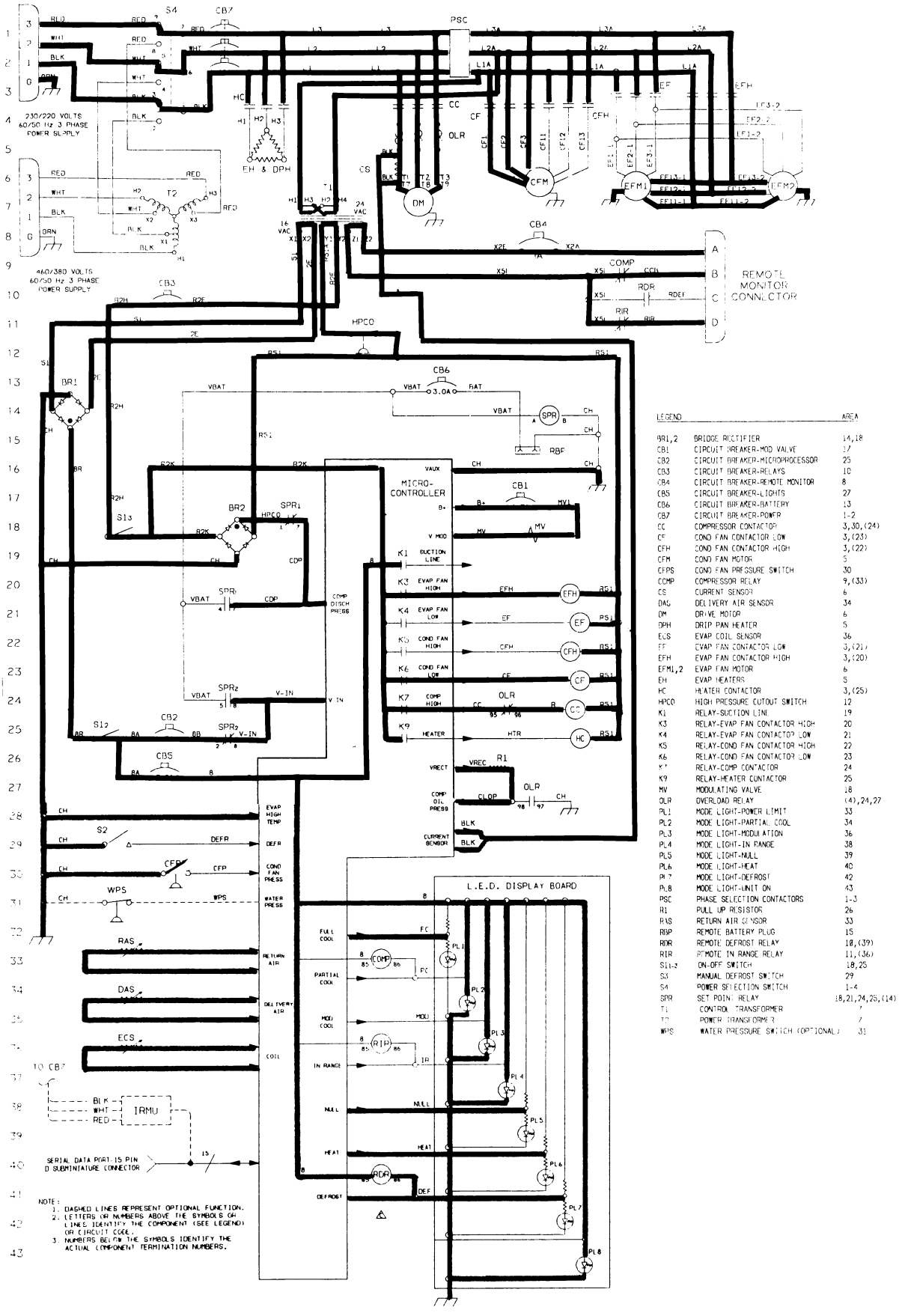
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTER. REM. MON. UNIT (OPTIONAL)	38
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(41)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1,1-3	ON-OFF SWITCH	18,25
S2	MANUAL DEFROST SWITCH	29
S3	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Modulated Cool Mode—Setpoint above 24 F (-4.4 C), high speed condenser fan, temperature out-of-range.



