Carrier
TRANSICOLD

Truck Refrigeration Unit

Supra 422, 522, 622, 722, 822, 922, 644,744, 844, 944 & Supra Multi-Temp

OPERATION AND SERVICE

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Carrier
TRANSICOLD

OPERATION AND SERVICE MANUAL

TRUCK REFRIGERATION UNITS

Supra 422, 522, 622, 722, 822, 922 644, 744, 844, 944 & Supra Multi-Temp

UNITED TECHNOLOGIES CARRIER TRANSICOLD

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SECTION 1
DESCRIPTION

1.1 INTRODUCTION

WARNING

Beware of unannounced starting of the fans and V-belts caused by the thermostat and the start/stop cycling of the unit.

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

The Supra models are one piece units designed for truck applications. The TDS models are equipped with an electric standby motor. The TDB models have a standby motor shell installed (without the motor winding) to allow the same belt arrangement for both units.

The model/serial number plate is located inside of the unit on the frame as shown in Figure 1-2.

The standard control system is a microprocessor controller (Refer to section 1.8). Once the controller (remote Cab Command within the cab of the truck) is set at the desired temperature, the unit will operate automatically to maintain the desired temperature within very close limits. The control system automatically selects high and low speed cooling or high and low speed heating as necessary to maintain the desired temperature.

The microprocessor controller, has an auto start/stop feature. The auto start/stop operation provides automatic cycling of the diesel engine or standby motor, which in turn offers an energy efficient alternative to continuous operation of the engine or standby motor with control of temperature by alternate cooling and heating of the supply air (evaporator outlet air).

The Supra models also have an optional Solid State temperature controller. Refer to section 1.10

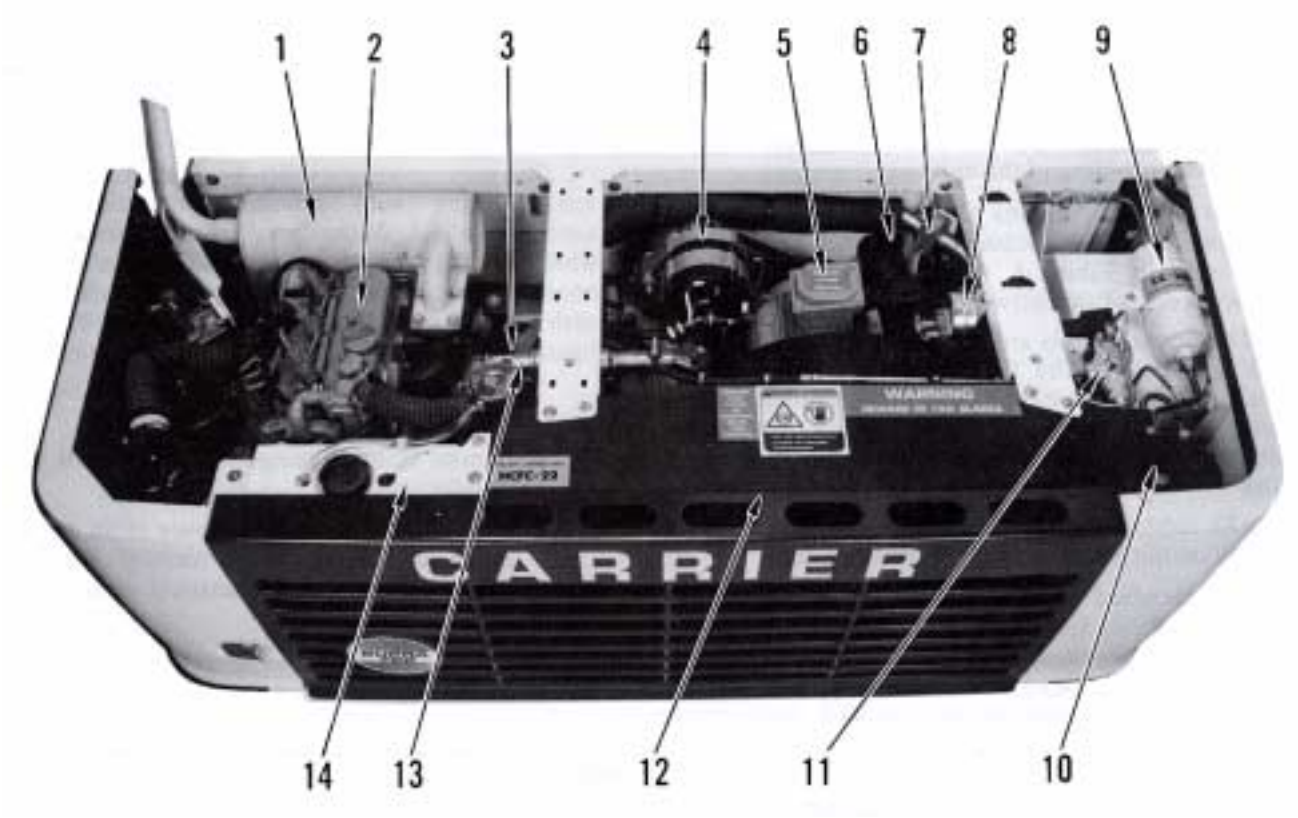
A remote standby receptacle is standard with all (TDS) standby units.

The evaporator assembly consists of an evaporator coil, expansion valve, two defrost thermostats (termination switches) and electrical evaporator fan motors.

Supra 922/944 also has a defrost damper and a damper solenoid.

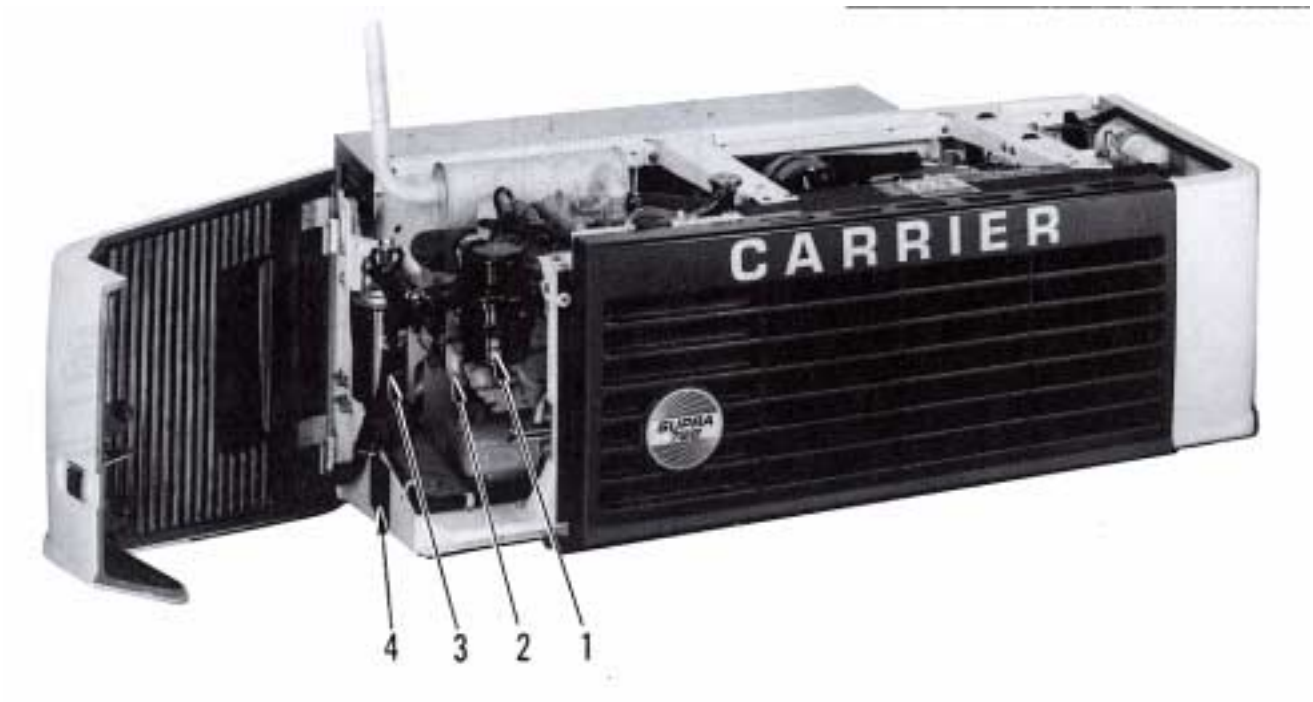
Table 1-1. Model Chart

Model	Refrigerant				Engine	Compressor	Standby Motor	
	R-22		R-404A					
	LB	KG	LB	KG			3ph, 50hz	3ph, 60hz
Supra 422, TDB-10	8	3.6	–	–	CT2-29TV	EF 210	–	–
Supra 422, TDS-10	8	3.6	–	–			4 hp	4.8 hp
Supra 522	8	3.6	–	–		05K 2 Cylinder	4 hp	4.8 hp
Supra 622, TDB-16	11	5.0	–	–	CT3-44TV		–	–
Supra 622, TDS-16	11	5.0	–	–			6.4 hp	7.6 hp
Supra 722, TDB-19	12	5.4	–	–			–	–
Supra 722, TDS-19	12	5.4	–	–			6.4 hp	7.6 hp
Supra 822	15	6.8	–	–		05K 4Cylinder	6.4 hp	7.6 hp
Supra 922, TDB-36	15	6.8	–	–	CT3-69TV	05G 6Cylinder	–	–
Supra 922, TDS-36	15	6.8	–	–	CT3-69TV	05G 6Cylinder	12.1 hp	14.7 hp
Supra 644, TDB-16	–	–	11	5.0	CT3-44TV	05K 2 Cylinder	–	–
Supra 644, TDS-16	–	–	11	5.0			6.4 hp	7.6 hp
Supra 744, TDB-19	–	–	12	5.4			–	–
Supra 744, TDS-19	–	–	12	5.4			6.4 hp	7.6 hp
Supra 844	–	–	15	6.8		05K 4Cylinder	6.4 hp	7.6 hp
Supra 944, TDB-32	–	–	15	6.8	CT3-69TV	05G 6Cylinder	–	–
Supra 944, TDS-32	–	–	15	6.8	CT3-69TV	05G 6Cylinder	12.1 hp	14.7 hp



1. Muffler
2. Engine (Refer toTable 1-1)
3. Compressor (Refer toTable 1-1)
4. Alternator
5. Electric Standby Motor
6. Accumulator
7. Quench Valve (Not Used on Supra 422)
8. Defrost Air Switch
9. Filter-Drier
10. Receiver
11. Hot Gas Valve (Three-Way)
12. Condenser
13. Compressor Pressure Regulating Valve (CPR)
14. Radiator Overflow Reservoir

Figure 1-1. Condensing Section -- Top View Model 722 Shown

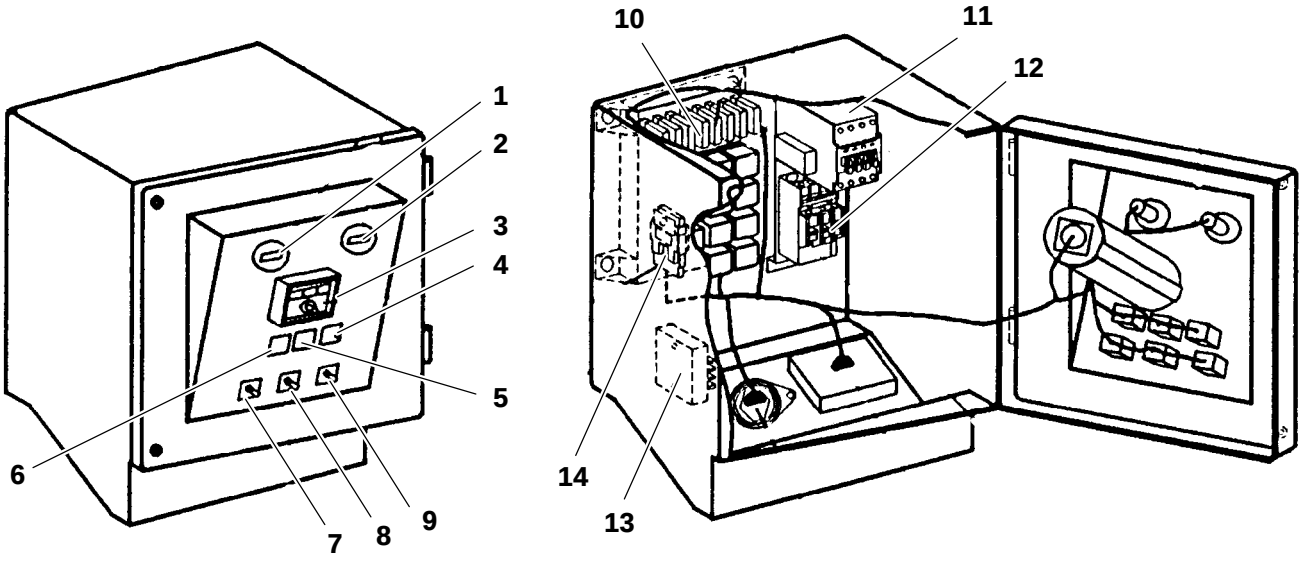


1. Air Cleaner
2. Speed & Run Solenoid
3. Fuel Filter
4. Serial/Model Plate

Figure 1-2. Unit Curbside View

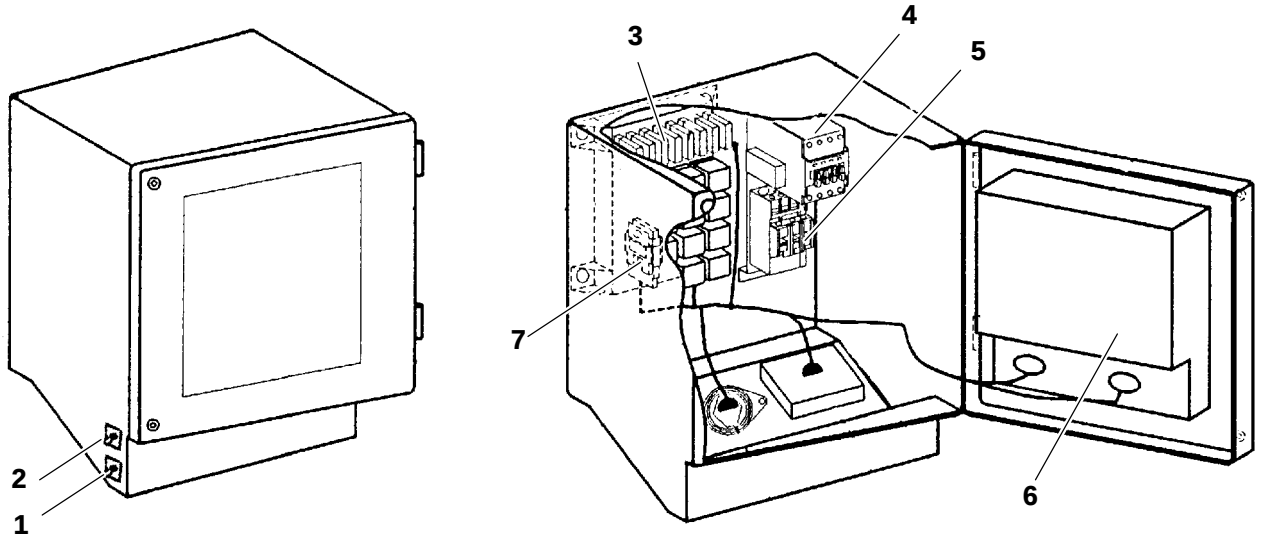
1. Electrical Box (See Figure 1-4 or Figure 1-5)
2. Temperature Controller Sensor
3. Evaporator Fan Motor

Figure 1-3. Unit Roadside View



1. Running Time Meter – Standby (RTMS)
2. Running Time Meter (RTM)
3. Temperature Control Module (TCM)
4. Cool Light (CL)
5. Heat Light (HL)
6. Defrost Light (DL)
7. Glow-Defrost Switch (GDS)
8. Start-Run-Stop Switch (SRS)
9. Selector Switch (SSW)
10. Relay/Fuse Board (See Figure 1-6)
11. Standby Motor Contactor (MC)
12. Motor Overload Relay (MOL)
13. Defrost Timer
14. Fuse (F1 80 amp)

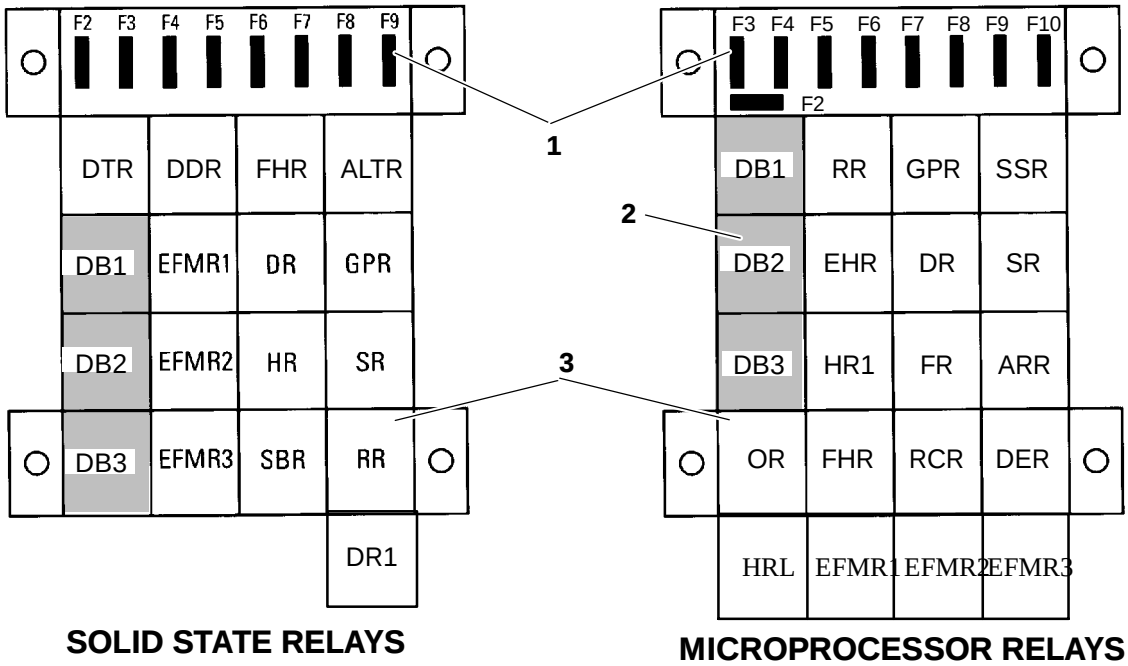
Figure 1-4. Electrical Box – Solid State Controller



1. Run-Stop Switch (RS)
2. Manual Glow/Crank Switch (MGC)
3. Relay/Fuse Board (See Figure 1-6)
4. Standby Motor Contactor (MC)
5. Motor Overload Relay (MOL)
6. Microprocessor Module
7. Fuse (F1 80 amp)

Note: See Figure 1-7 for Cab Command

Figure 1-5. Electrical Box – Microprocessor Controller



1. Fuses
2. Diode, Block (DB1, DB2 & DB3)
3. Relays (See Figure 6-1 or Figure 6-2)

Figure 1-6. Relay Module

1.2 ENGINE DATA

Engine Model		CT2-29TV (Z482)	CT3-44TV (D722)	CT3-69TV (D1105)
Used on		SUPRA 422/522	SUPRA 622/722/822	SUPRA 922/944
Displacement		479 cc (29.2 in^3)	719 cc (43.9 in^3)	1123 cc (68.5 in^3)
No. Cylinders		2	3	3
Horsepower		7.2 kw (9.6 hp) @2300rpm	10.3 kw (13.4 hp) @2200rpm	13.8 kw (18.5 hp) @2200rpm
Weight		53 kg (117 lbs)	63 kg (139 lbs)	89 kg (196 lbs)
Coolant Capacity		3 liters (3.2 U.S. quarts)	3.7 liters (3.9 U.S. quarts)	4.7 liters (5 U.S. quarts)
Oil Capacity		6.4 liters (6.7 U.S. quarts)	8.1 liters (8.5 U.S. quarts)	10.4 liters (11 U.S. quarts)
Operating Speeds	High	2300 rpm	SUPRA 622: 2050 rpm SUPRA 722: 2200 rpm SUPRA 822: 2300 rpm	SUPRA 922/944: 2250 rpm
	Low	1800 rpm	1800 rpm	1800 rpm
Injection Setting		140 to 150 kg/cm^2 (1991 to 2133 psi)		
Water Safety Switch		Closes at: 110 ¦ 3_C (230_ ¦ 5_F)		
Oil Pressure Safety Switch		Closes at: 1.05 ¦ 0.2 kg/cm^2 (15 ¦ 3 psig)		

a. Lubrication System

Lube Oil Viscosity: (API Classification CD)

Outdoor Temperature		SAE
Fahrenheit	**Centigrade**	
Below 32_	0_C	10W or 10W30
32_ to 77_F	0_ to 25_C	20W
Over 77_F	Over +25_C	30W or 15W40

1.3 COMPRESSOR REFERENCE DATA

Model	05G	05K 024	05K 012	EF 210
Displacement	37 cfm	400 cc (24.4 in^3)	200 cc (12.2 in^3)	169 cc (10.3 in^3)
No. Cylinders	6	4	2	2
No. Unloaders	1	0	0	0
Weight	62 kg (137 lbs)	49 kg (108 lbs)	38 kg (84 lbs)	6.8 kg (15 lbs)
Oil Charge	3.8 L (8.0 pts)	2.6 L (5.5 pts)	1.9 L (4.0 pints)	0.36 L (0.76 pints)

APPROVED COMPRESSOR OIL			
Refrigerant	**05G**	**05K**	**EF 210**
R-22	Zerol 150 (synthetic) P/N 07-00274	Suniso 3GS	ESSO S-68
R-404A	Mobil Arctic EAL 68		–
	Castrol Icematic SW-68C		

1.4 REFRIGERATION SYSTEM DATA

a. Defrost Timer

1-1/2, 3, 6, or 12 hours

b. Defrost Air Switch Setting

Initiates at: 16.5 ¦ 1.7 mm wg (0.65 ¦ .07 inch)

c. Defrost Thermostat

Opens at: 8_ ¦ 3_C (47_ ¦ 5_F)

Closes at: 3_ ¦ 3_C (37_ ¦ 5_F)

d. High Pressure Cutout Switch (HP)

R-22

Cutout at: 30 ¦ 0.7 kg/cm@ (428 ¦ 10 psig)
Cut-in at: 22.5 ¦ 0.7 kg/cm@ (320 ¦ 10 psig)

R-404A

Cutout at: 32.7 ¦ 0.7 kg/cm@ (465 ¦ 10 psig)
Cut-in at: 24.6 ¦ 0.7 kg/cm@ (350 ¦ 10 psig)

e. Refrigerant Charge

Refer to Table 1-1

f. Compressor Pressure Regulating Valve (CPR)

MODEL	CPR Setting	
	psig	kg/cm@
SUPRA 422	23 ¦ 1	1.6 ¦ 0.07
SUPRA 522/622	18 ¦ 1	1.3 ¦ 0.07
SUPRA 722	26 ¦ 1	1.8 ¦ 0.07
SUPRA 822	20 ¦ 1	1.4 ¦ 0.07
SUPRA 922	27 ¦ 1	1.9 ¦ 0.07
SUPRA 644	28 ¦ 1	1.7 ¦ 0.07
SUPRA 744	32 ¦ 1	2.25 ¦ 0.07
SUPRA 844	29 ¦ 1	2.0 ¦ 0.07
SUPRA 944	29 ¦ 1	2.0 ¦ 0.07

g. Thermostatic Expansion Valve Superheat

Setting at –17.8_C (0_F) box temperature:
7_C (13 ¦ 1_F)

h. Low Pressure Switch (LPS) –
Solid State Control ETO Only

Opens at: 38 cm (15 in.) hg vacuum

i. Quench Valve (Not Used on Supra 422 or R404A)

Opens at: 121_C (250_F)

j. Compressor Discharge Temperature Sensor

Unit shut down at:
154_C (310_F) for 3 minutes or 177_C (350_F)

1.5 ELECTRICAL DATA

a. Evaporator Fan Motors

Bearing Lubrication: Factory lubricated, additional grease not required

Horsepower	Operating Amps	Speed	Voltage
.15 kw (1/5 hp)	7 to 10 amps	2250 rpm	12 vdc

b. Standby Motors

Bearing Lubrication: Factory lubricated additional grease not required

Rotation Speed: 1760 rpm @ 60hz / 1500 rpm @ 50hz

STANDBY MOTOR					
SUPRA 422/522					
Voltage		**Type of Connection**	**Power**		**FULL LOAD AMPS**
3ph, 50 hz	**3ph, 60 hz**		**KW**	**HP**	
200		Δ	3.0	4.0	10.8
240		Δ			9.0
350		Y			6.1
415		Y			5.2
	208	Δ	3.6	4.8	12.5
	230	Δ			11.3
	380	Y			6.8
	460	Y			5.6
SUPRA 622/722/822/644/744/844					
200		Δ	4.8	6.4	17.3
240		Δ			14.4
350		Y			9.8
415		Y			8.3
	208	Δ	5.7	7.6	19.8
	230	Δ			17.9
	380	Y			10.8
	460	Y			8.9
SUPRA 922/944					
400		Y	9	12	25.1
	208	Δ	11	14.7	38.6
	460	Y	11	14.7	22.9

c. Alternator: 65 amps – North & South America
70 amps – Europe

d. Standby Motor Overload

STANDBY MOTOR OVERLOAD	
MODEL	**SETTING**
Supra 422	14 amps
Supra 522/622	9 amps
Supra 722/822	14 amps
Supra 922/944	39 amps

1.6 TORQUE VALUES

Assembly	kg–m	ft–lb
Power Tray to Frame	5.5	40
Standby Motor to Power Tray	5.5	40
Engine to Power Tray	7.0	50
Compressor to Power Tray	5.5	40
Standby Motor Pulley	4.5	32
Engine Pulley	3.0	22
Compressor Pulley	3.0	22
Evaporator Fan Motor	1.8	13
Evaporator Fan Grille	1.0	7
Condenser Coil to Chassis	1.0	7
Tensioner to Power Tray	3.0	22
Engine Support	5.5	40
Run & Speed Solenoids	1.0	7
Condenser Fan Blade	2.5	18
Engine Clutch	5.5	40

1.7 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions by automatically shutting down the unit when such conditions occur. This is accomplished by the safety devices listed in Table 1-2 or Table 1-3.

