Carrier
TRANSICOLD

Container Refrigeration Unit

Model 69NT40-489

OPERATION AND SERVICE

T-259 Rev F

Carrier
TRANSICOLD

OPERATION AND SERVICE MANUAL

CONTAINER REFRIGERATION UNIT

MODEL 69NT40-489

UNITED TECHNOLOGIES CARRIER TRANSICOLD

Carrier Transicold Division, Carrier Corporation, P.O. Box 4805, Syracuse, N.Y. 13221

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DESCRIPTION

1.1 INTRODUCTION

WARNING

It has been determined that pressurized, air-rich mixtures of refrigerants and air can undergo combustion when exposed to an ignition source.

This manual contains Operating Data, Electrical Data and Service Instructions for the refrigeration units listed in Table 1-1. Also Table 1-1 charts some significant differences between these models.

The unit, of lightweight aluminum frame construction, is an all electric, one piece self-contained, cooling and heating, refrigeration unit. The unit is designed to fit in the front of a container and to serve as the container front wall. Fork lift pockets are provided for installation and removal of the unit.

The unit is complete with a charge of R-134a, compressor lubricating oil (approved POE SW20 compressor oil for R-134a only), mode indicating lights, temperature controller and is ready for operation upon installation.

Some units are dual voltage, designed to operate on 190/230 or 380/460 volts AC, 3 phase, 50-60 hertz power. (Refer to section 1.5) Other units are designed to operate on 380/460 volts AC, 3 phase 50/60 hertz power only.

Operating control power is provided by a control transformer which steps down the AC supply power source to 18 to 24 volts and 30 to 36 voltsAC, 1 phase control power.

The temperature controller (Micro-Link 2) is a microprocessor based controller. Refer to section 1.12. Once the temperature controller is set at a desired container temperature, the unit will operate automatically to maintain the desired temperature within very close limits. The control system automatically selects cooling, holding or heating as necessary to maintain the desired temperature within the container.

WARNING

Beware of unannounced starting of the evaporator and condenser fans. Do not open the condenser fan grille before turning power OFF and disconnecting power plug.

Some units are equipped with a Carrier Transicold DataCorder (microprocessor based recorder). Detailed information on the DataCorder will be found in section 1.14. Some units are equipped with a Partlow mechanical temperature recorder or a Saginomiya battery driven temperature recorder.

Some units may have the integrated CTD EverFresh Controlled Atmosphere option installed. Refer to the Model Chart in Table 1-1. Separately bound manuals covering the CTD EverFresh Controlled Atmosphere option are also supplied, see chart below:

Manual Number	Equipment Covered	Type of Manual
T-265	Controlled Atmosphere option	Operation and Service
T-265PL	Controlled Atmosphere option	Service Parts List

Some units may have a TransFRESH controlled atmosphere system added. Contact TransFRESH Corporation, P.O. Box 1788, Salinas, CA 93902 for information on their system.

Table 1-1. Model Chart

NOTE

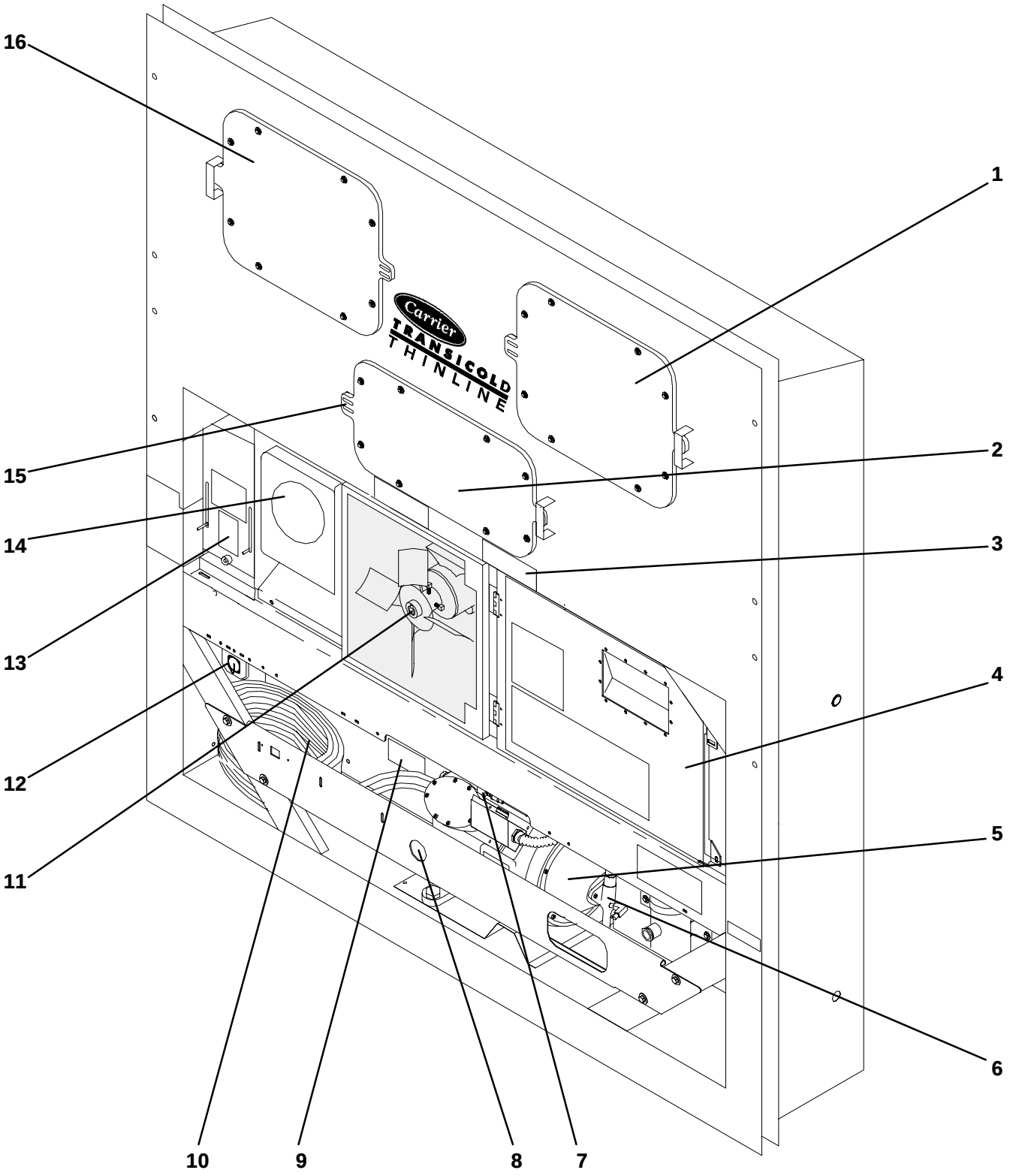
Models listed below may or may not include certain components (i.e., Transformer, DataCorder, Battery Packs for the Controller or DataCorder, Temperature Recorder), it will be up to the end user to ascertain if their unit model includes these components.

MODELS	UNIT WEIGHT		R-134a		USDA Cold Treatment	Transformer	Two Speed Evaporator Fan Motors	Dual Voltage Compressor	Water-Cooled Condenser	Receiver	Suction & Discharge Gauges	Humidity Sensor	Controlled Atmosphere Option	Communications Interface Module
	LB	KG	LB	KG										
69NT40-489	1265	573	11.5	5.2	X	–	–	X	–	X	–	–	–	–
69NT40-489-1	1265	573	11.5	5.2	A	–	–	X	–	X	–	–	–	–
69NT40-489-2	1265	574	11.5	5.2	–	–	–	–	X	–	–	–	–	–
69NT40-489-3	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	H	–
69NT40-489-4	1250	567	11.5	5.2	A	–	X	–	–	X	–	–	–	–
69NT40-489-5	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	–	–
69NT40-489-6	1310	594	11.5	5.2	–	D	X	X	–	X	–	–	–	–
69NT40-489-7	1230	557	11.5	5.2	A	–	X	–	–	X	–	X	–	–
69NT40-489-8	1235	560	11.5	5.2	X	–	X	–	–	X	–	X	–	–
69NT40-489-9	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	–	–
69NT40-489-10	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	I	–
69NT40-489-11	1265	573	11.5	5.2	A	–	–	X	–	X	–	–	–	–
69NT40-489-12	1265	573	11.5	5.2	A	–	–	X	–	X	X	–	–	–
69NT40-489-13	1250	567	11.5	5.2	A	B	X	–	–	X	–	–	–	–
69NT40-489-14	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	–	–
69NT40-489-15	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	–	–
69NT40-489-17	1250	567	11.5	5.2	A	B	X	–	–	X	–	–	–	X
69NT40-489-18	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	–	–
69NT40-489-19	1330	603	11.5	5.2	X	D	X	–	–	X	X	X	–	–
69NT40-489-20E	1550	703	11.5	5.2	X	C	X	X	–	X	–	–	G	–
69NT40-489-20M	1550	703	11.5	5.2	X	–	X	X	–	X	–	X	G	–
69NT40-489-21	1385	628	11.5	5.2	–	C	X	–	–	X	–	–	–	–
69NT40-489-22	1550	703	11.5	5.2	X	C	X	X	–	X	–	–	G	–
69NT40-489-23	1250	567	11.5	5.2	A	B	X	–	–	X	–	–	–	–
69NT40-489-25	1230	567	11.5	5.2	A	B	X	–	–	X	–	–	–	–
69NT40-489-26	1265	573	11.5	5.2	A	–	–	X	–	X	–	–	–	–
69NT40-489-29	1250	567	11.5	5.2	A	–	X	–	–	X	–	–	H	–
69NT40-489-30	1250	567	11.5	5.2	A	B	X	–	–	X	–	–	–	X
69NT40-489-31	1250	567	11.5	5.2	A	B	X	–	–	X	–	–	–	X
69NT40-489-50	1250	567	11.5	5.2	X	–	X	–	–	X	X	X	H	X
69NT40-489-51	1385	628	11.5	5.2	A	E	X	–	–	X	–	–	–	–
69NT40-489-52	1265	573	11.5	5.2	A	–	–	X	–	X	–	–	–	–
69NT40-489-54	1385	627	11.5	5.2	A	C	X	–	–	X	–	–	–	–
69NT40-489-56	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	H	–
69NT40-489-58	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	–	–
69NT40-489-59	1250	567	11.5	5.2	A	B	X	–	–	X	–	–	–	–
69NT40-489-60	1265	573	11.5	5.2	A	–	–	–	–	X	–	–	–	–
69NT40-489-61	1220	553	11.5	5.2	–	–	X	–	–	X	–	–	–	X
69NT40-489-62	1225	556	11.5	5.2	X	–	X	–	–	X	X	X	H	–
69NT40-489-63	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	–	–
69NT40-489-64	1250	567	11.5	5.2	A	B	X	–	–	X	–	–	–	–
69NT40-489-65	1355	615	9.0	4.1	A	B	X	–	–	X	–	–	–	–

Table 1-1. Model Chart (Continued)

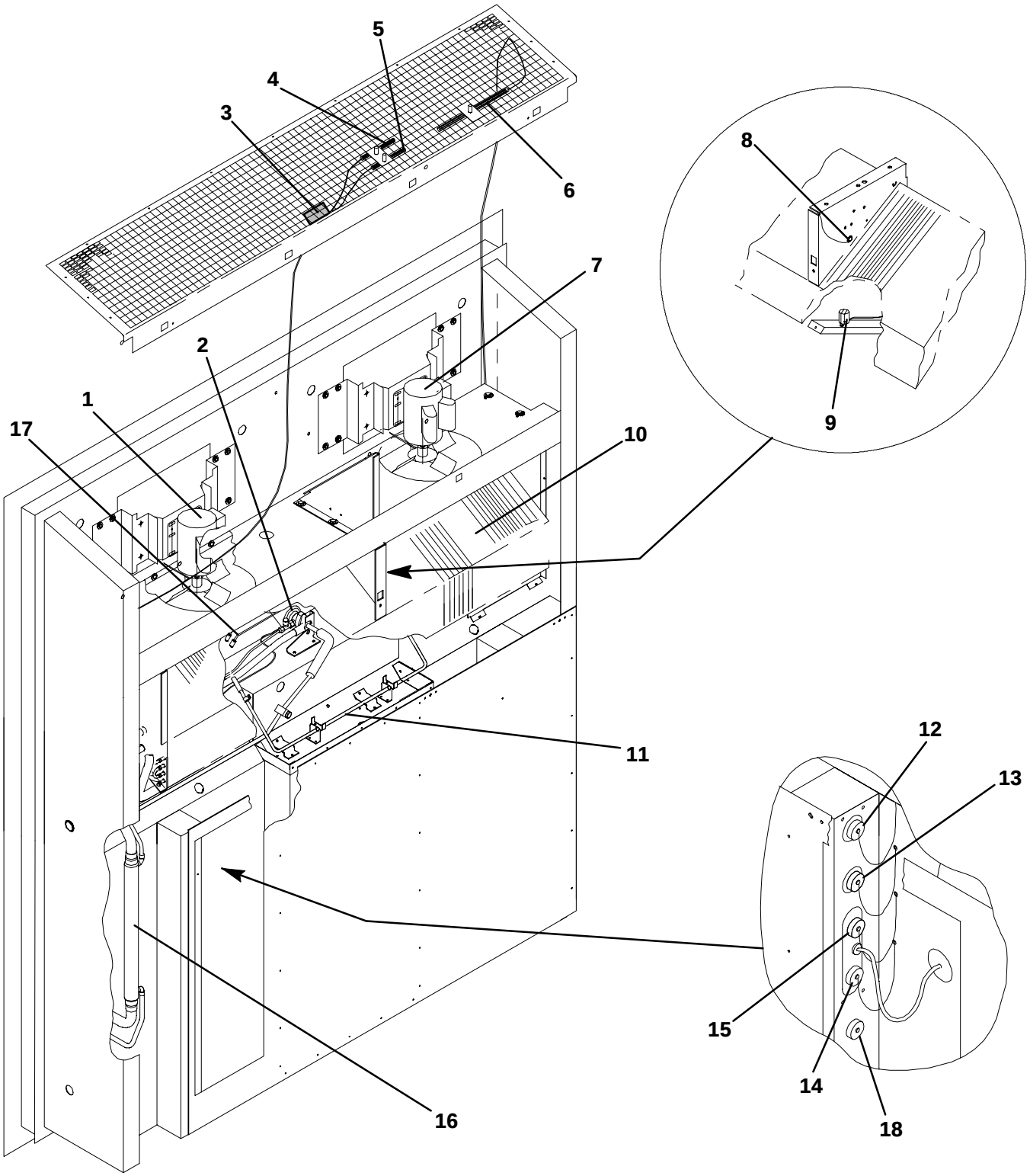
MODELS	UNIT WEIGHT		R-134a		USDA Cold Treatment	Transformer	Two Speed Evaporator Fan Motors	Dual Voltage Compressor	Water-Cooled Condenser	Receiver	Suction & Discharge Gauges	Humidity Sensor	Controlled Atmosphere Option	Communications Interface Module
	LB	KG	LB	KG										
69NT40-489-66	1250	567	11.5	5.2	X	–	X	–	–	X	–	–	–	X
69NT40-489-67	1235	560	11.5	5.2	X	–	X	–	–	X	–	X	–	–
69NT40-489-68	1385	628	11.5	5.2	A	B	X	–	–	X	–	–	–	–
69NT40-489-69	1385	628	11.5	5.2	A	E	X	–	–	X	–	–	H	–
69NT40-489-70	1250	566	11.5	5.2	A	B	X	–	–	X	–	–	–	–
69NT40-489-71	1250	567	11.5	5.2	A	B	X	–	–	X	–	–	–	–
69NT40-489-75	1310	594	11.5	5.2	–	D	X	X	–	X	–	–	–	–
69NT40-489-77	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	–	–
69NT40-489-78	1220	553	11.5	5.2	A	–	–	–	–	X	–	–	–	–
69NT40-489-79	1385	628	11.5	5.2	A	C	X	–	–	X	–	–	H	–
69NT40-489-80	1330	603	11.5	5.2	A	D	X	X	–	X	X	X	–	J
69NT40-489-81	1385	628	11.5	5.2	A	E	X	–	–	X	–	–	–	–
69NT40-489-83	1385	628	11.5	5.2	A	B	X	–	–	X	–	–	–	–
69NT40-489-84	1385	628	11.5	5.2	A	E	X	–	–	X	–	–	–	–

A – Provision for USDA Cold Treatment.
B – Provision for Dual Voltage Integral Transformer.
C – Factory installed Dual Voltage Integral Transformer.
D – Factory installed Dual Voltage Evaporator Transformer.
E – Factory installed Dual Voltage Modular Transformer.
F – Provision for Dual Voltage Modular Transformer.
G – Factory installed CTD Everfresh Controlled Atmosphere option.
H – Factory installed Transfresh Controlled Atmosphere option.
I – Provision for Transfresh Controlled Atmosphere option.
J – Provision for Communications Interface Module (RMU).
X – Features that apply to model.



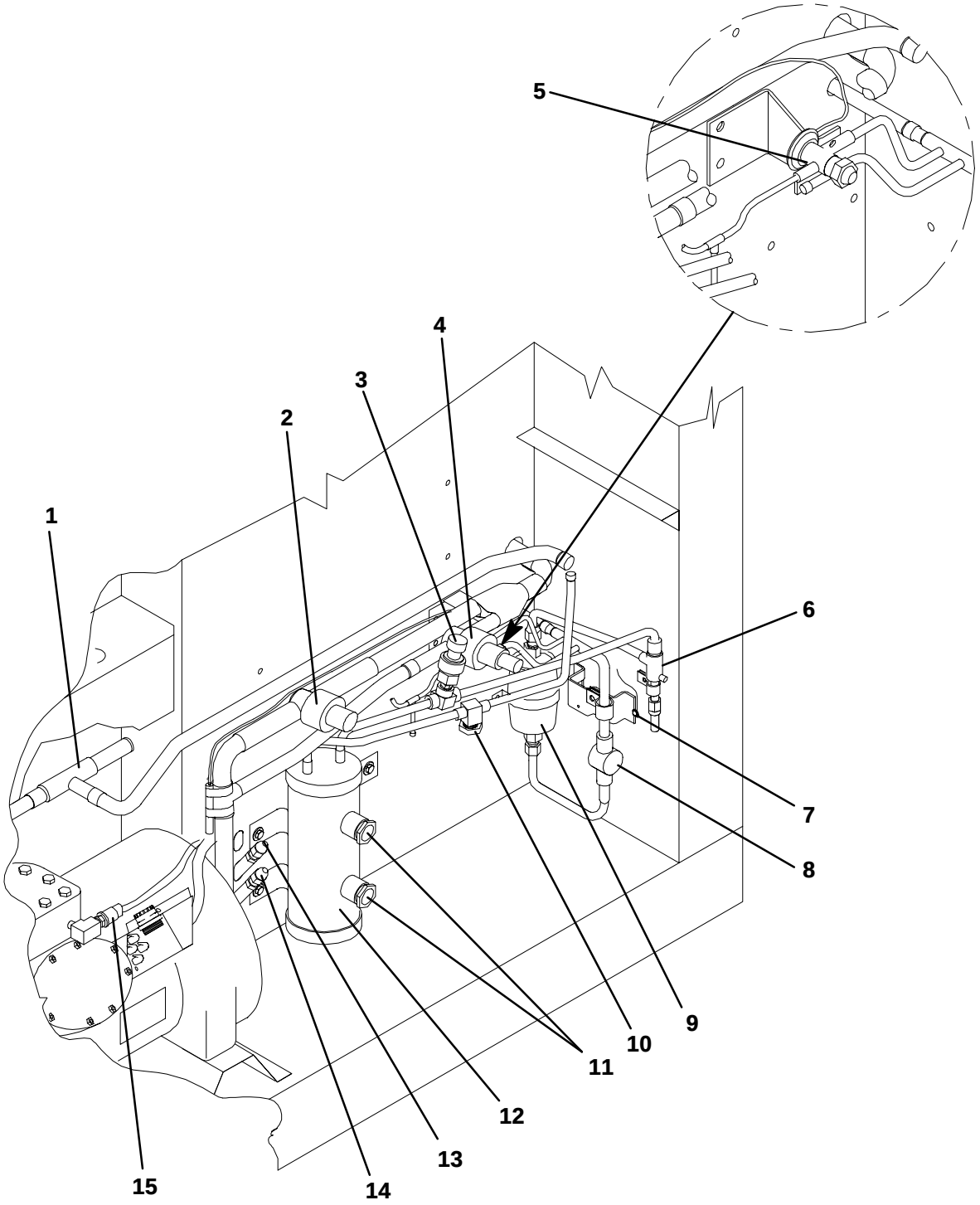
1. Access Panel (Evap. Fan Motor #1)
2. Access Panel (Heater & Thermostatic Expansion Valve Location) (See Figure 1-2)
3. Fork Lift Pockets
4. Control Box
5. Compressor (CP)
6. Suction Service Valve
7. High Pressure Switch (HPS)
8. Compressor Sight Glass View Port
9. Serial/Model No. Plate
10. Power Cable(s) and Plug(s)
11. Condenser Fan Motor (CM)
12. Interrogator Connector
13. Fresh Air Makeup Vent
14. Mechanical Recording Thermometer – Optional
15. TIR Sealing Provisions
16. Access Panel (Evap. Fan Motor #2)

Figure 1-1. Refrigeration Unit – Front



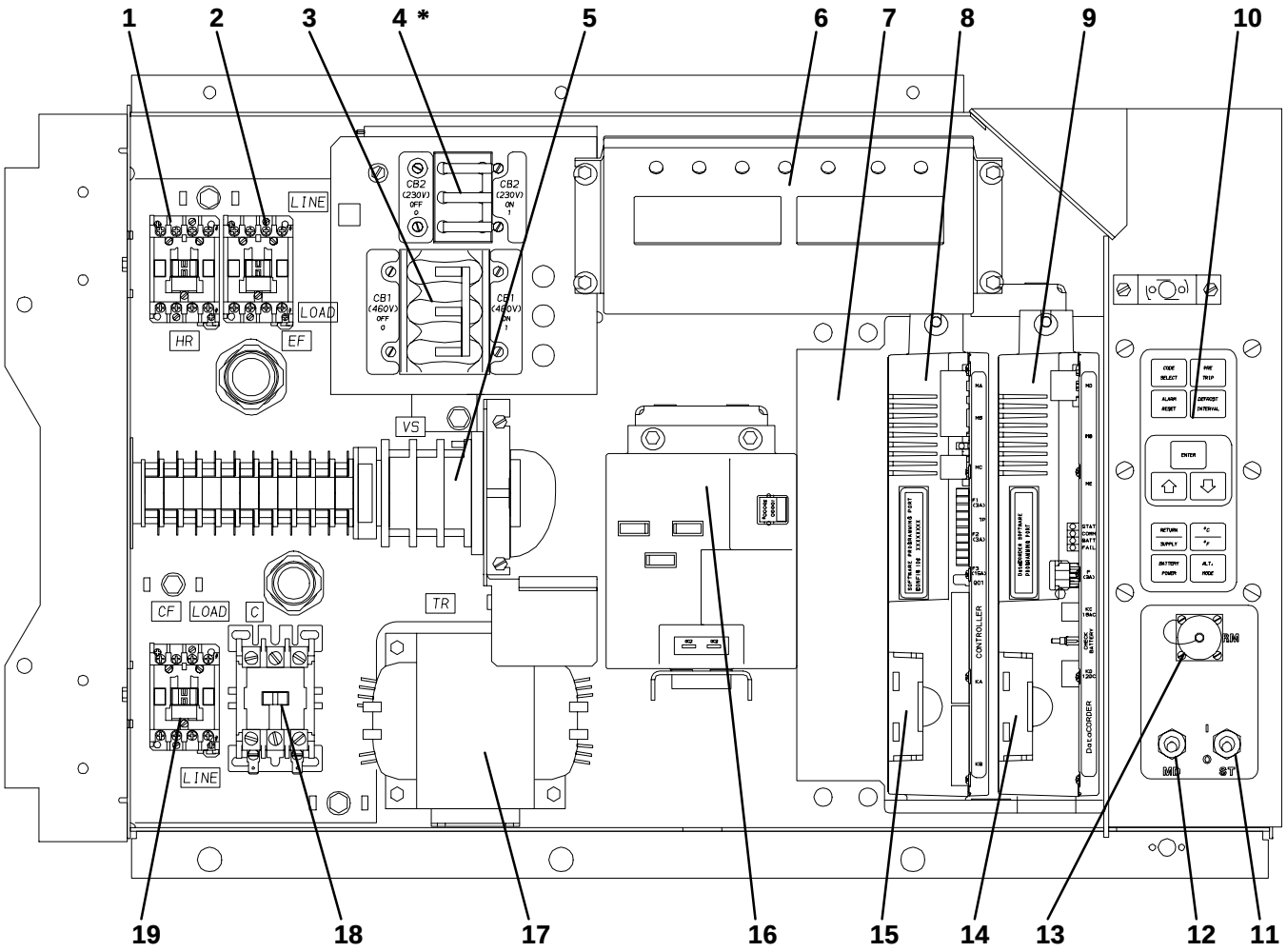
1. Evaporator Fan Motor #1 (EM1)
2. Thermostatic Expansion Valve
3. Humidity Sensor (HS) – Optional
4. Return Recorder Sensor (RRS) – Optional
5. Return Air Temperature Sensor (RTS)
6. Mechanical Recording Thermometer Bulb
7. Evaporator Fan Motor #2 (EM2)
8. Defrost Termination Sensor (DTS)
9. Heater Termination Thermostat (HTT)
10. Evaporator Coil
11. Drain Pan Heater (DPH)
12. USDA Probe Receptacle (PR3)
13. USDA Probe Receptacle (PR1)
14. Interrogator Receptacle (ICR)
15. USDA Probe Receptacle (PR2)
16. Heat Exchanger
17. Defrost Heaters
18. Cargo Probe – Optional

Figure 1-2. Refrigeration Unit – Rear (Panels Removed)

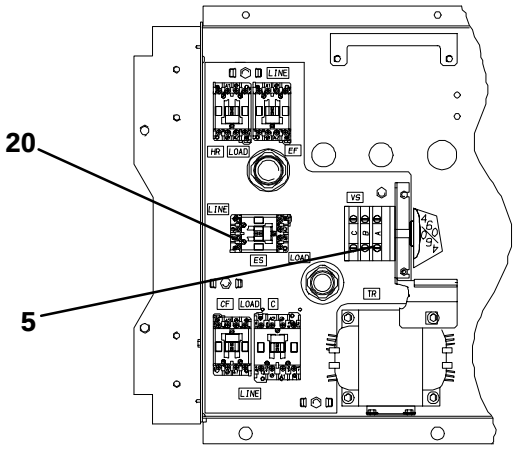


1. Discharge Pressure Regulator Valve
2. Suction Modulation Valve (SMV)
3. Condenser Pressure Control (CPC) – Optional
4. Suction Solenoid Valve (SSV)
5. Quench Expansion Valve
6. Manual Liquid Line Valve
7. Ambient Temperature Sensor (AMBS)
8. Moisture-Liquid Indicator
9. Filter-Drier
10. Fusible Plug or
    Rupture Disc
    (if equipped w/Water-Cooled Condenser)
11. Receiver Sight Glasses
12. Receiver (Shown) or Water-Cooled Condenser
13. Supply Air Temperature Sensor (STS)
14. Supply Recorder Sensor (SRS) – Optional
15. High Pressure Switch (HPS)

Figure 1-3. Receiver and Tubing Section



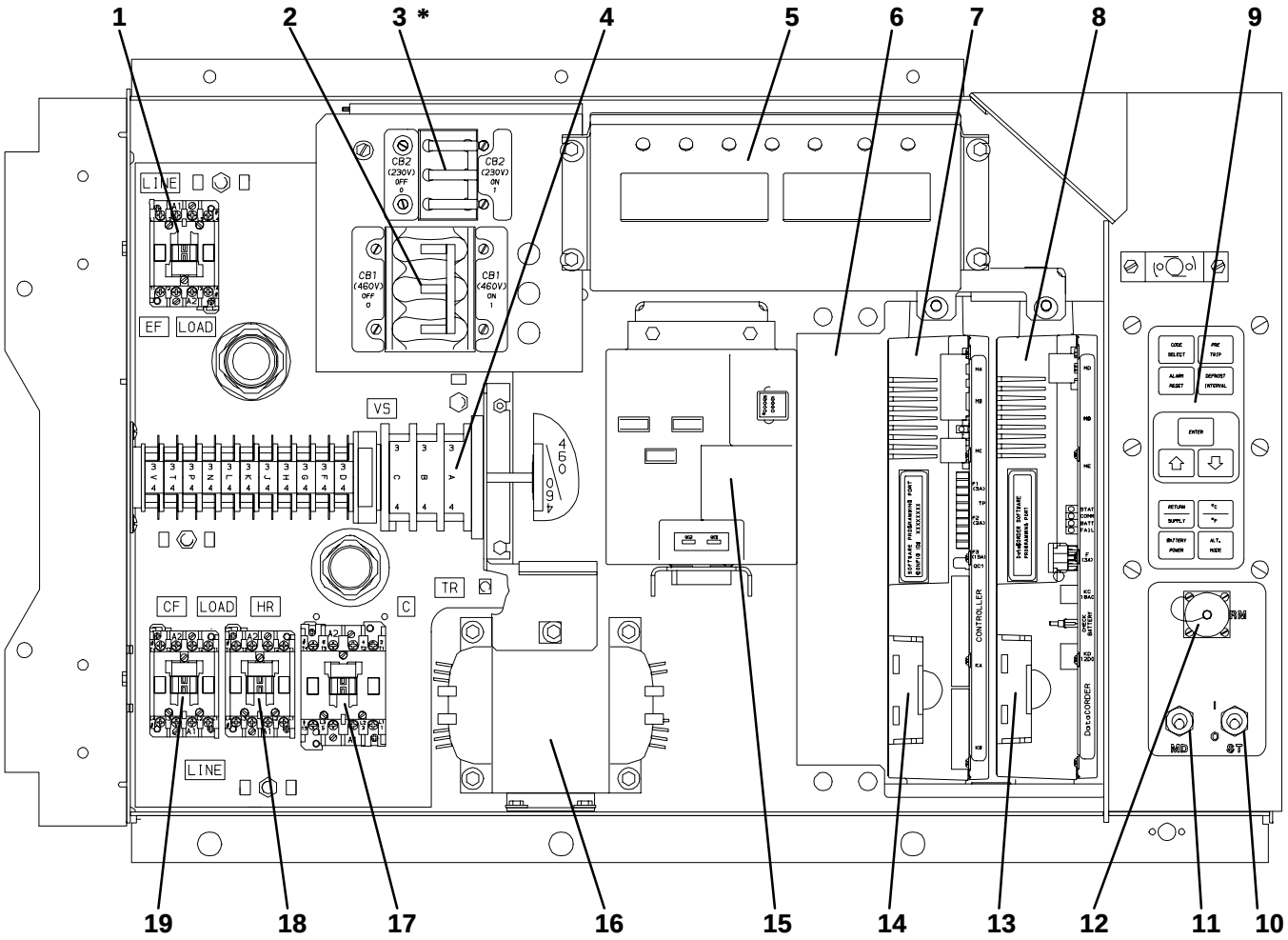
UNITS WITH SINGLE-SPEED EVAPORATOR MOTORS



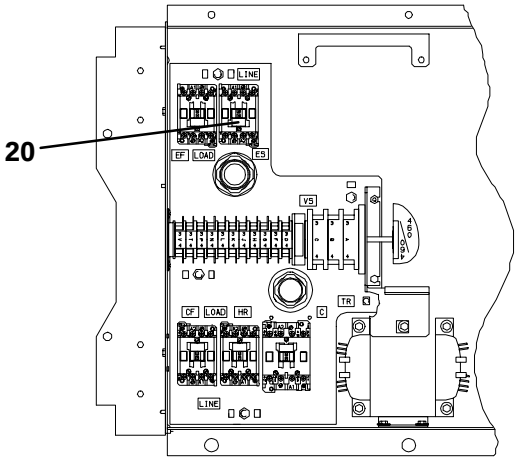
UNITS WITH DUAL-SPEED EVAPORATOR MOTORS

1. Heat Contactor (HR)
2. Evaporator Fan Motor Contactor (EF)
3. Circuit Breaker (CB-1) – 460V
4. ***** Circuit Breaker (CB-2) – 230V – Optional (See Figure 1-6 for excepted location)
5. Voltage Switch (VS) – Optional
6. Display Module
7. Slot location for Remote Monitoring Unit (RMU) – Optional
8. Controller Module
9. DataCorder Module – Optional
10. Keypad
11. Start-Stop Switch (ST)
12. Manual Defrost Switch (MDS)
13. Remote Monitoring Receptacle (RM) – Optional
14. DataCorder Battery Pack – Optional
15. Controller Battery Pack – Optional
16. High Voltage Module (HVM)
17. Control Transformer (TR)
18. Compressor Contactor (C)
19. Condenser Fan Motor Contactor (CF)
20. Evaporator Fan Motor Contactor (ES)

Figure 1-4. Control Box – Prior to Serial Number 90234597



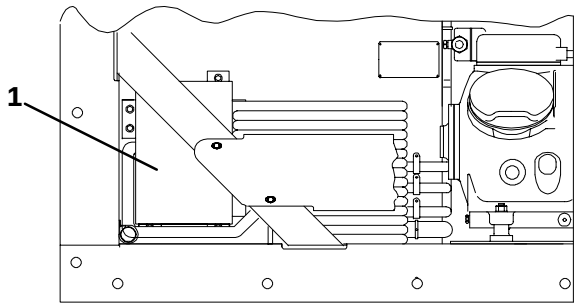
UNITS WITH SINGLE-SPEED EVAPORATOR MOTORS



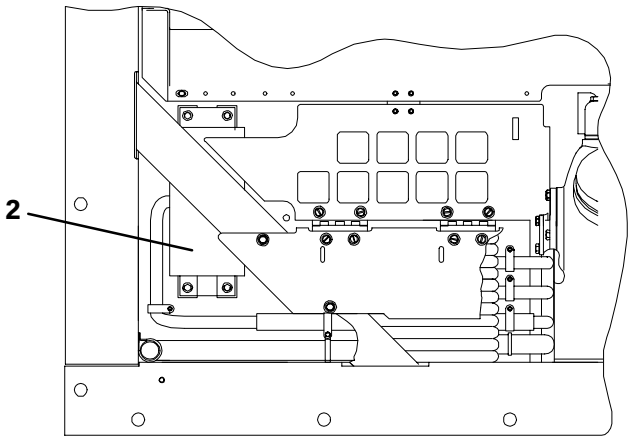
UNITS WITH DUAL-SPEED EVAPORATOR MOTORS

1. Evaporator Fan Motor Contactor (EF)
2. Circuit Breaker (CB-1) – 460V
3. * Circuit Breaker (CB-2) – 230V – Optional (See Figure 1-6 for excepted location)
4. Voltage Switch (VS) – Optional
5. Display Module
6. Slot location for Remote Monitoring Unit (RMU) – Optional
7. Controller Module
8. DataCorder Module – Optional
9. Keypad
10. Start-Stop Switch (ST)
11. Manual Defrost Switch (MDS)
12. Remote Monitoring Receptacle (RM) – Optional
13. DataCorder Battery Pack – Optional
14. Controller Battery Pack – Optional
15. High Voltage Module (HVM)
16. Control Transformer (TR)
17. Compressor Contactor (C)
18. Heat Contactor (HR)
19. Condenser Fan Motor Contactor (CF)
20. Evaporator Fan Motor Contactor (ES)

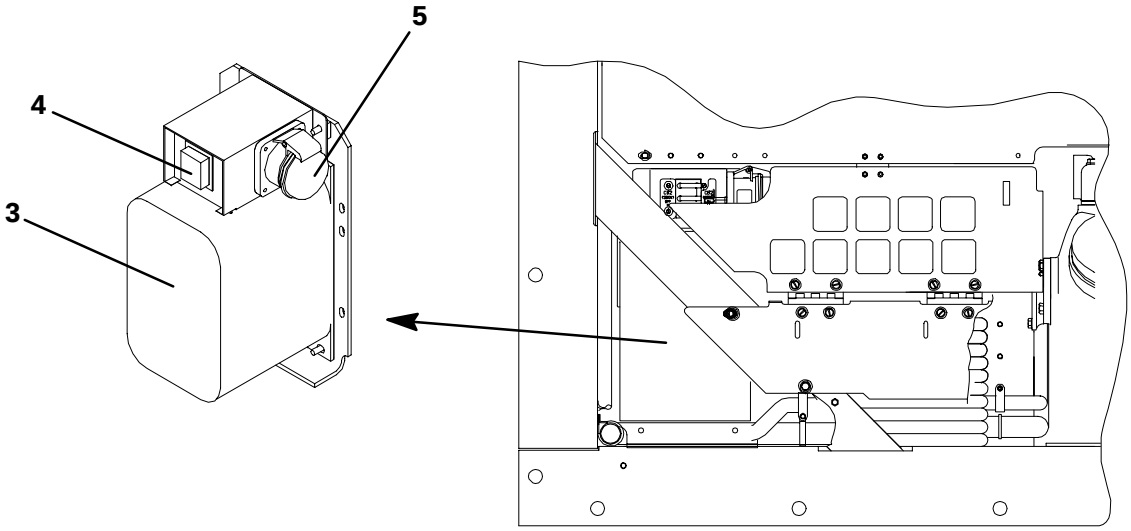
Figure 1-5. Control Box – Starting with Serial Number 90234597



Dual Voltage Integral Transformer



Dual Voltage Evaporator Transformer



Dual Voltage Modular Transformer

1. Dual Voltage Integral Transformer – Optional
2. Dual Voltage Evaporator Transformer – Optional
3. Dual Voltage Modular Transformer – Optional
4. Circuit Breaker (CB-2) – 230V – Optional
5. 460 VAC Power Receptacle

Figure 1-6. Power Autotransformer Options

1.2 GENERAL DESCRIPTION

a. Compressor Section

NOTE

Check the compressor Serial/Model Number plate for CFM displacement, refer to Table 1-2.

The compressor section includes the compressor (with high pressure switch), optional crankcase heater, power cable storage compartment, and an optional transformer (Refer to Table 1-1 and Figure 1-6) which is located to the left of the compressor.

NOTE

The dual voltage evaporator transformer is always on line and supplies 460v to the evaporator motor contactor, and 230v to the control transformer.

This section also contains the suction modulation valve, suction solenoid valve, quench expansion valve, moisture-liquid indicator, manual liquid line valve, filter-drier, fusible plug or rupture disc, discharge pressure regulator valve and optional discharge/suction pressure transducers.

The supply air temperature sensor (STS), supply recorder sensor (SRS) and ambient sensor (AMBS) are located at the right side of the compressor.

Table 1-2. Compressor Model Number Significance Chart

06DR2419CC1970

1st, 2nd & 3rd DIGIT
06D Hermetic Reciprocal

4th DIGIT	
R	Refrigeration Duty

6th & 7th DIGIT	DISPLACEMENT
41	41CFM

b. Condenser Section

The condensing section consists of a condenser fan motor, condenser fan and an air-cooled condenser coil. When the unit is operating, air is pulled in the bottom of the coil and discharges horizontally out through the front of the condenser fan grille.

c. Evaporator Section

The evaporator section contains the optional mechanical temperature recording bulb, return recorder sensor (RRS), return temperature sensor (RTS), thermostatic expansion valve, evaporator fan motors and fans (2), evaporator coil and heaters, drain pan and heater, defrost termination sensor, heat termination switch, and a heat exchanger. See Figure 1-2 and Figure 1-3 for sensor location.

The evaporator fans circulate air throughout the container by pulling air in the top of the refrigeration unit and directing the air through the evaporator coil where it is either heated or cooled, and then discharged out the bottom of the refrigeration unit into the container.

Some units are equipped with two-speed evaporator fan motors. Refer to Table 1-1. When transporting perishable (chilled) commodities, the fan motors will normally be in high speed above −10_C (+14_F) or −5_C (+23_F) optionally. If the unit is equipped with economy mode and it is turned on, the fan motors will run in low speed.

The evaporator coil heaters are accessible by removing the front, lower access panel. The defrost termination sensor (DTS) is located on the coil center tube-sheet and may be serviced by removing the upper rear, panel or by removing the left front, upper access panel and reaching through the evaporator fan venturi AFTER POWER IS TURNED OFF AND POWER PLUG DISCONNECTED.

d. Control Box

The control box includes the manual switches, circuit breaker(s), contactors, transformers, fuses, keypad, display module, high voltage module, controller module and an optional DataCorder module. (See Figure 1-4 or Figure 1-5).

1.3 REFRIGERATION SYSTEM DATA

a. Compressor – Motor Assembly

No. of Cylinders: 6
Model: 06DR
Weight (Dry): 260 lb (118 kg)

b. Approved Compressor Oil

Castrol Icematic – SW20

c. Compressor Oil Charge

3.6 liters (7.6 U.S. pints)

d. Compressor Oil Sight Glass

The oil level range should be between the bottom to 1/8 of the sight glass, with the compressor off.

e. Expansion Valve Superheat

Verify at −18_C (0_F) container box temperature:
3.36 to 4.48_C (6 to 8_F)

f. Heater Termination Thermostat

Opens: 54 (¦ 3)_C = 130 (¦ 5)_F
Closes: 38 (¦ 4)_C = 100 (¦ 7)_F

g. High Pressure Switch

Cutout: 25 (¦ 0.7) kg/cm@ = 350 (¦ 10) psig
Cut-In: 18 (¦ 0.7) kg/cm@ = 250 (¦ 10) psig

h. Refrigeration Charge

Refer to Table 1-1.

i. Fusible Plug

Melting point: 93_C = (200 _F)

j. Rupture Disc (Used on water-cooled units only)

Bursts at: 35 ±5% kg/cm@ = (500 ±5% psig)

k. Unit Weight

Refer to Table 1-1.

l. Water Pressure Switch (Optional)

Cut-In: 0.5 ¦ 0.2 kg/cm@ (7 ¦ 3 psig)
Cutout: 1.6 ¦ 0.4 kg/cm@ (22 ¦ 5 psig)

1.4 ELECTRICAL DATA

a. Circuit Breaker

CB-1 Trips at: 29 Amps
CB-2 Trips at: 62.5 Amps

b. Compressor Motor

Full Load Amps (FLA): 17.6 Amps @ 460 VAC
(with current limiting set at 21 amps)
(Model 69NT40)

c. Condenser Fan Motor

Bearing Lubrication: Factory lubricated, additional grease not required.
Full Load Amps: 2.6/1.3 @ 190/380 VAC/50 hz
3,2/1.6 @ 230/460 VAC/60 hz
Horsepower: 0.43/50 hz (0.75/60 hz)
Rotation: CCW when viewed from shaft end.
Speed: 1425/50 hz (1725/60 hz) RPM
Voltage and Frequency:
180 – 230/360 – 460 VAC @ 50 hz ¦ 1.25 hz
200 – 250/400 – 500 VAC @ 60 hz ¦ 1.5 hz

d. Drain Pan Heaters

Number of Heaters: 1
Rating: 750 watts +5 /–10 % @ 460 VAC
Resistance (cold): 285 ¦ 7.5% ohms nominal
Type: Sheath

e. Evaporator Coil Heaters

Number of Heaters: 4
Rating: 750 watts +5/–10% each @ 230 VAC
Resistance (cold): 66.8 to 77.2 ohms
Ambient: @ 20_C (68_F)
Type: Sheath

f. Evaporator Fan Motor(s)

Bearing Lubrication: Factory lubricated, additional grease not required
Full Load Amps:
High Speed: 1.6 @ 380 VAC/50 hz
(2.1 @ 460 VAC/60 hz)
Low Speed: 0.6 @ 380 VAC/50 hz
(0.6 @ 460 VAC/60 hz)
Single Speed Motor: 3.2/1.6 @ 190/380 VAC/50 hz
(0.58/1.0 @ 230/460 VAC/60 hz)

Nominal Horsepower:
High Speed: 0.58 @ 380 VAC/50 hz
(1.0 @ 460 VAC/60 hz)
Low Speed: 0.07 @ 380 VAC/50 hz
(0.12 @ 460 VAC/60 hz)
Single Speed Motor: 0.58 @ 50 hz
(1.0 @ 60 hz)

Rotation:
Evap. Fan Motor **#1** (See Figure 1-2):
CW when viewed from shaft end
CCW when viewed from end opposite shaft end
Evap. Fan Motor **#2** (See Figure 1-2):
CCW when viewed from shaft end
CW when viewed from end opposite shaft end

Speed:
High Speed: 2850 rpm @50 hz
(3450 rpm @ 60 hz)
Low Speed: 1425 rpm @ 50 hz
(1750 rpm @ 60 hz)
Single Speed Motor: 2850 rpm @ 50 hz
(3450 rpm @ 60 hz)

Voltage and Frequency:
180 – 230/360 – 460 VAC @ 50 hz ¦ 1.25 hz
200 – 250/400 – 500 VAC @ 60 hz ¦ 1.5 hz

g. Fuses

Control Circuit: 15 Amps (F3)
Controller: 5 Amps (F1 & F2)
DataCorder: 3 Amps (F)

h. Compressor Crankcase Heater (CCH) Optional

180 watts @ 460 vac

1.5 VOLTAGE SWITCH (OPTIONAL) AND POWER AUTOTRANSFORMER (OPTIONAL)

WARNING

Do not attempt to unplug the power cable before turning OFF:

1. Start-stop switch (ST).

2. Unit circuit breaker(s), CB-1 and CB-2 (if equipped).

3. External power source.

4. Make sure the power plugs are clean and dry before connecting to any power receptacle.

a. Voltage Switch (without Power Autotransformer)

Dual voltage units without a transformer consist entirely of dual mains voltage rated components that operate from both 190/230 VAC and 380/460 VAC power.

b. Step-Up Power Autotransformer (with or without voltage switch)

The transformer is either the whole-unit transformer (item 1 or item 3, Figure 1-6) or the evaporator transformer (item 2, Figure 1-6). (Also refer to Table 1-1) The transformer (if equipped) is located under the condenser coil on the left-hand side of the unit.

The transformer (item 1 or item 3, Figure 1-6) provides 380/460 VAC, 3 phase, 50/60 hertz power to the single mains voltage rated components of the unit when the 230 VAC (black) power cable is connected to a 190/230 VAC, 3 phase power source. The transformer (item 1) may be permanently installed in the unit (with accompanying voltage selector switch VS) or exist as a modular transformer (item 3) added to convert a single voltage (380/460 VAC) unit to dual voltage capability (without voltage selector switch VS). The module in addition to the transformer, includes a 230 VAC cable,

circuit breaker CB-2, and a receptacle to accept the unit 460 VAC power plug.

The evaporator transformer (item 2) is permanently installed and provides 380/460 VAC power to single voltage (two-speed) evaporator fan motors when the unit is operated on 190/230 VAC power and alternately provides 190/230 VAC power to the control transformer when the unit is operated from 380/460 VAC power. The remaining mains voltage rated components are dual voltage designs that operate from both 190/230 VAC and 380/460 VAC via the voltage selector switch (VS).

WARNING

Do not attempt to unplug the power cable before turning OFF:

1. Start-stop switch (ST).

2. Unit circuit breaker(s), CB-1 and CB-2 (if equipped).

3. External power source.

4. Make sure the power plugs are clean and dry before connecting to any power receptacle.

c. To Operate Unit on 190/230 VAC Power Supply

1. Make sure that the start-stop switch (ST, on control panel) and circuit breaker (CB-2, in the control box or on the modular transformer) are in position "0" (OFF). Make sure voltage switch (VS, in the control box) is in position 230; or if not equipped with a voltage switch (VS), then make sure the 460 VAC power plug is locked into the receptacle on the modular transformer and circuit breaker (CB-1, in the control box) is in position "1" (ON).

2. Plug the 230 VAC (black) cable into a de-energized 190/230 VAC, 3 phase power source. Energize the power source. Set circuit breaker (CB-2) to position "1" (ON). Close and secure control box door and then place the start-stop switch (ST) in position "1" (ON) to start the unit.

d. To Operate Unit on 380/460 VAC Power Supply

1. Make sure start-stop switch (ST, on control panel) and circuit breaker (CB-1, in the control box) are in position "0" (OFF). Make sure voltage switch (VS, in the control box, if equipped) is in position 460.

2. Plug the 460 VAC (yellow) cable into a de-energized 380/460 VAC, 3 phase power source. Energize the power source. Place circuit breaker (CB-1) in position "1" (ON). Close and secure control box door and then place the start-stop switch (ST) in position "1" (ON) to start the unit.

1.6 REFRIGERATION CIRCUIT

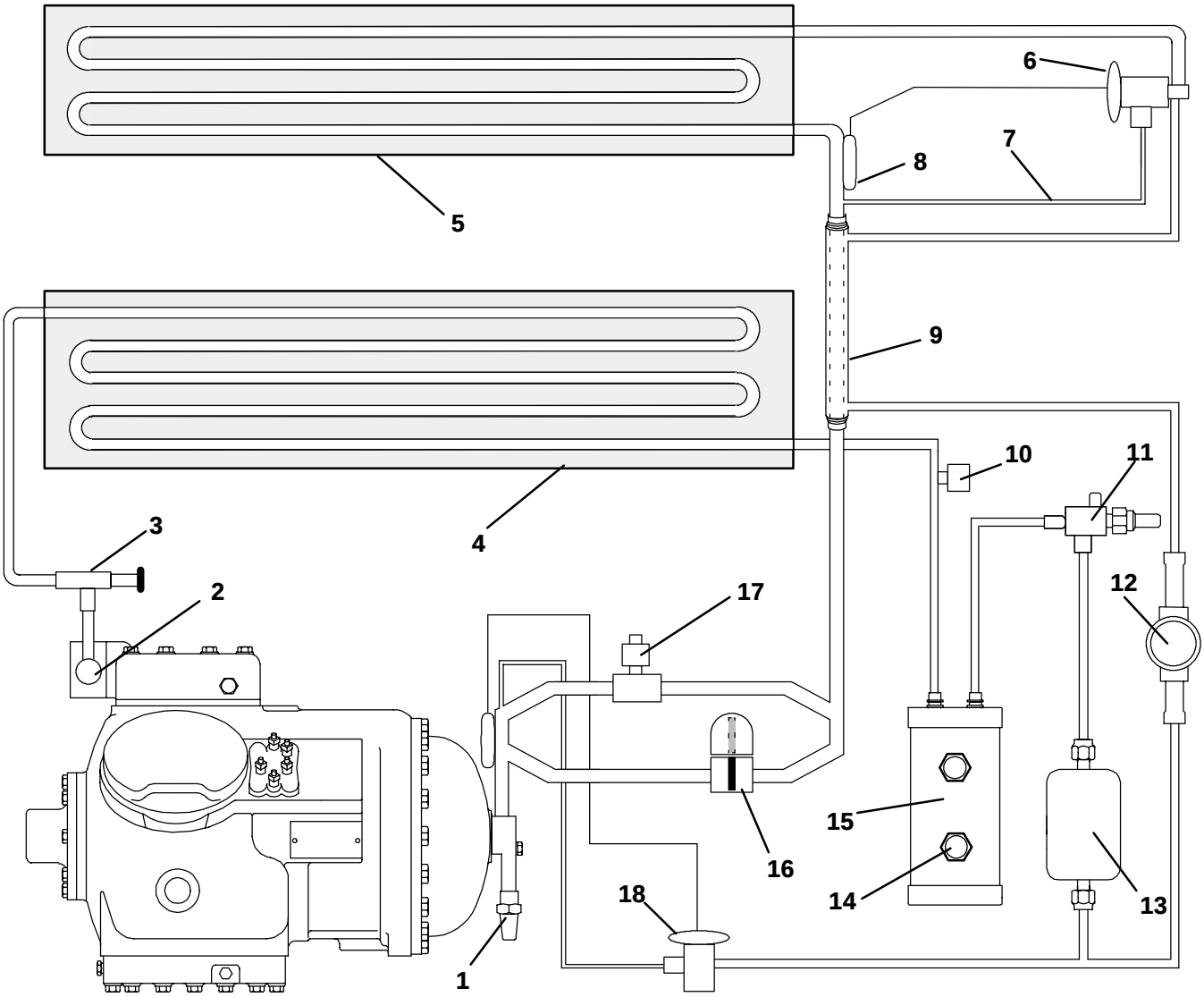
Starting at the compressor, the suction gas is compressed to a higher temperature and pressure.

When operating with the *air-cooled condenser,* the gas flows through the discharge service valve into the pressure regulator valve that is normally open, however, the pressure regulator valve may restrict the flow of refrigerant to maintain a minimum discharge pressure of 5 kg/cm@ (70 psig). Refrigerant gas then moves into the air-cooled condenser. Air flowing across the coil fins and tubes cools the gas to saturation temperature. By removing latent heat, the gas condenses to a high pressure/high temperature liquid and then flows to the receiver which stores the additional charge necessary for low temperature operation.

On units equipped with condenser pressure control (CPC), the condenser fan will cycle off if the condenser pressure is below 130 psig. If the condenser pressure goes above 200 psig, the condenser fan will cycle on.

From the receiver or water-cooled condenser, the liquid refrigerant continues through the manual liquid line valve, filter-drier (which keeps refrigerant clean and dry), a moisture-liquid indicator, a heat exchanger that increases subcooling of liquid refrigerant to the thermostatic expansion valve. As the liquid refrigerant passes through the orifice of the expansion valve some of it vaporizes into a gas (flash gas). Heat is absorbed from the return air by the balance of the liquid causing it to vaporize in the evaporator coil. The vapor then flows through the suction modulation valve (and suction solenoid valve under some conditions) to the compressor.

The thermostatic expansion valve bulb on the suction line near the evaporator coil outlet, controls the thermostatic expansion valve, maintaining a relatively constant superheat at the coil outlet regardless of load conditions except at abnormally high container temperatures such as during pulldown (valve at maximum operating pressure condition).



1. Suction Service Valve
2. Discharge Service Valve
3. Discharge Pressure Regulator Valve
4. Air-Cooled Condenser
5. Evaporator
6. Thermostatic Expansion Valve
7. External Equalizer Line
8. Thermostatic Expansion Valve Bulb
9. Heat Exchanger
10. Fusible Plug or
    Rupture Disc (if equipped w/Water-Cooled Condenser
11. Manual Liquid Line Valve
12. Moisture-Liquid Indicator
13. Filter-Drier
14. Sight Glass
15. Receiver or
    Water-Cooled Condenser
16. Suction Solenoid Valve
17. Suction Modulation Valve
18. Quench Expansion Valve

Figure 1-7. Refrigeration Circuit

Table 1-3. Safety and Protective Devices

UNSAFE CONDITIONS	SAFETY DEVICES	DEVICE SETTING
1. Excessive current draw	1. Circuit Breaker (CB-1) – Manual Reset	1. Trips at 29 amps **(460 VAC)**
	1. Circuit Breaker (CB-2) – Manual Reset	1. Refer to paragraph 1.4.a
2. Excessive current draw on control circuit	2. Fuse (F3)	2. 15 amps
3. Excessive current draw by the controller	3. Fuse (F1 & F2)	3. 5 amps
4. Excessive current draw by the optional DataCorder	4. Fuse (F)	4. 3 amps
5. Excessive condenser fan motor winding temperature	5. Internal Protection (IP-CM) – Automatic Reset	5. N/A
6. Excessive compressor motor winding temperature	6. Internal Protector (IP-CP) – Automatic Reset	6. N/A
7. Excessive evaporator fan motor(s) winding temperature	7. Internal Protector(s) (IP-EM) – Automatic Reset	7. N/A
8. Abnormal pressures in the high refrigerant side	8. Fusible Plug 8a. Rupture Disc	8. Refer to section 1.3.i. 8a. Refer to section 1.3.j.
9. Abnormally high discharge pressure	9. High Pressure Switch	9. Opens at 25 kg/cm@ (350 psig)
10. Excessive evaporator motor transformer or power (auto) transformer winding temperature	10. Internal Protector (IP-Trans) – Automatic Reset	10. Opens at 178 ¦ 5_C (350 ¦ 10_F) Closes at 150 ¦ 7_C (300 ¦ 12_F)

1.7 SAFETY AND PROTECTIVE DEVICES

Unit components are protected from damage by safety and protective devices listed in Table 1-3. These devices monitor the unit operating conditions and open a set of electrical contacts when an unsafe condition occurs.

Open safety switch contacts of one or more of the following devices IP-CP, HPS, or IP-Trans (Auto) will shut down the compressor.

Open safety switch contacts of device IP-CM will shut down the condenser fan motor.

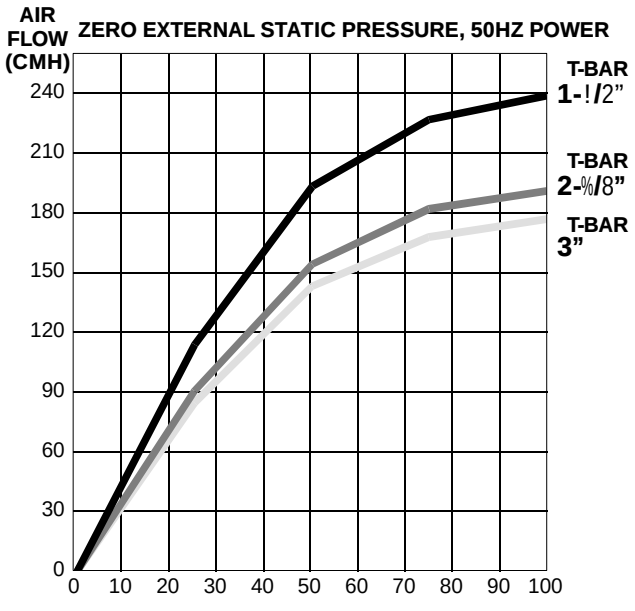
The entire refrigeration unit will shut down if one of the following safety devices open: (a) Circuit Breaker(s) or; (b) Fuse (F3/15A) or; (c) Evaporator Fan Motor Internal Protector(s) – (IP-EM).

1.8 FRESH AIR MAKEUP VENT

The purpose of the vent is to provide ventilation for commodities that require fresh air circulation and *must be closed* when transporting frozen foods.

Air exchange depends on static pressure differential which will vary depending on the container and how the container is loaded. The chart above gives air exchange values for an empty container. Higher values can be expected for a fully loaded container.

69NT40 FRESH AIR MAKEUP



For 60HZ operation multiply curves by 1.2

a. Full Open or Closed Positions

Maximum air flow is achieved by loosening the wing nuts and moving the cover to the maximum open position (100% position). The closed position is 0% air flow position.

The operator may adjust the opening to increase or decrease the air flow volume to meet the required air flow.

b. Air Sampling for Carbon Dioxide (CO_2) Level

Loosen wing nuts and move cover until the arrow on the cover is aligned with the "atmosphere sampling port" label. Tighten wing nuts and attach a 3/8 tube to the sampling tube.

If the internal atmosphere content has reached an unacceptable level, the operator may adjust the cover opening to meet the required air flow volume to ventilate the container.

1.9 REMOTE MONITORING (OPTIONAL)

NOTE

Models with an in-range light, the light will be illuminated if the container control air temperature is within the tolerance selected. Refer to section 1.12.5.

When the remote monitor is connected to the remote monitoring receptacle, the following remote circuits are energized.

Circuit	Function
Sockets B to A	Energizes remote cool light
Sockets C to A	Energizes remote defrost light
Sockets D to A	Energizes remote in-range light

1.10 SUCTION SOLENOID VALVE

The suction solenoid valve, shown in Figure 1-3 is controlled by the controller relay TS.

a. Operation

If set point is below −10_C (+14_F) or −5_C (+23_F) optionally, the controller relay (TS) closes to energize the suction solenoid valve (SSV). Once opened, the refrigerant flow rate and unit cooling capacity is increased.

If set point is above −10_C (+14_F) or −5_C (+23_F) optionally, and the suction solenoid valve (SSV) override is not activated, suction solenoid valve opens during temperature pulldown period unless current limiting or suction solenoid override restricts its use.

b. Suction Solenoid Override

This function restricts the opening of the suction solenoid valve (SSV) under certain high ambient and/or box temperature conditions. If the primary return sensor (RTS) fails (AL56), the suction solenoid valve will not open unless the ambient temperature is less than 10_C (50_F). If the ambient sensor fails (AL57), the suction solenoid valve will not be allowed to open until the return air temperature is less than 1.67_C (35_F). If both the ambient and return air (RTS) sensors fail, the suction solenoid valve will not be allowed to open until at least one of the sensors is repaired.

1.11 WATER-COOLED CONDENSER (OPTIONAL)

The water-cooled condenser is used when cooling water is available and heating the surrounding air is objectionable, such as in a ship's hold.

The water-cooled condenser is a shell and coil condenser with water circulating through the cupro-nickel coil. The refrigerant vapor is admitted to the shell side and is condensed on the outer surface of the coil.

To shift to water-cooled condenser operation, do the following:

a. Connect water supply line to inlet side of condenser and discharge line to outlet side of condenser.

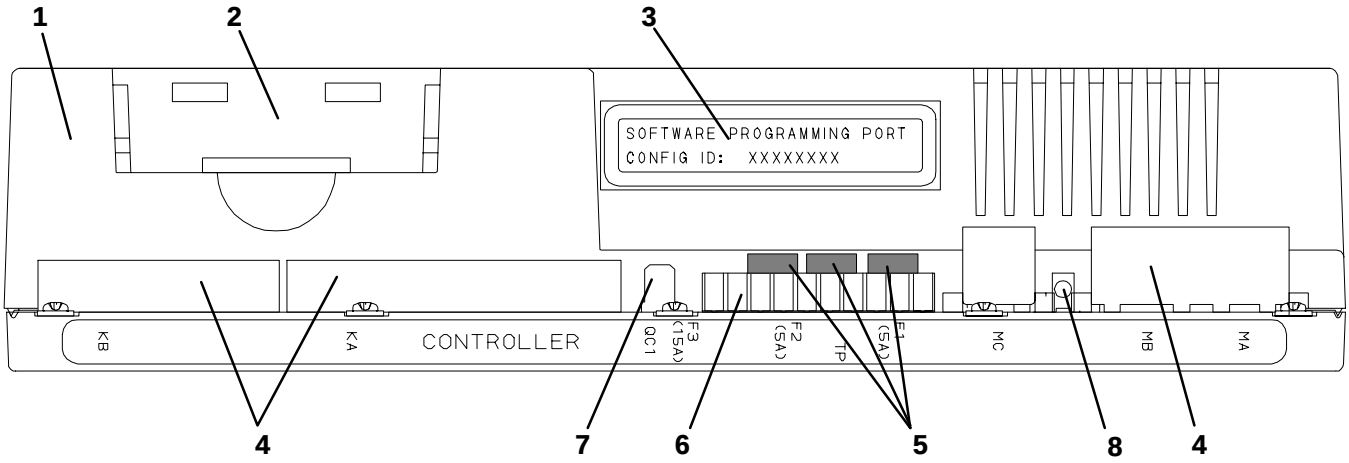
b. Maintain a flow rate of 11 to 26 liters per minute = 3 to 7 gallons per minute. The water pressure switch will open to de-energize the condenser fan relay. The condenser fan motor will stop and will remain stopped until the water pressure switch closes.

The refrigeration unit operating with the water-cooled condenser will perform as outlined in section 2.4 except that the condenser fan motor is stopped in all modes.

To shift to air-cooled condenser operation, do the following:

Disconnect the water supply and the discharge line to the water-cooled condenser. The refrigeration unit will shift to air-cooled condenser operation when the water pressure switch closes. (Refer to section 1.3.)

1.12 MICRO-LINK 2 CONTROLLER MODULE



1. Micro-Link 2 Controller Module
2. Battery Pack (Optional)
3. Software Port
4. Connectors
5. Fusess
6. Test Points
7. Control Circuit Power Connection
8. Status LED

Figure 1-8. Micro-Link 2 Controller Module

1.12.1 Brief Description

WARNING

Do not attempt to service the controller module, breaking the warranty seal will void the warranty.

CAUTION

Remove the controller module and unplug all wire harness connectors before performing any arc welding on any part of the container.

Do not remove wire harnesses from modules unless you are grounded to the unit frame with a static safe wrist strap.

The Carrier Transicold Micro-Link 2 controller is a custom-designed microprocessor based module which incorporates electronic logic to:

a. Control supply or return air temperature to extremely tight limits by providing modulated refrigeration control, electric heat control and defrost to ensure continuous conditioned air delivery to the load.

b. Provide dual independent readouts of set point and supply or return air temperatures.

c. Provide digital readout and ability to select data. Refer to Table 1-6 for Controller Function Codes.

d. For controller alarm digital display identification refer to Table 1-7.

e. Provide a pre-trip step-by-step checkout of refrigeration unit performance, proper component operation, proper electronic and refrigeration control operation, proper heater operation, probe calibration and current limiting. Refer to section 1.13.

f. Provide the ability to select or change Codes 27 to 37 and set point without AC power being hooked up. Refer to section 1.12.5.

g. The unit provides memory reprogramability and configuration through a memory card. The memory card automatically downloads new software to the controller when inserted, and controls output to the display of status information.

h. The Status/Power/Executing code LED indicates if the Controller is powered up and executing code. The LEDwill be off when power is off. The LED will pulse at a one second rate if code is being executed.

1.12.2 Controller Programming (Memory) Cards

The programming cards are used for loading software into the Controller. This is the same concept as using a floppy diskette to load software into a personal computer.

The software that can be loaded into the Controller module, comes in one of two forms. Either “Operational Software” or “Configuration Software.”

Operational Software:

This is the software that makes the Controller module do what it does. Turn fans on and off, turn compressors on and off, etc.

Configuration Software:

This is the software that tells the Operational Software what physical components are built into the container unit. Refer to Table 1-4.

Programming cards with either Operational Software or Configuration Software are available thru CTD Replacement Components Group.

The use of a programming card in the field, should only occur under unusual circumstances. Some of these circumstances may include:

a. A Controller module has an older version of Operational Software, and the need exists to upgrade to a newer version of the software.

b. A physical component in the container unit is changed to something different, resulting in a different configuration for the unit.

c. A Controller module was damaged in such a way that the integrity or existence of software within the module, is questionable.

Procedure for loading software:

Refer to section 4.28.1.

Table 1-4. Configuration Variables

Configuration #	TITLE	Default	Option
1	Bypass Valve Enable	In	Out
2	Evaporator Fan Speed	SS (Single)	dS (Dual)
3	Tri Sensor	dUAL	tHrEE
4	Dehumidification Mode	On	Off
5	Probe Calibration	noCal	CAL
6	Condenser Fan Speed Select	Off (Single)	On (Variable)
7	Unit Selection, 20FT/ 40FT/45FT	40ft	20ft,45
8	Single Phase/Three Phase Motor	1Ph	3Ph
9	Refrigerant Selection	r22	r12,r134a,bLEnd
10	Advanced Pre−Trip	P (Advanced)	none
11	Defrost “Off” Selection	noOFF	OFF
12	TXV/Solenoid Quench Valve	In (Solenoid)	Out (TXV)
13	Unloader	In	Out
14	Condenser Pressure Control	Out	In
15	Discharge Temperature Sensor	In	Out
16	Trim Heat	In	Out
17	RMU Command Set	nEW (Core)	Old (Phase 2)
18	Heater	Old (Low Watt)	nEW (High Watt)
19	Controlled Atmosphere	Out	In
20	Pressure Sensors (Transducers)	Out	In
21	Auto-Transformer	Out	In
22	Economy Mode Option	Off	On
23	Defrost Interval Timer Save Option	noSAV	SAV
24	Advanced Pre-Trip Enhanced Test	Off	On
25	Pre-Trip Test Points/Results Recording	rSLts	data
26	Heat Lockout	Set to −10_C	Set to−5_C
27	Suction Temperature Display	Out	In
28	Bulb Mode	Nor	bulb
29	Arctic Mode	Out	In

1.12.3 General Layout of the Controller Section

The Micro-Link 2 controller consists of a keypad, display module and a controller module. Connectors are used to attach the wiring of the unit to the controller module. The controller module is designed to permit ease of installation and removal.

All control functions are accessed by keypad selections and viewed on the display module, the functions are designed for optimum user friendliness and convenience.

The keypad (see Figure 1-9) is mounted on the right-hand side of the control box. The keypad consists of eleven (11) push energized membrane switches that act as the users interface with the controller and the optional DataCorder. Refer to Table 1-5.

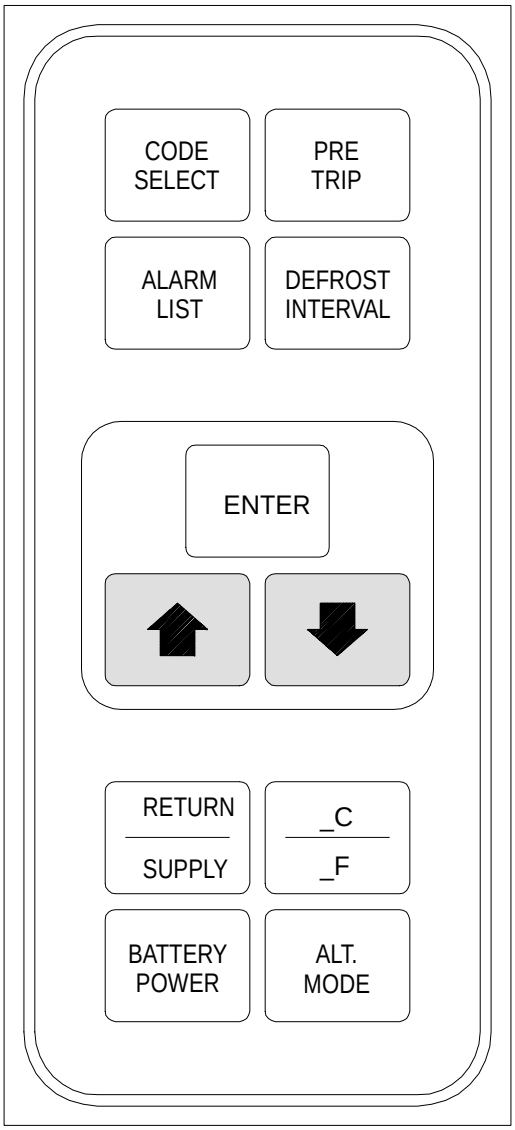


Figure 1-9. keypad

Table 1-5. Keypad Function

Key	Function
Arrow Up	Change set point upward. Change codes upward. Scan alarm list upward. Change user selectable features upward. Pre-trip advance forward. Pre-trip test interruption. DataCorder Function and Alarm Codes are scrolled upward after the ALT. MODE key is depressed.
Arrow Down	Change set point downward. Change codes downward. Scan alarm list downward. Change user selectable features downward. Pre-trip repeat backward. DataCorder Function and Alarm Codes are scrolled downward after the ALT. MODE key is depressed.
Return/Supply	Displays non-controlling probe temperature (momentary display).
_C/_F	Displays alternate temperature scale (momentary display).
Alarm List	Displays alarm list and clearing of the alarm queue (when followed by *Enter* key) for the controller, and also for the DataCorder after the ALT. MODE key is depressed.
Code Select	Access function codes (see arrow up and arrow down) for the controller, and also for the DataCorder after the ALT. MODE key is depressed..
Defrost Interval	Displays selected defrost interval.
Pre–Trip	Displays a pre-trip selection menu. Discontinues pre-trip in progress.
Battery Power	If the unit is equipped with the optional battery pack, initiate the battery backup mode to allow set point and function code selection if no A/C power is present.
Enter	Entering a set point change. Extending to 30 seconds the time a chosen data function code is displayed. Entering the value of a user selectable mode. Clearing the alarm list and initiating pre-trip. Also used for various DataCorder functions after the ALT. MODE key is depressed..
ALT. Mode	Allows access to DataCorder Function and Alarm Codes

The display module (see Figure 1-10) is mounted at a 20 degree downward tilt to aid in visibility when stacked in close quarters. The display module consists of:

a. Two – 25mm (1 inch) high, five digit LCD displays which are easily viewed in direct sunlight and back-lighted for superior low-light visibility.

b. Seven (7) Indicators:

- Cool – White Lamp:
  Lamp energized when the refrigerant compressor is energized.
- Heat – Orange LED:
  LED energized when the heaters are on, and the unit is in the heat or defrost (de-ice) mode.
- Defrost – Orange LED:
  LED energized when the heaters are on, and the unit is in the defrost mode.
- In-Range – Green LED:
  LED energized when the controlling temperature probe is in range. (Supply air probe will be used for control in the perishable ranges and the return air probe is used for control in the frozen ranges.)
- Alarm – Red LED:
  LED energized when there is an active or an inactive shutdown alarm (AL20 to AL27) in the alarm queue.
- Supply – Yellow LED:
  LED energized when supply temperature and set point are displayed.
  Flashes if dehumidification is enabled on units so equipped.
- Return – Yellow LED:
  LED energized when return temperature and set point are displayed.
  Flashes if dehumidification is enabled on units so equipped.