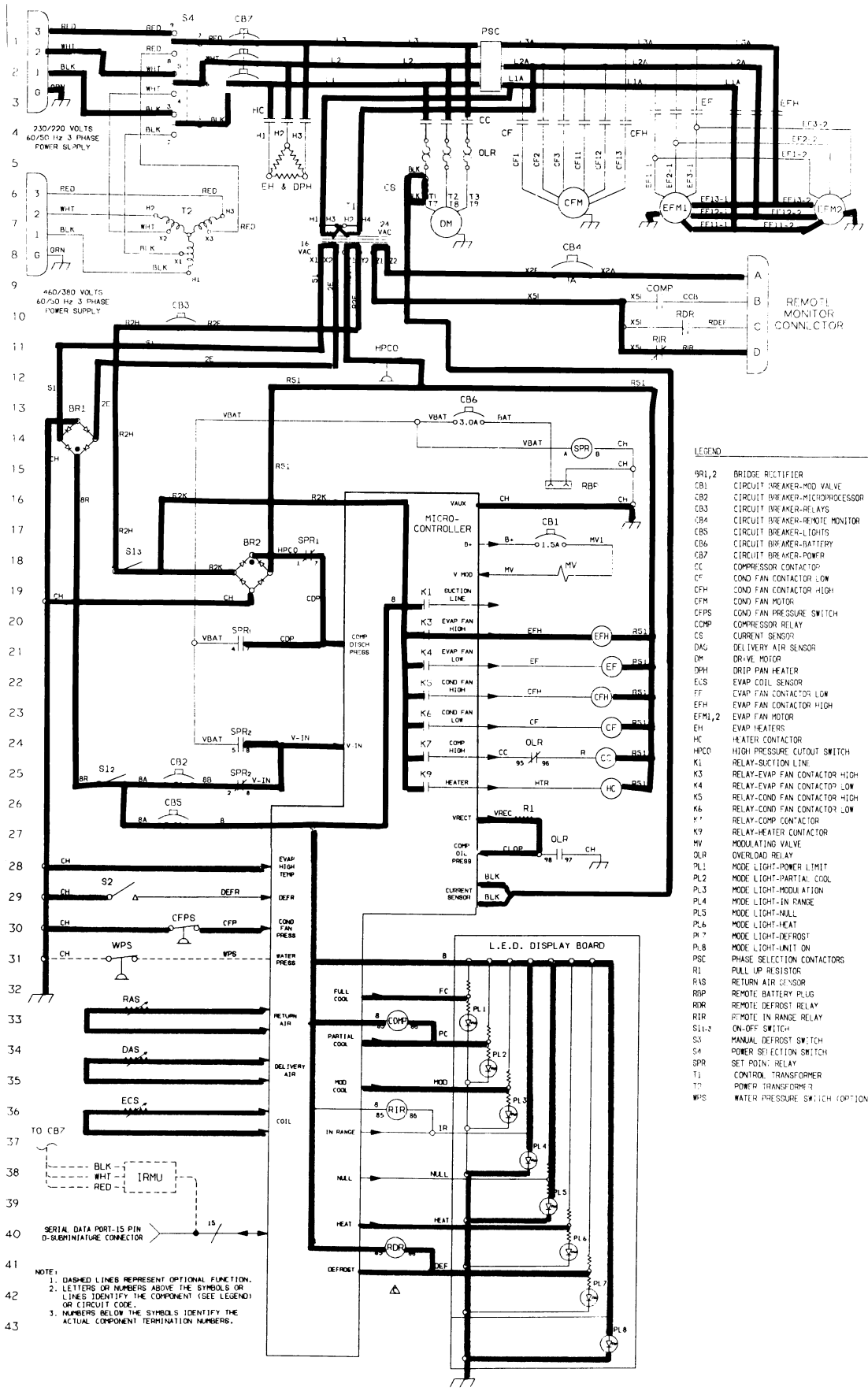
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTER. REM. MON. UNIT (OPTIONAL)	38
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	10,(41)
RIR	REMOTE IN RANGE RELAY	11,(36)
S11-3	ON-OFF SWITCH	18,25
S2	MANUAL DEFROST SWITCH	29
S3	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Modulated Cool Mode—Setpoint above 24 F (-4.4 C), low speed condenser fan, temperature in-range.