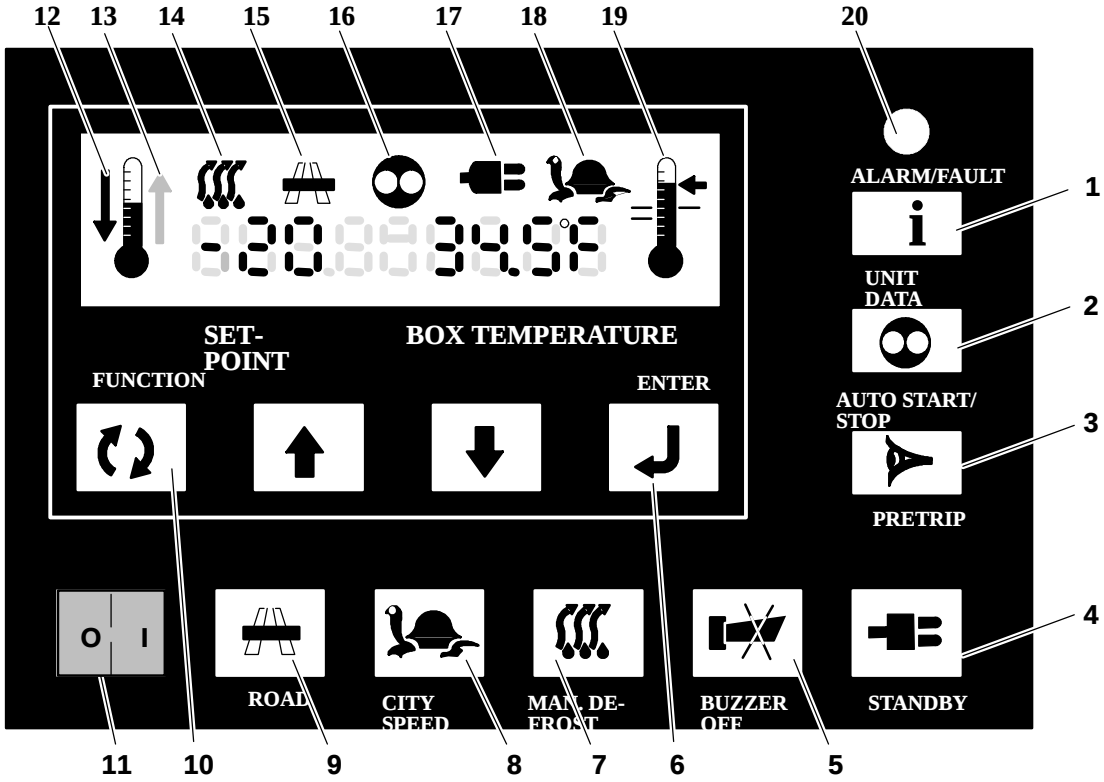
Table 1-2. Safety Devices -- Microprocessor Controller

Unsafe Conditions	Safety Device	Device Setting
1. Low engine lubricating oil pressure	Oil pressure safety switch (OP) automatic reset	Opens below 1 ¦ 0.2 kg/ cm@ (15 ¦ 3 psig)
2. High engine cooling water temperature	Water temperature sensor (microprocessor)	Opens above 110 ¦ 3_C (230 ¦ 5_F)
3. Excessive current draw by glow plug circuit , control circuit or start-er solenoid (SS)	Fuse (F1)	Opens at 80 amps
4. Excessive current draw by microprocessor	Fuse (F2)	Opens at 5 amps
5. Excessive current draw by control circuit	Fuse (F3)	Opens at 25 amps
6. Excessive current draw by speed control solenoid	Fuse (F4)	Opens at 15 amps
7. Excessive current draw by auto restart or out-of-range lights	Fuse (F5)	Opens at 7 1/2 amps
8. Excessive current draw by evaporator fan motors	Fuse (F7, F8, F9)	Opens at 20 amps
9. Excessive compressor discharge pressure	High pressure cutout switch (HP) automatic reset	Refer to Section 1.4.d.
10. Excessive compressor discharge temperature	Compressor discharge temperature sensor (CDT)	Shuts unit down above 154_C (310_F) for 3 minutes or 177_C (350_F)

Table 1-3. Safety Devices -- Solid State Controller

Unsafe Conditions	Safety Device	Device Setting
1. Low engine lubricating oil pressure	Oil pressure safety switch (OP) automatic reset	Opens below 1 ¦ 0.2 kg/ cm@ (15 ¦ 3 psig)
2. High engine cooling water temperature	Water temperature switch	Opens above 110 ¦ 3_C (230 ¦ 5_F)
3. Excessive current draw by glow plug circuit , control circuit or starter solenoid (SS)	Fuse (F1)	Opens at 80 amps
4. Excessive current draw by Solid State controller	Fuse (F2)	Opens at 20 amps
5. Excessive current draw by control circuit	Fuse (F3)	Opens at 20 amps
6. Excessive current draw by evaporator fan motors	Fuse (F5, F6, F7)	Opens at 20 amps
7. Excessive current draw by evaporator fan clutch	Fuse (F8)	Opens at 10 amps
8. Excessive current draw by fuel pump or run solenoid	Fuse (F9)	Opens at 15 amps
9. Excessive compressor discharge pressure	High pressure cutout switch (HP) automatic reset	Refer to Section 1.4.d.

1.8 MICROPROCESSOR CONTROLLER



1. Unit Data Key
2. Auto Start/Stop – Continuous Key
3. Pretrip Key
4. Stand-by Key
5. Buzzer Off Key
6. Enter Key
7. Manual Defrost Key
8. City Speed Key
9. Road Key
10. Function Key
11. ON–OFF Key
12. Cool Mode
13. Heat Mode
14. Defrost Mode
15 Road Mode
16. Autostart/Stop Mode
17. Stand-by Mode
18. City Speed Mode
19. Out-of-range
20. Fault Light

Figure 1-7. Cab Command

1.8.1 INTRODUCTION

The microprocessor controller is housed in the control box. This controller consists of 2 control boards and a relay module:

1. The Processor Board includes the microprocessor, program memory, and necessary input/output circuitry to interface with the unit.

2. The Relay Module contains replaceable relays, diodes and fuses along with the wiring harness.

The Cab Command is remote mounted in the truck. The Cab Command includes the LCD display, keypad and keypad interface. (See Figure 1-7)

CAUTION

Under no circumstances should anyone attempt to repair the Logic or Display Boards! (see section 4.22) Should a problem develop with these components, contact your nearest Carrier Transicold dealer for replacement.

The Carrier Transicold microprocessor controller incorporates the following features:

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

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

c. Digital readout and ability to select data. Refer to Table 1-4 for Function Codes and Table 1-5 for Unit Data.

d. For alarm digital display identification Refer to Table 1-6.

e. A pre-trip checkout of refrigeration unit operation. Refer to section 1.8.8

f. A self-test check on program memory and data memory. The self-test is executed each time the system is switched from “Stop” to “Start.” Errors, if any, shall be indicated on the display as a ERR.X, where X is a number corresponding to the number of the test. The unit shall display this error for 5 seconds and then reset the micro.

ERROR	CAUSE
ERR.1 ERR.2 ERR.3	Processor failure Check chip installation or Replace microprocessor.
ERR.4 or Display	Display board to logic board communication failure. This can be caused by a defective ribbon cable or ribbon cable not plugged in properly.

g. A communication link to transmit unit operational data to a remote computer. Refer to section 1.8.12

1.8.2 KEYPAD

The keypad has 12 keys which will allow the operator to initiate various functions, display operating data and change operating parameters.

Arrow Keys

The keypad has *up* and *down arrow keys* which are used to modify (increment or decrement) the displayed data. If the unit is in the default display then these keys will modify the setpoint selection.

Enter Key

The *enter key* is used to accept a change in unit parameters or a change in setpoint.

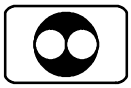
Manual Defrost Key

The *manual defrost key* is used to initiate a defrost cycle, given that the proper conditions are met (Refer to section 1.8.10).

Pretrip Check Key

The *pretrip check key* is used to initiate a pretrip cycle, given that the proper conditions are met (Refer to section 1.8.8).

Auto Start/Stop Continuous Key



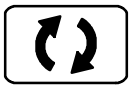
The *autostart/stop continuous key* is used to change the operating mode from "auto start/continuous run" to "auto start/stop." Each push of the key will alternate the operating modes. The operating status will be stored in memory and is retained through power outages. The digital display will indicate when stop/start is enabled (Refer to Section 1.8.11).

To start the unit in manual start mode, the *autostart/stop continuous* selection must be in continuous run mode.

NOTE

With software revision 3.08 or higher when configuration CNF11 is "ON" and setpoint is 32 to 42_ F (0 to 5.5_C) the unit is locked into continuous run. Start/Stop Continuous key is disabled.

Function Change Key



The *function change key* is used to display the operating parameters. Each time this key is pressed the display will advance to the next parameter. This key, in conjunction with the *up/down arrow* and *enter keys*, will allow the user to change the parameters (Refer to Section 1.8.5).

Unit Data Key

The *unit data key* is used to display the unit operating data. This key, in conjunction with the *up/down arrow* keys, will allow the user to display the unit's operating data values (i.e, coolant temperature, battery voltage, etc.) (Refer to Section 1.8.6).

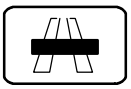
City Speed Key

The *city speed key* enables the city speed (low speed). Each push of the key toggles the operating mode. The operating status will be stored in memory. The display will indicate when city speed is activated.

Buzzer Off Key

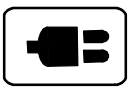
The *buzzer off key* will turn off the cab command buzzer. The buzzer is turned on when the fault light is energized and off when the fault light is de-energized.

Road Key



The *road key* selects the diesel engine operating mode. The operating status will be stored in memory.

Stand-by Key



The *stand-by key* selects the electric motor operating mode. The operating status will be stored in memory. "NO POWER" will be displayed, if unit is switch to standby and power plug is not plugged in.

1.8.3 SETPOINT

Setpoints of −30_C to +30_C (−22_F to +86_F) may be entered via keypad. The controller always retains the last entered setpoint in memory. If no setpoint is in memory (i.e., on initial startup), the controller shall lock out the run relay and flash "SP" on the left hand display until a valid setpoint is entered.

The setpoint may be changed up or down in whole numbers until the desired setpoint is displayed. The display will flash to indicate that the setpoint reading being displayed is a non-entered value. Each time the *up/down arrow key* is pressed, the 5 second display timer will be reset.

Depressing the *enter key* will cause the new displayed setpoint value to become active. If the display is flashing and the new value is not entered, after 5 seconds of no keypad activity, the display will revert back to the active setpoint.

1.8.4 DIGITAL DISPLAY

The digital display has 9 digits. The default display is setpoint on the left and controlled air temperature on the right. The readout is keypad selectable for Degrees C or Degrees F. (See Figure 1-7)

The display also has symbol indicators for the following modes: Cool, Heat, Defrost, Out-of-range, City Speed, Autostart/Stop, Stand-by, and Road (diesel operation).

On each power-up, the unit will display a Display Test for 5 seconds then display the default reading.

1.8.5 FUNCTIONAL PARAMETERS

NOTE

If configuration CNF11 is "ON" functional parameters are lockout. The ability to change functional parameters from keypad are disabled.

The functional parameters will control selected operating features of the unit. These parameters can be displayed by pressing the *function change key*. All functional parameters are retained in memory. The following sections describe the list of functions which can be modified via the keypad. A description of the function is displayed on the left side with the corresponding data on the right side. The function parameter list can be scrolled through by pressing the *function change key* or by using the *up/down arrow keys*. With each *function change key* push, the list is advanced one. If the function key is pressed and held for one second, the list will advanced one item at a time. This list will circular, meaning once the end of the list is reached the list will go to the first entry. While the functional parameter is displayed, the data can be changed by pressing *enter* then pressing either the *up or down arrow keys*. If the value is changed, the displayed data will then flash to indicate that the value has not been entered. If the new value is not entered in 5 seconds, the display will revert back to the last entered value. If the *enter key* is pressed, the display will stop flashing to indicate that the value has been entered. The new value will continue to be display for 5 seconds before reverting back to the default display. Each time a key is pressed, the 5 second delay will reset. To select a different functional parameter the *function change key* must be pressed first.

Code Vs English Messages

The description messages of the functional parameters, unit status and alarms can be displayed in English or Codes through this function selection. The two choices are displayed as, ENGLISH or CODES. With this parameter set to CODES, all display descriptions are set to their code display. This parameter will not change due to this selection. Refer to each section for the alternate display description.

Manual Glow Override

The auto start glow time can be manually overridden through this function. The messages is displayed as NORM GLOW or ADD GLOW. If the ADD GLOW selection is entered, the control will add 30 seconds of glow to the glow times listed in section 1.8.11. This feature must be selected before the 3 start attempts have been completed. At higher ambients, this override will only affect the second or third start attempt. The add glow time is deselected when the engine starts or fails to start. This parameter will not change due to the Code vs English selection.

Alarm Reset

Alarms can be reset through this function. The messages are displayed as ALARM RST or ALARM CLR. If the ALARM RST is displayed then there is at least one alarm present. Pressing the *enter key* will clear all the alarms present. If the ALARM CLR is displayed then there are no alarms present. See section 1.8.7. This parameter will not change due to the code vs English selection.

Table 1-4. Function Parameters

CODE	ENGLISH	DATA
FN0	DEFR	Defrost Interval
FN1 ON	CITY SPD	Low Speed
FN1 OFF	HIGH SPD	High Speed
FN2	OFF T	Minimum Off-time
FN3	ON T	On-time
FN4 A	REM PROBE	Controlling Probe – Return Air
FN4 B	SUP PROBE	Controlling Probe – Supply Air
FN5	Degrees F or C	Temperature Unit _C or _F
FN6 ON	TIME STRT	Maximum Off-time 30 Min.
FN6 OFF	TEMP STRT	Temperature Based Restarting
FN7	MOP STD	Future Expansion
FN8	2SET	Compartment 2 Setpoint
FN9	3SET	Compartment 3 Setpoint
FN10 ON	AUTO OP	Auto Start Operation
FN10 OFF	MAN OP	Manual Start Operation
FN11	T RANGE	Out-of-Range Tolerance
Code vs English = Code or English display format		
Manual Glow Override = Normal or Add 30sec		
Alarm RST = Alarm Reset Required Alarm CLR = No Alarm Active		

Defrost Interval

The defrost interval is displayed with the description DEFR or FN0. The data for the interval is displayed with one decimal place and then the capital letter H for hours (i.e., DEFR 12.0H). The defrost intervals are 1 $^{1}/_{2}$, 3, 6 or 12 hours.

Airflow

The status of the speed control solenoid override is displayed as CITY SPD or HIGH SPD. The code display is FN1. The city speed setting is "ON" and the high speed setting is "OFF." If the display shows CITY SPD, the unit is locked into low speed.

Minimum Off-Time

The off-time selection for the auto start mode is displayed with the description OFF T or FN2. The off-times are 10, 20, 30, 45 or 90 minutes. The data for the off-time is displayed with two digits and then the capital letter M for minutes (i.e. OFF T 20M).

On-Time

The on-time selection for the auto start mode is displayed with the description ON T or FN3. With software revision less than 3.10 the on-times are 4 or 7 minutes. With software revision 3.10 or higher the on-times are 1 or 4 minutes. The data for the on-time is displayed with two digits and then the capital letter M for minutes (i.e. ON T4 M).

Controlling Probe

The number of controlling probes is displayed with the following abbreviations: REM PROBE for a single probe (return air) control; SUP PROBE for a dual probe control (return and supply air). The code display is FN4. The 1-probe setting is "A" and the 2-probe setting is "B."

Standard Units Select

The standard unit select will control how all parameters are displayed. The two choices are DEGREES F and DEGREES C. This parameter also will control units that data is displayed in psig or bars (i.e, Degrees F or Degrees C). The code display is FN5. The selections are "F" or "C."

Maximum Off Time

The description for the maximum off time is TEMP STRT OR TIME STRT. The code display is FN6 and the selections are "ON" or "OFF." "ON" corresponds to TIME STRT. With the unit in time start, the control will force the engine to restart 30 minutes after shutoff.

MOP STD – Future Expansion

This function is not used at this time. The display is FN7.

Compartment 2 Setpoint

Setpoints may be entered through this function for the second compartment. The setpoint function will be displayed with the abbreviated description 2SET. The code display is FN8. The setpoint may be changed refer to section 1.8.3.

Compartment 3 Setpoint

Setpoints may be entered through this function for the third compartment. The setpoint function will be displayed with the abbreviated description 3SET. The code display is FN9. The setpoint may be changed refer to section 1.8.3.

Auto/Manual Start Operation

The selection for starting the unit are displayed AUTO OP (code FN10 ON) for auto start operation or MAN OP (code FN10 OFF) for manual start operation.

To start the unit in manual start mode, the START/STOP CONTINUOUS selection must be in "continuous run" mode.

Out-of-Range Tolerance

The out-of-range temperature tolerance selection is displayed with the description T RANGE or code FN11. The selection are A, B and C. A=2_C(3.6_F), B=3_C(5.4_F) and C=4_C (7.2_F).

When the out-of-range temperature is configured ON, the controller indicates out-of-range when the temperature has been within the tolerance band at least once, and then goes outside the tolerance band for 45 minutes. Also the unit will shut down.

When the out-of-range temperature is configured OFF, the controller indicates out-of-range when the temperature has been within the tolerance band at least once, and then goes outside the tolerance band for 15 minutes. Also the unit will continue to operate.

For set points at or below –12.2_C (+10_F) *frozen range* the unit is only considered out-of-range for temperatures above set point.

1.8.6 UNIT DATA

The *unit data key* can be used to display the unit operating data values. The data values are displayed for 5 seconds and then the display will revert back to the default display if no further action is taken. The following sections describe the list of data which can be displayed via the keypad. The description of the data is displayed on the left side with the actual data on the right side. The unit data list can be scrolled through by pressing the *unit data key*. With each successive key push, the list is advanced one. If the *unit data, up* or *down arrow key* is held for one second, the list will change at a rate of one item every 0.5 seconds. This list will circular, meaning once the end of the list is reached the list will go to the first entry. Each time the *unit data key* or the *up/down arrow key* is pressed, the display time will be reset to 5 seconds. If the *enter key* is pressed, the display time will be set to 30 seconds. The position in the unit data list will remain at the last selected value except if power is removed. If the display were to time out and revert to the default display, the operator would only have to press the *unit data key* to display the same data again.

Suction Pressure

The suction pressure is displayed with the description SUCT or CD1. The data is displayed with the proper unit designator P (psig) or B (Bars) (i.e. SUCT 25P) . The display is in inches of mercury for readings below 0 psig. The display range is –0.7 Bars to 29.4 Bars (–20 HG to 420 psig).

Engine Hours

The number of diesel engine hours are displayed with the description ENG or CD2. The data is displayed with units designator H (i.e, ENG 5040H OR CD2 5040H). The display range is 0 to 99999.

Engine Temperature

The coolant temperature is displayed with the description WT or CD3. The data is displayed with the proper unit designator (Degree C or Degree F (i.e, WT 185F or CD3 185F). The display range is –12_C to 130_C (10_F to 266_F).

Return Air Temperature

The return air temperature is displayed with the description RAS or CD4. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. RAS 85.0F). The display range is –38_C to 70_C (–36_F to 158_F).

Table 1-5. Unit Data Codes		
CODE	**ENGLISH**	**DATA**
CD1	SUCT	Suction Pressure
CD2	ENG	Engine Hours
CD3	WT	Engine Temperature
CD4	RAS	Return Air Temperature
*CD5	SAS	Supply Air Temperature
*CD6	REM	Remote Air Temperature
CD7	ATS	Ambient Temperature
CD8	EVP	Future Expansion
CD9	CDT	Discharge Temperature
CD10	BATT	Battery Voltage
CD11	SBY	Standby Hours
CD12	MOD V	Future Expansion
CD13	REV	Software Revision
CD14	SERL	Serial Number Low
CD15	SERU	Serial Number Upper
CD16	2RA	Compartment 2 Air Temperature
CD17	3RA	Compartment 3 Air Temperature
CD18	MHR1	Maintenance Hour Meter 1
CD19	MHR2	Maintenance Hour Meter 2
CD20	SON	Switch On Hour Meter
* Codes 5 & 6 are variable. SAS is displayed when the SUP Probe Function is selected. REM is displayed when the REM Probe Function is selected.		

Supply Air Temperature

The supply air temperature is displayed with the description SAS or CD5. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. SAS 85.0F). The display range is −38_C to 70_C (−36_F to 158_F). This unit data will be displayed only if the SUP PROBE is selected in the controlling probe functional parameter.

Remote Air Temperature

The remote air temperature is displayed with the description REM or CD6. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. REM 85.0F). The display range is −38_C to 70_C (−36_F to 158_F). This unit data will be displayed only if the REM PROBE is selected in the controlling probe functional parameter.

Ambient Temperature

The ambient temperature is displayed with the description ATS or CD7. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F, (i.e. ATS 85.0F) . The display range is −38_C to 70_C (−36_F to 158_F). If the sensor is absent, then the display will read −−− for the data.

Evp − Future Expansion

This unit data is not used at this time. The Code display is CD7.

Compressor Discharge Temperature

The compressor discharge temperature is displayed with the description CDT or CD9. The data is displayed with the proper unit designator, Degree C or Degree F, (i.e. CDT 85F) . The display range is −40_C to 200_C (−40_F to 392_F). If the sensor is absent, then the display will read −−− for the data.

Battery Voltage

The battery voltage is displayed with the description BATT or CD10. The data is displayed with one decimal place and then the capital letter V for volts (i.e, BATT 12.2V or CD10 12.2V). The voltage reading is displayed with a "+" plus sign if the battery status is good.

Standby Hours

The number of electric motor hours are displayed with the description SBY or CD11. The data is displayed in hours and units designator H (i.e, SBY 5040H or CD11 5040H). The display range is 0 to 99999.

Mod V − Future Expansion

This unit data is not used at this time. The Code display is CD12.

Software Revision

The Eprom software revision number is displayed with the description REV or CD13 on the left and Eprom software revision number on the right side. Pressing the *enter key* for 3 seconds will display REV U2 on the left and the board mounted software revision number on the right side.

Serial Number Low

The low serial number of the unit is displayed with the description SERL or CD14. The data is the lower 3 digits of the serial number burned in to the Eprom. (i.e, SERL 504 or CD14 504).

Serial Number Upper

The upper serial number of the unit is displayed with the description SERU or CD15. The data is the upper 3 digits of the serial number burned in to the Eprom. (i.e, SERH 001 or CD15 001).

Compartment 2 Air Temperature

The air temperature for the second compartment will be displayed with the abbreviated description 2RA on the left-hand side. The code display is CD16. The data will be displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. 2RA85.0F).