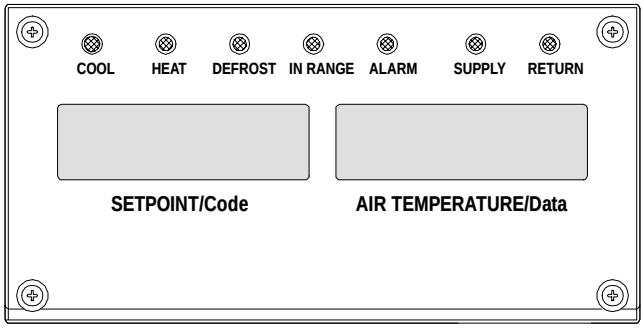


Figure 1-10. Display Module

NOTE

The default display mode will show the set point temperature on the left display and controlling probe temperature on the right display. The controlling probe in the perishable range will be the SUPPLY air probe and the controlling probe in the frozen range will be the RETURN air probe.

1.12.4 Controller Temperature Control

There are two control ranges, Frozen and Perishable (chill). The Frozen range is active with set points at or *below –10_C (+14_*F) or –5_C (+23_F) optionally and the Perishable range is active at set points *above –10_C (+14_*F) or –5_C (+23_F) optionally. See Figure 1-13 and Figure 1-14.

For Revision Level 1014 and above:

The Controller configuration variable for "Heat Lockout" (refer to Table 1-4) can be changed for set points of either –10_C (+14_F) or –5_C (+23_F) optionally.

NOTE

When upward set point changes are made the compressor is immediately cycled through a reliability enhancement algorithm (SMV is cycled between 70% to 0%) to remove any refrigerant trapped in the oil. This also happens when Current Limiting is first initiated at the start of P6-0 and P6-4, during Pre-Trip. For upward set point changes, current limiting and P6-0, the algorithm is 10 cycles long. For P6-4 it is 5 cycles long.

a. Perishable (chill) range above –10_C (+14_F) or –5_C (+23_F) optionally.

For set points ABOVE –10_C (+14_F) or –5_C (+23_F) optionally, the controller maintains SUPPLY air at the set temperature by the following modes of operation:

1. Operation in the Conventional Mode without Dehumidification (Code 33 OFF)

For Revision Level 1014 and above:

If the Condenser Pressure Control (CPC) logic is enabled, the condenser fan will cycle ON if condenser pressure is at or above 200 psig and will cycle OFF when condenser pressure drops below 130 psig.

If the unit starts and condenser pressure is below 200 psig, the condenser fan will not start until pressure reaches 200 psig.

For All Revision Levels:

The supply probe is used for control and is so indicated by the "SUPPLY" LED on the display module. The Perishable temperature range demands high accuracy. The unit is capable of maintaining supply air temperature to within ¦0.25_C (¦0.5_F) of the set point temperature setting. In Perishable range *above –10_C (+14_F)* or –5_C (+23_F) optionally, control is maintained by controlling the positions of the solenoid modulation valve (SMV) and suction solenoid valve (SSV, on 69NT40 only) with compressor energized.

When pulling down to the set point, both valves will be open to reduce the pulldown time unless suction solenoid override or current limiting is active. See section 1.10 for explanation of suction solenoid override. The current limit function will restrict the valves if the current is above the selected value. When the controlling probe temperature reaches set point, the suction solenoid valve will close.

When the controlling probe temperature enters the in-range temperature tolerance as selected at function code Cd30, the in-range light will energize.

The controller logic is designed so the suction modulation valve will begin to close as the set point is reached. The modulation valve will close to restrict refrigerant flow until the capacity of the unit and the load are balanced.

If the temperature drops below the set point, the compressor will remain running for a few minutes. This is to accommodate any initial overshoot which might occur. After this time and at 0.2_C (0.4_F) or greater below the set point, the compressor will be turned OFF.

The heaters will be energized if the temperature drops to 0.5_C (0.9_F) below the set point. The heaters will de-energize when the temperature rises to 0.2_C (0.4_F) below the set point. The compressor will not restart until the temperature rises to 0.2_C (0.4_F) above the set point and a 3 minute compressor off time delay has been satisfied.

2. Operation in the Dehumidification Mode (Code 33 Value Selected) – Optional

The dehumidification mode is activated by selecting Code 33 and selecting a desired relative humidity value and pressing the ENTER key. The control probe LED (SUPPLY) will flash ON and OFF every second to indicate that the dehumidification mode is active. Once the Mode is active and the following conditions are satisfied, the controller will activate the heat relay to begin dehumidification.

a. The humidity sensor reading is above the set point.

b. The pulldown mode is NOT active. (ie., The SSV valve is closed.)

c. The control probe (ie., SUPPLY) temperature is less than set point, plus 0.25_C.

d. The unit is in the control mode and the compressor is running.

e. The heater debounce timer (3 minutes minimum On or Off time) has timed out.

f. Heater termination thermostat (HTT) is closed.

g. The Controlled Atmosphere (CA) option VENT or Pre-Trip mode is not initiated.

If the above conditions remain true for at least one hour, on units so equipped, the evaporator fans will switch from high to low speed operation. The evaporator fan speed will switch every hour thereafter as long as all conditions are met (see Bulb Mode for different evaporator fan speed options). If any condition except for item a becomes false or the relative humidity sensed is 2% below the dehumidification set point, the high speed evaporator fans will be energized.

This applies power to the defrost and drain pan heaters. This added heat load causes the controller to open the modulating valve to match the new total heat load while still holding the supply air temperature very close to the set point.

Opening the modulating valve reduces the temperature of the evaporator coil surface which increases the rate water is condensed from the air passing through the coil. Removing water from the air reduces the relative humidity. When the relative humidity sensed is 2% below the set point (Code 33), the controller de-energizes the heat relay.

Thus the controller will continue to cycle heating to maintain relative humidity below the selected set point.

Two timers are provided in the Dehumidification mode to prevent rapid mode switching and consequent contactor wear. They are:

1. Heater debounce timer (3 minutes minimum On or Off time).

2. Temperature Out-of-range timer (5 minutes).

The heater debounce timer is activated whenever the heat contactor status is changed. The heat contactor remains energized (or de-energized) for at least 3 minutes even if the set point criteria is satisfied. This is to prevent rapid cycling of the heat contactor when the humidity set point is satisfied. If the mode is terminated by a condition other than the humidity sensor. For example, an out-of-range condition or compressor shutdown, the heat relay is de-energized immediately.

The out-of-range timer is provided to allow the heaters to remain energized during a temporary out-of-range condition. If the control probe temperature remains outside of the user selected in-range setting for more than 5 minutes, the heaters will be de-energized to allow the system to recover. The out-of-range timer starts as soon as the temperature exceeds the in-range tolerance value set by code Cd30.

Cooling capacity reduction by modulation is the same as described for the conventional operating mode when any of the above first four conditions (a thru d) are invalid.

With set points below –10_C (+14_F) or –5_C (+23_F) optionally, heating and dehumidification are locked out.

3. Operation in the Economy Mode (Code 34 set to ON)

The economy mode selection determines the status of the economy mode of operation. There are two values: “ON” & “OFF”. A code which represents the status of this function is recorded in the DataCorder memory whenever the value is changed.

Economy mode is a user selectable mode of operation provided for power saving purposes. Economy mode could be utilized in the transportation of temperature tolerant cargo or non-respiration items which do not require high airflow for removing respiration heat.

The economy mode is activated by selecting code Cd34 to the “ON” status. There is no active display indicator that economy mode has been activated, and a manual display of Cd34 is a way to be sure if the economy mode is or is not active.

In order to achieve economy mode perishable operation, a perishable set point must be selected PRIOR to activating economy mode. When economy mode perishable is active, low speed evaporator fans will be used along with the normal temperature control

algorithm. If the unit is not equipped with dual speed evaporator fans, then economy mode perishable will perform exactly the same as the normal control mode.

4. Operation in Bulb Mode (Code 35 set to bulb and Code 33 selected)

Bulb mode is an extension of the dehumidification mode and in as such, dehumidification must be enabled by selecting a value (percentage of relative humidity) at Code 33 before bulb mode Code 35 can be initiated.

To initiate bulb mode, use the ARROW keys to scroll to function code Cd35 and change from "Nor" to "bulb". Once the bulb mode is activated, the user may then change from the normal evaporator fan operation where the fan speed alternates every hour between low or high speed operation. This is done by toggling function code Cd36 from its default of "alt" to "Lo" or "Hi" respectively. If low speed evaporator fan operation is selected, this gives the user the additional capability of selecting dehumidification set points from 60 to 100% (instead of the normal 65 to 100%).

In addition, if bulb mode is active, the user is given the option to change the defrost termination sensor (DTS) temperature in which defrost is terminated from the normal 25.6_C (78_F) temperature setting to 4_C (39.2_F) in 0.1_C (0.2_F) increments. The temperature that the DTS temperature must go below before the defrost interval timer begins counting down also changes from 0_C to 10_C as the desired DTS temperature is raised.

Bulb mode is terminated anytime:

a. Code Cd35 is set to "Nor".
b. Code Cd33 for dehumidification is set to "Off".
c. Anytime the user changes the set point to one that is in the frozen range.

When bulb mode is disabled by any of the above means, the evaporator fan operation for dehumidification reverts to "alt" and the DTS termination setting resets to the normal 25.6_C (78_F).

b. Frozen range below −10_C (+14_F) or −5_C (+23_F) optionally

For set points BELOW −10_C (+14_F) or −5_C (+23_F) optionally, the controller maintains RETURN air at the set temperature by the following modes of operation:

1. Operation in the Conventional Mode (Code 33 OFF)

The return air probe is used for control and is so indicated by the LED on the display board.

The Frozen temperature range is not sensitive to minor temperature changes. The method of temperature control employed in this range takes advantage of this fact, to greatly improve the energy efficiency of the unit. Temperature control in the Frozen range *at or below −10_C (+14_F)* or −5_C (+23_F) optionally is accomplished by cycling the compressor on and off as the load demand requires.

If the return air temperature in the container drops 0.2_C (0.4_F) below the set point temperature, the compressor is cycled off. When the temperature is greater than 0.2_C (0.4_F) above the set point and the 3 minute time delay has been met, the compressor will restart. The unit will always operate at full capacity which means both the suction modulation (SMV) and suction solenoid (SSV) valves are fully open unless suction solenoid override or current limiting is activated. See section 1.10 for explanation of suction solenoid override.

To prevent on/off cycling of the compressor from occurring, a 3 minute compressor off time must be satisfied before the compressor will restart. Under a condition of a rapidly changing return air temperature, the time delay may allow the return air temperature to rise slightly more than 0.2_C (0.4_F) above the set point temperature before the compressor can restart.

2. Operation in the Economy Mode (Code 34 OFF)

The economy mode is deactivated by selecting code Cd34 to the "OFF" status. There is no active display indicator that economy mode has been deactivated, and a manual display of Cd34 is a way to be sure if the economy mode is or is not deactivated. A second way to deactivate economy mode is to change the set point. Once economy mode is deactivated, the system will return to normal control mode operations.

In order to achieve economy mode frozen operation, a frozen set point must be selected PRIOR to activating economy mode. When economy mode frozen is active, the system will perform normal frozen mode operations except that the entire refrigeration system excluding the Controller will be turned off when the control temperature is less than or equal to (the set point − 2_C, i.e., the set point is set at −11_C and the operator subtracts −2_C, the result will equal −13_C). After an off-cycle period of 60 minutes, the unit will turn on high speed evaporator fans for 2 minutes, and then check the control temperature. If the control temperature is greater than or equal to (set point + 0.2_C.) the unit will restart the refrigeration system and continue to cool until the previously mentioned off−cycle temperature criteria is met. If however, the control temperature is less than (set point + 0.2_C), the unit will turn off the evaporator fans and restart another 60 minute off-cycle.

3. Operation in the Bulb Mode (Code 35 OFF)

The unit will not run in bulb mode if a frozen range set point is selected. As described in section 1.12.4.a.4, if a frozen set point is selected the dehumidification evaporator fan speed reverts to alternating and the temperature above which DTS must go during defrost resets to 25.6_C (78_F).

1.12.5 Controller Function Codes

There are 37 functions which the operator may access to examine the operating status of the unit. To access these functions, perform the following: Press the CODE SELECT key, press an arrow key until the left window displays the desired code number (see Table 1-6). For the display only function codes, the right window will display the value of this item for 5 seconds before returning to the normal display mode. If a longer time is desired, pressing the ENTER key will extend the time to 30 seconds after the last pressing of the ENTER key. Below is an explanation of all Function codes.

Code 01 – Modulation Valve Opening (%)

The suction modulation valve (SMV) is a normally open valve which restricts flow of refrigerant to the compressor when energized by a pulse width modulated (PWM) output. The amount of closing of the valve is proportional to the applied current over the range of 0.2 to 1.3 A. The valve remains 100% open below 0.2 A and is 0% open at 1.3 A.

Code 02 – Future Expansion

This code is for future expansion.

Code 03 – Suction Solenoid Valve (Open or Closed)

Model (69NT40) will have a suction solenoid valve (SSV) to provide maximum refrigerant flow to the refrigeration unit. This valve will always be open for set points at or below –10_C (+14_F) or –5_C (+23_F) optionally and during temperature pulldown periods unless suction solenoid override or current limiting restricts its use.

Codes 04, 05 & 06 – Line Current, Phase A, B & C

The container is supplied by three-phase electrical power, so there are three current sensors in the unit. The current measured is used for control and diagnostic purposes.

For control processing, the highest of the three current values is used for current limiting purposes.

For diagnostic processing, the current draws are used to determine control unit operations. Whenever a heater or a motor is turned ON or OFF, the current draw increase/reduction for that activity is measured. The current draw is then tested to determine if it falls within the expected range of values for the respective unit. Failure of this test will result in a pre-trip failure or a control alarm indication.

Code 07 – Mains Power Voltage

The supply voltage level is decided 8 seconds after startup. If the value is >30 VAC, it is valid. If the read value is above 287.5 VAC, it is considered 460 VAC level, otherwise it is considered 230 VAC level.

When supply voltage is nominal 190/230 VAC, the 190/230 VAC current limit settings and current tables are used. When supply voltage is nominal 380/460 VAC, the 380/460 VAC current limit settings and current tables are used. When the sensor is invalid, the most recent valid reading is used to determine what current limit settings and current tables should be used. The current limit settings and current tables will continue to be determined in this way until the sensor becomes valid.

Code 08 – Mains Power Frequency

The value of the main power frequency is displayed in hertz. The frequency displayed will be halved if either F1 or F2 is bad and AL21 is active.

Code 09 – Ambient Temperature

The ambient sensor (AMBS) measures the temperature outside the container. For location of the sensor, see Figure 1-3.

Code 10 – Compressor Suction Temperature – Optional

Measured just prior to the compressor suction service valve, the compressor suction temperature is a display only temperature.

Table 1-6. Controller Function Code Assignments

CODE	DATA
(Inapplicable Functions Display - - - -)	
Display Only Functions	
Cd01	Modulation Valve Opening (%)
Cd02	Future Expansion
Cd03	Suction Solenoid Valve (Open/Closed)
Cd04	Line Current, Phase A
Cd05	Line Current, Phase B
Cd06	Line Current, Phase C
Cd07	Mains Power Voltage
Cd08	Mains Power Frequency
Cd09	Ambient Temperature
Cd10	Compressor Suction Temperature (Optional)
Cd11	Compressor Discharge Temperature (Optional)
Cd12	Compressor Suction Pressure (Optional)
Cd13	Compressor Discharge Pressure or Condenser Pressure (Optional)
Cd14	Future Expansion
Cd15	Future Expansion
Cd16	Compressor Motor Hour Meter
Cd17	Relative Humidity (%) (Optional)
Cd18	Software Revision #
Cd19	Battery Check
Cd20	Configuration ID
Cd21	Future Expansion
Cd22	Future Expansion
Cd23	Future Expansion
Cd24	Secondary Supply Air Temperature (Optional)
Cd25	Time Remaining Until Defrost
Cd26	Defrost Termination Sensor Temperature
Display/Select Functions	
Cd27	Defrost Interval (Hours)
Cd28	Temperature Units (_C or _F)
Cd29	Failure Action (Code)
Cd30	In-Range Tolerance
Cd31	Stagger Start Offset Time (Seconds)
Cd32	Current Limit (Amperes)
Cd33	Dehumidification Control (Optional)
Cd34	Economy Mode (Optional)
Cd35	Bulb Mode Select (Optional)
Cd36	Fan speed Select (Optional)
Cd37	Defrost Termination Sensor Setting (Optional)

Code 11 – Compressor Discharge Temperature – Optional

The compressor discharge temperature is measured near the compressor discharge valve.

Code 12 – Compressor Suction Pressure – Optional

Compressor Suction Pressure is displayed by using a pressure transducer.

Code 13 – Compressor Discharge Pressure or Condenser Pressure (CPC) – Optional

Compressor discharge or condenser pressure is displayed by using a pressure transducer.

Pressure is displayed in units of psig when code 28 is set to _F and units of bars when code 28 is set to _C. "P" appears after the value to indicate psig and "b" appears after the value to indicate bars.

Code 14 & 15 – Future Expansion

These codes are for future expansion.

Code 16 – Compressor Motor Hour Meter

Records total hours of compressor run time. Records total hours in increments of (10) ten hours (ie. 3000 hours displayed as 300).

Code 17 – Relative Humidity (%) – Optional

This code is only applicable to units with a humidity sensor (HS). This code displays in percent the relative humidity at that time.

Code 18 – Software Revision Number

The software revision number is displayed.

Code 19 – Battery Check

This code checks the optional battery pack, while the test is running "btest" will flash on the right display, followed by the result. "PASS" will be displayed for battery voltages greater than 7.0 volts, "FAIL" will be displayed for battery voltages between 4.5 and 7.0 volts, and "– – –" will be displayed for battery voltages less than 4.5 volts. After the result is displayed for four seconds, "btest" will again be displayed, and the user may continue to scroll through the various codes.

Code 20 – Configuration ID

This code indicates the dash number of the model for which the Controller is configured (i.e., if the unit is a 69NT40-489-62, the display will show 0062).

Code 21, 22, & 23 – Future Expansion

These codes are for future expansion.

Code 24 – Secondary Supply Air Temperature – Optional

The secondary supply air temperature (for 3 probe units) is measured at the same place as the primary supply air temperature.

Code 25 – Time Remaining Until Defrost

This code displays the time remaining until the unit goes into defrost (in tenths of an hour).

Code 26 – Defrost Termination Sensor

The defrost termination sensor is located immediately above the evaporator coil. It is used by the controller for defrost initiation and termination. (See Figure 1-2)

NOTE

The following are user-selectable functions. The operator can change the value of these functions to meet the operational needs of the container.

Code 27 – Defrost Interval (Hours)

The defrost interval is the time interval between defrost cycles of which there are 5 possible selectable values: 3, 6, 9, 12 or 24 hours. The factory default value is 3 hours.

The time interval of the first defrost will not begin counting down until DTS is below 10_C (50_F). The time interval to the next defrost cycle is entered into the controller at the time DTS is below 10_C (50_F) or at power-up. (See code Cd37 for deviations.)

NOTE

The defrost interval timer counts only during compressor run time.

For Revision Level 1013 and below:

When the interval timer has counted down 2.5 hours, the relationship between the control temperature and the set point is checked. If the control temperature is 5_C (41_F) above the set point, the unit immediately goes into the defrost mode. Upon termination of defrost, the user selected interval (ie., 3, 6, 9, 12 & 24 hr) is reset. During pulldown from high ambient, this cycle will repeat until the control temperature is less than 5_C (41_F) above the set point. At such time, the selected defrost interval time will be used.

If the control temperature drifts 5_C (41_F) above the set point after the 2.5 hours of countdown but prior to completion of the selected interval, the unit will immediately go into defrost. Upon termination of defrost, the defrost interval timer will be reset.

For All Revision Levels:

If DTS reaches 25.6_C (78_F) at any time during the timer count down, the interval is reset and the countdown begins over.

If DTS has failed (ie., AL60 is active) and the primary return sensor temperature is less than 10_C (50_F), the interval timer countdown begins. The interval timer is reset if the return sensor temperature rises above 25.6_C (78_F). (See section 2.4.4.)

Defrost Interval Timer Value Option:

If the software is configured to "ON" for this option, then the value of the defrost interval timer will be saved at power down and restored at power up. This option prevents short power interruptions from resetting an almost expired defrost interval, and possibly delaying a needed defrost cycle.

Code 28 – Temperature Units (_C or _F)

This code determines the temperature unit's _C or _F which will be used for all temperature displays. The user selects _C or _F by selecting code 28 and pushing the ENTER key. The factory default value is C.

Code 29 – Failure Action (Code)

If all of the control sensors are out of range (AL26) or there is an AL27 failure, the unit will enter the shutdown state defined by the failure action. The user selects one of four possible actions as designated by a selection code:

A – Full Cooling (SMV 100%)
B – Partial Cooling (SMV 50% open)
C – Evaporator Fan Only
D – Full System Shutdown – Factory Default

Code 30 – In-Range Tolerance

The in-range tolerance will determine the bandwidth of temperatures around the set point which will be designated as in-range. If the control temperature is in-range, the in-range light will be illuminated. There are four possible values.

1. ¦ 0.5_C (¦ 0.9_F)
2. ¦ 1.0_C (¦ 1.8_F)
3. ¦ 1.5_C (¦ 2.7_F)
4. ¦ 2.0_C (¦ 3.6_F)

Code 31 – Stagger Start Offset Time (Seconds)

The stagger start offset time is the amount of time that the unit will delay at start-up, thus allowing multiple units to stagger their control initiation when all units are powered up together. The eight possible offset values are in (seconds):

0 = Factory Default 3, 6, 9, 12, 15, 18, 21

Code 32 – Current Limit (Amperes)

The current limit is the maximum current demand allowed on any phase at any time. Limiting the unit's current (amperage) reduces the load on the mains power and lowers the compressor discharge pressure. Whenever this is desirable, the limit can be lowered. Note, however, that capacity is also reduced.

The 5 values for 460VAC operation are:

21 = Factory Default 15, 17, 19, 23

The 5 values for 230VAC operation are:

42 = Factory Default 30, 34, 38, 46

Code 33 – Dehumidification Control – Optional

This code is only applicable to units with a humidity sensor (HS).

Relative humidity set point is available only on units configured for dehumidification. If not configured the mode is permanently deactivated and Cd33 will display "– – – –".

When set point is available, it can be set to "OFF", "TEST", or 65 to 100% relative humidity in increments of 1%. If bulb mode is active (code Cd35) and "Lo" speed evaporator motors are selected (code Cd36) then set point ranges from 60 to 100%.

When "TEST" is selected or test set point is entered, the heaters should be turned on, indicating that dehumidification mode is activated. After a period of 5 minutes has elapsed in this mode, the previous mode selected is re-instated.

When the mode is activated, the control probe LED flashes on and off every second to alert the user.

Code 34 – Economy Mode – Optional

Economy mode is a user selectable mode of operation provided for power saving purposes. Economy mode could be utilized in the transportation of temperature tolerant cargo or non-respiring items which do not require high airflow for removing respiration heat.

Code 35 – Bulb Mode Select – Optional

Bulb mode is a user selectable mode of operation that is an extension of normal dehumidification. If dehumidification is set to "Off", code Cd35 will display "Nor" and the user will be unable to change it. After a dehumidification set point has been selected and entered for code Cd33, the user may then change code Cd35 to "bulb". After bulb has been selected and entered, the user may then go to codes Cd36 and Cd37 to make the desired changes.

Code 36 – Evaporator Fan Speed Select – Optional

This code is enabled only if a dehumidification set point has been selected at code Cd33 and "bulb" has been selected at code Cd35. If these conditions are not met, "alt" will be displayed indicating that the evaporator fans will alternate their speed whenever a dehumidification set point is selected. It also may not be changed. If a dehumidification set point has been selected along with bulb mode then "alt" may be selected or "Lo" for low speed evaporator fan only, or "Hi" for high speed evaporator fan only. If a setting other than alt has been selected and bulb mode is deactivated in any manner, then this selection reverts back to "alt".

Code 37 – Defrost Termination Sensor Setting – Optional

This code, as with code Cd36, is used in conjunction with bulb mode and dehumidification. If bulb mode is active, this code allows the user to change the temperature above which the DTS temperature must go to terminate defrost. It allows the user to change the setting from 4_C to 25.6_C in 0.1_C (0.2_F) increments. This value is changed using the UP/DOWN ARROW keys followed by the ENTER key when the desired value is displayed. If bulb mode is deactivated in any manner, the DTS setting above which defrost terminates defaults to the normal 25.6_C (78_F) setting.

1.12.6 Controller Alarms (See Table 1-7)

The alarm philosophy balances the protection of the refrigeration unit and that of the refrigerated cargo. The action taken when an error is detected always considers the survival of the cargo. Rechecks are made to confirm an error actually exists. Some alarms requiring compressor shutdown have time delays before and after to try to keep the compressor operating. An example is a low mains voltage. When the voltage drops over 25%, an indication is given on the display, but the unit will continue to run.

The red alarm light will illuminate for "20 series" alarms only. If a detectable problem is found to exist, its alarm code will be alternately displayed with the set point on the left display.

To determine if other alarms exist or have existed, the alarm list must be accessed. The alarm list will store

up to 16 alarms in the sequence in which they occurred. When accessing the alarm list, an "IA" or an "AA" will appear to the left of the alarm code number. The "IA" indicates an Inactive Alarm; one that has occurred, but no longer exists. The "AA" indicates an Active Alarm; one that is still indicating an improper condition.

The Alarm List Display Mode is entered by pressing the ALARM LIST key while in Set Point Selection or Default Display mode. The user will be able to display any alarms archived in the Alarm Queue. If no alarms, other than those related to the EEPROM (AL51), are active, the Alarm Queue may be cleared.

When the ALARM LIST key is pushed, the left display will show AL#, where # is the alarm number in the queue. The right display will shown AAXX, if the alarm is active, where XX is the alarm number or IAXX, if the alarm is inactive. The user can look through the alarm queue by depressing the UP ARROW key. At the end of the alarm list, if any of the alarm(s) in the list is active, END is displayed. If all the alarms in the list are inactive, then at the end of the alarm list, CLEAr is displayed. (The exception to this rule is the AL51 failure alarm, this alarm does not have to go inactive in order to clear the alarm list) At this time if the user pushes the ENTER key, then the alarm list will clear and display "----" on right display. Another alternative for the user to get to the end of the alarm list is by pushing the DOWN ARROW key after the ALARM LIST key is pushed. Thus, the DOWN ARROW key being pushed will allow the user to go backward in the alarm list. If a user pushes ALARM LIST key when there are no alarms in the list, then AL is displayed on left display and "----" on the right display. Upon clearing of the Alarm Queue, the Alarm light will be turned off.

Alarm 20 – Control Circuit Fuse Open (24 VAC)

Alarm 20 is triggered by fuse (F3) opening and will cause the software shutdown of all control units. This alarm will remain active until the 15 amp fuse is replaced.

Alarm 21 – Micro Circuit Fuse Open (18 VAC)

Alarm 21 is triggered by one of the fuses (F1/F2) being opened on 18 volts AC power supply to the controller. SMV will be opened and current limiting is halted. The compressor will cycle, temperature control will be obtained by cycling the compressor.

Alarm 22 – Evaporator Fan Motor Safety

Alarm 22 is triggered by the opening of the evaporator motor internal protector. This alarm will disable all control units until the motor protector resets. Also, refer to code Cd29.

Alarm 23 – Auto Transformer Safety – Optional

Alarm 23 is triggered by the auto transformer internal protector opening, and will result in the disabling of all control units except the evaporator fans. The alarm will stay active until the transformer protector resets. On units with dual voltage evaporator transformer (refer to Table 1-1), Alarm 23 is triggered by the internal protector opening, and will result in the disabling of all control units. The alarm will stay active until the transformer protector resets.

Alarm 24 – Compressor Motor Safety

Alarm 24 is triggered by the opening of the compressor motor internal protector. This alarm will disable all control units except for the evaporator fans and will remain active until the motor protector resets.

Alarm 25 – Condenser Fan Motor Safety

Alarm 25 is triggered by the opening of the condenser motor internal protector and will disable all control units except for the evaporator fans. This alarm will remain active until the motor protector resets. This alarm is deactivated if the unit is operating on water cooled condensing.

Table 1-7. Controller Alarm Indications

NO.	ALARM DESCRIPTION
AL20	Control Circuit Fuse Open (24 VAC)
AL21	Micro Circuit Fuse Open (18 VAC)
AL22	Evaporator Fan Motor Safety
AL23	Auto Transformer Safety
AL24	Compressor Motor Safety
AL25	Condenser Fan Motor Safety
AL26	All Supply and Return Air Sensor Failure
AL27	Probe Circuit Calibration Failure
AL51	Alarm List Failure
AL52	Alarm List Full
AL53	Mains Voltage Sensor Failure
AL54	Primary Supply Air Sensor Failure
AL55	Secondary Supply Air Sensor Failure
AL56	Primary Return Air Sensor Failure
AL57	Ambient Temperature Sensor Failure
AL58	Compressor High Pressure Safety
AL59	Heat Termination Thermostat (HTT) Safety
AL60	Defrost Termination Sensor Failure
AL61	Heaters Failure
AL62	Compressor Circuit Failure
AL63	Current Over Limit
AL64	Discharge Temperature Over Limit
AL65	Discharge or Condenser Pressure Sensor Failure
AL66	Suction Pressure Sensor Failure
AL67	Humidity Sensor Failure
ERR #	Internal Microprocessor Failure
Entr stpt	Enter Setpoint (Press Arrow & Enter)
LO	Low Mains Voltage
VENT	VENT mode - Controlled Atmosphere (CA) option
P-CA	Pre-Trip mode - Controlled Atmosphere (CA) option

Alarm 26 – All Supply and Return Air Sensor Failure

Alarm 26 is triggered if the controller determines that all of the control sensors are out-of-range. This can occur for box temperatures outside the range of −50_C to +70_C (−58_F to +158_F).

This alarm triggers the failure action code set by Code Cd29.

Alarm 27 – Probe Circuit System Calibration Failure

The controller has a built-in A/D (Analog to Digital) converter, used to convert analog readings (i.e. temperature sensors, current sensors, etc.) to digital readings. The controller continuously performs calibration tests on the A/D converter. If the A/D converter fails to calibrate for 30 consecutive seconds, this alarm is activated.

This alarm will be inactivated as soon as the A/D converter calibrates.

Alarm 51 – Alarm List Failure

During start-up diagnostics, the memory (EEPROM) is examined to determine validity of its contents. This is done by testing the set point and the alarm list. If the contents are invalid, Alarm 51 is set.

During control processing, any operation involving alarm list activity that results in an error will cause Alarm 51 to be set.

Alarm 51 is a "display only" alarm and is not written into the alarm list. Pressing the ENTER key when clear is displayed will result in an attempt to clear the alarm list. If that action is successful (all alarms are inactive), Alarm 51 will be reset.

Alarm 52 – Alarm List Full

Alarm 52 is set whenever the alarm list is determined to be full; at start-up or after recording an alarm in the list. Alarm 52 is displayed, but is not recorded in the alarm list.

This alarm can be reset by clearing the alarm list. This can be done only if all alarms written in the list are inactive.

Alarm 53 – Mains Voltage Sensor Failure

Alarm 53 is caused by three consecutive line voltage readings of less than 30VAC. When AL53 is active, the current limit settings and current draw tables will be determined based on the most recent valid voltage reading. The settings and tables will continue to be determined in this manner until the sensor is determined to be valid.

Alarm 54 – Primary Supply Air Sensor Failure

Alarm 54 is set by an invalid primary supply sensor reading, that is, outside the range of –50 to +70_C (–58_F to +158_F).

If Alarm 54 is set and the primary supply is the control sensor, the secondary supply sensor will be used for control if the unit is so equipped.

If the unit does not have a secondary supply probe, and AL54 is set, the (primary return sensor, minus 2_C) will be used for control.

Alarm 55 – Secondary Supply Air Sensor Failure

Alarm 55 is set by an invalid secondary supply sensor reading, that is, outside the range of –50 to +70_C (–58_F to +158_F).

If Alarm 55 is set and the secondary supply is the control sensor, the the primary return sensor will be used for control.

Alarm 56 – Primary Return Air Sensor Failure

Alarm 56 is set by an invalid primary return sensor reading, that is, outside the range of –50 to +70_C (–58_F to +158_F).

If Alarm 56 is set and the primary return is the control sensor, the primary supply sensor will be used for control.

Alarm 57 – Ambient Temperature Sensor Failure

Alarm 57 is triggered by an ambient temperature reading outside the valid range from –50_C (–58_F) to +70_C (+158_F). This is a display alarm and has no associated failure action.

Alarm 58 – Compressor High Pressure Safety

Alarm 58 is triggered when the compressor high discharge pressure safety switch remains open for at least one minute. This alarm will remain active until the pressure switch resets, at which time the compressor will restart.

Alarm 59 – Heat Termination Thermostat (HTT) Safety

Alarm 59 is triggered by the opening of the heat termination thermostat and will result in the disabling of the heater. This alarm will remain active until the thermostat resets.

Alarm 60 – Defrost Termination Sensor Failure

Alarm 60 is an indication of a probable failure of the defrost termination sensor (DTS). It is triggered by the opening of the heat termination thermostat (HTT) or the failure of the DTS to go above 25.6_C (78_F) within 2 hours of defrost initiation.

After one-half hour with a frozen range set point, or one-half hour of compressor run time, if the return air falls below 7_C (45_F), the controller checks to ensure defrost termination sensor (DTS) has dropped to 10_C or below. If not, a DTS failure alarm is given and the defrost mode is operated off of return temperature sensor (RTS). The defrost mode will be terminated after one hour by the controller.

Alarm 61 – Heaters Failure

Alarm 61 is the heater alarm caused by detection of improper amperage resulting from heater activation (deactivation). Each phase of the power source is checked for proper amperage.

This alarm is a display alarm with no resulting failure action, and will be reset by a proper amp draw of the heater.

Alarm 62 – Compressor Circuit Failure

Alarm 62 is triggered by improper current draw increase (decrease) resulting from compressor turn on (off). The compressor is expected to draw a minimum of 2 amps; failure to do so will cause the alarm.

This is a display alarm with no associated failure action and will be reset by a proper amp draw of the compressor.

Alarm 63 – Current Over Limit

Alarm 63 is triggered within the current limiting system. If the compressor is ON and current limiting procedures cannot maintain a current level below the user selected limit, the current limit alarm is activated.

This alarm is a display alarm and is inactivated by power cycling the unit, changing the current limit via the code select Cd32, or if the SMV is allowed to open to 100% and the suction solenoid valve is allowed to open.

Alarm 64 – Discharge Temperature Over Limit

Alarm 64 is triggered if the discharge temperature is sensed greater than 154_C (310_F) for 3 continuous minutes, or if it exceeds 177_C (350_F), or if the sensor is out of range. This is a display alarm and has no associated failure action.

Alarm 65 – Discharge Pressure or Condenser Pressure (CPC) Sensor Failure

Alarm 65 is triggered by a compressor discharge or condenser pressure sensor reading outside the valid range of 73.20 cm Hg (30 in Hg) to 32.34 Kg/cm^2 (460 psig). This is a display alarm and has no associated failure action.

Alarm 66 – Suction Pressure Sensor Failure

Alarm 66 is triggered by a suction pressure sensor reading outside the valid range of 73.20 cm Hg (30 in Hg) to 32.34 Kg/cm^2 (460 psig). This is a display alarm and has no associated failure action.

Alarm 67 – Humidity Sensor Failure

Alarm 67 is triggered by a humidity sensor reading outside the valid range of 0% to 100% relative humidity.

If alarm 67 is active and the dehumidification mode was previously activated, then it will be deactivated.

ERR # - Internal Microprocessor Failure

The controller performs self-check routines. if an internal (electronic) failure occurs, an ERR #0–5 will appear on the display. This is an indication the controller needs to be replaced.

Entr stpt - Enter Setpoint (Press Arrow & Enter)

The Controller is prompting the operator to enter a set point.

LO - Low Mains Voltage (Change of function codes Cd27-Cd33 disabled and no alarm stored.)

This message will be alternately displayed with the set point whenever the mains voltage is less than 75% of its proper voltage.

VENT

This message will be alternately displayed with the set point whenever the CTD Controlled Atmosphere (CA) option is in the VENT mode.

P-CA

This message will be alternately displayed with the set point whenever the CTD Controlled Atmosphere (CA) option is in the Pre-Trip mode.

NOTE

The left display of the Refrigeration Controller will alternately display P-CA and set point for units with the CTD Controlled Atmosphere (CA) option (refer to Table 1-1).

1.13 PRE-TRIP DIAGNOSTICS

NOTE

The Refrigeration Controller will be locked-out of Pre-Trip if the CTD Controlled Atmosphere (CA) option (refer to Table 1-1) is in either the Vent or Pre-Trip mode.

CAUTION

Pre-trip inspection should not be performed with critical temperature cargoes in the container.

Pre-trip Diagnostics is an independent mode which will suspend the normal Control Mode activities when initiated by the user. With pre-trip diagnostics, either all the pre-trip tests can be executed in a defined sequence (Auto Mode), or one of the pre-trip tests can be selected to be executed (Manual Mode), based on the sequence of key selections made.

a. Starting and Terminating Pre-Trip

A Pre-trip selection menu is displayed by pressing the PRE-TRIP key. This places the user into a test selection menu. If no selection is made, the pre-trip menu selection process will terminate automatically. Pre-Trip will terminate if the VENT mode is selected on the CA Controller. The user must scroll through the selection by pressing the UP ARROW or DOWN ARROW keys, then pressing the ENTER key when the selection is made. While the tests are being executed, the user can terminate the pre-trip mode by holding the PRE-TRIP key. The unit will then resume normal operation. If the user decides to terminate a test but remain at the test selection menu, the user may press the UP ARROW key. When this is done all machinery outputs will be de-energized and the test selection menu will be displayed.

The pre-trip diagnostics may also be initiated via communication, but when initiated will always attempt to execute the entire battery of tests (auto mode).

b. Current Limiting During Pre-Trip

Throughout the duration of any pre-trip mode, the Current Limit processing is active.

NOTE

When current limiting is initiated, the compressor is immediately cycled through a reliability enhancement algorithm (SMV is cycled between 70% to 0%), to remove any refrigerant trapped in the oil of the compressor. This also happens during Pre-Trip tests P6-0 and P6-4. For current limiting and P6-0 the algorithm is 10 cycles long, and for P6-4 its 5 cycles long.

c. Test Codes

A detailed description of the pre-trip test codes is listed in the following section, however, for a quick reference list refer to Table 1-8.

Table 1-8. Pre-Trip Test Codes

TEST CODE	DESCRIPTION
P	Pre-Trip Initiated
P1-0	Heaters Turned On
P1-1	Heaters Turned Off
P2-0	Condenser Fan On
P2-1	Condenser Fan Off
P3-0	Low Speed Evaporator Fan Motors On
P3-1	Low Speed Evaporator Fan Motors Off
P4-0	High Speed Evaporator Fan Motors On
P4-1	High Speed Evaporator Fan Motors Off
P5-0	Probe Test
P5-1	Probe Test
P6-0	Compressor Started
P6-1	Future Expansion
P6-2	Suction Modulation Valve (Open)
P6-3	Future Expansion
P6-4	Suction Modulation Valve (Closed)
P6-5	Suction Solenoid Valve
P6-6	Future Expansion
P6-7	Future Expansion
P6-8	Future Expansion
P7-0	High Pressure Switch Closed
P7-1	High Pressure Switch Open
P8-0	Perishable Mode Heat Test
P8-1	Perishable Mode Pull Down Test
P8-2	Perishable Mode Maintain Temperature Test
P9-0	Defrost Test
P10-0	Frozen Mode (Setup) Test
P10-1	Frozen Mode (Pull Down) Test
P10-2	Frozen Mode Maintain Temperature Test

1.13.1 Pre-Trip

In this mode, the unit will automatically test unit components using internal measurements and comparison logic, and will provide a "PASS" or "FAIL" display to indicate the results of each test.

If the user depresses the PRE-TRIP key, the unit gives access to a pre-trip selection menu. The contents of the menu is shown as follows:

For Revision Level 1013 and below:

Auto, P1, P2, P3, P4, P5, P6, rSLts

For Revision Level 1014 and above:

Auto 1, Auto 2 (Optional), P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, rSLts

If the pre-trip was last executed manually since power up, the last menu selection will appear on the left display. If pre-trip was not executed since power up, then the right display will display "Auto 1" upon execution of pre-trip. The user may scroll through the test selection menu using the arrow keys.

A given test is selected by pressing ENTER while it is displayed. The entire battery of tests may be run by pressing ENTER while "Auto 1" or "Auto 2" is displayed.

During this selection mode, failure to press either an arrow key or ENTER for 5 seconds will return the unit to its default display, and normal operating mode.

Any test may be interrupted by pressing the UP ARROW. This will return the user to the test selection mode described above, and all machinery outputs will be de-energized.

While given tests from "Auto 1" are running, PX-X will be on the left display, where the X's indicate the test number and sub-test. The right display will show a countdown time in minutes and seconds, indicating how much time there is left remaining in the test.

For "Auto 2", the left display will show PX-X, while the left display will show applicable data.

a. Manual Test Operation

Individually selected tests, other than the LED/Display test will perform the operations necessary to verify the operation of the component under test. At the conclusion of the selected test, PASS or FAIL will be displayed. Upon failure, the Supply and Return LED's will flash on alternately. This message will remain displayed for up to three minutes, in which time a user may select another test. If the three minutes expires, the unit will terminate pre-trip and return to control mode operation. Following any individually selected test, all outputs will be de-energized.

b. Auto Test Operation From Keypad

If "Auto 1" or "Auto 2" test is initiated, then the unit will execute a series of consecutive tests, each related to an identifiable unit component, without any need of user interface directly. These tests vary in length, depending on the component under test.

When an automatic test fails, it will be repeated once automatically. A repeated test failure will cause "FAIL" to be shown on the right display, with the corresponding test number to the left. The user may then press the DOWN ARROW to repeat the test or the UP ARROW to skip to the next test. The unit will wait indefinitely for user input. Holding the PRE-TRIP key will terminate the pre-trip mode operation.

When "Auto 1" is allowed to run to completion without being interrupted, the unit will exit the pre-trip mode, and return to normal control operation.

When "Auto 2" is allowed to run to completion without being interrupted, the unit will terminate pre-trip and display "Auto 2" "end". The unit will remain

suspended in this mode until the user depresses the ENTER key.

c. Auto Test Operation From Serial Communications

Pre-trip may also be initiated via communications. The operation is the same as for the Auto Test mode described above except that should a test fail, the pre-trip mode will automatically terminate. When initiated via communications, a test may not be interrupted with an arrow key, but the pre-trip mode can be terminated with the PRE-TRIP key.

d. Pre-Trip Test Results

At the end of the pre-trip test selection menu, the message "P" "rSLts" will be displayed. Pressing the ENTER key will allow the user to see the results for all sub tests (i.e. 1-0, 1-1, etc). The results will be displayed as "PASS" or "FAIL" for all the tests run to completion since power up. If a test has not been run since power up, "– – – –" will be displayed.

1.13.2 Pre-Trip Mode

P - Indicator Lamps, LEDs And Displays

All lights and display segments will be energized for 5 seconds at the start of the pre-trip. Since the unit cannot recognize lights and display failures, there are no test codes or results associated with this phase of pre-trip.

P1-0 – Heater On Test

Setup: Heater must start in the off condition, and be turned on, a current draw test is done after 15 seconds.

Pass/Fail Criteria: Passes if change in current draw is in the range specified.

P1-1 – Heater Off Test

Setup: Heater must start in the on condition, and be turned off, a current draw test is done after ten (10) seconds.

Pass/Fail Criteria: Passes if change in current draw is in the range specified.

P2-0 – Condenser Fan On Test

Requirements: WPS input must be closed.

Setup: Condenser fan is turned on, a current draw test is done after fifteen (15) seconds.

Pass/Fail Criteria: Passes if change in current draw test is in the range specified.

P2-1 – Condenser Fan Off Test

Setup: Condenser fan is turned off, a current draw test is done after ten (10) seconds.

Pass/Fail Criteria: Passes if change in current draw test is in the range specified.

P3 – Low Speed Evaporator Fans

Requirements: The unit must be equipped with a low speed evaporator fan, as determined by the Evaporator Fan speed select configuration variable.

P3-0 – Low Speed Evaporator Fan On Test

Setup: The low speed Evaporator Fan is turned on, a current draw test is done after sixty (60) seconds.

Pass/Fail Criteria: Passes if change in current draw is in the range specified.

P3-1 – Low Speed Evaporator Fan Off Test

Setup: The low speed Evaporator Fan is turned off, a current draw test is done after ten (10) seconds.

Pass/Fail Criteria: Passes if change in current draw is in the range specified.

P4-0 – High Speed Evaporator Fan On Test

Setup: The high speed Evaporator Fan is turned on, a current draw test is done after sixty (60) seconds.

Pass/Fail Criteria: Passes if change in current draw is in the range specified.

P4-1 – High Speed Evaporator Fan Off Test

Setup: The high speed Evaporator Fan is turned off, a current draw test is done after ten (10) seconds.

Pass/Fail Criteria: Passes if change in current draw is in the range specified.

P5-0 – Supply/Return Probes Test

Setup: The High Speed Evaporator Fan is turned on and run for 8 minutes, with all other outputs de-energized.

Pass/Fail Criteria: A temperature comparison is made between the return and supply probes.

Note: If this test fails "P5-0" and "FAIL" will be displayed. If both Probe tests (this and the PRIMARY/SECONDARY TEST) pass, the display will read ' P5 ' 'PASS'.

P5-1 – Primary/Secondary Test

Requirements: For units equipped with secondary supply probe only

Pass/Fail Criteria: After 8 minutes, the temperature difference between primary and secondary probe (supply) is compared to a standard.

Note: If this test fails, "P5-1" and FAIL will be displayed. If both Probe tests (this and the SUPPLY/RETURN TEST) pass, because of the multiple tests, the display will read 'P 5' 'PASS'.

P6-0 – Compressor Test

Setup: The compressor is started, a current draw test is done for one-hundred fifty (150) seconds with the additional outputs (if installed) in the following states:

SSV	Closed (69NT40)
Quench	Closed
Unloader	Energized (R-22)
SMV	70%to 0% (Refer to the NOTE in the beginning of section 1.12.4 for a more detailed description.)

Pass/Fail Criteria: Passes if the change in current draw is within the valid range.

P6-1 – Future Expansion

This test is for future expansion.

P6-2 – Suction Modulation Valve (Open) Test

Setup: The Suction modulation valve is opened to 100 % unless restricted by current limit function, and the unit is run for two minutes.

Pass/Fail Criteria: The supply and return probe temperature reading difference is compared to a predetermined value.

P6-3 – Future Expansion

This test is for future expansion.

P6-4 – Suction Modulation Valve (Closed) Test

Setup: The SMV is cycled between 70% to 0% five (5) times and then the unit is run for 5 minutes with the SMV open at 20%.

Pass/Fail Criteria: The supply and return probe temperature reading difference is compared to a predetermined value.

P6-5 – Suction Solenoid Valve Test (69NT40)

Requirements: The unit must be equipped with a (SSV). Current limiting may close SSV. If this happens, the test will automatically pass.

Setup: The (SSV) is opened, the SMV is closed, and the unit is run for one minute.

Pass/Fail Criteria: The supply and return probe temperature reading difference is compared to a predetermined value

P6-6, P6-7 & P6-8 – Future Expansion

These tests are for future expansion.

P7-0 – High Pressure Switch (Open) Test

Setup: When the unit is running, the condenser fan is de-energized, and a 15 minute timer is started. The right display shows discharge temperature.

Pass/Fail Criteria: The high pressure switch fails to open in 900 seconds.

NOTE

This test is skipped if the unit does NOT have:

- A compressor discharge sensor (CPDS).
- A discharge pressure sensor (DPT).
- A condenser pressure transducer (CPT).

In addition, this test is skipped if:

- The sensed ambient temperature is less than 7_C (45_F).
- If the return air temperature is less than –17.8_C (0_F).
- If the water pressure switch (WPS) is open indicating that the unit is operating with a water-cooled condenser.

Pass/Fail Criteria: Under conditions of the above note; the test immediately fails if any of the following inputs are sensed to be invalid:

- Compressor discharge sensor (CPDS).
- Discharge pressure sensor (DPT).
- Condenser pressure transducer (CPT).
- Return temperature sensor (RTS).
- Ambient sensor (AMBS).

Otherwise, the test fails if:

- High pressure switch (HPS) fails to open within 15 minutes.
- Discharge temperature exceeds 138_C (280_F).
- Discharge temperature is less than or equal to ambient temperature plus 5_C (41_F).
- Condenser pressure transducer (CPT) or discharge pressure sensor (DPT) pressure exceeds 27.42 kg/cm_2 (390 psig).

P7-1 – High Pressure Switch (Close) Test

Requirements: Test P7-0 must pass for this test to execute.

Setup: The condenser fan is started and a 60 second timer is started.

Pass/Fail Criteria: If the high pressure switch closes within the 60 second time limit.

P8-0 – Perishable Mode (Heat) Test

Setup: If the container temperature is below 60_F, the set point is changed to 60_F, and a 60 minute timer is started, also the left display will read “P8–0”. The control will then heat the container until 60_F is reached. If the container temperature is above 60_F at the start of the test, then the test proceeds immediately to test P8-1 and the left display will change to “P8–1”.

Pass/Fail Criteria: The test fails if the 60 minute timer expires before the control temperature reaches set point and the display will read “P8–0” “FAIL”.

P8-1 – Perishable Mode (Pull Down) Test

Requirements: Control temperature must be at least 60_F.

Setup: The set point is changed to 32_F, and a 180 minute timer is started, also the left display will read ”P8–1”, the right display will show the supply air temperature. The unit will then start to pull down the container temperature to the 32_F set point.

Pass/Fail Criteria: The test passes if the container temperature reaches set point before the 180 minute timer expires.

P8-2 – Perishable Mode (Maintain Temperature) Test

Requirements: Test P8-1 must pass for this test to execute.

Setup: The left display will read “P8–2”, and the right display will show the supply air temperature. A 60 minute timer is started, and the unit will be required to maintain the 32_F temperature to within + or – 0.5_C (0.9_F) of set point until a DataCorder recording is executed. The recorder supply probe temperature running total (and it’s reading’s counter) will be zeroed out for the remainder of the recording period at the start of this test, so that the actual value recorded in the DataCorder will be an average of only this test’s results. Once a recording occurs, the average recorder supply temperature will be recorded in the DataCorder, as well as stored in memory for use in applying the test pass/fail criteria.

Pass/Fail Criteria: If the temperature remains within + or – 0.5_C. of set point from test start to DataCorder

recording, the test passes. If temperature is outside of the tolerance range at the DataCorder recording, the test fails.

P9-0 – Defrost Test

Setup: The DTS temperature will show on the right display, and the right display will show the supply air temperature. The unit will run full cool for 30 minutes maximum while the DTS sensor temperature is above 10_C. Once the DTS is below 10_C, the unit simulates defrost by running the heaters for up to two (2) hours, or until the DTS senses temperature above 25.6_C.

Pass/Fail Criteria: The test fails if: The DTS does not go below 10_C after 30 minutes of full cooling, and also if the HTT is open when the DTS is below 10_C. The test also fails if the HTT opens anytime during the defrost cycle and also if the return air temperature exceeds 120_F anytime during the heat cycle.

P10-0 – Frozen Mode (Setup) Test

Setup: After completion of the DTS test, the set point will be set to 7_C (45_F). The left display will read "P100", and if the container temperature is below 45_F, will continue this display until the container is heated up to set point. The left display will change to "P101" and execute the frozen pull down test when the container temperature reaches set point, or if the container temperature initially was greater than or equal to set point. The maximum time allowed in heat mode is TBD.

Pass/Fail Criteria: If this time limit is exceeded, the test fails. There will be no pass indication for this test. However, if the test fails the display will read "P100" "FAIL".

P10-1 – Frozen Mode (Pull Down) Test

Setup: When the container temperature is greater than or equal to the 45_F. set point which was set in the frozen mode heat test, the left display will read "P101", the right display will show the return air temperature, and the set point will then be changed to –17.7_C (0_F). The unit will then have a maximum of 3 hours to pull the container temperature down to the 0_F set point.

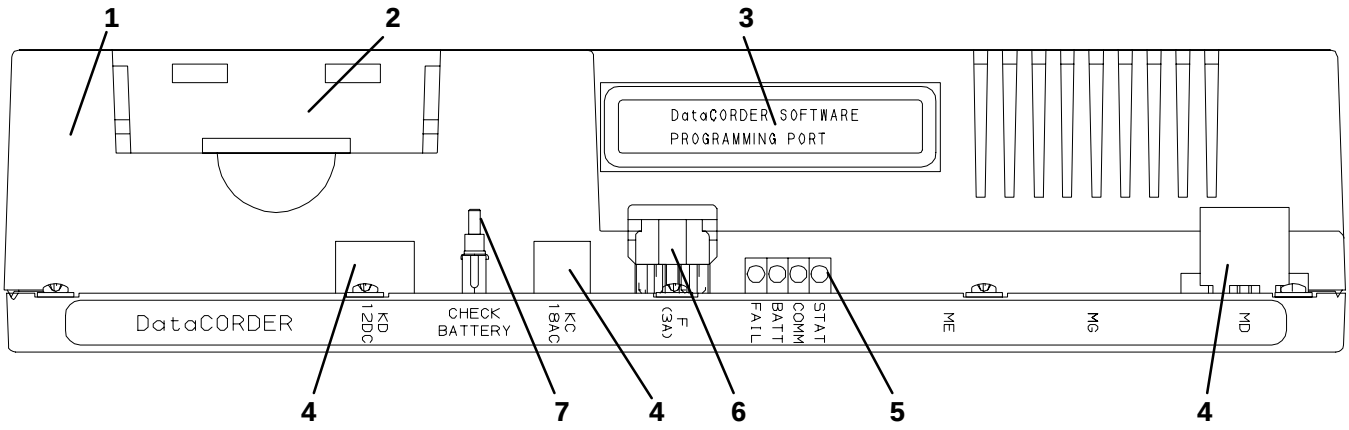
Pass/Fail Criteria: If this occurs within the 3 hour time limit, the test passes. If pull down is not completed within the 3 hour time limit, the test fails.

P10-2 – Frozen Mode (Maintain Temperature) Test

Setup: After the unit has successfully completed the frozen pull down test, the left display will read "P102", and the right display will show the return air temperature. The unit will then be required to maintain the 0_F temperature within + or – 0.5_C (0.9_F) of set point until a DataCorder recording is executed. The recorder return probe temperature running total (and it's reading's counter) will be zeroed out for the remainder of the recording period at the start of this test, so that the actual value recorded in the DataCorder will be an average of only this test's results. Once a recording occurs, the average recorder return temperature will be recorded in the DataCorder, as well as stored in memory for use in applying the test pass/fail criteria.

Pass/Fail Criteria: If the temperature remains within + or – 0.5_C of set point from test start to DataCorder recording, the test passes. If temperature is outside of the tolerance range at the DataCorder recording, the test fails.

1.14 DATACORDER MODULE (OPTIONAL)



1. DataCorder Module
2. Battery Pack (Optional)
3. Software Port
4. Connector
5. Status LED's
6. Fuse
7. Manual Battery Switch

Figure 1-11. DataCorder Module

1.14.1 Brief Description

WARNING

Do not attempt to service the DataCorder module, breaking the warranty seal will void the warranty.

CAUTION

Remove DataCorder module and unplug all wire harness connectors before performing any arc welding on any part of the container.

Do not remove wire harnesses from module unless you are grounded to the unit frame with a static safe wrist strap.

Carrier Transicold has developed a recorder, which we have termed the "DataCorder", in a self-contained module which consists of:

- Microprocessor
- Program memory
- Data memory
- Real time clock (RTC)
- Six thermistor inputs
- Two voltage inputs
- Four status LED's
- Two communication ports
- Power supply (optional battery pack).

This recorder eliminates the mechanical recorder and paper chart, and replaces it with a custom-designed module (see Figure 1-11) that interfaces with the controller module and the Interrogator to:

a. Operate as a stand alone device or in conjunction with other modules such as the Temperature Controller, CTD Controlled Atmosphere (CA) Controller, etc.

b. Log data at 15, 30, 60 or 120 minute intervals.

c. Record DataCorder alarms and display through the Temperature Controller digital display identification. (Refer to Table 1-10.)

d. Store at least one years worth of data based on continuous unit operation at factory default settings.

Factory default settings are:

One (1) hour logging interval.
Configured for two (2) probes.

e. Record DataCorder/Network generated data and events as follows:

- Container ID Change
- Controller S/W Upgrade
- Controller Replacement
- DataCorder Alarm Activity
- DataCorder Battery Low (Battery Pack)
- DataCorder S/W Upgrade
- Data Retrieval
- Defrost Start
- Defrost End
- Dehumidification Start
- Dehumidification End
- Controller Alarm Activity
- Controller Communication Not Responding
- Controller Communication Responding
- Power Loss (w/wo battery backup)
- Power Up (w/wo battery backup)
- "Auto 1" Pre-Trip Start
- "Auto 1" Pre-Trip End
- Remote Probe Temperatures in the Container (USDA Cold treatment and Cargo probe recording)
- Return Air Temperature
- Set Point Change
- Supply Air Temperature
- Real Time Clock (RTC) Battery (Internal Battery) Replaced
- Real Time Clock (RTC) Modification
- Trip Start
- Economy Mode Start
- Economy Mode End
- "Auto 2" Pre-Trip Start
- "Auto 2" Pre-Trip End

– Bulb Mode Start
– Bulb Mode End

1.14.2 DataCorder Programming (Memory) Cards

The programming cards are used for loading software into the DataCorder. This is the same concept as using a floppy diskette to load software into a personal computer.

The software that can be loaded into the DataCorder module, comes in one of two forms. Either "Operational Software" or "Configuration Software."

Operational Software:

This is the software that makes the DataCorder module do what it does. Wake the unit up at a specified time, request information from other modules in the unit, take readings from probes, etc.

Configuration Software:

This is the software that tells the Operational Software what physical components are built into the Container Unit, how many sensors to record, what recording interval should be used, etc..

- Configuration Type – Standard or Generic
- Sensor Logging (Network) – Average or Snapshot
- Sensor Logging (Thermistor) – Average, Snapshot or USDA
- Sensor Format – 1 Byte or 2 Byte (i.e. Accuracy)
- Sensor configuration – 2, 5, 6, 9, 24, 54, 64 and 94 sensors, refer to section 1.14.3.h.
- Logging Interval – 15, 30, 60 or 120 Minutes
- DataCorder alarm format – Auto, on or off

Programming cards with either Operational Software or Configuration Software are available thru CTD Replacement Components Group.

The use of a programming card in the field, should only occur under unusual circumstances. Some of these circumstances may include:

a. A DataCorder module has an older version of Operational Software, and the need exists to upgrade to a newer version of the software.

b. A physical component in the container unit is changed to something different, resulting in a different Configuration for the Unit.

c. A DataCorder module was damaged in such a way that the integrity or existence of software within the module, is questionable.

Procedure for loading software:

Refer to section 4.28.2.

1.14.3 Functions

To access the DataCorder functions codes or alarms, first press the ALT. MODE key, then press the applicable key for functions (CODE SELECT) or alarms (ALARM LIST).

a. Memory Card Operations

The DataCorder will support the download of code via a memory card using the software port. See Figure 1-11.

b. Keypad/Display Interface

The DataCorder uses the controller module display and keypad. The display formats and data are read from the DataCorder as they are needed. Dynamic data is read from the DataCorder once every second. Data to be written to the DataCorder is sent once the editing session is complete. The DataCorder contains three types of display parameters. These are Configuration Codes, Display Codes, and Alarm Codes.

c. DataCorder Power-Up

The DataCorder may be powered up in several ways:

1. *Normal AC power:* The DataCorder is powered up when the unit is turned on via the stop-start switch (ST).

2. *Normal DC power:* If a rechargeable battery pack is installed (fully charged), the user may plug the interrogation cable into the front interrogation receptacle and the DataCorder will power up for communications.

Or a 12 volt DC battery pack is plugged into the back of the interrogation cable which is then plugged into the rear interrogation port. (No rechargeable battery pack is required with this method.) The user may now interrogate the DataCorder, however, only the DataCorder is powered up and not the Controller.

3. *Push button on the DataCorder when a battery pack is used:* The user must depress the manual battery switch (see Figure 1-11) for about ten seconds to power up the DataCorder and to perform a test on the rechargeable battery. If the battery is good, the "STAT LED" will first illuminate followed shortly by the "BATTERY STATUS LED". Once the "BATTERY STATUS LED" starts flashing, the user can assume the battery charge is sufficient for normal battery back-up operation at the time of the test. If, for some reason, the "STAT LED" does not illuminate or the "BATTERY STATUS LED" illuminates to a steady position (does not flash) or does not illuminate at all, then the user can presume that the battery is in need of a charge.

4. *Real Time Clock (RTC) because a logging interval has expired:* If the DataCorder is equipped with a charged battery pack and AC power is not present, the DataCorder will power up when the RTC indicates that a data recording should take place. When the DataCorder is through recording, it will power down.

d. DataCorder Diagnostics

The DataCorder start up diagnostics processing will occur each time there is a power up or after a hardware reset. This processing will test the DataCorder hardware for proper operation. If any critical test fails, then depending on the LED fail code display decision in the DataCorder header, the FAIL LED will first be on for 10 seconds then flash the test code three times to indicate what test failed (i.e., if the timer test fails the FAIL LED will come on at first for ten seconds, then it will quickly flash on/off four times, three times in a row) The DataCorder will then reset itself and start again. The following tests will be run:

- Data Memory Test (code 1)
- Program Memory Test (code 2)
- Watchdog Timer Test (code 3)
- Timer Test (code 4)
- Programmable Counters Test (code 5)
- Analog to Digital Converters Test (code 6)

e. DataCorder Battery Pack Test

If the DataCorder has the optional battery pack backup, then the battery voltage will be tested once every fifteen minutes if it is low or dead. If the battery voltage is less than 6.0V then the battery voltage is considered low. An event will be generated when the battery voltage transitions from good to low or bad indicating that the battery voltage is low.

f. Trip Start Processing

For the user to initiate a Trip Start, press the ALT. MODE key and select Code dC30, then depressing the ENTER key for 5 seconds to initiate Trip Start. The right display will display the message "StArt" for five seconds and a Trip Start event code will be generated. Trip start may also be initiated via communications using the interrogation program.

g. Display vs. Configuration Codes

The DataCorder contains two types of display codes; Display and Configuration. Display codes will display parameter values, but will not let them be modified. Configuration codes can be modified via the interrogator or with the insertion of a new configuration software card.

h. Data Recording Mode

The DataCorder recording mode is labeled as Standard. To examine an example of a report using a standard configuration, see Figure 1-12.

Generic Mode:

The generic recording mode is used for special applications (i.e., CTD Controlled Atmosphere option).

Standard Mode:

The standard recording mode allows the user to configure the DataCorder to monitor data using one of 8 standard configurations. These are as follows:

1. 2 sensors (dCF02 = 2) – 2 thermistor inputs (supply & return)
2. 5 sensors (dCF02 = 5) – 2 thermistor inputs (supply & return)
   – 3 usda thermistor inputs
3. 6 sensors (dCF02 = 6) – 2 thermistor inputs (supply & return)
   – 3 usda thermistor inputs
   – 1 humidity input
4. 9 sensors (dCF02 = 9) – 2 thermistor inputs (supply & return)
   – 3 usda thermistor inputs
   – 3 CA inputs
   – 1 humidity input
5. 3 sensors (dCF02 = 24) – 2 thermistor inputs (supply & return)
   – 1 cargo probe
6. 6 sensors (dCF02 = 54) – 2 thermistor inputs (supply & return)
   – 3 usda thermistor inputs
   – 1 cargo probe
7. 7 sensors (dCF02 = 64) – 2 thermistor inputs (supply & return)
   – 3 usda thermistor inputs
   – 1 humidity input
   – 1 cargo probe
8. 10 sensors (dCF02 = 94) – 2 thermistor inputs (supply & return)
   – 3 usda thermistor inputs
   – 3 CA inputs
   – 1 humidity input
   – 1 cargo probe

The 6 thermistor inputs will be DataCorder inputs. The 3 Controlled Atmosphere inputs will be read over a network from the optional Controlled Atmosphere module. The humidity input will be read from the controller module.

In addition, if no Controller alarms are active, the most recent active DataCorder alarm will be displayed on the Controller display alternately with set point.

i. DataCorder Alarm History List

The DataCorder contains a buffer of up to 8 alarms. The list may be displayed by pressing the ALARM LIST key. The alarm history keypad and display processing will be the same as the controller module. The format of an alarm history display entry is as follows:

Left Display:

"dALnn" where nn = the alarm history entry 01-08

Right Display:

"xA nn" where x = 'I' (inactive) or 'A' (active)

Or:

"– – – –" if no alarms are currently in the alarm history list

j. Alarm Processing

The DataCorder contains an 8 alarm history queue which will contain the first 8 alarms detected by the DataCorder. The alarms and their corresponding alarm codes are specified in Table 1-10. The alarm queue will be located in memory (EEPROM). The queue will also have a corresponding status which will indicate whether each alarm is currently active or inactive. If multiple consecutive occurrences of an alarm are generated then only the first will be stored. The queue may be cleared by using the keypad. (If more than 8 alarms occur before the queue is cleared, then those alarms after the first 8 will be ignored.) In addition, AL91 will appear if the DataCorder alarm queue is full.

1.14.4 Status LED's

The DataCorder contains four status LEDs. These are as follows:

- Status/Power/Executing Code (Yellow)
- Communication (Green)
- Battery Status (Yellow)
- FAIL/Alarm (Red)

Status/Power/Executing Code LED:

The Status/Power/Executing code LED indicates if the DataCorder is powered up and executing code. The LED will be off when power is off or the DataCorder is in a sleep mode running off the battery. The LED will pulse at a one second rate if code is being executed.

Communication LED:

The Communication LED will usually be off. It will illuminate whenever there is a response from a device which the DataCorder wishes to communicate with. If there is a valid response to the DataCorder, this LED will flash for five seconds. If an invalid response to a DataCorder initiated communication occurs, then this LED will turn on solid for five seconds.

Battery Status LED:

The Battery status LED flashes at a one second rate when the battery voltage is greater than or equal to 6.0V. It will be on solid when the battery voltage is less than 6.0V but greater than or equal to 4.0V. It will be off when the battery voltage is less than 4.0V.

Fail/Alarm LED:

The Fail/Alarm LED indicates if a hardware fault or alarm has occurred in the DataCorder. If a hardware fault occurs, the LED will flash the fail code three times, then the processor will reset. The fail codes and their code numbers are defined below. Fail codes will only be displayed on power up. If the DataCorder powers up properly, then this LED will indicate an active alarm condition that has been detected. The alarm LED should turn on when an active alarm is detected, and be off when the alarm goes inactive.

CODE	TEST
1	Data Memory Test
2	Program Memory Test
3	Watchdog Timer Test
4	Timer Test
5	Programmable Timers Test
6	Analog to Digital Converter Test

If an alarm occurs, then the LED will be on solid until the alarm goes away. The alarm codes are listed in Table 1-10.

The out of range values are as follows:

Thermistor Inputs:
Low limit = −50.0 degC, High limit = 70.0 degC
Voltage Inputs:
Low limit = −0.5 Volts, High Limit = 5.5 Volts
"AA" Batteries:
Low Battery Voltage less than 6.0V
No Battery Voltage less than 4.0V
Real Time Clock (RTC) Battery:
Low battery Voltage less than 2.5 Volts

1.14.5 DataCorder Function Codes

There are 35 functions which the operator may access to examine the operating status of the unit. To access these functions, perform the following: Press the ALT. MODE & CODE SELECT keys, press an arrow key until the left window displays the desired code number (see Table 1-9). The right window will display the value of this item for 5 seconds before returning to the normal display mode. If a longer time is desired, pressing the ENTER key will extend the time to 30 seconds after the last pressing of the ENTER key. Below is an explanation of all Function codes.

Code dC 1 – DataCorder Supply Temperature

Current supply air temperature.

Code dC 2 – DataCorder Return Temperature

Current return air temperature.

Code dC 3, 4, 5 – USDA 1, 2, 3 Temperatures

Current temperatures of the three USDA probes.

Code dC 6 – 13 – Network Sensors 1 – 8

Current values of the network sensors (as configured). Network sensor 1 (Code 6) is the humidity sensor and its value is obtained from the Controller once every minute.

Code dC 14 – Cargo Probe Temperature

Current temperature of the cargo probe.

Code dC 15, 16 – Voltage Sensors 1, 2

Future expansion.

Code dC 17, 18 – Discrete Input

Future expansion.

Code dC 19 – Discrete Output

Future expansion.

Code dC 20 – 24 – Temperature Sensors 1 – 5 Calibration

Current calibration offset values for each of the five probes; supply, return, USDA # 1,2, & 3. These values are input via the interrogation program.

Code dC 25 – Software Revision #

Revision # (number) of the operating software currently in the DataCorder.

Code dC 26, 27 – S/N, Left 4, Right 4

The DataCorder serial number consists of 8 characters. Code 26 contains the first 4 characters. Code 27 contains the last 4 characters.

Code dC 28 – Minimum Days Left

An approximation of the number of logging days remaining until the DataCorder starts to overwrite the existing data.

Code dC 29 – Days Stored

Number of days of data that are currently stored in the DataCorder.

Code dC 30 – Date of last Trip start

The date when a Trip Start was initiated by the user.

Code dC 31 – Battery Test

Shows the current status of the optional battery pack.

PASS – Battery pack is sufficiently charged.

FAIL – Battery pack voltage is low.

Code dC 32 – Time: Hour, Minute

Current time on the RTC (Real Time Clock) in the DataCorder.

Code dC 33 – Date: Month, Day

Current date (month and day) on the RTC in the DataCorder.

Code dC 34 – Date: Year

Current year on the RTC in the DataCorder.

Code dC 35 – Cargo Probe Calibration Value

Current calibration value for the Cargo Probe. This value is an input via the interrogation program.

Table 1-9. DataCorder Function Code Assignments

CODE	DESCRIPTION
(Inapplicable Functions Display ----)	
Press ALT. MODE to access	
dC 1	Recorder Supply Temperature
dC 2	Recorder Return Temperature
dC 3 - 5	USDA 1,2,3 Temperatures
dC 6 - 13	Network Sensors 1-8
dC 14	Cargo Probe Temperature
dC 15 - 16	Voltage Sensors 1,2
dC 17, 18	Discrete Inputs 1-6
dC 19	Discrete Output
dC 20 - 24	Temperature Sensors 1-5 Calibration
dC 25	Software Revision #
dC 26, 27	S/N, Left 4, Right 4
dC 28	Minimum Days Left
dC 29	Days Stored
dC 30	Date of last Trip start
dC 31	Battery Test
dC 32	Time: Hour, Minute
dC 33	Date: Month, Day
dC 34	Date: Year
dC 35	Cargo Probe Calibration Value

1.14.6 DataCorder Alarm Codes

The Alarm List Display Mode is entered by pressing the ALT. MODE & ALARM LIST keys while in Set Point Selection or Default Display mode. The user will be able to display any alarms archived in the Alarm Queue. If no alarms, other than those related to the EEprom, are active, the Alarm Queue may be cleared.

When the ALT. MODE & ALARM LIST keys are pushed, the left display will show AL# where # is the alarms number in the queue and the right display will shown AAXX, if the alarm is active, where XX is the alarm number or IAXX, if the alarm is inactive. The user can look through the alarm queue by depressing the UP ARROW key. At the end of the alarm list, if any of the alarm(s) in the list is active, END is displayed. If all the alarms in the list are inactive, then at the end of the alarm list, CLEAr is displayed. (The exception to this rule is the DataCorder Alarm Queue Full AL91 alarm, this alarm does not have to go inactive in order to clear the alarm list) At this time if the user pushes the ENTER key, then the alarm list will clear and display "----" on right display. Another alternative for the user to get to the end of the alarm list is by pushing the DOWN ARROW key after the ALARM LIST key is pushed. Thus, the DOWN ARROW key being pushed will allow the user to go backward in the alarm list. If a user pushes the ALARM LIST key when there are no alarms in the list, then AL is displayed on the left display and "----" on the the right display. Upon clearing of the Alarm Queue, the Alarm light will be turned off.