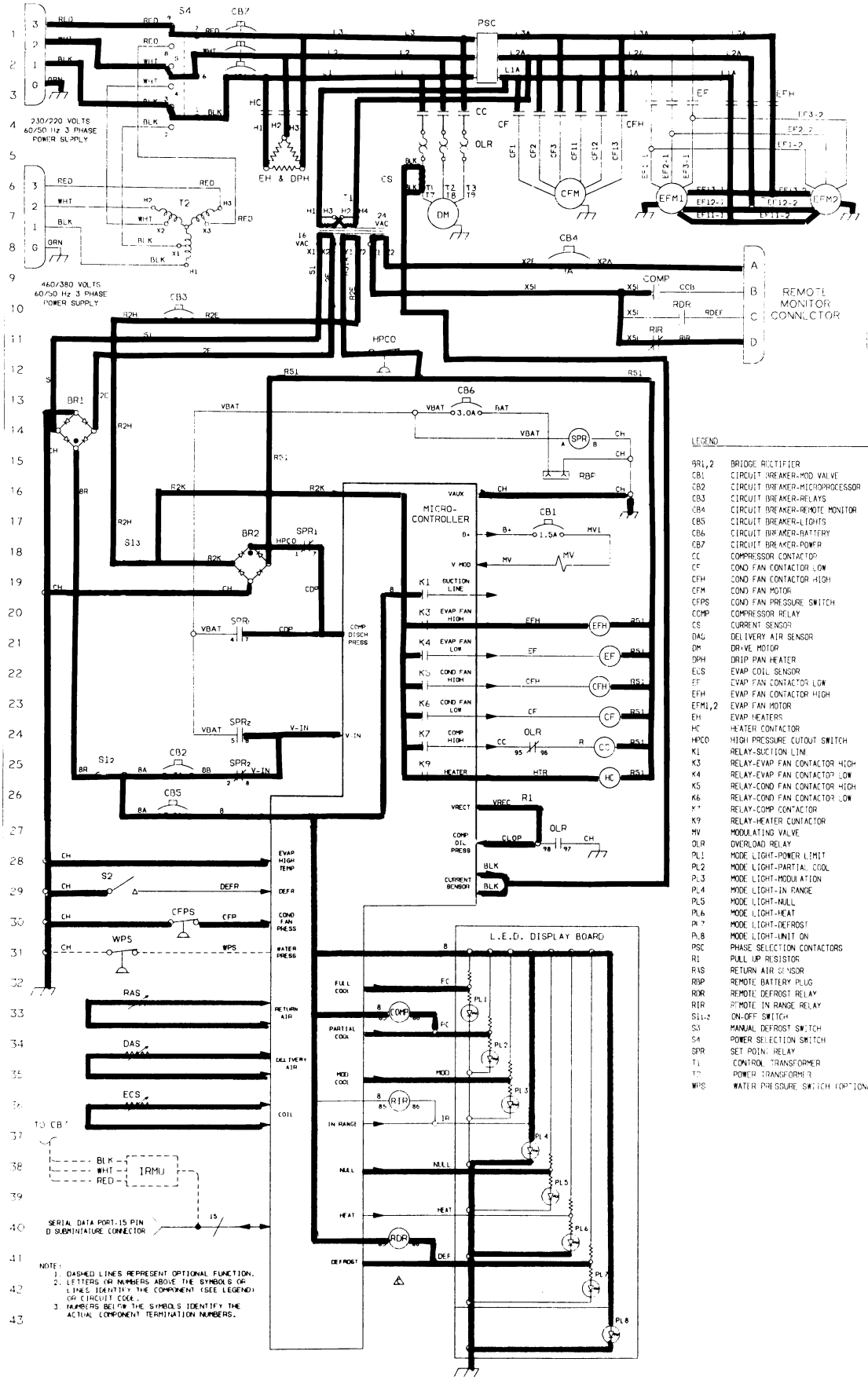
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1-3	ON-OFF SWITCH	18,25
S3	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Null Mode — Setpoint Above 24 F (-4.4 C)



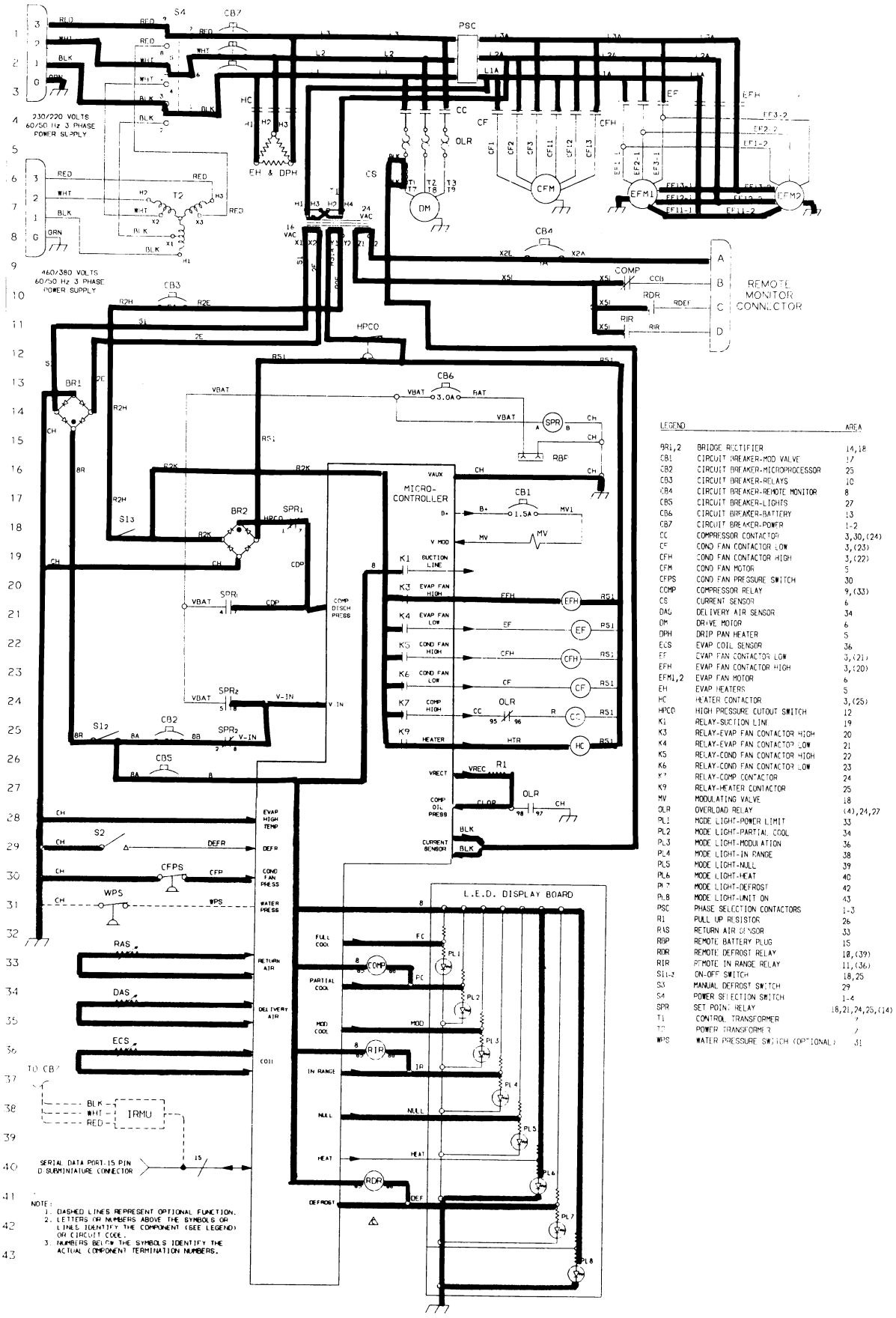
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1,2	ON-OFF SWITCH	18,25
S3	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Heat Mode—Setpoint above 24 F (-4.4 C), temperature in-range.