Compartment 3 Air Temperature

The air temperature for the second compartment will be displayed with the abbreviated description 3RA on the left-hand side. The code display is CD17. The data will be displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. 3RA85.0F).

Maintenance Hour Meter 1

The maintenance hour meter 1 setting is displayed with the description MHR1 or CD18. The maintenance hour meter is compared to one of the hour meters (diesel, standby, or switch on) determined by its mode. If the hour meter is greater than the maintenance hour meter an alarm will be generated.

Maintenance Hour Meter 2

The maintenance hour meter 2 setting is displayed with the description MHR2 on the left side or CD19. The maintenance hour meter is compared to one of the hour meters (diesel, standby, or switch on) determined by its mode. If the hour meter is greater than the maintenance hour meter an alarm will be generated.

Switch On Hour Meter

The number of switch on hours is displayed with the description SON or CD20 (i.e. SON 2347H or CD20 2347H). The display range is 0 to 99999.

1.8.7 ALARM DISPLAY

The fault light (FL) is turned on only for alarms that specify it. The default display will be overridden if a alarm is generated. When an alarm is generated, the display will alternate the default display (setpoint/air temperature) and the active alarm(s). Each item will be displayed for 3 to 10 seconds, and will continue to scroll through the list. See section 1.8.5 for the procedure on resetting alarms.

Low Oil Pressure Alarm

The low oil pressure alarm is displayed with the description ENG OIL or AL0. This alarm is generated if the control senses low oil pressure under the proper conditions. The fault light (FL) is turned on. Engine will shut down.

High Coolant Temperature Alarm

The high coolant temperature alarm is displayed with the description ENG HOT or AL1. This alarm is generated if the control senses a high coolant temperature over 110_C (230_F). The fault light (FL) is turned on and the engine will shut down.

High Pressure Alarm

The high pressure alarm is displayed with the description HI PRESS or AL2. This alarm is generated if the high pressure switch opens. The fault light (FL) is turned on and the engine will shut down.

Start Failure Alarm

The start failure alarm is displayed with the description STARTFAIL or AL3. This alarm is generated if the engine fails to start. The fault light (FL) is turned on.

If function MAN OP (manual start mode) is selected the start failure alarm will be generated if the engine fails to start in 5 minutes.

Low Battery Voltage Alarm

The low battery voltage alarm is displayed with the description LOW BATT or AL4. This alarm is generated if the battery voltage falls below 10 vdc. The fault light (FL) is turned on.

Table 1-6. Alarm Display

CODE	ENGLISH	ALARM DESCRIPTION
AL0	ENG OIL	✔Low Oil Pressure
AL1	ENG HOT	✔High Coolant Temperature
AL2	HI PRESS	✔High Pressure
AL3	STARTFAIL	✔Start Failure
AL4	LOW BATT	✔Low Battery Voltage
AL5	HI BATT	✔High Battery Voltage
AL6	DEFRFAIL	Defrost Override
AL7	ALT AUX	✔Alternator Auxiliary
AL8	STARTER	✔Starter Motor
AL9	RA SENSOR	✔Return Air Sensor
AL10	SA SENSOR	Supply Air Sensor
AL11	WT SENSOR	Coolant Temperature Sensor
AL12	HIGH CDT	✔High Discharge Temperature
AL13	CD SENSOR	Discharge Temperature Sensor
AL14	SBY MOTOR	✔Standby Motor Overload
AL15	FUSE BAD	✔Fuse Open
AL17	DISPLAY	Display
AL18	SERVICE 1	Maintenance Hour Meter 1
AL19	SERVICE 2	Maintenance Hour Meter 2
AL20	OUT RANGE	✔Main Compartment Out-of-range
AL21	2RA OUT	✔Remote Compartment 2 Out-of-range
AL22	3RA OUT	✔Remote Compartment 3 Out-of-range
NO POWER		No Power for Standby
✔ = FAULT LIGHT ON		

High Battery Voltage Alarm

The high battery voltage alarm is displayed with the description HI BATT or AL5. This alarm is generated if the battery voltage is above 17 vdc. The fault light (FL) is turned on and the engine will shut down.

Defrost Override Alarm

The defrost override alarm is displayed with the description DEFR FAIL or AL6. This alarm is generated if the unit is in a defrost override mode (See Section 1.8.10).

Alternator Auxiliary Alarm

The alternator auxiliary alarm is displayed with the description ALT AUX or AL7. This alarm is generated if the alternator auxiliary signal is not present with the engine running. (See Section 1.8.11) The fault light (FL) is turned on.

Starter Motor Alarm

The starter motor alarm is displayed with the description STARTER or AL8. This alarm is generated if the starter motor input signal is not present with starter solenoid energized. The fault light (FL) is turned on.

Return Air Sensor Alarm

The return air sensor alarm is displayed with the description RA SENSOR or AL9. This alarm is generated if the return air sensor is open or shorted. The fault light (FL) is turned on if the unit shuts down because there is no controlling probe.

Supply Air Sensor Alarm

The supply air sensor alarm is displayed with the description SA SENSOR or AL10. This alarm is generated if the supply air sensor is open or shorted. This alarm will be disabled if the REM PROBE is selected in the controlling probe functional parameter.

Coolant Temperature Sensor Alarm

The coolant temperature sensor alarm is displayed with the description WT SENSOR or AL11. This alarm is generated if the coolant temperature sensor is open or shorted.

Compressor Discharge Temperature Alarm

The compressor discharge temperature alarm is displayed with the description HIGH CDT or AL12. This alarm is generated if the temperature is sensed above 155_C (310_F) for 3 minutes. If the discharge temperature exceeds 177_C (350_ F), the 3 minute timer is overridden and the unit shut down immediately. The fault light (FL) is turned on.

Compressor Discharge Temperature Sensor Alarm

The compressor discharge temperature sensor alarm is displayed with the description CD SENSOR or AL13. This alarm is generated if the sensor is open or shorted.

Standby Motor Overload Alarm

The standby motor overload alarm is displayed with the description SBY MOTOR or AL14. This alarm is generated when the MOL input is sensed open with the Run Relay energized in electric mode (Diesel/Electric Relay energized).

Fuse Alarm

The fuse alarm is displayed with the description FUSE BAD or AL15. This alarm is generated when the FUSE input is sensed low. The fault light (FL) is turned on.

Display Alarm

When no communications exist between the main board and the display board for 8 seconds, the display alarm description is DISPLAY or AL17

Maintenance Hour Meter 1 Alarm

The maintenance hour meter alarm 1 is displayed with the description SERVICE 1 or AL18. This alarm is generated when the designated hour meter is greater than maintenance hour meter 1.

Maintenance Hour Meter 2 Alarm

The maintenance hour meter alarm 2 is displayed with the description SERVICE 2 or AL19. This alarm is generated when the designated hour meter is greater than maintenance hour meter 2.

Out-of-Range Alarm

The out-of-range alarm is displayed with the description OUT RANGE or AL20. This alarm is generated when the main compartment is out-of-range refer to section 1.8.5. The fault light (FL) is turned on.

Remote Compartment 2 Out-of-range Alarm

The Code display is AL21. This alarm is generated when the remote compartment 2 is out-of-range refer to section 1.8.5. The fault light (FL) is turned on.

Remote Compartment 3 Out-of-range Alarm

The Code display is AL22. This alarm is generated when the remote compartment 3 is out-of-range refer to section 1.8.5. The fault light (FL) is turned on.

No Power for Standby Alarm

"NO POWER" will be displayed, if unit is switch to standby and power plug is not plugged in.

1.8.8 PRE-TRIP

The *pretrip key* is for checking unit operation and evaluating operation of all modes and indicating a failure when detected. The following details the sequence :

a. Unit operating and box temperature is below 4.4_C (40_F).

b. Operator presses the *pretrip key*. If the defrost thermostat (DTT) is closed, the controller will display "PPPP." If DTT is open, no response – end of test.

c. Controller displays "PPPP" Pre-trip mode is started.

d. After 30 seconds in high speed cool, unit cycles to low speed loaded cool.

e. After 30 seconds, unit cycles to low speed unloaded cool.

f. After 30 seconds, unit cycles to low speed unloaded heat.

g. After 30 seconds, unit cycles to low speed loaded heat.

h. After 30 seconds, unit cycles to high speed heat and displays coolant temperature.

i. After 30 seconds, unit cycles to high speed cool and displays defrost interval selected for 30 seconds, then unit cycles to defrost if DTT is closed.

j. After standard defrost cycle, Pre-trip is terminated and unit returns to normal operation.

1.8.9 HEAT/COOL MODE

There are two control ranges, Frozen and Perishable. The Frozen range is active with set points at or *below –12_C (+10_*F) and the Perishable range is active at set points *above –12_C (+10_*F).

The system is configured for cooling mode for engine start and during the oil pressure delay.

Hot gas heating is applied by energizing the HR1 relay which will energize the hot gas solenoid. The relay will also control the remote heat and cool lights.

Heating is locked out of operation at setpoint temperatures at or below *–12_C (+10_*F) except during defrost.

Default Mode

When in frozen range (setpoint at or below *+10_*F), unit shall default to low speed if a loss of control (bad sensor) is detected. Since electric driven units have no low speed, the default in the frozen range shall be high speed cooling. When in perishable range (setpoint *> +10_*F), the unit shall shut down. The proper alarm indication shall be displayed when this mode is active.

1.8.10 DEFROST CYCLE

Defrost is an independent cycle overriding cooling and heating functions to de-ice the evaporator as required. The controller displays "DF" during defrost mode on the right hand temperature display. The left hand display will continue to display the setpoint.

a. Defrost Timer Initiation

A defrost timer initiation is a keypad selection (Refer to Section 1.8.5). The defrost timer is reset to zero whenever a defrost cycle is initiated. The controller holds in memory the last entered defrost interval.

b. Defrost Air Switch Initiation

An external defrost signal (DA) may be supplied as a set of normally open switch contacts closing to initiate the defrost cycle.

c. Manual Defrost Initiation

The defrost cycle may be initiated by pushing the *manual defrost key*. (DTT must be closed)

d. Defrost Function

The defrost mode is initiated upon expiration of the defrost timing interval with the presence of a signal from the defrost termination thermostat (DTT). It may also be initiated by the presence of a momentary manual defrost signal. Defrost may also be initiated by an external defrost signal from a device such as an air switch. The defrost mode terminates when the defrost termination thermostat (DTT) opens indicating the defrost cycle is complete. The defrost timer runs only when the DTT is closed. The defrost interval timer resets to zero when defrost is initiated by any means. The timer does not accumulate time during defrost mode, during standby off cycles or auto-start off cycles.

A defrost output is energized during defrost mode to de-energize the evaporator fan motors or energize the damper solenoid to prevent hot air circulation to the load.

In addition, the heating outputs (SR & HR1) are enabled to apply high-speed heat for hot gas heating.

The compressor operates at maximum capacity on diesel and diesel/electric units during defrost.

e. Fail safe Defrost Termination

Should the defrost cycle not complete within 45 minutes or if the external defrost signal does not clear at defrost termination, the defrost cycle is terminated. The internal timer is reset for 1.5 hours and the external defrost signal is ignored for defrost initiation. The manual defrost switch will override this mode and start a new 45 minute cycle. When defrost override is active, the appropriate alarm will be indicated. If the run relay is de-energized during defrost, defrost is terminated.

f. Defrost Termination at Low Speed

The defrost terminates with HR1 and speed relay de-energizing. The defrost output will de-energize 5 seconds after HR1. If the temperature control requires high speed, it will energize 2 seconds after defrost relay is de-energized.

1.8.11 AUTO START/STOP OPERATION

Automatic start/stop is provided to permit starting/restarting of the diesel-driven compressor as required. This feature fully enables automatic control of the diesel engine starting and stopping. The main function of automatic engine cycling is to turn off the refrigeration system near setpoint to provide a fuel efficient temperature control system and to initiate a restart sequence after conditions are met. System shut-off is allowed only if the battery condition signal is good. The engine coolant temperature shall override the minimum off time and out-of-range condition to force engine restarting when the engine coolant temperature drops below 1_C (34_F). A restart will also be initiated if the battery voltage falls below 11.0 Vdc.

a. Autostart/Stop – Continuous

NOTE

With software revision 3.08 or higher when configuration CNF11 is "ON" and setpoint is 32 to 42_ F (0 to 5.5_C) the unit is locked into continuous run. Start/Stop Continuous key is disabled.

A key is provided to select between continuous run and auto start/stop operating mode. In the continuous run mode, the diesel engine will not shut down except for safeties or if the engine stalls. This function also apply to the operation of the electric motor.

b. Auto Mode Indicator

The "Auto start/stop" indicator is lit and ARL light will be on to indicate the autostart/stop mode has been selected.

c. Auto Start Failure

If the unit fails to start, shuts down on a safety, or fails to run for the minimum run time, three consecutive times, the "Start/Fail" alarm is activated.

d. Continuous Run Mode

In continuous run mode, the engine is started but not allowed to shut off except for safeties or if the engine stalls.

e. Auto Start Sequence

When the starting conditions are met, the start sequence will begin by energizing the run relay, and after 5 seconds energize the glow plug relay (GPR) to supply power to the glow plugs, and 5 seconds later the starter is energized. On initial power-up, the control will delay 5 seconds before the starting sequence begins. If the required glow time is zero, the control will energize the starter after a 5 second delay. After a period of time , the starter solenoid (SS) is energized to crank the engine. The engine will crank for 10 seconds or until engine

operation is sensed by the alternator signal. The glow relay is de-energized after the auxiliary input is sensed on. A 15 second null cycle will elapse before subsequent start attempts. The run relay will remain energized until the next starting sequence.

Before the next starting sequence, the oil pressure alternator auxiliary output is checked to insure that the engine is not running. For the second and third start attempts the glow time is increased by 5 seconds over the glow time of the first attempt listed below. The control allows three consecutive start attempts before the starting is locked out and the start failure alarm is activated.

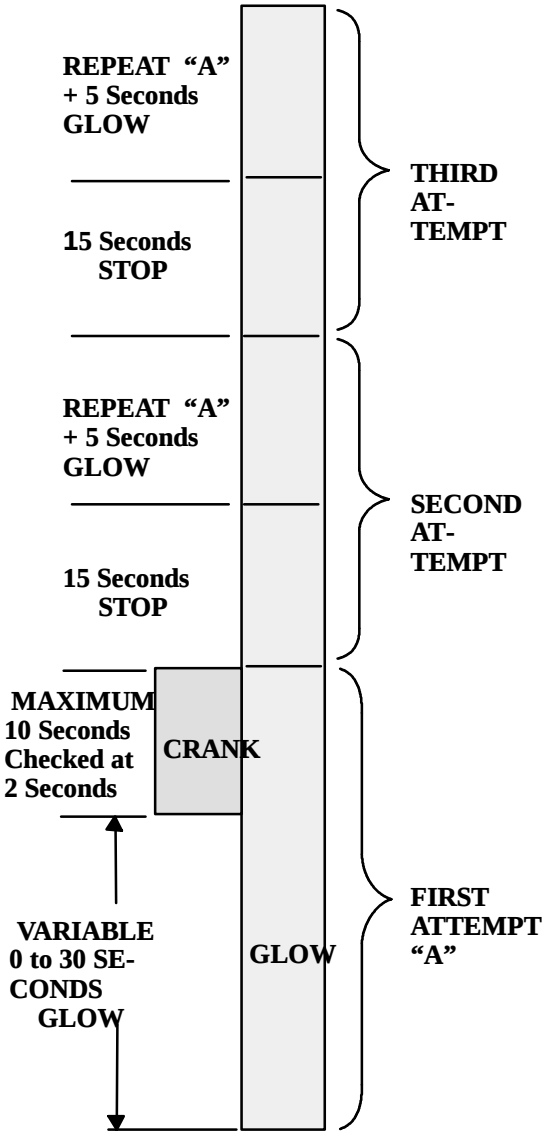


Figure 1-8. Auto Start Sequence

f. Variable Glow Time

The glow time for the first start attempt will vary in duration based on engine coolant temperature and the engine as follows:

Engine Coolant Temperature Glow Time	
Temperature	**Seconds**
Less than 0_C (32_F)	55
1_C to 10_C (33_F to 50_F)	40
11_C to 25_C (51_F to 77_F)	25
Greater than 26_C (78_F)	10

The second and third start attempts have a glow time that is 5 seconds greater than the table amount. The glow time can be manually overridden through the function parameters. If the coolant temperature sensor is defective the control assume a temperature of less than 0_C (32_F) for the glow timing.

g. Minimum On Time

The engine is allowed to turn off only after a minimum of 4 or 7 minutes of run time.

After the minimum on-time, the unit will go to fully loaded for setpoints greater than −12_C (10_F) and high speed loaded for setpoints of −12_C (10_F) or less.

The unit will not cycle off if the engine coolant temperature is less than 50_C (122_F) or the battery is less than 13.4 volts. If the unit can not cycle off, it will operate normally in continuous mode. If all temperature probes fail and the setpoint is −12_C (10_F) or less, the unit will not shut down.

The unit will shut down when the box temperature is within ±0.3_C (±0.5_F) of setpoint for setpoints in the Perishable range or +0.3C (+0.5_F) above setpoint for setpoints in the Frozen range.

h. Minimum Off-Time

Keypad provision is provided to select the minimum off-time of 10, 20, 30, 45 or 90 minutes.

After the minimum off-time, the unit will restart for temperatures beyond ±2.0_C (±3.6_F) of setpoint for the Perishable range or above +2.0_C (+3.6_F) of setpoint for the Frozen range.

The minimum off-time is overridden if the temperature is more than ±6_C (±11_F) from setpoint.

i. Battery Voltage

Provisions are made to sense when the battery is good. A good battery is defined as having 13.4v at 24C_ (75_F). This condition is used to allow shut- off of the diesel engine.

If the battery voltage falls below 10v during glow cycle, the starter will not engage and the start sequence

will continue, this is considered a failed start. The start sequence is repeated until the unit starts or three consecutive start attempts have failed.

Table 1-7. Battery Voltages

Message Display	Voltage Level	Description
LOW BATT AL4	10 or Less	Unit will shut down except during cranking.
	11 to 13.4	If the unit has cycled off in auto start/stop mode and battery voltage drops below 11.0 volts, the unit is automatically started to charge battery. Unit will operate until a battery voltage of 13.4 volts is obtained at which level unit will stop if temperatures are satisfied.
HI BATT AL5	17 or more	Unit will shut down.

j. Oil Pressure Signal

When the oil pressure switch is closed it shows that the engine is running and prevents engagement of the starter motor when operating in the auto mode.

k. Maximum Off-Time

Provision for a keypad selectable feature is provided which will cause the engine to be started 30 minutes after the engine has stopped regardless of the box temperature.

1.8.12 Remote Monitoring -- Microlink(Optional)

The microprocessor controller is equipped with a RS232 communication port. This port can be used to communicate unit operating data to a mobile satellite transmitter. This information will then be relayed back to the office via a modem to a computer.

There are presently three (3) protocols supported. The protocol for the QualComm transmitter, the protocol for the HUGHES transmitter, and Carrier Communication Protocol. The microprocessor will power up and transmit a HUGHES protocol packet and continue to transmit a packet every hour. The microprocessor will transmit in the Carrier, QualComm protocol if a data packet is requested.

1.9 SWITCHES AND CONTROLS MICROPROCESSOR CONTROLLER

1.9.1 Introduction

Components required for monitoring and controlling the diesel engine – refrigeration system are located in the electrical box door. The water temperature sensor is located on top of the engine.

1.9.2 Electrical Box Door (See Figure 1-5)

1. Run-Stop Switch (RS)

When placed in the RUN position, this switch provides power to the microprocessor.

To stop the unit or remove power from the microprocessor, move the run-stop switch to the STOP position.

2. Manual Glow/Crank Switch (MGC)

The manual glow/crank switch when held in the GLOW position, energizes (approximately 7.5 amps per plug at 12 vdc) the glow plugs in the engine to pre-heat the combustion chamber. The CRANK position of the switch is used to manually engage the engine starter.

1.9.3 Location of Engine Safety Devices

a. Oil Pressure Safety Switch (OP)

This switch, set to open below 1.0 ± 0.2 kg/cm@ (15 ± 3 psig), will automatically stop the engine upon loss of oil pressure. See Figure 1-1 for location.

b. Water Temperature Sensor (WTS)

This sensor senses engine water temperature. The microprocessor will stop the unit when this temperature exceeds 110 ± 3_C (230 ± 5_F). The sensor is located near the thermostat housing in the cylinder head.

1.10 SWITCHES AND CONTROLS SOLID STATE CONTROLLER

1.10.1 Introduction

Components required for monitoring and controlling the diesel engine – refrigeration system are located in the electrical box door. The water temperature sensor is located on top of the engine.

1.10.2 Control Panel and Related Components

a. Indicating Lights

1. Cool Light

When illuminated indicated unit in either high or low speed cooling mode.

2. Defrost Light

When illuminated indicates unit is in defrost mode (high speed only). When the unit is in defrost, the heating light will also be illuminated.

3. Heat Light

When illuminated indicated unit in either high or low speed heating mode.

b. Meter, Running Time (RTM/RTMS)

These meters designates the total hours and provides an accurate readout of accumulated engine/standby motor running time. This data can be used to establish the proper periodic maintenance schedule. (Refer to Section 4.1.)

c. Switches

1. Glow/Defrost Switch

The glow/defrost switch (momentary contact type), when held in the UP position (pre-heat) permits battery current to flow to the glow plugs in the engine to pre-heat the combustion chamber. The glow plugs are located under the fuel injectors. When starting engine, it is necessary to continue to hold the glow/defrost switch in

the UP position until the engine has developed sufficient oil pressure to close the oil pressure safety switch (OP).

The glow/defrost switch (momentary contact), when held in the DOWN position is provided so that the system may be placed in the defrost mode manually by the operator. When this switch is closed, the unit will defrost in the same manner as when on automatic defrost. (Refer to Section 3.4.4)

2. Start-Run-Stop Switch

This switch is a three position switch, which are: START(momentary contact), RUN and STOP. With the switch in the START position, power is supplied to the starter motor. Releasing this switch, after engine start-up, will automatically place the switch in the RUN position. The switch must be moved manually to the STOP position.

3. Selector Switch (SSW)

This switch is used to select mode of operation, either engine drive or standby electric motor drive. Also when this switch is placed in standby position the electric motor will not start until the oil pressure safety switch (OPS) closes.

d. Defrost Timer – Solid State – Optional

The solid state defrost timer is an optional method of defrost initiation. The timer will automatically initiate defrost mode at a preset time interval of 1-1/2, 3 or 6 hours. The defrost intervals are selected by placing the jumper shunt in the appropriate interval position. The interval time designations are labeled on the side of the defrost timer.

A second jumper shunt located on the timer is used to determine defrost termination. The two designations for termination are the 1" and 20 minute positions. The 1" position will allow termination by the defrost thermostats (DT). The 20 minute position will automatically terminate defrost after 20 minutes has elapsed. It is recommended in applications were a 7 day (approximately) deep frozen conditions apply, the defrost termination shunt should be placed in the 20 minute position. This will prevent potential ice buildup over time.

NOTE

The evaporator coil temperature must be below 2.8_C (37_F) before defrost can be initiated.

Test points are provided on the defrost timer. By placing a jumper across the test points (designated TEST on the side of the timer) will accelerate the timer to initiate defrost within a seconds.

Also located on the defrost timer is an LED that will blink on and off at approximately 3 second intervals which indicates the timer is functioning, and a 1 amp fuse for timer protection.

e. Motor Overload (MOL)

The function of the motor overload is to protect the standby motor against high amperage draw. The overload provides an adjustable knob to set the maximum amperage overload draw. In this application the setting should be 12.5 amps.

The motor overload is also equipped with a reset button. This button has three positions: automatic reset, manual and test. In this application the button should remain in the automatic reset position.

1.11 COMPRESSOR PRESSURE REGULATING VALVE (CPR)

This adjustable regulating valve is installed on the suction line of the compressor to regulate the amount of suction pressure entering the compressor. The CPR valve is adjusted to maintain a maximum suction pressure for CPR settings refer to section 1.4.

The suction pressure is controlled to avoid overloading the electric motor or engine during high box temperature operation. To adjust the CPR valve, refer to section 4.20.

1.12 HOT GAS VALVE (Three-Way)

a. Description

Operation of the hot gas (three-way) valve is governed by the position of the plunger in the hot gas solenoid. The valve is pilot operated and therefore depends on the refrigerant gas to shift the piston assembly.

b. Cooling Operation (See Figure 1-9.)