Table 1-10. DataCorder Alarm Indications

CODE	ALARM DESCRIPTION
Press ALT. MODE to access	
AL70	Recorder Supply Temperature Out of Range
AL71	Recorder Return Temperature Out of Range
AL72 – 74	USDA Temperature Out of Range
AL75	Cargo Probe Out of Range
AL76, 77	Voltage Sensors 1 - 3 Out of Range
AL78 – 85	Network Sensors 1 - 3 Out of Range
AL86 – 90	Errors 1 - 5 Out of Range
AL91	DataCorder Alarm Queue Full

Alarm 70 – Recorder Supply Temperature Out of Range

The supply air probe temperature is outside of its specified range.

Alarm 71 – Recorder Return Temperature Out of Range

The return air probe temperature is outside of its specified range.

Alarm 72 – 74 – USDA Temperature Out of Range

The USDA probe temperature reading is outside of its specified range.

Alarm 75 – Cargo Probe Out of Range

The cargo probe temperature reading is outside of its specified range.

Alarm 76, 77 – Voltage Sensors 1 & 2 Out of Range

Future expansion.

Alarm 78 – 85 – Network Sensors Out of Range

The network sensor is outside of its specified range.

Alarm 86 – 90 – Errors 1 – 5

There are technical difficulties within the DataCorder module, contact your local Carrier Transicold Field Service Representative.

Alarm 91 – DataCorder Alarm Queue Full

The DataCorder alarm queue is determined to be full (8 alarms).

For Revision Level 2005 and above:

The DataCorder alarms for the USDA and cargo probes are configurable using the interrogation program or via configuration card. There are four new configuration variables for the DataCorder. They are listed below in with their descriptions and selection values:

Table 1-11. DataCorder Alarm Configurations

Configuration Variable	Description	Selection Values
dCF07	USDA 1	Auto,On,Off
dCF08	USDA 2	Auto,On,Off
dCF09	USDA 3	Auto,On,Off
dCF10	Cargo Probe	Auto,On,Off

The default configuration for the four probes is "Auto". If the alarms are configured as "Auto", and then if all of the probes are missing (i.e., appear open circuited to the DataCorder), then no alarms are activated. As soon as one of the probes is installed (plugged into the receptacle), then all of the alarms are enabled and the remaining probes that are not installed will give active alarm indications. This was done to assist those users who wish to keep their DataCorder configured for USDA recording , however, do not wish to install the probes for every trip.

If a probe alarm is configured to be "On", then its associated alarm is always enabled. This means that, as long as the probe remains in-circuit (plugged in) the alarm will not be activated. Probes with this configuration have alarms that act like the alarms for the supply and return recorder sensors. It is presumed that normal operation includes the probe in question.

If a probe alarm is configured to be "Off", then the alarm for this probe is always disabled. This means that it is not possible to activate the respective alarm for this probe no matter what the circumstance.

1.14.7 USDA/ Message Trip Comment

A special case event is supported for allowing the user to enter comments for a (USDA or any message) trip recording. The comments will be received from the interrogator and have a maximum length of 78 characters. Only one comment will be recorded per day. In the event that multiple comments occur, then only the last will be saved.

1.14.8 USDA Recording

A special type of recording is provided for USDA cold treatment purposes. Cold treatment recording requires that three remote probes are placed in the cargo at various locations. (An optional fourth cargo probe is also available.) Provision is made to connect these probes to the DataCorder via receptacles located at the rear left-hand side of the unit. Four (Five, on some units) receptacles are provided. Four (three pin) are for the probes and one (five pin) is provided for the Interrogator. All receptacles are sized to accept a Deutsch HD16-5-16S size plug with a tricam coupling locking device (with the exception of models 69NT40-489-50 and -489-62). The DataCorder inputs are designed to accept a two wire thermistor probe.

A label on the back panel of the unit shows which receptacle is used for each probe. The USDA #1, #2 and #3 probes (and possibly the optional Cargo probe) are installed in their receptacles.

The DataCorder can record up to six probe temperatures (supply, return, USDA #1, #2, #3 and an optional cargo probe) every minute over the hour interval to calculate an average temperature for recording.

The standard DataCorder report displays the supply and return air temperatures. The cold treatment report displays USDA #1, #2, #3 and the return air temperature. Cold treatment recording is backed up by a battery so recording will continue if AC power is lost.

1.14.9 Pre-Trip Data Recording

Some units come equipped with the ability to record pass/fail information along with unit data resulting from the initiation of pre-trip (see section 1.13.2). This information is stored in the DataCorder and is obtained from the Temperature Controller. The data is time stamped and may be extracted via interrogation using a CTD MS−DOS based interrogation program. See Table 1-12 for a description of the data stored in the DataCorder for each corresponding Pre-Trip test:

Table 1-12. DataCorder Pre-Trip Data

Test #	Test Description	Test Data
1-0	Heater On	Pass/Fail/Skip Result, Change in current for Phase A, B and C
1-1	Heater Off	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
2-0	Condenser Fan On	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
2-1	Condenser Fan Off	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
3-0	Low Speed Evaporator Fan On	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
3-1	Low Speed Evaporator Fan On	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
4-0	High Speed Evaporator Fan On	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
4-1	High Speed Evaporator Fan On	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
5-0	Supply/Return Probe Test	Pass/Fail/Skip Result, STS, RTS
5-1	Primary/Secondary Supply Probe Test	Pass/Fail/Skip Result, STS, Secondary STS
6-0	Compressor On	Pass/Fail/Skip Result, Change in currents for Phase A, B and C
6-2	Suction Modulation Valve Open	Pass/Fail/Skip Result, STS, RTS, Is current limit in effect? (Y,N)?
6-4	Suction Modulation Valve Closed	Pass/Fail/Skip Result, STS, RTS
6-5	Suction Solenoid Valve Open	Pass/Fail/Skip Result, STS, RTS, Is current limit in effect? (Y,N)?
7-0	High Pressure Switch Closed	Pass/Fail/Skip Result, AMBS, DPT or CPT (if equipped)
7-1	High Pressure Switch Open	Pass/Fail/Skip Result, STS, DPT or CPT (if equipped)
8-0	Perishable Heat	Pass/Fail/Skip Result, STS, time it takes to heat to 16_C (60_F)
8-1	Perishable Pull Down	Pass/Fail/Skip Result, STS, time it takes to pull down to 0_C (32_F)
8-2	Perishable Maintain	Pass/Fail/Skip Result, STS, Averaged DataCorder supply temperature (SRS) over last recording interval.
9-0	Defrost Test	Pass/Fail/Skip Result, DTS temperature at end of test, line voltage, line frequency, time in defrost.
10-0	Frozen Mode Set-up	Pass/Fail/Skip Result, STS, time unit is in heat.
10-1	Frozen Mode Pull Down	Pass/Fail/Skip Result, STS, time to pull down unit to −17.8_C (0_F).
10-2	Frozen Mode Maintain	Pass/Fail/Skip Result, STS, Averaged DataCorder return temperature (RRS) over last recording interval.

1.14.10 DataCorder Communications

a. DataCorder Retrieval – Interrogation

Data retrieval from the DataCorder can be accomplished with two devices: (1) a stand-alone DOS based portable computer with appropriate cable and software or (2) a Remote Monitoring Unit (RMU).

NOTE

The RMU designation is used in the industry, however, be aware that CTD uses the designation CI (Communications Interface Module) on its schematics.

The optional interrogation software for a portable computer is supplied on a 3.5 and 5.25 inch floppy disk. This software allows interrogation, screen view of the data, hard copy report generation, cold treatment probe calibration, cold treatment initialization and file management.

NOTE

Refer to the Interrogation manual 62-02575 for a more detailed explanation of the interrogation software.

A short report on specific interrogations can be displayed on the computer to identify key information such as Trip Start, Power Outages, and Temperature Out-of-Range conditions.

1.15 USDA COLD TREATMENT PROCEDURE

Sustained cold temperature has been employed as an effective postharvest method for the control of the Mediterranean and certain other tropical fruit flies. Exposing infested fruit to temperatures of 2.2 degrees Celsius (36_F) or below for specific periods results in the mortality of the various stages of this group of notoriously injurious insects.

In response to the demand to replace fumigation with this environmentally sound process, Carrier has integrated this Cold Treatment capability into its DataCorder. These units have the ability to maintain the container temperature within 1/4 degree Celsius of setpoint and record minute changes in product temperature within the DataCorder memory and thus meet USDA criteria (refer to section 1.14.8).

The following is a summary of the steps required to initiate a USDA Cold Treatment.

a. Pre-cool the container to the treatment temperature or below.

b. The product should be pre-cooled to treatment temperature.

c. Install the DataCorder module battery pack.

d. Probe calibration is achieved by ice bathing the three USDA probes and performing the calibration function on a DOS based portable computer. This calibration determines the three probe offsets. Refer to the Interrogation manual 62-02575 for more details.

e. The product is then loaded directly from the pre-cooling storage area to the container so that the product temperature does not rise.

f. Placement of probes – there are three probes required for a USDA cold treatment procedure.

Sensor 1	Place in pulp of the product located next to the return air intake.
Sensor 2	Place in pulp of the product five feet from the end of the load for 40 ft. containers and three feet from the end of the load for 20 ft. containers. This probe should be placed in a center carton at 1/2 the height of the load.
Sensor 3	Place in pulp of product five feet from the end of the load for 40 ft. containers and three feet from the end of the load for 20 ft. containers. This probe should be placed in a carton at a side wall at 1/2 the height of the load.

g. To initiate USDA Recording (begin the cold treatment recording) connect the Interrogator and perform the configuration as follows:

1. Trip Start
2. Trip Comment
3 Configure for 5 probes
4. 1 hour logging interval
5. USDA temperature log in
6. Two byte memory storage format
7. Probe calibration

h. Interrogation software is available for DOS based personal computers which allow retrieval of trip data from the DataCorder memory. Contact a Carrier Transicold Service Parts representative for details.

1.16 HUMIDITY CONTROL (OPTIONAL)

NOTE

The supply air must be in-range for the humidity circuit to energize.

The humidity control is designed to operate when transporting a chill load, controller set above −10_C (+14_F) or −5_C (+23_F) optionally, and is locked out when the controller is set below −10_C or −5_C (optionally).

Code Cd33 is factory set at 70% R.H. for units equipped with a humidity sensor and configured for humidity sensing. When humidity configuration is "OFF", this means either the unit is not equipped with a humidity sensor or has not been configured for humidity control. (See Cd33, page 1−24)

a. The humidity control will be in operation if:

1. Unit is equipped with a humidity sensor and configured for dehumidification.

2. Supply air is in-range (in-range light illuminated).

3. Dehumidification control code Cd33 is properly set for desired R.H.

4. Controller is set above −10_C (+14_F) or −5_C (+23_F) optionally.

5. Container relative humidity is above 2% of code Cd33 setting.

If all 5 factors are met, the humidity control circuit energizes the heaters and heat light.

b. For testing purposes:

WARNING

Beware of rotating evaporator fan when conducting following test.

1. Set the controller set pointer within 2_C (3.6_F) of container supply air temperature.

2. Change the set point of code Cd33 to test the heaters. They should be energized (heat light ON) and then reset code Cd33 to the desired level.

1.17 NITROGEN FEED (OPTIONAL)

The purpose of the nitrogen feed option is to provide a way to inject nitrogen into the air stream of the unit. This is done by connecting a nitrogen line to the quick-connect on the front of the unit, with a 1/4" nipple conforming to the MIL-C-4109. The nitrogen can then be feed into the unit. The unit is equipped with a pressure relief device to prevent the pressure in the container from exceeding two inches water gauge.

WARNING

Do not use a nitrogen feed inlet pressure higher than 35 PSI.

CONTAINER ABCDXXXXXXX ON 08Jul 94 FROM 15Apr94 TO 17Apr94 (DEGREES C) PAGE: 1

HEADER INFORMATION

DataCorder SN: XXXXXXXX

ALARMS REPORT

ALARM NUM FIRST ACTIVE LAST ACTIVE

CONTROLLER ALARMS:

60 17Apr94 03:28 17Apr94 16:13

DataCorder ALARMS

No Alarms Reported

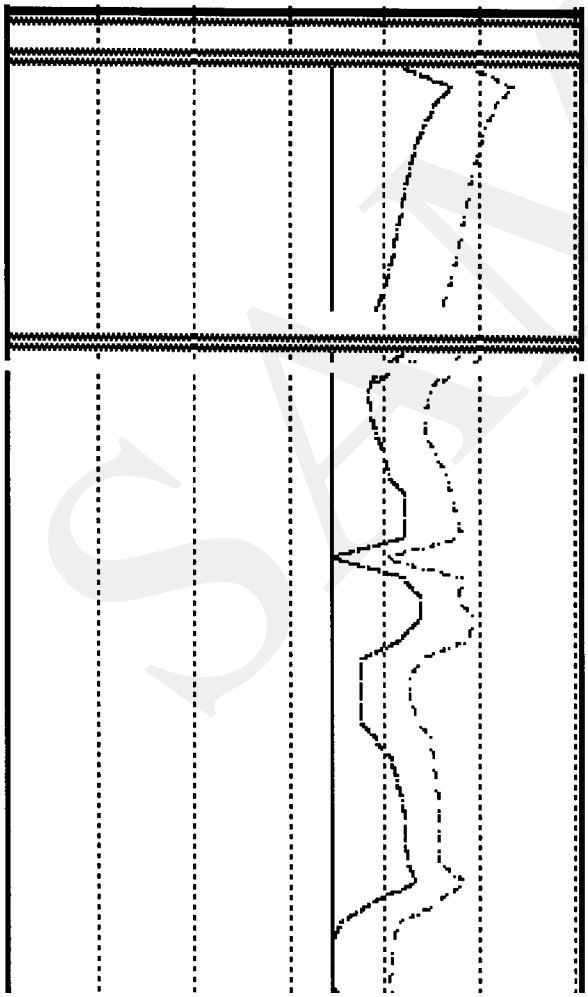
USDA SUMMARY

DATE: 15Apr94 23:49 Trip Start

LEGEND

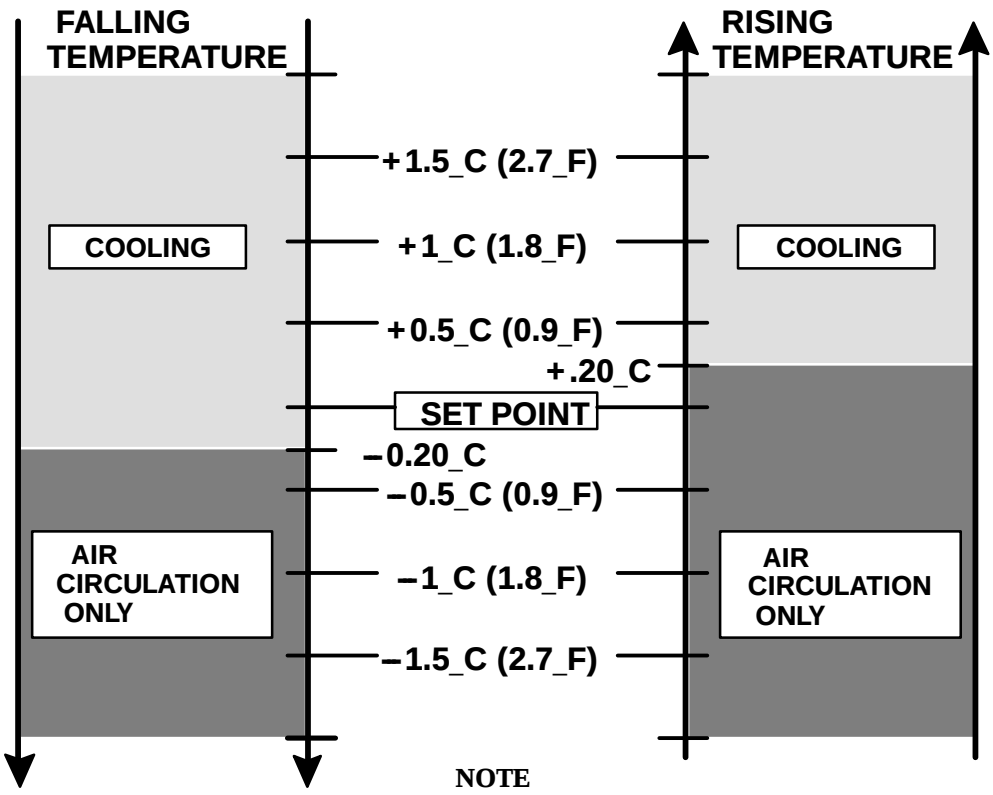
SP	Setpoint Change	DS	Defrost Start	DE	Defrost End
PS, PE	Pretrip Start/End	DHS, DHE	Dehumid Start/End	AL	Alarm Activity
NEW SN	Controller Rep.	NEW ID	Container ID	TS	Trip Start
dal	DataCorder Alm	OFF	Power Loss	BATT	Power Loss
NEW SW	Software Upgrade	COMM	NetWork Off		

Setp
SupAir
RetAir



DATE	TIME	Setp	SupAir	RetAir	TEXT
15Apr94	00:00	4.00	20.75	26.50	SP=4.00 C, TS
16Apr94	00:00	4.00	11.00	18.25	
16Apr94	01:00	4.00	16.25	22.75	
16Apr94	02:00	4.00	14.25	20.75	COMM OFF, OFF
16Apr94	03:00	4.00	13.25	19.75	
16Apr94	04:00	4.00	12.50	19.25	
16Apr94	05:00	4.00	12.00	18.50	
16Apr94	06:00	4.00	11.25	18.00	
16Apr94	07:00	4.00	11.00	17.75	
16Apr94	08:00	4.00	10.50	17.25	OFF, COMM OFF
16Apr94	09:00	4.00	10.25	17.00	OFF
16Apr94	10:00	4.00	9.75	16.50	OFF, COMM OFF
16Apr94	11:00	4.00	9.25	16.00	
16Apr94	12:00	4.00	8.50	15.25	
16Apr94	14:00	4.00	11.25	17.50	OFF
16Apr94	15:00	4.00	8.50	15.00	
16Apr94	16:00	4.00	7.75	14.00	
16Apr94	17:00	4.00	8.00	13.50	
16Apr94	18:00	4.00	8.50	13.50	
16Apr94	19:00	4.00	9.25	14.50	
16Apr94	20:00	4.00	9.75	15.75	
16Apr94	21:00	4.00	11.25	16.25	
16Apr94	22:00	4.00	11.50	16.75	
16Apr94	23:00	4.00	11.50	17.25	OFF
17Apr94	00:00	4.00	3.75	9.25	
17Apr94	01:00	4.00	11.50	17.25	
17Apr94	02:00	4.00	13.00	17.00	
17Apr94	03:00	4.00	13.00	18.25	DS
17Apr94	04:00	4.00	11.00	18.00	DE=60min, AL60, AL60
17Apr94	05:00	4.00	6.75	13.00	AL60
17Apr94	06:00	4.00	6.75	12.00	AL60
17Apr94	07:00	4.00	6.75	12.00	AL60
17Apr94	08:00	4.00	6.75	12.75	AL60
17Apr94	09:00	4.00	8.50	14.00	AL60
17Apr94	10:00	4.00	10.00	14.25	AL60
17Apr94	11:00	4.00	10.50	14.50	AL60
17Apr94	12:00	4.00	11.00	14.75	AL60
17Apr94	13:00	4.00	11.50	14.75	AL60 in this hr.
17Apr94	14:00	4.00	11.50	14.75	AL60
17Apr94	15:00	4.00	11.75	14.75	AL60
17Apr94	16:00	4.00	12.50	17.50	OFF, DS
17Apr94	17:00	4.00	8.00	14.50	AL60, DE=60min, OFF
17Apr94	18:00	4.00	4.75	10.75	
17Apr94	19:00	4.00	3.75	10.00	
17Apr94	20:00	4.00	3.75	10.00	SP=4.00 C
17Apr94	21:00	4.00	3.75	9.75	

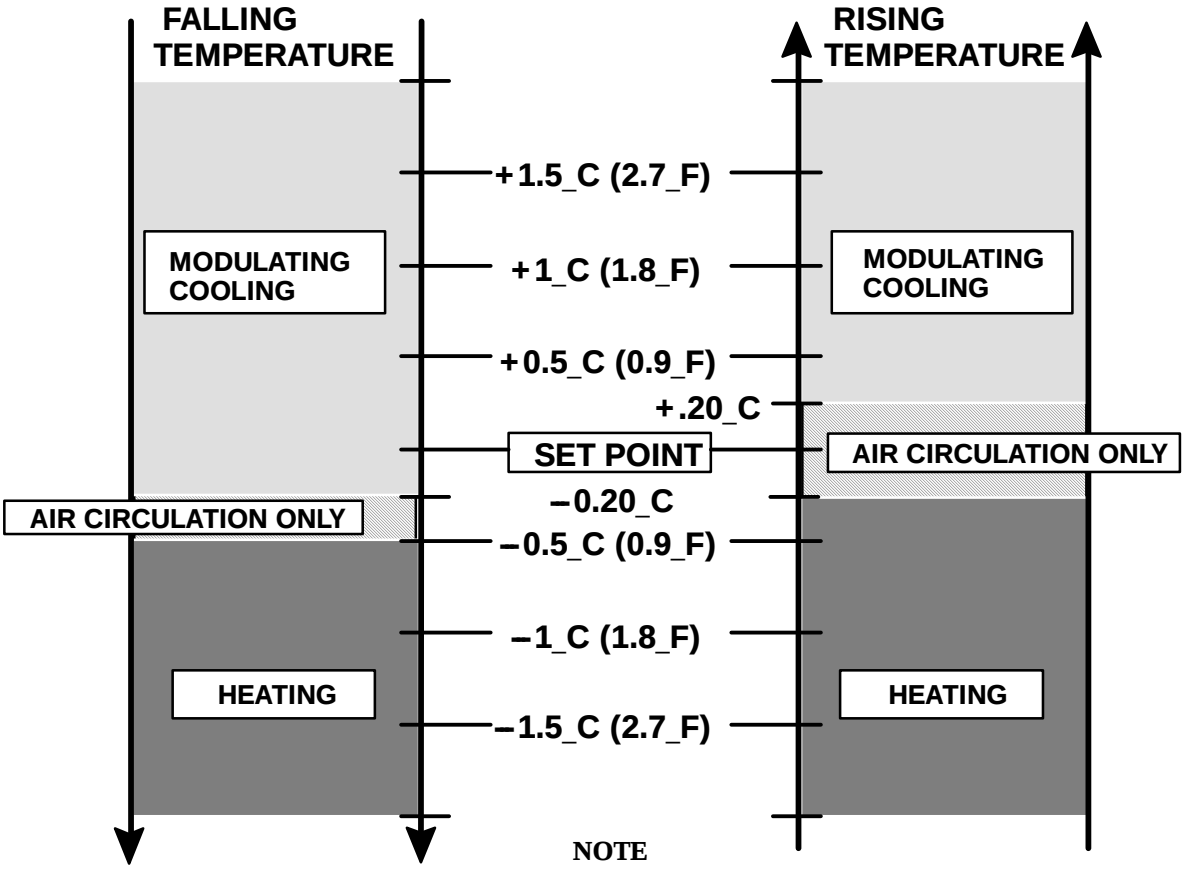
Figure 1-12. Standard Configuration Report Sample



NOTE

For In-range Tolerance, Refer to section 1.12.5 Code 30.
For Economy Mode refer to section 2.4.5.

Figure 1-13. Controller Set Point BELOW –10_C (+14_F) or –5_C (+23_F) optionally



NOTE

For In-range Tolerance, Refer to section 1.12.5 Code 30.
For Economy Mode refer to section 2.4.5.

Figure 1-14. Controller Set Point ABOVE –10_C (+14_F) or –5_C (+23_F) optionally

SECTION 2
OPERATION

2.1 PRE-TRIP INSPECTION (Before Starting)

WARNING

Beware of unannounced starting of the evaporator and condenser fans.

a. If container is empty, check inside for the following:

1. Check channels or "T" bars on floor for cleanliness. Channels must be free of debris for proper air circulation.

2. Check container panels, insulation and door seals for damage. Effect permanent or temporary repairs.

3. Visually check evaporator fan motor mounting bolts for proper securement.

4. Check for dirt or grease on evaporator fan or fan deck and clean if necessary.

5. Check evaporator coil for cleanliness or obstructions. Wash with fresh water. (Refer to section 4.14)

6. Check defrost drain pans and drain lines for obstructions and clear if necessary. Wash with fresh water.

7. Check panels on refrigeration unit for loose bolts and condition of panels. Make sure T.I.R. devices are in place on access panels.

b. Check condenser coil for cleanliness. Wash with fresh water. (Refer to section 4.17)

c. Check position of fresh air makeup vent cover. Operator must determine if fresh air makeup vent cover is to be opened or closed.

d. Open Partlow recording thermometer (if so equipped) door and do the following:

1. Manually wind clock on recording thermometer (key is located in a clip.) KEY MUST STAY WITH THE THERMOMETER

2. Lift stylus (pen) by pulling the marking tip outward until the stylus arm snaps into it's retracted position.

3. Install new chart on recording thermometer making sure chart is under the four corner tabs. Lower the stylus until stylus has made contact with the chart. Then close and secure door.

e. Open Saginomiya recording thermometer (if so equipped) door and do the following:

1. Check Chart drive battery condition. (Refer to section 4.20)

2. Lift stylus (pen) by pushing in the stylus lifter and rotating the lifter clockwise (raising stylus at same time) until lifter locks in position.

3. Install new chart on recording thermometer making sure chart is under the four corner tabs. Release stylus lifter by pushing down and rotating lifter counterclockwise until stylus lifter locks in position and stylus has made contact with chart. Then close door.

f. Open control box door. Check for loose electrical connections or hardware.

g. Check color of moisture-liquid indicator.

h. Check oil level in compressor sight glass.

i. Start refrigeration unit. (Refer to section 2.3.)

2.2 STARTING AND STOPPING INSTRUCTIONS

CAUTION

Make sure that the unit circuit breaker(s) (CB-1 & CB-2) and the start-stop switch (ST) are in the OFF position before connecting to any electrical power source.

a. Starting the Unit

1. Refer to Pre-Trip Inspection, section 2.1.

2. Check power source for proper voltage. Connect unit power plug and turn main power ON.

3. Turn refrigeration unit circuit breaker(s), and the start-stop switch ON (position "1").

4. *Units equipped with a DataCORDER:*

Trip start is initiated by depressing the ALT. MODE key and selecting Code dc30, then depressing the *ENTER* key for 5 (five) seconds.

5. Refer to section 2.3 after unit is running.

b. Stopping the Unit

Turn the start-stop switch to position "0" (OFF position).

2.3 AFTER STARTING INSPECTION

a. Check rotation of condenser and evaporator fans.

b. Check compressor oil level. (Refer to section 4.10)

c. Run unit at least 5 minutes to stabilize. Start controller Pre-Trip diagnostics. (Refer to section 1.13)

2.4 UNIT OPERATION

2.4.1 Crankcase Heater

Whenever the crankcase heater is installed, it will be operational whenever the compressor is off and their is power to the unit. The heater is connected to a set of normally closed auxillary contacts on the compressor contactor.

2.4.2 Cooling – Controller Set BELOW −10_C (+14_F) or −5_C (+23_F) optionally

NOTES

1. The suction solenoid valve (SSV) will be open to increase the refrigerant flow rate and cooling capacity unless SSV override is activated.
2. In the frozen range the suction modulation valve is 100% open.
3. Setting the controller below −10_C (+14_F) or −5_C (+23_F) optionally on units with two-speed motors will place the motors in low speed (contactor ES energized).

When the return air temperature decreases to 0.2_C (0.4_F) below set point, relays TC and TN de-energizes. This results in de-energizing the compressor and condenser fan motor. Also, the cool light is de-energized. The

evaporator fan motors continue to run to circulate air throughout the container.

When the return air temperature increases to 0.2_C (0.4_F) above set point, and providing a sufficient off time period has elapsed, relays TC and TN energizes to restart the compressor and condenser fan motor. Also, at this time,the cool light is illuminated.

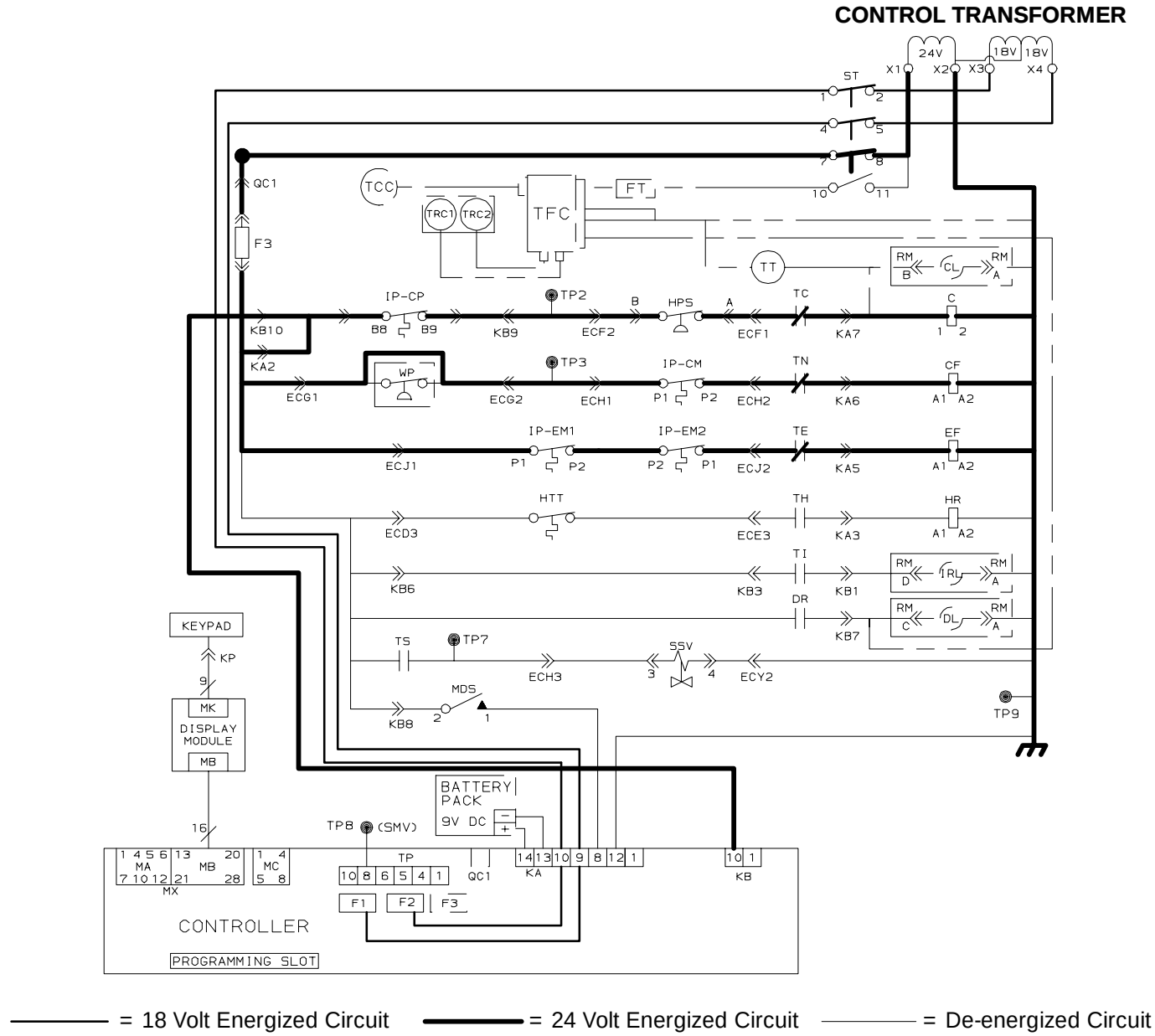


Figure 2-1. Cooling

2.4.3 Controller Set ABOVE −10_C (+14_F) or −5_C (+23_F) optionally

NOTE

Setting the controller above −10_C (+14_F) or −5_C (+23_F) optionally on units with two-speed motors will place the motors in high speed. (Contactor EF energized)

a. Cooling (See Figure 2-1.)

With decreasing supply air temperature and if the supply air is above set point, the unit will be cooling with the condenser fan motor, compressor motor and evaporator fan motors energized. Also, at this time, the cool light is illuminated.

When the air temperature decreases to a tolerance above set point, relay TI energizes and the in-range light is illuminated. (Refer to section 1.12.5, Code 30).

If the air temperature continues to fall, modulating cooling starts at approximately 2.5_C (4.5_F) above set

point. The modulating valve will have a variable current up to 1.30 amps at full modulation.

During this cooling mode, a running sum of the temperature differential (supply air temperature – set point) is kept. When the supply air falls below set point, the differential is negative. The longer supply air remains below set point, the more negative the running sum becomes.

When the supply air temperature decreases to 0.2_C below set point and the running sum is less than –250 degrees C seconds, relays TN and TC de-energize shutting off the condenser fan and compressor motors. Also, the cool light is de-energized.

The evaporator fan motors continue to run to circulate air throughout the container. The in-range light remains illuminated as long as the supply air is within a tolerance of set point, and the 15 minute override is met.

If the unit is in the holding mode (neither heating or cooling) and the supply air temperature increases to 0.2_C (0.4_F) above set point, and providing a 3 minute off time has elapsed, relay TC energizes to restart the compressor. Also, at this time, the condenser fan motor starts and the cool light is illuminated.

b. Heating (See Figure 2-2.)

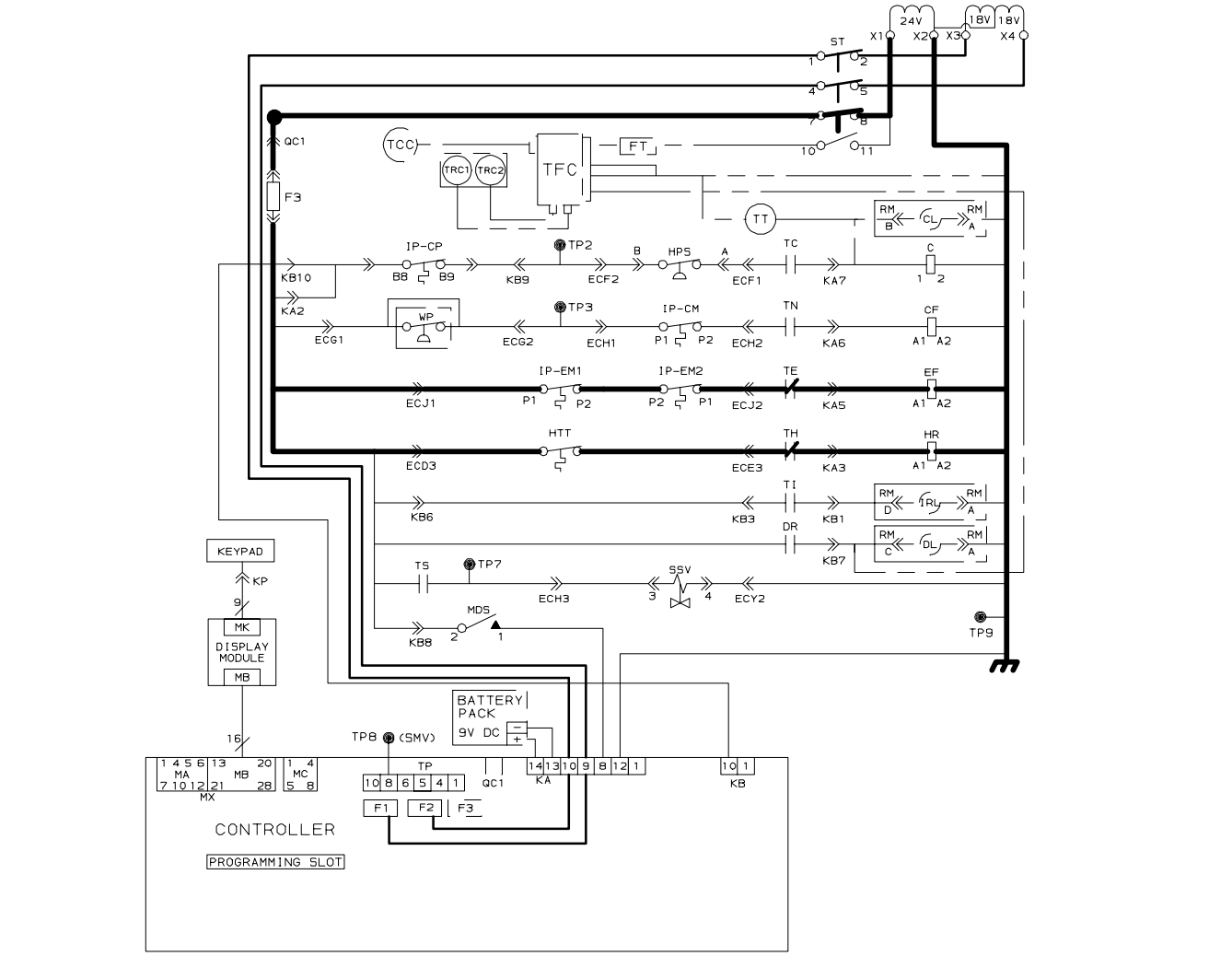
The unit *will only heat* when the controller set point is above –10_C (+14_F) or –5_C (+23_F) optionally as relay TH is electronically locked out to prevent heating when the controller set point is *below* –10_C (+14_F) or –5_C (+23_F) optionally.

If the air temperature decreases 0.5_C (0.9_F) below controller set point, TH closes and the system enters the heating mode which is designed to raise the container air temperature. When TH closes, power flows through TH contacts and the heat termination thermostat to energize the heat relay (HR). This in turn energizes the heaters and heat light. The evaporator fans continue to run to circulate air throughout the container.

As the supply air decreases to the in-range tolerance below set point, relay TI and the in-range light de-energize (after 15 minutes time delay) and will remain de-energized until the supply air increases to a tolerance below set point. (Refer to section 1.12.5, Code 30)

When the temperature rises to 0.2_C (0.4_F) below set point, TH opens (heating off) and the system again enters the holding zone. The compressor and condenser fan motor are not running as contactors C and CF remain de-energized. The evaporator fans continue to run to circulate air throughout the container.

A safety heater termination thermostat (HTT) attached to an evaporator coil support, set to open at 54.5_C (130_F), will open the heating circuit if overheating occurs.



——— = 18 Volt Energized Circuit ━━━ = 24 Volt Energized Circuit ——— = De-energized Circuit

Figure 2-2. Heating Mode

2.4.4 Defrost (See Figure 2-3.)

NOTE

Unit will not initiate defrost if the CTD Controlled Atmosphere (CA) option is in the Vent or Pre-Trip mode.

Refer to section 1.12.5 (Code 27) for description of the defrost interval selector and automatic defrost initiation.

When the defrost mode is initiated, the controller relay contacts (TH) close to supply power to the heat relay (HR) and in turn, energizes the defrost heaters. The defrost light is illuminated.

TC opens to de-energize the compressor contactor and cool light. Also TN relay opens to de-energize the condenser fan motor contactor (CF).

Also TE (and TV for units with two speed fans) relays open to stop the evaporator fan motors.

The in-range light remains illuminated during defrost.

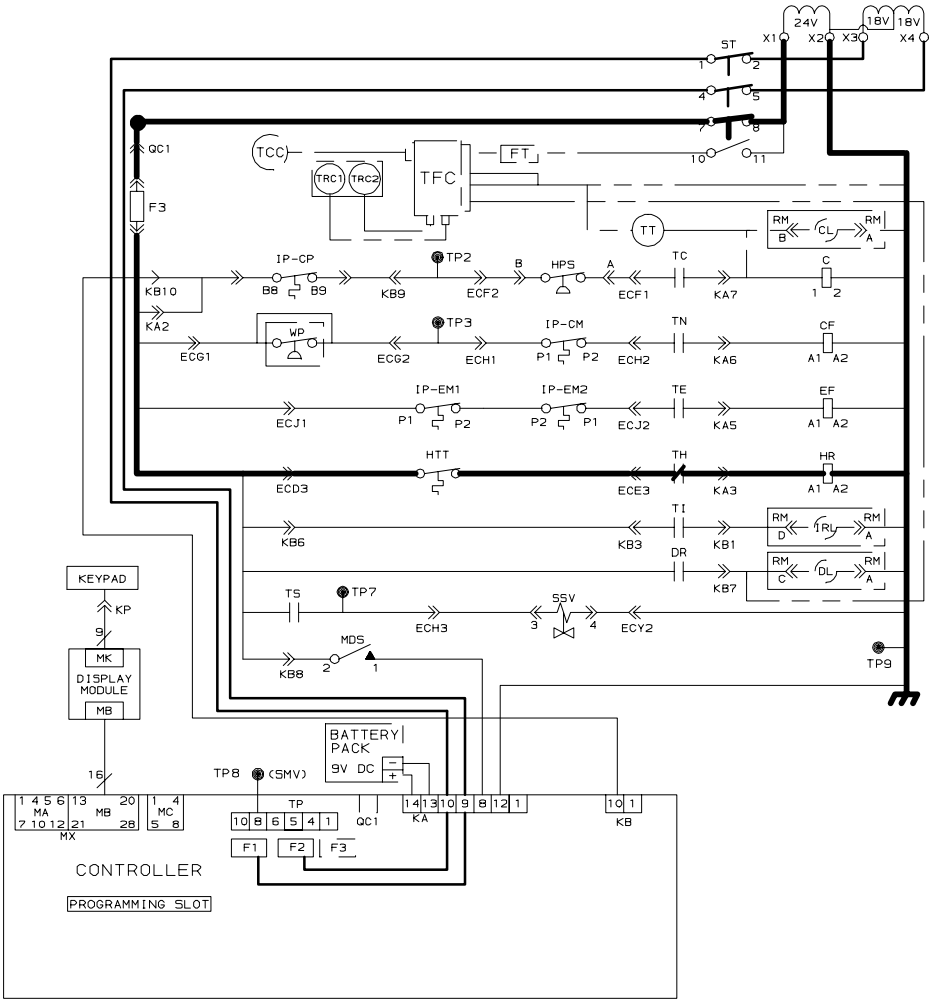
When the coil temperature reaches 25.6_C (78_F) defrost termination sensor (DTS) causes the controller to interrupt the defrost cycle and the unit returns to its normal function.

NOTE

Defrost will be terminated if the Controlled Atmosphere (CA) option Pre-Trip mode is initiated. Defrost will be locked-out if CA is in Pre-Trip.

The 54.5_C (130_F) heat termination thermostat (HTT) will open the circuit if the defrost mode does not terminate at 25.6_C (78_F). The controller will terminate defrost if termination does not occur within 2.0 hours. An alarm will be given of a possible DTS failure.

When the return air falls to 7_C (45_F), the controller checks to ensure defrost termination sensor (DTS) has dropped to 10_C or below. If not, a DTS failure alarm is given and the defrost mode is operated off of return temperature sensor (RTS). The defrost mode will be terminated after one hour by the controller.



——— = 18 Volt Energized Circuit ——— = 24 Volt Energized Circuit ——— = De-energized Circuit

Figure 2-3. Defrost

2.4.5 Economy (See Figure 2-4.)

NOTE

Setting the controller above −10_C (+14_F) or −5_C (+23_F) optionally on units with two-speed motors will place the motors in low speed. (Contactor ES energized)

With decreasing supply air temperature and if the supply air is above set point, the unit will be cooling with the condenser fan motor, compressor motor and evaporator fan motors energized. Also, at this time, the cool light is illuminated.

When the air temperature decreases to a tolerance above set point, relay TI energizes and the in-range light is illuminated. (Refer to section 1.12.5, Code 30).

If the air temperature continues to fall, modulating cooling starts at approximately 2.5_C (4.5_F) above set point. The modulating valve will have a variable current up to 1.30 amps at full modulation.

During this cooling mode, a running sum of the temperature differential (supply air temperature − set point) is kept. When the supply air falls below set point, the differential is negative. The longer supply air remains below set point, the more negative the running sum becomes.

When the supply air temperature decreases to 0.2_C below set point and the running sum is less than −250 degrees C seconds, relays TN and TC de-energize shutting off the condenser fan and compressor motors. Also, the cool light is de-energized.

The evaporator fan motors continue to run to circulate air throughout the container. The in-range light remains illuminated as long as the supply air is within a tolerance of set point, and the 15 minute out of range time has not elapsed.

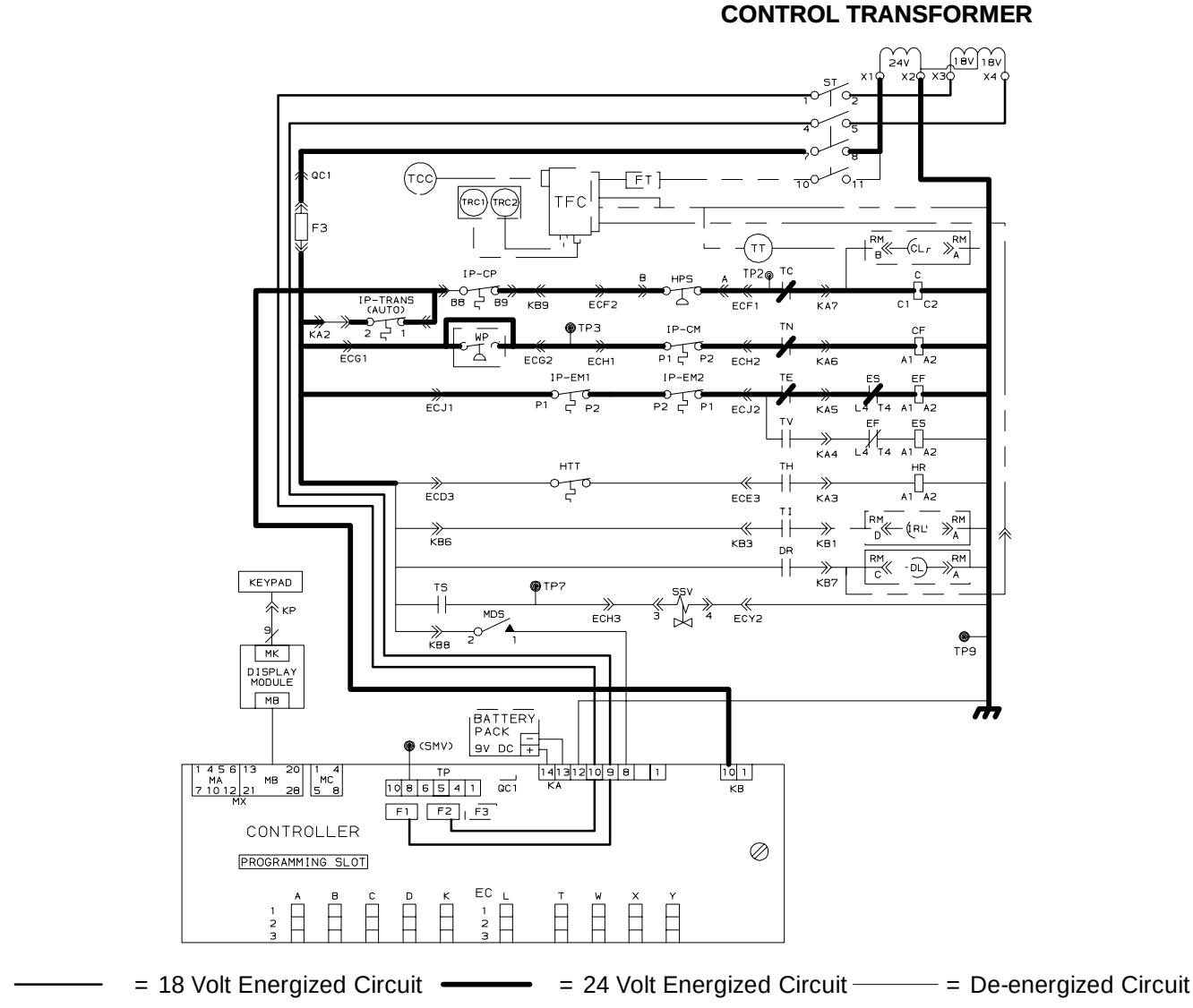


Figure 2-4. Economy Mode

Table 2-1. Electrical Control Positions – BELOW –10_C (+14_F) or –5_C (+23_F) optionally

CONTROL CIRCUIT	COOLING	HOLDING ZONE	**Dehumidification	HEATING	DEFROST
Compressor Contactor (C)	Energized	De-energized	**	**	De-energized
Condenser Fan Motor Contactor (CF)	Energized	De-energized	**	**	De-energized
Single Speed Evaporator Motor Relay (EF)	Energized	Energized	**	**	De-energized
High Speed Evaporator Motor Relay (EF)	De-energized	De-energized	Refer to section 1.12.4.a.2	Refer to section 1.12.4.a.2	De-energized
Low Speed Evaporator Motor Relay (ES)	Energized	Energized	Refer to section 1.12.4.a.2	Refer to section 1.12.4.a.2	De-energized
Defrost Relay (DR)	De-energized	De-energized	**	**	Energized
Heater Relay (HR)	De-energized	De-energized	**	**	Energized
INDICATING LIGHTS					
Cool	ON	OFF	**	**	OFF
Defrost	OFF	OFF	**	**	ON
In-Range	On - If In-Range (Refer to paragraph 1.12.5, Code 30) →				
Heat	OFF	OFF	**	**	ON
POWER CIRCUIT					
Compressor	Energized	De-energized	**	**	De-energized
Condenser Fan Motor	Energized	De-energized	**	**	De-energized
Heaters	De-energized	De-energized	**	**	Energized
Evaporator Fan Motors	Energized	Energized	**	**	De-energized

***** Unit with optional Humidity sensor

** Dehumidification and heating modes do not operate at set points below -10_C (14_F) or the optional setting of -5_C (23_F)

Table 2-2. Electrical Control Positions – ABOVE –10_C (+14_F) or –5_C (+23_F) optionally

CONTROL CIRCUIT	COOLING	HOLDING ZONE	* Dehumidification	HEATING	DEFROST
Compressor Contactor (C)	Energized	De-energized	Energized	De-energized	De-energized
Condenser Fan Motor Contactor (CF)	Energized	De-energized	Energized	De-energized	De-energized
Single Speed Evaporator Motor Relay (EF)	Energized	Energized	Energized	Energized	De-energized
High Speed Evaporator Motor Relay (EF)	Energized	Energized	Refer to section 1.12.4.a.2	Refer to section 1.12.4.a.2	De-energized
Low Speed Evaporator Motor Relay (ES)	De-energized	De-energized	Refer to section 1.12.4.a.2	Refer to section 1.12.4.a.2	De-energized
Defrost Relay (DR)	De-energized	De-energized	De-energized	De-energized	Energized
Heater Relay (HR)	De-energized	De-energized	Energized	Energized	Energized
INDICATING LIGHTS					
Cool	ON	OFF	ON	OFF	OFF
Defrost	OFF	OFF	OFF	OFF	ON
In-Range	On - If In-Range (Refer to paragraph 1.12.5, Code 30) →				
Heat	OFF	OFF	ON	ON	ON
POWER CIRCUIT					
Compressor	Energized	De-energized	Energized	De-energized	De-energized
Condenser Fan Motor	Energized	De-energized	Energized	De-energized	De-energized
Heaters	De-energized	De-energized	Energized	Energized	Energized
Evaporator Fan Motors	Energized	Energized	Energized	Energized	De-energized

SECTION 3
TROUBLESHOOTING

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1 UNIT WILL NOT START OR STARTS THEN STOPS		
No power to unit	External power source OFF	Turn on
	Start-Stop switch OFF or defective	Check
	Circuit breaker tripped or OFF	Check
	Modular transformer not connected	4.22
Loss of control power	Circuit breaker OFF or defective	Check
	Control transformer defective (TR)	Replace
	Fuse blown (F3)	Check
	Start-Stop switch OFF or defective	Check
Loss of control power in respective branch of control circuit only	Evaporator fan motor internal protector open	4.15
	Condenser fan motor internal protector open	4.18
	Compressor internal protector open	4.7
	High pressure switch open	3.7
	Heat termination thermostat (HTT) open	Replace
Compressor hums, but does not start	Low line voltage	Check
	Single phasing	Check
	Shorted or grounded motor windings	4.7
	Compressor seized	4.7
	Voltage switch (VS) not wired properly	Check
3.2 UNIT RUNS BUT HAS INSUFFICIENT COOLING		
Compressor	Compressor valves defective	4.7
Refrigeration System	Abnormal pressures	3.7
	Temperature controller malfunction	3.9
	Evaporator fan or motor defective	4.15
	Suction modulation valve malfunction	4.25
	Suction solenoid valve malfunction	1.10/4.24
3.3 UNIT OPERATES LONG OR CONTINUOUSLY IN COOLING		
Container	Hot load	Normal
	Defective box insulation or air leak	Repair
Refrigeration System	Shortage of refrigerant	4.4/4.6
	Evaporator coil covered with ice	3.6
	Evaporator coil plugged with debris	4.14
	Evaporator fan(s) rotating backwards	4.15/4.27
	Defective evaporator fan motor/capacitor	4.15/4.27
	Air bypass around evaporator coil	Check
	Controller set too low	Reset
	Compressor service valves or liquid line shutoff valve partially closed	Open valves completely
	Dirty condenser	4.17
	Compressor worn	4.7
	Current limit (Code 32) set to wrong value	1.12.5

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.4 UNIT WILL NOT HEAT OR HAS INSUFFICIENT HEATING		
No power to unit	Start-Stop switch OFF or defective	Check
	Circuit breaker OFF or defective	Check
	External power source OFF	Turn on
No control power	Circuit breaker or fuse defective	Replace
	Transformer defective (TR)	Replace
	Evaporator fan internal motor protector open	4.15
	Heat relay defective	Check
	Heater termination switch open	4.14
Unit will not heat or has insufficient heat	Heater(s) defective	4.16
	Heater contactor or coil defective	Replace
	Evaporator fan motor(s) defective or rotating backwards	4.15/4.27
	Evaporator fan motor contactor defective	Replace
	Temperature controller malfunction	3.9
	Defective wiring	Replace
	Loose terminal connections	Tighten
	Low line voltage	1.5
3.5 UNIT WILL NOT TERMINATE HEATING		
Unit fails to stop heating	Temperature controller improperly set	Reset
	Temperature controller malfunction	3.9
	Heater termination switch remains closed along with the heat relay	4.14
3.6 UNIT WILL NOT DEFROST PROPERLY		
Will not initiate defrost automatically	Defrost timer malfunction	1.12.5
	Loose terminal connections	Tighten
	Defective wiring	Replace
	Defrost termination sensor defective or heat termination switch open	Replace
	Heater contactor or coil defective	Replace
Will not initiate defrost manually	Manual defrost switch defective	Replace
	Defrost termination sensor open	2.4.4
Initiates but relay (DR) drops out	Low line voltage	1.5
Initiates but does not defrost	Heater contactor or coil defective	Replace
	Heater(s) burned out	4.16

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.7 ABNORMAL PRESSURES (COOLING)		
High discharge pressure	Condenser coil dirty	4.17
	Condenser fan rotating backwards	4.18
	Condenser fan inoperative	4.18
	Refrigerant overcharge or noncondensibles	4.6
	Discharge pressure regulator valve	Replace
Low suction pressure	Suction service valve partially closed	Open
	Filter-drier partially plugged	4.12
	Low refrigerant charge	4.4/4.6
	Expansion valve defective	4.26
	No evaporator air flow or restricted air flow	3.10
	Excessive frost on evaporator coil	3.6
	Evaporator fan(s) rotating backwards	4.16/4.27
	Discharge pressure regulator valve	Replace
Suction and discharge pressures tend to equalize when unit is operating	Heat exchanger defective	Replace
	Compressor valves defective	4.8
	Compressor cycling/stopped	Check
3.8 ABNORMAL NOISE OR VIBRATIONS		
Compressor	Loose mounting bolts	Tighten
	Worn bearings	4.7
	Worn or broken valves	4.7
	Liquid slugging	3.11
	Insufficient oil	4.10
Condenser or Evaporator Fan	Bent, loose or striking venturi	Check
	Worn motor bearings	4.15/4.18
	Bent motor shaft	4.15/4.18
3.9 TEMPERATURE CONTROLLER MALFUNCTION		
Will not control	Defective Sensor	4.23
	Defective wiring	Check
	Fuse (F1, F2) blown	Replace
3.10 NO EVAPORATOR AIR FLOW OR RESTRICTED AIR FLOW		
Evaporator coil blocked	Frost on coil	3.6
	Dirty coil	4.14
No or partial evaporator air flow	Evaporator fan motor internal protector open	4.15
	Evaporator fan motor(s) defective	4.15/4.27
	Evaporator fan(s) loose or defective	4.15

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.11 THERMOSTATIC EXPANSION VALVE MALFUNCTION		
Low suction pressure with high superheat	Low refrigerant charge	4.4/4.6
	External equalizer line plugged	Open
	Wax, oil or dirt plugging valve or orifice	4.26
	Ice formation at valve seat	4.4/4.6
	Superheat too high	4.26.c
	Power assembly failure	4.26
	Loss of element/bulb charge	4.26
	Broken capillary	4.26
	Foreign material in valve	
High suction pressure with low superheat	Superheat setting too low	4.26.c
	External equalizer line plugged	Open
	Ice holding valve open	4.4/4.5
	Foreign material in valve	4.26
Liquid slugging in compressor	Pin and seat of expansion valve eroded or held open by foreign material	4.26
Fluctuating suction pressure	Improper bulb location or installation	4.26
	Low superheat setting	4.26.c
3.12 POWER AUTOTRANSFORMER MALFUNCTION		
Unit will not start	Circuit breaker (CB-2) tripped	Check
	Power transformer internal protector open	4.22
	Power transformer defective	4.22
	Power source not turned ON	Check
3.13 EVAPORATOR MOTOR TRANSFORMER MALFUNCTION		
Unit will not start	Voltage switch (VS) not wired properly	Check
	Evaporator motor transformer internal protector open	Check
	Evaporator motor transformer defective	Check
	Power source not turned ON	Check
3.14 WATER-COOLED CONDENSER OR WATER PRESSURE SWITCH MALFUNCTION		
High discharge pressure	Dirty coil	4.29
	Noncondensibles	
Condenser fan starts and stops	Water pressure switch malfunction	Check
	Water supply interruption	

SECTION 4

SERVICE

NOTE

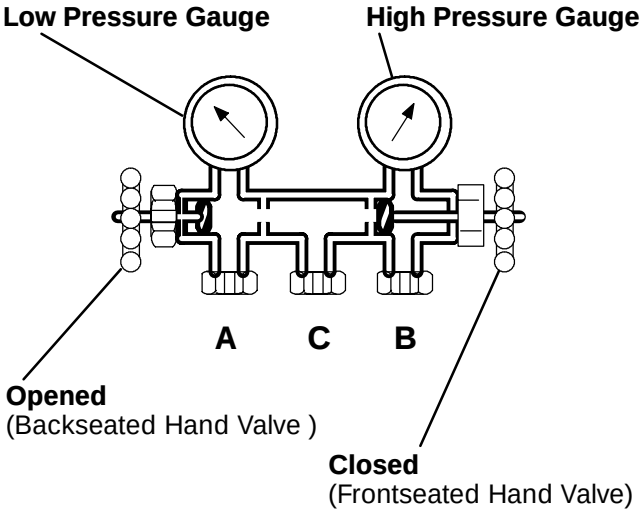
To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws, U.S.A. EPA section 608.

4.1 MANIFOLD GAUGE SET

The manifold gauge set can be used to determine system operating pressure, add a refrigerant charge, equalize or evacuate the system.

The manifold gauge in Figure 4-1 shows hand valves, gauges and refrigerant openings. When the low pressure hand valve is frontseated (turned all the way in), the low (evaporator) pressure can be checked. When the high pressure hand valve is frontseated, high (condensing) pressure can be checked. When both valves are open (turning counter clockwise), high pressure vapor will flow into the low side. When the low pressure valve is open, the system can be charged. Oil can also be added to the system.

Only a R-134a manifold gauge set with self-sealing hoses as shown in Figure 4-2 (CTD P/N 07-00294-00, which includes items 1 through 6) can be used when working on the models covered within this manual.



A. Connection to Low Side of System
B. Connection to High Side of System
C. Connection to Either:
Refrigerant Cylinder or
Oil Container

Figure 4-1. Manifold Gauge Set

a. Connecting the Manifold Gauge Set (See Figure 4-2)

1. Remove service valve stem caps and check both service valves to make sure they are backseated (counter clockwise). Remove service port caps.

NOTE

If a manifold gauge set is new or was exposed to the atmosphere. Due to repair, it will need to be evacuated to remove contaminants and air as follows:

a. Midseat both hand valves.

b. Connect the utility hose (yellow) to a vacuum pump.

c. Evacuate to 10 inches of vacuum.

d. Charge with R-134a to a slightly positive pressure of 0.1 kg/cm@ (1.0 psig).

e. The gauge set is now ready for use.

2. Connect the high side field service coupling (backseated) to the discharge service valve port (or the manual liquid line valve port, whichever is applicable).

3. Turn the high side field service coupling (red knob) clockwise, which will open the high side of the system to the gauge set.

4. Connect the low side field service coupling to the suction service valve port.

5. Turn the low side field service coupling (blue knob), which will open the low side of the system to the gauge set.

6. To read system pressures; slightly midseat the discharge and suction service valves, and frontseat both manifold gauge set hand valves.

CAUTION

To prevent trapping liquid refrigerant in the service valve after charging, while the compressor is ON and before disconnecting the manifold gauge set, perform the following steps:

a. Backseat applicable discharge or manual liquid line valve.
b. Midseat manifold gauge set hand valves.
c. Allow the gauge set to pull down to suction pressure.

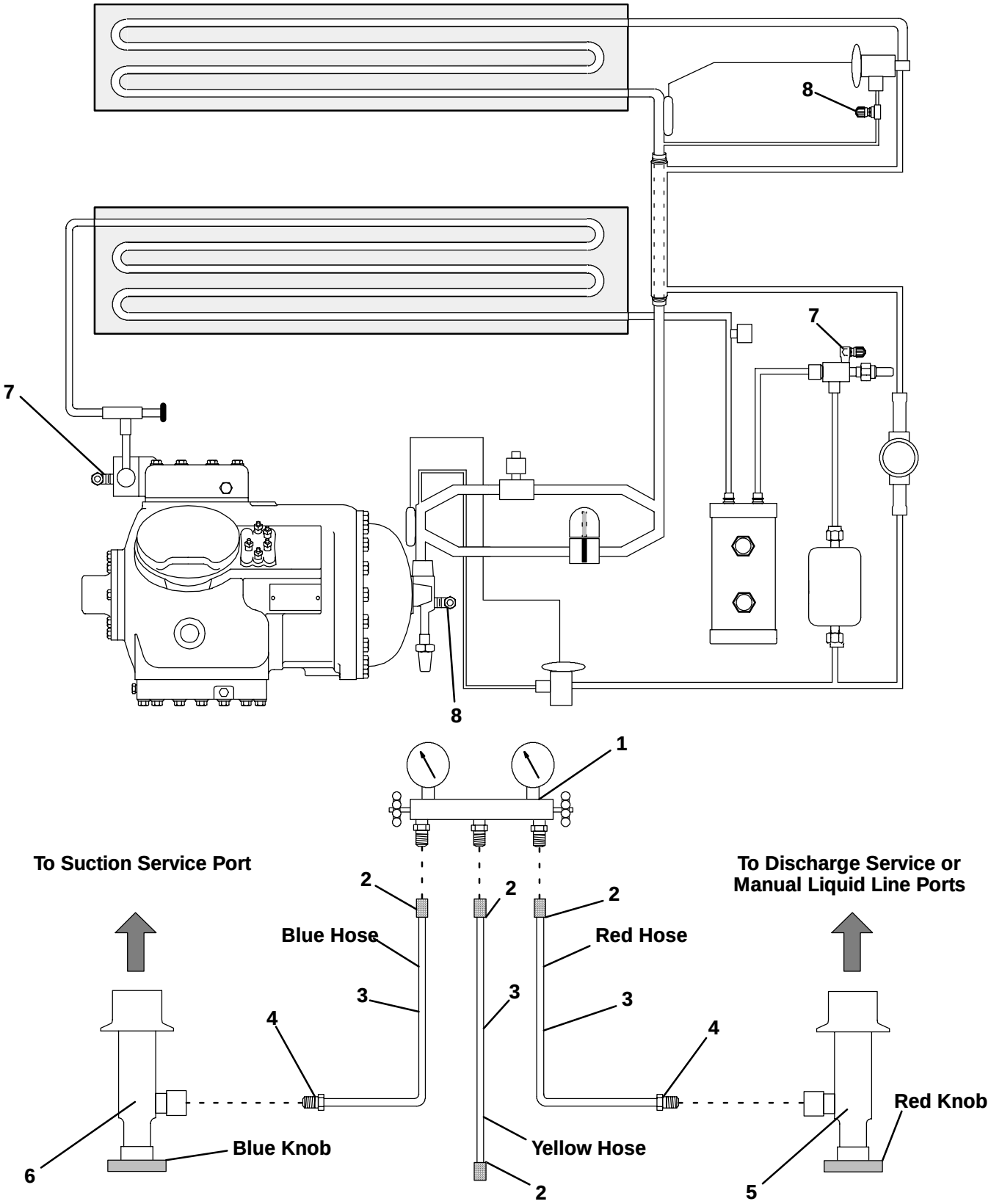
b. Removing the Manifold Gauge Set

1. While the compressor is still ON, backseat the discharge service valve.

2. Midseat both hand valves on the manifold gauge set and allow the pressure in the manifold gauge set to be drawn down to suction pressure. This enables the liquid that condensed in the high side hose to be returned to the system.

3. Backseat the suction service valve. Backseat both field service couplings, and remove the couplings from the service ports.

4. Install both service valve stem caps and service port caps (finger-tight only).



1. Manifold Gauge Set
2. Hose Fitting (0.500-16 Acme)
3. Refrigeration or Evacuation Hoses (SAE J2196/R-134a)
4 Hose Fitting w/O-ring (M14 x 1.5)
5. High Side Field Service Coupling
6. Low Side Field Service Coupling
7. High Side Service Port (SAE J639 Male)
8. Low Side Service Port (SAE J639 Male)

Figure 4-2. R-134a Manifold Gauge Set Connection

4.2 SUCTION AND DISCHARGE SERVICE VALVES

The suction and discharge service valves used on the compressor are equipped with mating flanges for connection to flanges on the compressor. These valves are provided with a double seat and a gauge connection, which enable servicing of the compressor and refrigerant lines.

Turning the valve stem clockwise (all the way forward) will frontseat the valve to close off the suction or discharge line and opens the gauge connection to the compressor. See Figure 4-3. Turning the valve stem counterclockwise (all the way out) will backseat the valve to open the suction or discharge line to the compressor and close off the gauge connection.

With the valve stem midway between frontseated and backseated positions, suction or discharge line is open to both the compressor and the gauge connection.

For example, when connecting a manifold gauge to measure suction or discharge pressure, the valve stem is fully backseated. Then, to measure suction or discharge pressure, crack open the valves 1/4 to 1/2 turn.

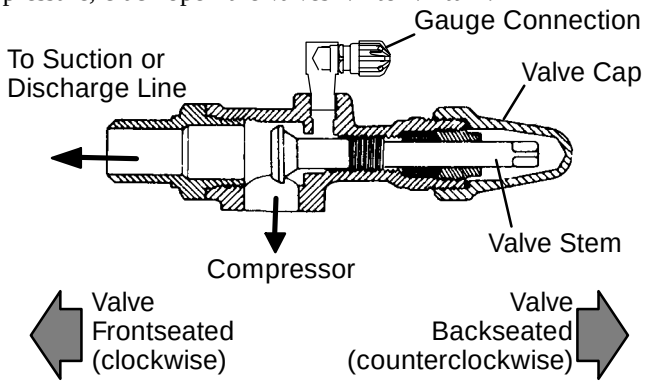


Figure 4-3. Suction or Discharge Service Valve

4.3 PUMPING THE UNIT DOWN OR REMOVING THE REFRIGERANT

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws, U.S.A. EPA section 608.

a. Pumping the Unit Down

To service the filter-drier, moisture-liquid indicator, expansion valve, suction modulation valve, suction solenoid valve or evaporator coil, pump most of the refrigerant into the condenser coil and receiver as follows:

1. Install gauges and mid seat the suction and discharge valves (turn clockwise) as specified in section 4.1.a.

2. Allow the compressor to run 10 to 15 minutes. Then close (front seat) liquid line valve by turning clockwise. Start the unit and run in a cooling mode. Place start-stop switch in the OFF position when the unit reaches and maintains a positive pressure of 0.1 kg/cm@ (1.0 psig).

NOTE

The unit may need to be cycled several times to achive this reading.

3. Frontseat (close) the suction service valve and the refrigerant will be trapped between the compressor suction service valve and the liquid line valve.

4. Before opening up any part of the system, a slight positive pressure should be indicated on the pressure gauge. If a vacuum is indicated, emit refrigerant by cracking the liquid line valve momentarily to build up a slight positive pressure 0.1 kg/cm@ (1.0 psig)..

5. When opening up the refrigerant system, certain parts may frost. Allow the part to warm to ambient temperature before dismantling. This avoids internal condensation which puts moisture in the system.

6. After repairs have been made, be sure to perform a refrigerant leak check (section 4.4), and evacuate and dehydrate the system (section 4.5).

7. Check refrigerant charge (Refer to section 4.6).

4.4 REFRIGERANT LEAK CHECKING

WARNING

Never mix refrigerants with air for leak testing. It has been determined that pressurized, air-rich mixtures of refrigerants and air can undergo combustion when exposed to an ignition source.

a. The recommended procedure for finding leaks in a system is with a R-134a electronic leak detector. Testing joints with soapsuds is satisfactory only for locating large leaks.

b. If the system is without refrigerant, charge the system with refrigerant to build up pressure between 2.1 to 3.5 kg/cm@ (30 to 50 psig). Remove refrigerant cylinder and leak check all connections.

NOTE

It must be emphasized that only the correct refrigerant cylinder be connected to pressurize the system. Any other gas or vapor will contaminate the system which will require additional purging and evacuation of the system.

c. Remove refrigerant using a refrigerant recovery system and repair any leaks.

d. Evacuate and dehydrate the unit. (Refer to section 4.5)

e. Charge unit per section 4.6.

4.5 EVACUATION AND DEHYDRATION

4.5.1 General

Moisture is the deadly enemy of refrigeration systems. The presence of moisture in a refrigeration system can have many undesirable effects. The most common are copper plating, acid sludge formation, "freezing-up" of metering devices by free water, and formation of acids, resulting in metal corrosion.

4.5.2 Preparation

a. Evacuate and dehydrate only after pressure leak test. (Refer to section 4.4)

b. Essential tools to properly evacuate and dehydrate any system include a vacuum pump (8 m^3H = 5 cfm volume displacement, P/N 07-00176-01) and electronic vacuum gauge.

c. If possible, keep the ambient temperature above 15.6_C (60_F) to speed evaporation of moisture. If ambient temperature is lower than 15.6_C (60_F) ice might form before moisture removal is complete. Heat lamps or alternate sources of heat may be used to raise the system temperature.

d. Replace the filter-drier with a section of copper tubing with the appropriate fittings. This idea will help speed up the evacuation procedure.

4.5.3 Procedure

a. Remove all refrigerant using a refrigerant recovery system.

b. The recommended method to evacuate and dehydrate the system is to connect three evacuation hoses (Do not use standard service hoses, as they are not suited for evacuation purposes.) as shown in Figure 4-4 to the vacuum pump and refrigeration unit. Also, as shown, connect a evacuation manifold, with evacuation hoses only, to the vacuum pump, electronic vacuum gauge, and refrigerant recovery system.

c. With the unit service valves closed (back seated) and the vacuum pump and electronic vacuum gauge valves open, start the pump and draw a deep vacuum. Shut off the pump and check to see if the vacuum holds. This operation is to test the evacuation setup for leaks, repair if necessary.

d. Midseat the refrigerant system service valves.

e. Then open the vacuum pump and electronic vacuum gauge valves, if they are not already open. Start the vacuum pump. Evacuate unit until the electronic vacuum gauge indicates 2000 microns. Close the electronic vacuum gauge and vacuum pump valves. Shut off the vacuum pump. Wait a few minutes to be sure the vacuum holds.

f. Break the vacuum with clean dry refrigerant gas. Use refrigerant that the unit calls for. Raise system pressure to approximately 2 psig by monitoring it with the compound gauge.

g. Remove refrigerant using a refrigerant recovery system.

h. Repeat steps e through g one time.

i. Remove the copper tubing and change the filter-drier. Evacuate unit to 500 microns. Close the electronic vacuum gauge and vacuum pump valves. Shut off the vacuum pump. Wait five minutes to see if vacuum holds. This checks for residual moisture and/or leaks.

j. With a vacuum still in the unit, the refrigerant charge may be drawn into the system from a refrigerant container on weight scales. The correct amount of refrigerant may be added by observing the scales. (Refer to section 4.6)

4.6 REFRIGERANT CHARGE

4.6.1 Checking the Refrigerant Charge

NOTES

1. Set the controller set point to −25_C (−13_F) to ensure that the suction modulation valve is fully open when checking operation of unit.