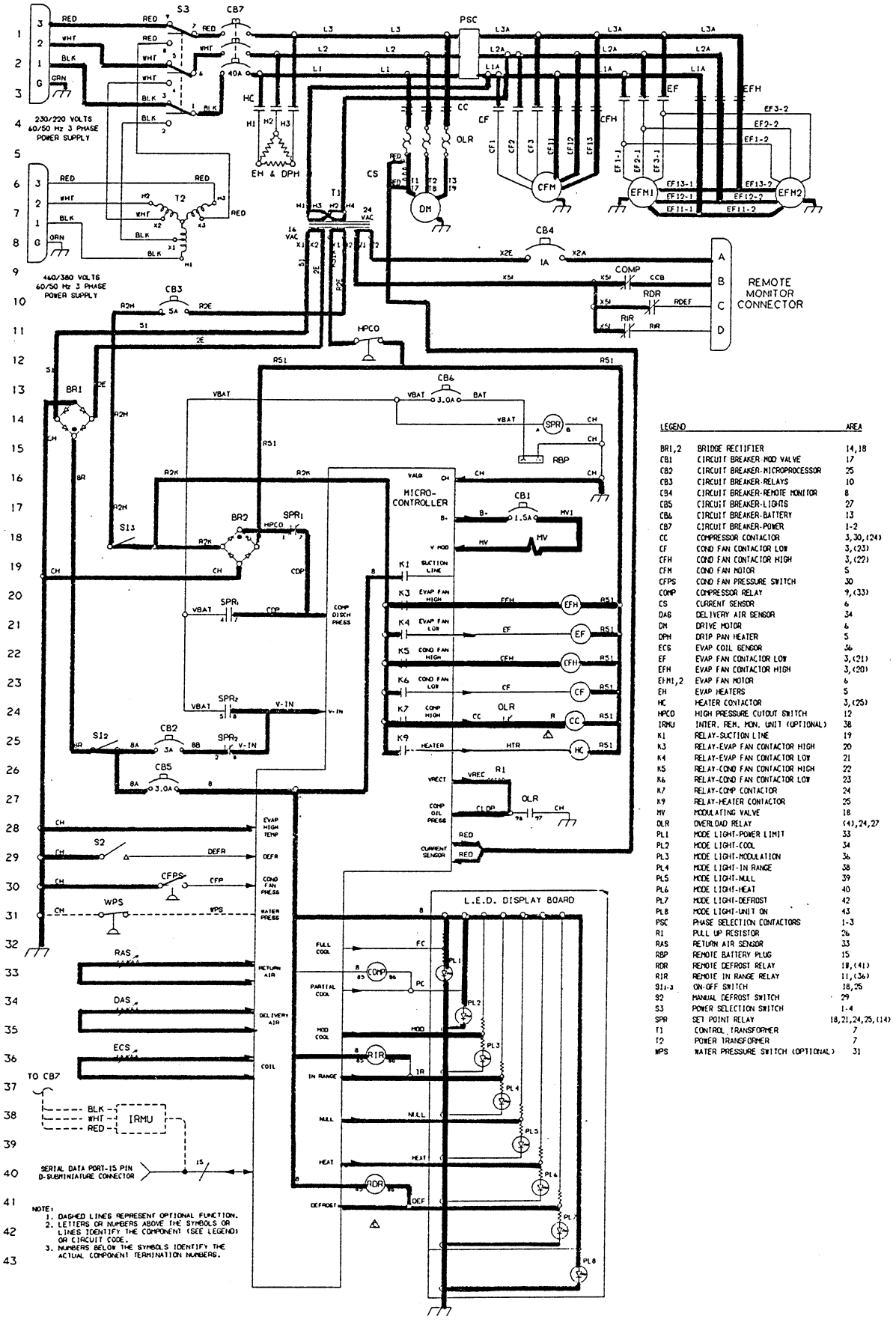
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1,2	ON-OFF SWITCH	18,25
S2	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,26,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Heat Mode—Setpoint above 24 F (-4.4 C), temperature out-of-range.