With the solenoid coil de-energized the valve is in the cool operating mode and the refrigerant gas is diverted to the condenser. The volume directly above the piston assembly is open to suction pressure through the external pilot connection and the volume underneath the piston assembly is open to discharge pressure through the compressor discharge connection. This difference in pressure across the piston assembly results in the piston assembly being shifted upward, shutting the heat and defrost port, opening the condenser port, and allowing refrigerant to flow to the condenser.

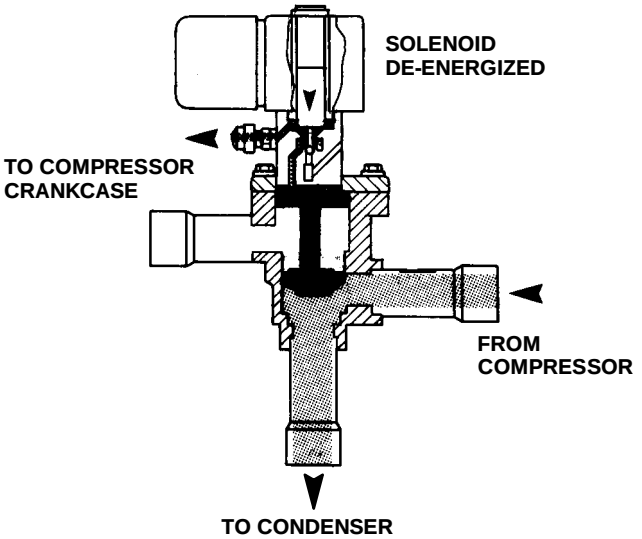


Figure 1-9. Hot Gas Valve -- Cooling Flow

c. Heat and Defrost Operation (See Figure 1-10.)

When the hot gas solenoid coil is energized, discharge gas flows to the evaporator for heating or defrost. When energized, the solenoid plunger is lifted, allowing discharge gas to fill the volume above the piston assembly. Discharge gas is also allowed to fill the volume

below the piston assembly through the compressor discharge connection. The pressure on both sides of the piston assembly is now equal and the piston spring exerts a force on top of the piston assembly and shifts it downward. The condenser port is now closed and the evaporator port is open. In both the energized and de-energized positions, the bypass of discharge gas to the suction port is prevented.

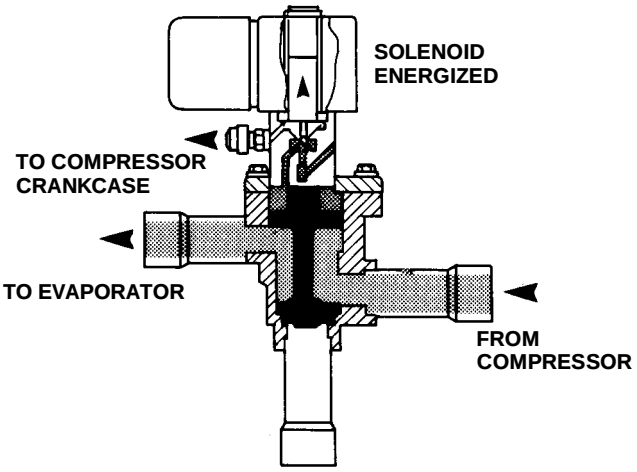


Figure 1-10. Hot Gas Valve -- Heat and Defrost Flow

1.13 ACCUMULATOR

The accumulator is a refrigerant holding tank located in the suction line between the evaporator and compressor. The purpose of the accumulator is to prevent or minimize entry of any liquid refrigerant (that may be entrained in the suction line) into the compressor, causing internal damage.

This is accomplished by the compressor drawing the refrigerant vapor through the outlet pipe of the accumulator, which is equipped with an orifice. This orifice controls the oil return to the compressor and prevents the accumulation of oil within the accumulator tank.

1.14 BATTERY CHARGING ALTERNATOR

1.14.1 Alternator Operation

CAUTION

Observe proper polarity when installing battery, negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator. As a precautionary measure, disconnect positive battery terminal when charging battery in unit. Connecting charger in reverse will destroy the rectifier diodes in alternator.

The alternator converts mechanical and magnetic energy to alternating current (A.C.) and voltage, by the rotation of an electromagnetic field (rotor) inside a three phase stator assembly. The alternating current and voltage is changed to direct current and voltage, by passing A.C. energy through a three phase, full-wave rectifier system. Six silicon rectifier diodes are used. (See Figure 1-13)

1.14.2 Integral Voltage Regulator Operation (12 volts d-c)

The regulator is an all-electronic, transistorized device. No mechanical contacts or relays are used to perform the voltage regulation of the alternator system. The electronic circuitry should never require adjustment and the solid state active elements used have proved reliable enough to warrant a sealed unit. The system is temperature compensated to permit the ideal charging rate at all temperatures.

The regulator is an electronic switching device. It senses the voltage appearing at the auxiliary terminal of the alternator and supplies the necessary field current for maintaining the system voltage at the output terminal. The output current is determined by the load.

1. Positive Output(B+)
2. 12vdc Test Lamp Terminal (D+)
3. Ground Terminal
4. Excitation Input
5. Suppression Capacitor
6. Regulator, Brush Holder & Brushes

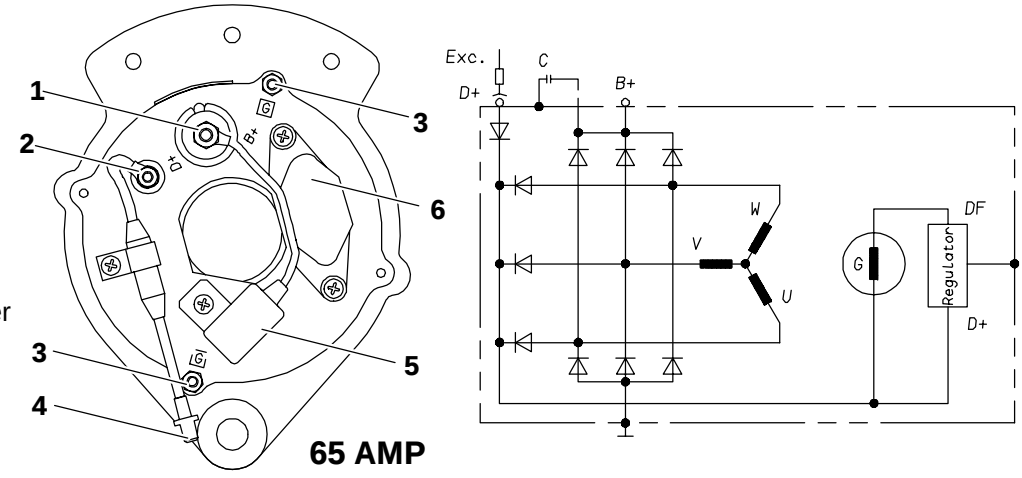
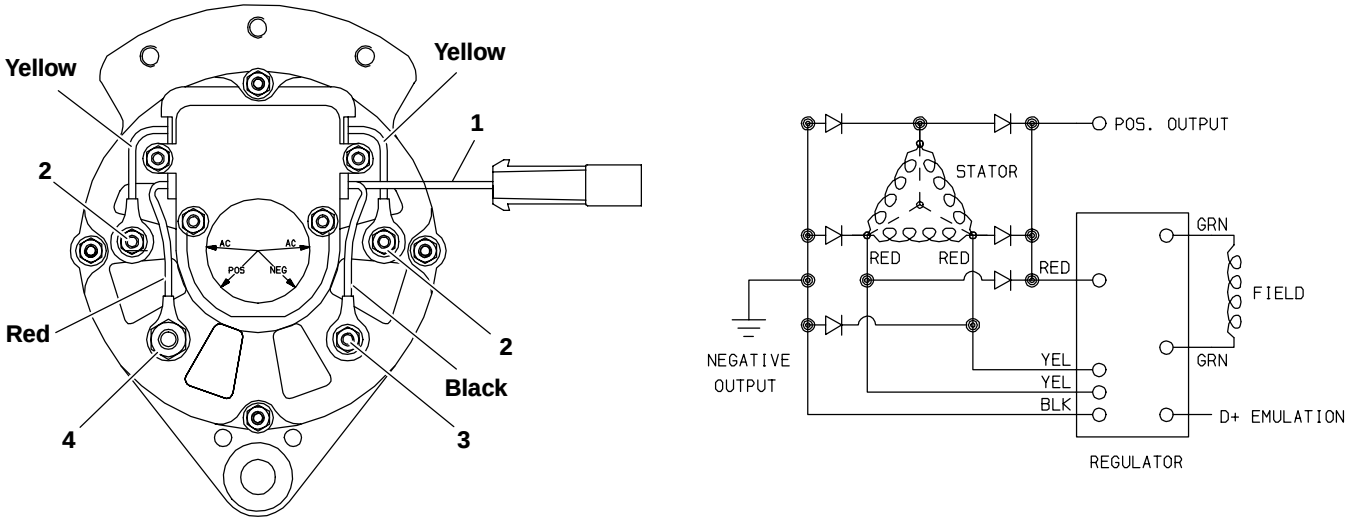
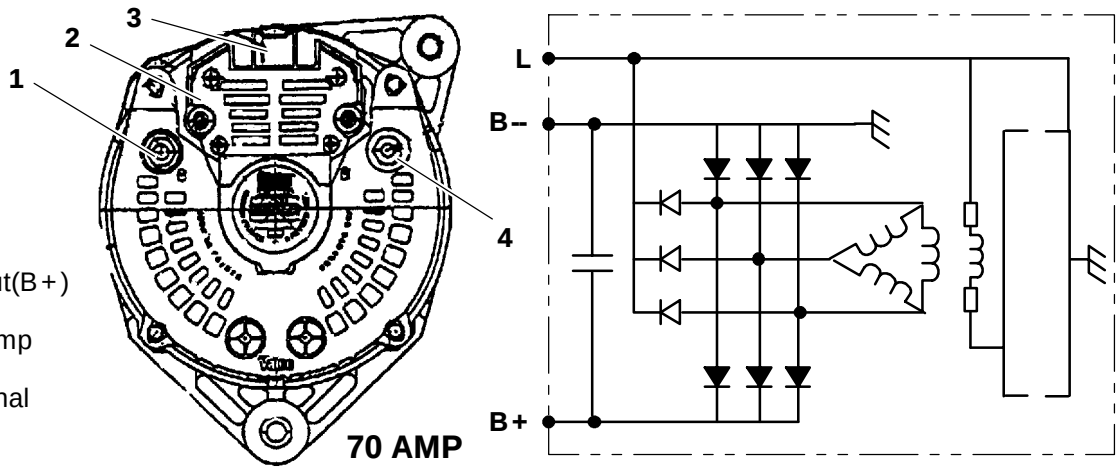


Figure 1-11. 65 Amp Alternator and Regulator (P/N 30-00393-00)



1. D+ Emulation (Orange)
2. #10-24 AC Terminal
3. #10-24 Ground Screw
4. 1/4-20 Positive Output Cable

Figure 1-12. 65 Amp Alternator and Regulator (P/N 30-00409-02)



1. Positive Output(B+)
2. Regulator
3. 12vdc Test Lamp Terminal (L)
4. Ground Terminal

Figure 1-13. 70 Amp Alternator and Regulator for Units Built In Europe (ETO)

1.15 REFRIGERANT CIRCUIT DURING COOLING (See Figure 1-14)

When cooling, the unit operates as a vapor compression refrigeration system. The main components of the system are the reciprocating compressor, air-cooled condenser, thermostatic expansion valve, direct expansion evaporator, and hot gas valve (three-way).

The compressor raises the pressure and temperature of the refrigerant and forces it into the condenser tubes. The condenser fan circulates surrounding air over the outside of the condenser tubes. Heat transfer is thus established from the refrigerant gas (inside the tubes) to the condenser air (flowing over the tubes). The condenser tubes have fins designed to improve the transfer of heat. This removal of heat causes the refrigerant to liquefy; liquid refrigerant flows from the condenser and through a check valve to the receiver.

The receiver stores the additional charge necessary for low ambient operation and for heating and defrost modes.

The refrigerant leaves the receiver and flows through a manual receiver shutoff valve (king valve). The refrigerant then flows through the subcooler. The subcooler occupies a portion of the main condensing coil surface and gives off further heat to the passing air.

The refrigerant then flows through a filter-drier where an absorbent keeps the refrigerant clean and dry.

In R-404A units the refrigerant flows to the "Liquid/suction" heat exchanger. Here the liquid is further reduced in temperature by giving off some of its heat to the suction gas.

The liquid then flows to an externally equalized thermostatic expansion valve (TXV) which reduces the pressure of the liquid and meters the flow of liquid refrigerant to the evaporator to obtain maximum use of the evaporator heat transfer surface.

The evaporator tubes have aluminum fins to increase heat transfer; therefore heat is removed from the air circulated through the evaporator. This cold air is circulated throughout the truck to maintain the cargo at the desired temperature.

The transfer of heat from the air to the low temperature liquid refrigerant causes the liquid to vaporize.

In R-22 units this low temperature, low pressure vapor passes into the accumulator tank.

In R-404A units this low temperature, low pressure vapor passes through the "suction line/liquid line" heat exchanger where it absorbs more heat from the high pressure/high temperature liquid and then returns to the accumulator.

The compressor draws this vapor out of the accumulator through a pick-up tube which is equipped with a metering orifice. This orifice prevents the accumulation of oil in the accumulator tank. The metering orifice is calibrated to control the rate of oil flowing back to the compressor.

The vapor refrigerant then enters the compressor pressure regulating valve (CPR) which regulates refrigerant pressure entering the compressor, where the cycle starts over.

The quench valve (not used on Supra 422 or R-404A units) opens as required to maintain a 132_C (270_F) maximum discharge temperature.

1.16 REFRIGERANT CIRCUIT DURING HEAT AND DEFROST (See Figure 1-14)

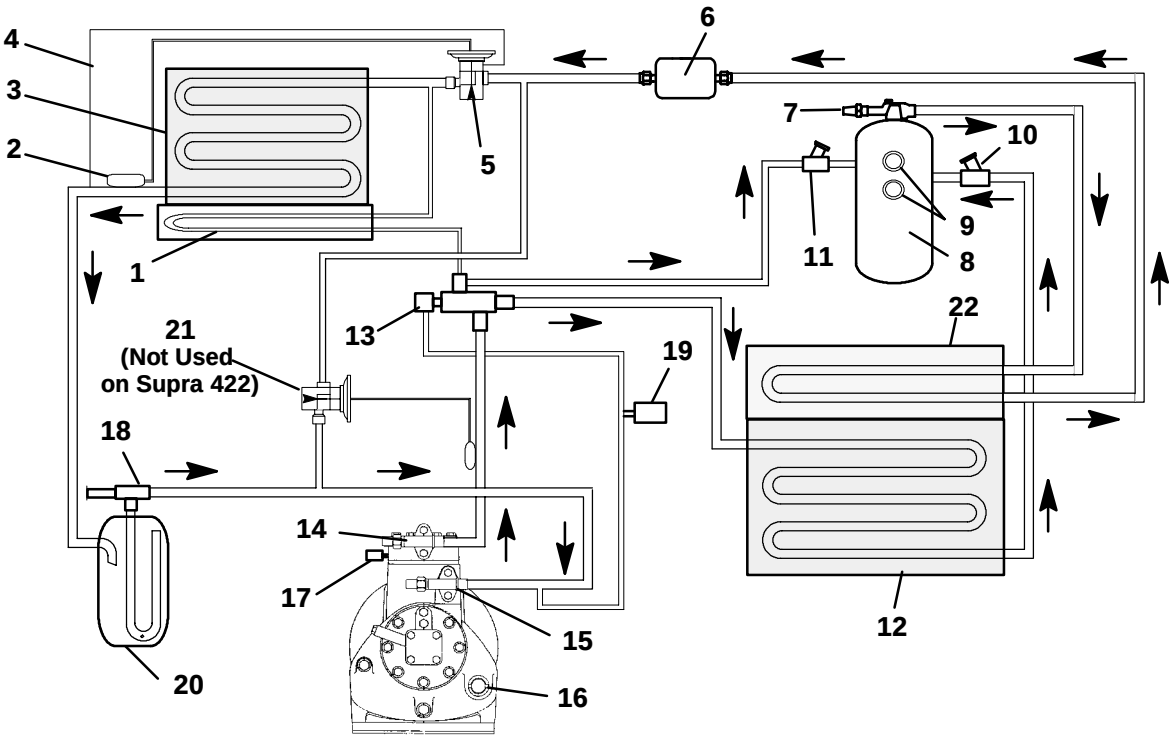
When refrigerant vapor is compressed to a high pressure and temperature in a reciprocating compressor, the mechanical energy necessary to operate the compressor is transferred to the gas as it is being compressed. This energy is referred to as the "heat of compression" and is used as the source of heat during the heating cycle.

When the controller calls for heating or defrost, the hot gas valve (three-way) solenoid energizes, closing the port to the condenser and opening a port which allows heated refrigerant vapor to flow directly to the evaporator coil.

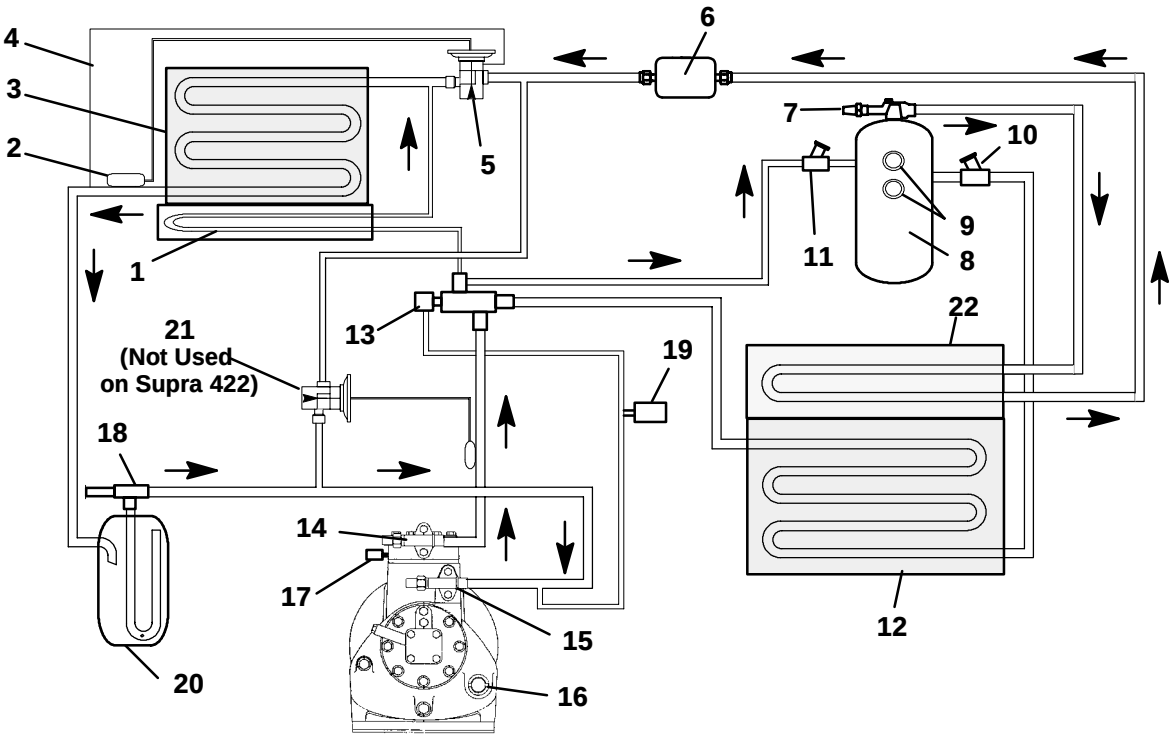
The main difference between heating and defrosting is that, when in heating all the evaporator fans continue to run, blowing the air over the heated coils to heat the product. When defrosting, the evaporator fans stop, allowing the heated vapor to defrost any ice build up there maybe.

The function of the bypass line from the hot gas valve to the receiver is to allow discharge pressure into the receiver. Under pressure the liquid refrigerant will flow from the receiver through the expansion valve to the evaporator. This will force all the refrigerant out of the receiver and into the evaporator to be used for heating.

The quench valve (not used on Supra 422 or R-404A units) opens as required to maintain a 132_C (270_F) maximum discharge temperature.



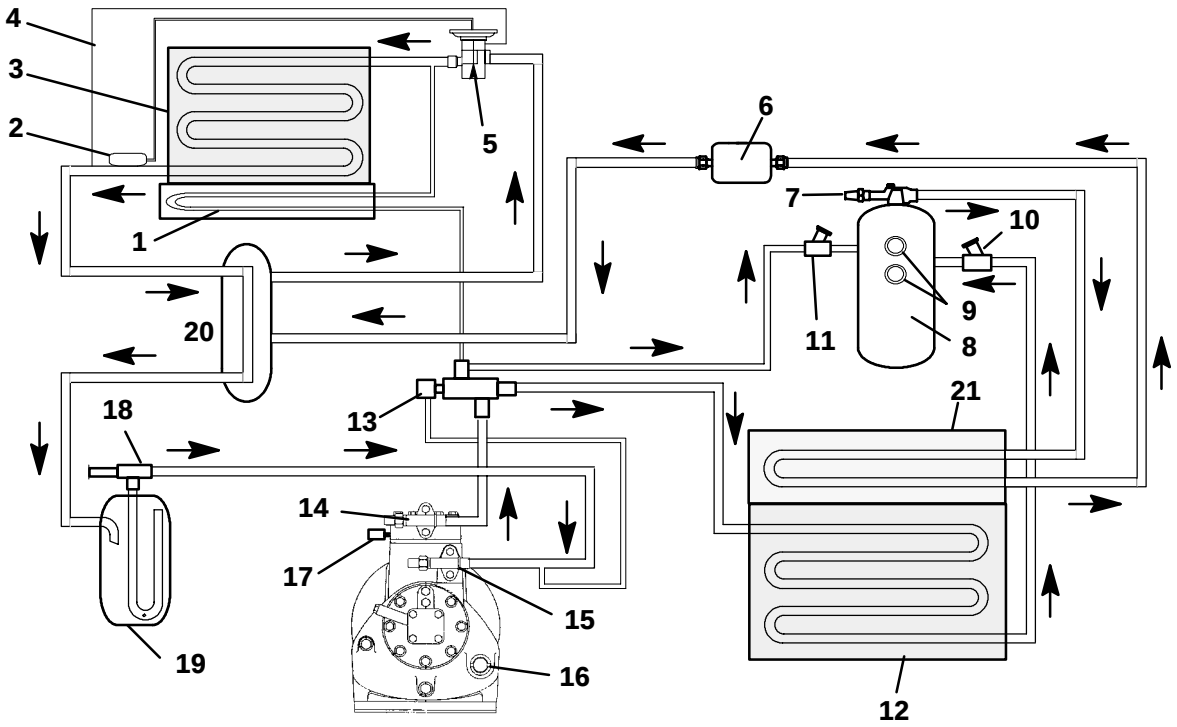
COOLING CYCLE



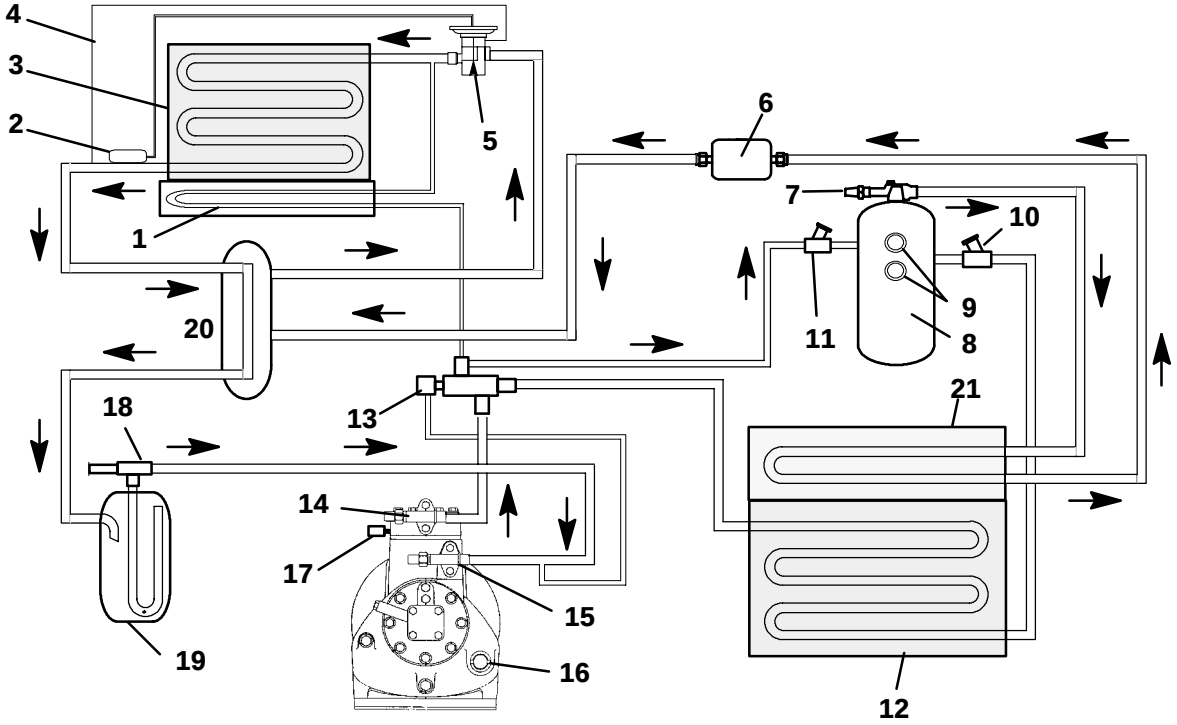
HEAT AND DEFROST CYCLE

1. Drain Pan Heater
2. Expansion Valve Bulb
3. Evaporator
4. External Equalizer Line
5. Expansion Valve
6. Filter-Drier
7. Receiver (King) Valve
8. Receiver
9. Receiver Sight Glass
10. Receiver Inlet Check Valve
11. Bypass Check Valve
12. Condenser
13. Hot Gas Valve (Three-Way)
14. Discharge Service Valve
15 Suction Service Valve
16. Compressor
17. High Pressure Switch (HP)
18. Compressor Pressure Regulating Valve (CPR)
19. Low Pressure Switch (LP) Solid State Control (ETO) Only
20. Accumulator
21. Quench Valve (Not Used on Supra 422)
22. Subcooler

Figure 1-14. R-22 Refrigeration Circuit



COOLING CYCLE



HEAT AND DEFROST CYCLE

1. Drain Pan Heater
2. Expansion Valve Bulb
3. Evaporator
4. External Equalizer Line
5. Expansion Valve
6. Filter-Drier
7. Receiver (King) Valve
8. Receiver
9. Receiver Sight Glass
10. Receiver Inlet Check Valve
11. Bypass Check Valve
12. Condenser
13. Hot Gas Valve (Three-Way)
14. Discharge Service Valve
15 Suction Service Valve
16. Compressor
17. High Pressure Switch (HP)
18. Compressor Pressure Regulating Valve (CPR)
19. Accumulator
20. Heat Exchanger
21. Subcooler

Figure 1-15. R-404A Refrigeration Circuit

1.17 05G COMPRESSOR UNLOADER

1.17.1 Unloading in Temperature Mode

The 05G compressor is equipped with an unloader (electronically controlled by the microprocessor) for capacity control.