2. The refrigerant level should only be checked when the unit is running with the suction modulation valve fully open. The container temperature should be approximately 1.7_C (35_F) or −17.8_C (0_F).

a. Connect the gauge manifold to the compressor discharge and suction service valves.

b. *Units equipped with the receiver;* partially block the condenser coil inlet air starting from the front of the condenser coil. Increase the area blocked until the compressor discharge pressure is raised to approximately 12 kg/cm@ (175 psig). Refrigerant level on the receiver will normally be between the sight glasses. If not, refer to section 4.6.3.

c. *Units equipped with the water-cooled condenser*; check charge only on air-cooled operation. Refrigerant level in the water-cooled operation will be normally above sight glass. Partially block the condenser coil inlet air starting from the front of the condenser coil. Increase the area blocked until the compressor discharge pressure is raised to approximately 12 kg/cm@ (175 psig). Refrigerant should appear at center line of sight glass on the water-cooled condenser. If not, refer to section 4.6.3.

4.6.2 Adding Refrigerant to System (Full Charge)

a. Evacuate unit and leave in deep vacuum. (Refer to section 4.5)

b. Place cylinder of R-134a on scale and connect charging line from cylinder to liquid line valve. Purge charging line at liquid line valve and then note weight of cylinder and refrigerant.

c. Open liquid valve on cylinder. Open liquid line valve half-way and allow the liquid refrigerant to flow into the unit until the correct weight of refrigerant has been added as indicated by scales. Correct charge is noted in Table 4-6.

NOTE

It may be necessary to finish charging unit through suction service valve in gas form, due to pressure rise in high side of the system. (Refer to section 4.6.3)

d. Backseat manual liquid line valve (to close off gauge port). Close liquid valve on cylinder.

e. Start unit in cooling mode. Run approximately ten minutes and check the refrigerant charge. (Refer to section 4.6.1)

4.6.3 Adding Refrigerant to System (Partial Charge)

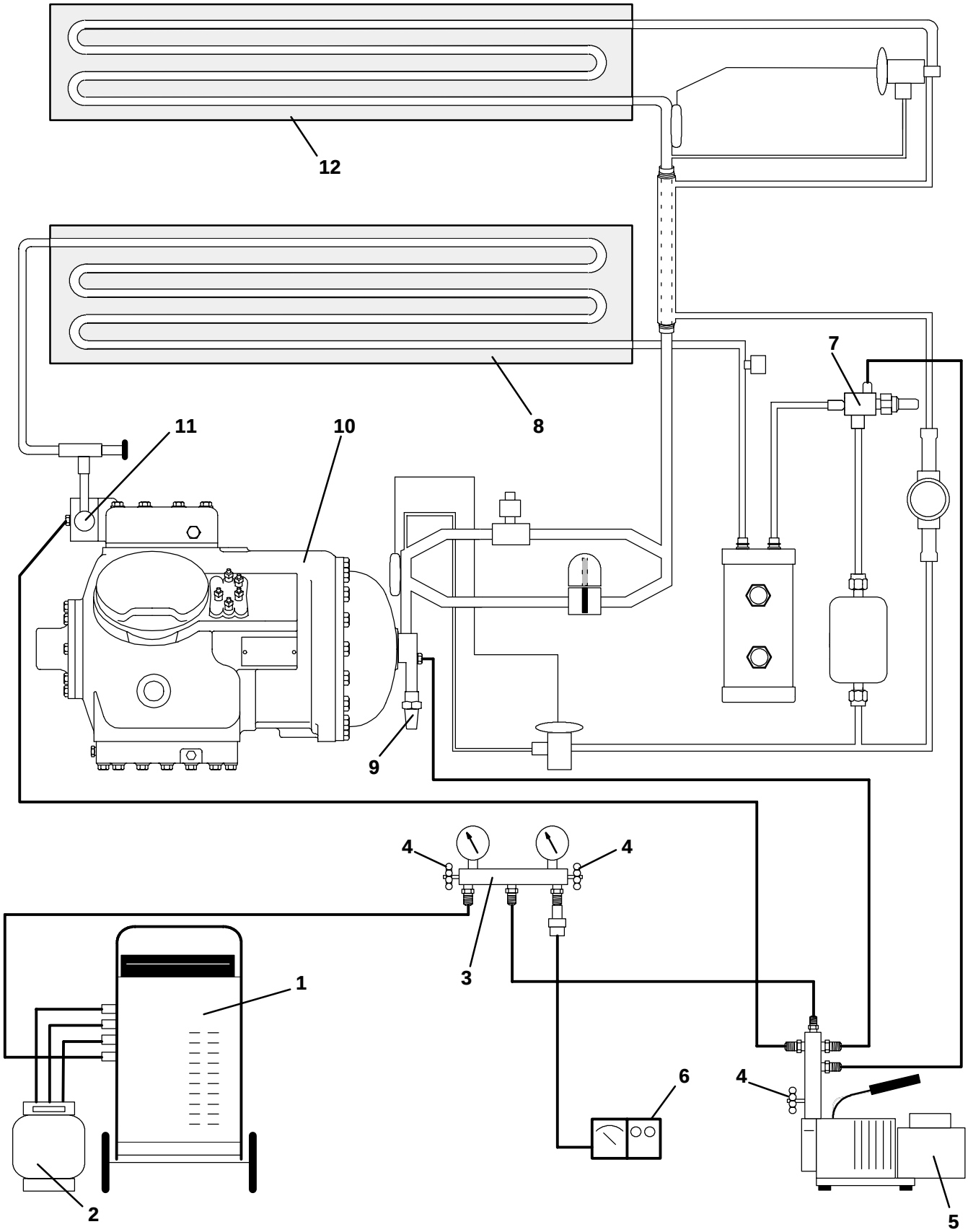
a. Examine the unit refrigerant system for any evidence of leaks. Repair as necessary. (Refer to section 4.4.)

b. Maintain the conditions outlined in section 4.6.1.

c. Fully backseat (to close off gauge port) the suction service valve (see Figure 1-3) and remove the service port cap.

d. Connect charging line between suction service valve port and cylinder of refrigerant-134a. Open VAPOR valve.

e. Partially frontseat (turn clockwise) the suction service valve and slowly add charge until the refrigerant appears at the proper level (refer to section 4.6.1).



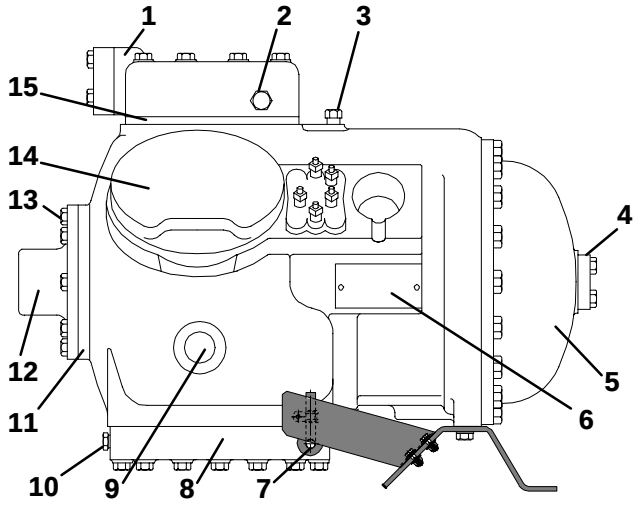
1. Refrigerant Recovery Unit
2. Refrigerant Cylinder
3. Evacuation Manifold (R-134a)
4 Hand Valve
5. Vacuum Pump
6. Electronic Vacuum Gauge
7. Manual Liquid Line Valve
8. Condenser Coil
9. Suction Service Valve
10. Compressor
11. Discharge Service Valve
12. Evaporator Coil

Figure 4-4. Vacuum Pump Connections

4.7 COMPRESSOR MODEL 06DR REPLACEMENT (See Figure 4-5.)

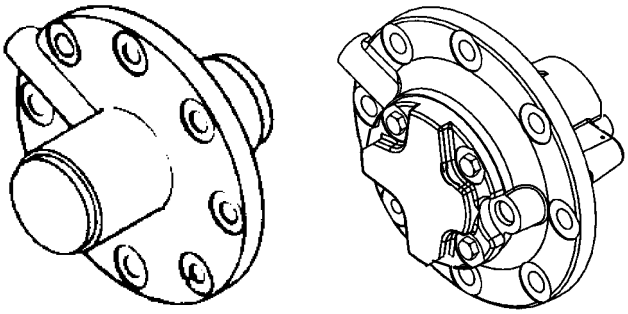
WARNING

Make sure power to the unit is OFF and power plug disconnected before replacing the compressor.



1. Discharge Valve Flange
2. High Side Pressure Connection
3. Low Side Pressure Connection
4. Suction Valve Flange
5. Motor End Cover
6. Serial/Model No. Plate
7. Crankcase Heater (Optional)
8. Bottom Plate
9. Sight Glass
10. Oil Drain Plug
11. Bearing Head
12. Oil Pump (See Figure 4-6)
13. Oil Fill Plug (Refer to section 4.10)
14. Cylinder Head
15. Valve Plate

Figure 4-5. Compressor – Model 06DR



Gear Pump **Low Profile Gear Pump**

Figure 4-6. Oil Pump

There are two types of oil pumps; gear and low profile gear. Force-feed lubrication of the compressor is accomplished by a oil pump driven directly from the compressor crankshaft. Refrigeration oil is drawn from the compressor crankcase through the oil filter screen and pick up tube to the oil pump located in the bearing head assembly. The crankshaft is drilled to enable the pump to supply oil to the main bearings, connecting rod bearings, and the shaft seal.

NOTES

1. Check the compressor Serial/Model Number plate for CFM displacement, refer to Table 1-2.

2. The compressor should not operate in a vacuum greater than 500 mm Hg vacuum (20 inches Hg vacuum).

3. The service replacement compressor is sold without shutoff valves (but with valve pads), and without terminal box and cover. Customer should retain the original terminal box, cover, and high pressure switch for use on replacement compressor.

4. Check oil level in service replacement compressor. (Refer to sections 1.3 and 4.10.)

5. A compressor terminal wiring kit must be ordered as a separate item when ordering replacement compressor. Appropriate installation instructions are included with kit.

6. Refer to Table 4-4 and Table 4-5, for applicable compressor wear limits and torque values.

7. Refer to Figure 4-32 for charts on compressor pressure-temperature and motor current curves.

a. Remove the protective guard from lower section of the unit.

b. Remove refrigerant. (Refer to section 4.3)

c. Disconnect wiring in the compressor junction box after identifying same. Disconnect wiring from compressor terminals and remove compressor junction box.

d. Remove bolts from service valve flanges.

e. To remove the optional crankcase heater (CCH), refer to Figure 4-5. Remove cushion clamp from the mounting bracket. Unbolt and remove crankcase heater mounting bracket. Pull heater straight out of crankcase.

f. Remove compressor plate mounting bolts.

g. Remove compressor and mounting plate. The compressor weighs approximately 118 kg (260 pounds).

h. Remove high pressure switch (HPS) from compressor and check operation of switch (refer to section 4.13.2).

i. Remove compressor mounting bolts from mounting plate and install mounting plate on replacement compressor.

j. Install replacement compressor terminal wiring kit (following instructions included with kit).

k. Install high pressure switch on compressor.

l. Install compressor and mounting plate in unit.

m. Install junction box to compressor and connect all wiring per wiring diagram and then install junction box cover.

n. Install new gaskets on service valves.

o. Install mounting bolts in service valves and torque to a value of 2.77 to 4.15 mkg (20-30 ft/lb).

p. Install a new filter-drier. (Refer to section 4.12)

q. Evacuate and Dehydrate per section 4.5
Add refrigerant to system per section 4.6.2

r. Start unit and check refrigerant charge. (Refer to section 4.6.1.)

s. Check moisture-liquid indicator for wetness. Change filter-drier if necessary. (Refer to sections 4.11 and 4.12)

t. Check compressor oil level per section 4.10. Add oil if necessary.

u. Fully backseat (open) both suction and discharge service valves.

v. Remove gauges.

4.8 COMPRESSOR DISASSEMBLY

WARNING

Before disassembly of the compressor make sure to relieve the internal pressure very carefully by slightly loosening the bolts on both service valve flanges/blank valve pads, then lightly tap the sides of the valve flanges/pads with a hammer to break the seal.

CAUTION

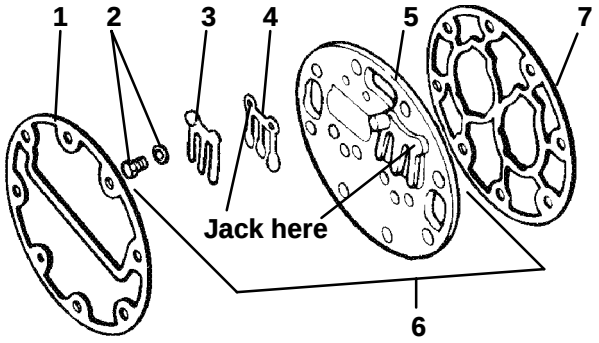
Removing the press fit stator in the field is not recommended. The rotor and stator are a matched pair and should not be separated.

When disassembling compressor, matchmark parts so they may be replaced in their same relative positions. (See Figure 4-5 for an illustration of the compressor.) Refer to Table 4-4 and Table 4-5 for compressor wear limits and bolt torque values.

a. Place the compressor in a position where it will be convenient to drain the oil. Remove the oil plug on oil pump inlet passage (See Figure 4-9 for location) to vent the crankcase. Loosen the drain plug (See Figure 4-5) in bottom plate and allow the oil to drain out slowly. Remove the plug slowly to relieve any crankcase pressure. A plug in the bottom center of the crankcase may also be removed for draining the motor end more quickly. (Some units do not have this plug.)

b. Remove cylinder head capscrews. If the cylinder head is stuck, tap the center of the cylinder head with a wooden or lead mallet. DO NOT STRIKE THE SIDE OF THE CYLINDER HEAD! Be careful not to drop the head or damage the gasket sealing surface. (See Figure 4-5 and Figure 4-7.) Remove cylinder head gasket.

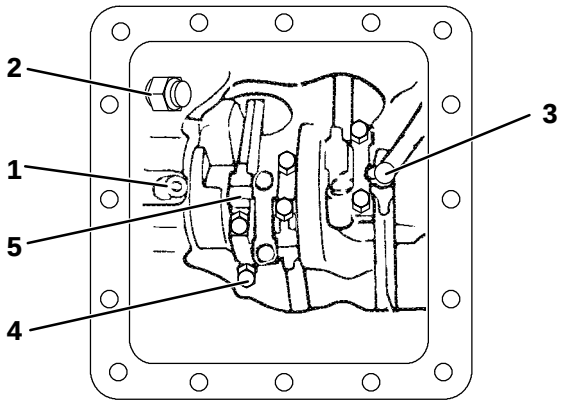
c. Free the valve plate from the cylinder deck by using the outside discharge valve hold down capscrew as a jack screw through the tapped hole of the valve plate after the valve stops and valves have been removed. Remove the valve plate gasket. (See Figure 4-7.)



1. Cylinder Head Gasket
2. Discharge Valve Screw and Lockwasher
3. Discharge Valve Stop
4. Discharge Valve
5. Valve Plate
6. Valve Plate Assembly
7. Valve Plate Gasket

Figure 4-7. Exploded View of Valve Plate

d. Turn the compressor over on its side and remove the bottom plate. Match mark each connecting rod cap and connecting rod for correct reassembly. Remove the bolts and connecting rod caps (See Figure 4-8). Push the piston rods up as far as they will go without having the piston rings extend above the cylinders.



1. Oil Pressure Relief Valve
2. Oil Return Check Valve
3. Oil Suction Tube
4. Capscrew
5. Connecting Rod and Cap Assembly

Figure 4-8. Bottom Plate Removed

CAUTION

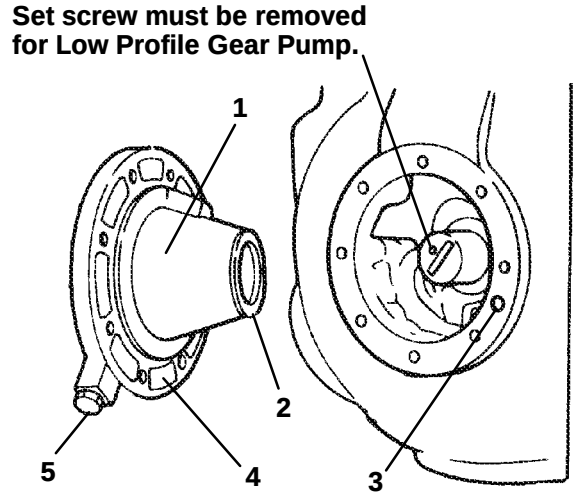
The copper tube which connects to the oil suction strainer extends out the bottom with the bottom plate removed. Take precautions to avoid bending or breaking it while changing crankcase positions.

e. If necessary, remove the oil return check valve. Inspect it for check valve operation (flow in one direction only). Replace assembly if its check valve operation is impaired. (See Figure 4-8.)

f. There are two types of oil pumps; gear and low profile gear. See Figure 4-6 to identify which oil pump is used.

If it was determined that the oil pump was not operating properly, the entire oil pump and bearing head assembly must be replaced. Replacement parts for the pump are not available.

To remove the oil pump. Remove eight capscrews, oil pump bearing head assembly, gasket and thrust washer. (See Figure 4-9)



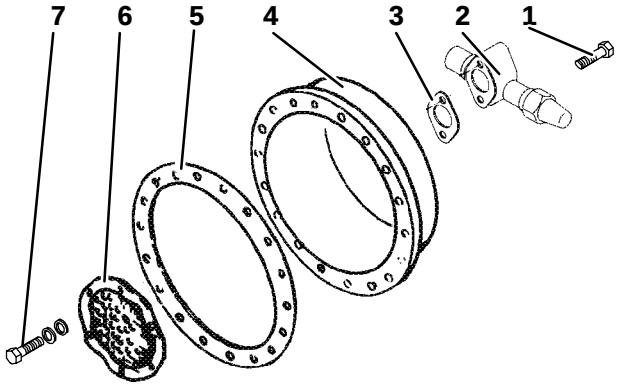
1. Oil Pump & Bearing Head
2. Thrust Washer (Gear Pump Only)
3. Oil Pickup Tube
4. Oil Inlet Port
5. Oil Pump Inlet

Figure 4-9. Oil Pump and Bearing Head

g. Be very careful not to damage the motor windings when removing the motor end cover as the cover fits over the winding coils. Remove all capscrews except one in the top of the cover. Then, while holding the cover in place, remove the remaining capscrew. Do not allow the cover to drop from its own weight. To prevent striking the winding, move the cover off horizontally and in line with the motor axis.

h. Remove the refrigerant suction strainer and if it is removed with ease it may be cleaned with solvent and replaced. (See Figure 4-10.) If the strainer is broken, corroded or clogged with dirt that is not easily removed, replace the strainer. Install new gaskets upon reassembly.

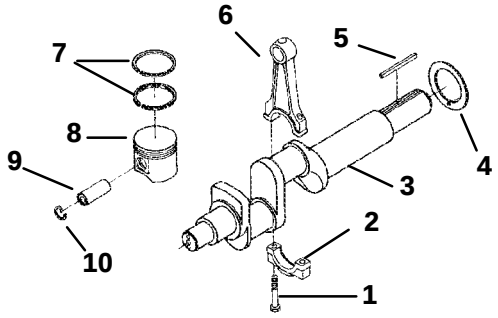
i. Block the compressor crankshaft so that it cannot turn. Use a screw driver to bend back the tabs on the lockwasher and remove the equalizer tube. (See Figure 4-12.) The slinger at the end of the shaft draws vapor from the crankcase. It may discharge through a tee or a single equalizer tube.



1. Valve Capscrew
2. Suction Service Valve
3. Valve Gasket
4. Motor End Cover
5. Motor End Cover Gasket
6. Suction Strainer
7. Strainer Screws and Washers

Figure 4-10. Motor End Cover

j. If the piston rings extend beyond the cylinder tops, the pistons can be pulled through the bottom plate opening after the piston rings are compressed. A piston ring-compresser will facilitate removal. Each piston pin is locked in place by lock rings which are snapped into grooves in the piston wall.

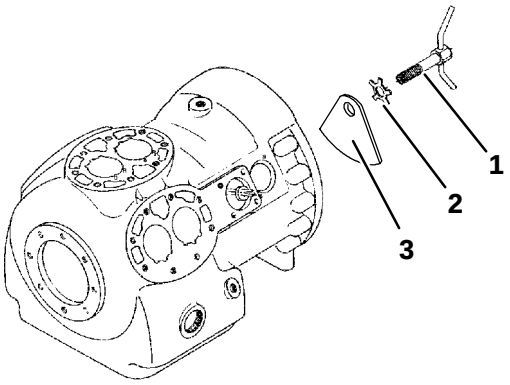


1. Capscrew
2. Cap
3. Crankshaft
4. Thrust Washer
5. Rotor Drive Key
6. Connecting Rod
7. Compression Ring
8. Piston
9. Pin
10. Retainer

Figure 4-11. Crankshaft Assembly

k. Since the stator is not replaced in the field, the terminal plate assembly need not be disturbed unless a leak exists or a terminal part requires replacing.

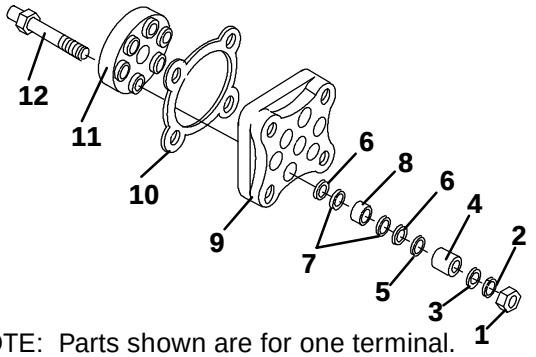
Disassemble and assemble the terminal plate as shown in Figure 4-13.



1. Equalizer Tube and Lockscrew Assembly
2. Lockwasher
3. Counterweight – Motor End

Figure 4-12. Removing Equalizing Tube and Lock Screw Assembly

The terminal mounting plate assembly as originally installed is assembled so as to leave a small space between the outer terminal bushing and the surface of the mounting plate. This is to provide further crush of the terminal bushing in case a leak should occur. To stop leak, tighten the terminal bushing nut only enough to stop the escape of gas. Do not tighten until terminal bushing is flush with the mounting plate. The tightening torque used at the factory is 0.21 to 0.23 mkg (18 to 20 inch pounds) maximum to prevent damage to the plastic parts.



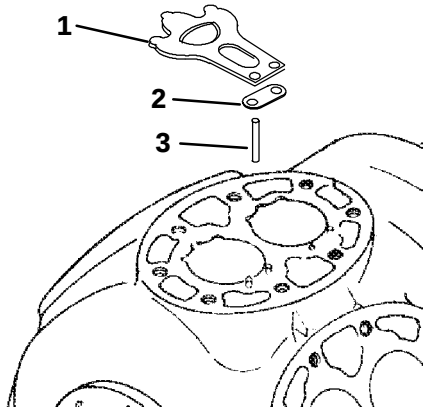
NOTE: Parts shown are for one terminal.

1. Terminal Bushing Nut
2. Lock Washer
3. Terminal Washer
4. Outer Terminal Bushing
5. O-Ring
6. Terminal Bushing Washers (Grey)
7. Terminal Bushing Washers (Red)
8. Inner Terminal Bushing
9. Terminal Mounting Plate
10. Cover Gasket
11. Inner Terminal Block
12. Terminal Screw

Figure 4-13. Terminal Mounting Assembly

4.9 COMPRESSOR REASSEMBLY

To clean compressor parts, use a suitable solvent with proper precautions. Coat all moving parts with the proper compressor oil before assembly. Refer to Table 4-5, for applicable compressor torque values.



1. Suction Valve
2. Suction Valve Positioning Spring
3. Valve Plate Dowel Pin

Figure 4-14. Suction Valve & Positioning Springs

a. Suction and Discharge Valves

If the valve seats look damaged or worn, replace valve plate assembly. Always use new valves because it is difficult to reinstall used discharge valves so that they will seat as before removal. Any valve wear will cause leakage for this reason.

Suction valves are positioned by dowel pins (see Figure 4-14) and will assume their original position when reinstalled. No two valves are likely to wear exactly the same. Never interchange used valves.

Do not omit the suction valve positioning springs. (See Figure 4-14.) Place the springs so that the ends bear against the cylinder deck (middle bowed away from cylinder deck). Use new gaskets when reinstalling valve plates and cylinder heads.

b. Compression Rings

The compression ring is chamfered on the inside circumference. This ring is installed with the chamfer towards the top. Stagger the ring end gaps so they are not aligned.

The gap between the ends of the piston rings can be checked with a feeler gauge by inserting the ring into the piston bore about one inch below the top of the bore. Square the ring in the bore by pushing it slightly with a piston. The maximum and minimum allowable ring gaps are 0.33 and 0.127 mm (0.013 and 0.005 inch)

Compression ring

Figure 4-15. Piston Rings

c. Installing the Components

1. Push pistons from the inside of the crankcase through the cylinders being careful not to break the rings. Place chamfered side of connecting rod against radius of crankpins. Install the crankshaft through the pump end of the compressor. Do not damage main bearings. Install matching connecting rod caps through bottom cover plate.

2. The oil screen (located in the bottom of the crankcase), is connected to the inlet of the oil pump. Whenever the compressor crankcase is opened, inspect the screen for holes or an accumulation of dirt. The screen can be cleaned with a suitable solvent.

There are two types of oil pumps; vane and gear. See Figure 4-6 to identify which oil pump is used, then follow the correct procedure below. Clean all parts; coat all moving parts with compressor oil before proceeding with reassembly.

Gear Oil Pump:

a. Install the pump end thrust washer on the two dowel pins located on the bearing head. (See Figure 4-9)

CAUTION

Ensure that the thrust washer does not fall off the dowel pins while installing the gear oil pump.

b. Install the bearing head assembly with a new gasket on the compressor crankshaft. Carefully push oil pump on by hand ensuring that the thrust washer remains on the dowel pins, the tang on the end of the drive segment engages the slot in the crankshaft, and the oil inlet port on the pump is aligned with the oil pickup tube in the crankcase. The pump should mount flush with the crankcase and should be oriented as shown in Figure 4-16.

c. Align the gasket and install the eight capscrews in the mounting flange. Refer to Table 4-5, for applicable torque values.

Low Profile Gear Oil Pump:

a. The set screw on the crankshaft must be removed for the low profile gear pump.

CAUTION

The set screw on the crankshaft must be removed for the low profile gear pump (See Figure 4-9).

b. Install the bearing head assembly with a new gasket on the compressor crankshaft. Carefully push oil pump on by hand ensuring that the tang on the end of the drive engages the slot in the crankshaft, and the oil inlet port on the pump is aligned with the oil pickup tube in the crankcase. The pump should mount flush with the crankcase and should be oriented as shown in Figure 4-16.

c. Align the gasket and install the eight capscrews in the mounting flange. Refer to Table 4-5, for applicable torque values.

3. Install rotor with key. Screw on equalizer tube and lock screw assembly with lock washer and bend over tabs of lock washer. Assemble suction strainer to motor and cover and bolt cover to crankcase. Assemble valve plates and gaskets. Assemble cylinder heads and gaskets. Feel if the shaft will turn by hand.

4. Install oil suction screen and bottom plate.

Compressor Crankcase Heater: (CCH)

Before installing the crankcase heater be sure to coat the walls of this port with a thermal conductive compond, CTD P/N 02-00010-00. This compound is necessary to ensure proper operation of the heater, and prevent damage to the heating element due to excessive heat.

Checking The Crankcase Heater:

The heater will consume approx. 180 watts when powered with 460 vac. The resulting current through the heater will be approx. 0.4 amps. This may be verified by using a clamp-on ammeter while the heater is operational.

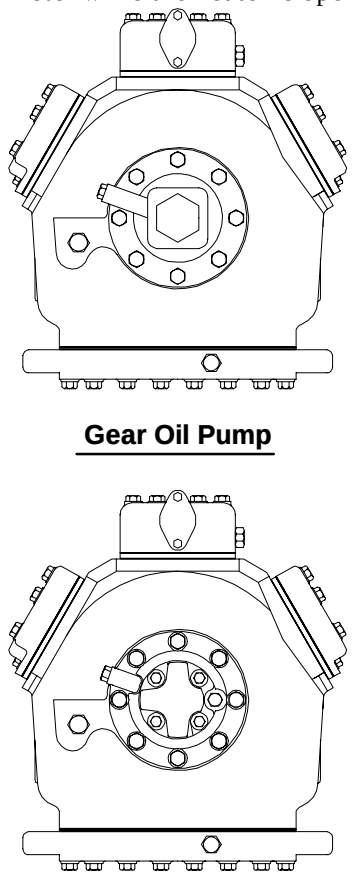


Figure 4-16. Compressor Pump End View

4.10 COMPRESSOR OIL LEVEL

CAUTION

Use only Carrier Transicold approved Polyol Ester Oil (POE) – Castrol-Icematic SW20 compressor oil with R-134a. Buy in quantities of one quart or smaller. When using this hygroscopic oil, immediately reseal. Do not leave container of oil open or contamination will occur.

a. To Check the Oil Level in the Compressor:

1. Operate the unit in cooling for at least 20 minutes.

2. Check the front oil sight glass on the compressor to ensure that no foaming of the oil is present after 20 minutes of operation. If the oil is foaming excessively after 20 minutes of operation, check the refrigerant system for flood-back of liquid refrigerant. Correct this situation before performing step a.3.

3. Turn unit off to check the oil level. The correct oil level range should be between the bottom to 1/8 of the sight glass. If the level is above 1/8, oil must be removed from the compressor. To remove oil from the compressor, follow step d. If the level is below the bottom of the sight glass, add oil to the compressor following step b. below.

b. Adding Oil with Compressor in System

In an emergency where an oil pump is not available, oil may be drawn into the compressor through the suction service valve.

CAUTION

Extreme care must be taken to ensure the manifold common connection remains immersed in oil at all times. Otherwise air and moisture will be drawn into the compressor.

Connect the suction connection of the gauge manifold to the compressor suction service valve port, and immerse the common connection of the gauge manifold in an open container of refrigeration oil. Crack the suction service valve and gauge valve to vent a small amount of refrigerant through the common connection and the oil to purge the lines of air. Close the gauge manifold valve.

With the unit running, frontseat the suction service valve and pull a vacuum in the compressor crankcase. SLOWLY crack the suction gauge manifold valve and oil will flow through the suction service valve into the compressor. Add oil as necessary.

Run unit for 20 minutes, in cooling, and check oil level at the compressor sight glass.

c. Adding Oil to Service Replacement Compressor

NOTES

1. The correct oil charge is 3.6 liters (7.6 U.S. pints).

2. Service replacement compressors are shipped without oil.

3. When at first adding oil to the compressor, add only 3 liters (6.3 pints) to the compressor. Run the unit for 20 minutes, in cooling, and check the oil level in the compressor sight glass. Add oil as necessary. This procedure is suggested due to the oil that has migrated with refrigerant to other parts of the system.

If compressor is without oil:

First, make sure that what oil does exist in the compressor is the correct one, then add oil, (sections 1.3 and 4.10) through the suction service valve flange cavity or by removing the oil fill plug. (See Figure 4-5.) Some compressors have the oil plug located on the crankcase, at the right or left side of the oil pump.

d. To Remove Oil From an 06DR Compressor:

1. If the oil level recorded in step a.3 is above 1/8 of the sight glass, oil must be removed from the compressor.

2. Close (frontseat) suction service valve and pump unit down to 1.2 to 1.3 kg/cm@ (2 to 4 psig). Frontseat discharge service valve and slowly bleed remaining refrigerant.

3. Remove the oil drain plug on the bottom plate of the compressor and drain the proper amount of oil from the compressor to obtain the 1/8 sight glass maximum level.

CAUTION

Care must be taken when removing the oil drain plug, as pressure will build up inside the compressor causing rapid oil loss.

4. Replace the drain plug securely back into the compressor.

DO NOT FORGET TO OPEN SUCTION AND DISCHARGE SERVICE VALVES.

5. Repeat Step a. to ensure proper oil level.

4.11 MOISTURE-LIQUID INDICATOR

When the refrigeration system is operating, the moisture-liquid indicator provides an indication of moisture in the system.

The indicator element is highly sensitive to moisture and will gradually change color in direct relation to an increase or decrease in the moisture content of the system. The safe, caution, and unsafe system operating conditions are then easily determined by matching the element color with the colors displayed on the reference label.

To change indicator or lens:

a. Pump down the unit per section 4.3 and install new indicator or lens. Replace filter-drier.

b. Evacuate the unit per section 4.5 and add refrigerant charge per section 4.6.

c. Start unit and after twelve hours re-check indicator. If indicator does not indicate a safe condition, pump unit down and change filter-drier. (Refer to section 4.12.)

4.12 FILTER-DRIER

If the sight glass appears to be flashing or bubbles are constantly moving through the sight glass when the suction modulation valve is fully open, the unit may have a low refrigerant charge, or the filter-drier could be partially plugged.

To Check Filter-Drier:

a. One test for a restricted or plugged filter-drier is by feeling the liquid line inlet and outlet connections of the drier cartridge. If the outlet side feels cooler than the inlet side, then the filter-drier should be changed.

b. Another test is that the moisture-liquid indicator shows moisture in the system. (Refer to section 4.11.)

To Replace Filter-Drier:

a. Pump unit down to 0 psi and replace filter-drier. (Refer to section 4.3.)

b. Evacuate the unit per section 4.5 and open manual liquid line valve.

c. After unit is in operation, inspect for moisture in system. (Refer to section 4.11.)

4.13 HIGH PRESSURE SWITCH

4.13.1 Replacing High Pressure Switch

a. Turn OFF unit start-stop switch. Frontseat both suction and discharge service valves to isolate compressor. Remove the refrigerant from the compressor.

b. Disconnect wiring from defective switch. The high pressure switch is located on the center head and is removed by turning counterclockwise. (See Figure 1-1.)

c. Install a new high pressure switch after verifying switch settings. (Refer to section 4.13.2.)

d. Evacuate and dehydrate the compressor per section 4.5.1.

4.13.2 Checking High Pressure Switch

WARNING

Do not use a nitrogen cylinder without a pressure regulator. Do not use oxygen in or near a refrigeration system as an explosion may occur.

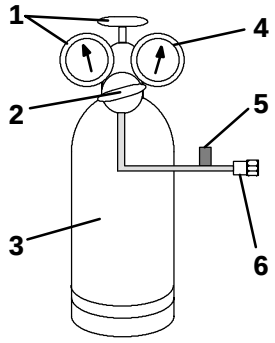
NOTE

The high pressure switch (HPS) is non-adjustable.

a. Remove switch as outlined in section 4.13.1.

b. Connect ohmmeter or continuity light across switch terminals. Ohm meter will indicate no resistance or continuity light will be illuminated if switch closed after relieving compressor pressure.

c. Connect hose to a cylinder of dry nitrogen. (See Figure 4-17.)



1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge (0 to 36 kg/cm@ = 0 to 400 psig)
5. Bleed-Off Valve
6. 1/4 inch Connection

Figure 4-17. Typical Setup for Testing High Pressure Switch

d. Set nitrogen pressure regulator at 26.4 kg/cm@ (375 psig) with bleed-off valve closed.

e. Close valve on cylinder and open bleed-off valve.

f. Open cylinder valve. Slowly close bleed-off valve to increase pressure on switch. The switch should open at a static pressure up to 25 kg/cm@ (350 psig). If light is used, light will go out and if ohmmeter is used, the meter will indicate open circuits.

g. Slowly open bleed-off valve to decrease the pressure. The switch will close at 18 kg/cm@ (250 psig).

4.14 EVAPORATOR COIL AND HEATER ASSEMBLY

The evaporator section, including the coil, should be cleaned with fresh water or steam, preferably. Another recommendation is to use Oakite 202 or similar cleaner following *manufacturer's instructions.*

The two drain pan hoses connected to the drain pan, are routed behind the condenser fan motor and compressor. The drain pan line(s) must be open to ensure adequate drainage.

To Replace Evaporator Coil:

a. Pump unit down. (See Figure 1-3, refer to section 4.3.)

b. With power OFF and power plug removed, remove the screws securing the panel covering the evaporator section (upper panel).

c. Disconnect the defrost heater wiring.

d. Disconnect the sensor from the coil. The defrost termination sensor (DTS) is located on the middle coil support as shown in Figure 1-2.

e. Remove middle coil support.

f. Remove the mounting hardware from the coil.

g. Unsolder the two coil connections, one at the distributor and the other at the coil header.

h. After defective coil is removed from unit, remove defrost heaters and install on replacement coil.

i. Install coil assembly by reversing above steps.

j. Leak check connections per section 4.4. Evacuate the unit per section 4.5 and add refrigerant charge per section 4.6.2.

4.15 EVAPORATOR FAN AND MOTOR ASSEMBLY

The evaporator fans circulate air throughout the container by pulling air in the top of the unit. The air is forced through the evaporator coil where it is either heated or cooled and then discharged out the bottom of the refrigeration unit into the container. (Refer to section 1.4.) The fan motor bearings are factory lubricated and do not require additional grease.

WARNING

Always turn OFF the unit circuit breakers (CB-1 & CB-2) and disconnect main power supply before working on moving parts.

a. Remove upper access panel (See Figure 1-1) by removing mounting bolts and T.I.R. locking device. Reach inside of unit and remove Ty-Rap securing wire harness loop.

b. Remove the two lower mounting bolts that secure the motor-fan assembly to the unit. Loosen the two upper bolts as the motor mount upper holes are slotted.

c. Remove motor, fan, and wiring from unit. Place fan motor and fan on a support. Remove the wiring and fan.

d. Lubricate fan motor shaft with a graphite-oil solution (Never-Seez). Apply thread sealer (Loctite H, brown in color) to the two fan set screws. Install fan on motor. The evaporator fan locating dimension is shown in Figure 4-18.

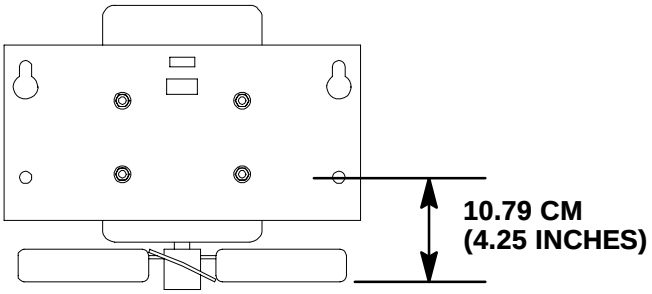


Figure 4-18. Evaporator Fan Locating Dimension

e. Connect wiring per applicable wiring diagram and install motor and fan assembly in unit. Apply power, momentarily, to check fan rotation. (Refer to section 1.4.) If fan spins backwards, refer to section 4.25 for two-speed motors.

Replace access panel, making sure panel does not leak. Make sure that the T.I.R. locking device is lockwired.

4.16 EVAPORATOR COIL HEATERS

WARNING

Before servicing unit, make sure the unit circuit breakers (CB-1 & CB-2) and the start-stop switch (ST) are in the OFF position. Also disconnect power plug and cable.

a. Remove the lower access panel (Figure 1-1) by removing the T.I.R. locking device lockwire and mounting screws.

b. Determine which heater(s) need replacing by checking resistance on each heater as shown in section 1.4.e.

c. Remove hold-down clamp securing heaters to coil.

d. Lift the "U" portion of the heater (with opposite end down and away from coil). Move heater left (or right) enough to clear the heater end support.

4.17 CONDENSER COIL

The condenser consists of a series of parallel copper tubes expanded into copper fins. The condenser coil must be cleaned with fresh water or steam, so the air flow is not restricted. Fan rotation is counterclockwise when viewed from shaft end of motor.

WARNING

Do not open the condenser fan grille before turning power OFF and disconnecting power plug.

To Replace Condenser Coil:

a. Remove the refrigerant charge per section 4.3.

b. Remove the condenser coil guard.

c. Unsolder discharge line and remove the line to the water-cooled condenser (if so equipped).

d. Remove coil mounting hardware and then remove the coil.

e. Install replacement coil and solder connections.

f. Leak check the coil per section 4.4. Evacuate the unit per section 4.5 and then, charge the unit with refrigerant per section 4.6.1.

4.18 CONDENSER FAN AND MOTOR ASSEMBLY

WARNING

Do not open condenser fan grille before turning power OFF and disconnecting power plug.

NOTE

The replacement motor should be degreased and sprayed with a coat of Tectyl before installing in unit.

The condenser fan rotates counterclockwise (viewed from front of unit) and pulls air through the the condenser coil and discharges horizontally through the front of the unit.

a. Open condenser fan screen guard.

b. Loosen square head set screws (2) on fan. (Thread sealer has been applied to set screws at installation.) Then disconnect wiring from motor junction box.

CAUTION

Take necessary steps (place plywood over coil or use sling on motor) to prevent motor from falling into condenser coil.

c. Remove motor mounting hardware and replace the motor. It is recommended that new locknuts be used when replacing motor. Connect wiring per wiring diagram.

d. Install fan loosely on motor shaft (hub side in). Install venturi. Apply "Loctite H" to fan set screws. Adjust fan within venturi so that the outer edge of the fan projects (7.9 mm = 5/16") out from edge of venturi. Spin fan by hand to check clearance.

e. Close and secure condenser fan screen guard.

f. Apply power to unit and check fan rotation. If fan motor rotates backwards, reverse wires 5 and 8.

4.19 RECORDING THERMOMETER (PARTLOW)

a. Instruments for Checking Bulb Temperature

The recording thermometer may be equipped with one or two Simpson accessories (#344 units), each consisting of a thermistor probe and receptacle (mounted to instrument case.) Single probe is attached to the element (bulb) capillary which senses the container return air temperature. If using two probes, the other probe is attached to the supply air temperature sensor.

In the event of a failure with the #344 test lead, other instruments for checking bulb temperatures are:

Simpson Meter, CTC P/N 07-00013 or Robinair Thermistor Temperature Tester, Model 12860:

A resistance thermometer with RCA lead and a phono-plug at each end may be used to compare bulb temperature and stylus indicated temperature on the chart by inserting one end of the lead into the receptacle provided on the controller and the other end in the meter. Always check resistance thermometer before using. (Refer to para. b.)

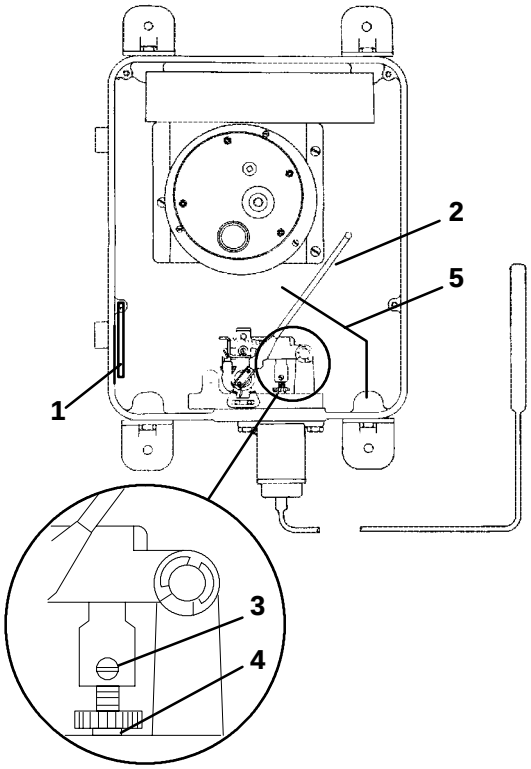
Ohmmeter:

1. Place one probe of ohmmeter in the middle of the receptacle provided on the chart platen, Figure 4-19, and ground other probe to unit.

2. Note reading of meter and using Table 4-2, convert resistance to temperature.

CAUTION

The inside mechanism of the control, particularly the inside of the element housing should never be oiled, however, control mechanisms should be sprayed periodically (every 60 days) with corrosion inhibiting CRC 3-36a or 6-66 or LPS no. 2.



1. Wind-up Key
2. Stylus
3. Set Screw
4. Pinion Shaft
5. Stylus Lifter

Figure 4-19. Partlow Recording Thermometer

b. Checking Resistance Thermometer

Calibrate the resistance thermometer by completely filling a thermos container full of ice cubes or chips and filling the voids between the ice with plain water. Stir the solution until the mixture registers 0 to 0.3_C (32 to 32.5_F), as indicated by a laboratory thermometer. Immerse the resistance thermometer in the 0_C (32_F) solution and check its accuracy at this temperature. With this instrument, be certain that the recommended length of the check probe is immersed so that it accurately will reflect temperature. Bear in mind that this measurement checks the test probe at 0_C (32_F) only; it is possible for this type of instrument to be inaccurate at other temperatures. Rezero check thermometer, if necessary, by manufacturer's instructions.

c. Checking the Recording Thermometer Bulb Temperature

Checking temperature is accomplished by comparing the instrument's indicated temperature (stylus) with the known temperature existing at the element sensing bulb. To properly check the temperature of the recorder, the element sensing bulb should be stabilized at a temperature of 0_C (32_F). This is accomplished by using one of the two following methods, whichever is more convenient.

Unit Running:

Place set point at 0_C (32_F). After unit has pulled down to this temperature, allow the compressor to cycle ON-OFF 3 to 5 times to be certain temperature has stabilized at 0_C (32_F) as verified by the resistance thermometer. If the temperature indicated by the thermometer differs from 0_C (32_F) by more than 0.6_C (1_F) when compressor cycles off, rezeroing must be performed.

Unit Off:

Place the recording thermometer element (sensing bulb) in 0_C (32_F) ice-water bath. Ice-water bath is prepared by filling an insulated container (of sufficient size to completely immerse bulb) with ice cubes or chipped ice, then filling voids between ice with water, and agitating until mixture reaches 0_C (32_F) as shown by a laboratory thermometer.

When the temperature at the element sensing bulb has stabilized at 0_C (32_F), as indicated by stable stylus indication, compare temperature indicated by stylus with temperature shown by a laboratory thermometer. If the two readings do not agree, the recording thermometer should be rezeroed. (Refer to paragraph d.)

d. Rezeroing the Recording Thermometer

1. Be certain that the element bulb temperature has stabilized at 0_C (32_F). Note the amount of temperature difference between the test meter or thermometer reading and the stylus indicated temperature.

If the difference noted between the known element temperature and indicated temperature is within acceptable limits (0.3 of 0_C = 1/2_ of 32_F), do not attempt to rezero. If more than 0.3_C (1/2_F) in variation, carefully note the number of degrees.

2. If recording thermometer is found to require rezeroing:

(a) Loosen set screw, item 3, Figure 4-19 and zero thermometer by turning pinion shaft, item 4. Lengthening pinion shaft (counterclockwise) raises stylus indicated temperature reading: shortening shaft (clockwise) lowers stylus reading. Then retighten set screw.

(b) Reset control at 0_C (32_F), start the refrigeration unit and repeat accuracy check. After temperature stabilization, recording thermometer should be within 0.3_C (1/2_F) limits.

e. Replacing Recording Thermometer Element (Bulb and Capillary)

The element is mercury-filled and the temperature-pressure of the element controls the stylus which moves across the chart in response to temperature changes as sensed by the bulb located in the evaporator supply air.

The element flange contains three O-rings. Care should be taken to install the new element flange without damaging the O-rings. It is possible for a mercury leak to develop at the flange if O-ring damage occurs.

The stylus will continue to fall (container temperature will actually be higher) if a leak develops in the flange, capillary or bulb.

To replace the recording thermometer element:

1. Turn unit OFF and disconnect power source.

2. Remove upper back panel. Remove bulb clamps securing bulb to unit.

3. Remove two flange screws from recording thermometer and feed capillary and element through the unit.

4. Push replacement bulb end and capillary through the unit.

5. Fill slots with silastic (RTV432, Dow Corning).

6. Attach bulb clamps tightly to bulb.

7. Connect element flange to recorder making sure hub of flange faces out to fit into the hole in instrument case (recording thermometer).

8. Rezero the recorder. (Refer to sections 4.19.a. through 4.19.d.)

9. Install inlet air grille and upper panel. Start unit and check recorder calibration.

CAUTION

Capillary tubing may be bent, but never sharper than 1/2" radius: extra care should be taken when bending adjacent to welds. The sensing bulb should never be bent, as this will affect calibration.

4.20 RECORDING THERMOMETER (SAGINOMIYA)

NOTE

Do not overtighten chart nut after replacing chart.

a. Battery

1. Open door and remove chart nut and platen.

2. Push voltage indicator test switch, item 2, Figure 4-20. Replace battery if voltage indicator points to the red or white zone.

b. Calibration

1. Install new chart on platen.

2. Place recorder bulb in ice bath (0 ¦ 0.2_C = 32 ¦ 0.35_F). (Remove rear upper panel to remove bulb.) Leave bulb immersed in ice bath for **10 minutes.**

3. After 10 minutes, rotate the chart by hand and check the stylus indicated temperature. Do not touch stylus during the checkout procedure.

4. If adjustment is required, loosen setscrew (cross-recessed head). Using a 7 mm wrench, rotate the adjustment screw clockwise to set the stylus 1 to 2_C (1.8 to 3.6_F) higher than desired temperature.

5. Rotate the adjustment screw counterclockwise to set the stylus about 0.5_C (0.9_F) higher than set temperature. Rotate the chart by hand. The indicated temperature should be 0_C (32_F).

c. Replacing Sensor Probe

1. Remove box from unit.

2. Remove nut and bushing, item 9, Figure 4-20.

3. Install replacement probe and bushing. Seal with silicone before securing to case.

4. Install box into unit.

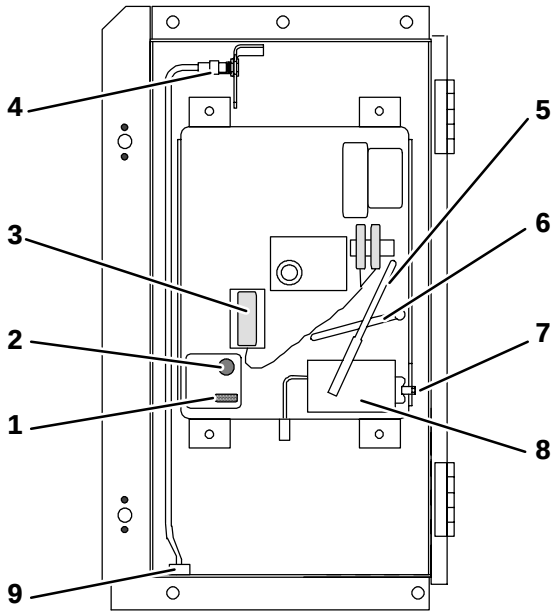
NOTES

1. One full turn with the adjustment screw changes the indicated temperature by approximately 5_C (9_F).

2. Overtightening of setscrew may change set temperature.

3. Calibration should only be done when bulb temperature is decreasing.

4. DO NOT move stylus by hand.



1. Voltage Indicator
2. Indicator Test Switch
3. Battery ("C" size, Alkaline)
4. Sensor Assembly
5. Stylus
6. Stylus Lifter
7. Setscrew (Adjustment)
8. Bulb and Mechanism
9. Bushing and Nut

Figure 4-20. Saginomiya Recording Thermometer

4.21 MAINTENANCE OF PAINTED SURFACES

The refrigeration unit is protected by a special paint system against the corrosive atmosphere in which it normally operates. However, should the paint system be damaged, the base metal can corrode. In order to protect

the refrigeration unit from the highly corrosive sea atmosphere or if the protective paint system is scratched or damaged, clean area to bare metal using a wire brush, emery paper or equivalent cleaning method. Immediately following cleaning, spray or brush on zinc rich primer. After the primer has dried, spray or brush on finish coat of paint to match original unit color.

4.22 POWER AUTOTRANSFORMER (OPTIONAL)

The transformer is either the whole-unit transformer (item 1 or item 3, Figure 1-6) or the evaporator transformer (item 2, Figure 1-6). Also, refer to Table 1-1 to determine which transformer is listed for the unit.

For the modular transformer (item 3, Figure 1-6):

If the unit does not start, check the following:

a. Make sure the 460 vac (yellow) power cable is plugged into the receptacle (item 5, Figure 1-6) and locked in place.

b. Make sure that circuit breakers CB-1 and CB-2 are in the "ON" position. If the circuit breakers do not hold in, check voltage supply.

c. There is no internal protector for this particular transformer design, therfore, no checking of the internal protector is required.

For transformer (item 1, Figure 1-6) or the evaporator transformer (item 2, Figure 1-6):

If the unit does not start when connected to a 190/230 vac power supply, check the following:

a. Make sure circuit breaker (CB-2) is in the ON position. If CB-2 does not hold in, check voltage supply.

b. Check to see if the transformer internal protector (IP-AUTO-TRANS) is closed. Allow a reasonable length of time for transformer to cool down. The transformer includes two (2) internal protectors. Only one is wired into the system as the second protector is a spare.

c. *To Check for Continuity Across the Internal Protector (IP-AUTO-TRANS):*

1. Turn power OFF and disconnect power source.

2. Disconnect white wires **1 and 2** from the KA and KB connector on the Controller.

3. Check for continuity across the internal protector (IP). If (IP) is open and will not reset, connect wires **3 and 4** (18 gauge) to the KA and KB connector. Check to see if unit will start.

d. If the internal protector and circuit breakers (CB-1 and CB-2) are good, check the transformer. Use a voltmeter and with the primary supply circuit ON check the primary (input) voltage (230 vac). Next, check the secondary (output) voltage (460 vac) at the voltage selector switch. The transformer is defective if voltage is not available.

4.23 SENSOR CHECKOUT PROCEDURE (AMBS, DTS, RRS, RTS, SRS & STS)

An accurate ohmmeter must be used to check the resistance values shown in Table 4-1.

Due to the variations and inaccuracies in ohmmeters, thermometers or other test equipment, a reading within 2% of the chart value would indicate a good sensor. If a sensor is defective, the resistance reading will usually be much higher or lower than the resistance values given in Table 4-1.

4.23.1 Checking Sensor (RRS, RTS, SRS or STS)

a. Place the sensor (sensing bulb) in 0_C (32_F) ice-water bath. Ice-water bath is prepared by filling an insulated container (of sufficient size to completely immerse bulb) with ice cubes or chipped ice, then filling voids between ice with water, and agitating until mixture reaches 0_C (32_F) as shown by a laboratory thermometer.

b. Start unit and check air temperature/data readout on the control panel. You should have a reading of 0_C (32_F); if not, continue on to the following step.

c. Turn unit OFF and disconnect power supply.

d. Refer to section 4.28 for removal of the Controller or DataCORDER module.

RTS or STS:

In the box there is a plug connector marked (EC) that is connected to the Controller module, find the wires marked RTS or STS, depending on which sensor needs replaced. Follow that wire to the connector and using the pins of the plug, measure the ohms resistance. Readings are shown in Table 4-1.

RRS or SRS:

In the box there is a plug connector marked (ED) that is connected to the optional DataCORDER module, find the wires marked RRS or SRS, depending on which sensor needs replaced. Follow that wire to the connector and using the pins of the plug, measure the ohms resistance. Readings are shown in Table 4-1.

4.23.2 Replacing Sensor (RRS, RTS, SRS or STS)

a. Turn unit power OFF and disconnect power supply.

b. Cut cable 15.24 cm (6 inches) from shoulder of defective sensor and discard.

c. Cut one wire of existing cable 25.4 mm (1.0 inch) shorter than the other wire.

d. Cut one replacement sensor wire (opposite color) back 25.4 mm (1.0 inch). (See Figure 4-21.)

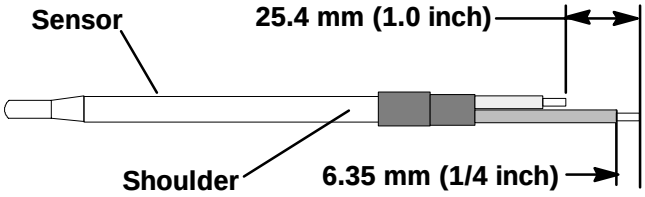


Figure 4-21. Sensor (RRS, RTS, SRS or STS)

e. Strip back insulation on all wiring 6.35mm (1/4 inch).

f. Slide a large piece of heat shrink tubing over the cable and the two small pieces of heat shrink tubing over the wires before adding crimp fittings as shown in Figure 4-22.

g. Slip crimp fittings over dressed wires (keep wire colors together). Make sure wires are pushed into crimp fittings as far as possible and crimp with crimping tool.

h. Solder spliced wires with a 60% tin and 40% lead Rosincore solder.

i. Slide heat shrink tubing over splice so that both ends of tubing cover both ends of crimp as shown in Figure 4-22.

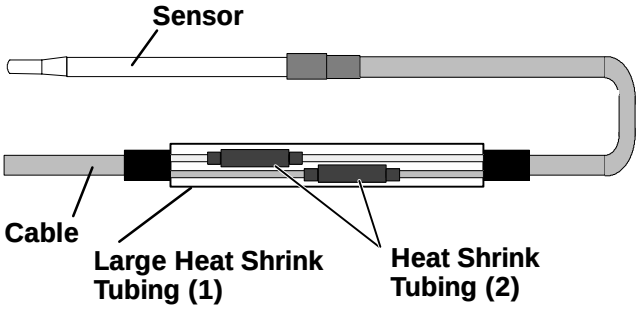


Figure 4-22. Sensor and Cable Assembly (RRS, RTS, SRS or STS)

j. Heat tubing, preferably with a flameless heat gun. If not available, a propane torch will work *(caution should be taken not to burn the heat shrink tubing or wire insulation*). Make sure all seams are sealed tightly against the wiring to prevent moisture seepage.

k. Slide large heat shrink tubing over both splices and shrink tubing and heat as in step j.

CAUTION

Do not allow moisture to enter wire splice area as this may affect the sensor resistance.

l. Secure sensor to unit and check sensor resistance as detailed in section 4.23.1.

4.23.3 Checking Sensor (AMBS or DTS)

a. Turn unit OFF and disconnect power supply.

b. Refer to section 4.28 for removal of the Controller module.

AMBS or DTS:

In the box there is a plug connector marked (EC) that is connected to the Controller module, find the wires marked AMBS or DTS, depending on which sensor needs replaced. Follow that wire to the connector and using the pins of the plug, measure the ohms resistance. Readings are shown in Table 4-1.

4.23.4 Replacing Sensor (AMBS or DTS)

a. Turn unit power OFF and disconnect power supply.

b. Cut wires 25.4 cm (10 inches) from the back of the mounting stud of the defective sensor and discard.

c. Cut one wire of the remaining two wires from step b above, 25.4 mm (1.0 inch) shorter than the other wire.

d. Cut one replacement sensor wire back 25.4 mm (1.0 inch). (See Figure 4-23.)

e. Strip back insulation on all wiring 6.35mm (1/4 inch).

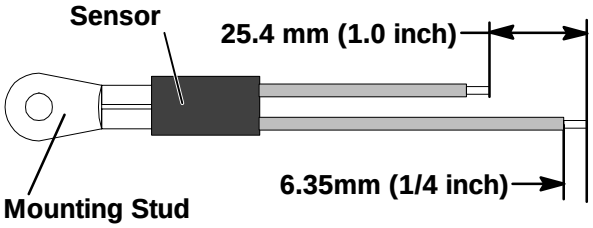


Figure 4-23. Sensor (AMBS or DTS)

f. Slide two small pieces of heat shrink tubing over each wire before adding crimp fittings as shown in Figure 4-24.

g. Slip crimp fittings over dressed wires. Make sure wires are pushed into crimp fittings as far as possible and crimp with crimping tool.

h. Solder spliced wires with a 60% tin and 40% lead Rosincore solder.

i. Slide heat shrink tubing over splice so that both ends of tubing cover both ends of crimp as shown in Figure 4-24.

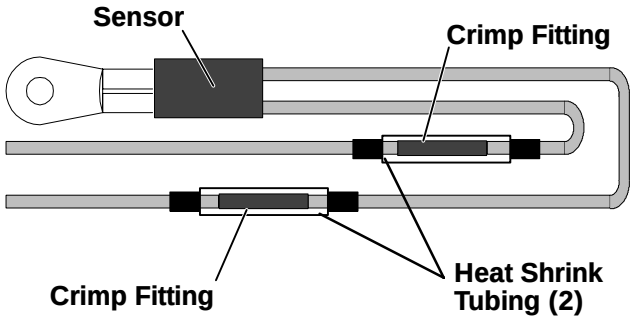


Figure 4-24. Sensor and Wire Assembly (AMBS or DTS)

j. Heat tubing, preferably with a flameless heat gun. If not available, a propane torch will work *(caution should be taken not to burn the heat shrink tubing or wire insulation*). Make sure all seams are sealed tightly against the wiring to prevent moisture seepage.

CAUTION

Do not allow moisture to enter wire splice area as this may affect the sensor resistance.

k. Secure sensor to unit and check sensor resistance as detailed in section 4.23.3.

4.24 SUCCTION SOLENOID VALVE

a. Replacing the Coil

NOTE

The coil may be replaced without removing the refrigerant.

1. Disconnect leads by unplugging the connector. Remove snap cap or locknut. Lift off coil. (See Figure 4-25)

2. Verify coil type, voltage and frequency of old and new coil. This information appears on the coil housing.

b. Replacing Valve Internal Parts – Alco (See Figure 4-25)

1. Pump down the unit. (Refer to section 4.3.)

2. Remove snap cap, and coil.

3. Remove enclosing tube collar (item 4, Figure 4-25) using installation/removal tool supplied with repair kit (item 3).

4. Check plunger for restriction due to: (a) Corroded or worn parts; (b) Foreign material lodged in valve; (c) Bent or dented enclosing tube.

5. Remove top plate, diaphragm spring, diaphragm and body gaskets.

6. Install new parts, assemble in reverse order of disassembly.

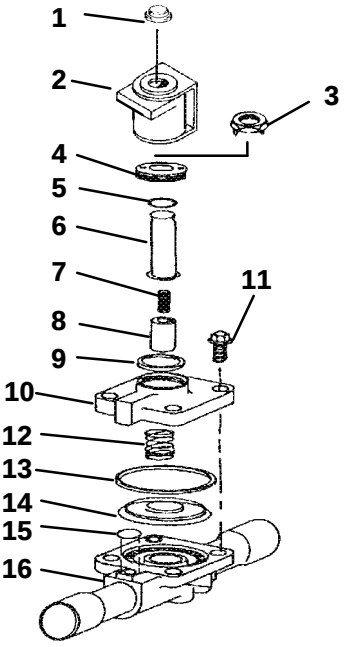
7. Torque the 4 capscrews to 40 inch pounds.

8. Do not overtighten enclosing tube assembly. Torque to a value of 1.15 mkg (100 inch pounds).

9. Remove supplied installation/removal tool. Install coil, and snap cap.

10. Dehydrate and evacuate the system. (Refer to section 4.5) Charge unit with refrigerant per section 4.6.1.

11. Plug in the connector. Start unit and check operation.



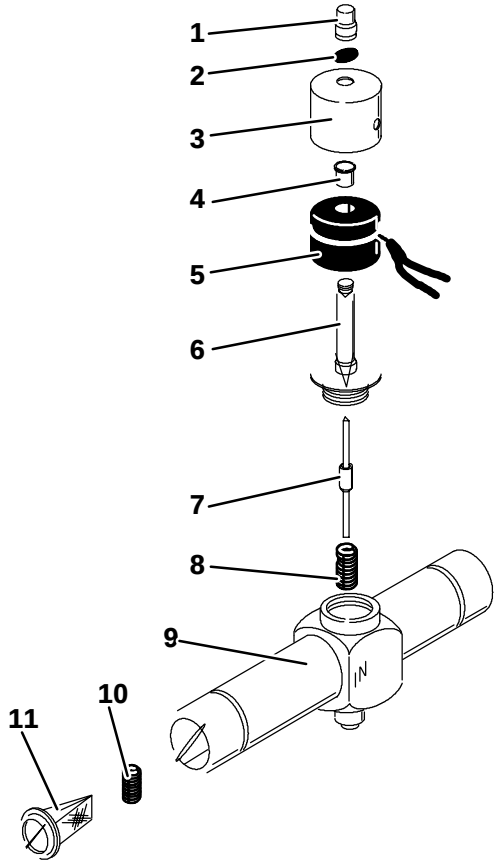
1. Snap Cap
2. Coil
3. Installation/Removal Tool
4. Enclosing Tube Collar
5. O-Ring
6. Enclosing Tube
7. Spring
8. Plunger
9. Gasket
10. Top Plate
11. Capscrews
12. Spring
13. Gasket
14. Diaphragm
15. O-Ring
16. Body

Figure 4-25. Suction Solenoid Valve – Alco

4.25 SUCTION MODULATION VALVE (SMV)

NOTE

When repairing suction modulation valve with the enclosing tube kit (CTD P/N 14-50021-01) be sure not to remove items 7, 8 & 10. (See Figure 4-26) Proper alignment of these items is achieved only at the factory.



1. Coil Nut
2. Coil Nut O-ring
3. Coil Housing
4. Solenoid Coil Sleeve
5. Solenoid Coil
6. Enclosing Tube Assy.
7. Piston
8. Top Return Spring
9. Valve Body
10. Bottom Return Spring
11. Filter

Figure 4-26. Suction Modulation Valve

a. Coil Checkout Procedure

WARNING

Make sure power to the unit is OFF and power plug disconnected before replacing the coil.

1. Disconnect the modulation valve coil wires by unplugging the connector (Refer to section 5).

2. Using a reliable digital ohmmeter, test each lead's resistance to ground. If the resistance indicates a ground short is present, inspect the length of wiring for damaged or exposed wires. Replace where necessary.

3. Setting the digital ohmmeter for low range check coil's resistance. If coil's resistance is below 5 ohms it is recommended to be replaced. New coils have an approximate resistance of 7.6 ohms at 25_ C (77_ F). The chart below gives the resistance of a new coil at various ambient temperatures.

Ambient Temperature	Cold Coil
10_ F	6.45 ohms
40_ F	6.90 ohms
70_ F	7.40 ohms
100_ F	7.90 ohms

4. Plug in the connector for the modulation valve.

NOTE

A cold coil is a coil which had not been operating and is assumed to be at ambient temperature. Hot coils, taken after the unit has been operating in deep modulation for a long period of time, may give higher resistance readings.

b. Replacing the Coil

Remove locking nut and remove coil after disconnecting wiring. When replacing nut, torque to a value of 0.41 mkg (3 ft-lb).

c. To Replace Valve

1. Pump down the unit per section 4.3.

2. Remove two bolts from suction service valve.

3. Melt solder at modulating valve connection and rotate valve and tubing enough to clear compressor. Remove valve and tubing. Replace defective suction modulation valve being careful to wrap body of replacement valve with a wet cloth while brazing. The coil need not be removed.

4. Install new suction service valve gasket and install bolts in suction service valve. Torque to a value of 2.77 to 4.15 mkg (20 to 30 ft/lb).

5. Solder all connections and leak check same.

6. Dehydrate and evacuate the unit per section 4.5 and then check and add refrigerant charge per section 4.6 as required.

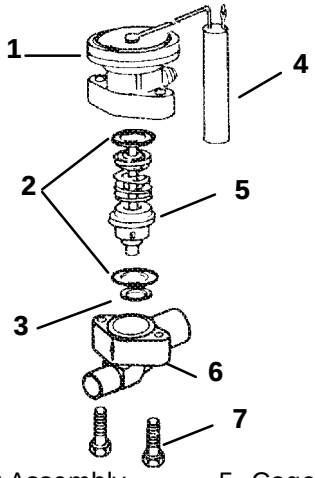
4.26 THERMOSTATIC EXPANSION VALVE

The thermal expansion valve is an automatic device which maintains constant superheat of the refrigerant gas leaving the evaporator regardless of suction pressure. The valve functions are: (a) automatic response of refrigerant flow to match the evaporator load and (b) prevention of liquid refrigerant entering the compressor. Unless the valve is defective, it seldom requires any maintenance other than some minor periodic maintenance as follows:

1. Make sure that the excess capillary tube is secured to the power head assembly and wrapped with "Presstite".

2. Make sure that the thermal bulb is tightly secured to the suction line and wrapped with "Presstite".

a. Removing Expansion Valve (See Figure 4-27)



1. Power Assembly
2. Body Flange Gaskets
3. Seat Gasket
4. Bulb
5. Cage Assembly
6. Body Flange
7. Body Flange Screws

Figure 4-27. Thermostatic Expansion Valve – Alco

1. Pump down the unit per section 4.3.

2. Remove insulation (Presstite) from expansion valve bulb and power assembly and then remove thermal bulb from the suction line.

3. Loosen flare nut and disconnect equalizing line from expansion valve.

4. Remove capscrews and lift off power assembly and remove cage assembly. Check for foreign material in valve body.

5. The thermal bulb is located below the center of the suction line (4 o'clock position). This area must be clean to ensure positive bulb contact.

b. Installing Expansion Valve

CAUTION

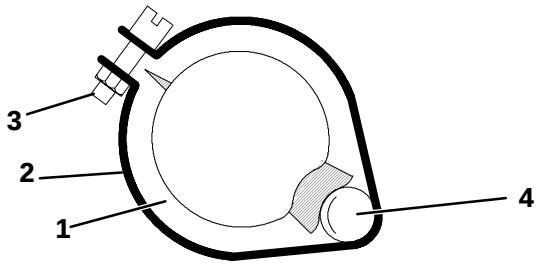
If the thermostatic valve needs to be replaced, then the power head and cage assembly are to be replaced as a pair. They are a matched pair and replacing one without the other will affect the superheat setting.

1. Replace all gaskets, make sure to lightly coat with oil. Insert cage and power assembly and bolts. Tighten bolts equally. Fasten equalizer flare nut to expansion valve.

2. Leak check the unit per section 4.4. Evacuate and dehydrate unit per section 4.5 and add refrigerant charge per section 4.6.2.

3. Clean suction line with sandpaper before installing bulb to ensure proper heat transfer. Strap thermal bulb to suction line, making sure bulb is placed firmly into the indentation of the suction line. See Figure 4-28 for bulb placement.

4. Check superheat. (Refer to section 1.3 and see Table 4-6.) Verify at –18_C (0_F) container box temperature.



1. Suction Line
2. TXV Bulb Clamp
3. Nut and Bolt
4. TXV Bulb

Figure 4-28. Thermostatic Expansion Valve Bulb

c. Checking Superheat

NOTE

It is not recommended adjusting internal adjustable valves. This valve has been factory adjusted and set with "Locktite" that's applied to the internal adjusting nut.

Due to the time involved in adjusting the superheat, replace the valve rather than adjusting it.

To Measure Superheat:

1. Open access panel to expose the expansion valve and service port (see Figure 1-1).

2. Attach a temperature tester sensor near the expansion valve bulb and insulate. Make sure the suction line is clean and firm contact is made with the sensor.

3. Connect an accurate gauge to the service port.

4. Run unit until unit has stabilized. Set controller 5.5_C (10_F) below container temperature.

5. From the temperature/pressure chart (Table 4-6), determine the saturation temperature corresponding to the evaporator outlet pressure.

6. Note the temperature of the suction gas at the expansion valve bulb.

7. Subtract the saturation temperature determined in Step 6 from the average temperature measured in Step 5. The difference is the superheat of the suction gas.

NOTE

Suction pressure must be 0.5 kg/cm@ (6 psig) below valve M.O.P. (maximum operating pressure). Example: if valve rated at 55 MOP, suction pressure must be below this MOP. Recommended pressure is below 3.44 kg/cm@ (49 psig).

4.27 EVAPORATOR FAN MOTOR CAPACITORS (OPTIONAL)

The evaporator fan motors are of the permanent-split capacitor type. The motor is equipped with one capacitor (used in the high speed circuit) and another capacitor is used for the low speed circuit.

a. When to check for a defective capacitor

1. Fan motor will not change speed. For example: controller settings above −10_C (+14_F) should cause the motor to run in high speed.

Controller settings below −10_C (+14_F) should cause the motor to run in low speed.