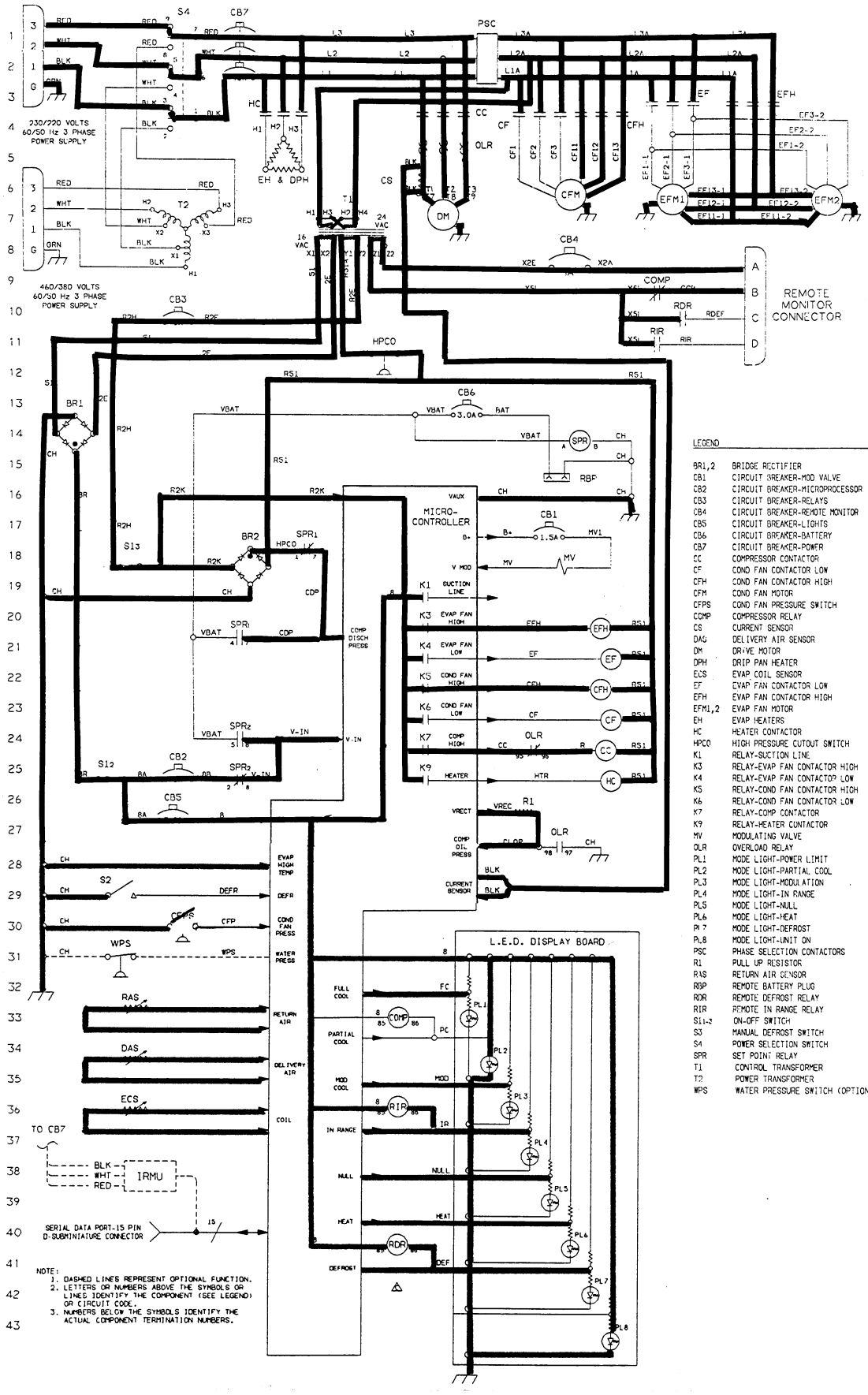
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	10,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1,2	ON-OFF SWITCH	18,25
S2	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Cool Mode—Setpoint below 24 F (-4.4 C), container return air temperature above 24 F (-4.4 C), temperature out-of-range, power monitor limiting unit power consumption.