The capacity controlled cylinders are easily identified by the solenoid which extends from the side of the cylinder head. When the solenoid is energized the cylinders unload. The unloaded cylinders operate with little or no pressure differential, consuming very little power. A de-energized solenoid reloads the cylinders.

NOTE

The unloader relay is locked in for a minimum of 2 minutes once it is energized due to suction pressure.

There are two modes of unloader operation, temperature control and suction pressure control.

a. Temperature Control Within 1.4_F (0.8_C) of Set Point

1. Cool light (CL) or heat light (HL) illuminated (depending on mode of operation).

2. If in low speed cooling, unloader relays (UFR) may energize to unload compressor banks. Refer to Table 1-8

3. In low speed heating, front unloader relay (UFR) energizes to unload compressor bank.

Table 1-8. Unloading in Temperature Mode

SETPOINT BELOW 10_F (--12_C)	Cylinder	SETPOINT ABOVE 10_F (--12_C)	Cylinder
Supra 922/944			
Cool High Speed	6	Cool High Speed	6
		Cool Low Speed	4
		Heat Low Speed	4
Cool Low Speed	6	Heat Low Speed	6
Cool Low Speed	4	Heat High Speed	6

b. Perishable Cooling Unloader Control

Diesel

During perishable cooling the unloader is energized when the temperature approaches setpoint. If a supply probe is present the unloader is energized when the supply temperature decreases 5.4_F (3_C) below setpoint. It will stay unloaded until the supply temperature rises above setpoint. If a supply probe is not present the unloader is energized when the return temperature decreases more than 9_F (5_C) above setpoint. It will stay unloaded until the return temperature rises more than 14.4_F (8_C) above setpoint. The return probe logic is disabled for ambient temperature higher than 90_F (32.2_C).

Standby

During perishable cooling the unloader is energized when the control temperature reaches less than 2_F (1.1_C) above setpoint. The unloader stay energized until the control temperature reaches 2.5_F (1.4_C) above setpoint.

c. Perishable Heating Unloader Control

Diesel

During perishable heating the front unloader is energized when the control temperature increases to 0.9_F (0.5_C) below setpoint. The unloader will stay energized until the control temperature decreases to 1.5_F (0.8_C) below setpoint.

Note: These switch points may vary slightly depending on the amount of overshoot around setpoint.

Standby

During perishable heating the unloader is energized when the control temperature increases to 1.5_F (0.8_C) below setpoint. The unloader will stay energized until the control temperature decreases to 2_F (1.1_C) below setpoint.

d. Frozen Unloader Control

Diesel

During frozen mode, heating is not allowed. The front unloader is energized when the control temperature decreases to 1.5_F (0.8_C) above setpoint. The unloader will stay energized until the control temperature reaches 2_F (1.1_C) above setpoint.

Standby

During frozen mode, heating is not allowed. The front unloader is energized when the control temperature decreases to 2_F (1.1_C) above setpoint. The unloader will stay energized until the control temperature reaches 2.5_F (1.4_C) above setpoint.

1.17.2 Suction Pressure Operation -- Diesel Engine

The microprocessor will monitor suction pressure of the refrigeration system R-22 or R404A and control the unloader to maintain a maximum operating pressure. A suction pressure transducer is used to signal the microprocessor when to load or unload the compressor.

a. R-22 Refrigeration System

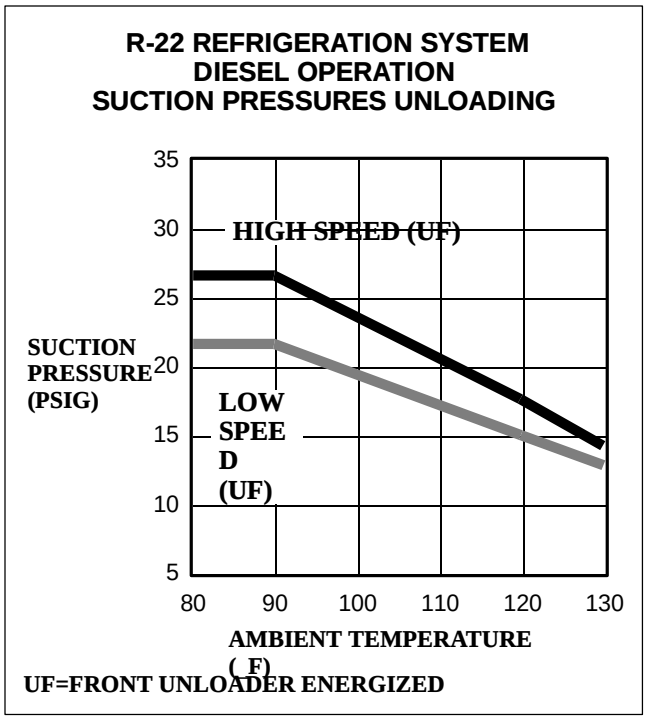
At ambient temperatures of 90_F (32.2_C) or below

When the system is operating at *high speed* and the suction pressure drops below 26 psig, the front bank is loaded.

When the system is operating at *low speed* and the suction pressure drops below 21 psig, the front bank is loaded.

At ambient temperatures of 90_F (32.2_C) or higher

At ambient temperatures of 90_F or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to following chart)



b. R-404A Refrigeration System

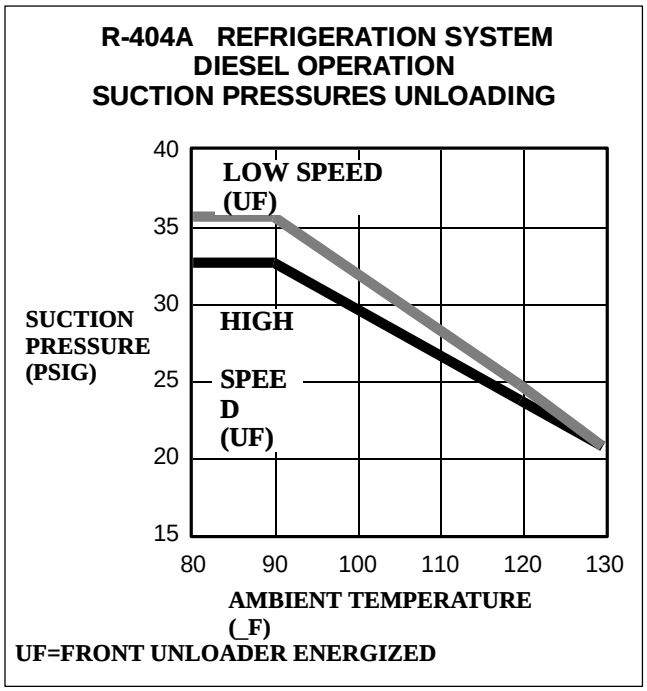
At ambient temperatures of 90_F (32.2_C) <u>or below</u>

When the system is operating at *high speed* and the suction pressure drops below 33 psig, the front bank is loaded.

When the system is operating at *low speed* and the suction pressure drops below 35 psig, the front bank is loaded.

At ambient temperatures of 90_F (32.2_C) <u>or higher</u>

At ambient temperatures of 90_F or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to chart below)



1.17.3 Suction Pressure Operation -- Standby Motor

The microprocessor will monitor suction pressure of the refrigeration system and control the unloader to maintain a maximum operating pressure. A suction pressure transducer is used to signal the microprocessor when to load or unload the compressor.

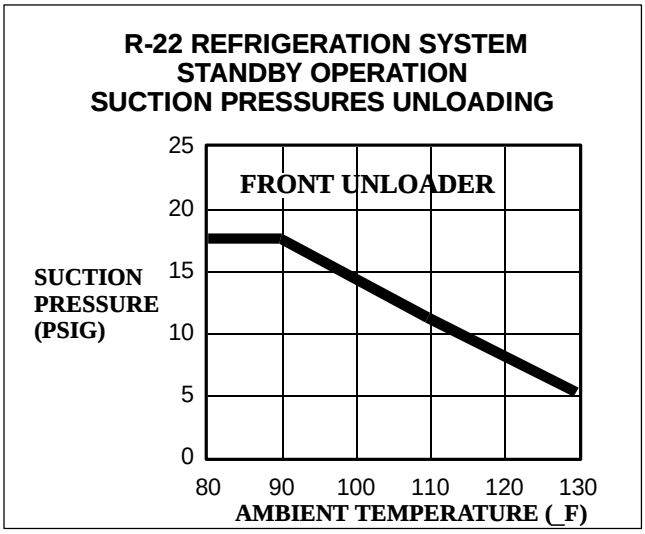
a. R-22 Refrigeration System

At ambient temperatures of 90_F (32.2_C) <u>or below</u>

When the system is operating and the suction pressure drops below 18 psig, the front bank is loaded.

At ambient temperatures of 90_F (32.2_C) <u>or higher</u>

At ambient temperatures of 90_F or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to chart below)



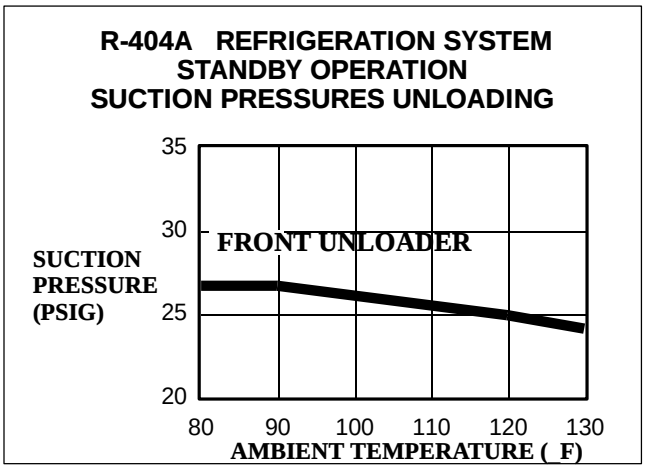
b. R-404A Refrigeration System

At ambient temperatures of 90_F (32.2_C) <u>or below</u>

When the system is operating and the suction pressure drops below 26 psig, the front bank is loaded.

At ambient temperatures of 90_F (32.2_C) <u>or higher</u>

At ambient temperatures of 90_F or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to chart below)



1.17.4 Hot Gas Bypass Unloader

a. Major Working Parts

1. Solenoid and valve system
2. Spring loaded piston type bypass control valve
3. Spring loaded discharge check valve

b. Unloaded Operation

Pressure from the discharge manifold (Figure 1-16, item 15) passes through the strainer (9) and bleed orifice (8) to the back of the piston bypass valve (7). Unless bled away, this pressure would tend to close the piston (6) against the piston spring (5) pressure.

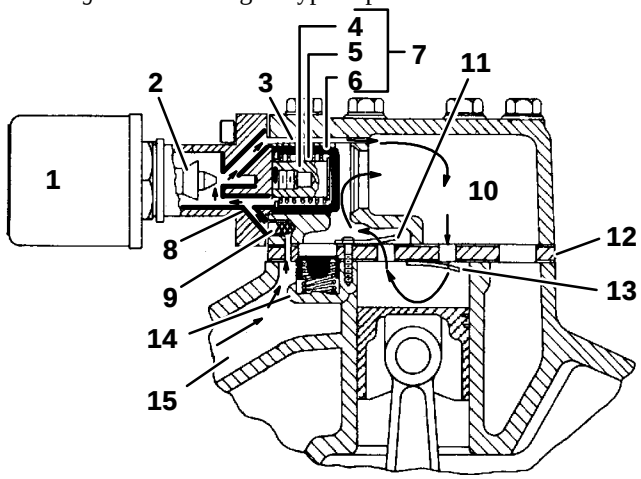
With the solenoid valve (1) *energized* the solenoid valve stem (2) will *open* the gas bypass port (3).

Refrigerant pressure will be bled to the suction manifold (10) through the opened gas bypass port . A reduction in pressure on the piston bypass valve will take place because the rate of bleed through the gas bypass port is greater than the rate of bleed through the *bleed orifice* (8)**.**

When the pressure behind the piston has been reduced sufficiently, the valve spring will force the piston bypass valve *back*, *opening* the gas bypass from the discharge manifold to the suction manifold.

Discharge pressure in the discharge manifold will close the discharge piston check valve assembly (14) isolating the compressor discharge manifold from the individual cylinder bank manifold.

The *unloaded* cylinder bank will continue to operate *fully unloaded* until the solenoid valve control device is *de-energized* and the gas bypass port is closed.



1. Solenoid Valve
2. Valve Stem
3. Gas Bypass Port
4. Spring Guide
5. Spring
6. Piston
7. Piston Bypass Valve
8. Bleed Orifice
9. Strainer
10. Suction Manifold
11. Cylinder Discharge Valve
12. Valve Plate
13. Cylinder Suction Valve
14. Discharge Piston Check Valve Assembly
15. Discharge Manifold

Figure 1-16. Compressor Cylinder Head Unloaded Hot Gas Bypass

c. Loaded Operation

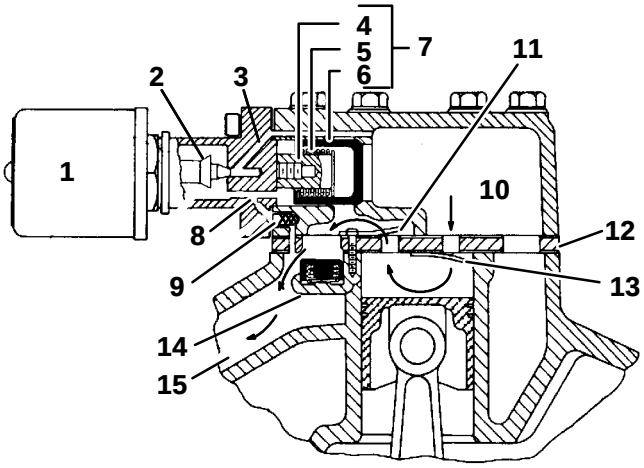
Discharge pressure bleeds from the discharge manifold (Figure 1-17, item 15) through the strainer (9) and (8) bleed orifice to the solenoid valve stem (2) chamber and the back of the piston bypass valve (7).

With the solenoid valve (1) *de-energized* the solenoid valve stem will *close* the gas bypass port (3).

Refrigerant pressure will overcome the bypass valve spring (5) tension and force the piston (6) *forward closing* the gas bypass from the discharge manifold to the suction manifold (10).

Cylinder discharge pressure will force open the discharge piston check valve assembly (14). Refrigerant gas will pass into the compressor discharge manifold.

The loaded cylinder bank will continue to operate fully loaded until the solenoid valve control device is energized and the gas bypass port is opened.



1. Solenoid Valve
2. Valve Stem
3. Gas Bypass Port
4. Spring Guide
5. Spring
6. Piston
7. Piston Bypass Valve
8. Bleed Orifice
9. Strainer
10. Suction Manifold
11. Cylinder Discharge Valve
12. Valve Plate
13. Cylinder Suction Valve
14. Discharge Piston Check Valve Assembly
15. Discharge Manifold

Figure 1-17. Compressor Cylinder Head Loaded Hot Gas Bypass

SECTION 2

OPERATION – UNITS WITH MICROPROCESSOR CONTROLLER

2.1 PRE-TRIP INSPECTION

a. Before Starting Engine

1. Drain water and sediment from fuel tank sump. Then fill tank with diesel fuel.

2. Check radiator coolant level. (Add pre-mixed 50/50 permanent antifreeze-water as required.) USE ETHYLENE GLYCOL ONLY. (Refer to section 1.2)

3. Check evaporator and condenser coil for cleanliness.

4. Check engine lubrication and fuel filter, oil lines, and connections for leaks. (Tighten connections and/or replace gaskets.)

5. Check engine oil level. (Refer to section 1.2)

6. Check V-belts for proper tension, fraying or cracks. Adjust belt or replace.

7. Check battery terminals for cleanliness and tightness. Clean and coat with a mineral type grease (such as Vaseline).

8. Check engine air cleaner for cleanliness and condition of air cleaner hose.

9. Check defrost drain pan hoses. (Should be clear of debris.)

10. Check defrost air switch tubes and connections for breaks or air leaks.

b. After Starting Refrigeration Unit

1. Check water temperature. (Should be 65 to 82_C = 150 to 180_F.)

2. Check engine speed. (Refer to section 4.2.3)

3. Listen for abnormal noises. (Refer to section 3.3.7)

4. Check compressor oil level. (Refer to section 4.9)

5. Observe any signs of lube or fuel oil leaks.

6. Check radiator hoses for leaks.

7. Check refrigerant level. (Refer to section 4.7)

8. Feel filter-drier. Excessive temperature drop across drier indicates restriction. (Refer to section 4.13)

9. Start microprocessor Pre-trip Inspection. (Refer to Section 1.8.8)

2.2 STARTING AND STOPPING INSTRUCTIONS – ENGINE DRIVE

WARNING

Under no circumstances should ether or any other starting aids be used to start engine.

NOTE

Whenever starting the engine, in order to reduce starter cranking and engine loads, the microprocessor always starts and operates in low speed, unloaded cool for the first 15 seconds. After first 15 seconds the microprocessor will allow the unit to operate normally, providing the coolant temperature is above 26_C (79_F). In order to prolong engine life, the microprocessor will prevent operation in high speed until coolant temperature reaches this temperature.

2.2.1 AUTOMATIC START

a. Starting Instructions

1. Place the *Run-Stop Switch* in the RUN position.

2. Place the *On-Off Switch* (Cab Command) to ON position and press the *Road Key*. The microprocessor will perform a self-test (all display messages will appear in display window). Then setpoint and box temperature will be displayed.

3. The microprocessor will energize glow cycle (length of time depends on engine temperature) and start the engine.

4. To change the setpoint press the *Up Or Down Arrow Key* and then the *Enter Key*.

5. Pressing the *Auto S/S–Continuous Key* changes the operation of the unit between automatic start/stop (unit will automatically start and stop in response to changing box temperature) or automatic start continuous run (unit will operate continuously after starting).

b. Stopping Instructions

Place the *On-Off Switch* (Cab Command) to OFF position or place *Run-Stop Switch* in the STOP position to stop unit.

2.2.2 MANUAL STARTING

a. Starting Instructions (Manual Starting)

1. To start the unit manually, place *Run-Stop Switch* to RUN position and the *On-Off Switch* (Cab Command) to ON position.

2. Press the *Auto S/S–Continuous Key* (if necessary) to erase AUTOSTART/STOP Symbol from the display.

3. Press the *Function Change Key* until AUTO OP or MAN OP appears on the display.

a. **If AUTO OP appears:**

(1) Press the *Enter Key*.

(2) Press the *Up Or Down Arrow Key* to make MAN OP appear on the display.

(3) Press the *Enter Key*. The unit is in MANUAL START mode.

b. **If MAN OP appears:** the unit is in MANUAL START mode.

4. Use the *Manual Glow/Crank Switch* to start the unit refer to Table 2-1.

NOTE

Once the unit is programmed for Man OP, the *Auto S/S – Continuous Key* can be used to toggle between Auto Start/Stop and Manual Start Continuous Run

Table 2-1. Manual Glow Time

Ambient Temperature	Glow Time in Seconds
Less than 0°C (32°F)	55
1°C to 10°C (33°F to 50°F)	40
11°C to 25°C (51°F to 77°F)	25
Greater than 26°C (78°F)	10

b. Stopping Instructions

Place the *On-Off Switch* (Cab Command) to OFF position or place *Run-Stop Switch* in the STOP position to stop unit.

2.3 STARTING AND STOPPING INSTRUCTIONS – STANDBY MOTOR DRIVE

1. Plug in the power plug.

2. Place the *On-Off Switch* (Cab Command) to ON position and press the *Standby Key*. The microprocessor will perform a self-test (all display messages will appear in display window). Then setpoint and box temperature will be displayed.

"NO POWER" will be displayed if unit is switch to standby and power plug not plugged in.

2.4 CONTROL CIRCUIT OPERATION – ENGINE DRIVE

2.4.1 Introduction

NOTE

To make it easier to locate the schematic components referred to in the written text, the schematic in this manual has map coordinates added to the margins. These locations have also been added to the legend.

The controller boards shown on the electrical schematic (Figure 5-1) that interface with unit components are the analog interface or processor board on the left and the relay module on the right.

Connections to these boards are made through 3 multiple-pin plug connectors HC, HC2, & MP. The address system (example HCD2-MPW2) indicates a wire between plug HC, pin D2 and microprocessor MP & pin W2.

The processor board connections are mainly inputs and outputs for control switches, temperature sensors, safety, and auto start functions that control the operation of the unit. The processor board also controls the operation of the relay board through plug connections.

The relay module, which contains plug-in interchangeable relays provides the microprocessor with a means for switching the unit components to achieve a desired operating mode.

2.4.2 Cooling

There are two control ranges, Frozen and Perishable. The Frozen range is active with set points at or *below −12°C (+10°*F) and the Perishable range is active at set points *above −12°C (+10°*F).

The controller automatically selects the mode necessary to maintain box temperature at set point.

If the unit is in high speed cool, the microprocessor will pull terminal N3 low to energize the speed relay. A set of normally open contacts (SR) close to energize the speed control solenoid (SCS). The engine will be in high speed.

When the unit is running in high speed cool and with the evaporator coil temperature below 4.4°C (40°F) to close at least one defrost termination thermostat, a pre-trip may be initiated by depressing the *Pretrip Key*. The operator now may verify the pre-trip sequence. (Refer to Section 1.8.8)

As the box temperature falls toward set point, the microprocessor will place the unit in low speed cool. The temperature at which this occurs is not fixed but depends upon the operating conditions.

The speed relay (SR) de-energizes to open the circuit to the speed control solenoid (SCS). Engine speed decreases from high speed to low speed.

Supra 922/944 has an unloader, when the unit goes to low speed it will also unload. To do this, the microprocessor will pull terminals X2 low, completing the

ground path for the unloader relay (UFR). The coil energizes to close the UFR contacts and unloader (UF) energize to unload the compressor (Refer to Section 1.17).

For set points above −12°C (+10°F) and with decreasing temperature, the unit will shift to low speed heat.