2. Motor running in wrong direction (after checking for correct wiring application).

b. Removing the capacitor

WARNING

Make sure power to the unit is OFF and power plug disconnected before removing capacitor(s).

1. The capacitor located on the motor and above the evaporator fan deck may be removed by two methods:

(a) *If container is empty*, open upper, rear, panel of the unit and capacitor may be serviced after disconnecting power plug.

(b) *If container is full*, turn the unit power OFF and disconnect power plug. Remove the evaporator fan motor access panel. (See Figure 1-1). Remove two lower capscrews securing motor assembly to bracket and then remove Ty-Raps from wire harness. Loosen two upper capscrews on the fan motor assembly. Remove or set aside motor to reach capacitors.

WARNING

With power OFF discharge the capacitor and disconnect the circuit wiring.

c. Checking the capacitor

Three methods for checking capacitors are:

(1) Direct replacement, (2) volt-ohmmeter, and (3) capacitor analyzer.

1. *Direct replacement* of capacitor with one of the same value.

2. *Volt-ohmmeter set on RX 10,000 ohms.* Connect ohmmeter leads across the capacitor terminals and observe the meter needle. If the capacitor is good, the needle will make a rapid swing toward zero resistance and then gradually swing back toward a very high resistance reading.

If the capacitor has failed open, the ohmmeter needle will not move when the meter probes touch the terminals. If the capacitor is shorted, the needle will swing to zero resistance position and stay there.

3. *Capacitor analyzer*

The function of the analyzer is to read the microfarad value of a capacitor and to detect insulation breakdown under load conditions. The important advantages of a analyzer is its ability to locate capacitors that have failed to hold their microfarad ratings or ones that are breaking down internally during operation. It is also useful in identifying capacitors when their microfarad rating marks have become unreadable.

4.28 CONTROLLER AND DATACORDER

a. Handling of Controller and DataCORDER

Here is a list of guidelines that should be followed when handling the Controller or DataCORDER modules. These steps should be implemented when replacing either module, when doing *any* arc welding on the unit, or *when service to the refrigeration unit requires handling and removal of the Controller.*

CAUTION

Remove Controller/DataCORDER modules and unplug all connectors before performing any arc welding on any part of the container.

Do not remove wire harnesses from modules unless you are grounded to the unit frame with a static safe wrist strap.

1. Obtain a grounding wrist strap and a static dissipation mat. The wrist strap, when properly grounded, will dissipate any potential build up on the body. The dissipation mat will provide a static free work surface on which to place and/or service the Controller. Note: Use a dissipation mat, order CTD P/N 07-00277-00.

2. Disconnect and secure power to the unit.

3. Place strap on wrist and attach the ground or clip end of the wrist strap to any exposed unpainted metal area on the refrigeration unit frame (bolts, screws, etc.).

4. Carefully remove the Controller/DataCORDER. Do not touch any of the electrical components if possible. Place the Controller on the static mat.

5. If you are servicing the refrigeration unit, you are free to remove the ground strap from your wrist and complete your work.

6. Upon completion of your service work, put the wrist strap back on, and re-install the Controller into the refrigeration unit.

b. Removing and Installing Controller Module

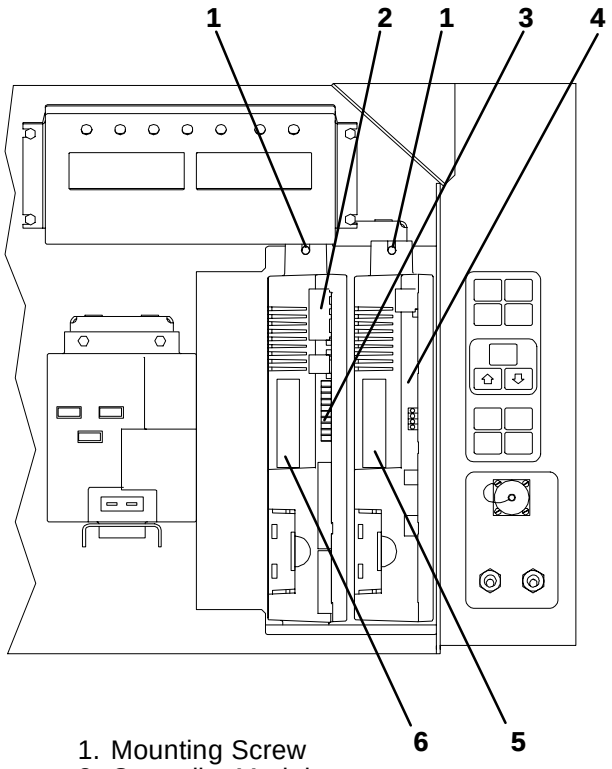
Removal:

1. Disconnect all front wire harness connectors (MA, MB, MC, KA & KB) and move wiring out of way.

-2. Loosen one mountig screw (see Figure 4-29, item 1) and pull out the top of the Controller module (item2), then lift up and out.

3. Turning the module around wiil give access to the two back connectors (EC) which the user can now disconnect. Remove module.

4. Remove the new Controller module from its packaging and install it in the refrigeration unit. Place the old Controller into the same packaging that accompanied the new module. *Make sure that you package it in the exact same manner.*



1. Mounting Screw
2. Controller Module
3. Test Points
4. DataCORDER Module – Optional
5. DataCORDER Software Port
6. Controller Software Port

Figure 4-29. Controller side of the Control Box

NOTE

This packaging has been designed to protect the Controller from both physical and electrostatic discharge damage during storage and transit.

Installation:

Install the Controller module by reversing the above steps.

Torque values for item 1 are 0.23 mkg (20 inch-pounds), and 0.12 mkg (10 inch-pounds) for all connectors.

c. Removing and Installing the DataCORDER Module

NOTE

For ease of installation and removal of the DataCORDER, first remove Controller.

Installation for units without DataCORDER:

1. A connector mounting plate (located on the back wall of the control box where the DataCORDER module mounts, see Figure 4-29) is used to keep moisture from entering the control box. Remove the mounting plate screws and disassemble connector from the plate. Wire tie the connector mounting plate to the wire harness for future use

2. Remove the new DataCORDER module from its packaging and connect the back wire harness connector (ED) to the DataCORDER (item 4).

3. Tilt the top of the module forward and insert the bottom of the module into the slot provided, then tilt back, tighten the mounting screw (see Figure 4-29, item 1).

4. Connect the front wire harness connectors (MD & KC) to the DataCORDER (item 4).

Removal:

Remove the DataCORDER module by reversing the above steps. If the user is not immediately replacing the DataCORDER, make sure to cut the wire tie holding the connector mounting plate to the wire harness and then assemble plate and connector to mount to the control box.

Installation for units with DataCORDER:

1. Repeat the installation steps above, except for step one.

2. Place the old DataCORDER into the same packaging that accompanied the new module. *Make sure that you package it in the exact same manner.*

NOTE

This packaging has been designed to protect the DataCORDER from both physical and electrostatic discharge damage during storage and transit.

Torque values for item 1 are 0.23 mkg (20 inch-pounds), and 0.12 mkg (10 inch-pounds) for all connectors.

4.28.1 Controller Programming Procedure

To load new software into the Controller module, the programming card is inserted into the programming/software port.

WARNING

The unit must be OFF whenever a programming card is inserted or removed from the programming/software port.

The metal door on the programming card must be facing to the left when inserting.

Procedure for loading Operational Software:

a. Turn unit OFF, via start-stop switch (ST).

b. Insert the programming card, for Operational Software, into the programming/software port. (See Figure 4-29)

c. Turn unit ON, via start-stop switch (ST).

d. The Display module will read:

(1.) If the correct card is being used the digital display will alternate back and forth between the messages “rEV XXXX” and “Press EntR”.

(2.) If a defective card is being used: the Display will blink the message “bAd CArd”. (Turn start-stop switch OFF and remove the card.)

e. Press the ENTER key on the keypad.

f. The Display will show the message “Pro SoFt”. This message will last for up to one minute.

g. The Display module will read:

(1.) When the software loading has successfully completed: the Display will show the message “Pro donE”.

(2.) If a problem occurs while loading the software: the Display will blink the message “Pro FAIL” or “bad 12V”. (Turn start-stop switch OFF and remove the card.)

h. Turn unit OFF, via start-stop switch (ST).

i. Remove the programming card from the programming/software port.

j. Turn unit ON, via start-stop switch (ST).

Procedure for loading Configuration Software:

a. Turn unit OFF, via start-stop switch (ST).

b. Insert the programming card, for Configuration Software, into the programming/software port. (See Figure 4-29)

c. Turn unit ON, via start-stop switch (ST).

d. The Display module will read:

(1.) If the correct card is being used the digital display will show “nt40” on the left LCD display and “489XX” on the right LCD display. “XX” will indicate the dash number for a given unit model number (i.e., For the unit 69NT40-489-62, the left display will show “nt40” and the right display will show “48962”.)

(2.) If a defective card is being used: the Display will blink the message “bAd CArd”. (Turn start-stop switch OFF and remove the card.)

e. Press the ENTER key on the keypad.

f. The Display will show the message “EEPrM LOAd”. This message will last for up to one minute.

g. The Display module will read:

(1.) When the software loading has successfully completed: the Display will show the message “Cnf donE”.

(2.) If a problem occurs while loading the software: the Display will blink the message “Pro FAIL” or “bad 12V”. (Turn start-stop switch OFF and remove the card.)

h. Turn unit OFF, via start-stop switch (ST).

i. Remove the programming card from the programming/software port.

j. Turn unit ON, via start-stop switch (ST).

4.28.2 DataCORDER Programming Procedure

To load new software into the DataCORDER module, the programming card is inserted into the programming/software port.

WARNING

The unit must be OFF whenever a programming card is inserted or removed from the programming/software port.

The metal door on the programming card must be facing to the left when inserting.

Procedure for loading Operational or Configuration Software:

a. Turn unit OFF, via start-stop switch (ST).

b. Insert the programming card into the programming/software port. (See Figure 4-29)

c. Turn unit ON, via start-stop switch (ST).

d. The STAT LED on the DataCORDER will read:

(1.) If the correct card is being used, the STAT LED on the DataCORDER will blink on and off. (This process will take about one minute.)

(2.) If a defective card is being used, the STAT LED will turn on and the FAIL LED will blink on and off. (Turn start-stop switch OFF and remove the card.)

e. The STAT LED on the DataCORDER will:

(1.) When the software loading has successfully completed, the STAT LED will stop blinking and turn on.

(2.) If a problem occurs while loading the software, the FAIL LED will turn on. (Turn start-stop switch OFF and remove the card.)

f. Turn unit OFF, via start-stop switch (ST).

g. Remove the programming card from the programming/software port.

h. Turn unit ON, via start-stop switch (ST).

4.28.3 Controller Trouble-Shooting

A group of test points (tp) is provided on the Controller (see Figure 4-29, item 3) for trouble-shooting electrical circuits (refer to Section 5). A description of the test points is as follows:

NOTE

Use a digital voltmeter to measure AC voltage between TP's and ground (TP9) except for TP8.

TP2

This test point enables the user to check if the internal protector for the compressor motor (IP-CP) is open or closed (and the Auto Transformer-IP if so equipped).

TP3

This test point enables the user to check if the optional water pressure switch (WP) contact is open or closed.

TP7

This test point enables the user to check if the Controller relay (TS) contact is open or closed.

TP8

This test point enables the user to check the suction modulation valve current (amp) by measuring DC volts between TP8 and TP9. The voltage measured is approximately equal to the current (amps) in the modulation circuit.

TP9

This test point is the chassis (unit frame) ground connection.

4.29 WATER-COOLED CONDENSER

The water-cooled condenser is of the shell and coil type with circulating water through the cupro-nickel coil. The refrigerant vapor is admitted to the shell side and is condensed on the outer surface of the coil.

Rust, scale and slime on the water-cooling surfaces inside of the coil interfere with the transfer of heat, reduce system capacity, cause higher head pressures and increase the load on the system.

By checking the leaving water temperature and the actual condensing temperature, it can be determined if the condenser coil is becoming dirty. A larger than normal difference between leaving condensing water temperature and actual condensing temperature, coupled with a small difference in temperature of entering and leaving condensing water, is an indication of a dirty condensing coil.

To find the approximate condensing temperature, with the unit running in the cooling mode, install a gauge 0 to 36.2 kg/cm@ (0 to 500 psig) on the compressor discharge service valve.

For example: if the discharge pressure is 10.3 kg/cm@ (146.4 psig), and referring to Table 4-6, R-134a pressure-temperature chart, the 10.3 kg/cm@ (146.4 psig) converts to 43_C (110_F).

If the water-cooled condenser is dirty, it may be cleaned and de-scaled by the following procedure:

a. Turn unit off and disconnect main power.

b. Disconnect water pressure switch tubing by loosening the two flare nuts. Install 1/4 inch flare cap on water-cooled condenser inlet tube (replaces tubing flare nut). De-scale tubing if necessary.

What You Will Need:

1. Oakite composition No. 22, available as a powder in 68 kg (150 lb) and 136 kg (300 lb).

2. Oakite composition No. 32, available as a liquid in cases, each containing 3.785 liters (4 U.S. gallon) bottles and also in carboys of 52.6 kg (116 lbs) net.

3. Fresh clean water.

4. Acid proof pump and containers, or bottles with rubber hose.

NOTE

When Oakite compound No. 32 is being used for the first time, the local Oakite Technical Service representative should be called in for their suggestions in planning the procedure. They will show you how to do the work with a minimum dismantling of equipment: how to estimate the time and amount of compound required; how to prepare the solution; how to control and conclude the de-scaling operation by rinsing and neutralizing equipment before putting it back into service. Their knowledge of metals, types of scale, water conditions and de-scaling techniques will be invaluable to you.

What You Will Do – (Summary):

1. Drain water from condenser tubing circuit. Clean water tubes with Oakite No. 22 to remove mud and slime.

2. Flush.

3. De-scale water tubes with Oakite No. 32 to remove scale.

4. Flush.

5. Neutralize.

6. Flush.

7. Put unit back in service under normal load and check head (discharge) pressure.

Detailed Procedure:

1. Drain and flush the water circuit of the condenser coil. If scale on the tube inner surfaces is accompanied by slime, a thorough cleaning is necessary before de-scaling process can be accomplished.

2. To remove slime or mud, use Oakite composition No. 22, mixed 170 grams (6 ounces) per 3.785 liters (1 U.S. gallon) of water. Warm this solution and circulate through the tubes until all slime and mud has been removed.

3. After cleaning, flush tubes thoroughly with fresh clean water.

4. Prepare a 15% by volume solution for de-scaling, by diluting Oakite compound No. 32 with water. This is accomplished by slowly adding 0.47 liter (1 U.S. pint) of the acid (Oakite No. 32) to 2.8 liters (3 U.S. quarts) of water.

WARNING

Oakite No. 32 is an acid – therefore be sure that the acid is slowly added to the water. DO NOT PUT WATER INTO THE ACID! – this will cause spattering and excessive heat.

Wear rubber gloves and wash the solution from the skin immediately if accidental contact occurs. Do not allow the solution to splash onto concrete.

5. Fill the tubes with this solution by filling from the bottom. See Figure 4-30. Important: – be sure to provide a vent at the top for escaping gas.

6. Allow the Oakite No. 32 solution to soak in the tube coils for several hours, periodically pump-circulating it with an acid-proof pump.

An alternate method may be used, whereby a bottle (See Figure 4-31) filled with the solution and attached to the coils by a hose can serve the same purpose, by raising and lowering of the bottle. The solution must contact the scale at every point for thorough de-scaling, therefore ensure that no air pockets exist, by regularly opening the vent to release gas. *Keep flames away from the vent gases.*

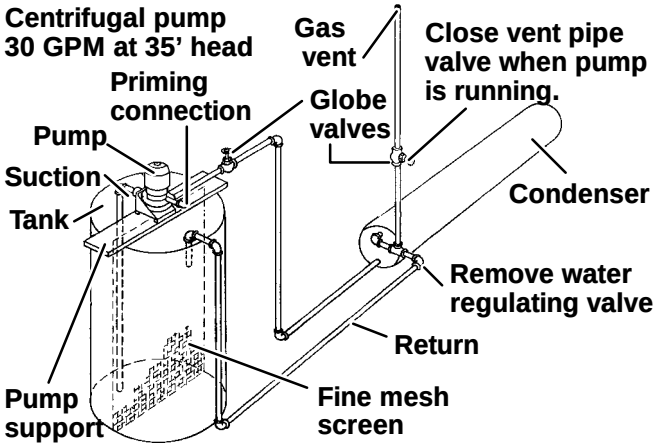


Figure 4-30. Water-Cooled Condenser Cleaning – Forced Circulation

7. The time required for de-scaling will vary, depending upon the extent of the deposits. One way to determine when de-scaling has been completed is to titrate the solution periodically, using titrating equipment provided free by the Oakite Technical Service representative. As scale is being dissolved, titrate readings will indicate that the Oakite No. 32 solution is losing strength. When the reading remains constant for a reasonable time, this is an indication that scale has been dissolved.

8. When de-scaling is complete, drain the solution and flush thoroughly with water.

9. Next circulate a 56.7 gram (2 ounce) per 3.785 liter (1 U.S. gallon) solution of Oakite No. 22 thru the tubes to neutralize. Drain this solution.

10. Flush the tubes thoroughly with fresh water.

NOTE

If the condenser cooling water is not being used as drinking water or is not re-circulated in a closed or tower system, neutralizing is not necessary.

11. Put the unit back in service and operate under normal load. Check the head pressure. If normal, a thorough de-scaling has been achieved.

What You Can Do For Further Help:

Contact the Engineering and Service Department of the OAKITE PRODUCTS CO., 19 Rector Street, New York, NY 10006 U.S.A. for the name and address of the service representative in your area.

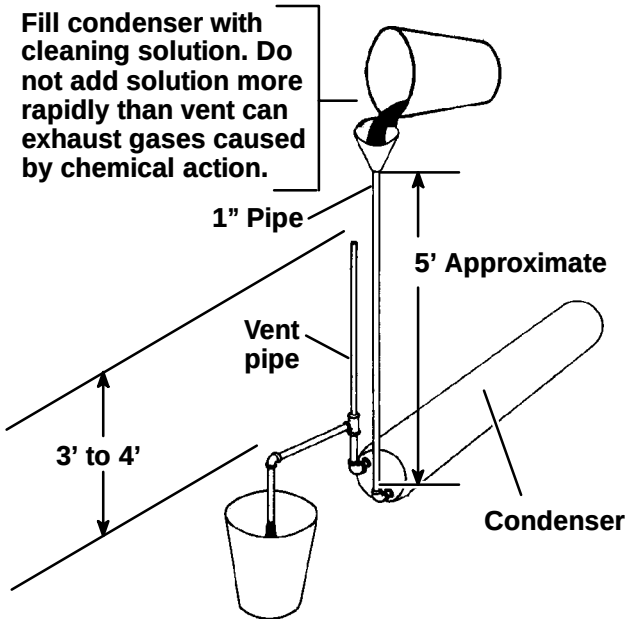


Figure 4-31. Water-Cooled Condenser Cleaning – Gravity Circulation

Table 4-1. AMBS, DTS, RRS, RTS, SRS and STS Temperature-Resistance Chart

Temperature Centigrade	Temperature Fahrenheit	Resistance (Ohms)
RRS, RTS, SRS and STS:		
0	32	32,650 ± 91
25	77	10,000 ± 50
AMBS and DTS		
0	32	32,650 +1720 − 1620
25	77	10,000 + 450 − 430

Table 4-2. Partlow Bulb Temperature-Resistance Chart

TEMPERATURE		RESISTANCE
˚F	˚C	(OHMS)
−10	−23.3	12561.00
−5	−20.6	10579.70
0	−17.8	8944.17
5	−15.0	7588.89
15	−9.4	5520.32
20	−6.7	4731.71
25	−3.9	4068.68
30	−1.1	3509.36
32	0	3310.57
35	1.7	3035.99
40	4.4	2634.10
45	7.2	2291.85
50	10.0	1999.52
55	12.8	1749.11
60	15.6	1534.00
65	18.3	1348.72
75	23.9	1050.14
80	26.7	929.87
85	29.4	825.21
90	32.2	733.93
95	35.0	654.12
100	37.8	584.19
105	40.6	522.79

Table 4-3. Recommended Bolt Torque Values

BOLT DIA.	THREADS	TORQUE	MKG
FREE SPINNING			
#4	40	5.2 in-lbs	0.05
#6	32	9.6 in-lbs	0.11
#8	32	20 in-lbs	0.23
#10	24	23 in-lbs	0.26
1/4	20	75 in-lbs	0.86
5/16	18	11 ft-lbs	1.52
3/8	16	20 ft-lbs	2.76
7/16	14	31 ft-lbs	4.28
1/2	13	43 ft-lbs	5.94
9/16	12	57 ft-lbs	7.88
5/8	11	92 ft-lbs	12.72
3/4	10	124 ft-lbs	17.14
NONFREE SPINNING (LOCKNUTS ETC.)			
1/4	20	82.5 in-lbs	0.95
5/16	18	145.2 in-lbs	1.67
3/8	16	22.0 ft-lbs	3.04
7/16	14	34.1 ft-lbs	4.71
1/2	13	47.3 ft-lbs	6.54
9/16	12	62.7 ft-lbs	8.67
5/8	11	101.2 ft-lbs	13.99
3/4	10	136.4 ft-lbs	18.86

Table 4-4. Wear Limits For Compressors

PART NAME	FACTORY MAXIMUM		FACTORY MINIMUM		MAXIMUM WEAR BEFORE REPAIR	
	INCHES	MM	INCHES	MM	INCHES	MM
MAIN BEARING						
Main Bearing Diameter	1.6268	41.3207			.0020	0.0508
Main Bearing Journal Diameter			1.6233	41.2318	.0020	0.0508
PUMP END						
Main Bearing Diameter	1.3760	34.9504			.0020	0.0508
Main Bearing Journal Diameter			1.3735	34.8869	.0020	0.0508
CONNECTING ROD	1.3768	34.9707			.0020	0.0508
Piston Pin Bearing			0.6878	17.4701	.0010	0.0254
CRANKPIN DIAMETER			1.3735	34.8869	.0025	0.0635
Throw	1.072	27.2288	1.070	27.1780		
THRUST WASHER (Thickness)	0.154	3.9116	0.1520	03.8608	.0250	0.6350
CYLINDERS						
Bore	2.0010	50.8254			.0020	0.0508
Piston (Diameter)			1.9860	50.4444	.0020	0.0508
Piston Pin (Diameter)			0.6873	17.4574	.0010	0.0254
Piston Ring Gap	0.013	00.3302	0.0050	00.1270	.0250	0.6350
Piston Ring Side Clearance	0.002	00.0508	0.0010	00.0254	.0020	0.0508

Table 4-5. Compressor Torque Values

SIZE DIAMETER (INCHES)	THREADS PER INCH	TORQUE RANGE		USAGE
		FT-LB	MKG	
1/16	27 (pipe)	8 – 12	1.11 – 1.66	Pipe Plug – Crankshaft
1/8	20 (pipe)	6 – 10	0.83 – 1.38	Oil Return Check Valve – Crankcase
1/4	20 (pipe)	20 – 25	2.77 – 3.46	Pipe Plug – Gauge Connection
1/4	20	10 – 12	1.38 – 1.66	Connecting Rod Capscrew
1/4	28	12 – 15	1.66 – 2.07	Baffle Plate – Crankcase
		12 – 16	1.66 – 2.21	Side Shield
		6 – 10	0.83 – 1.38	Oil Pump Drive Segment
		12 – 16	1.66 – 2.21	Unloader Valve
5/16	18	16 – 20	2.21 – 2.77	Cover Plate – Plate End
				Bearing Head
				Terminal Block Cap Screws
		20 – 30	2.77 – 4.15	Suction Valve
				Discharge Valve
3/8	16	40 – 50	5.53 – 6.92	Pump End Bearing Head
				Bottom Plate – Crankcase Compressor Foot
				Cylinder Head
7/16	14	55 – 60	7.61 – 8.30	Motor End Cover – Crankcase
5/8	11	25 – 30	3.46 – 4.15	Crankshaft
5/8	18	60 – 75	8.30 – 10.37	Oil Bypass Plug – Crankcase
#10	32	4 – 6	0.55 – 0.83	Oil Pump Drive Segment
1-1/2	18 NEF	35 – 45	4.84 – 6.22	Oil Level Sight Glass

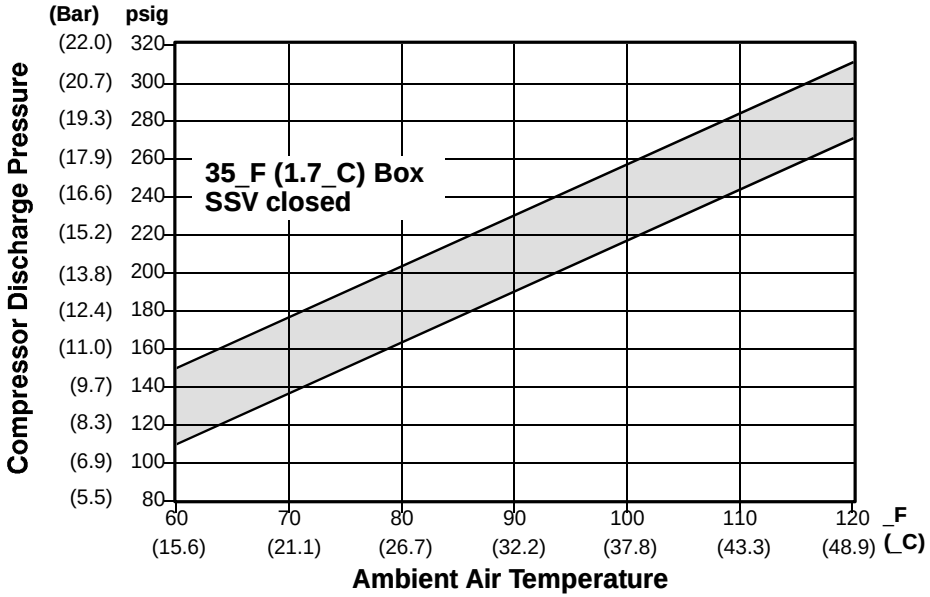
NEF – National Extra Fine

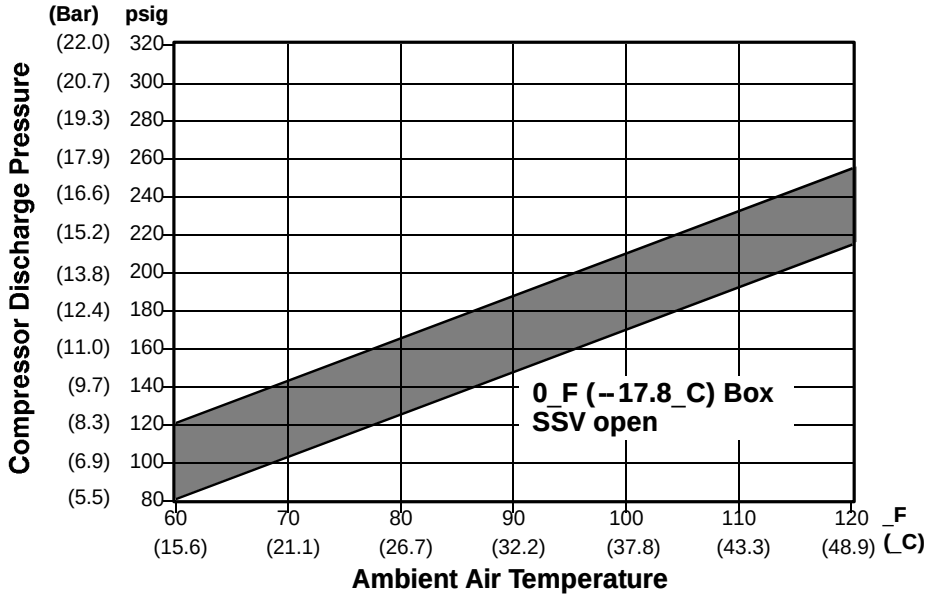
Table 4-6. Temperature-Pressure Chart – R-134a

BOLD FIGURES = Inches Mercury Vacuum (cm Hg Vac)
LIGHT FIGURES = psig (kg/cm@)

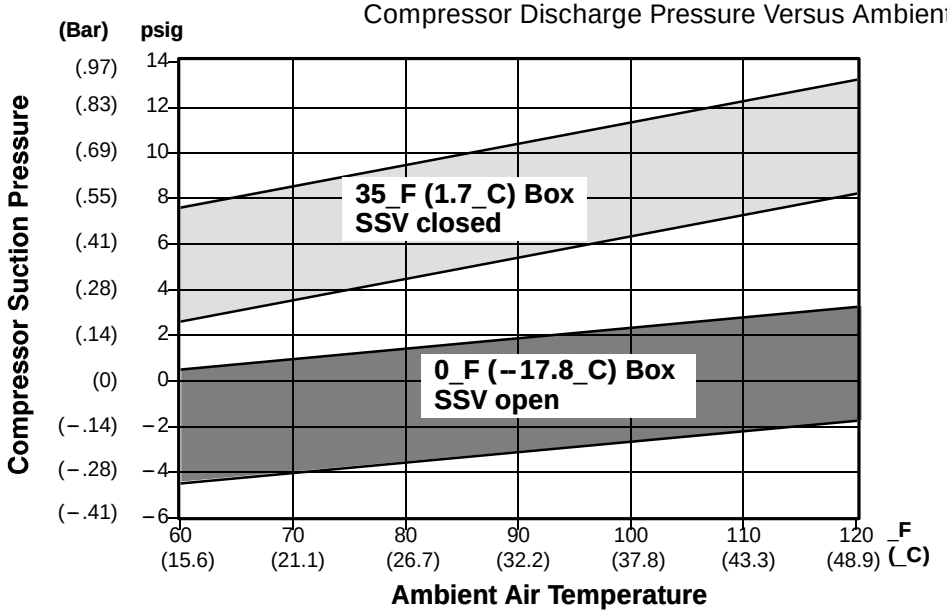
TEMPERATURE		PRESSURE			TEMPERATURE		PRESSURE		
˚F	˚C	Psig	Kg/cm^2	Bar	˚F	˚C	Psig	Kg/cm^2	Bar
–40	**–40**	**14.6**	**37.08**	**–.49**	30	–1	26.1	1.84	1.80
–35	**–37**	**12.3**	**31.25**	**–.42**	32	0	27.8	1.95	1.92
–30	**–34**	**9.7**	**24.64**	**–.33**	34	1	29.6	2.08	2.04
–25	**–32**	**6.7**	**17.00**	**–.23**	36	2	31.3	2.20	2.16
–20	**–29**	**3.5**	**8.89**	**–.12**	38	3	33.2	2.33	2.29
–18	**–28**	**2.1**	**5.33**	**–.07**	40	4	35.1	2.47	2.42
–16	**–27**	**0.6**	**1.52**	**–.02**	45	7	40.1	2.82	2.76
–14	–26	0.4	.03	.03	50	10	45.5	3.30	3.14
–12	–24	1.2	.08	.08	55	13	51.2	3.60	3.53
–10	–23	2.0	.14	.14	60	16	57.4	4.04	3.96
–8	–22	2.9	.20	.20	65	18	64.1	4.51	4.42
–6	–21	3.7	.26	.26	70	21	71.1	5.00	4.90
–4	–20	4.6	.32	.32	75	24	78.7	5.53	5.43
–2	–19	5.6	.39	.39	80	27	86.7	6.10	5.98
–0	–18	6.5	.46	.45	85	29	95.3	6.70	6.57
2	–17	7.6	.53	.52	90	32	104.3	7.33	7.19
4	–16	8.6	.60	.59	95	35	114.0	8.01	7.86
6	–14	9.7	.68	.67	100	38	124.2	8.73	8.56
8	–13	10.8	.76	.74	105	41	135.0	9.49	9.31
10	–12	12.0	.84	.83	110	43	146.4	10.29	10.09
12	–11	13.2	.93	.91	115	46	158.4	11.14	10.92
14	–10	14.5	1.02	1.00	120	49	171.2	12.04	11.80
16	–9	15.8	1.11	1.09	125	52	184.6	12.98	12.73
18	–8	17.1	1.20	1.18	130	54	198.7	13.97	13.70
20	–7	18.5	1.30	1.28	135	57	213.6	15.02	14.73
22	–6	19.9	1.40	1.37	140	60	229.2	16.11	15.80
24	–4	21.4	1.50	1.48	145	63	245.6	17.27	16.93
26	–3	22.9	1.61	1.58	150	66	262.9	18.48	18.13
28	–2	24.5	1.72	1.69	155	68	281.1	19.76	19.37

Note: Curves to be used as troubleshooting guide only for model series 69NT40-489 with fresh air makeup vent closed, unit powered on 460vac/60hz and SMV 100% open.

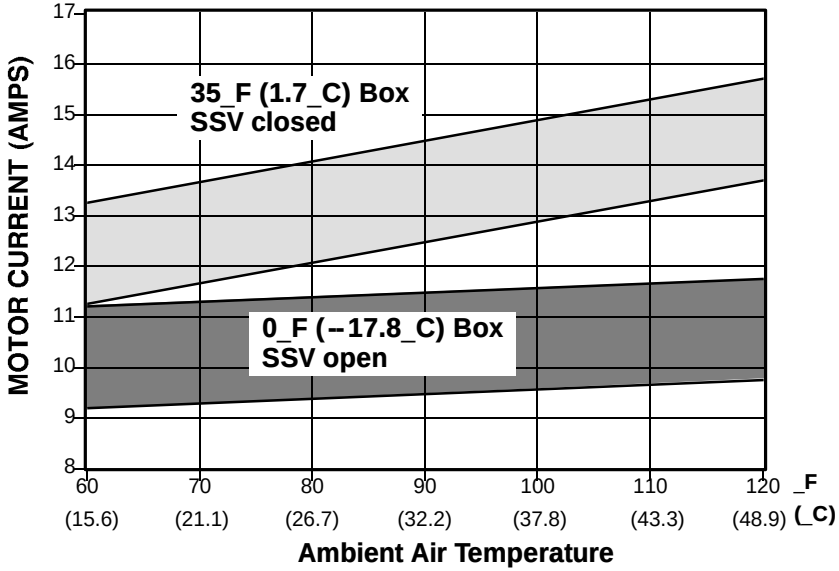




Compressor Discharge Pressure Versus Ambient Air Temperature at Stable Box Temperature



Compressor Suction Pressure Versus Ambient Air Temperature at Stable Box Temperature



Compressor–Motor Current Versus Ambient Air Temperature At Stable Box Temperature

Figure 4-32. R-134a Compressor Pressure and Motor Current Curves Versus Ambient Temperature

SECTION 5

ELECTRICAL WIRING SCHEMATIC AND DIAGRAMS

5.1 INTRODUCTION

This section contains Electrical Schematics and Wiring Diagrams covering the Models listed in Table 1-1. The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered herein.

WARNING

It has been determined that pressurized, air-rich mixtures of refrigerants and air can undergo combustion when exposed to an ignition source.

WARNING

Beware of unannounced starting of the evaporator and condenser fans. Do not open the condenser fan grille before turning power OFF and disconnecting power plug.

WARNING

Make sure power to the unit is OFF and power plug disconnected before removing capacitor(s).

WARNING

Do not attempt to remove power plug(s) before turning OFF start-stop switch (ST), unit circuit breaker(s) and external power source.

Make sure the power plugs are clean and dry before connecting to any power receptacle.

WARNING

Make sure power to the unit is OFF and power plug disconnected before replacing the compressor.

WARNING

Before disassembly of the compressor make sure to relieve the internal pressure very carefully by slightly loosening the bolts on both service valve flanges/blank valve pads, then lightly tap the sides of the valve flanges/pads with a hammer to break the seal.

CAUTION

Use only Carrier Transicold approved Polyol Ester Oil (POE) – Castrol-Icematic SW20 compressor oil with R-134a. Buy in quantities of one quart or smaller. When using this hygroscopic oil, immediately reseal. Do not leave container of oil open or contamination will occur.

WARNING

Do not attempt to do service work on the Controller/DataCORDER modules, breaking of the warranty seal will cause the warranty to void.

CAUTION

Remove the Controller/DataCORDER modules and unplug all wire harness connectors before performing any arc welding on any part of the container.

Do not remove wire harnesses from modules unless you are grounded to the unit frame with a static safe wrist strap.

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws, U.S.A. EPA section 608.

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
L8,P1	C	—	COMPRESSOR CONTACTOR
G1	CB1	—	CIRCUIT BREAKER 460V
G3	CB2	—	CIRCUIT BREAKER 230V
L9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (LIGHT)
P4	DPH	—	DRAIN PAN HEATER
K13	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P6,P8,P9,L10, G10,H10,T7,T9	EF	—	EVAPORATOR FAN CONTACTOR
	EM	—	EVAPORATOR FAN MOTOR
C7,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
L11,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G11	HTT	—	HEAT TERMINATION THERMOSTAT
M2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
G10,H8,H9,H10	IP	—	INTERNAL PROTECTOR
L12	IRL	—	IN-RANGE LIGHT (OPTION)
C14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
M19,N19,P19,R19	PR	—	PROBE RECEPTACLE (USDA) (OPTION)
L7,L12,L13	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H14	SSV	—	SUCTION SOLENOID VALVE
L5	ST	—	START-STOP SWITCH
C19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
E6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K11	TH	—	CONTROLLER RELAY (HEATING)
K12	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
G8,G9,G14, M14,D16	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
R5,R6,R8,J1, J3,T3,R1,R2	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-1. Electrical Schematic – Models 69NT40-489,-489-11 & (Model 69NT40-489-1 – Prior to Serial # 90234597) (Sheet 1 of 2)

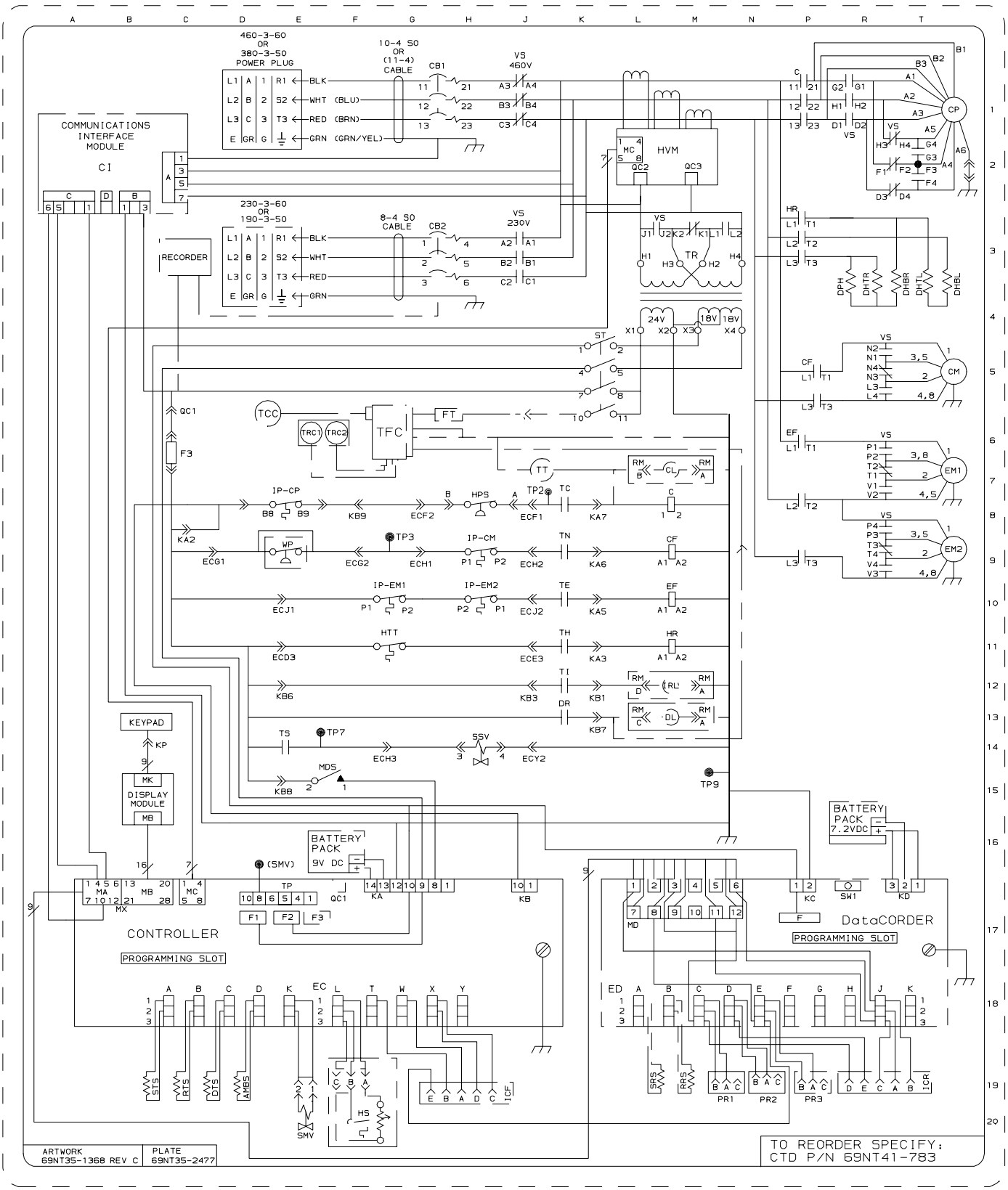


Figure 5-1. Electrical Schematic – Models 69NT40-489,-489-11 &
(Model 69NT40-489-1 – Prior to Serial # 90234597)
(Sheet 2 of 2)

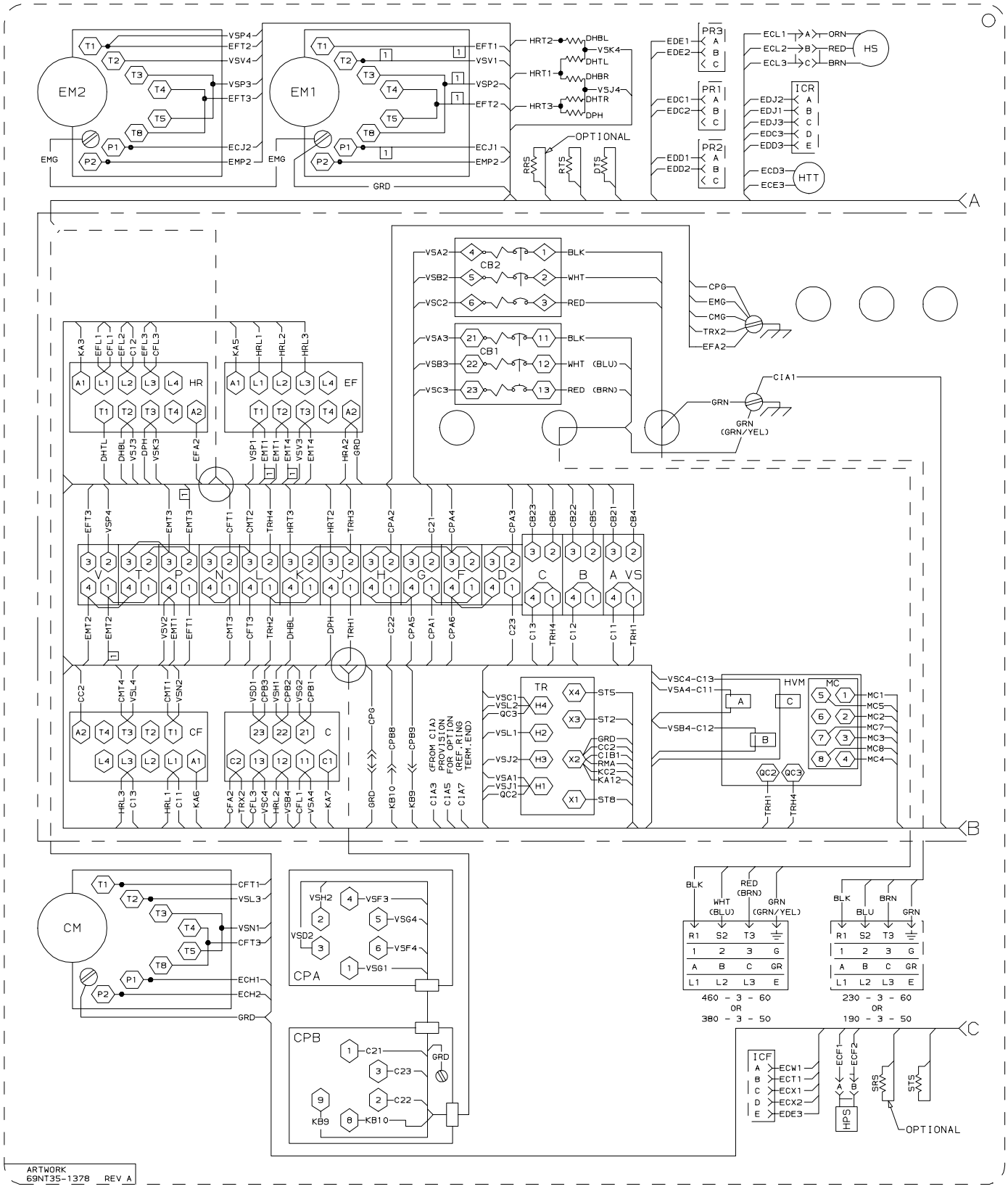


Figure 5-2. Electrical Wiring Diagram – Models 69NT40-489,-489-11 &
(Model 69NT40-489-1 – Prior to Serial # 90234597)
(Sheet 1 of 2)

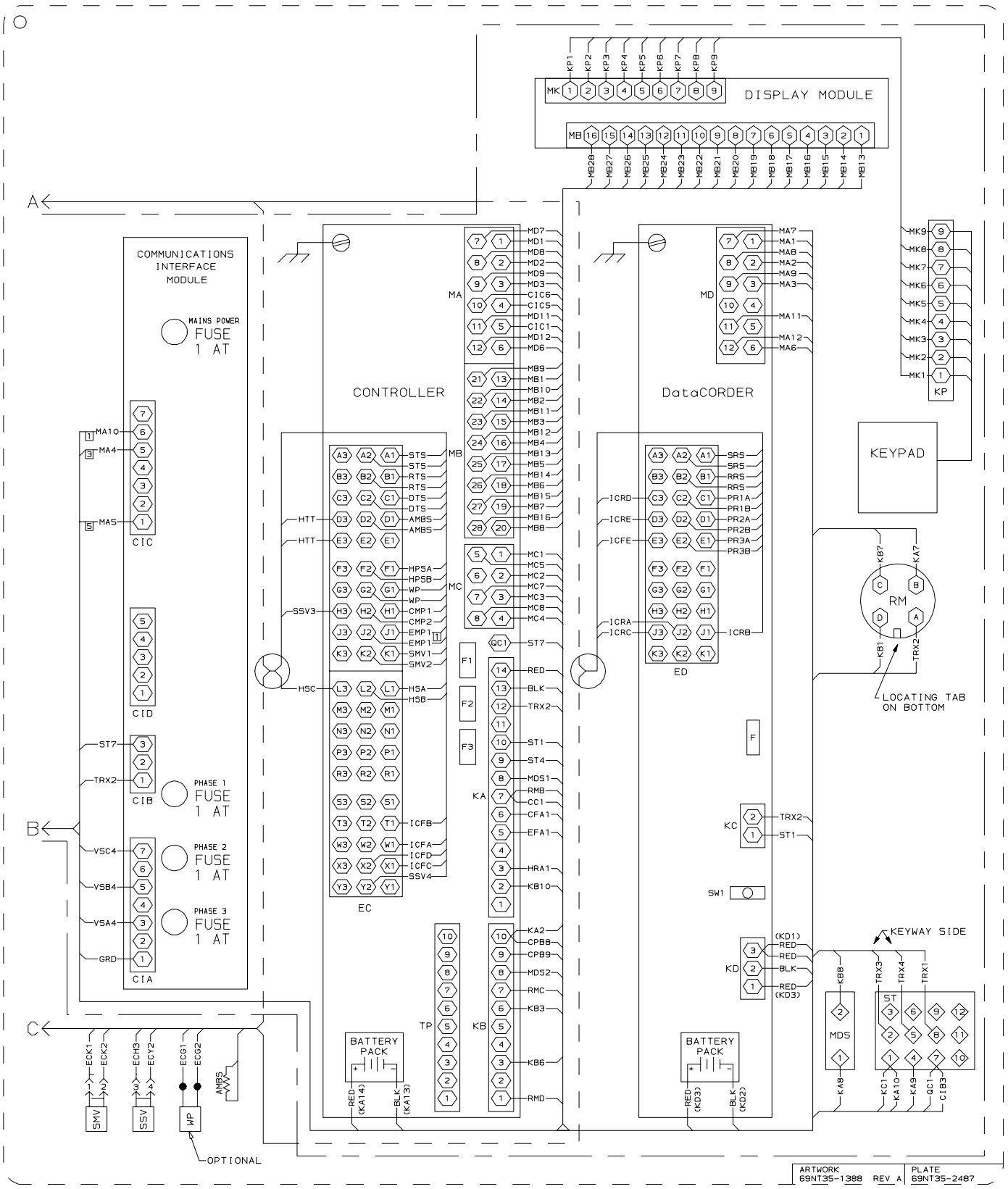


Figure 5-2. Electrical Wiring Diagram – Models 69NT40-489,-489-11 & (Model 69NT40-489-1 – Prior to Serial # 90234597) (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL	DESCRIPTION
D19	AMBS	AMBIENT SENSOR
L8,P1	C	COMPRESSOR CONTACTOR
G1	CB1	CIRCUIT BREAKER 460V
L9,P5	CF	CONDENSER FAN CONTACTOR
B2	CI	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	COOL LIGHT (OPTION)
T5,H9	CM	CONDENSER FAN MOTOR
T1,E8	CP	COMPRESSOR MOTOR
T4	DHBL	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	DEFROST HEATER - TOP LEFT
R4	DHTR	DEFROST HEATER - TOP RIGHT
L13	DL	DEFROST LIGHT (LIGHT)
P4	DPH	DRAIN PAN HEATER
K13	DR	DEFROST RELAY
D19	DTS	DEFROST TEMPERATURE SENSOR
P6,P8,P9,L10,	EF	EVAPORATOR FAN CONTACTOR
G10,H10,T7,T9	EM	EVAPORATOR FAN MOTOR
C7,D17,E17, P17,H6	F	FUSE
	FLA	FULL LOAD AMPS
H8	HPS	HIGH PRESSURE SWITCH
L11,P3	HR	HEATER CONTACTOR
F20	HS	HUMIDITY SENSOR
G11	HTT	HEAT TERMINATION THERMOSTAT
M2	HVM	HIGH VOLTAGE MODULE
H19,T19	IC	INTERROGATOR CONNECTOR (OPTION)
G10,H8,H9,H10	IP	INTERNAL PROTECTOR
L12	IRL	IN-RANGE LIGHT (OPTION)
C14	KP	KEYPAD CONNECTOR
F15	MDS	MANUAL DEFROST SWITCH
M19,N19,P19,R19	PR	PROBE RECEPTACLE (USDA)(OPTION)
L7,L12,L13	RM	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	RETURN RECORDER SENSOR (OPTION)
C19	RTS	RETURN TEMPERATURE SENSOR
E20	SMV	SUCTION MODULATION VALVE
L19	SRS	SUPPLY RECORDER SENSOR (OPTION)
H14	SSV	SUCTION SOLENOID VALVE
L5	ST	START-STOP SWITCH
C19	STS	SUPPLY TEMPERATURE SENSOR
K8	TC	CONTROLLER RELAY (COOLING)
E6	TCC	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	CONTROLLER RELAY (EVAPORATOR FANS)
G6	TFC	TRANSFRESH CONTROLLER (OPTION)
K11	TH	CONTROLLER RELAY (HEATING)
K12	TI	INRANGE RELAY
K9	TN	CONTROLLER RELAY (CONDENSER FAN)
G8,G9,G14, M14,D16	TP	TEST POINT
M3	TR	TRANSFORMER
F6	TRC	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	TOTAL TIME METER (OPTION)
E9	WP	WATER PRESSURE SWITCH (OPTION)

Figure 5-3. Electrical Schematic – Model 69NT40-489-2 (Sheet 1 of 2)

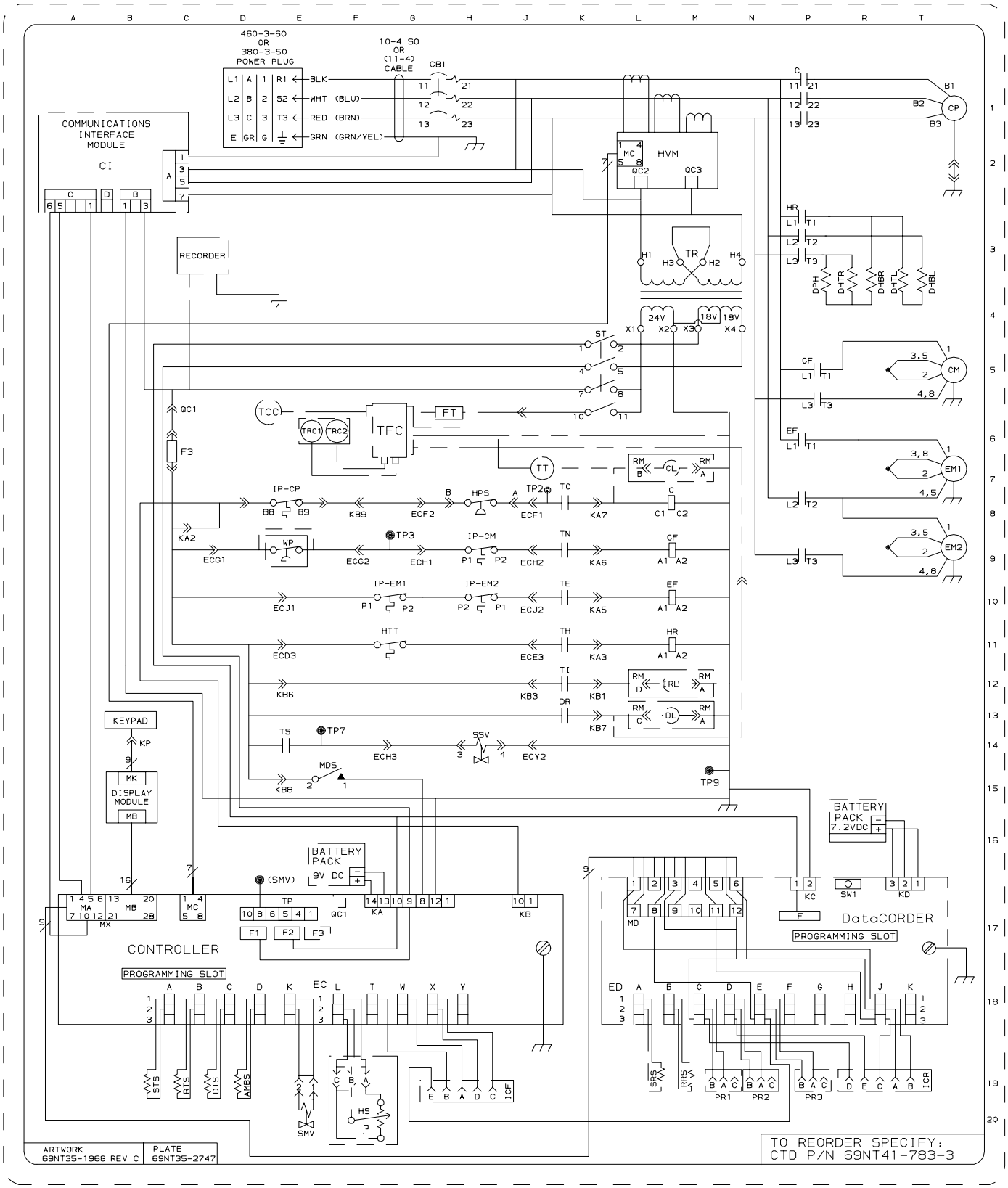


Figure 5-3. Electrical Schematic – Model 69NT40-489-2
(Sheet 2 of 2)

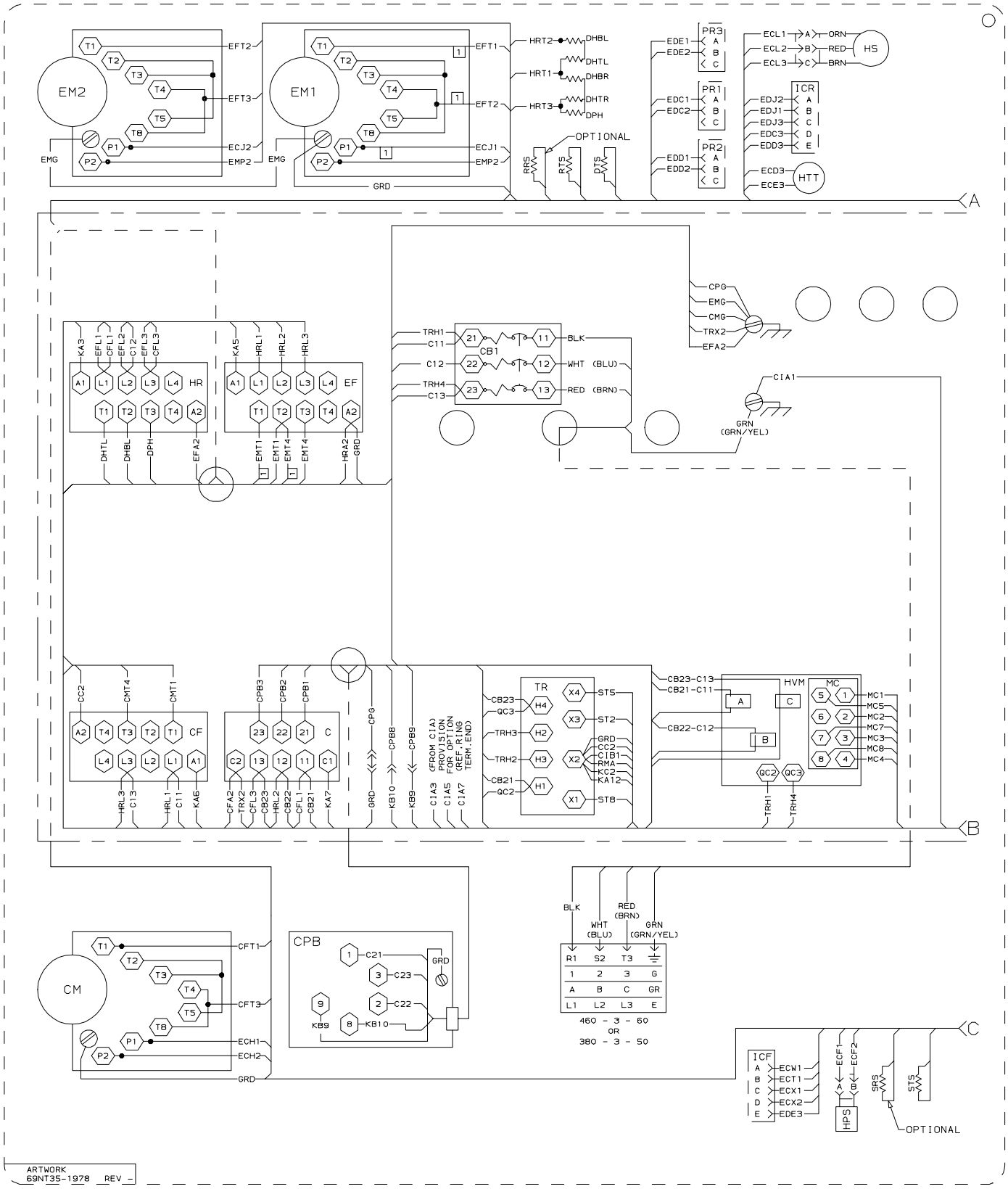


Figure 5-4. Electrical Wiring Diagram – Model 69NT40-489-2
(Sheet 1 of 2)

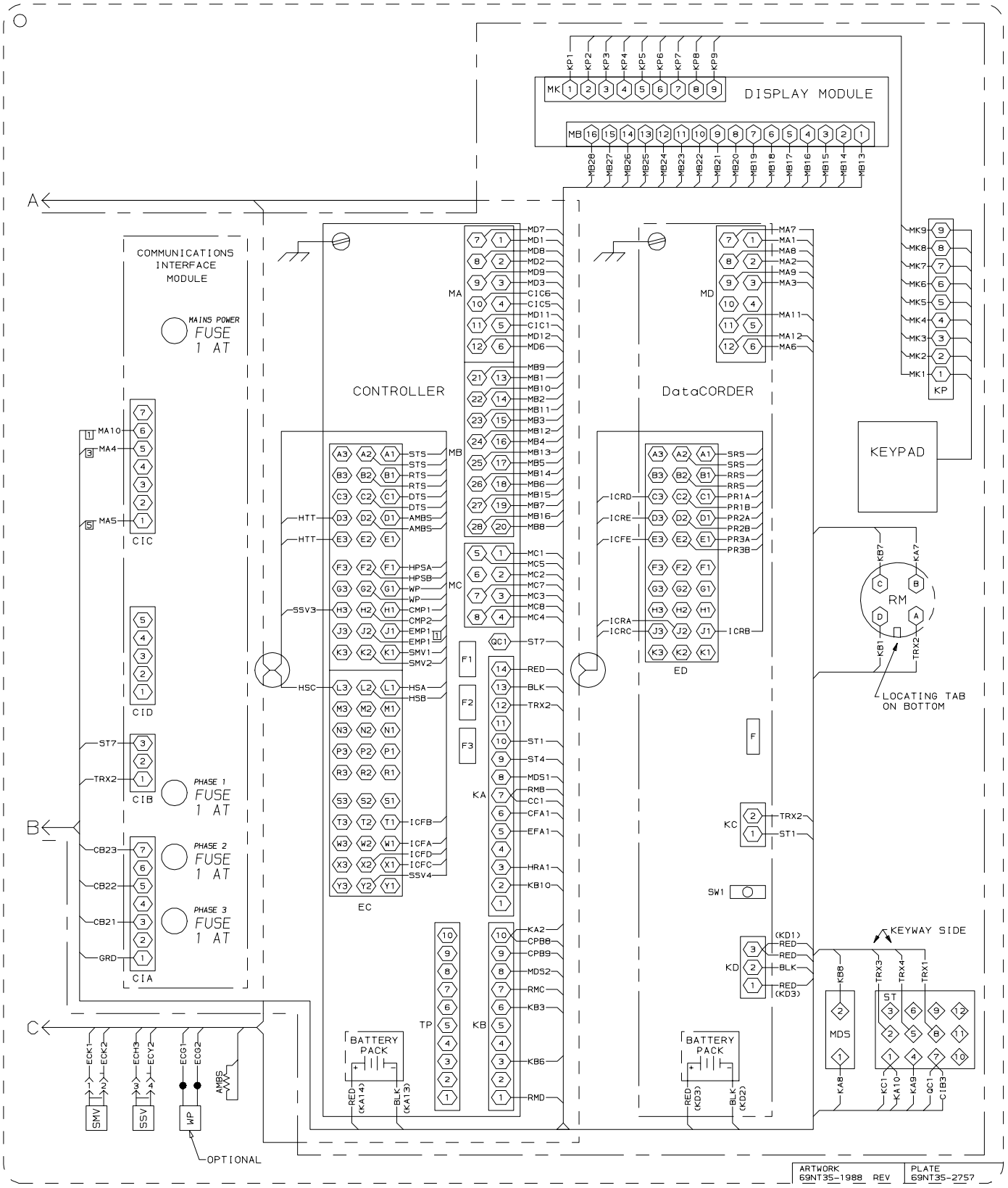


Figure 5-4. Electrical Wiring Diagram – Model 69NT40-489-2 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
F3	CB2	—	CIRCUIT BREAKER 230V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
E8,G10,H9 H10,C8	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
B19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
H3,C8	TRANS	—	TRANSFORMER (AUTO 230/460)
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)
J1,J3	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-5. Electrical Schematic – Model 69NT40-489-10 & (Model 69NT40-489-3 – Prior to Serial # 90234597) (Sheet 1 of 2)

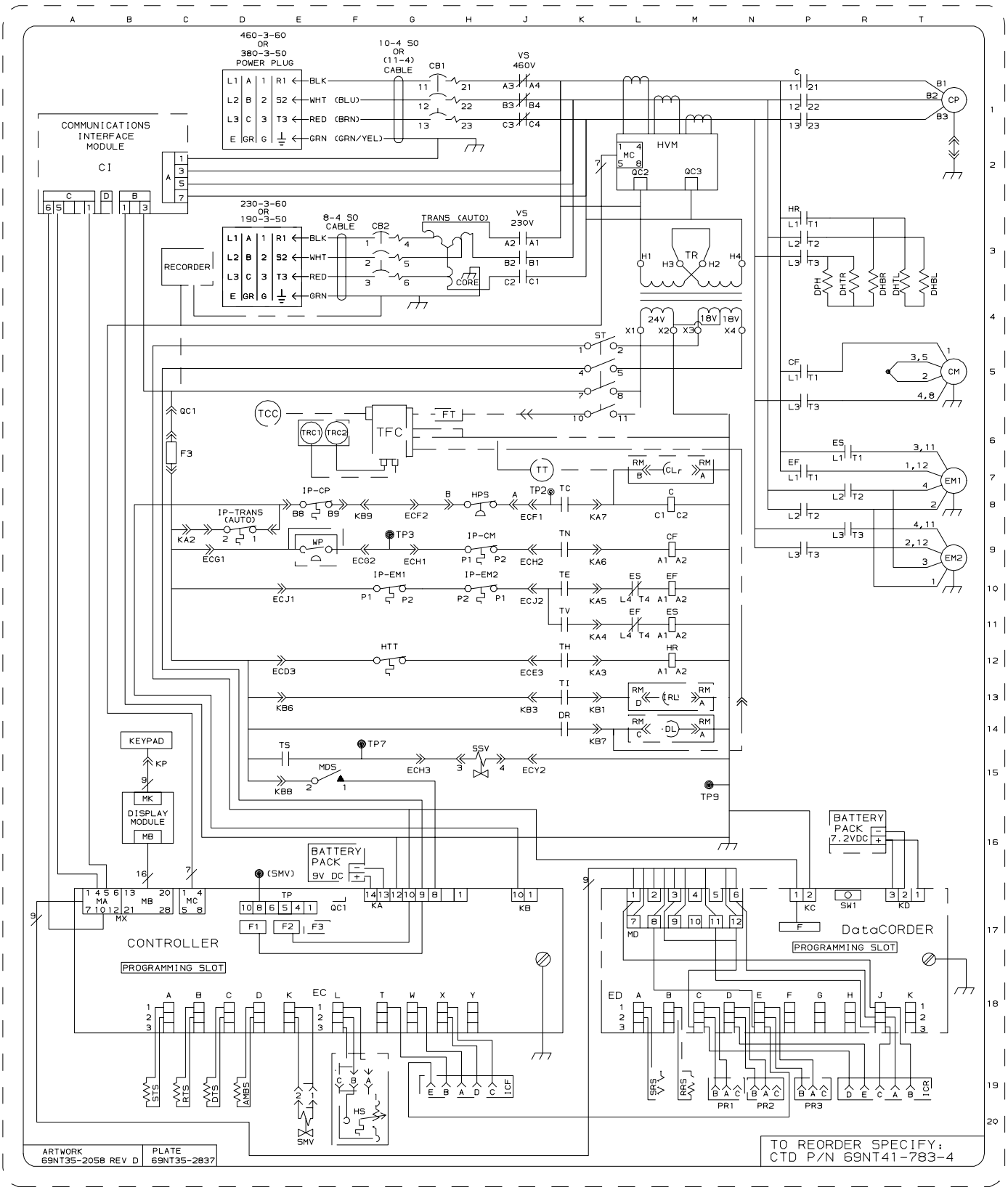


Figure 5-5. Electrical Schematic – Model 69NT40-489-10 &
(Model 69NT40-489-3 – Prior to Serial # 90234597)
(Sheet 2 of 2)

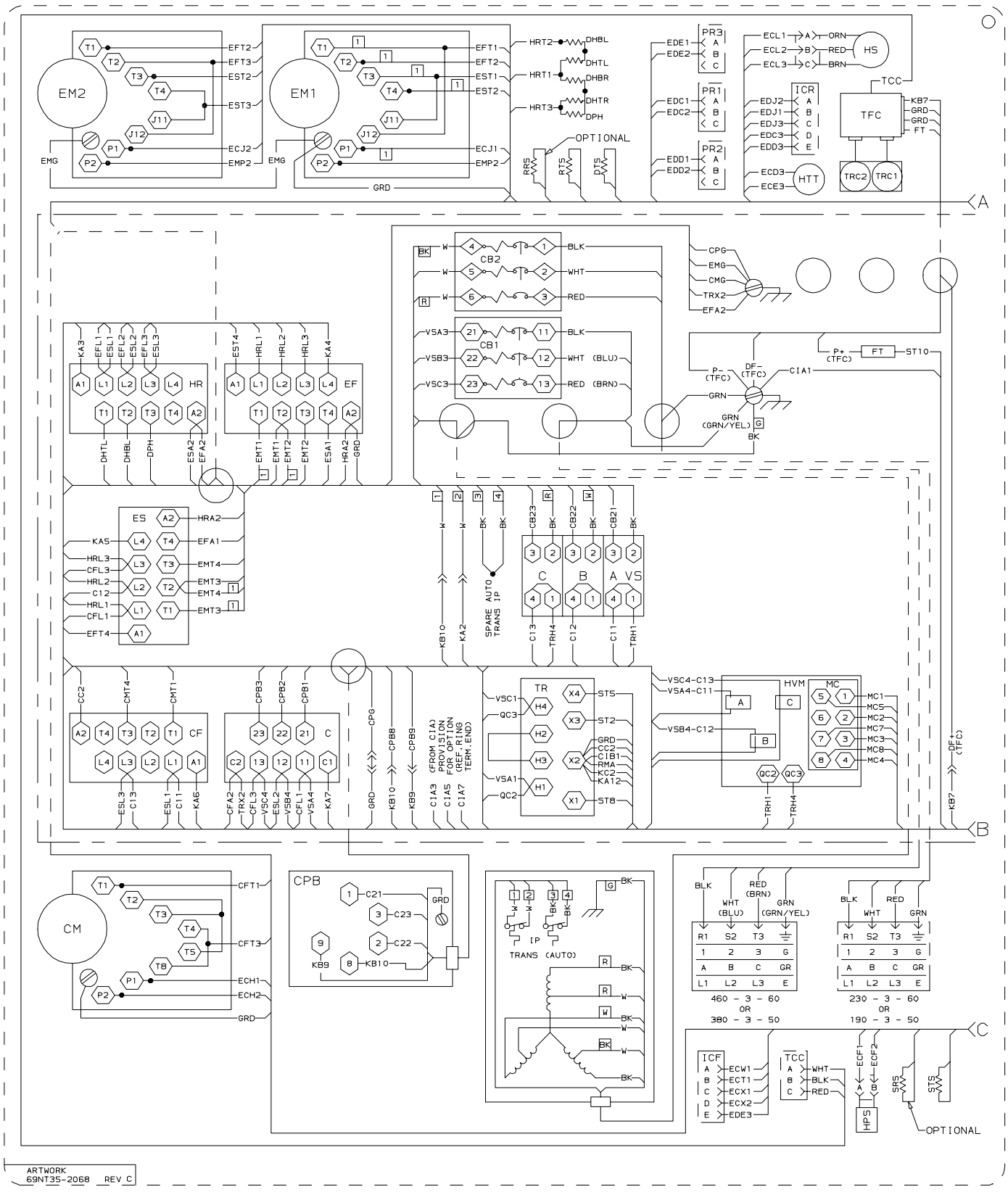


Figure 5-6. Electrical Wiring Diagram – Model 69NT40-489-10 &
(Model 69NT40-489-3 – Prior to Serial # 90234597)
(Sheet 1 of 2)