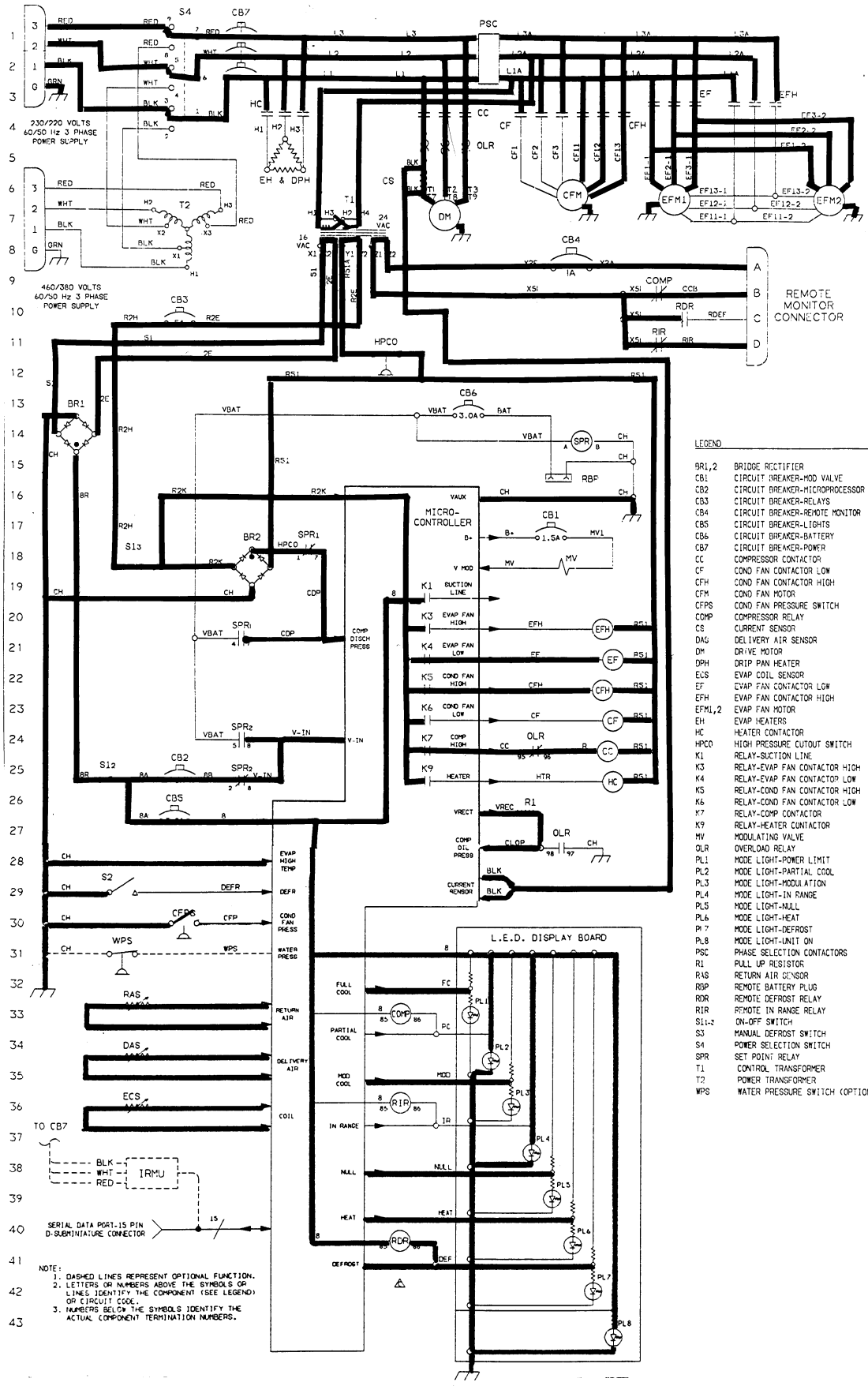
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
IRMU	INTER. REM. MON. UNIT (OPTIONAL)	38
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	19,(41)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1-3	ON-OFF SWITCH	18,25
S2	MANUAL DEFROST SWITCH	29
S3	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Cool Mode—Setpoint below 24 F (-4.4 C), container return air temperature above 24 F (-4.4 C), temperature out-of-range.