Unit will remain in various stages of heating until the box temperature increases enough to place the unit in the low speed cool mode. As the box temperature increases, the unit will shift to high speed cool mode (speed relay energizes).

2.4.3 Heating

Refer to section 1.16 for description on heating cycle.

The unit will only heat when the controller is set above −12°C (+10°F) as the heat relays are electronically locked out with set points at or below −12°C (+10°F).

The controller automatically selects the mode necessary to maintain box temperature at set point. The heating modes are as follows with descending temperatures:

(a) Low Speed Heating, (b) High Speed Heating

The controller will shift the unit into low speed unloaded heat when the box temperature falls below set point. The microprocessor pulls terminal X1 low to complete the ground paths for the heat relay (HR1).

When the unloader front relay (UFR) energizes, a set of N.O. contacts (UFR) close to energize the compressor front unloader (UF). Compressor will be in 4 cylinder heating.

If more heating capacity is required, the unit will shift to high speed heating. The microprocessor energizes the HR1, and speed relay (SR) coils. Terminals X1 and N3 will be pulled low. SR contacts close to energize the speed control solenoid (SCS). The engine will be in high speed.

The microprocessor will break the ground path to de-energize the front unloader relay, which in turn, de-energizes the compressor unloader (compressor shifts from 4 cylinder to 6 cylinder operation).

2.4.4 Defrost

Refer to sections 1.8.10 and 1.16 for the heat and defrost cycle.

NOTE

The unit will be in high speed in the defrost mode.

The defrost mode may be initiated by three different ways if the evaporator coil is below 1.7°C (35°F). (Refer to section 1.4)

Method one to initiate defrost is by pressing the *Manual Defrost Key*.

Method two is that defrost may be initiated automatically at preset intervals by the defrost timer in the microprocessor. (Refer to section 1.8.2). The manual defrost key and defrost timer are part of the microprocessor and are not shown on the schematic.

The third means of defrost initiation is by the defrost air switch (DA). The switch is an air pressure differential switch which measures air pressure differential across the evaporator coil and initiates the defrost cycle when the air pressure differential increases enough to close the DA contacts, such as would happen when excessive frost builds up on the evaporator coil surface.

When the defrost air switch contacts close, there is a 12 vdc potential to terminal K1 on the microprocessor. The microprocessor looks for voltage at terminal K2. Voltage at K2 indicates that at least one defrost termination thermostat is closed. The unit will shift to the defrost mode if voltage is present at K2.

If both defrost thermostats (klixons) are open (no voltage at K2), defrost cannot be initiated by any means.

In defrost the microprocessor pulls terminals X1 and N3 low to shift the unit into high speed heat. The processor also pulls terminal W2 low to energize the defrost relay coil. This closes the N.O. defrost relay contacts to energize the defrost light on the remote light bar. The defrost and heat display will also be illuminated.

Also N.C. defrost relay contacts open to to stop the evaporator fans.

On Supra 922/944 the microprocessor pulls terminal W3 low to energize damper relay (DPR). This closes N.O. damper relay contacts to energize (close) defrost damper solenoid (DDS).

The unit will remain in defrost until both defrost termination thermostats open to remove voltage from the defrost relay. If the thermostats fail to open in 45 minutes, the microprocessor will terminate defrost and shift between normal control and defrost at 1 1/2 hour intervals. This will also occur if the defrost air switch is stuck closed.

If the problem corrects itself, (thermostats opens for example), the unit will automatically resume its normal functions).

The defrost termination starts with HR1 and speed relay de-energizing. The defrost output will de-energize 5 seconds after HR1. If the temperature control requires high speed, it will energize 2 seconds after defrost relay is de-energized.

NOTE

The microprocessor (chip 2.06 or higher) will lock out evaporator fans for 1 minute at the termination of defrost.

2.5 CONTROL CIRCUIT OPERATION – STANDBY MOTOR DRIVE

NOTE

To make it easier to locate the schematic components referred to in the written text, the schematic in this manual has map coordinates added to the margins. These locations have also been added to the legend.

The relay module, which contains plug-in interchangeable relays provides the controller with a means for switching the unit components to achieve a desired operating mode.

2.5.1 Electric Standby Features

1. Two Operating Modes
2. Minimum "ON" Time (5 Minutes)
3. Minimum "OFF" Time (5 Minutes)
4. Low Battery Protection

1. Two operating modes: Electric Standby can operate in the Start/Stop mode or the Continuous Run mode.

During Start/Stop operation, (Perishable Range) the unit will operate in 3 modes: A) "Cool" cycle B) "Off" cycle C) "Heat" cycle

During Start/Stop operation, (Frozen Range) the unit will operate in 2 modes: A) "Cool" cycle B) "Off" cycle

In the Start/Stop mode, when the box temperature gets close to setpoint, the controller will cycle the Standby Motor(SBM) off to conserve energy. The microprocessor automatically locks out heating for entered setpoints at or below –12.2°C (10°F). Therefore, it is possible for the box temperature to fall below setpoint in the frozen range.

2. Minimum "ON" time (5 minutes): The unit *must* run for the minimum run-time before it can consider shutting off. This minimum run time is to prevent short cycling and ensure adequate air flow through the load to allow the controller to accurately sense load temperature and bring the battery up to minimum voltage level. It also prevents "hot spots" in a properly loaded box.

After the minimum run time is complete, the microprocessor will look at the remaining conditions that must be satisfied to allow a shutdown. These are:

A) Battery condition – Battery voltage must be above 13.4 volts. (measured at Y1)

B) The box temperature (active probe) must be satisfied:

Perishable Range Setpoints +/– 0.3°C (0.5°F)

Frozen Range Setpoints + 0.3°C (0.5°F)

If *ALL* of these conditions are not satisfied, the motor will continue to run until they are. This prevents rapid cycling of the electric drive motor.

3) Minimum "OFF" time (5 minutes): Once the motor has cycled off, it will remain off for the minimum "off time". This prevents the motor from rapid cycling due to changes in air temperature. Air temperature in the box can change rapidly, but it takes time for the product temperature to change.

4) Low battery voltage protection: The microprocessor will restart the unit if the battery voltage drops below 11.0 volts to recharge the battery after the minimum off-time delay.

NOTE

When in Continuous Run, perishable range, the unit will cycle between cool and heat to maintain box temperature at setpoint. In frozen range the unit will run in cool only. Continuous Run is normally used for perishable products that require constant air flow.

2.5.2 Standby Cool

When in standby cool, Start/Stop, the microprocessor will energize the following circuits:

First the microprocessor will energize (ARR), this will close a set of N.O. (ARR) contacts, energizing the Auto Restart Light (ARL) on the light bar, indicating to the operator that the unit is in the START/STOP mode and may start at any time. After a 5 second delay the Diesel Electric Relay (DER) will be energized, this will open the N.C. (DER) contacts to prevent the Fuel Heater Relay (FHR), Fuel Pump (FP) and the Fuel Solenoid (FS) from being energized during standby operation. At the same time the N.O. (DER) contacts will close. This will energize the Power Light (PL) on the light bar indicating to the operator that the unit is in the standby mode of operation, and also energize the Motor Contactor (MC). With the motor contactor energized, the N.O. (MC) contacts will close, supplying voltage to energize the standby motor.

At the same time, (RR) will be energized, closing the N.O. (RR) contacts supplying voltage to the refrigeration control circuitry.

2.5.3 Standby OFF

In the start/stop mode,after the standby motor has run at least five minutes and the controller is ready to switch from cool to heat (box temperature near setpoint), the microprocessor will de-energize the (RR) causing the standby motor to cycle off.

When the unit is "OFF," the microprocessor keeps (ARR) energized. The unit will remain off for at least 5 minutes before restarting. If after 5 minutes, the battery voltage drops below 11.0 volts or the box temperature drifts out-of-range, +/– 2.0°C (3.6°F) from setpoint for perishable range and +2.0°C (3.6°F) above setpoint for frozen range, the standby motor will restart.

2.5.4 Standby Defrost

Standby defrost operates the same as engine drive defrost refer to section 2.4.4.

Table 2-2. Relay Operation -- Microprocessor Controller																
Mode	**DER**	**GPR**	**RR**	**RCR**	**SSR**	**SR**	**Perish-able[1]**	**Frozen[1]**	**HR1**	**EFMR 1,2,3**	**EHR**	**DR**	**OR**	**ARR**	**FHR**	**DPR**
							UF	**UF**								
Off	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Glow	O	I	I	I	O	O	I	I	O	O	O	O	I or O	I or O	I or O	O
Start	O	I	I	I	I	I	I	I	O	O	O	O	I or O	I or O	I or O	O
High Speed Cooling	O	O	I	I	O	I	O	O	O	I	O	O	I or O	I or O	I or O	O
Low Speed Cooling	O	O	I	I	O	O	I	I	O	I	O	O	I or O	I or O	I or O	O
Off Cycle	O	O	O	I	O	O	O	O	O	O	O	O	I or O	I or O	O	O
Low Speed Heating	O	O	I	I	O	O	I	N/A	I	I	O	O	I or O	I or O	I or O	O
High Speed Heating	O	O	I	I	O	I	O	N/A	I	I	I or O	O	I or O	I or O	I or O	O
Defrost	O	O	I	I	O	I	O	O	I	O	I or O	I	I or O	I or O	I or O	I
STANDBY MOTOR OPERATION																
Cooling	I	O	I	I	O	O	O	O	O	I	O	O	I or O	I or O	O	O
Cooling Unloaded	I	O	I	I	O	O	I	I	O	I	O	O	I or O	I or O	O	O
Off Cycle	I	O	O	I	O	O	O	O	O	O	O	O	I or O	I or O	O	O
Heating	I	O	I	I	O	O	O	N/A	I	I	I	O	I or O	I or O	O	O
Heating Unloaded	I	O	I	I	O	O	I	N/A	I	I	O	O	I or O	I or O	O	O
Defrost	I	O	I	I	O	O	O	O	I	O	O	I	I or O	I or O	O	I

I = Output is ON
O = Output is OFF
[1] Sequence shown is thermostat control selection. This may be overridden by suction pressure.

SECTION 3

OPERATION – UNITS WITH SOLID STATE CONTROLLER

3.1 PRE-TRIP INSPECTION

a. Before Starting Engine

1. Drain water and sediment from fuel tank sump. Then fill tank with diesel fuel.

2. Check radiator coolant level. (Add pre-mixed 50/50 permanent antifreeze-water as required.) USE ETHYLENE GLYCOL ONLY. (Refer to section 1.2)

3. Check evaporator and condenser coil for cleanliness.

4. Check engine lubrication and fuel filter, oil lines, and connections for leaks. (Tighten connections and/or replace gaskets.)

5. Check engine oil level. (Refer to section 1.2)

6. Check V-belts for proper tension, fraying or cracks. Adjust belt or replace.

7. Check battery terminals for cleanliness and tightness. Clean and coat with a mineral type grease (such as Vaseline).

8. Check engine air cleaner for cleanliness and condition of air cleaner hose.

9. Check defrost drain pan hoses. (Should be clear of debris.)

10. Check defrost air switch tubes and connections for breaks or air leaks.

b. After Starting Refrigeration Unit

1. Check engine speed. (Refer to section 4.2.3)

2. Listen for abnormal noises. (Refer to section 3.3.7)

3. Check compressor oil level. (Refer to section 4.9)

4. Observe any signs of lube or fuel oil leaks.

5. Check radiator hoses for leaks.

6. Check refrigerant level. (Refer to section 4.7)

7. Feel filter-drier. Excessive temperature drop across drier indicates restriction. (Refer to section 4.13)

3.2 STARTING AND STOPPING INSTRUCTIONS – ENGINE DRIVE

a. Starting Instructions

WARNING

Under no circumstances should ether or any other starting aids be used to start engine.

NOTE

When starting the engine, it is necessary to continue to hold the glow/defrost switch in the UP position until the engine develops sufficient oil pressure to close the oil pressure safety switch (OP), energizing and completing all circuits for unit operation.

1. Hold Glow/Defrost Switch in the UP position for 30 seconds.

NOTE

Below –17.8°C (0°F), hold glow/defrost switch for two minutes, release switch for 30 seconds and again hold glow/defrost switch for two minutes. If engine does not start after 10 seconds cranking, wait for 30 seconds before repeating starting procedure.

2. With the Glow/Defrost Switch held in the UP position, push the Start-Run-Stop Switch to the START position.

3. After engine has started, release the START switch but continue to hold the glow/defrost switch in the UP position until the oil pressure safety switch closes (when engine develops sufficient oil pressure). The glow plug switch will automatically be in the OFF position when released.

4. Set the temperature controller for desired cargo temperature.

5. Complete pre-trip inspection. (Refer to Section 3.1.b.)

Table 3-1. Manual Glow Time

Ambient Temperature	Glow Time in Seconds
Less than 0°C (32°F)	55
1°C to 10°C (33°F to 50°F)	40
11°C to 25°C (51°F to 77°F)	25
Greater than 26°C (78°F)	10

b. Stopping Instructions

Place Start-Run-Stop switch in the STOP position.

3.3 STARTING AND STOPPING INSTRUCTIONS – STANDBY MOTOR DRIVE

WARNING

Beware of unannounced starting of fans and V-belts caused by thermostatic cycling of unit during standby operation.

a. Starting Instructions

1. Place the Start-Run-Stop Switch in the STOP position.

2. Place the Engine/Standby Switch in the STANDBY position.

3. Plug in the power plug.

4. Place the Start-Run-Stop Switch Switch in the RUN position.

5. Check for proper motor rotation. Condenser air must be drawn into unit. To reverse rotation, stop unit, disconnect power cord and change polarity of plug.

b. Stopping Instructions

WARNING

When changing from standby operation, first turn the unit OFF, turn OFF main power and remove power plug.

1. Place the Start-Run-Stop Switch in the STOP position.

3.4 CONTROL CIRCUIT OPERATION – ENGINE DRIVE

3.4.1 Introduction

NOTE

To make it easier to locate the schematic components referred to in the written text, the schematic in this manual has map coordinates added to the margins. These locations have also been added to the legend.

The relay module, which contains plug-in interchangeable relays provides the controller with a means for switching the unit components to achieve a desired operating mode.

3.4.2 Cooling

There are two control ranges, Frozen and Perishable. The Frozen range is active with set points at or *below −12°C (+10°*F) and the Perishable range is active at set points *above −12°C (+10°*F).

The controller automatically selects the mode necessary to maintain box temperature at set point.

If the unit is in high speed cool, the controller will de-energize the speed relay. A set of normally closed contacts (SR) close to energize the speed control solenoid (SCS). The engine will be in high speed.

As the box temperature falls toward set point, the controller will place the unit in low speed cool. (See Figure 3-1, Figure 3-2, Figure 3-3 or Figure 3-4)

The speed relay (SR) energizes to open the circuit to the speed control solenoid (SCS). Engine speed decreases from high speed to low speed.

For set points above −12°C (+10°F) and with decreasing temperature, the unit will shift to low speed heat.

Unit will remain in various stages of heating until the box temperature increases enough to place the unit in the low speed cool mode. As the box temperature increases, the unit will shift to high speed cool mode (speed relay energizes).

3.4.3 Heating

Refer to section 1.16 for description on heating cycle.

The unit will only heat when the controller is set above −12°C (+10°F) as the heat relays are electronically locked out with set points at or below −12°C (+10°F).

The controller automatically selects the mode necessary to maintain box temperature at set point. The heating modes are as follows with descending temperatures: (a) Low Speed Heating, (b) High Speed Heating

The heat light will also be illuminated. The controller will shift the unit into low speed heat when the box temperature falls below set point. (See Figure 3-1 or Figure 3-3)

If more heating capacity is required, the unit will shift to high speed heating.

3.4.4 Defrost

Refer to section 1.16 for the heat and defrost cycle.

NOTE

The unit will be in high speed in the defrost mode.

The defrost mode may be initiated by three different ways if the evaporator coil is below 1.7°C (35°F). (Refer to Section 1.4)

Method one to initiate defrost is to place the Glow/Defrost Switch in the DEFROST position.

Method two is that defrost may be initiated automatically at preset intervals by the defrost timer.

The third means of defrost initiation is by the defrost air switch (DA). The switch is an air pressure differential switch which measures air pressure differential across the evaporator coil and initiates the defrost cycle when the air pressure differential increases enough to close the DA contacts, such as would happen when excessive frost builds up on the evaporator coil surface.

In defrost the controller will shift the unit into high speed heat. The defrost and heat light will also be illuminated.

Also N.C. defrost relay contacts open to stop the evaporator fans.

The unit will remain in defrost until one defrost termination thermostat opens to remove voltage from the defrost relay.

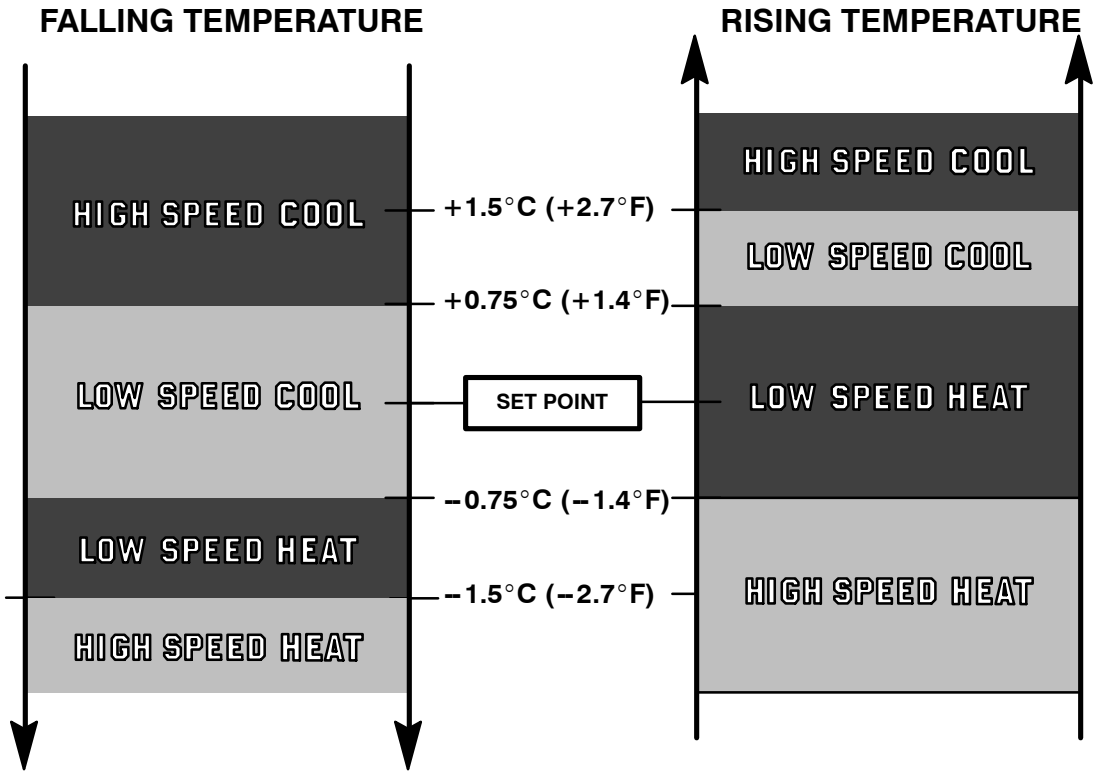
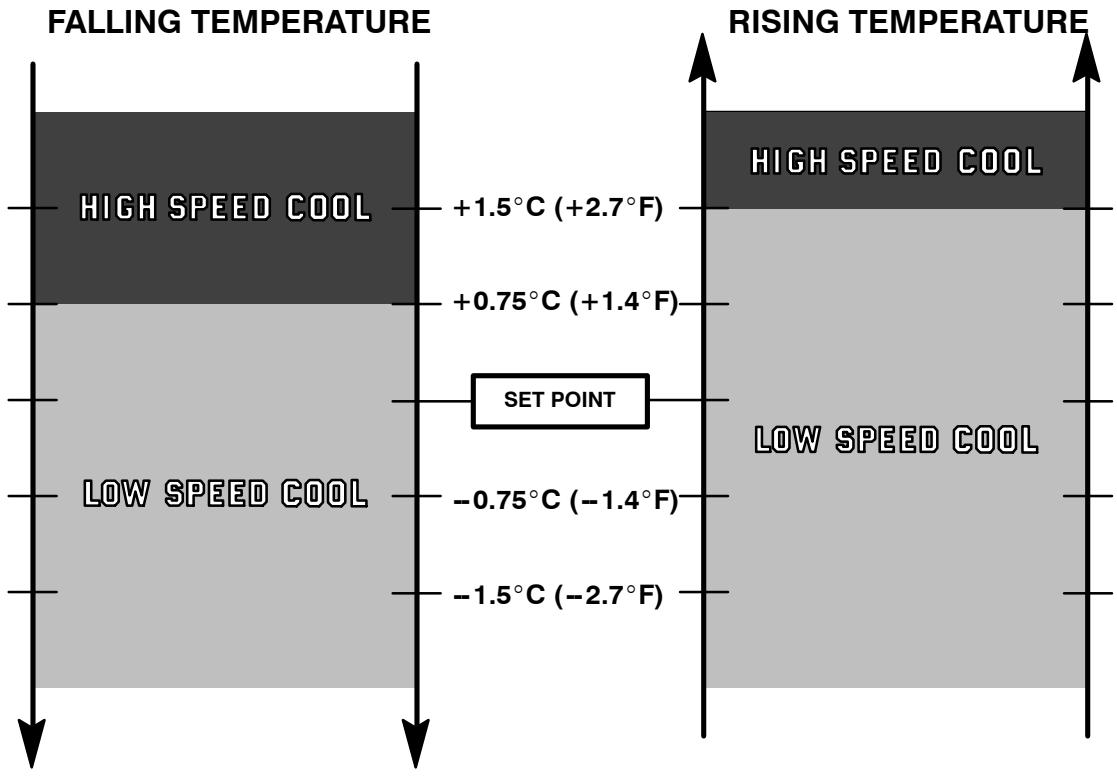


Figure 3-1. Temperature Controller Operating Sequence – Engine Drive Controller Set Point Above –12°C (+10°F)



NOTE: The controller prevents heating when set below +10°F (–12°C).

Figure 3-2. Temperature Controller Operating Sequence – Engine Drive Controller Set Point Below –12°C (+10°F)

3.5 CONTROL CIRCUIT OPERATION – STANDBY MOTOR DRIVE

The control circuitry for standby operation is the same as for the engine operation: 12 volts DC is supplied from the battery and the alternator to power the control circuit. The high voltage section of the schematic is controlled by a low voltage (12VDC) Motor Contactor (MC) in the control circuitry.

1. Perishable range setpoints above 10°F (–12°C) Standby Cool, Standby OFF, Standby Heat

During Standby operation, there are three operating modes for the (TCM) in the perishable range. The electric motor is limited to one operating speed. When the box temperature is significantly above setpoint, the unit will be in the COOL mode of operation. (TCM calling for high speed cool.) When the box temperature falls to 0.75°C (1.4°F) above setpoint, the unit will cycle OFF. (TCM calling for low speed cool.) When the box temperature gets to 0.75°C (1.4°F) below setpoint the unit will switch to the HEAT mode. (TCM calling for high speed heat.)

NOTE

When the (TCM) energizes low speed, the standby relay will also energize. This will cycle the unit off.

2. Frozen Range Setpoints Below –12°C (10°F) Standby Cool, Standby Off

When in the frozen range of operation, the unit will operate in COOL and OFF. The HEAT output from the (TCM) is locked out. Therefore, it is possible for the box temperature to fall below setpoint in the frozen range.

3.5.1 Standby Cool

This schematic shows the unit in the standby cool mode of operation. With the Start-Run-Stop switch (SRS), in the RUN position and the Selector Switch (SSW), in the STANDBY position, the following electrical circuits will be energized.

Looking at the (SRS), potential will be present at terminal (SRS-4) to (SSW-5), through to (SSW-6). From (SSW-6) voltage will be available to the positive terminal of the Motor Overload Timer (MOT). Also voltage will flow through diode (D2) to terminals 2 and 11 of the Temperature Control Module (TCM). At the same time, voltage will flow from (SSW-6) through the N.C. Standby Relay (SBR) contacts, N.C. Oil Pressure Safety switch (OPS), and the Overload Protector (OL) to (MOT-95), energizing (MOT). With (MOT) energized, voltage will flow from (MOT-S) to the Motor Contactor Pilot Relay (MCP) terminal (MPC-86) and through diode (D14) to the (RR) terminal (RR-86), energizing both (MCP) and (RR).