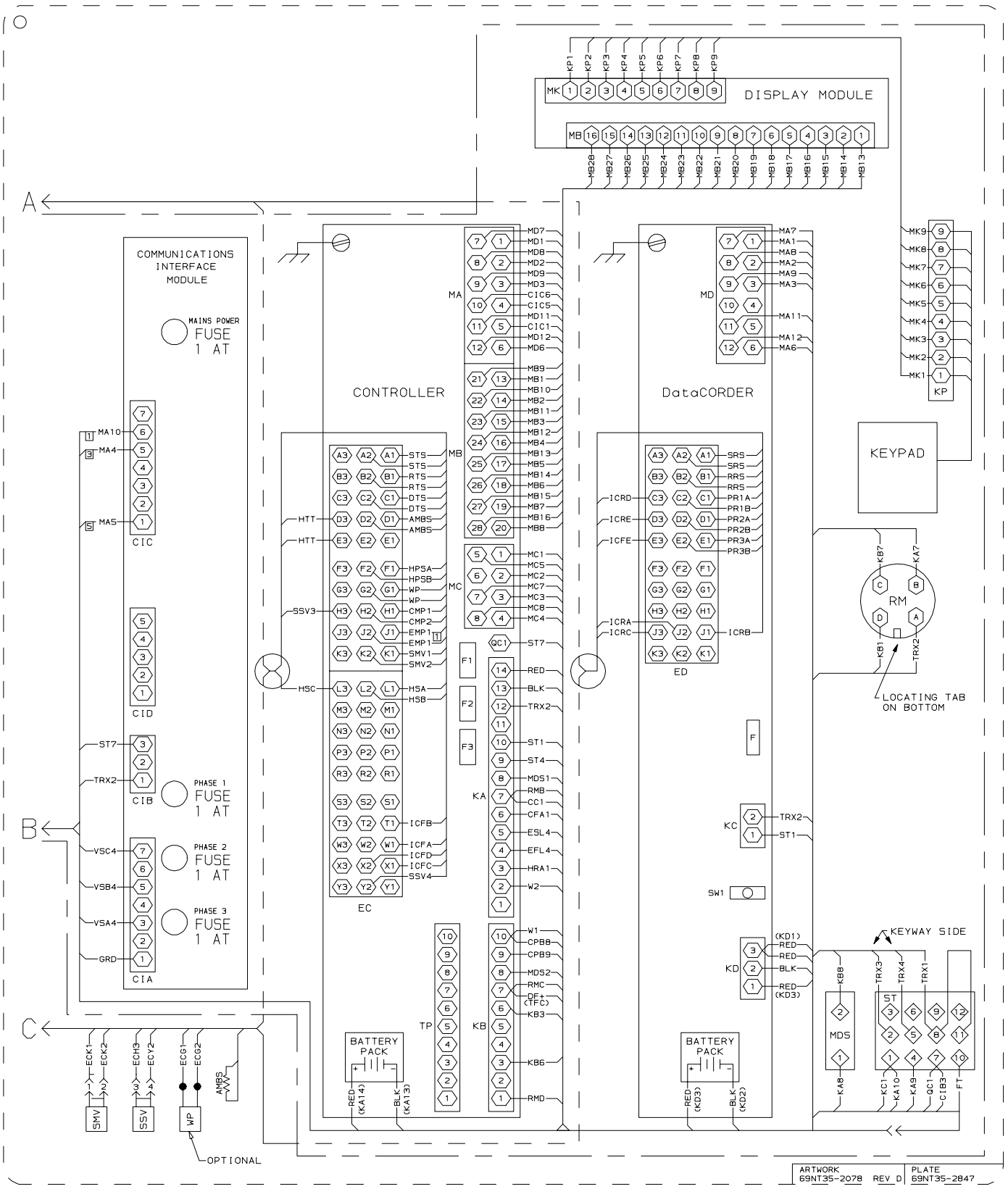


Figure 5-6. Electrical Wiring Diagram – Model 69NT40-489-10 &
(Model 69NT40-489-3 – Prior to Serial # 90234597)
(Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
E8,G10,H9,H10	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
B19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-7. Electrical Schematic – Models 69NT40-489-4, -489-7, -489-8, -489-29 & (Model 69NT40-489-13 – Prior to Serial # 90234597) (Sheet 1 of 2)

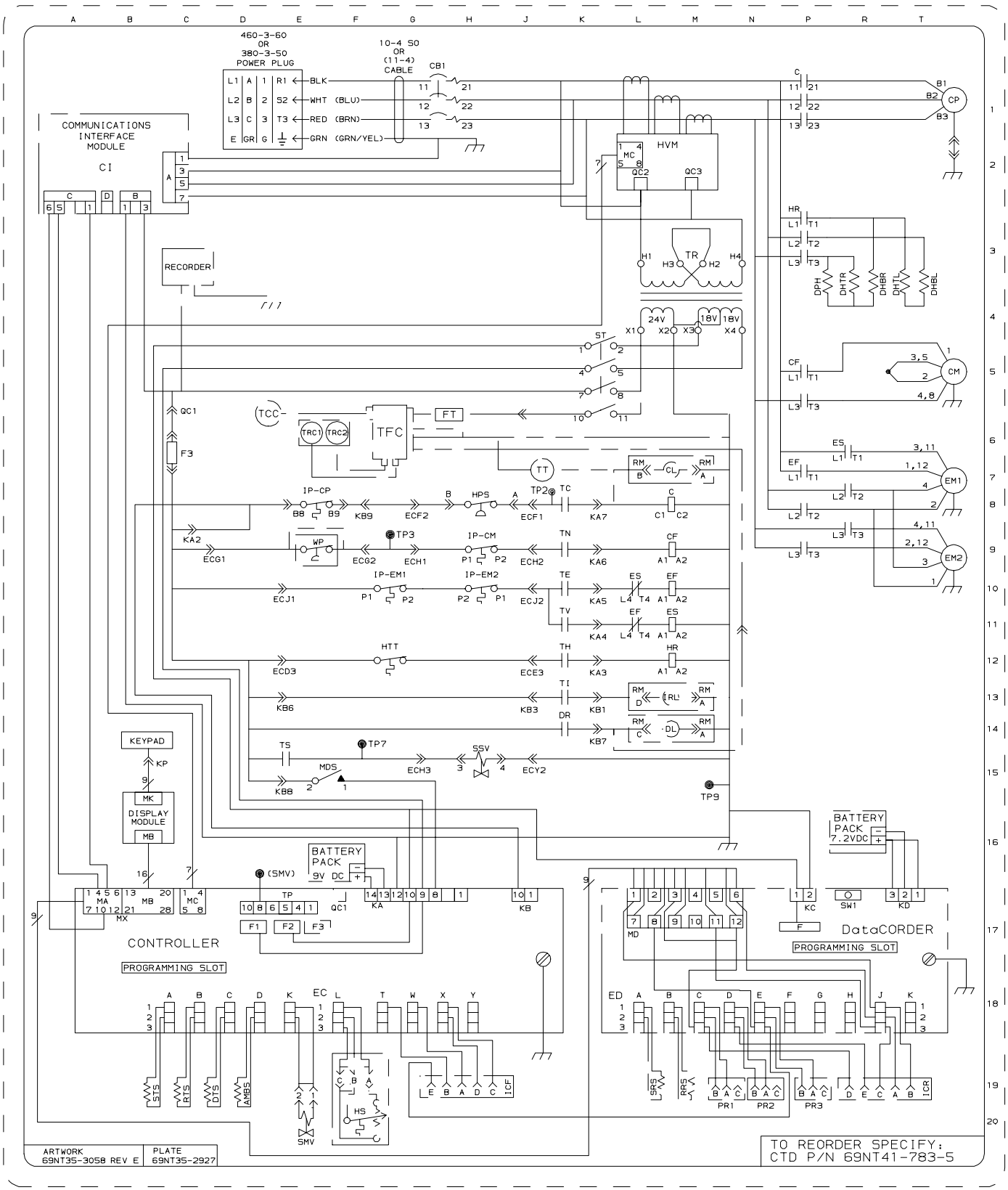


Figure 5-7. Electrical Schematic – Models 69NT40-489-4, -489-7, -489-8, -489-29 & (Model 69NT40-489-13 – Prior to Serial # 90234597) (Sheet 2 of 2)

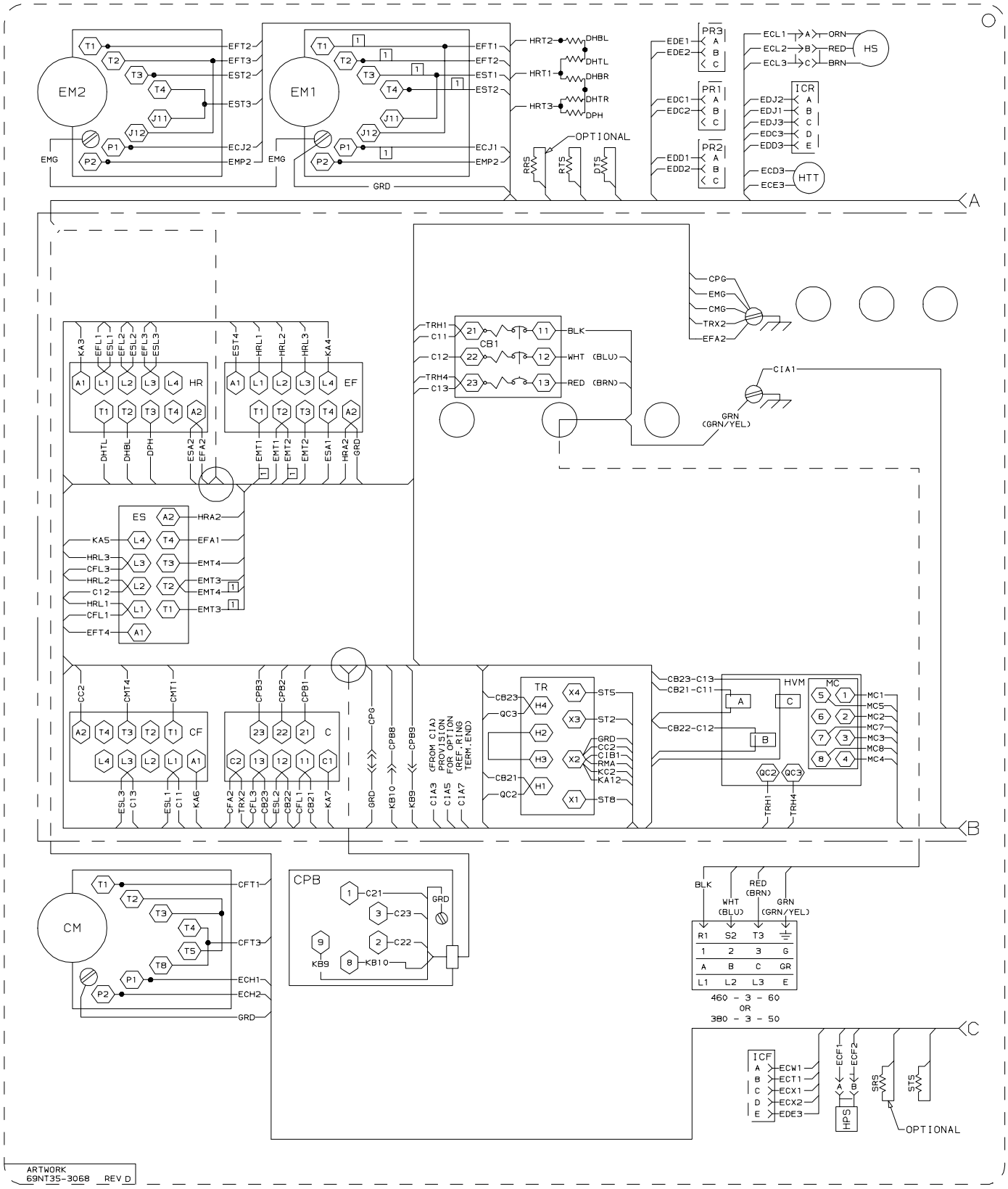


Figure 5-8. Electrical Wiring Diagram – Models 69NT40-489-4, -489-7, -489-8, -489-29 & (Model 69NT40-489-13 – Prior to Serial # 90234597) (Sheet 1 of 2)

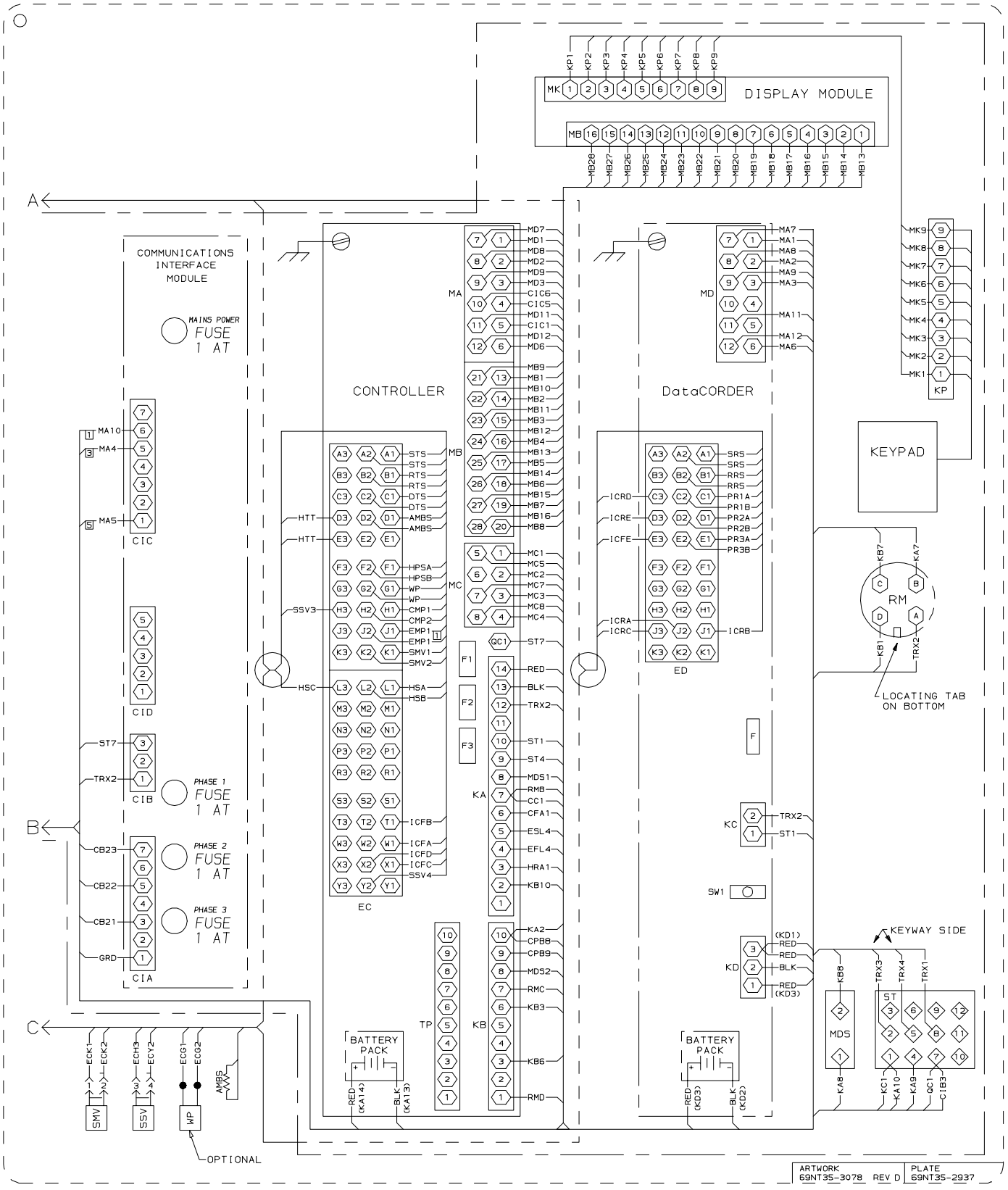


Figure 5-8. Electrical Wiring Diagram – Models 69NT40-489-4, -489-7, -489-8, -489-29 & (Model 69NT40-489-13 – Prior to Serial # 90234597) (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
F3	CB2	—	CIRCUIT BREAKER 230V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
E8,G10,H9 H10,C8	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
B19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
H3,C8	TRANS	—	TRANSFORMER (AUTO 230/460)
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)
J1,J3	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-9. Electrical Schematic – Models 69NT40-489-5, -489-9 – Prior to Serial # 90234597 (Sheet 1 of 2)

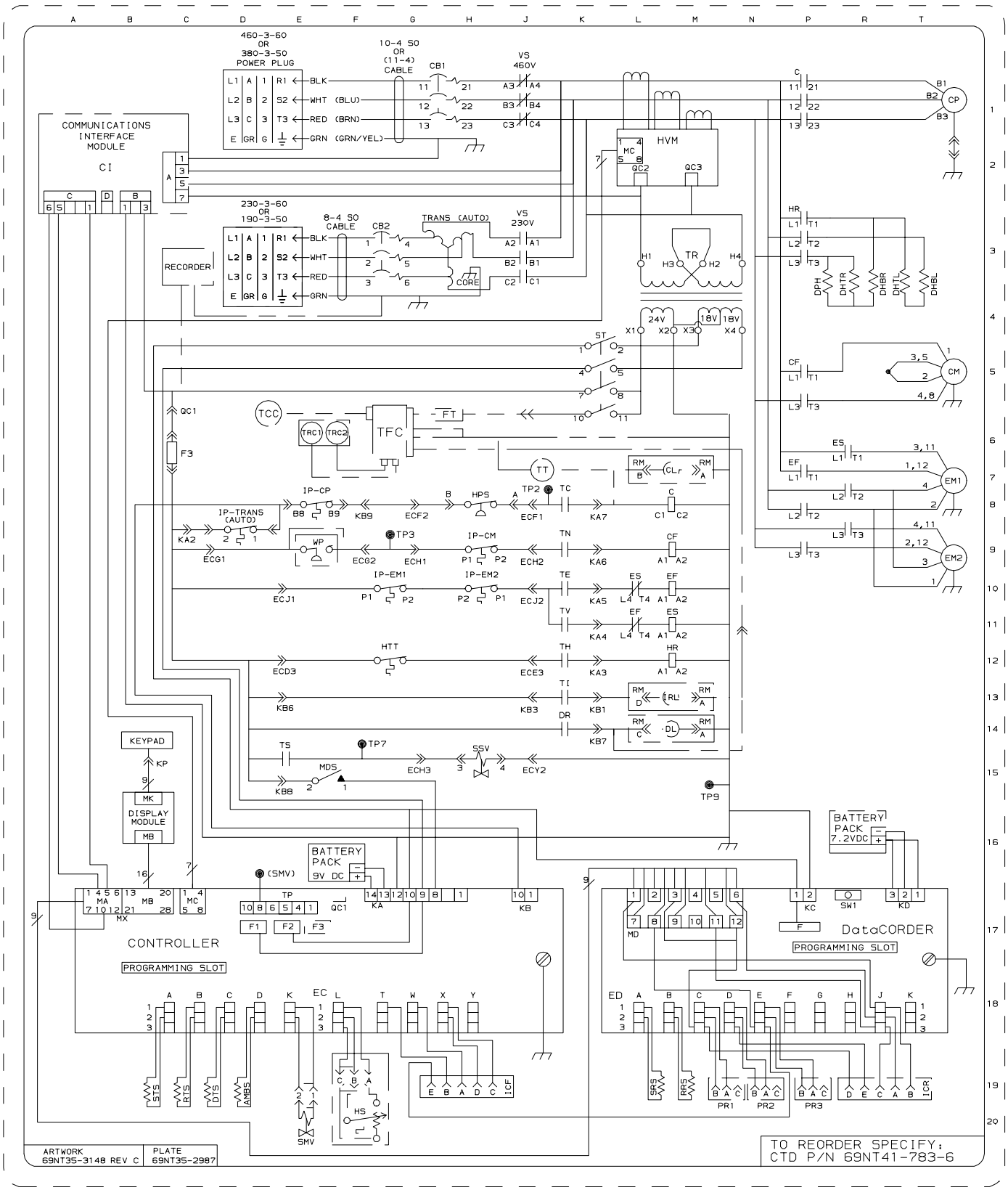


Figure 5-9. Electrical Schematic – Models 69NT40-489-5, -489-9 – Prior to Serial # 90234597 (Sheet 2 of 2)

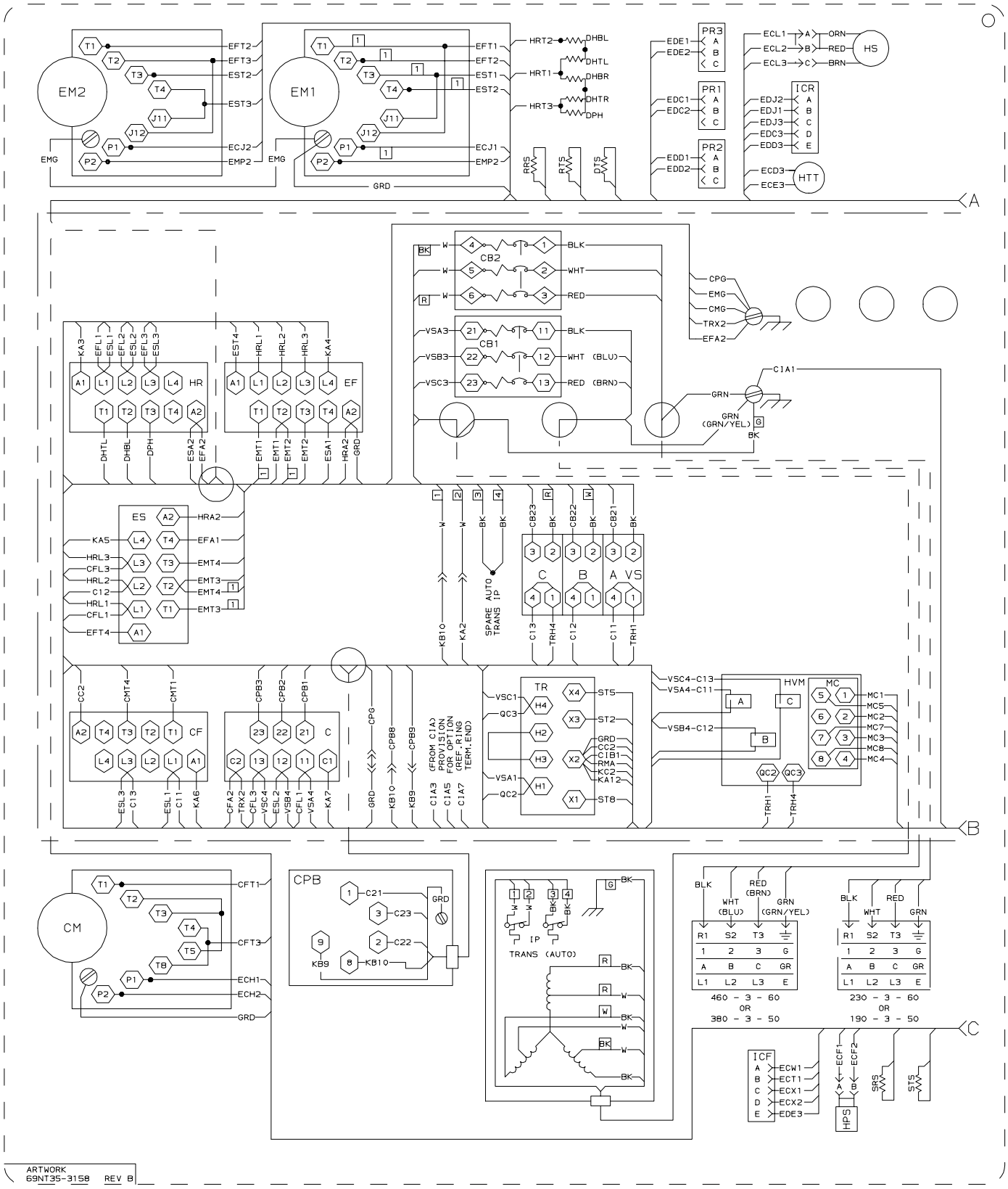


Figure 5-10. Electrical Wiring Diagram – Models 69NT40-489-5, -489-9 – Prior to Serial # 90234597 (Sheet 1 of 2)

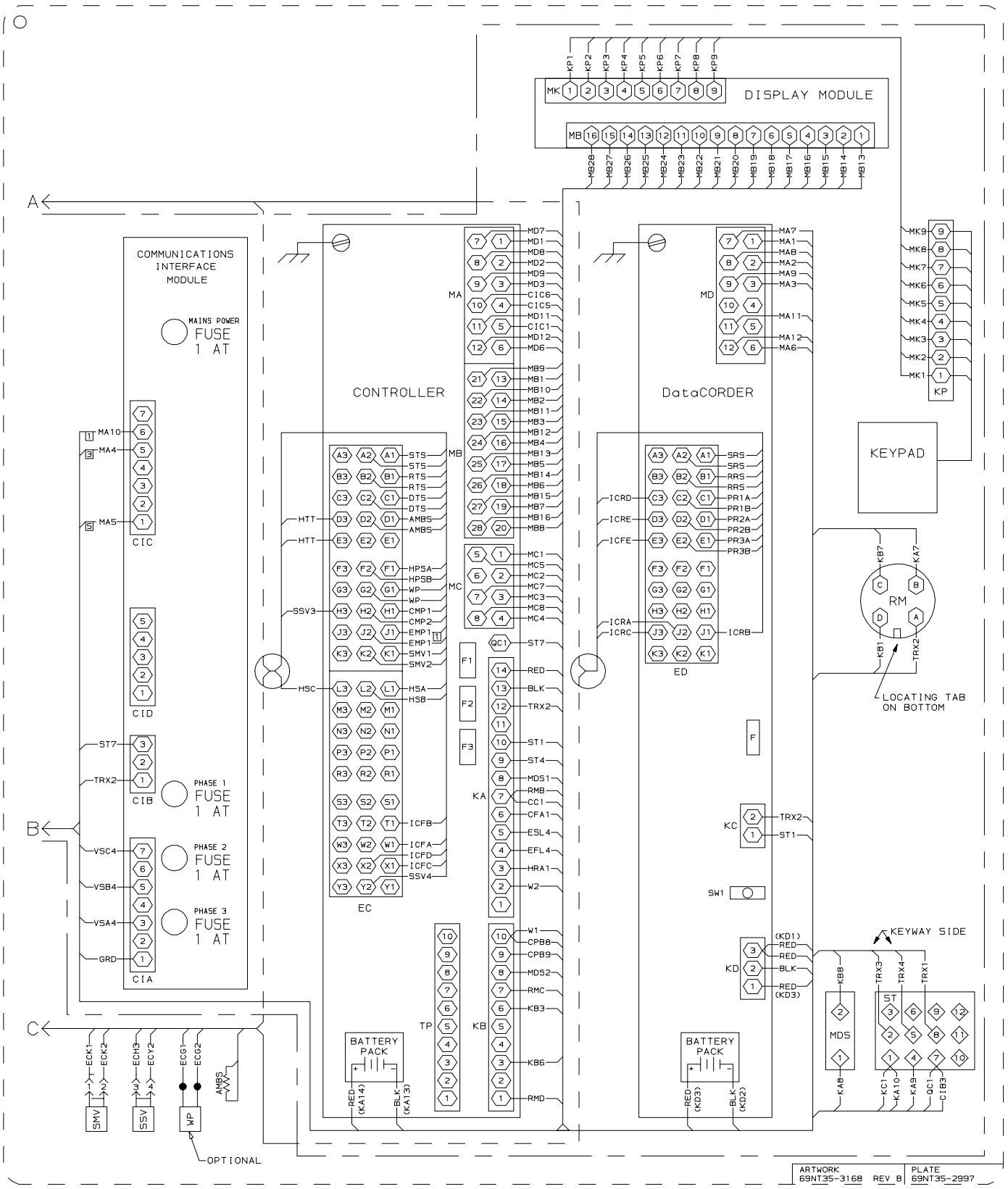


Figure 5-10. Electrical Wiring Diagram – Models 69NT40-489-5, -489-9 – Prior to Serial # 90234597 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
L8,P1	C	—	COMPRESSOR CONTACTOR
G1	CB1	—	CIRCUIT BREAKER 460V
G3	CB2	—	CIRCUIT BREAKER 230V
L9,P5	CF	—	CONDENSER FAN CONTACTOR
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (LIGHT)
P4	DPH	—	DRAIN PAN HEATER
F20	DPT	—	DISCHARGE PRESSURE TRANSDUCER
K13	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P6,P7,P8,L10	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,R6,R7,R8	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C7,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
L11,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G11	HTT	—	HEAT TERMINATION THERMOSTAT
M2	HVM	—	HIGH VOLTAGE MODULE
G10,H5,H8,H9,H10	IP	—	INTERNAL PROTECTOR
L12	IRL	—	IN-RANGE LIGHT (OPTION)
C14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
L7,L12,L13	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
H14	SSV	—	SUCTION SOLENOID VALVE
G20	SPT	—	SUCTION PRESSURE TRANSDUCER
L5	ST	—	START-STOP SWITCH
C19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
E6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAP.)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K11	TH	—	CONTROLLER RELAY (HEATING)
K12	TI	—	IN-RANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
G8,G9,G14, M14,D16	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
H5,R10,R11	TRANS	—	TRANSFORMER (AUTO 230/460)
F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K10	TV	—	CONTROLLER RELAY (LOW SPEED EVAP.)
P6,P7,P8,P10, P11,J1,J3,T3,R1, R2,R5	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-11. Electrical Schematic – Model 69NT40-489-6,-489-75 (Sheet 1 of 2)

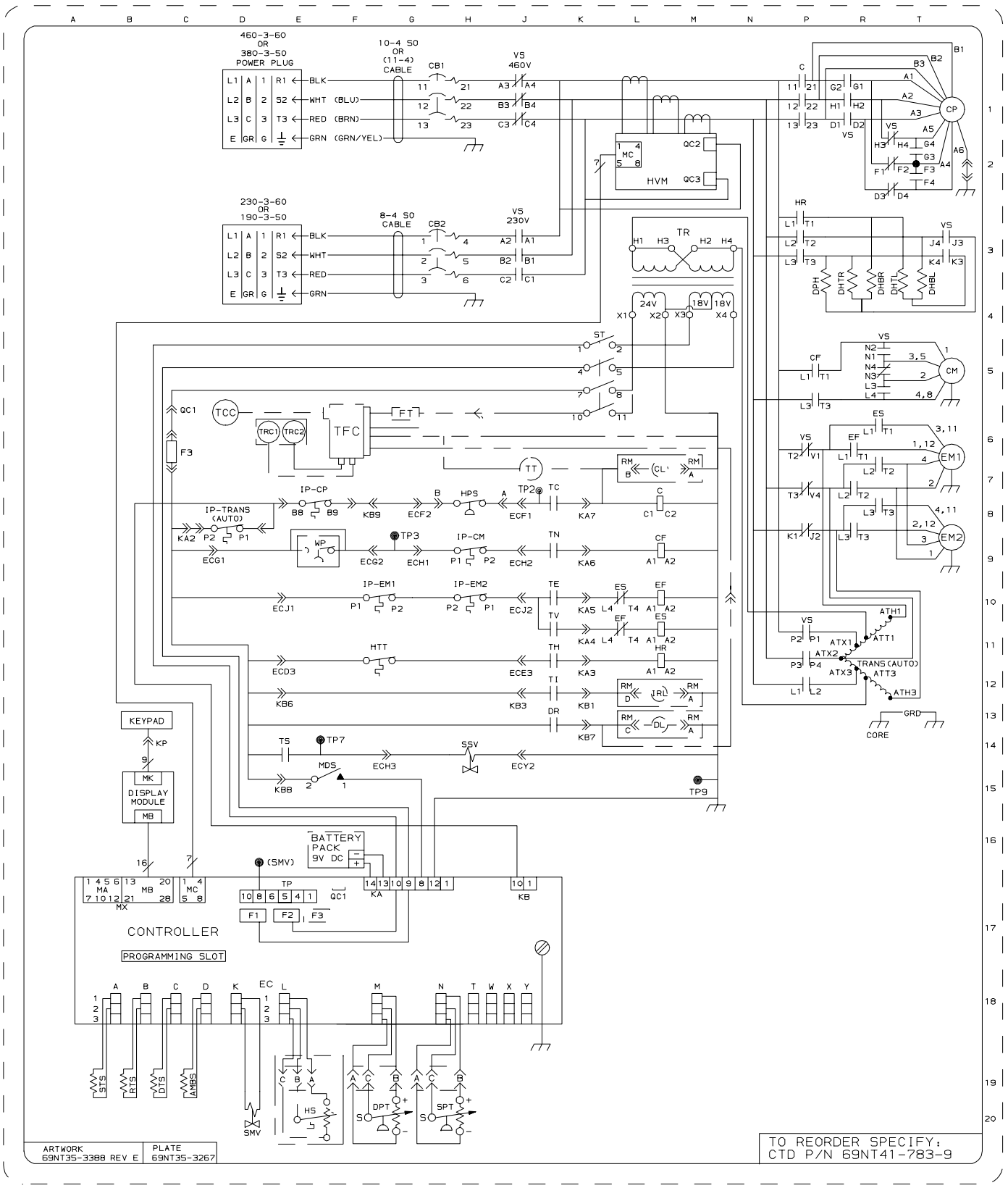


Figure 5-11. Electrical Schematic – Model 69NT40-489-6,-489-75
(Sheet 2 of 2)

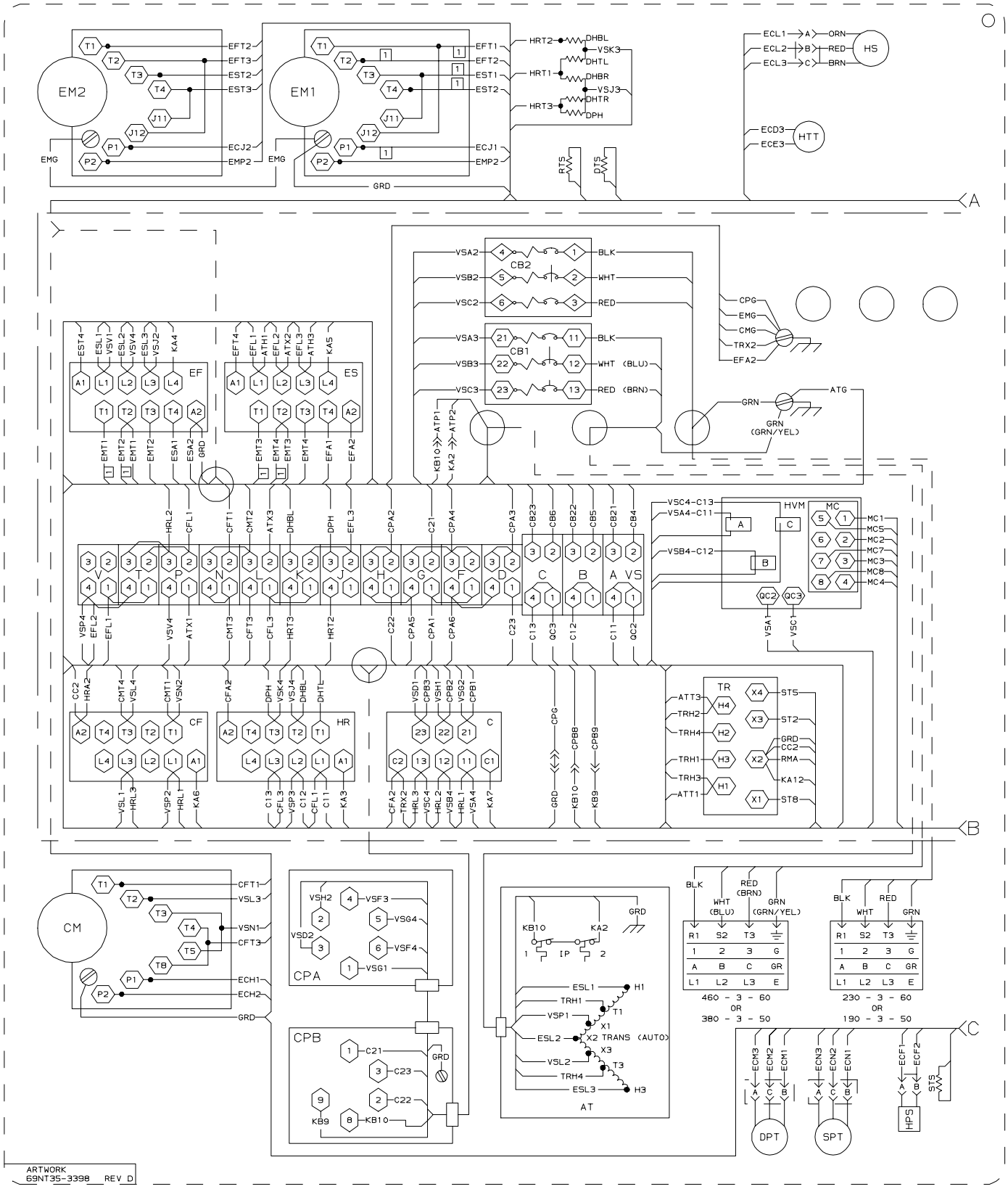


Figure 5-12. Electrical Wiring Diagram – Model 69NT40-489-6,-489-75 (Sheet 1 of 2)

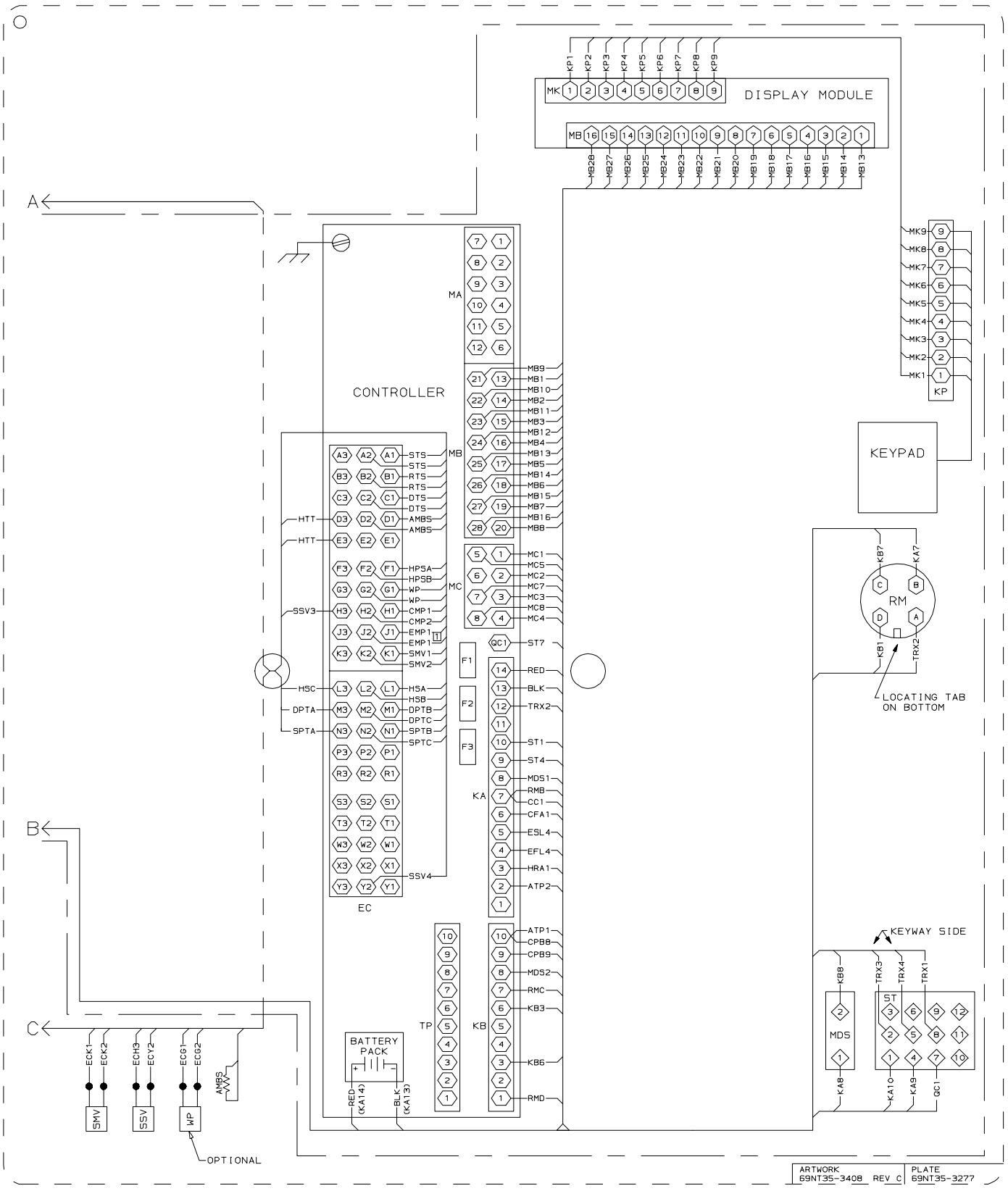


Figure 5-12. Electrical Wiring Diagram – Model 69NT40-489-6,-489-75 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
L8,P1	C	—	COMPRESSOR CONTACTOR
G1	CB1	—	CIRCUIT BREAKER 460V
G3	CB2	—	CIRCUIT BREAKER 230V
L9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (LIGHT)
P4	DPH	—	DRAIN PAN HEATER
K13	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P6,P8,P9,L10, G10,H10,T7,T9	EF	—	EVAPORATOR FAN CONTACTOR
	EM	—	EVAPORATOR FAN MOTOR
C7,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
L11,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G11	HTT	—	HEAT TERMINATION THERMOSTAT
M2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
G10,H8,H9,H10	IP	—	INTERNAL PROTECTOR
L12	IRL	—	IN-RANGE LIGHT (OPTION)
C14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
M19,N19,P19,R19	PR	—	PROBE RECEPTACLE (USDA)(OPTION)
L7,L12,L13	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H14	SSV	—	SUCTION SOLENOID VALVE
L5	ST	—	START-STOP SWITCH (CIRCUIT BREAKER)
C19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
E6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K11	TH	—	CONTROLLER RELAY (HEATING)
K12	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
G8,G9,G14, M14,D16	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
R5,R6,R8,J1, J3,T3,R1,R2	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-13. Electrical Schematic – Model 69NT40-489-12 – Prior to Serial # 90234597 (Sheet 1 of 2)

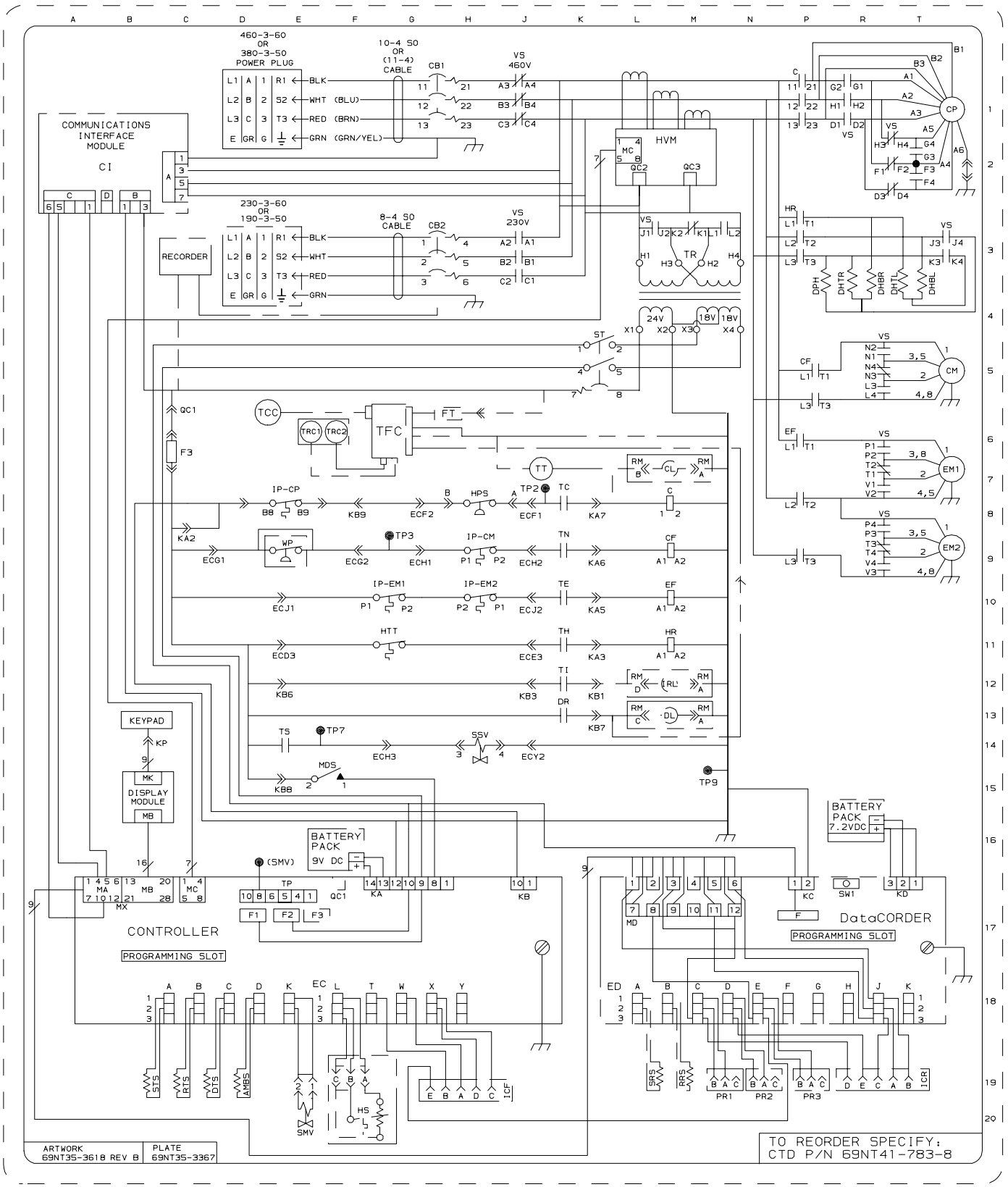


Figure 5-13. Electrical Schematic – Model 69NT40-489-12 – Prior to Serial # 90234597 (Sheet 2 of 2)

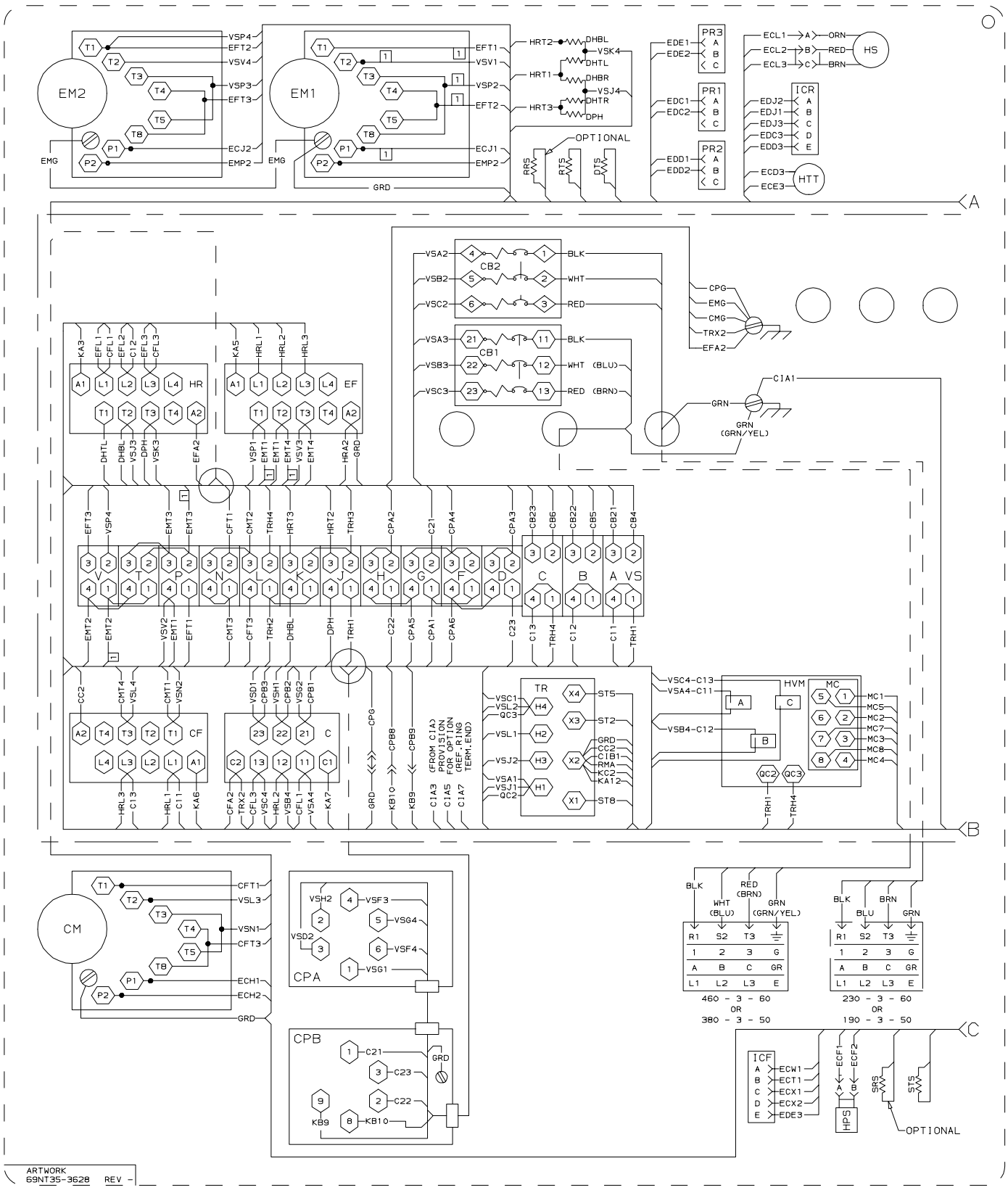


Figure 5-14. Electrical Wiring Diagram – Model 69NT40-489-12 – Prior to Serial # 90234597 (Sheet 1 of 2)

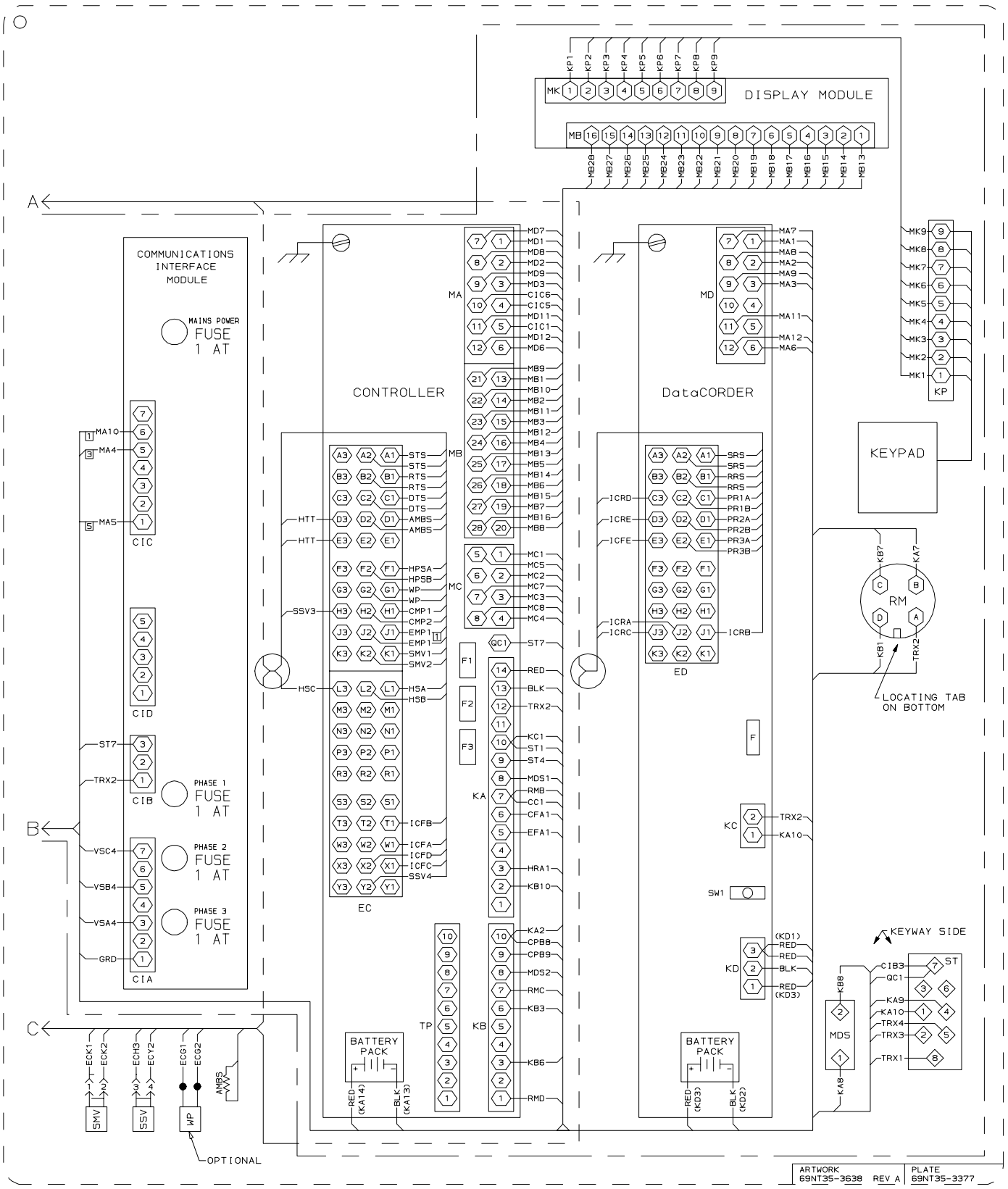


Figure 5-14. Electrical Wiring Diagram – Model 69NT40-489-12 – Prior to Serial # 90234597 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
L8,P1	C	—	COMPRESSOR CONTACTOR
G1	CB1	—	CIRCUIT BREAKER 460V
G3	CB2	—	CIRCUIT BREAKER 230V
L9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (LIGHT)
P4	DPH	—	DRAIN PAN HEATER
K13	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P6,P8,P9,L10, G10,H10,T7,T9	EF	—	EVAPORATOR FAN CONTACTOR
	EM	—	EVAPORATOR FAN MOTOR
C7,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
L11,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G11	HTT	—	HEAT TERMINATION THERMOSTAT
M2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
G10,H8,H9,H10	IP	—	INTERNAL PROTECTOR
L12	IRL	—	IN-RANGE LIGHT (OPTION)
C14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
M19,N19,P19,R19	PR	—	PROBE RECEPTACLE (USDA)(OPTION)
L7,L12,L13	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H14	SSV	—	SUCTION SOLENOID VALVE
L5	ST	—	START-STOP SWITCH (CIRCUIT BREAKER)
C19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
E6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K11	TH	—	CONTROLLER RELAY (HEATING)
K12	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
G8,G9,G14, M14,D16	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
R5,R6,R8,J1, J3,T3,R1,R2	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-15. Electrical Schematic – Model 69NT40-489-12 – Starting with Serial # 90234597 (Sheet 1 of 2)

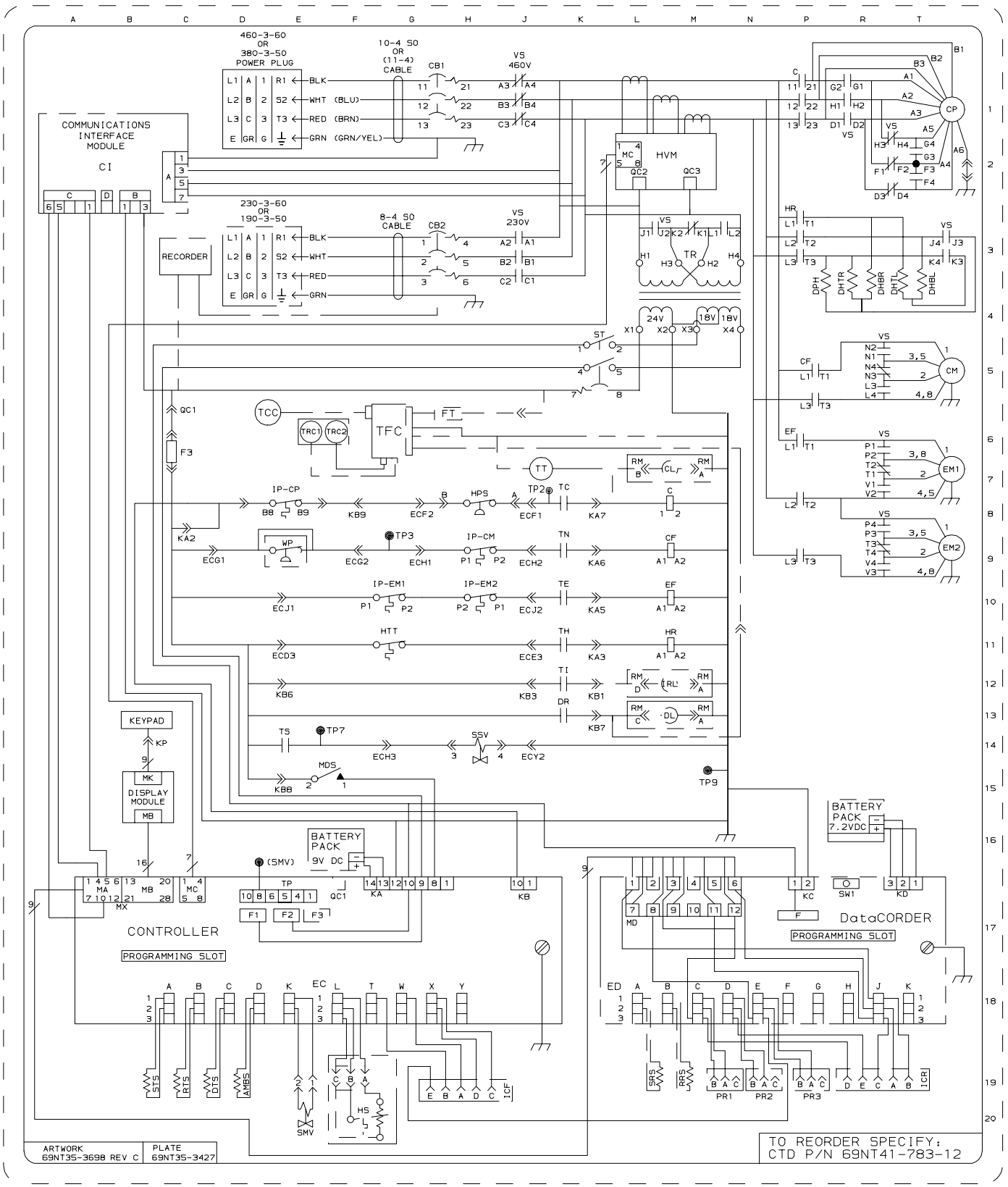


Figure 5-15. Electrical Schematic – Model 69NT40-489-12 – Starting with Serial # 90234597 (Sheet 2 of 2)

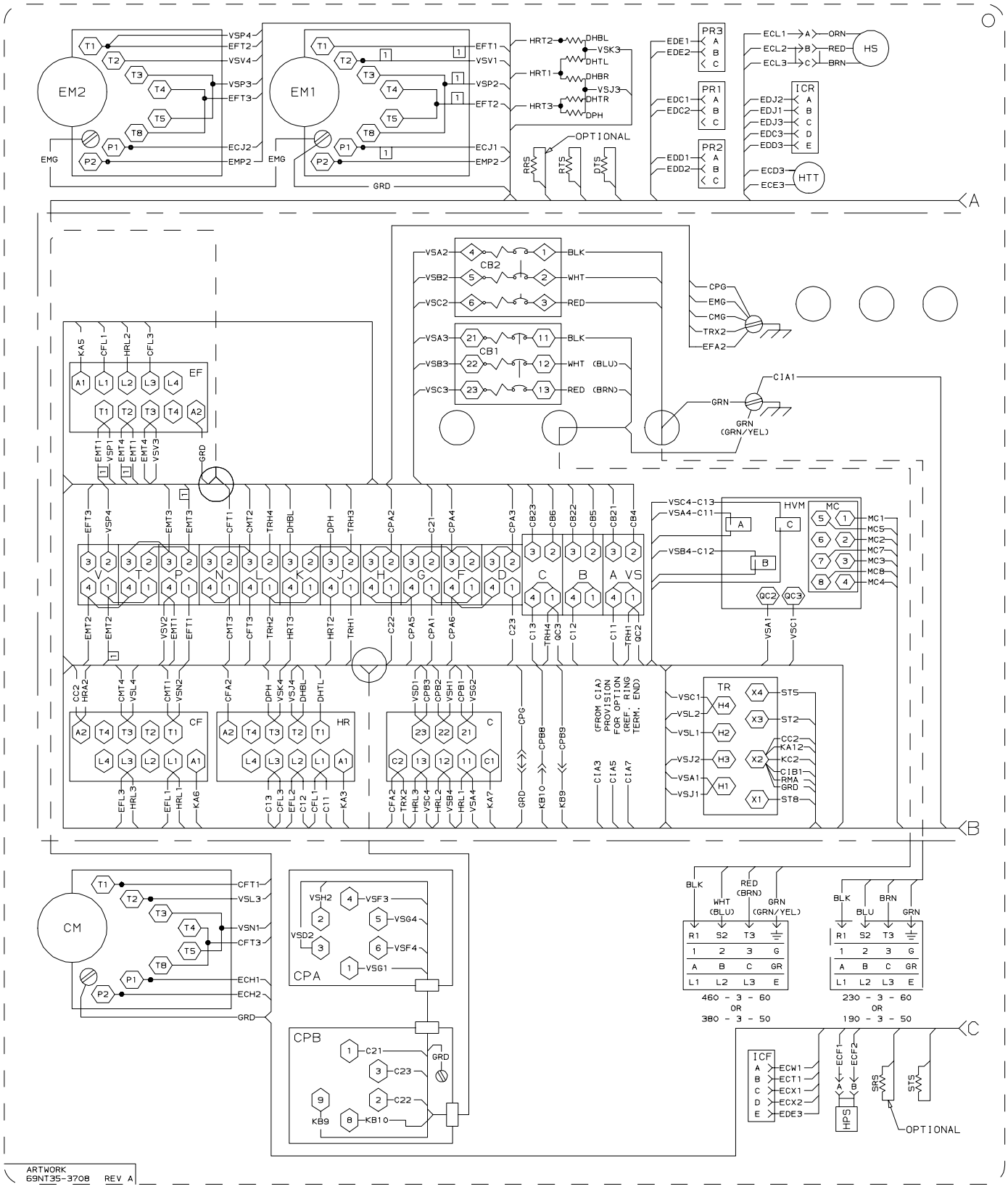


Figure 5-16. Electrical Wiring Diagram – Model 69NT40-489-12 – Starting with Serial # 90234597 (Sheet 1 of 2)

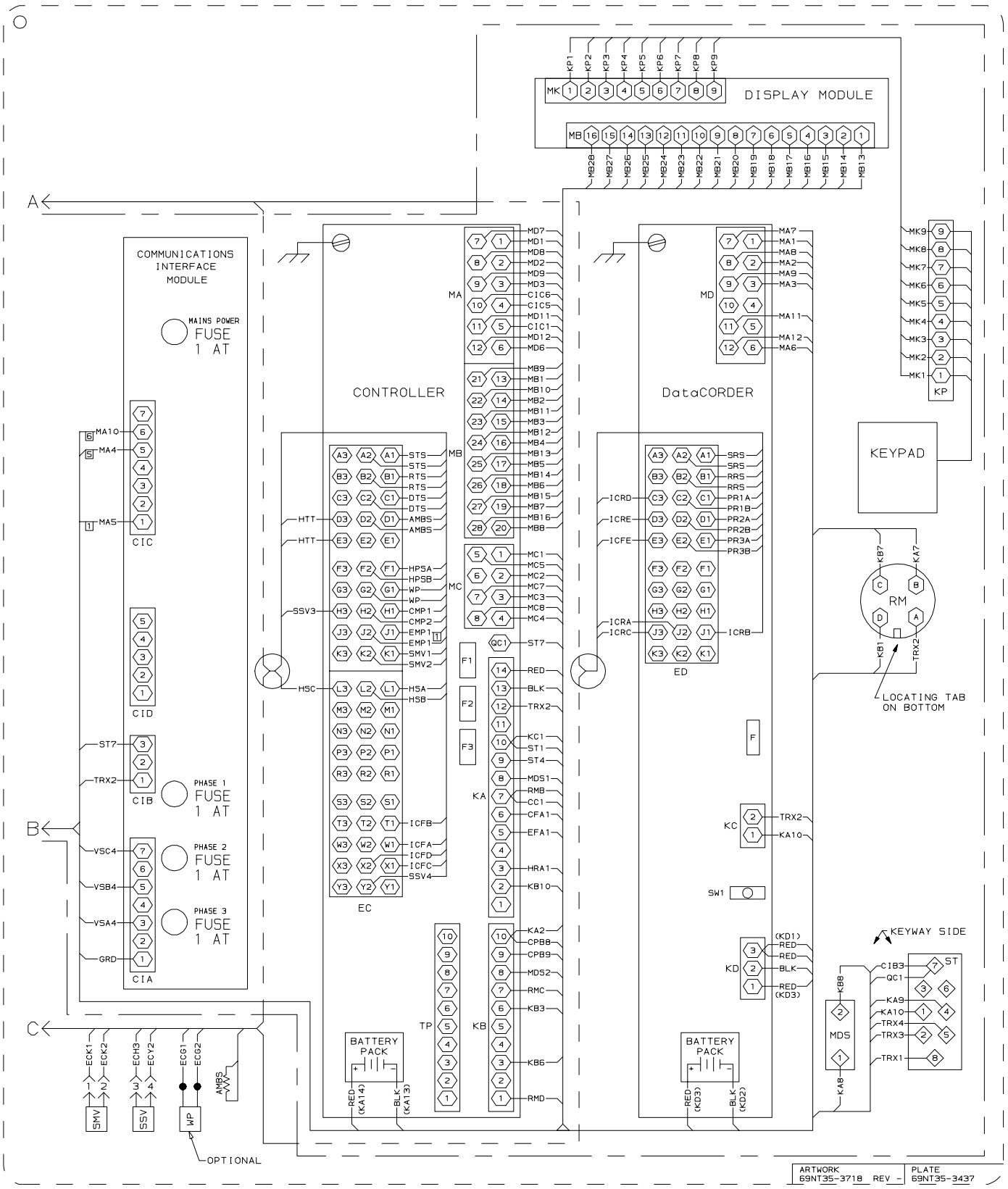


Figure 5-16. Electrical Wiring Diagram – Model 69NT40-489-12 – Starting with Serial # 90234597 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
E8,G10,H9,H10	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
B19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-17. Electrical Schematic – Models 69NT40-489-17,-489-23,-489-25,-489-59,-489-61,-489-64,-489-66,-489-67,-489-70,-489-71 & (Model 69NT40-489-13 – Starting with Serial # 90234597) (Sheet 1 of 2)

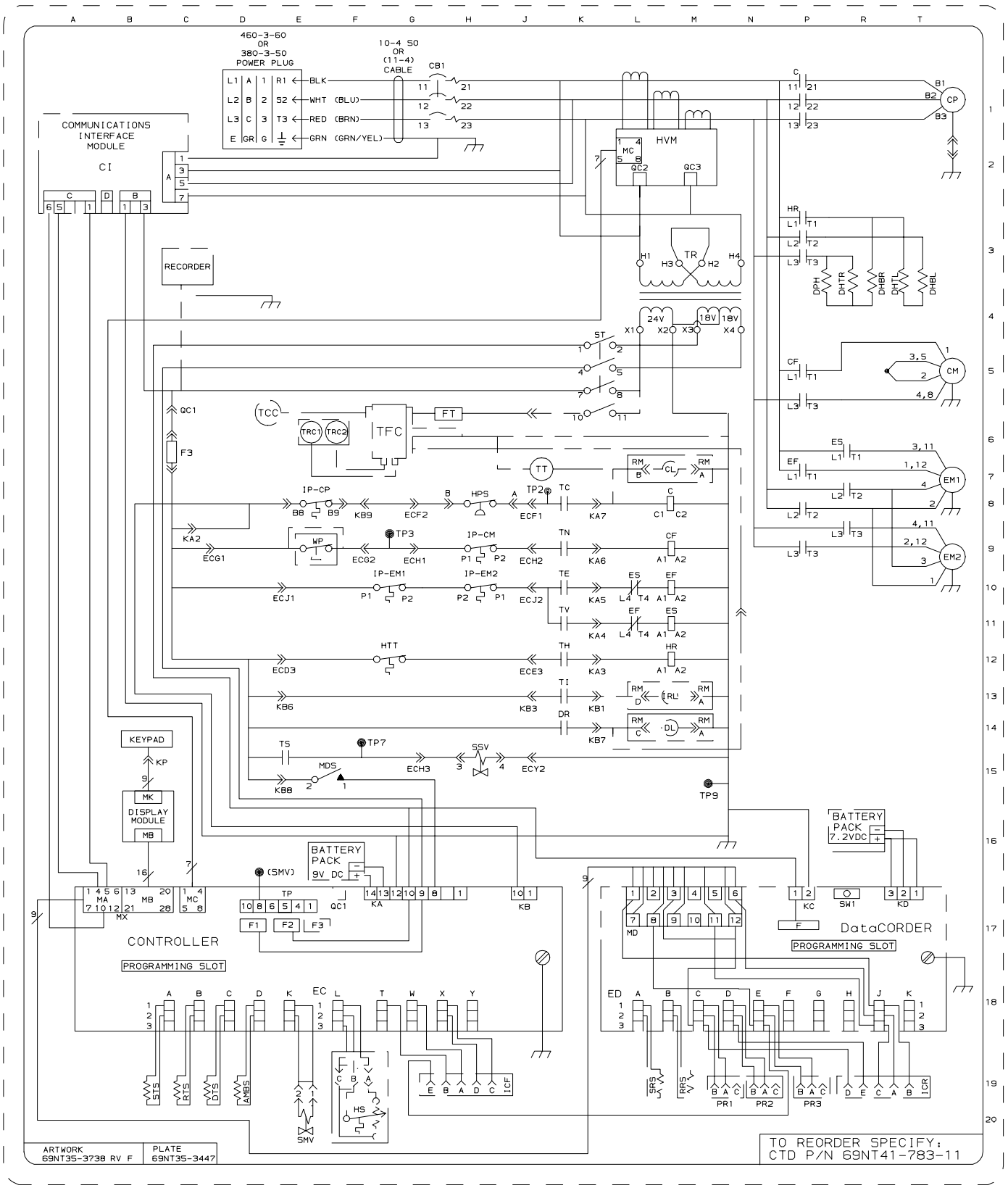


Figure 5-17. Electrical Schematic – Models 69NT40-489-17,-489-23,-489-25,-489-59,-489-61,-489-64,-489-66,-489-67,-489-70,-489-71 & (Model 69NT40-489-13 – Starting with Serial # 90234597) (Sheet 2 of 2)

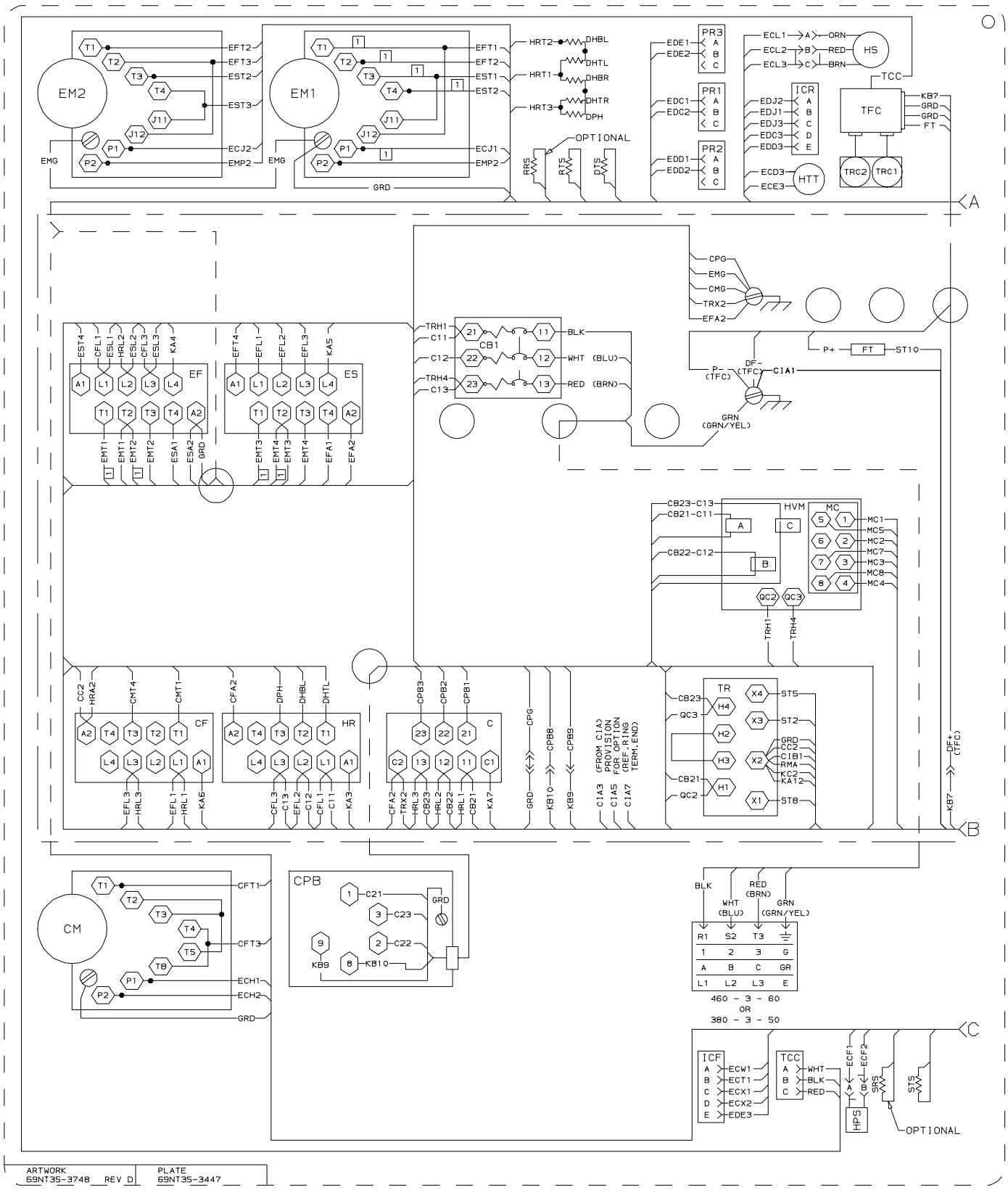


Figure 5-18. Electrical Wiring Diagram – Models 69NT40-489-17,-489-23,-489-25,-489-59,-489-61,-489-64,-489-66,-489-67,-489-70,-489-71 & (Model 69NT40-489-13 – Starting with Serial # 90234597) (Sheet 1 of 2)