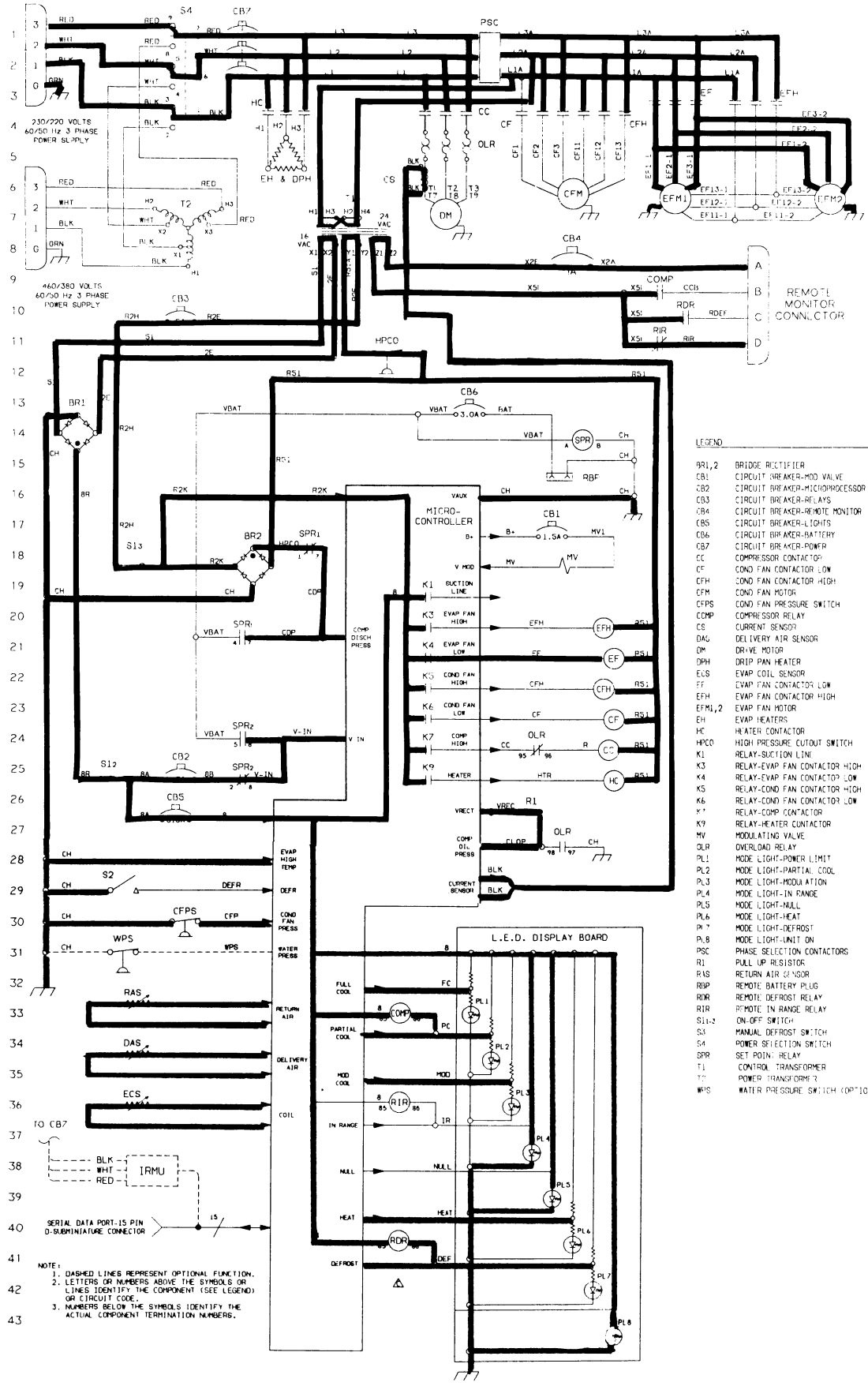
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	26
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1-3	ON-OFF SWITCH	18,25
S3	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Cool Mode—Setpoint below 24 F (-4.4 C), container return air temperature below 24 F (-4.4 C), temperature in-range.



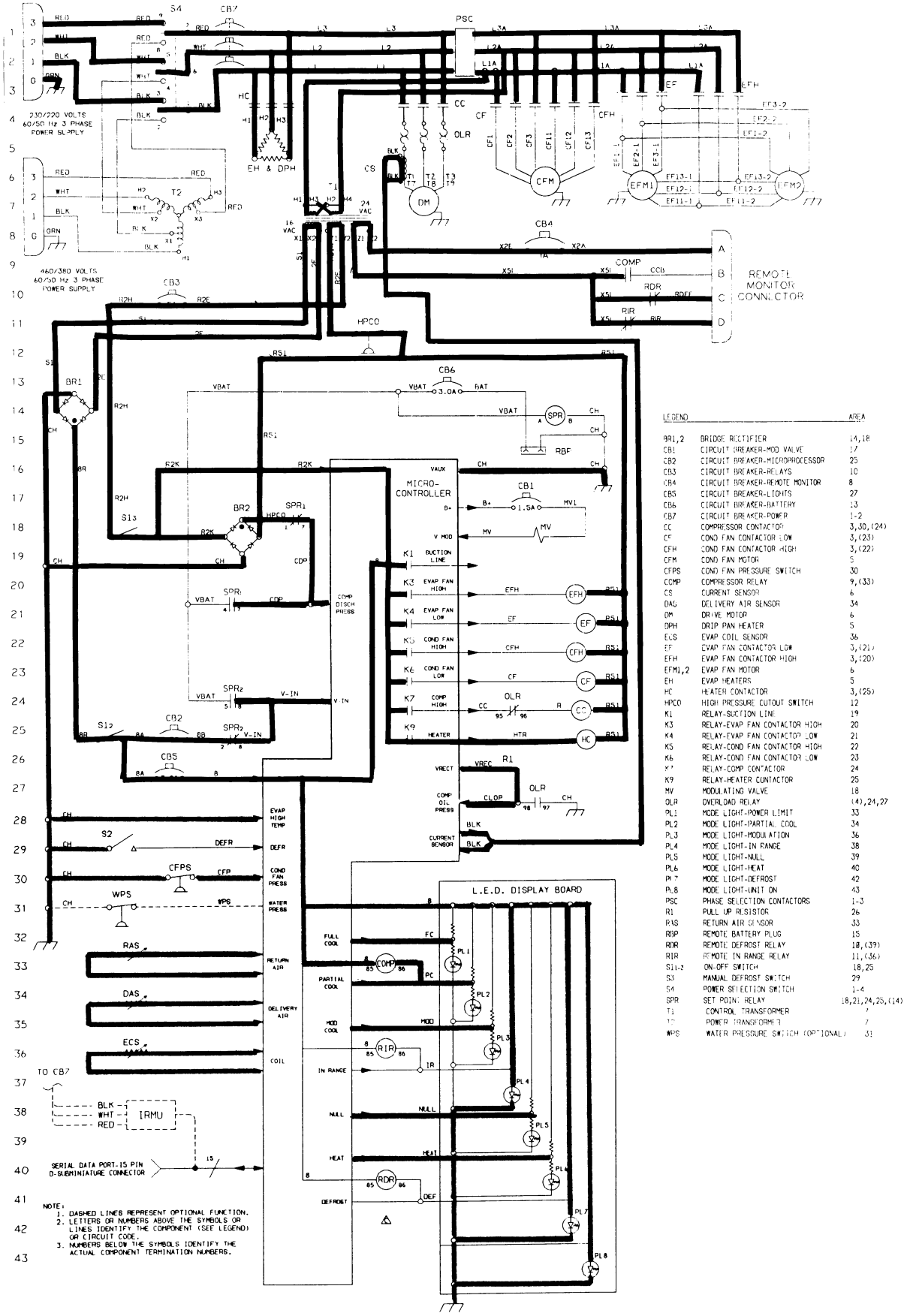
LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1-2	ON-OFF SWITCH	18,25
S3	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Null Mode—Setpoint below 24 F (-4.4 C).



LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	18,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S11-2	ON-OFF SWITCH	18,25
S3	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31

Defrost Mode—Defrost override timer maintaining in-range signal.



LEGEND		AREA
BR1,2	BRIDGE RECTIFIER	14,18
CB1	CIRCUIT BREAKER-MOD VALVE	17
CB2	CIRCUIT BREAKER-MICROPROCESSOR	25
CB3	CIRCUIT BREAKER-RELAYS	10
CB4	CIRCUIT BREAKER-REMOTE MONITOR	8
CB5	CIRCUIT BREAKER-LIGHTS	27
CB6	CIRCUIT BREAKER-BATTERY	13
CB7	CIRCUIT BREAKER-POWER	1-2
CC	COMPRESSOR CONTACTOR	3,30,(24)
CF	COND FAN CONTACTOR LOW	3,(23)
CFH	COND FAN CONTACTOR HIGH	3,(22)
CFM	COND FAN MOTOR	5