When (RR) energizes, the N.O. (RR) contacts close, supplying voltage to the N.C. (MCP) contacts,(energized open), and through the N.O. (MCP) contacts, (energized closed), to the Run Time Meter Standby (RTMS) and to the Motor Contactor (MC) terminal (MC-86)

Looking back to the N.O. (RR) contacts (energized closed), voltage is available through diode (D12) to energize the Alternator Relay (RALT), through the N.C. Heat Relay (HR) contacts energizing the Cool Light (CL), and through the N.C. Defrost Relay (DR) contacts to the N.C. (RALT) contacts (energized open). Also through diode (D1) to the Temperature Control Module (TCM), Solid State Defrost Timer (SDT), Defrost Timer Relay (DTR) terminal (DTR-86), N.O. (DTR) contacts, and the N.O. Defrost Air Switch (DA). Voltage will also be available at the N.O. Defrost Relay (DR) contacts.

With (MC) energized, the N.O. (MC) contacts close , supplying high voltage to the Standby Motor (SBM). When (SBM) is turning fast enough to cause the Alternator (ALT) to charge the system, the (RALT) will de-energize, closing the N.C. (RALT) contacts. This will energize the Evaporator Fan Motor Relays (EMFR1), (EMFR2), and (EMFR3) closing the N.O. (EFMR) contacts, energizing the Evaporator Fan Motors (EFM1), (EFM2), and (EFM3).

3.5.2 Standby OFF

When the unit is running on Standby the (TCM) will cycle the unit off when the box temperature falls to 1.4°F (0.75°C) above set point and the (TCM) attempts to select low speed. To do this, the (TCM) will supply voltage from (TCM-8) to energize the Standby Relay (SBR). When (SBR) is energized, the N.C. (SBR) contacts will open, breaking the voltage path to (MOT-95). With no voltage at (MOT-95), the (MOT) will de-energize (MOT-S). At this time, (MCP) and (RR) will de-energize.

When (MCP) is de-energized, the N.O. (MCP) contacts will open causing (MC) to de-energize. This will open the N.O. (MC) contacts, shutting down the Standby Motor.

With (RR) de-energized, the N.O. (RR) contacts will open. This de-energizes the refrigeration control circuitry.

The (TCM) will remain energized from terminal (SSW-6) through diode (D2), allowing the (TCM) to monitor box temperature even during the OFF cycle.

NOTE

The Standby mode of operation has a minimum off time of 5 minutes to prevent rapid on-off cycling of the standby motor. This is controlled by (MOT). When the voltage has been removed from (MOT-S), a 5 minute off-time delay timer will start. If (MOT-95) receives voltage during the 5 minute off-time delay, (MOT-S) will remain energized until the timer times out.

3.5.3 Standby Defrost

Standby defrost operates the same as engine drive defrost refer to section 3.4.4.

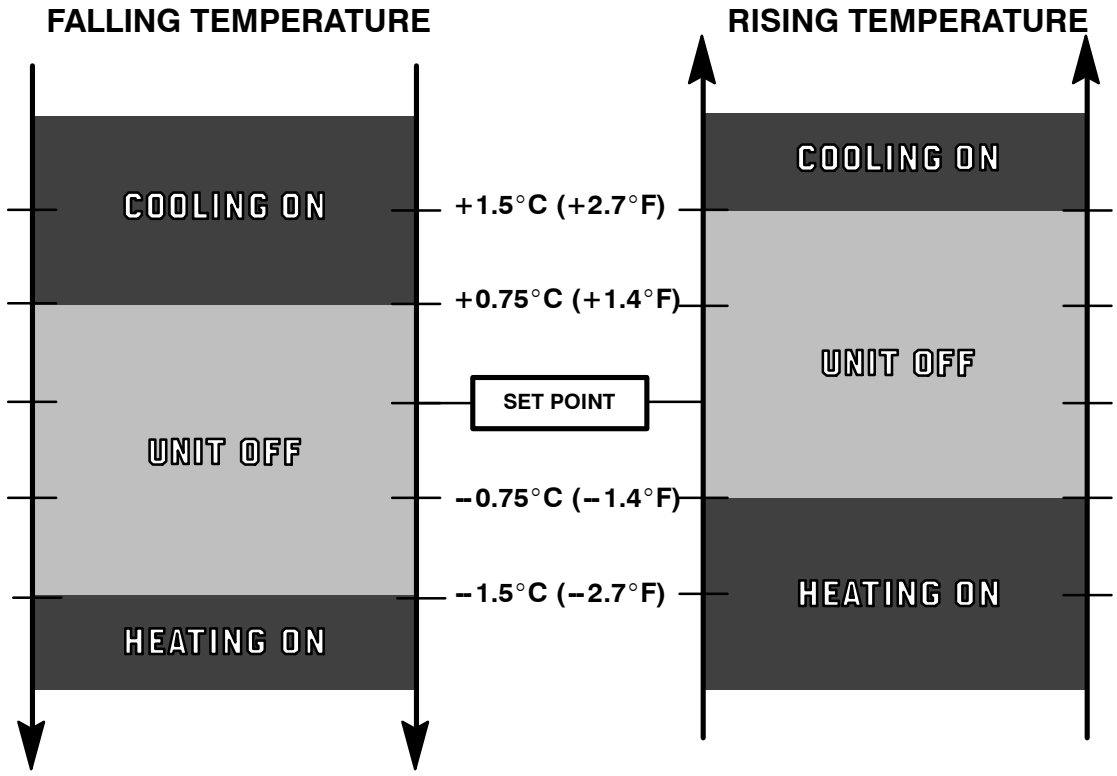
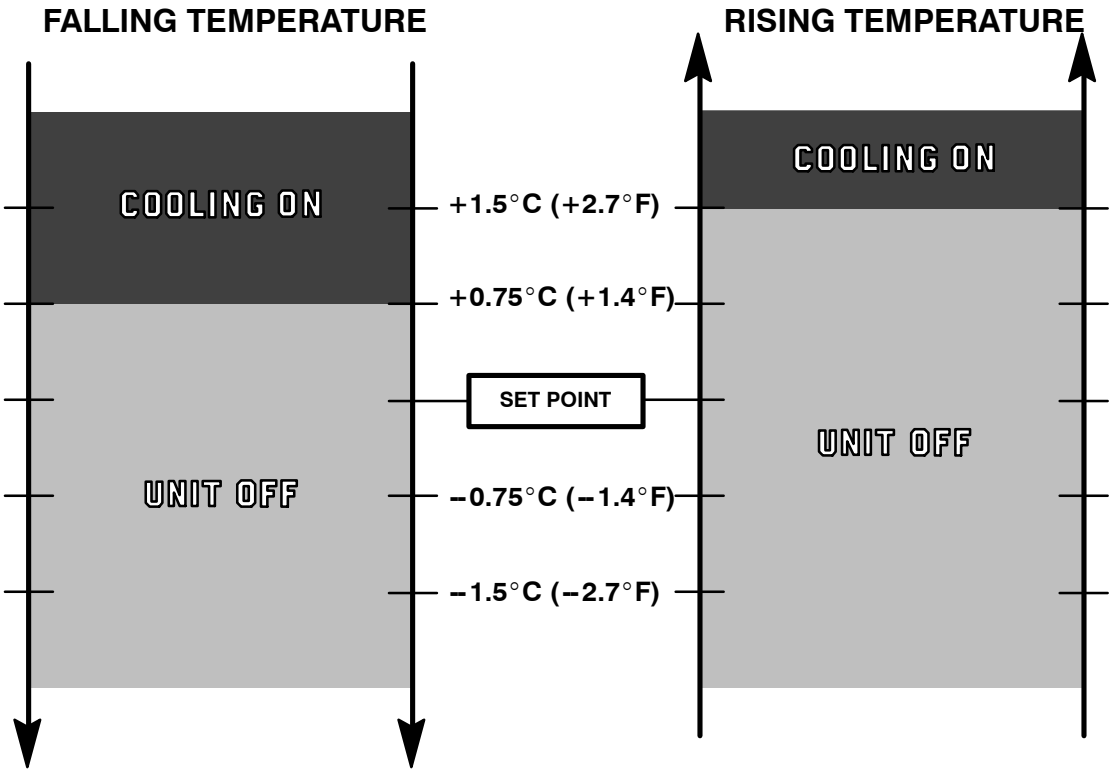


Figure 3-3. Temperature Controller Operating Sequence – Standby Operation Controller Set Point Above –12°C (+10°F)



NOTE: The controller prevents heating when set below +10°F (–12°C).

Figure 3-4. Temperature Controller Operating Sequence – Standby Operation Controller Set Point Below –12°C (+10°F)

Table 3-2. Relay Operation -- Solid State Controller												
Mode	**SBR**	**MCP**	**GPR**	**RR**	**SR**	**HR**	**DDR**	**EFMR 1,2,3**	**DR**	**DTR**	**RALT**	**FHR**
Off	O	O	O	O	O	O	O	O	O	O	O	O
Glow	O	O	I	I	O	O	O	O	O	O	I	I or O
Start	O	O	I	I	O	O	O	O	O	O	I or O	I or O
High Speed Cooling	O	O	O	I	O	O	O	I	O	O	O	I or O
Low Speed Cooling	O	O	O	I	I	O	O	I	O	O	O	I or O
Off Cycle	O	O	O	O	O	O	O	O	O	O	O	O
Low Speed Heating	O	O	O	I	I	I	O	I	O	O	O	I or O
High Speed Heating	O	O	O	I	O	I	O	I	O	O	O	I or O
Defrost	O	O	O	I	O	I	I	O	I	I or O	O	I or O
STANDBY MOTOR OPERATION												
Cooling	O	I	O	I	O	O	O	I	O	O	O	O
Off Cycle	I	O	O	O	I	O	O	O	O	O	O	O
Heating	O	I	O	I	O	I	O	I	O	O	O	O
Defrost	O	I	O	I	O	I	I	O	I	I or O	O	O

I = Output is ON
O = Output is OFF

SECTION 4

SERVICE

WARNING

Beware of V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Run-Stop switch is in the STOP position. Also disconnect the negative battery cable.

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant.

4.1 MAINTENANCE SCHEDULE

UNIT ON	UNIT OFF	OPERATION	REFERENCE SECTION
a. Daily Inspection			
	X	Pre-Trip Inspection – before starting	2.1.a or 3.1.a
X		Pre-Trip Inspection – after starting	2.1.b or 3.1.b
b. First 250 Hour Inspection and Maintenance			
X	X	Perform daily inspection	4.1
	X	Check wire harness for chafing and loose terminals	Replace/Tighten
	X	Check unit mounting bolts for tightness	1.6
	X	Check standby motor bearings for end play	None
	X	Change engine lube oil and filter	4.2.2
c. Every 750 Hour Inspection and Maintenance			
X	X	Perform daily inspection	4.1
	X	Tighten all electrical connections	None
	X	Check defrost air switch calibration	4.15
	X	Check that evaporator drain lines are clear	None
	X	Replace fuel filter	4.2.5
	X	Remove and inspect evaporator fan motor brushes	4.16
X		Check engine speeds	1.2

d. Oil Change Intervals

MODEL	Without Bypass Oil Filter	With Bypass Oil Filter
Supra 422/522	500 Hours	600 Hours
Supra 622/722/822	750 Hours	1000 Hours
Supra 922/944	1000 Hours	1250 Hours

4.2 SERVICING ENGINE RELATED COMPONENTS

4.2.1 Cooling System

The condenser and radiator assembly is designed with the radiator located above the condenser coil. The condenser fans draw the air through the condenser and radiator coil. To provide maximum air flow the condenser fan belt should be checked periodically and adjusted if necessary to prevent slippage.

The condenser and radiator can be cleaned at the same time. The radiator must be cleaned internally as well as externally to maintain adequate cooling.

CAUTION

Use only ethylene glycol anti-freeze (with inhibitors) in system as glycol by itself will damage the cooling system.
Always add pre-mixed 50/50 anti-freeze and water to radiator/engine. Never exceed more than a 50% concentration of anti-freeze. Use a low silicate anti-freeze.

a. Remove all foreign material from the radiator/condenser coil by reversing the normal air flow. (Air is pulled in through the front and discharges over the standby motor.) Compressed air or water may be used as a cleaning agent. It may be necessary to use warm water mixed with any good commercial dishwasher detergent. Rinse coil with fresh water if a detergent is used.

b. Drain coolant by removing lower radiator hose and radiator cap.

c. Install hose and fill system with clean, untreated water to which three to five percent of an akalined based radiator cleaner should be added (six ounces – dry 151 grams to one gallon = 3.78 liters) of water.

d. Run engine 6 to 12 hours and drain system while warm. Rinse system three times after it has cooled down. Refill system with water.

e. Run engine to operating temperature. Drain system again and fill with treated water/anti-freeze. (see Caution and refer to section 1.2) NEVER POUR COLD WATER INTO A HOT ENGINE, however hot water can always be added to a cold engine.

4.2.2 Changing Lube Oil and Lube Oil Filters

After warming up the engine, stop engine, remove drain plug from oil reservoir and drain engine lube oil.

CAUTION

When changing oil filters, the new filters should be primed with clean oil. if the filters are not primed, the engine may operate for a period with no oil supplied to the bearings.

Replace filter(s), lightly oil gasket on filter before installing and add lube oil. (Refer to section 1.2) Warm up engine and check for leaks.

4.2.3 Replacing the Speed and Run Control Solenoids

a. Run Solenoid (see Figure 4-1).

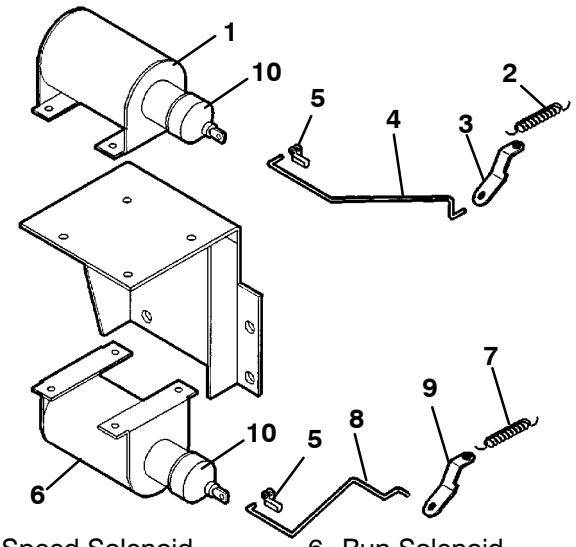
1. Remove spring (item 7) from the engine run lever.

2. Disconnect wiring to solenoid. Remove clip (item 5) from linkage rod (item 8). Remove mounting hardware and solenoid.

3. Attach linkage to new solenoid and install the clip to the linkage rod. Install the replacement solenoid and mounting hardware loosely. Connect the ground wire and spring.

4. Energize the solenoid with a jumper wire connected to a battery. Slide the solenoid far enough back on the bracket to set the engine run lever (item 9) against the stop. Tighten solenoid mounting hardware.

5. De-energize the solenoid. If the engine does not shut off, repeat step 4 and adjust the solenoid forward slightly. When operating correctly, tighten solenoid mounting hardware and reconnect the positive wire.



1. Speed Solenoid
2. Spring (Speed Control)
3. Engine Speed Lever
4. Linkage Rod (Speed)
5. Clip
6. Run Solenoid
7. Spring (Run Control)
8. Linkage Rod (Run)
9. Engine Run Lever
10. Boot

Figure 4-1. Speed and Run Control Solenoids

b. Speed Control Solenoid (see Figure 4-1).

1. Remove spring (item 2) from the engine speed lever (item 3).

2. Disconnect wiring to solenoid. Disconnect linkage rod (item 4) from solenoid. Remove mounting hardware and solenoid.

3. Attach linkage to new solenoid and install the clip (item 5) to the linkage rod. Install the replacement solenoid and mounting hardware loosely. Connect the ground wire and spring.

4. Energize the solenoid with a jumper wire connected to a battery. Slide the solenoid far enough back on the bracket to set the engine speed lever against the stop. Tighten solenoid mounting hardware.

5. With the engine stopped, place a mark on the crankshaft sheave (white paint for example). Check engine speed. Speed may be verified by a Strobette model 964 (strobe–tachometer) Carrier Transicold P/N 07-00206.

6. Disconnect the jumper wire and start the engine. The engine is in low speed. Refer to section 1.2 for engine speed. Reconnect the jumper wire to energize the solenoid. The engine should increase to high speed. If engine speed is not correct (engine lever against stop), stop engine and move the solenoid forward slightly. Repeat procedure if adjustments need to be made.

7. When operating correctly, tighten solenoid mounting hardware and reconnect the positive wire.

8. If adjustment is not achieved by doing step 6, stop engine and remove linkage from solenoid. Remove boot (item 10) from solenoid and pull solenoid shaft out (far enough to loosen jam nut on solenoid shaft). Energize solenoid for maximum force (pull) and then turn shaft clockwise to shorten.

9. De-energize solenoid, tighten shaft jam nut and replace boot. Connect linkage and repeat steps 5 and 6.

4.2.4 Engine Air Cleaner

a. Inspection

The oil type air cleaner, hose and connections should be inspected for leaks. A damaged air cleaner or hose can seriously affect the performance and life of the engine. If housing has been dented or damaged, check all connections immediately.

When inspecting air cleaner housing and hoses, check the connections for mechanical tightness and look for fractures in the inlet and outlet hoses. When leakage occurs and adjustment does not correct the problem, replace necessary parts or gaskets. Swelled or distorted gaskets must always be replaced.

b. Service Procedure (Dry Type)

1. Stop engine, remove air filter. Install new air filter.

c. Service Procedure (Oil Type)

The air cleaner is designed to effectively remove contaminants from the air stream entering the engine. An excessive accumulation of these contaminants in the air cleaner will impair operation, therefore, a service schedule must be set up and followed.

1. Oil Cups

When to Service: Remove the oil cup at regular intervals. Initially inspect daily or as often as conditions require. Never allow more than 12.7 mm (1/2 inch) of dirt deposit in either cup. More than 12.7 mm (1/2 inch) accumulation could cause oil and dirt to enter the engine causing accelerated engine wear. Heavily contaminated oil will not allow the air cleaner to function properly.

CAUTION

Always cover the engine inlet tube while the air cleaner is being serviced.

How to Service: Stop the engine and remove the oil cup from the air cleaner. Dump the oil from the oil cups. Remove the inner cup from the oil cup and clean.

Reassemble and fill both oil cups to the indicated level with SAE #10 oil for temperatures below freezing or SAE #30 for temperatures above freezing. It is generally a recommended practice to use the same oil as required in the engine crankcase.

CAUTION

Do not under fill or over fill the cups. over filling of cups means loss of capacity and under filling means lack of efficiency.

2. Body Assembly

When to Service: The lower portion of the fixed element should be inspected each time the oil cup is inspected or serviced. If there is any sign of contaminant build up or plugging, the body assembly should be removed and back flushed. At least once a year or at regular engine service periods remove the entire air cleaner and perform the following:

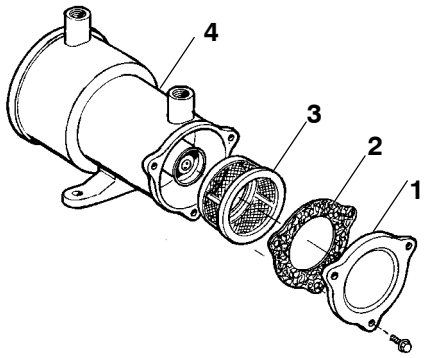
a. Remove oil cup. Check and clean center tube. DO NOT USE GASOLINE.

b. Pump solvent through the air outlet with sufficient force and volume to produce a hard, even stream out the bottom of the body assembly. Reverse flush until all foreign material is removed.

4.2.5 Servicing Fuel Pump

a. To Check or Replace Filter

1. Remove 3 screws from cover (item 1, Figure 4-2).
2. Remove cover, gasket and filter.
3. Wash filter in cleaning solvent and blow out with air pressure. Clean cover.
4. To Install reverse above steps.



1. Cover
2. Gasket
3. Filter
4. Fuel Pump

Figure 4-2. Electric Fuel Pump

4.2.6 Servicing Glow Plugs

The glow plugs, when energized, draw a nominal 7.0 amps at 10.5 vdc. When servicing, the glow plug is to be fitted carefully into the cylinder head to prevent damage to glow plug. Torque value for the glow plug is 0.8 to 1.5 mkg (6 to 11 ft-lb).

Checking for a Defective Glow Plug

a. One method is to place an ammeter (or clip-on ammeter) in series with each glow plug and energize the plugs. Each plug (if good) should show amperage draw.

b. A second method is to disconnect the wire connection to the plug and test the resistance from the plug to a ground on the engine block. The reading should be 0.7 to 1.2 ohms if the plug is good.

4.3 SERVICING AND ADJUSTING V-BELTS

WARNING

Beware of V-belts and belt driven components as the unit may start automatically.

4.3.1 Belt Tension Gauge

It is recommended using a belt tension gauge (tester) P/N 07-00203, shown in Figure 4-4 whenever V-belts are adjusted or replaced.

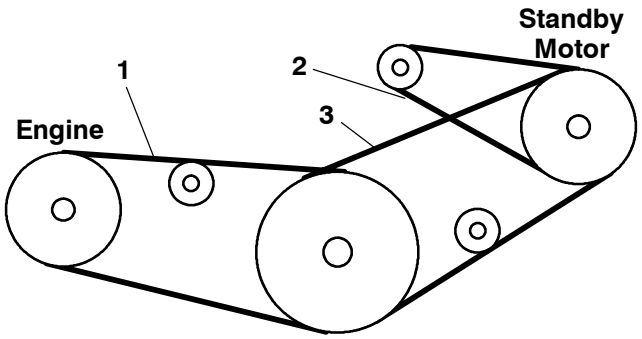
A belt tension gauge provides an accurate and easy method of adjusting belts to their proper tension. Properly adjusted belts give long lasting and efficient service. Too much tension shortens belt and bearing life, and too little tension causes slippage and excessive belt wear. It is also important to keep belts and sheaves free of any foreign material which may cause the belts to slip.

The belt tension gauge can be used to adjust all belts. The readings which we specify for Carrier Transicold units are applicable only for our belts and application, as the tension is dependent on the size of the belt and distance between sheaves. When using this gauge, it should be placed as close as possible to the midpoint between two sheaves. (See Figure 4-3)

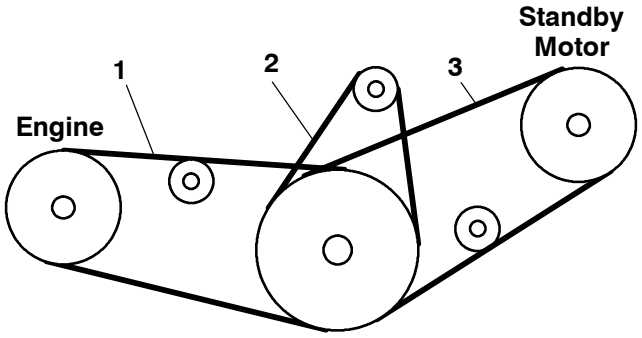
The V-belts must be kept in good condition with the proper tension to provide adequate air movement across the coils.

When installing a new V-belt the tension should be somewhat higher than specified and readjusted after allowing the unit to run for some time.

Table 4-1. Belt Tension (See Figure 4-4)	
BELTS	**Tension**
CT3-44TV engine (D722) Water pump	30 to 40
CT2-29TV engine (Z482) Water pump	30
Engine to Compressor	30 to 50
Alternator	30 to 50
Standby Motor to Compressor	30 to 50



Supra 422 With Evaporator Motors



Supra 522 to 822 With Evaporator Motors

1. Engine to Compressor V-belt
2. Alternator V-belt
3. Standby Motor to Compressor V-belt

Figure 4-3. V-Belt Arrangement

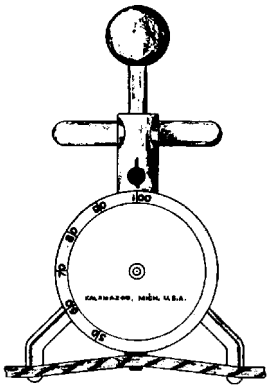


Figure 4-4 Belt Tension Gauge (Part No. 07-00203)

4.3.2 Alternator V-Belt

a. Make sure negative battery terminal is disconnected.

b. For Supra 422 place V-belt on alternator sheave and standby motor pulley. For Supra 522 to 822 place V-belt on alternator sheave and driving pulley.

c. Pivot alternator to place tension on belt using hand force only. *Do not use pry bar or excessive force as it may cause bearing failure.* For correct belt tension see Table 4-1. Tighten pivot and adjustment bolts.

4.3.3 Water Pump Belt Tensioner

Water pump belt is driven by the diesel engine crankshaft pulley. The automatic belt tensioner ensures the correct tension.