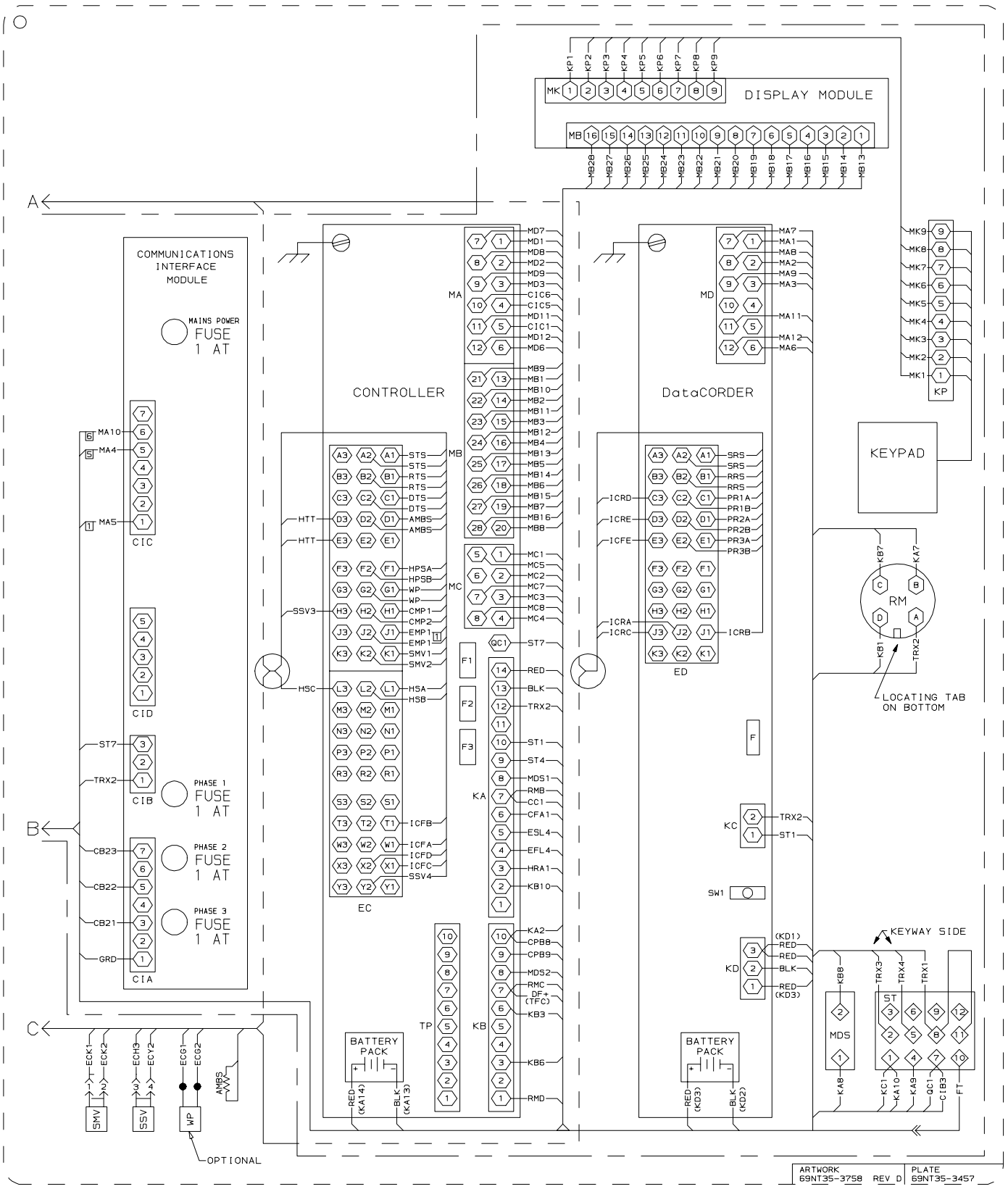


Figure 5-18. Electrical Wiring Diagram – Models 69NT40-489-17,-489-23,-489-25,-489-59,-489-61,-489-64,-489-66,-489-67,-489-70,-489-71 & (Model 69NT40-489-13 – Starting with Serial # 90234597) (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
L8,P1	C	—	COMPRESSOR CONTACTOR
G1	CB1	—	CIRCUIT BREAKER 460V
G3	CB2	—	CIRCUIT BREAKER 230V
L9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (LIGHT)
P4	DPH	—	DRAIN PAN HEATER
K13	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P6,P8,P9,L10, G10,H10,T7,T9	EF	—	EVAPORATOR FAN CONTACTOR
	EM	—	EVAPORATOR FAN MOTOR
C7,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
L11,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G11	HTT	—	HEAT TERMINATION THERMOSTAT
M2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
G10,H8,H9,H10	IP	—	INTERNAL PROTECTOR
L12	IRL	—	IN-RANGE LIGHT (OPTION)
C14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
M19,N19,P19,R19	PR	—	PROBE RECEPTACLE (USDA)(OPTION)
L7,L12,L13	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H14	SSV	—	SUCTION SOLENOID VALVE
L5	ST	—	START-STOP SWITCH (CIRCUIT BREAKER)
C19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
E6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K11	TH	—	CONTROLLER RELAY (HEATING)
K12	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
G8,G9,G14, M14,D16	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
R5,R6,R8,J1, J3,T3,R1,R2	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-19. Electrical Schematic – Model 69NT40-489-26,-489-52,-489-60 & (Model 69NT40-489-1 – Starting with Serial # 90234597) (Sheet 1 of 2)

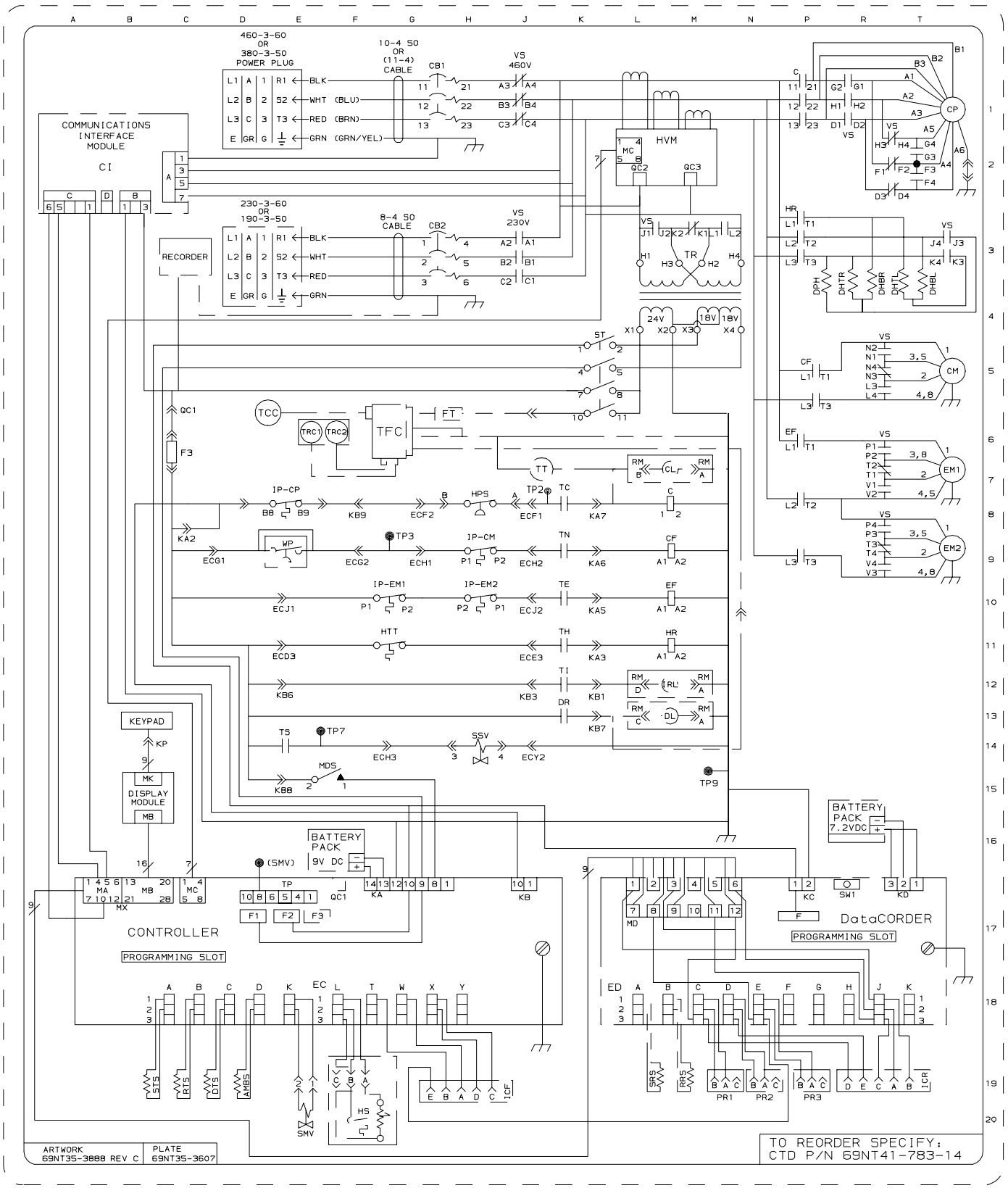


Figure 5-19. Electrical Schematic – Model 69NT40-489-26,-489-52,-489-60 &
(Model 69NT40-489-1 – Starting with Serial # 90234597)
(Sheet 2 of 2)

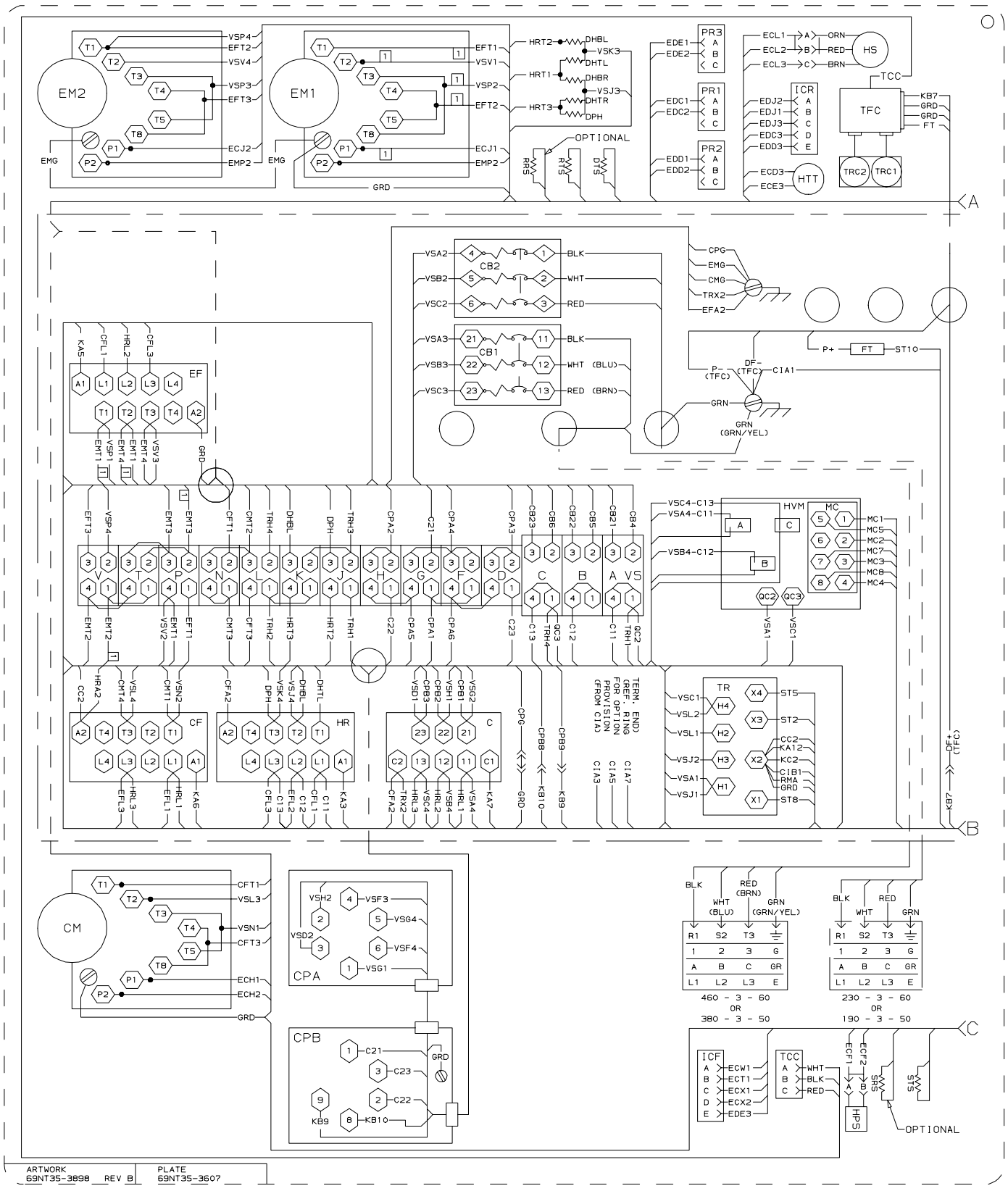


Figure 5-20. Electrical Wiring Diagram – Model 69NT40-489-26,-489-52,-489-60 & (Model 69NT40-489-1 – Starting with Serial # 90234597) (Sheet 1 of 2)

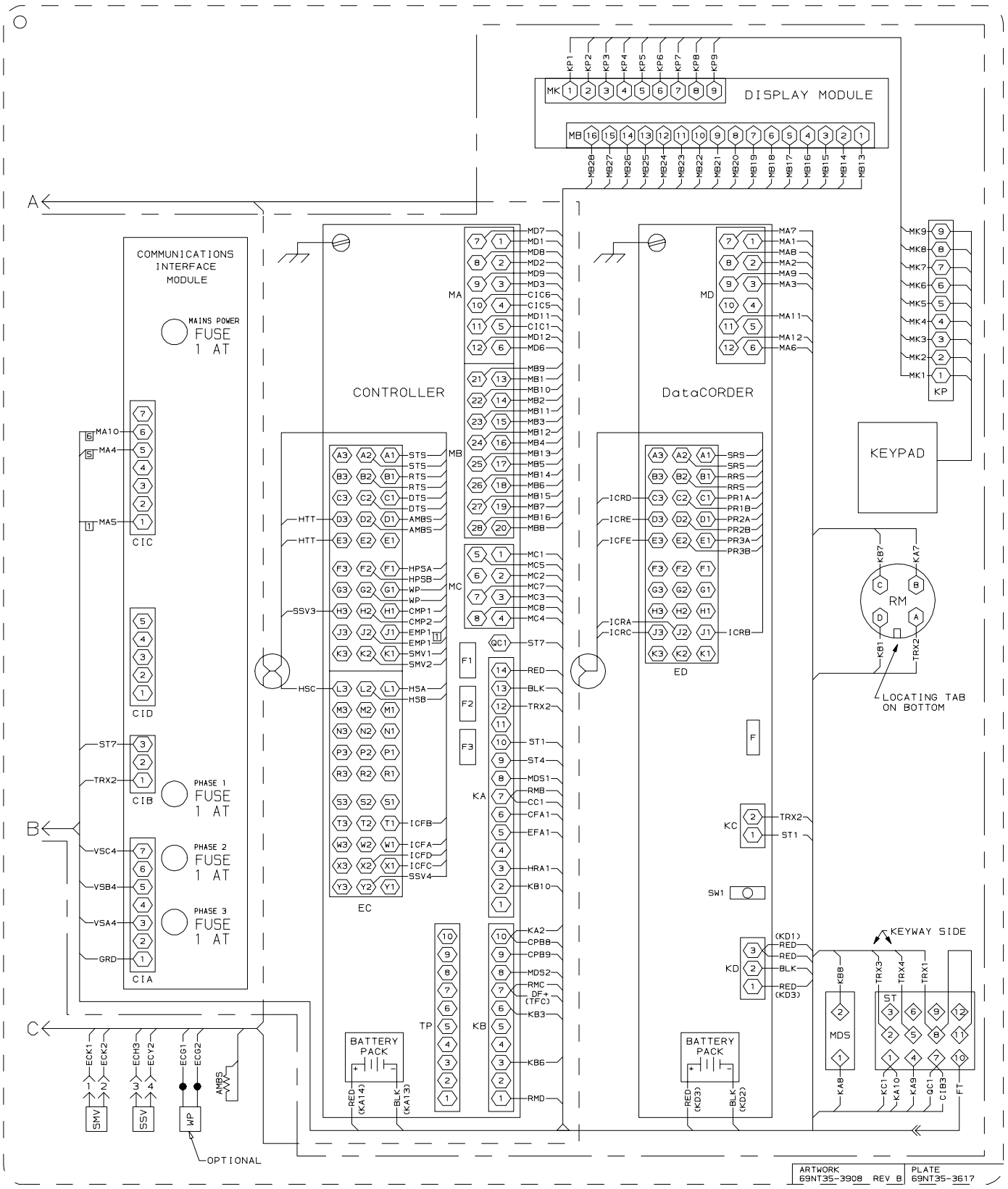


Figure 5-20. Electrical Wiring Diagram – Model 69NT40-489-26,-489-52,-489-60 & (Model 69NT40-489-1 – Starting with Serial # 90234597) (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
F3	CB2	—	CIRCUIT BREAKER 230V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
E8,G10,H9 H10,C8	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
B19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
H3,C8	TRANS	—	TRANSFORMER (AUTO 230/460)
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)
J1,J3	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-21. Electrical Schematic – Model 69NT40-489-3 – Starting with Serial # 90234597 (Sheet 1 of 2)

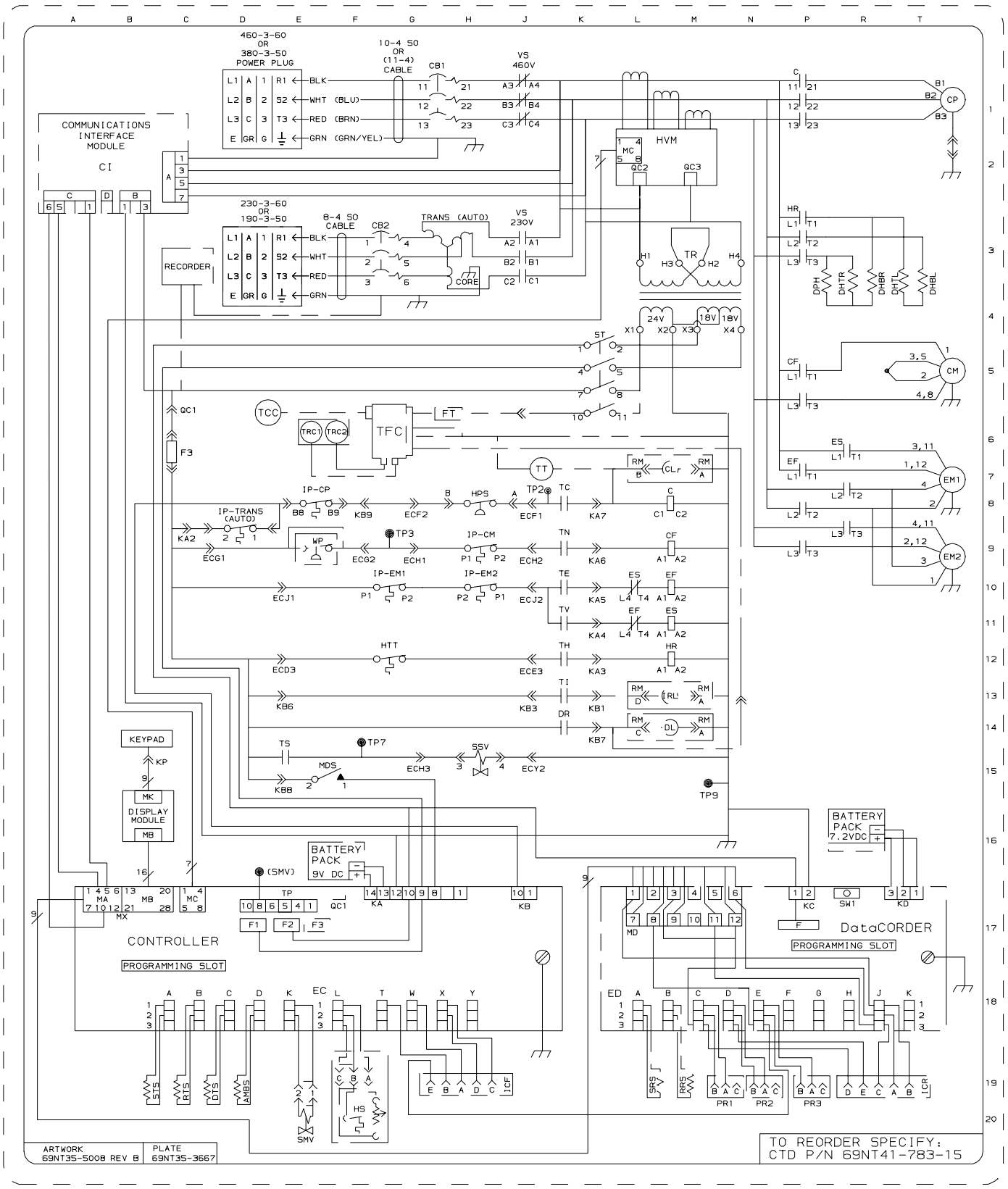


Figure 5-21. Electrical Schematic – Model 69NT40-489-3 – Starting with Serial # 90234597 (Sheet 2 of 2)

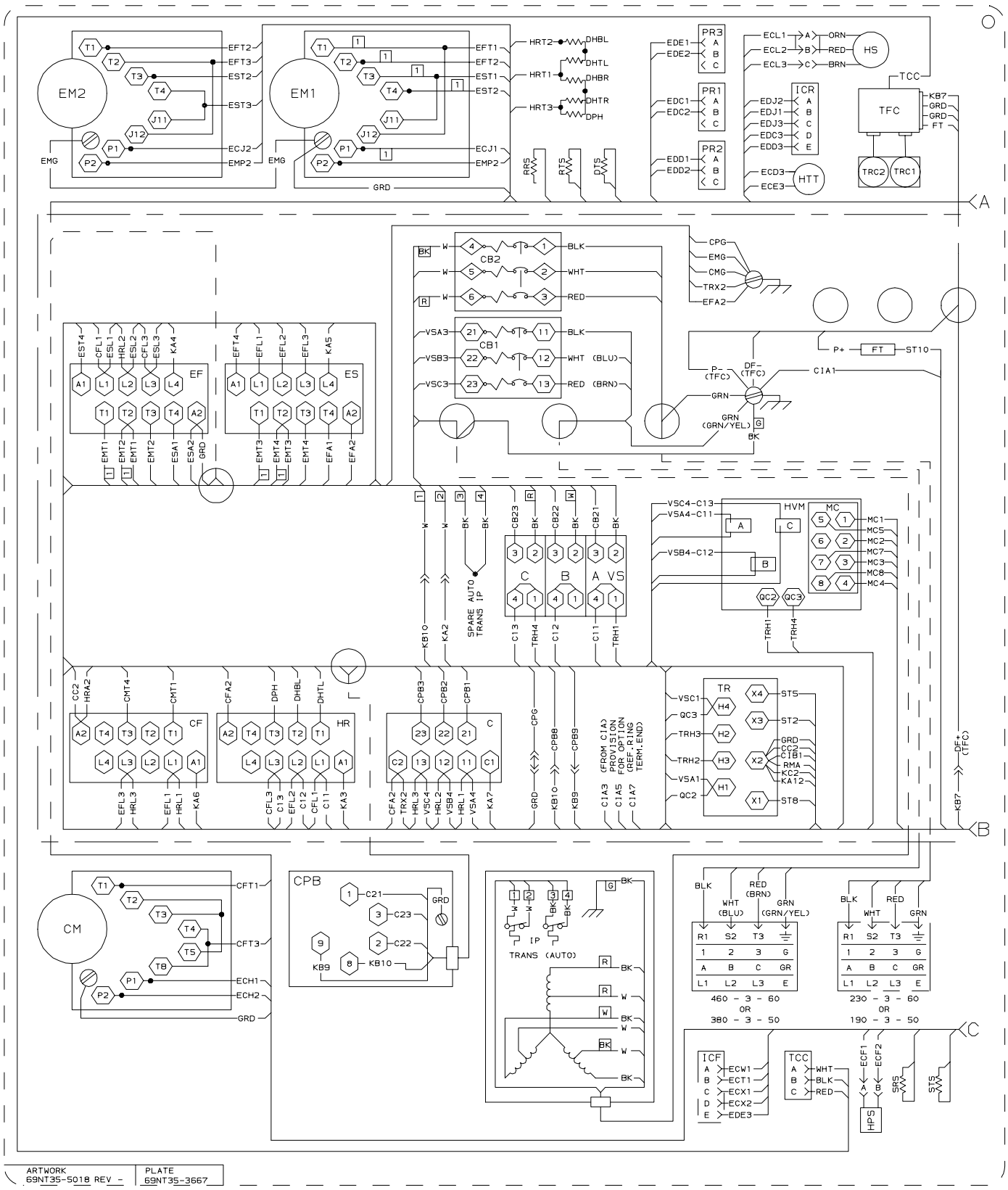


Figure 5-22. Electrical Wiring Diagram – Model 69NT40-489-3 – Starting with Serial # 90234597 (Sheet 1 of 2)

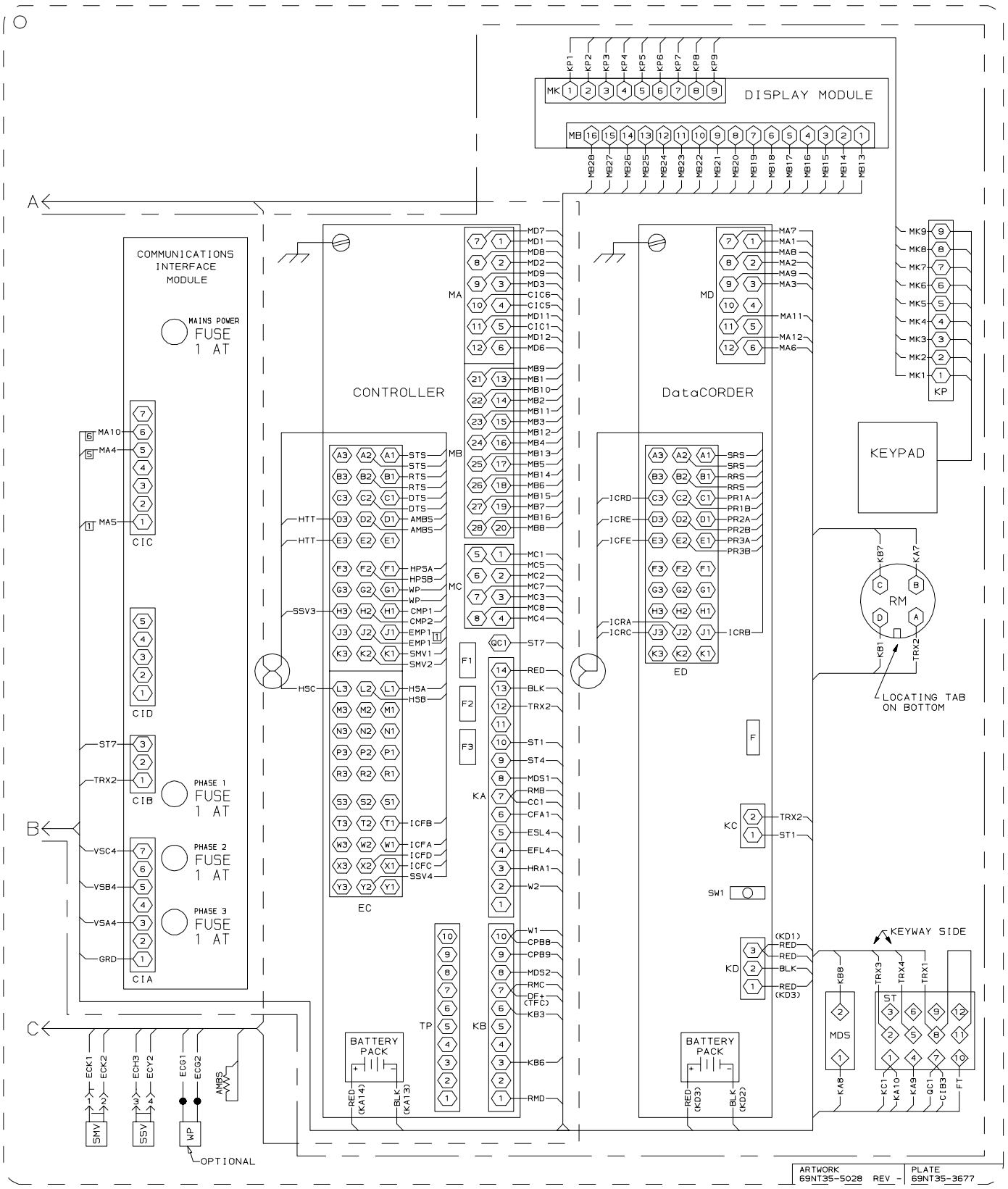


Figure 5-22. Electrical Wiring Diagram – Model 69NT40-489-3 – Starting with Serial # 90234597 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
F3	CB2	—	CIRCUIT BREAKER 230V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
E8,G10,H9 H10,C8	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
B19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
H3,C8	TRANS	—	TRANSFORMER (AUTO 230/460)
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)
J1,J3	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-23. Electrical Schematic – Models 69NT40-489-14,-489-15,-489-18,-489-21,-489-54,-489-56,-489-58,-489-63,-489-65,-489-68,-489-77,-79,-83 & (Models 69NT40-489-5,-489-9 – Starting with Serial # 90234597) (Sheet 1 of 2)

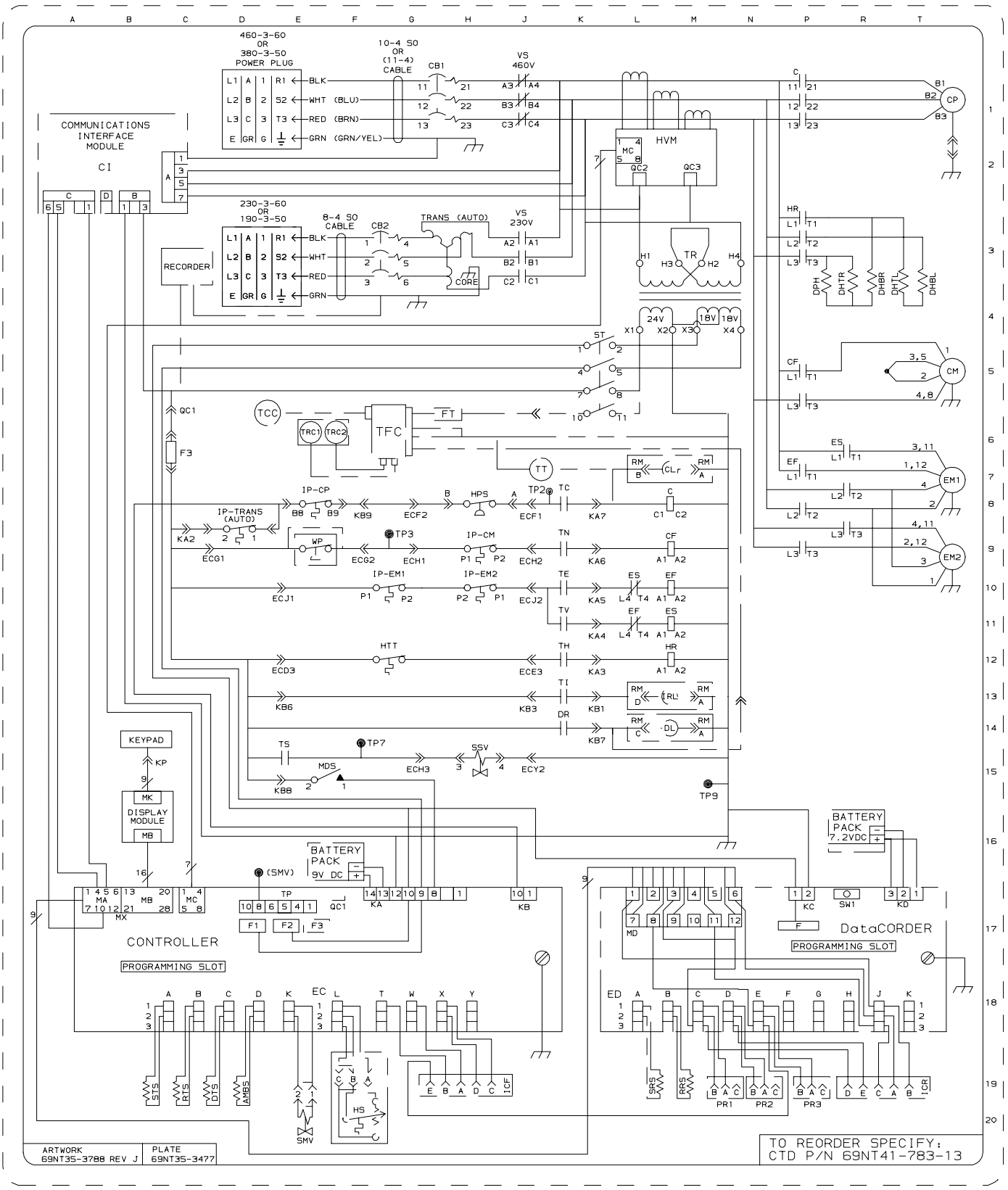


Figure 5-23. Electrical Schematic – Models 69NT40-489-14,-489-15,-489-18,-489-21,-489-54,-489-56,-489-58,-489-63,-489-65,-489-68,-489-77,-79,-83 & (Models 69NT40-489-5,-489-9 – Starting with Serial # 90234597) (Sheet 2 of 2)

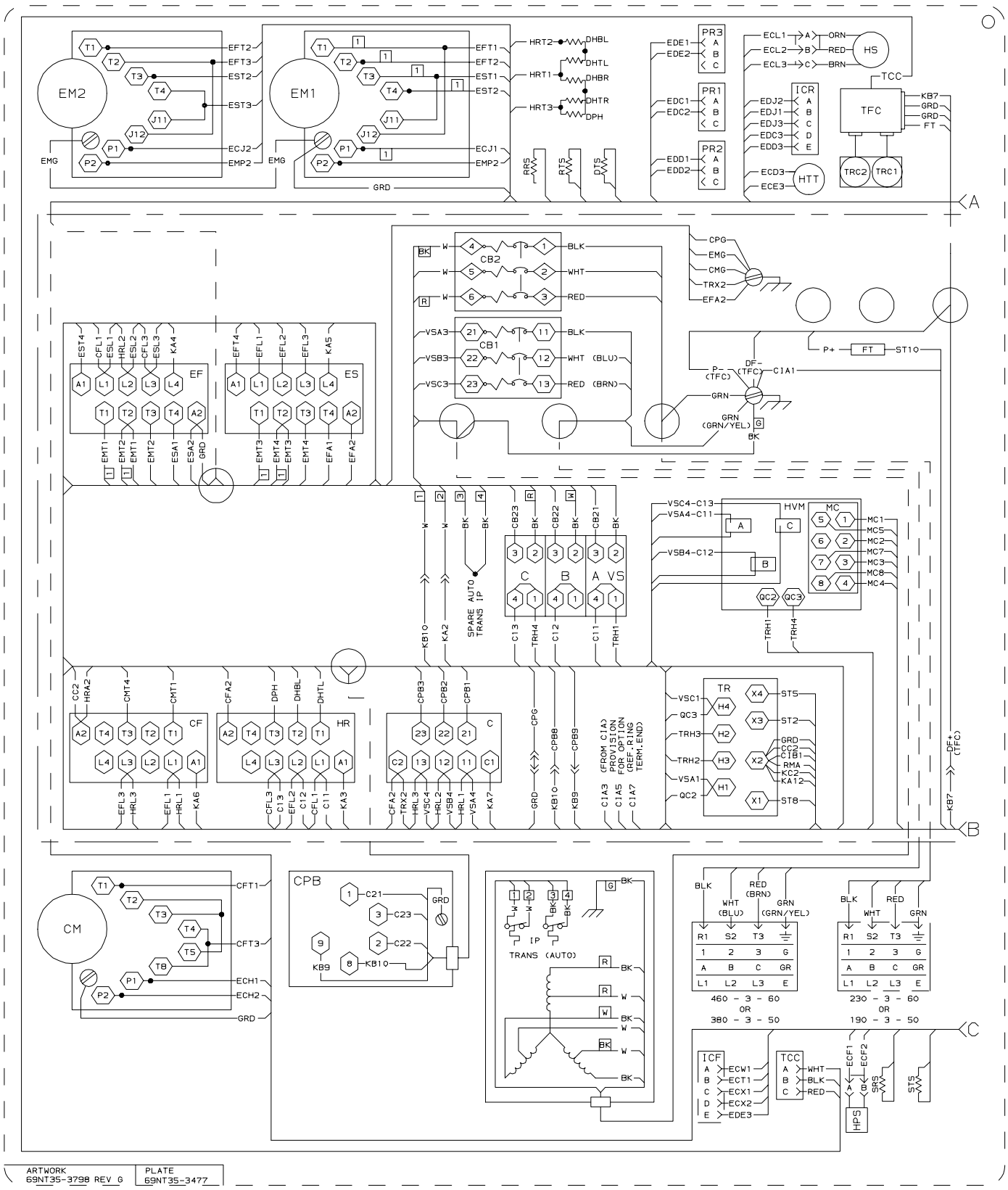


Figure 5-24. Electrical Wiring Diagram – Models 69NT40-489-14,-489-15,-489-18,-489-21,-489-54,-489-56,-489-58,-489-63,-489-65,-489-68,-489-77,-79,-83 & (Models 69NT40-489-5,-489-9 – Starting with Serial # 90234597) (Sheet 1 of 2)

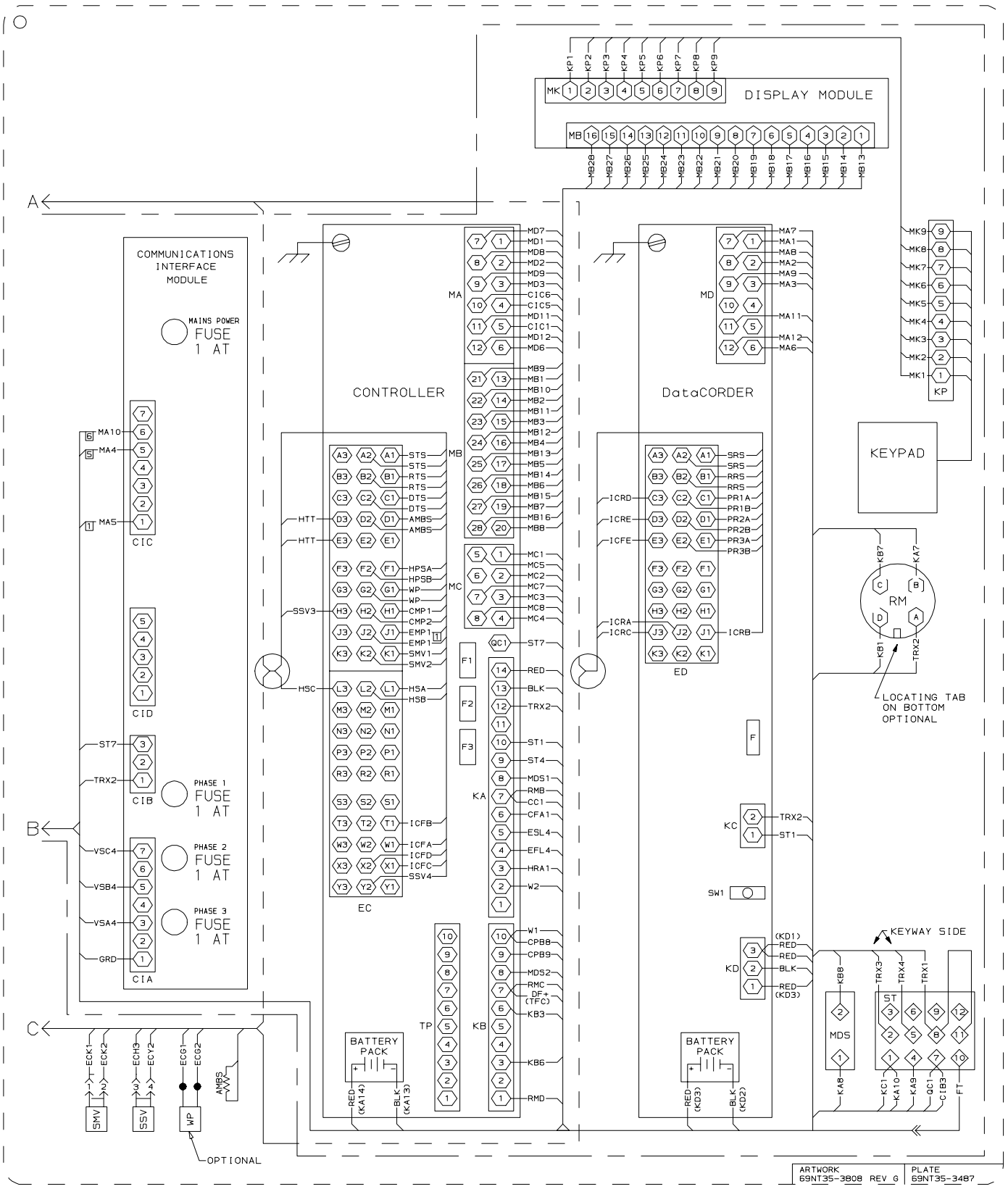


Figure 5-24. Electrical Wiring Diagram – Models 69NT40-489-14,-489-15,-489-18,-489-21,-489-54,-489-56,-489-58,-489-63,-489-65,-489-68,-489-77,-79,-83 & (Models 69NT40-489-5,-489-9 – Starting with Serial # 90234597) (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
L8,P1	C	—	COMPRESSOR CONTACTOR
G1	CB1	—	CIRCUIT BREAKER 460V
G3	CB2	—	CIRCUIT BREAKER 230V
L9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (LIGHT)
P4	DPH	—	DRAIN PAN HEATER
K13	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P6,P8,P9,L10, G10,H10,T7,T9	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
	EM	—	EVAPORATOR FAN MOTOR
L10,R6,R7,R8	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C7,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
L11,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G11	HTT	—	HEAT TERMINATION THERMOSTAT
M2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
D8,E7,H9,F10,H10	IP	—	INTERNAL PROTECTOR
L12	IRL	—	IN-RANGE LIGHT (OPTION)
C14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
M19,N19,P19,R19	PR	—	PROBE RECEPTACLE (USDA) (OPTION)
L7,L12,L13	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H14	SSV	—	SUCTION SOLENOID VALVE
L5	ST	—	START-STOP SWITCH (CIRCUIT BREAKER)
C19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
E6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K11	TH	—	CONTROLLER RELAY (HEATING)
K12	TI	—	IN-RANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
G8,G9,G14, M14,D16	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
H5,R10,R11	TRANS	—	TRANSFORMER (AUTO 230/460)
F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K10	TV	—	CONTROLLER RELAY (LOW SPEED EVAP.)
P6,P7,P8,P10, P11,J1,J3,T3,R1, R2,R5	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-25. Electrical Schematic – Model 69NT40-489-19 (Sheet 1 of 2)

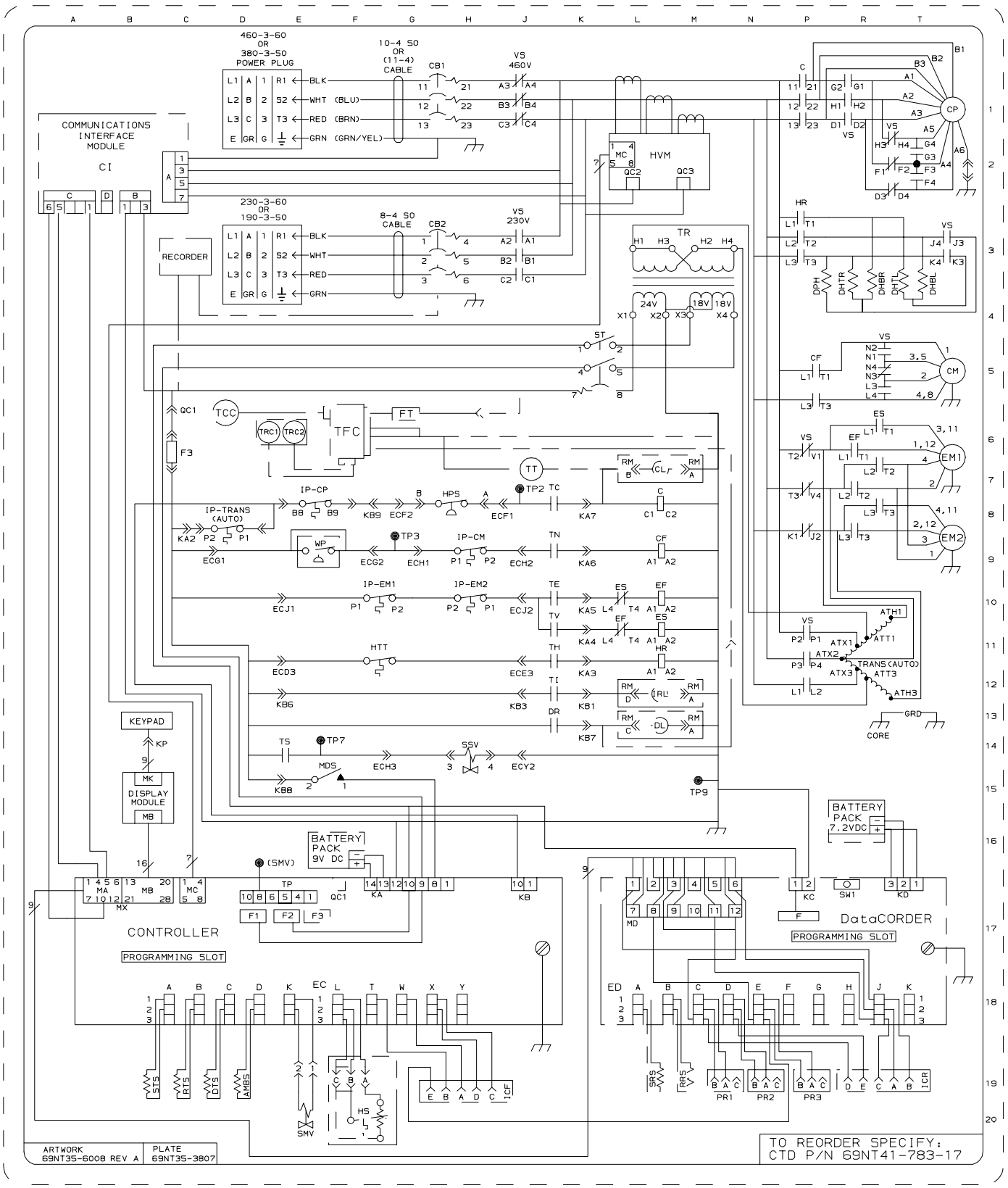


Figure 5-25. Electrical Schematic – Model 69NT40-489-19
(Sheet 2 of 2)

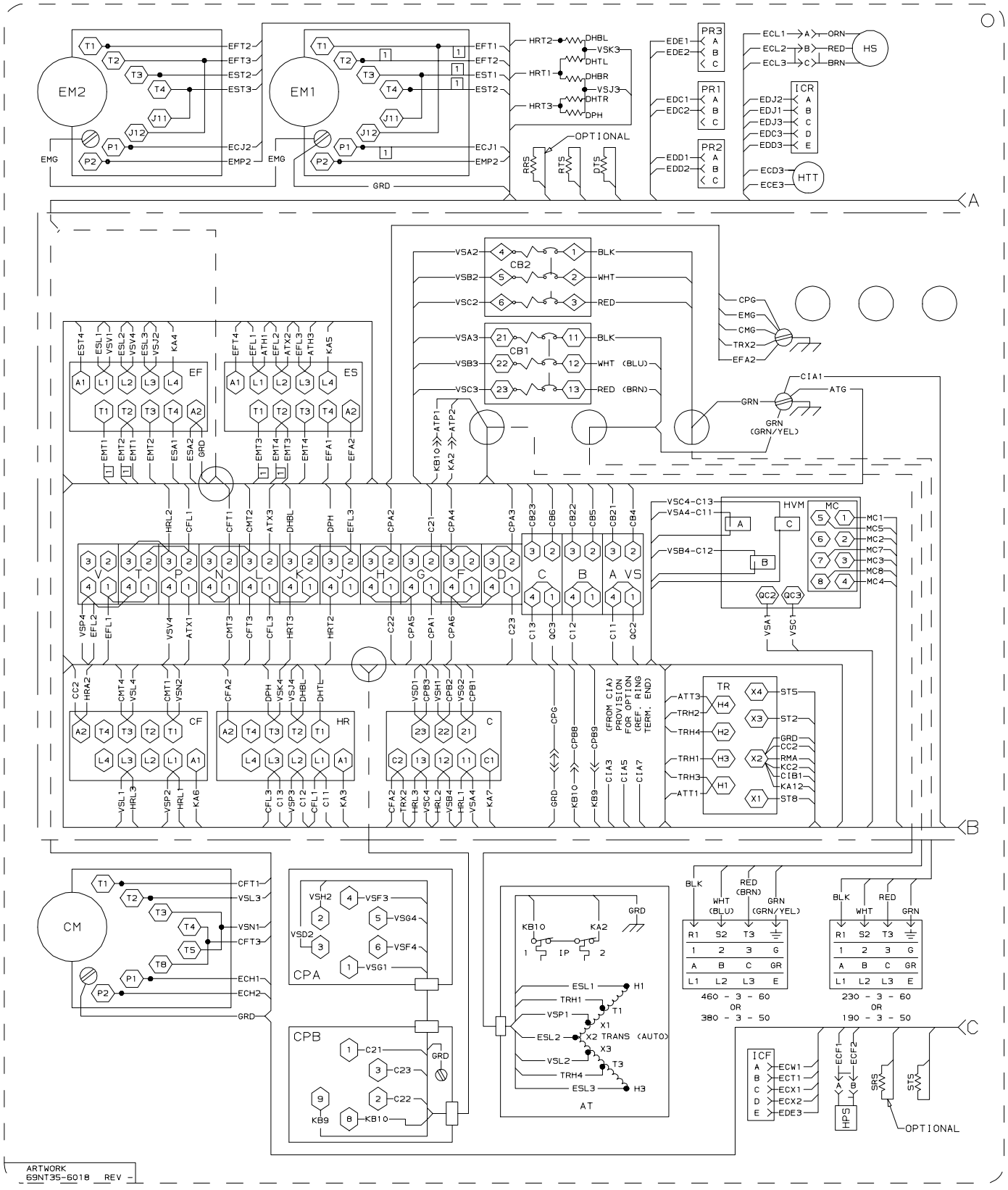


Figure 5-26. Electrical Wiring Diagram – Model 69NT40-489-19 (Sheet 1 of 2)

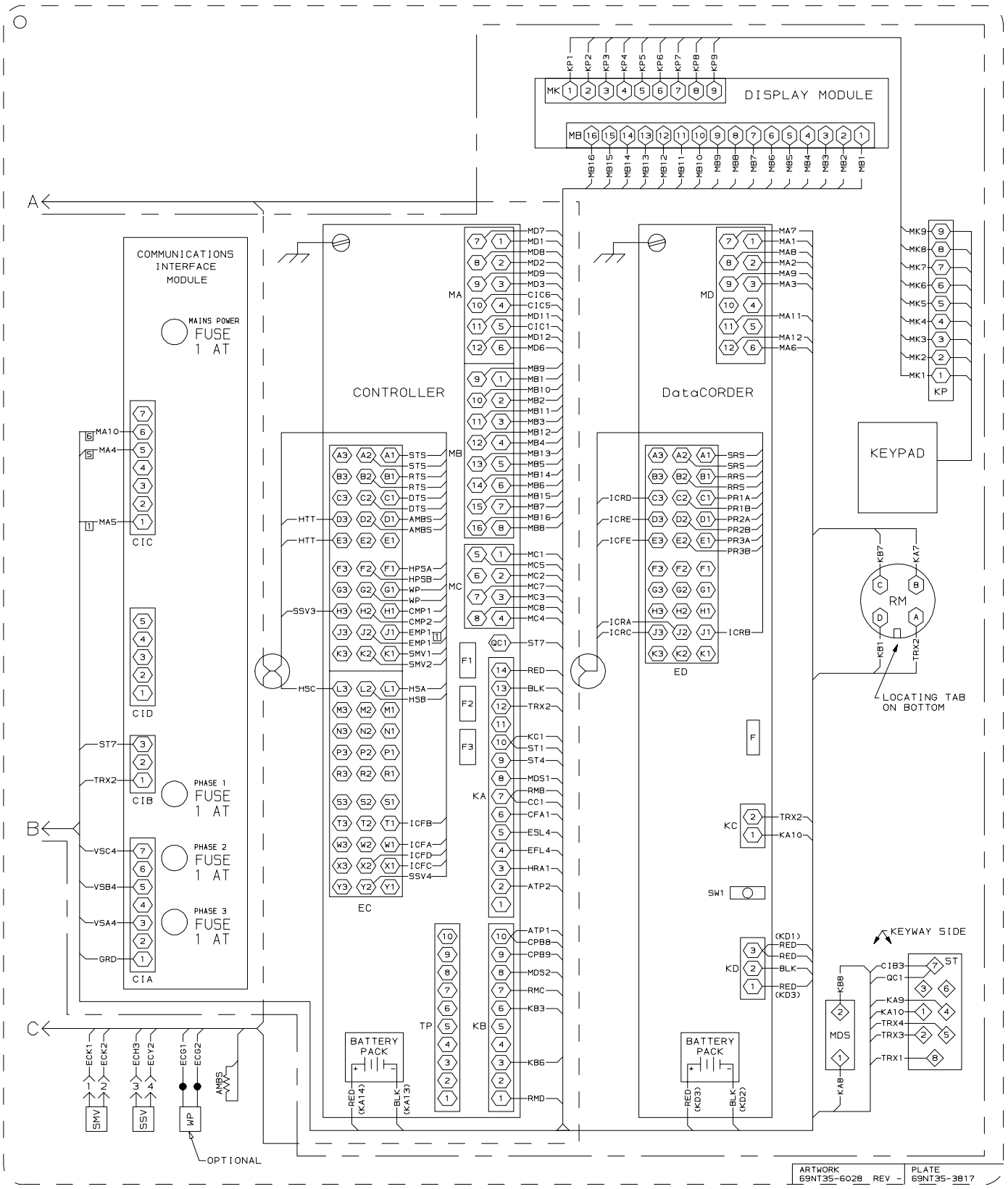
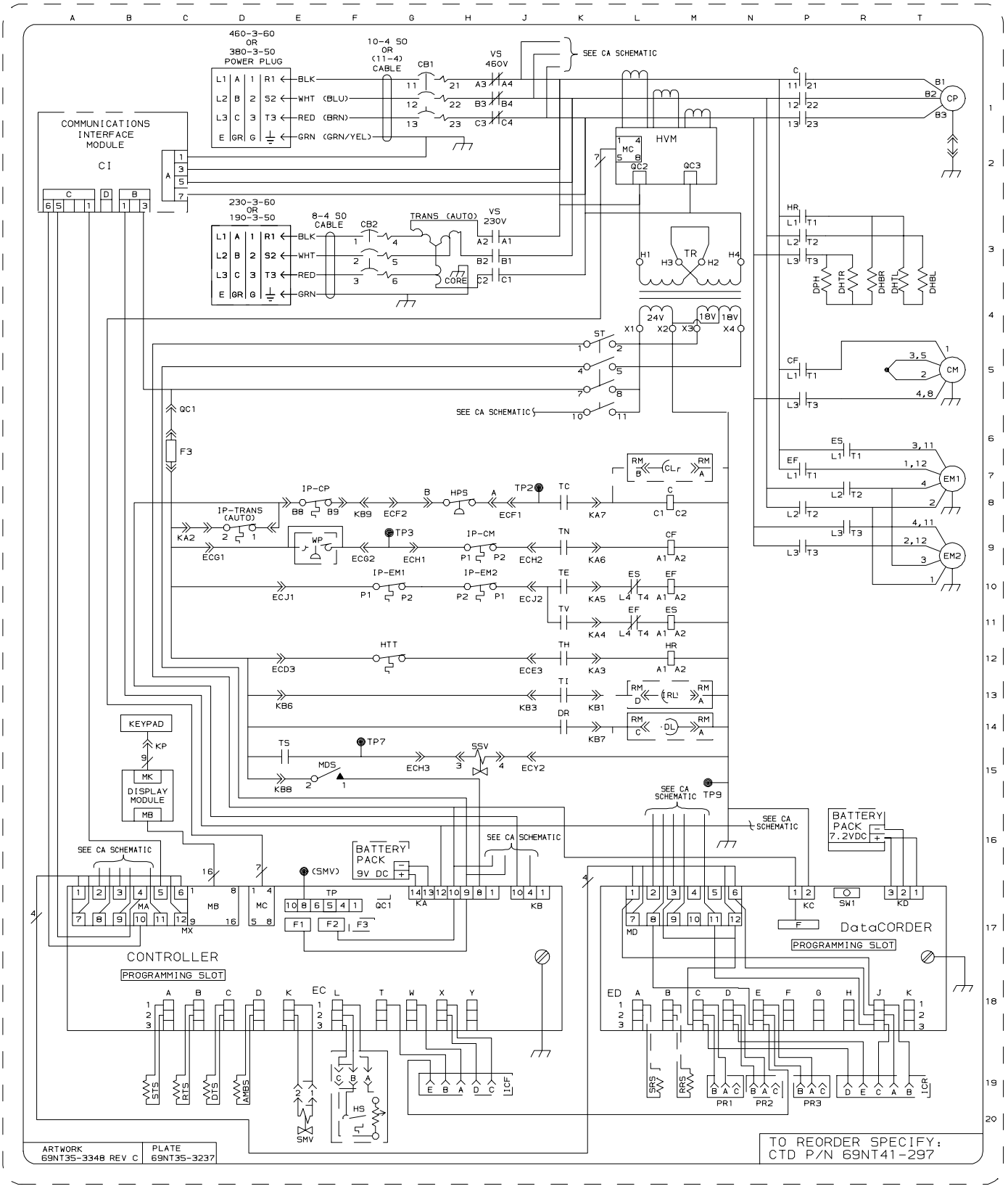


Figure 5-26. Electrical Wiring Diagram – Model 69NT40-489-19 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
F3	CB2	—	CIRCUIT BREAKER 230V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
E8,G10,H9 H10,C8	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
B19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
H3,C8	TRANS	—	TRANSFORMER (AUTO 230/460)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)
J1,J3	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

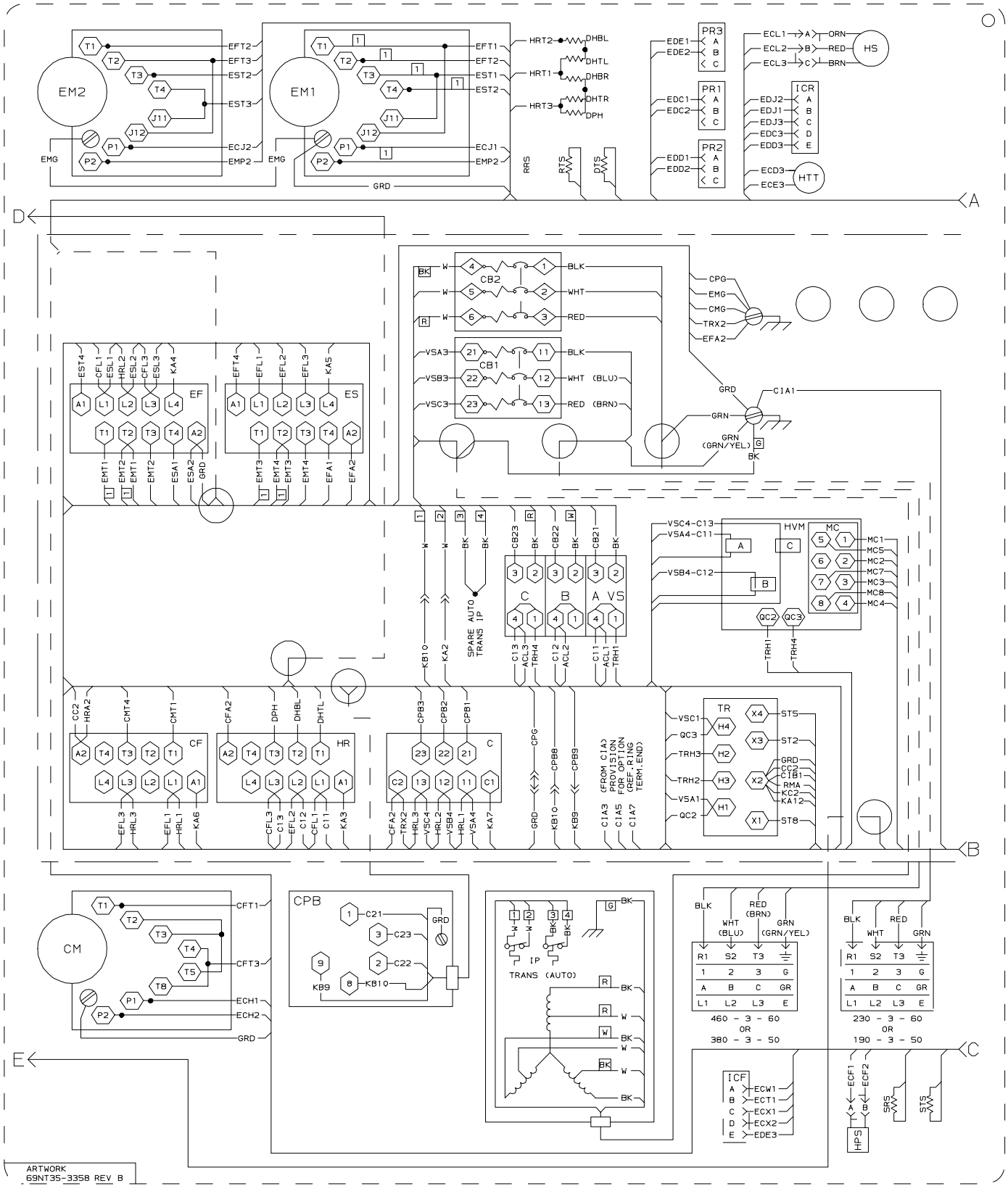
Figure 5-27. Electrical Schematic – Models 69NT40-489-20E,-489-20M,-489-22 (Sheet 1 of 2)



NOTE

For for units which are configured to single voltage, ignore references to Power (Auto) Transformer and related components (i.e., CB2, VS, etc).

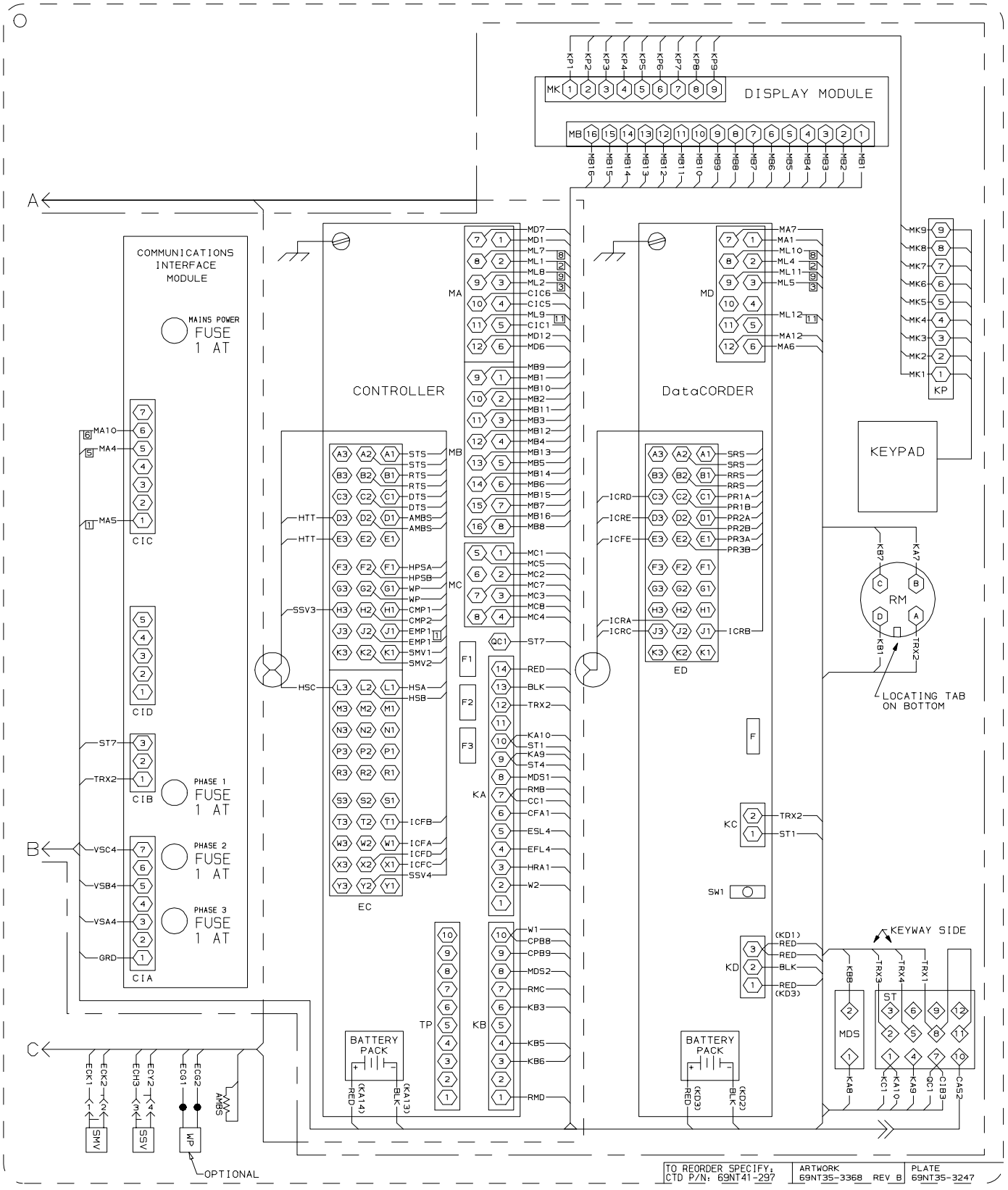
Figure 5-27. Electrical Schematic – Models 69NT40-489-20E,-489-20M,-489-22 (Sheet 2 of 2)



NOTE

For for units which are configured to single voltage, ignore references to Power (Auto) Transformer and related components (i.e., CB2, VS, etc).

Figure 5-28. Electrical Wiring Diagram – Models 69NT40-489-20E,-489-20M,-489-22 (Sheet 1 of 2)



NOTE

For for units which are configured to single voltage, ignore references to Power (Auto) Transformer and related components (i.e., CB2, VS, etc).