CFPS	COND FAN PRESSURE SWITCH	30
COMP	COMPRESSOR RELAY	9,(33)
CS	CURRENT SENSOR	6
DAS	DELIVERY AIR SENSOR	34
DM	DRIVE MOTOR	6
DPH	DRIP PAN HEATER	5
ECS	EVAP COIL SENSOR	36
EF	EVAP FAN CONTACTOR LOW	3,(21)
EFH	EVAP FAN CONTACTOR HIGH	3,(20)
EFM1,2	EVAP FAN MOTOR	6
EH	EVAP HEATERS	5
HC	HEATER CONTACTOR	3,(25)
HPCO	HIGH PRESSURE CUTOUT SWITCH	12
K1	RELAY-SUCTION LINE	19
K3	RELAY-EVAP FAN CONTACTOR HIGH	20
K4	RELAY-EVAP FAN CONTACTOR LOW	21
K5	RELAY-COND FAN CONTACTOR HIGH	22
K6	RELAY-COND FAN CONTACTOR LOW	23
K7	RELAY-COMP CONTACTOR	24
K9	RELAY-HEATER CONTACTOR	25
MV	MODULATING VALVE	18
OLR	OVERLOAD RELAY	(4),24,27
PL1	MODE LIGHT-POWER LIMIT	33
PL2	MODE LIGHT-PARTIAL COOL	34
PL3	MODE LIGHT-MODULATION	36
PL4	MODE LIGHT-IN RANGE	38
PL5	MODE LIGHT-NULL	39
PL6	MODE LIGHT-HEAT	40
PL7	MODE LIGHT-DEFROST	42
PL8	MODE LIGHT-UNIT ON	43
PSC	PHASE SELECTION CONTACTORS	1-3
R1	PULL UP RESISTOR	26
RAS	RETURN AIR SENSOR	33
RBP	REMOTE BATTERY PLUG	15
RDR	REMOTE DEFROST RELAY	10,(39)
RIR	REMOTE IN RANGE RELAY	11,(36)
S1,2	ON-OFF SWITCH	18,25
S3	MANUAL DEFROST SWITCH	29
S4	POWER SELECTION SWITCH	1-4
SPR	SET POINT RELAY	18,21,24,25,(14)
T1	CONTROL TRANSFORMER	7
T2	POWER TRANSFORMER	7
WPS	WATER PRESSURE SWITCH (OPTIONAL)	31