Figure 5-28. Electrical Wiring Diagram – Models 69NT40-489-20E,-489-20M,-489-22 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
A19	CPDS	—	COMPRESSOR DISCHARGE SENSOR (TEMP.)
D19	CPSS	—	COMPRESSOR SUCTION SENSOR (TEMP.)
G20	CPT	—	CONDENSER PRESSURE TRANSDUCER
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR
E8,G10,H9,H10	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR
C19	RTS	—	RETURN TEMPERATURE SENSOR
D20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
A19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-29. Electrical Schematic – Models 69NT40-489-50 (Sheet 1 of 2)

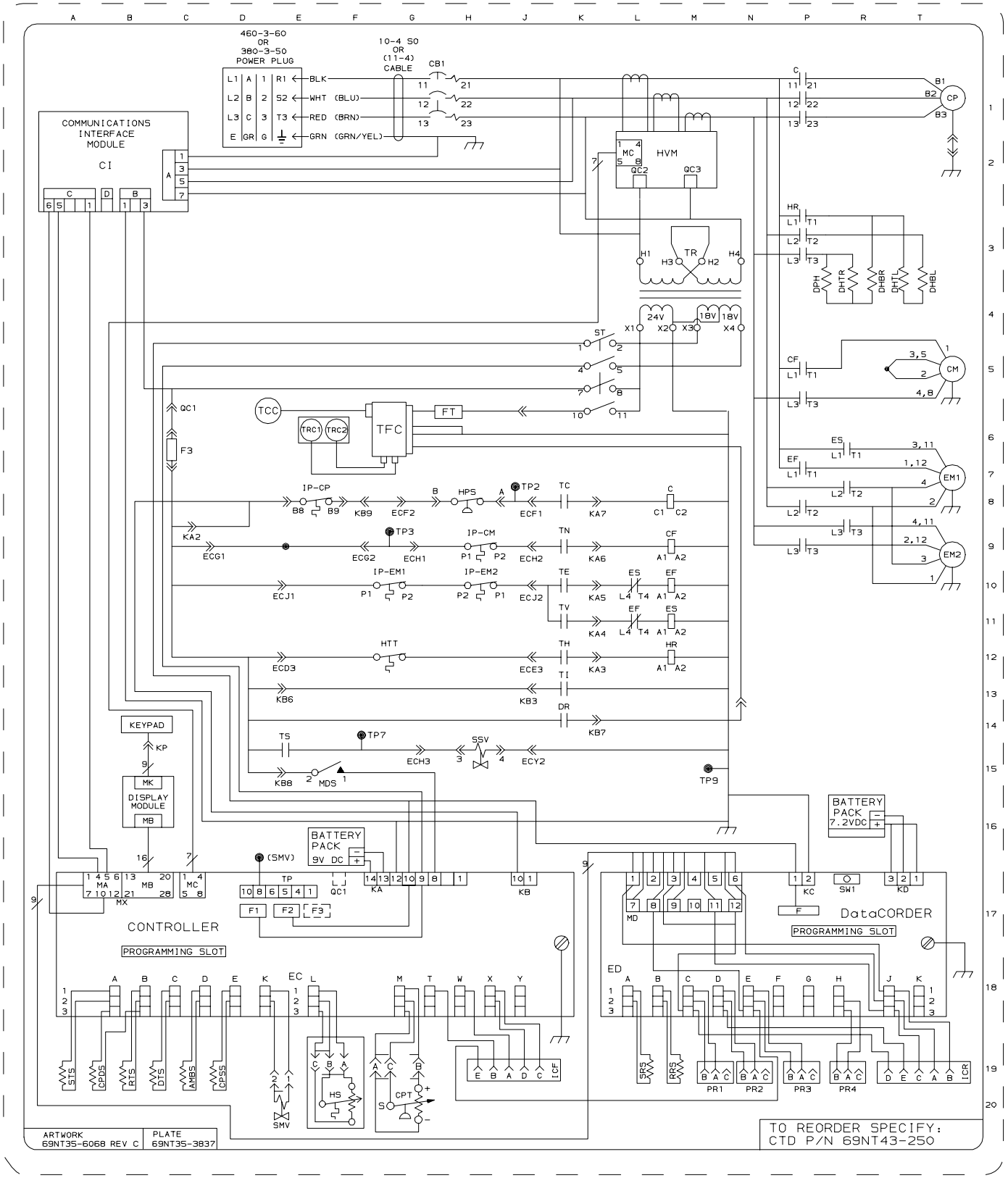


Figure 5-29. Electrical Schematic – Models 69NT40-489-50 (Sheet 2 of 2)

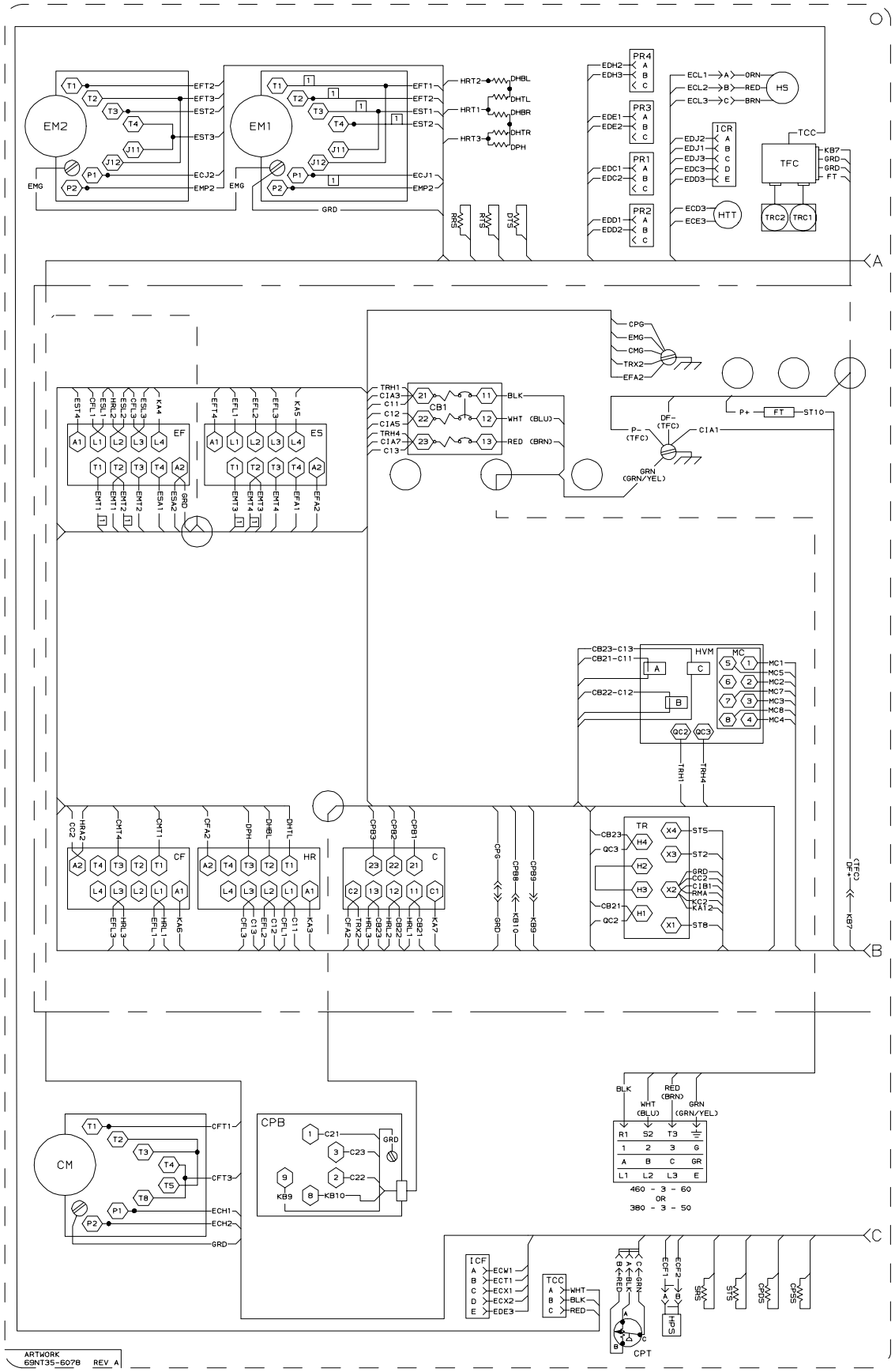


Figure 5-30. Electrical Wiring Diagram – Models 69NT40-489-50 (Sheet 1 of 2)

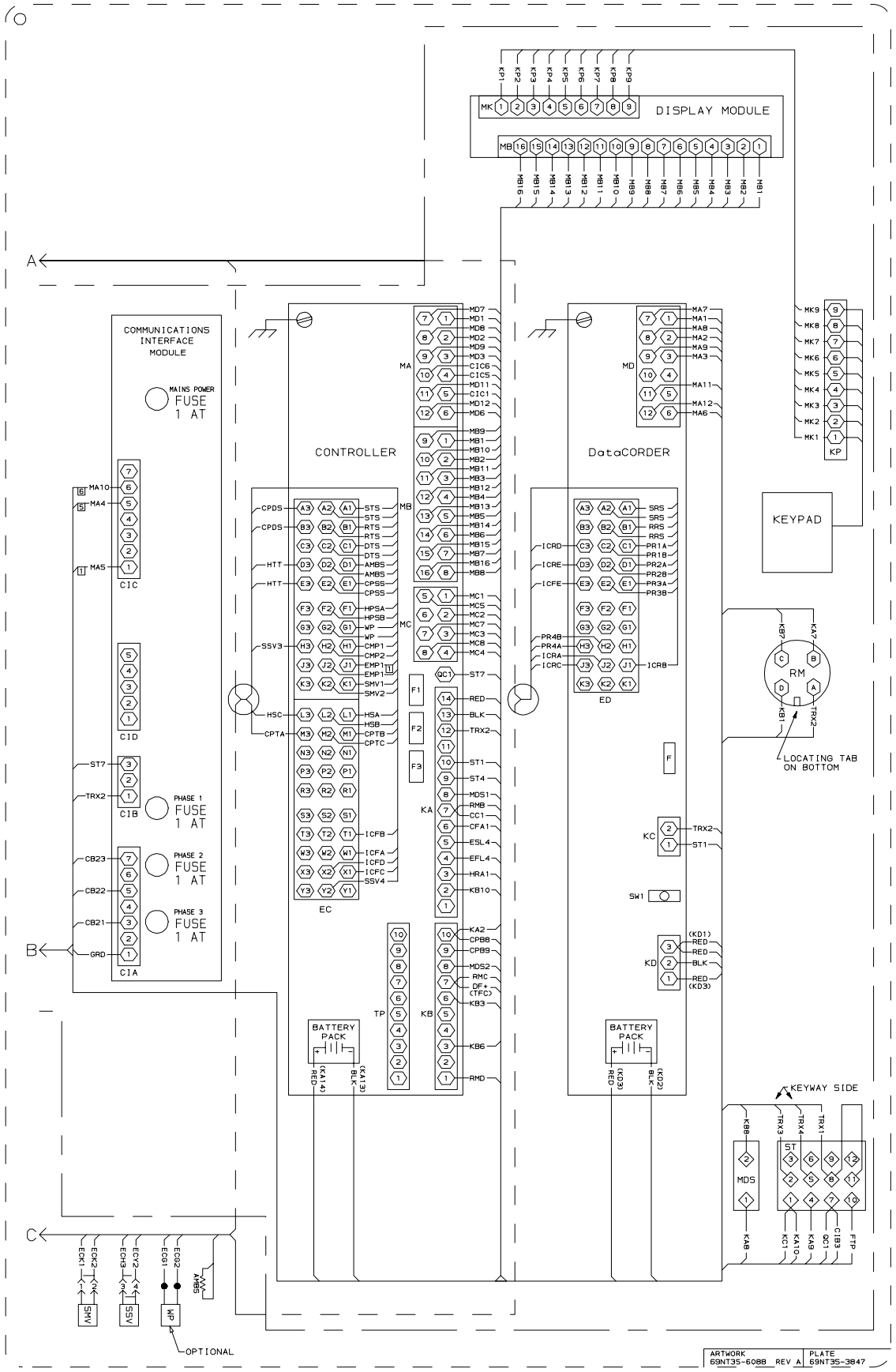


Figure 5-30. Electrical Wiring Diagram – Models 69NT40-489-50 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
J1	CB1	—	CIRCUIT BREAKER 460V
D1	CB2	—	CIRCUIT BREAKER 230V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
A3	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
D1	DVM	—	DUAL VOLTAGE MODULE (OPTIONAL)
E2	DVR	—	DUAL VOLTAGE RECEPTACLE (OPTIONAL)
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
E8,G10,H9,H10	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
B19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
D3	TRANS	—	TRANSFORMER (AUTO 230/460)
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-31. Electrical Schematic – Models 69NT40-489-51,-489-69,-489-81,-489-84 (Sheet 1 of 2)

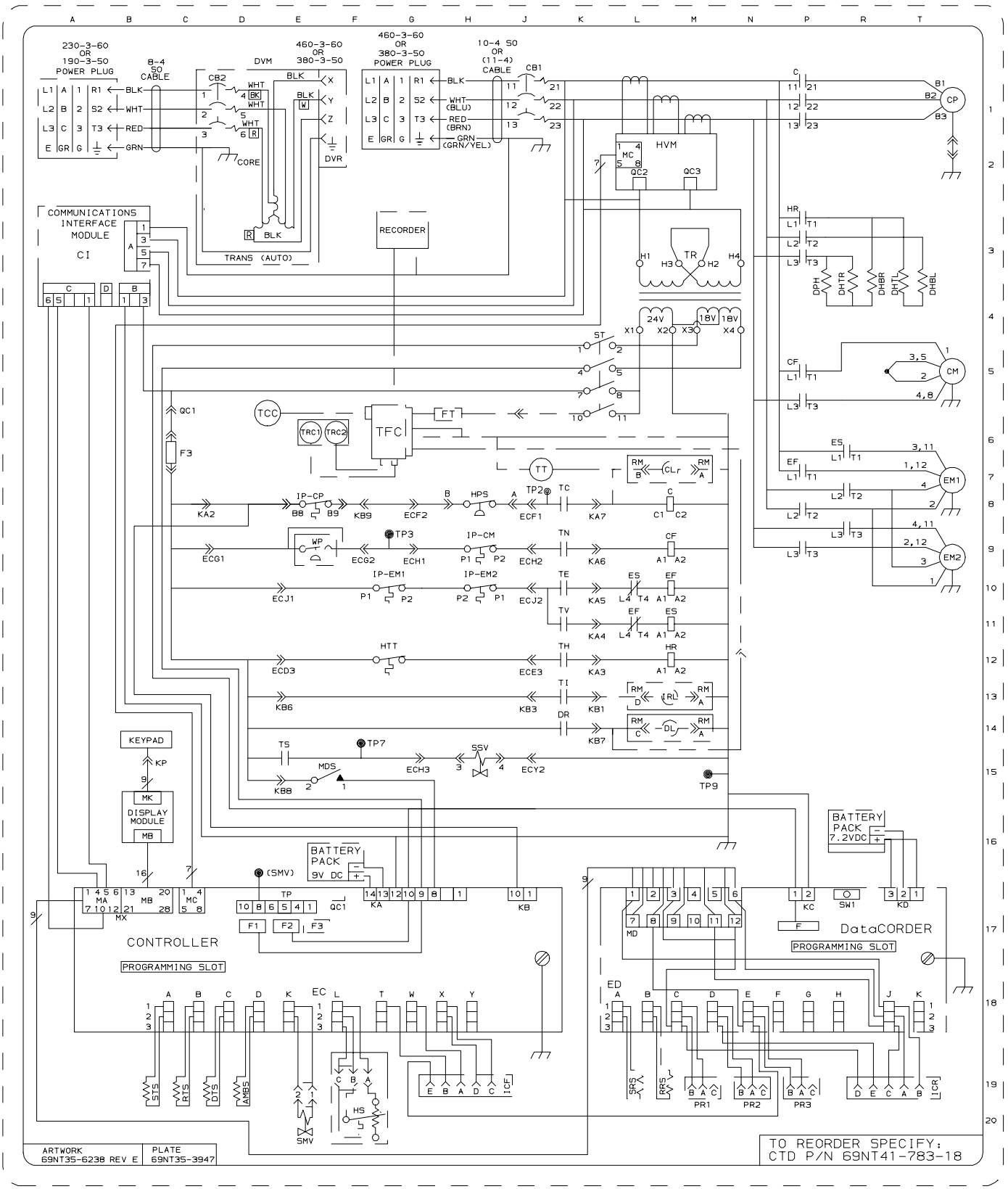


Figure 5-31. Electrical Schematic – Models 69NT40-489-51,-489-69,-489-81,-489-84 (Sheet 2 of 2)

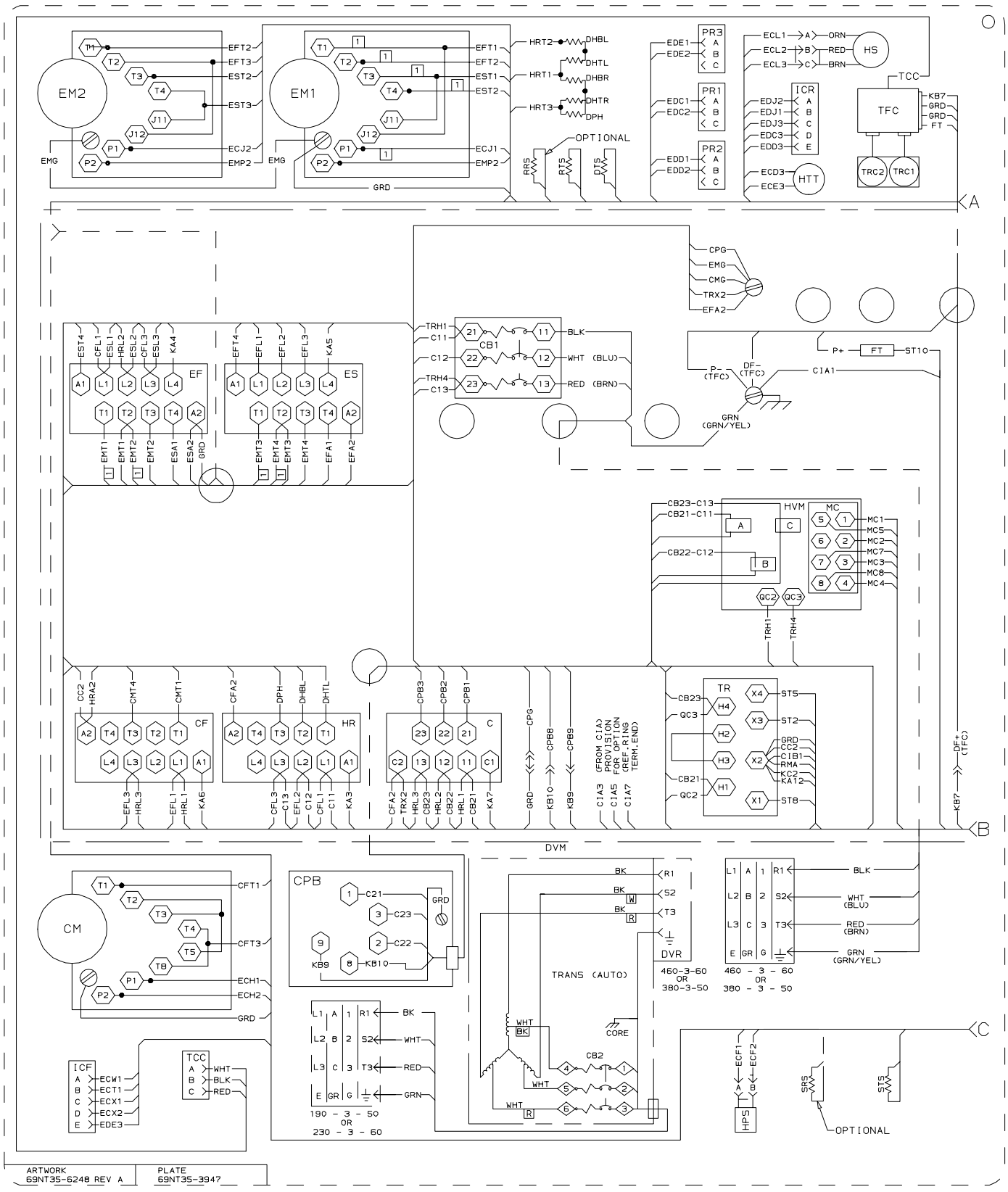


Figure 5-32. Electrical Wiring Diagram – Models 69NT40-489-51,-489-69,-489-81,-489-84 (Sheet 1 of 2)

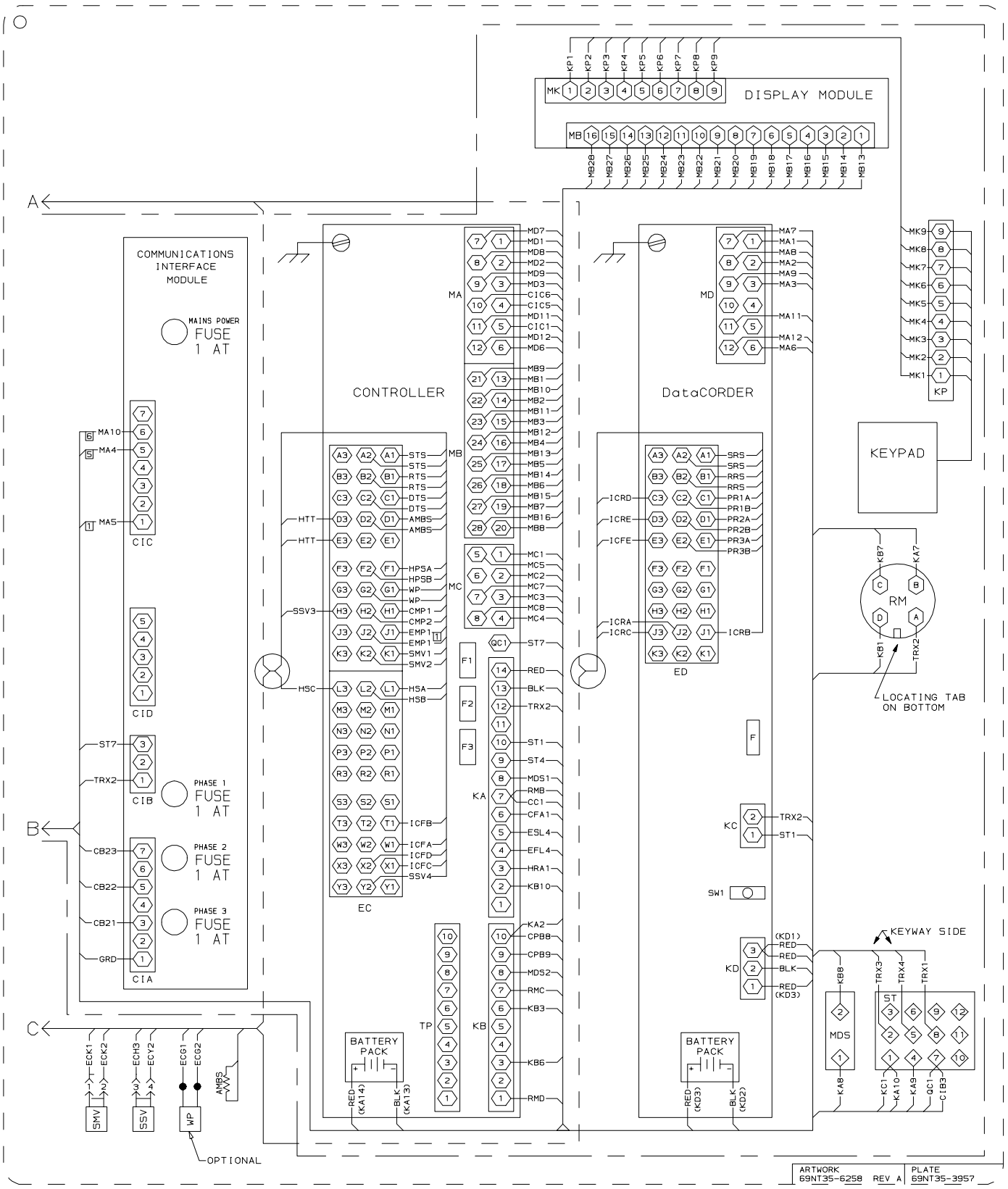


Figure 5-32. Electrical Wiring Diagram – Models 69NT40-489-51,-489-69,-489-81,-489-84 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTIONAL)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
A19	CPDS	—	COMPRESSOR DISCHARGE SENSOR (TEMP.)
D19	CPSS	—	COMPRESSOR SUCTION SENSOR (TEMP.)
G20	CPT	—	CONDENSER PRESSURE TRANSDUCER
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR
E8,G10,H9,H10	IP	—	INTERNAL PROTECTOR
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
M19	RRS	—	RETURN RECORDER SENSOR
C19	RTS	—	RETURN TEMPERATURE SENSOR
D20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
A19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)

Figure 5-33. Electrical Schematic – Models 69NT40-489-62 (Sheet 1 of 2)

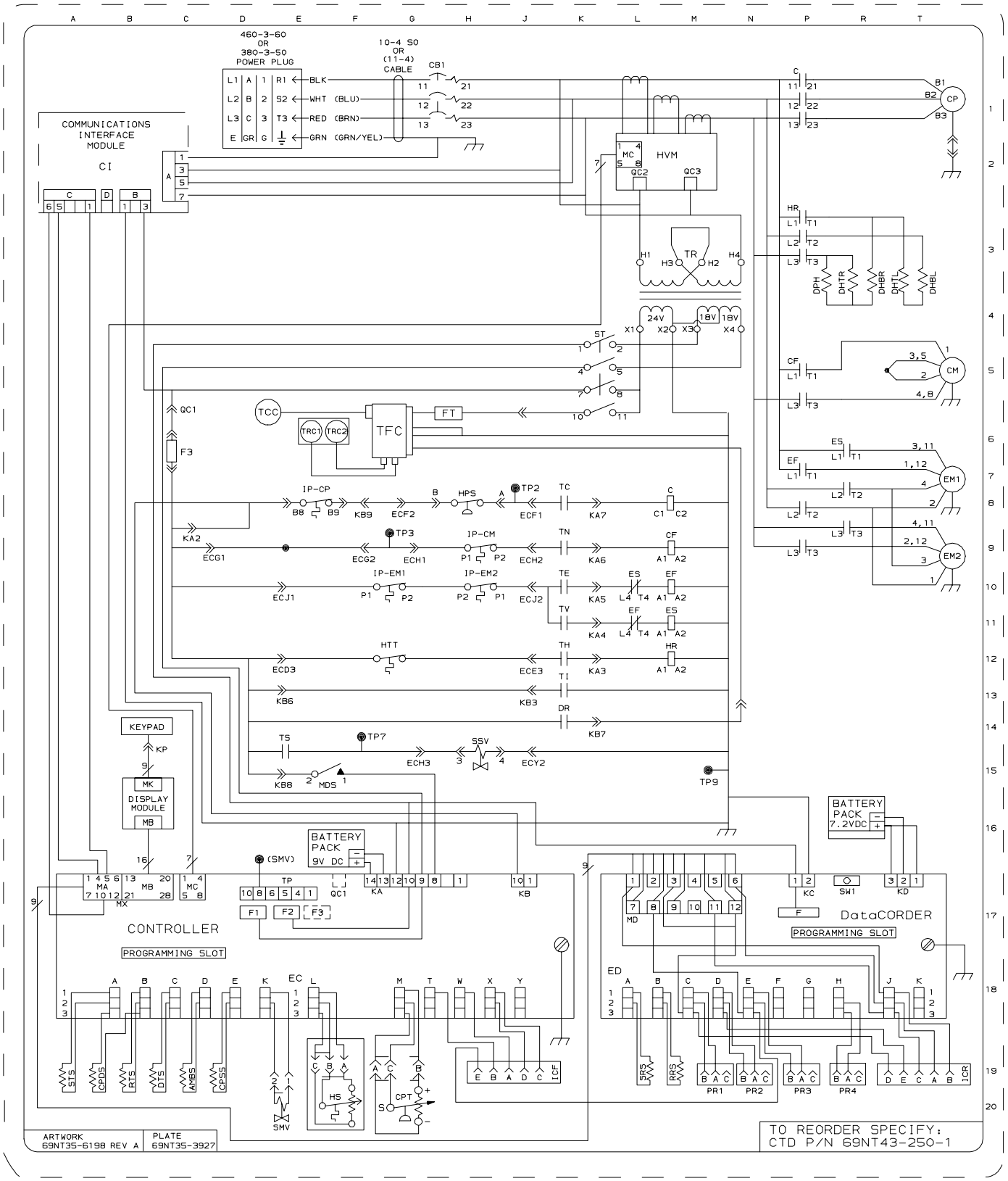


Figure 5-33. Electrical Schematic – Models 69NT40-489-62
(Sheet 2 of 2)

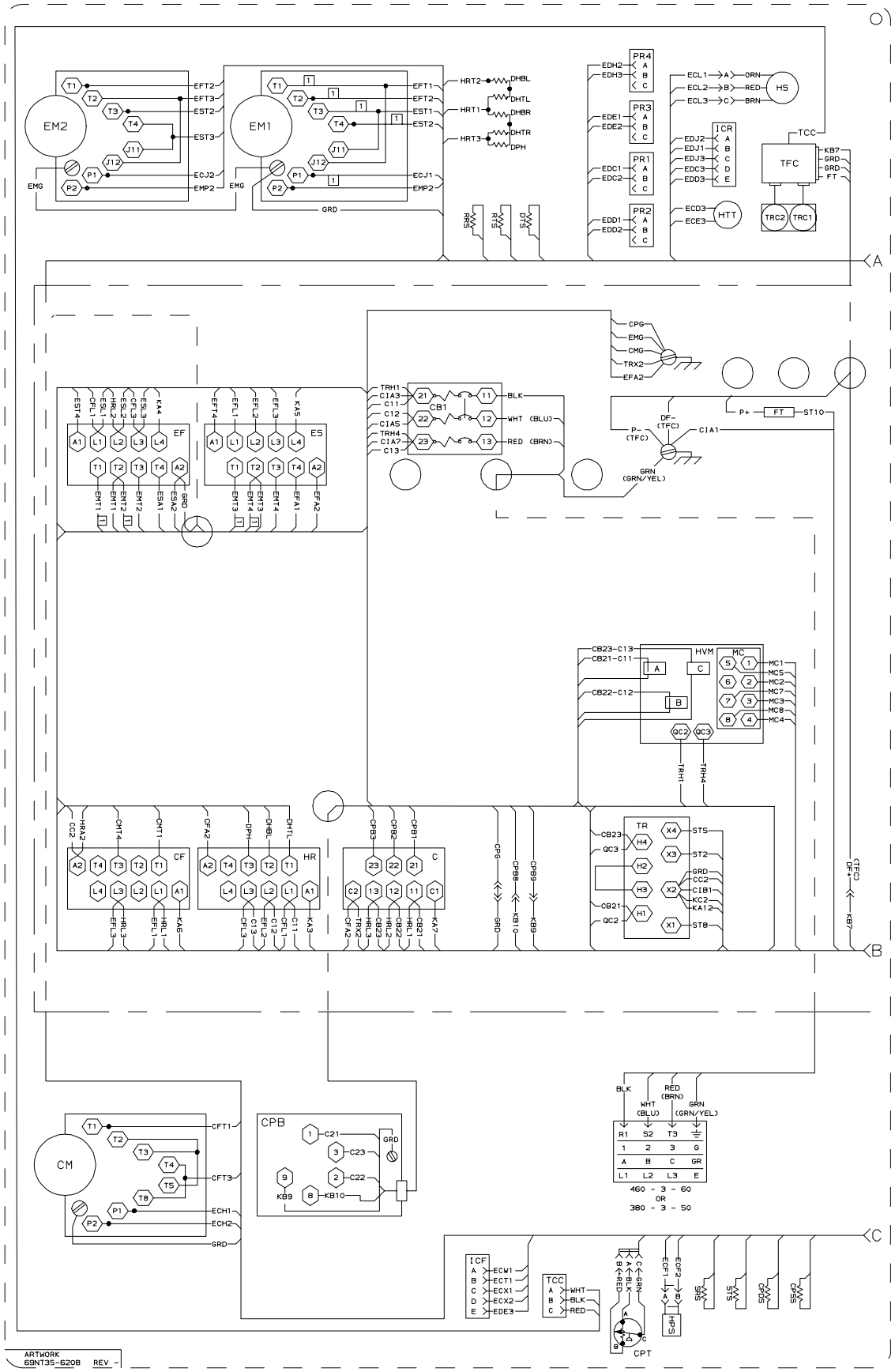


Figure 5-34. Electrical Wiring Diagram – Models 69NT40-489-62 (Sheet 1 of 2)

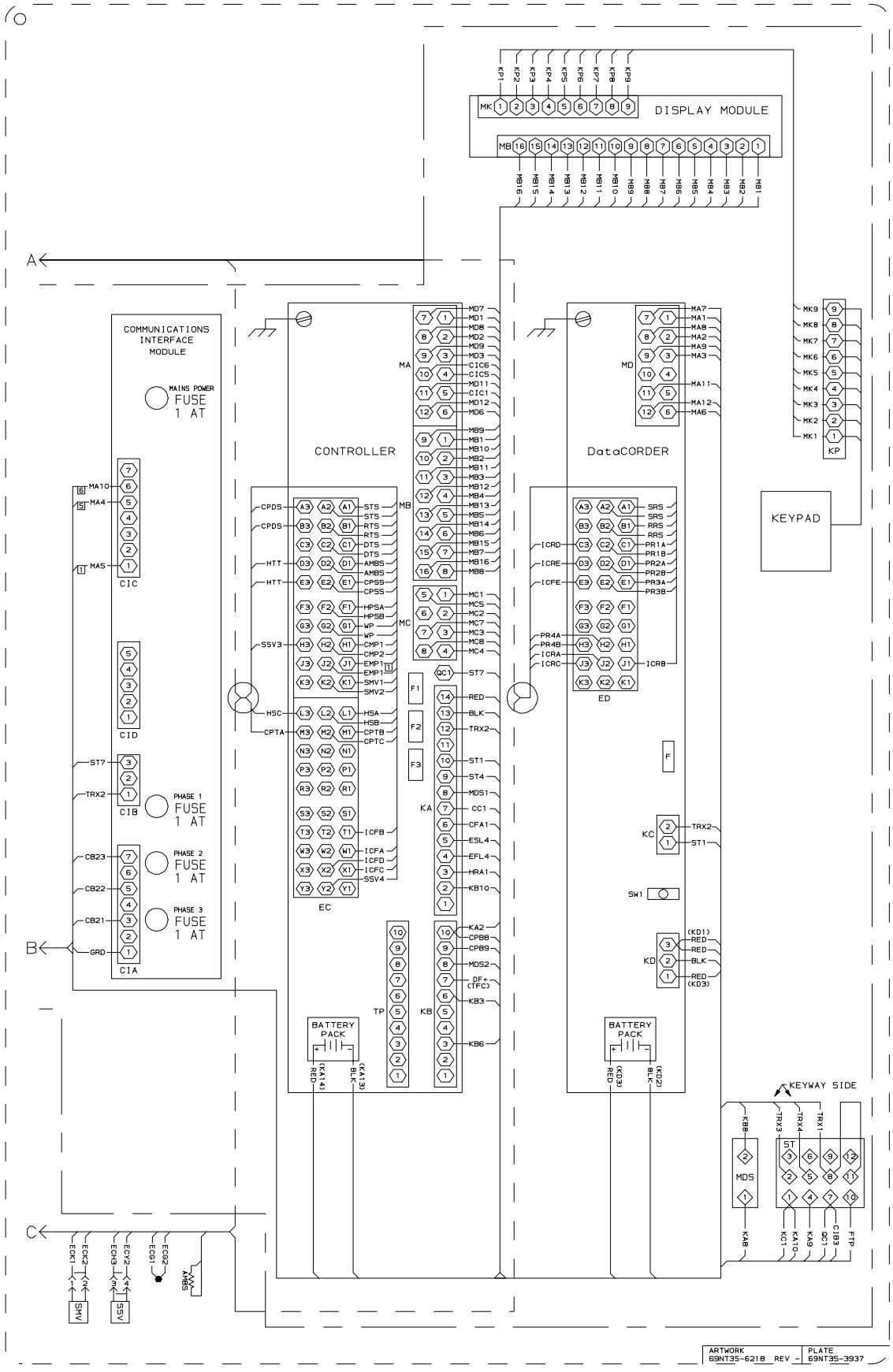


Figure 5-34. Electrical Wiring Diagram – Models 69NT40-489-62 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
F20	DPT	—	DISCHARGE PRESSURE TRANSDUCER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
E8,G10,H9,H10	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
G20	SPT	—	SUCTION PRESSURE TRANSDUCER
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
B19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-35. Electrical Schematic – Models 69NT40-489-78 (Sheet 1 of 2)

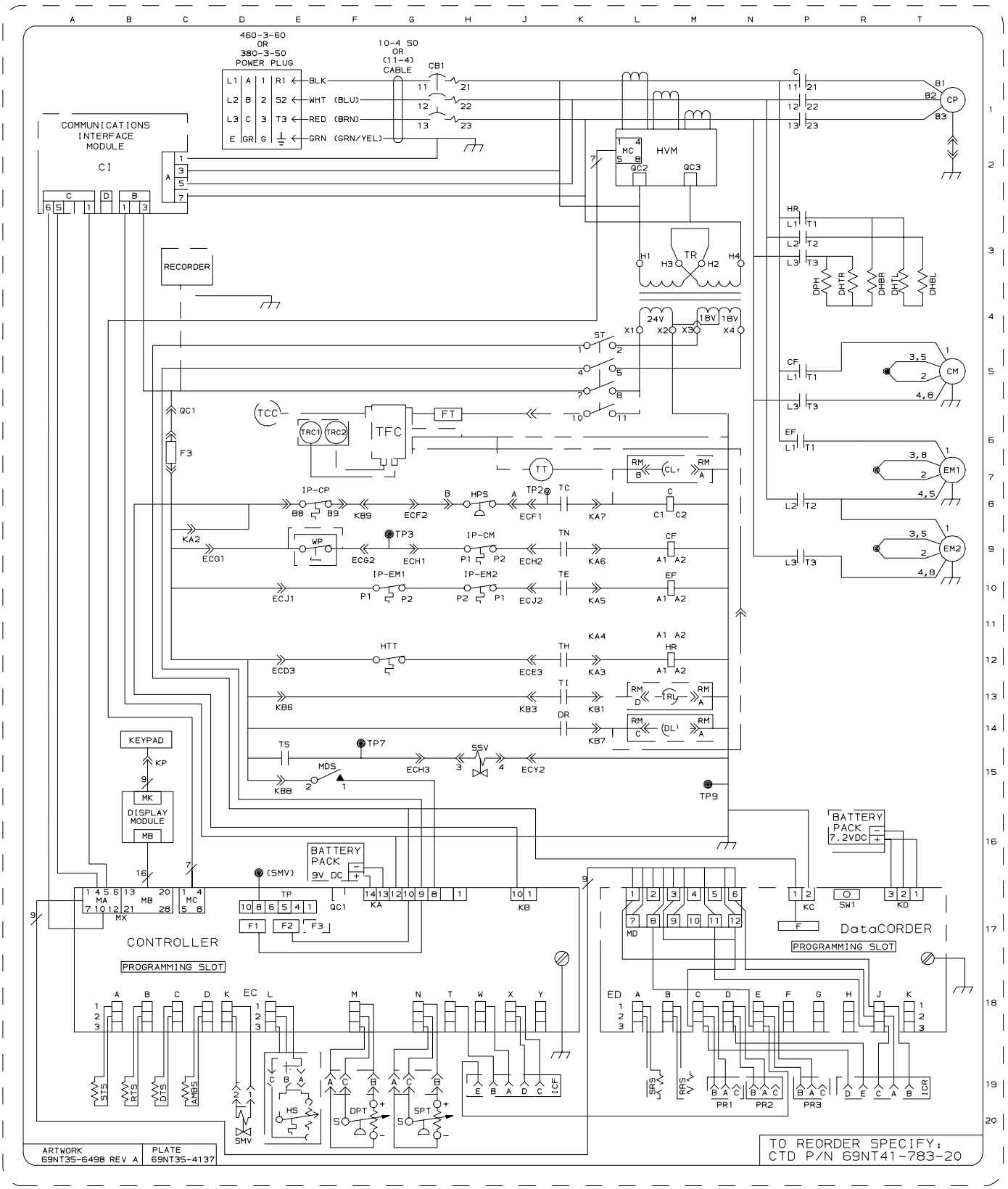


Figure 5-35. Electrical Schematic – Models 69NT40-489-78 (Sheet 2 of 2)

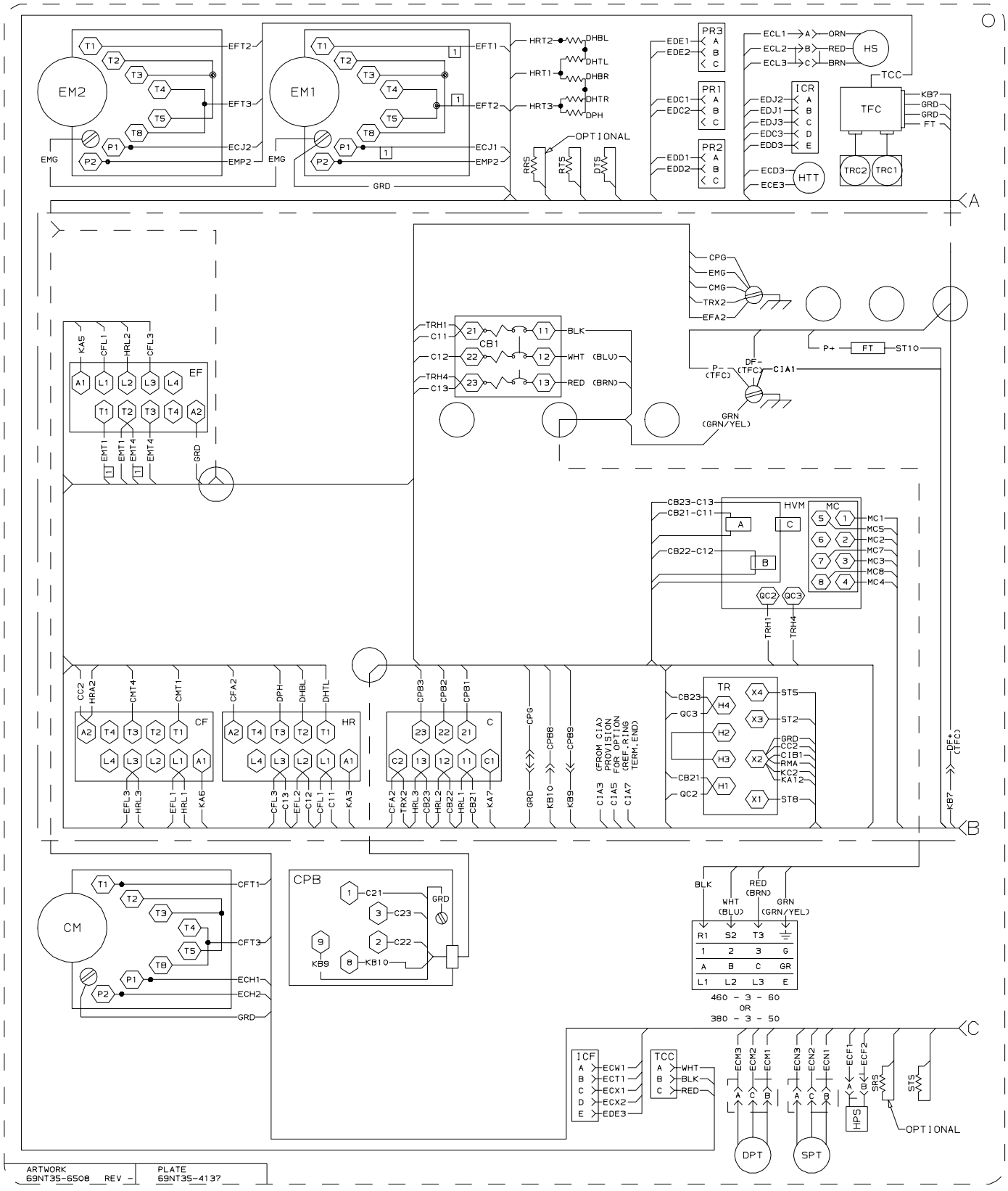


Figure 5-36. Electrical Wiring Diagram – Models 69NT40-489-78 (Sheet 1 of 2)

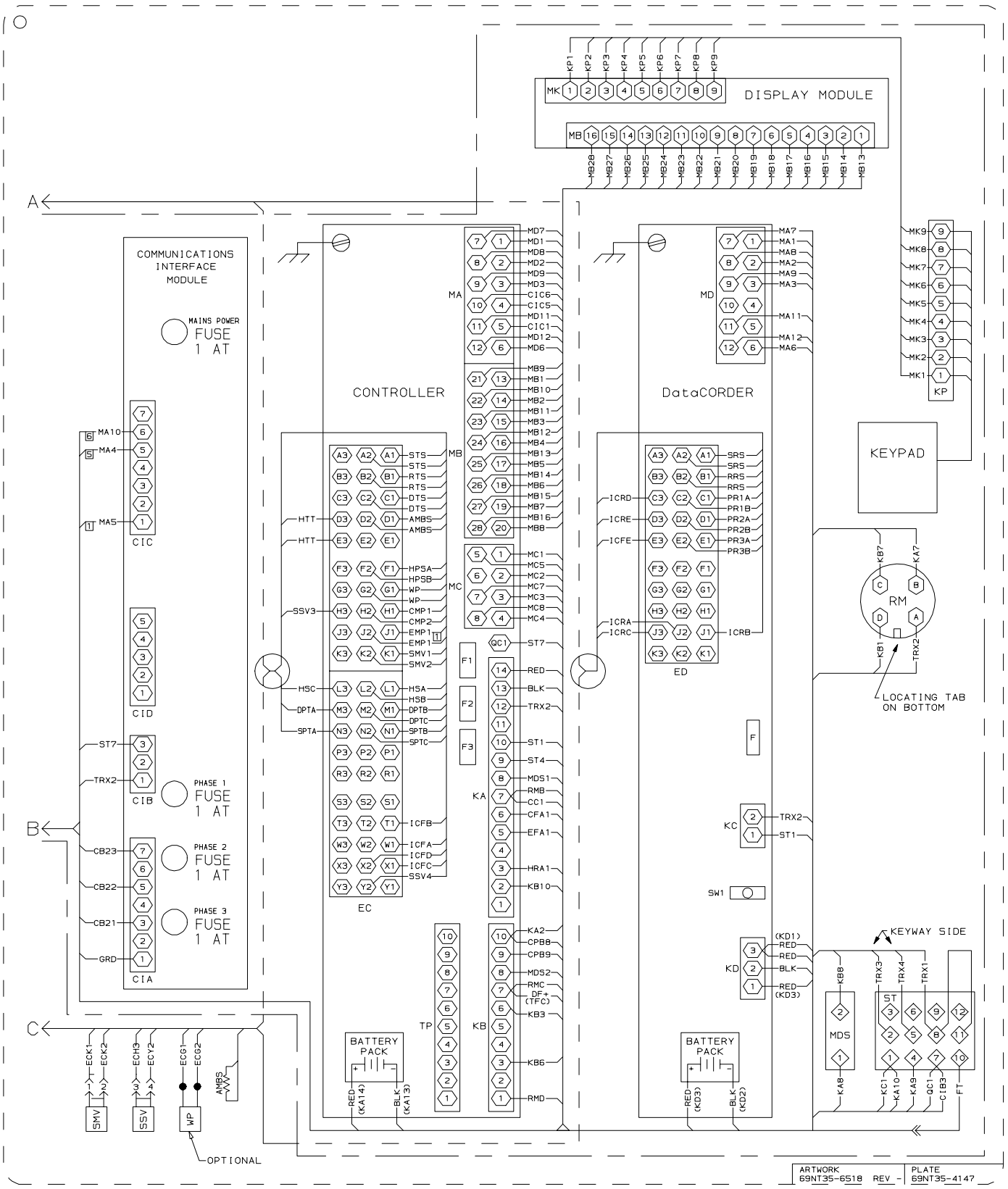


Figure 5-36. Electrical Wiring Diagram – Models 69NT40-489-78 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
L8,P1	C	—	COMPRESSOR CONTACTOR
G1	CB1	—	CIRCUIT BREAKER 460V
G3	CB2	—	CIRCUIT BREAKER 230V
L9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K13	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P6,P8,P9,L10, G10,H10,T7,T9	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
	EM	—	EVAPORATOR FAN MOTOR
L10,R6,R7,R8	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C7,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
L11,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G11	HTT	—	HEAT TERMINATION THERMOSTAT
M2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
D8,E7,H9,F10,H10	IP	—	INTERNAL PROTECTOR
L12	IRL	—	IN-RANGE LIGHT (OPTION)
C14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
M19,N19,P19,R19	PR	—	PROBE RECEPTACLE (USDA) (OPTION)
L7,L12,L13	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H14	SSV	—	SUCTION SOLENOID VALVE
L5	ST	—	START-STOP SWITCH
C19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
E6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K11	TH	—	CONTROLLER RELAY (HEATING)
K12	TI	—	IN-RANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
G8,G9,G14, M14,D16	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
H5,R10,R11	TRANS	—	TRANSFORMER (AUTO 230/460)
F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K10	TV	—	CONTROLLER RELAY (LOW SPEED EVAP.)
P6,P7,P8,P10, P11,J1,J3,T3,R1, R2,R5	VS	—	VOLTAGE SWITCH
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-37. Electrical Schematic – Models 69NT40-489-80 (Sheet 1 of 2)

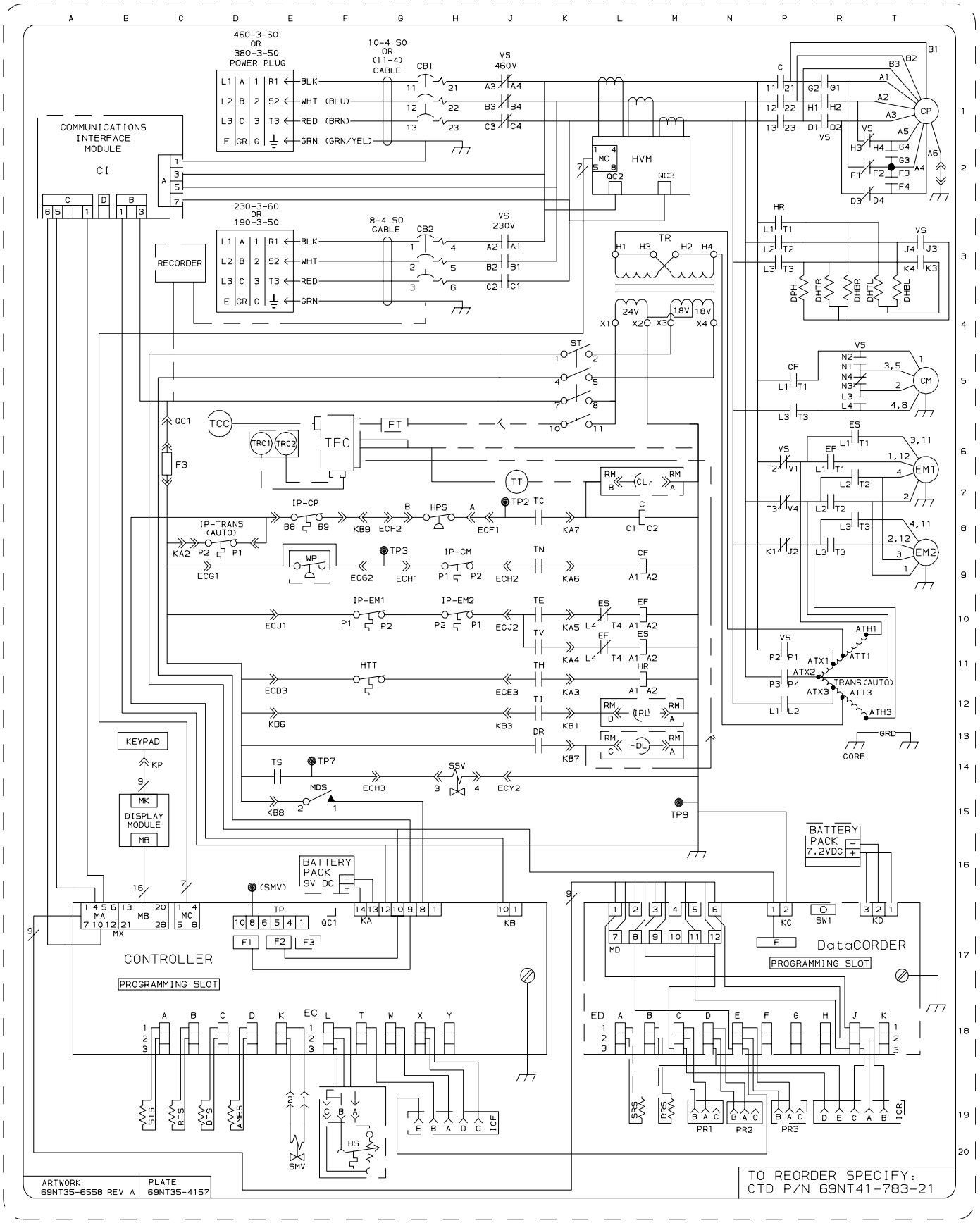


Figure 5-37. Electrical Schematic – Models 69NT40-489-80 (Sheet 2 of 2)

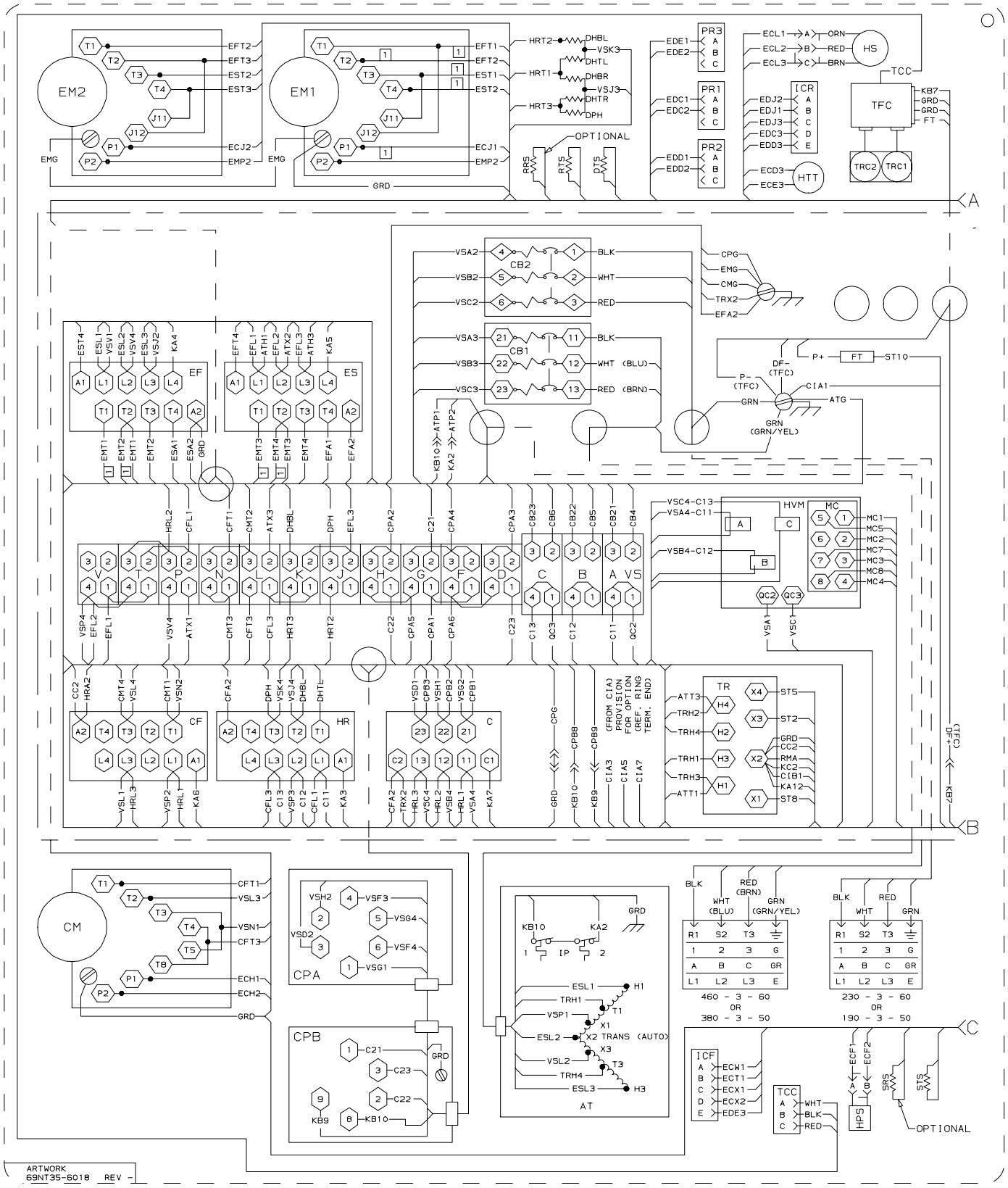


Figure 5-38. Electrical Wiring Diagram – Models 69NT40-489-80 (Sheet 1 of 2)

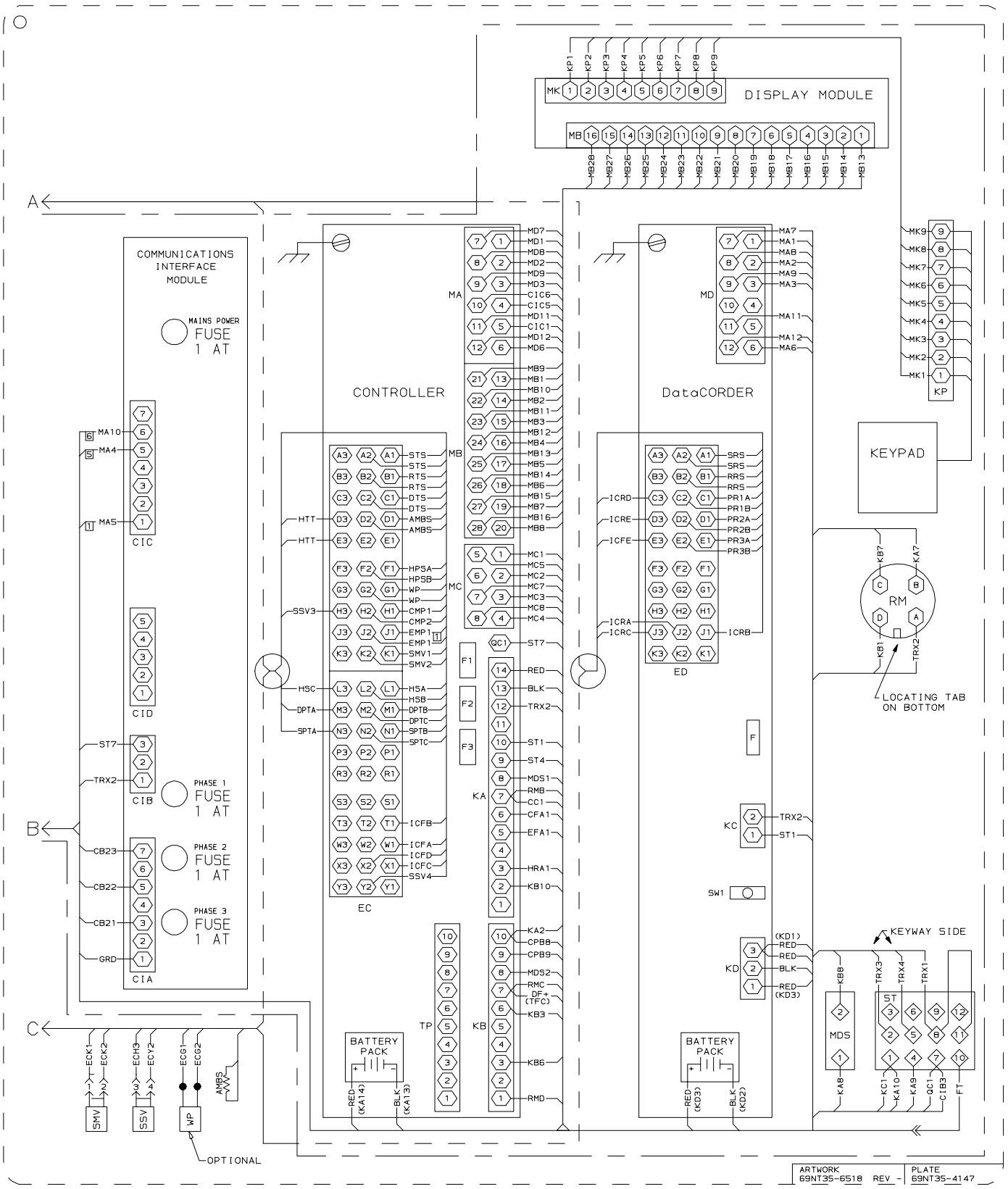


Figure 5-38. Electrical Wiring Diagram – Models 69NT40-489-80 (Sheet 2 of 2)

LEGEND

ZONE	SYMBOL		DESCRIPTION
D19	AMBS	—	AMBIENT SENSOR
M8,P1,P2	C	—	COMPRESSOR CONTACTOR
H1	CB1	—	CIRCUIT BREAKER 460V
R2	CCH	—	COMPRESSOR CRANKCASE HEATER
M9,P5	CF	—	CONDENSER FAN CONTACTOR
B2	CI	—	COMMUNICATIONS INTERFACE MODULE (OPTION)
M7	CL	—	COOL LIGHT (OPTION)
T5,H9	CM	—	CONDENSER FAN MOTOR
T1,E8	CP	—	COMPRESSOR MOTOR
T4	DHBL	—	DEFROST HEATER - BOTTOM LEFT
R4	DHBR	—	DEFROST HEATER - BOTTOM RIGHT
R4	DHTL	—	DEFROST HEATER - TOP LEFT
R4	DHTR	—	DEFROST HEATER - TOP RIGHT
L13	DL	—	DEFROST LIGHT (OPTION)
P4	DPH	—	DRAIN PAN HEATER
K14	DR	—	DEFROST RELAY
D19	DTS	—	DEFROST TEMPERATURE SENSOR
P7,M10,L11	EF	—	EVAPORATOR FAN CONTACTOR (HIGH SPEED)
G10,H10,T7,T9	EM	—	EVAPORATOR FAN MOTOR
L10,M11,R6	ES	—	EVAPORATOR FAN CONTACTOR (LOW SPEED)
C6,D17,E17, P17,H6	F	—	FUSE
	FLA	—	FULL LOAD AMPS
H8	HPS	—	HIGH PRESSURE SWITCH
M12,P3	HR	—	HEATER CONTACTOR
F20	HS	—	HUMIDITY SENSOR
G12	HTT	—	HEAT TERMINATION THERMOSTAT
L2	HVM	—	HIGH VOLTAGE MODULE
H19,T19	IC	—	INTERROGATOR CONNECTOR (OPTION)
E8,G10,H9,H10	IP	—	INTERNAL PROTECTOR
M13	IRL	—	IN-RANGE LIGHT (OPTION)
B14	KP	—	KEYPAD CONNECTOR
F15	MDS	—	MANUAL DEFROST SWITCH
N19,P19	PR	—	PROBE RECEPTACLE (USDA OPTION)
L7,L13,L14	RM	—	REMOTE MONITORING RECEPTACLE (OPTION)
M19	RRS	—	RETURN RECORDER SENSOR (OPTION)
C19	RTS	—	RETURN TEMPERATURE SENSOR
E20	SMV	—	SUCTION MODULATION VALVE
L19	SRS	—	SUPPLY RECORDER SENSOR (OPTION)
H15	SSV	—	SUCTION SOLENOID VALVE
K5	ST	—	START-STOP SWITCH
B19	STS	—	SUPPLY TEMPERATURE SENSOR
K8	TC	—	CONTROLLER RELAY (COOLING)
D6	TCC	—	TRANSFRESH COMMUNICATIONS CONNECTOR (OPTION)
K10	TE	—	CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS)
G6	TFC	—	TRANSFRESH CONTROLLER (OPTION)
K12	TH	—	CONTROLLER RELAY (HEATING)
K13	TI	—	INRANGE RELAY
K9	TN	—	CONTROLLER RELAY (CONDENSER FAN)
D16,F14,G8, G9,M15	TP	—	TEST POINT
M3	TR	—	TRANSFORMER
E6,F6	TRC	—	TRANSFRESH REAR CONNECTOR (OPTION)
E14	TS	—	CONTROLLER RELAY(SUCTION SOLENOID VALVE)
J7	TT	—	TOTAL TIME METER (OPTION)
K11	TV	—	CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS)
E9	WP	—	WATER PRESSURE SWITCH (OPTION)

Figure 5-39. Electrical Schematic – Models 69NT40-489-30,-31 (Sheet 1 of 2)

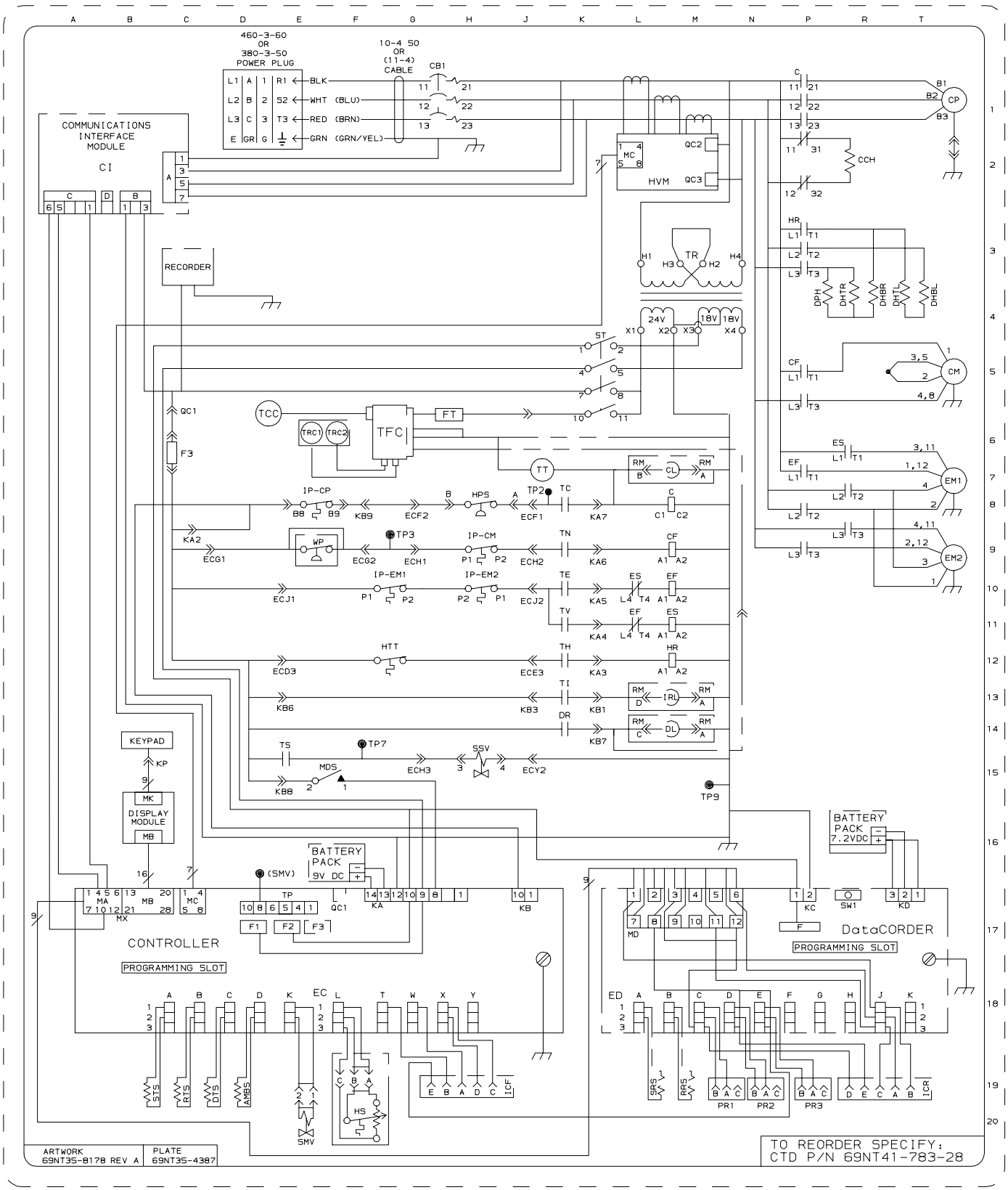


Figure 5-39. Electrical Schematic – Models 69NT40-489-30,-31
(Sheet 2 of 2)

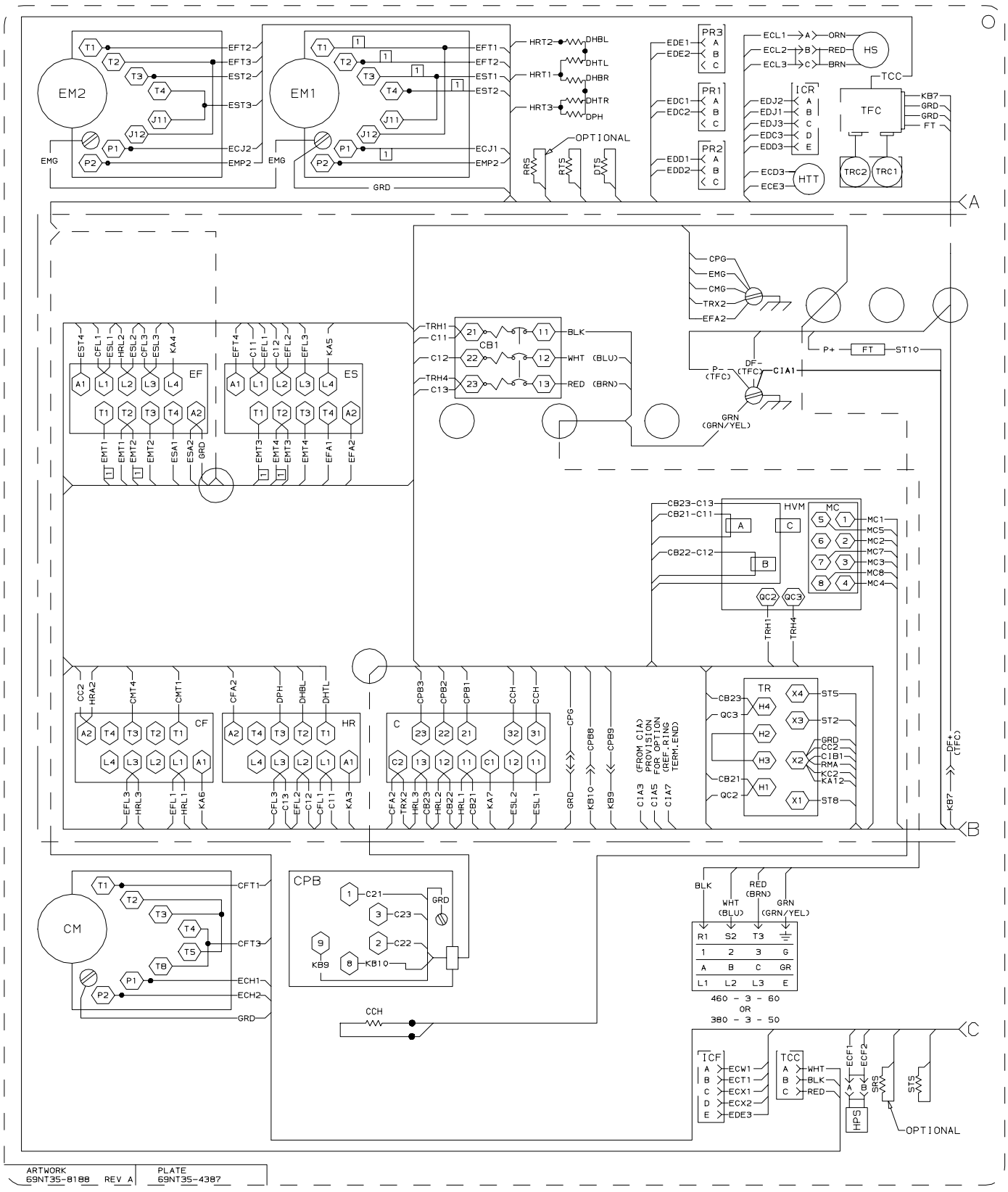


Figure 5-40. Electrical Wiring Diagram – Models 69NT40-489-30,-31 (Sheet 1 of 2)

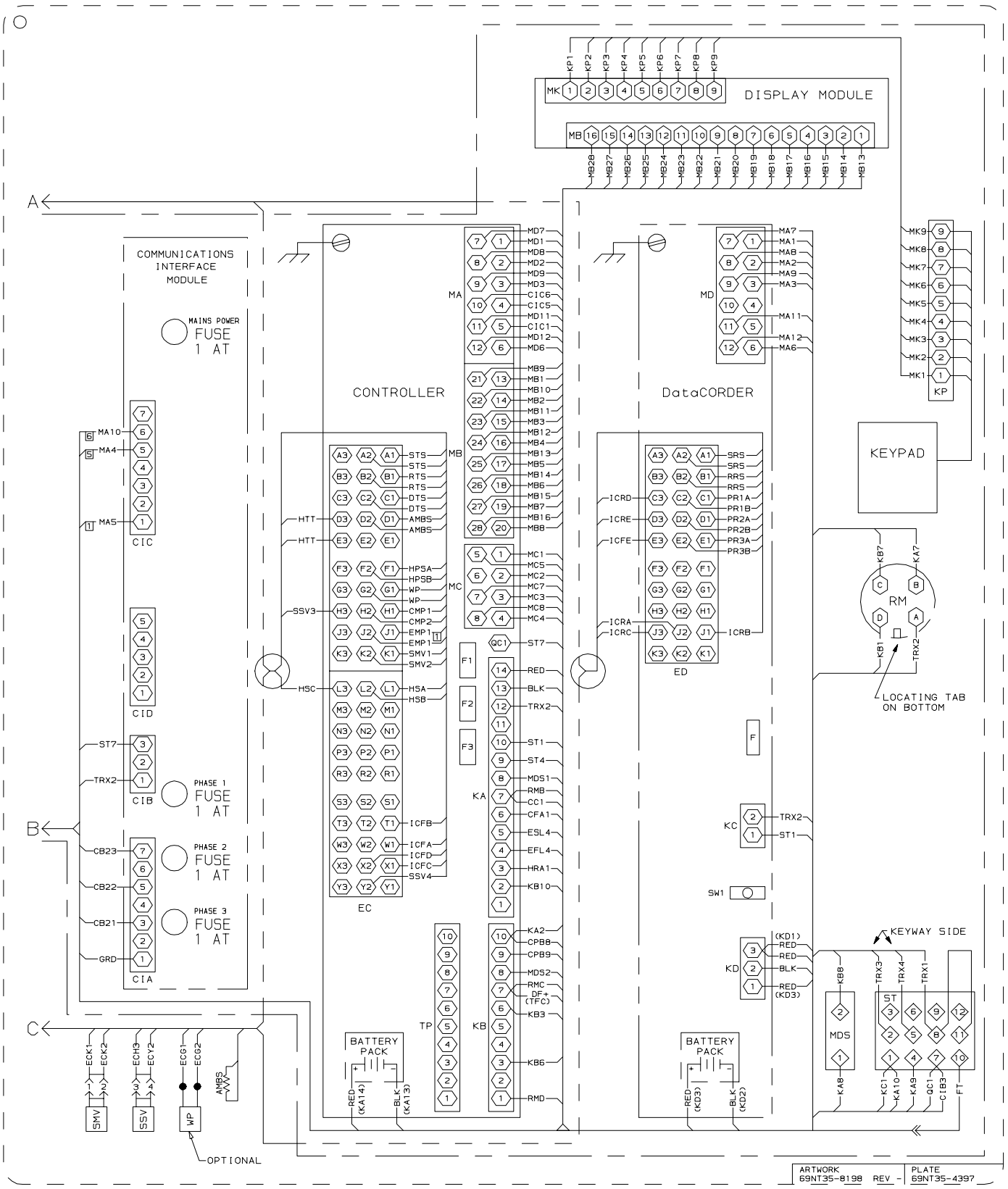


Figure 5-40. Electrical Wiring Diagram – Models 69NT40-489-30,-31 (Sheet 2 of 2)