To change the water pump belt, proceed as follows:

a. To compress the tensioner spring, place a threaded bolt or rod into hole and turn clockwise. This will draw the spring up and slacken V-belt for easy removal.

b. After replacing V-belt, remove the bolt to release the spring to return the idler to it's correct tension.

4.3.4 Standby Motor – Compressor V-Belt

a. Remove alternator V-belt. (Refer to Section 4.3.2)

b. Loosen the V-belt idler securing bolt (22mm).

c. Replace V-belt and alternator V-belt. Position the idler to correct belt tension. Tighten the idler retaining bolt.

4.3.5 Engine – Compressor V-Belts

a. To allow for easy removal, installation and adjustment of the V-belts, it is recommended that the muffler be disconnected from the muffler bracket and moved.

b. Except for Supra 422 remove alternator V-belt. (Refer to Section 4.3.2)

c. Remove the standby motor – compressor V-belt. (Refer to Section 4.3.4)

d. Loosen belt idler bolt (24 mm). Move idler to remove V-belts.

e. Replace V-belts. Position the idler to the correct belt tension. Tighten the idler retaining bolt.

4.4 PUMPING THE UNIT DOWN OR REMOVING THE REFRIGERANT CHARGE

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant.

a. Pumping the Unit Down

To service the filter-drier, expansion valve, quench valve, CPR valve or evaporator coil, pump most of refrigerant into condenser coil and receiver as follows:

1. Backseat suction and discharge service valve (turn counterclockwise) to close off gauge connection and attach manifold gauges to valves.

2. Open valves two turns (clockwise). Purge gauge line.

3. Close the receiver outlet (king) valve by turning clockwise. Start unit and run in high speed cooling. Place Run-stop switch in the STOP position when unit reaches 0.1 kg/cm^2 (1 psig).

4. Frontseat (close) suction service valve and the refrigerant will be trapped between the compressor suction service valve and the manual shutoff (King) valve.

5. Before opening up any part of the system, a slight positive pressure should be indicated on the pressure gauge.

6. 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.

7. Open (backseat) King valve and midseat suction service valve.

8. Leak check connections with a leak detector. (Refer to section 4.5)

9. Start the unit in cooling and check for noncondensibles.

10. Check the refrigerant charge. (Refer to section 4.7.3)

NOTE

Store the refrigerant charge in an evacuated container if the system must be opened between the compressor discharge valve and receiver.

Whenever the system is opened, it must be evacuated and dehydrated. (Refer to section 4.6)

b. Removing the Refrigerant Charge

Connect a refrigerant recovery system to the unit to remove refrigerant charge. Refer to instruction provided by the manufacture of the refrigerant recovery system.

4.5 REFRIGERANT LEAK CHECKING

If system was opened and repairs completed, leak check the unit.

a. The recommended procedure for finding leaks in a system is with a halide torch or electronic leak detector. Testing joints with soapsuds is satisfactory only for locating large leaks.

b. If system is without refrigerant, charge system with refrigerant to build up pressure between 2.1 to 3.5 kg/cm^2 (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 high side (discharge) of the system.

c. Remove refrigerant using a refrigerant recovery system and repair any leaks. Evacuate and dehydrate the unit. (Refer to section 4.6) Charge unit with refrigerant. (Refer to section 4.7)

4.6 EVACUATION AND DEHYDRATION

4.6.1 General

Moisture is the deadly enemy of refrigerant 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.

4.6.2 Preparation

a. Evacuate and dehydrate only after pressure leak test. (Refer to section 4.5)

b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump (5 cfm = 8m3H volume displacement, P/N 07-00176-01) and a good vacuum indicator such as a thermocouple vacuum gauge (vacuum indicator). (Available through Robinair Manufacturing, Montpelier, Ohio, Part Number 14010.)

NOTE

It is not recommended using a compound gauge because of its inherent inaccuracy.

c. 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 system temperature.

4.6.3 Procedure for Evacuation and Dehydrating System

a. Remove 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 4-5 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.

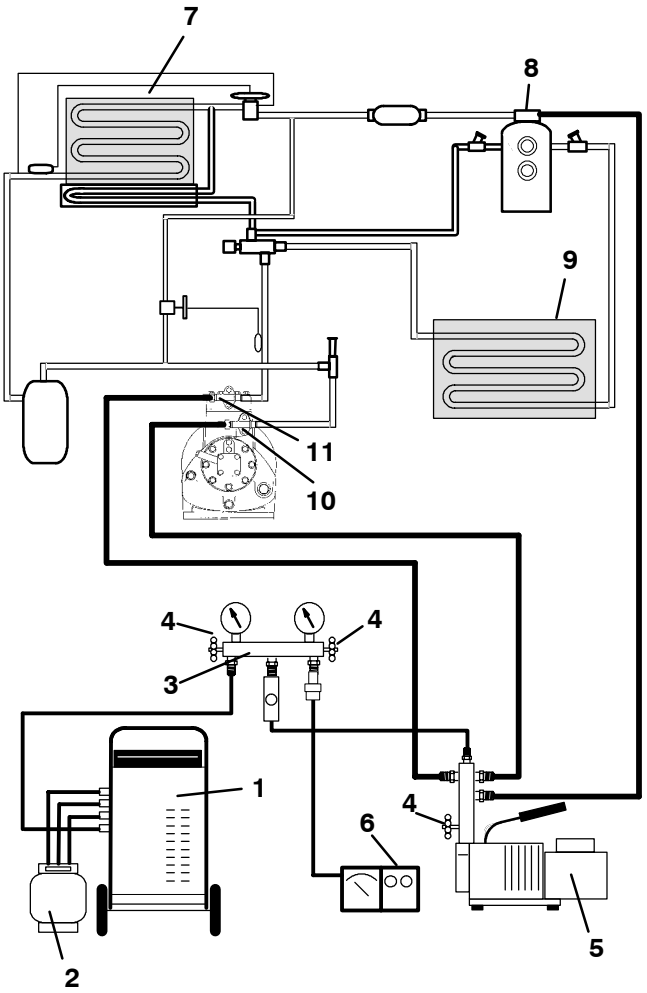
f. Break the vacuum with clean dry refrigerant. Use refrigerant that the unit calls for. Raise system pressure to approximately 2 psig.

g. Remove refrigerant using a refrigerant recovery system.

h. Repeat steps e through g one time.

i. Evacuate unit to 500 microns. Close off vacuum pump valve and stop 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 4.7)



1. Refrigerant Recovery Unit
2. Refrigerant Cylinder
3. Evacuation Manifold
4. Valve
5. Vacuum Pump
6. Electronic Vacuum Gauge
7. Evaporator Coil
8. Receiver Outlet (King) Valve
9. Condenser Coil
10. Suction Service Valve
11. Discharge Service Valve

Figure 4-5. Vacuum Pump Connection

4.7 CHARGING THE REFRIGERATION SYSTEM

4.7.1 Installing a Complete Charge

a. Dehydrate unit and leave in deep vacuum. (Refer to section 4.6)

b. Place refrigerant cylinder on scale and connect charging line from cylinder to receiver outlet (king) valve. Purge charging line at outlet valve.

c. Note weight of refrigerant cylinder.

d. Open liquid valve on refrigerant cylinder. Open king 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 will be found in section 1.3.

NOTE

It is possible that all liquid may not be pulled into the receiver, as outlined in step d. In this case, vapor charge remaining refrigerant through the suction service valve. (Refer to section 4.7.2)

e. When refrigerant cylinder weight (scale) indicates that the correct charge has been added, close liquid line valve on cylinder and backseat the king valve.

4.7.2 Adding a Partial Charge -- R-22 Only

CAUTION

Do not vapor charge R-404A. Only liquid charging through the liquid line king valve is acceptable.

a. Place refrigerant cylinder on scale and note weight. Backseat suction service valve and connect charging line between suction valve port and refrigerant cylinder. Open VAPOR valve on cylinder and purge charging line.

b. Run the unit in high speed cool and open suction service valve three turns.

c. If necessary partially block the condenser coil to raise the head pressure to 14.8 kg/cm^2 (210 psig). The unit is correctly charged when the lower receiver sight glass is full and no refrigerant is in the upper receiver sight glass.

d. Backseat (close) suction service valve. Close vapor valve on refrigerant cylinder, noting weight.

e. Start unit and check for noncondensibles.

4.7.3 Checking the Refrigerant Charge

a. Start unit in cooling mode. Run approximately ten minutes. Partially block off air flow to condenser coil so discharge pressure rises to 14.8 kg/cm^2 (210 psig).

The unit is correctly charged when the lower receiver sight glass is full and no refrigerant is in the upper receiver sight glass.

4.8 REPLACING THE COMPRESSOR

a. Removing

If compressor is inoperative and unit still has refrigerant pressure, frontseat suction and discharge service valves to trap most of the refrigerant in the unit.

If compressor runs, pump down the unit. (Refer to section 4.4.a)

1. Slowly release compressor pressure to a recovery system.

2. Remove bolts from suction and discharge service valve flanges.

3. Disconnect wiring to compressor discharge temperature sensor (CDT), suction pressure transducer and the wiring to the high pressure switch (HP).

4. Release idler pulleys and remove belts.

5. Remove the four bolts holding the compressor to the power tray. Remove the compressor from chassis.

6. Remove the pulley from the compressor.

7. Drain oil from defective compressor before shipping.

b. Installing

1. To install the compressor, reverse the procedure outlined when removing the compressor. Refer to section 1.6 for torque values.

NOTE

The service replacement compressor is sold without shutoff valves (but with valve pads). Customer should retain the original capacity control valves for use on replacement compressor. Check oil level in service replacement compressor. (Refer to sections 1.3, and 4.9)

2. Attach two lines (with hand valves near vacuum pump) to the suction and discharge service valves. Dehydrate and evacuate compressor to 500 microns (29.90" Hg vacuum = 75.9 cm Hg vacuum). Turn off valves on both lines to pump.

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

4. Remove vacuum pump lines and install manifold gauges.

5. Check refrigerant level (Refer to section 4.7.3)

NOTE

It is important to check the compressor oil level of the new compressor and fill if necessary.

6. Check compressor oil level. (Refer to section 4.9) Add oil if necessary.

7. Check refrigerant cycles.

4.9 CHECKING 05K COMPRESSOR OIL LEVEL

a. To Check Oil Level in 05K Compressor:

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

2. Check the 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 3.

3. Check the level of the oil in the front sight glass with the compressor operating. The correct level should be between bottom and 1/4 of the sight glass. If the level is above 1/4, oil must be removed from the compressor. To remove oil from the compressor, follow step d. If the level is below sight glass, add oil to the compressor following step b.

b. Adding Oil with Compressor in System

Two methods for adding oil are the oil pump method and closed system method.

1. Oil Pump Method

One compressor oil pump that may be purchased is a Robinair, part no. 14388. This oil pump adapts to a one U.S. gallon (3.785 liters) metal refrigeration oil container and pumps 2-1/2 ounces (0.0725 liters) per stroke when connected to the suction service valve port. Also there is no need to remove pump from can after each use.

When the compressor is in operation, the pump check valve prevents the loss of refrigerant, while allowing servicemen to develop sufficient pressure to overcome the operating suction pressure to add oil as necessary.

Backseat suction service valve and connect oil charging hose to port. Crack the service valve and purge the oil hose at oil pump. Add oil as necessary.

2. Closed System Method

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.

c. Adding Oil to Service Replacement Compressor

Service replacement compressors may or may not be shipped with oil.

If compressor is without oil:

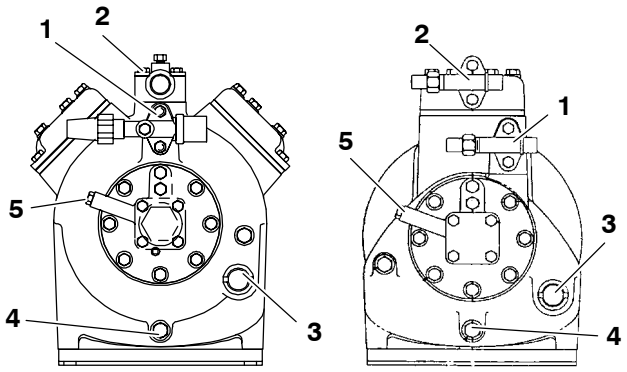
Add correct oil charge (Refer to section 1.3) by removing the oil fill plug (See Figure 4-6)

d. To remove oil from the compressor:

1. Close suction service valve (frontseat) and pump unit down to 0.1 to 0.3 kg/cm^2 (2 to 4 psig). Frontseat discharge service valve and slowly bleed remaining refrigerant.

2. Remove the oil drain plug from compressor and drain the proper amount of oil from the compressor. Replace the plug securely back into the compressor.

3. Open service valves and run unit to check oil level, repeat as required to ensure proper oil level.



4 CYLINDER **2 CYLINDER**

1. Suction Service Valve
2. Discharge Service Valve
3. Oil Level Sight Glass
4. Oil Drain Plug
5. Oil Fill Plug

Figure 4-6. Compressor -- Model 05K

4.10 CHECKING EF 210 YORK COMPRESSOR OIL LEVEL

a. Checking EF 210 York Compressor Oil Level

1. Run unit for 20 minutes to stabilize box temperature at a maximum temperature of 35°F (1.7°C). It is very important to check the compressor oil level after the system has been in operation and the desired box temperature is obtained; because an amount of oil will be absorbed by the refrigerant and entrained in the system.

2. Slowly close the suction service valve on the compressor until the suction pressure is 0 psig. Stop the compressor and frontseat the suction and discharge service valves.

CAUTION

It is very important that the suction service valve be closed slowly when pumping down the system, because an abnormal amount of oil may leave the compressor due to the sudden pressure reduction on the refrigerant saturated oil in the compressor crankcase.

3. Slowly loosen one of the compressor oil fill plugs to release remaining compressor pressure.

The residual refrigerant in the crankcase will generate a slight continuing pressure and outflow of refrigerant vapor during the period when the compressor is exposed to the atmosphere, preventing the entrance of serious amounts of either air or moisture.

4. Remove the oil fill plug and determine the oil level by using a dipstick (CTD P/N 17-32127) and Table 4-2. (A dipstick may be made, see Figure 4-7.)

The compressor oil charge after the system is stabilized should be maintained between 6 ounces (0.17 liter) minimum and 10 ounces (0.29 liter) maximum for best results.

5. When the compressor is mounted in the vertical position, the oil level may be checked from either oil fill hole when the crankshaft is pointing up or down.

6. Purge the crankcase by cracking the suction valve for 1 or 2 seconds.

7. Replace oil fill plug. When inserting the oil fill plug, the sealing O-ring is slipped over the oil fill plug threads in such a manner that the O-ring is not twisted. Insert the oil plug in the oil fill opening and tighten the plug to a torque value of 4 to 11 ft lb (0.55 to 1.5 mkg). If the plug leaks, do not attempt to stop the leak by over tightening the oil fill plug. A leak may be caused by dirt under the O-ring or on the seat, a fractured O-ring, or a damaged seat on the oil fill plug or oil fill opening. To stop leaks at the oil fill plug, correct the mechanical damages and insert a new O-ring.

8. Fully backseat suction and discharge service valves.

Table 4-2. Oil Charge Vs. Oil Level Increments (York Compressor)

Oil Charge (Ounces)	Vertical Mount (Inches)
6	$^{7}/_{8}$
8	1
10	$1\ ^{1}/_{8}$
12	$1\ ^{3}/_{8}$

b. Making a York Compressor Oil Dipstick

1. The oil dipstick can be formed as shown in Figure 4-7 from a $^{1}/_{8}$ inch diameter by $8\ ^{5}/_{16}$ long stick, preferably nonferrous material which is not subject to corrosion.

2. Place notches at the end of the dipstick in $^{1}/_{8}$ inch increments. This will help determine the oil depth.

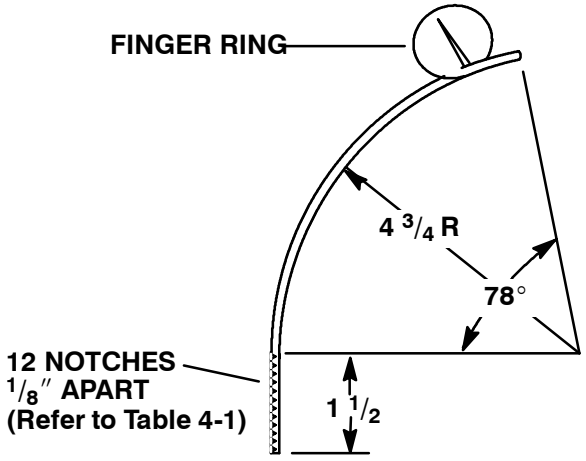


Figure 4-7. York Compressor Oil Dipstick

4.11 CHECKING 05GCOMPRESSOR OIL LEVEL

a. To Check the Oil Level in the 05G Compressor:

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

2. Check the 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 3.

3. Check the level of the oil in the sight glass with the compressor operating (See Figure 4-8).

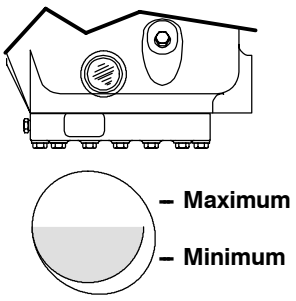


Figure 4-8. Oil Level in Sight Glass– 05G

b. Adding Oil with Compressor in System

Two methods for adding oil are the oil pump method and closed system method.

1. Oil Pump Method

One compressor oil pump that may be purchased is a Robinair, part no. 14388. This oil pump adapts to a one U.S. gallon (3.785 liters) metal refrigeration oil container and pumps 2-1/2 ounces (0.0725 liters) per stroke when connected to the oil fill (item4, Figure 4-6). Also there is no need to remove pump from can after each use.

When the compressor is in operation, the pump check valve prevents the loss of refrigerant, while allowing servicemen to develop sufficient pressure to overcome the operating suction pressure to add oil as necessary.

Backseat suction service valve and connect oil charging hose to oil fill (item4, Figure 4-6). Purge the oil hose at oil pump. Add oil as necessary (Refer to section 1.3).

2. Closed System Method

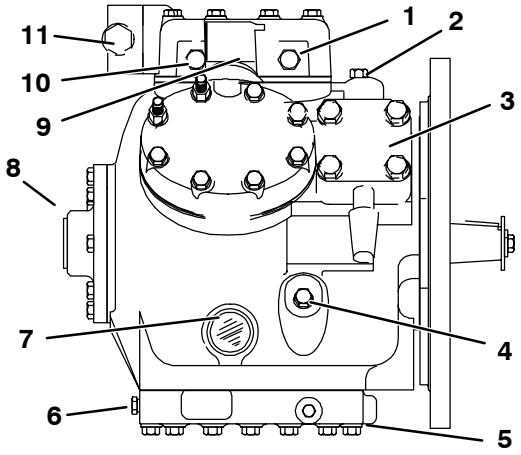
In an emergency where an oil pump is not available, oil may be drawn into the compressor through the suction service valve.

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 (Refer to section 1.3).



1. High Pressure Switch Connection
2. Suction Pressure Transducer Connection
3. Suction Service Valve
4. Oil Fill Plug
5. Bottom Plate
6. Oil Drain Plug
7. Oil Level Sight Glass
8. Oil Pump
9. Unloader Solenoid
10. Discharge Thermistor Connection
11. Discharge Service Valve

Figure 4-9. Compressor – 05G

c. Adding Oil to Service Replacement Compressor

Service replacement compressors may or may not be shipped with oil.

If compressor is without oil:

Add correct oil charge (Refer to section 1.3) through the suction service valve flange cavity or by removing the oil fill plug (See Figure 4-6)

d. To remove oil from the compressor:

1. Close suction service valve (frontseat) and pump unit down to 2 to 4 psig (0.1 to 0.3 kg/cm^2). Frontseat discharge service valve and slowly bleed remaining refrigerant.

2. Remove the oil drain plug from the compressor and drain the proper amount of oil. Replace the plug securely back into the compressor.

3. Open service valves and run unit to check oil level, repeat as required to ensure proper oil level.

4.12 COMPRESSOR UNLOADER VALVE

The compressor unloader (located on the compressor cylinder head) is controlled by relay UFR and the temperature controller. (Refer to section 1.17)

a. Checkout Procedure

1. Connect manifold gauges to the compressor suction and discharge service valves and start unit in cooling with the trailer temperature at least 5°F (2.8°C) above set point and the compressor will be fully loaded (unloader coil de-energized). Note suction pressure.

2. Remove wiring from the front unloader coil. Place electrical tape over wire terminals.

3. Set controller upscale (cooler to warmer). This mechanically simulates falling temperature. Approximately 2°F (1.1°C) below box temperature the unloader coils will energize, but only the rear unloader valve will unload. Note suction pressure, a rise of approximately 3 psig (0.2 kg/cm^2) will be noted on the suction pressure gauge.

4. Reconnect wiring on the front unloader. The front unloader will retract and an additional 3 psig (0.2 kg/cm^2) rise on the suction gauge will be noted. Compressor is now fully unloaded and only the top bank is loaded (two cylinders).

5. Reverse the above procedure to check out compressor loading. Suction pressure will drop with this test.

NOTE

If either unloader coil energizes and the suction pressure does not change, the unloader assembly must be checked.

b. Solenoid Coil Replacement

NOTE

The coil may be removed without pumping the unit down.

1. Disconnect leads. Remove retainer. Lift off coil. (See Figure 4-10)

2. Verify coil type, voltage and frequency of old and new coil. This information appears on the coil housing.

3. Place new coil over enclosing tube, retainer and connect wiring.

c. Replacing Solenoid Valve Internal Parts (See Figure 4-10)

1. Pump down the unit. Frontseat both service valves to isolate the compressor.

2. Remove coil retainer, and coil.

3. Remove enclosing tube collar (item 4, Figure 4-10) using installation/removal tool supplied with repair kit (item 3).

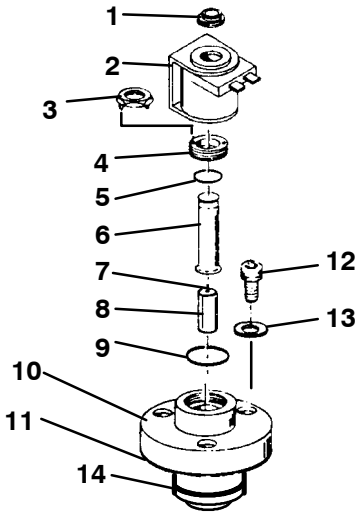
4. Check plunger for restriction due to: (a) Corroded or worn parts; (b) Foreign material lodged in valve; (c) Bent or dented enclosing tube.

5. Install new parts. Do not overtighten enclosing tube assembly. Torque to a value of 100 inch pounds (1.15 mkg).

6. Remove supplied installation/removal tool. Install coil, voltage plate, and retainer.

7. Evacuate and dehydrate the compressor. (Refer to section 4.8.p through 4.8.w.)

8. Start unit and check unloader operation (Refer to section 4.12.a).



1. Retainer
2. Coil Assembly
3. Installation/Removal Tool
4. Enclosing Tube Collar
5. "O" Ring
6. Enclosing Tube
7. Plunger Spring
8. Plunger Assembly
9. Gasket
10. Valve Body
11. Gasket
12. Bolt
13. Gasket, Bolt
14. Piston Ring

Figure 4-10. Unloader Solenoid Valve

4.13 CHECKING AND REPLACING FILTER-DRIER

To Check Filter-Drier

Check for a restricted or plugged filter-drier 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.

To Replace Filter-Drier

a. Pump down the unit per section 4.4. Remove bracket, then replace drier.

b. Check refrigerant level. (Refer to section 4.7.3)

4.14 CHECKING AND REPLACING HIGH PRESSURE CUTOUT SWITCH

4.14.1 Replacing High Pressure Switch

a. Pump down the unit. (Refer to section 4.4.a) Frontseat both suction and discharge service valves to isolate compressor.

b. *Slowly* release compressor pressure through the service valve gauge ports.

c. Disconnect wiring from defective switch. The high pressure switch is located near the top of the compressor. (See Figure 4-6)

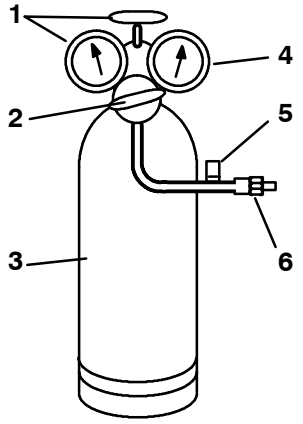
d. Install new cutout switch after verifying switch settings. (Refer to section 4.14.2)

e. Evacuate and dehydrate the compressor. (Refer to section 4.8)

4.14.2 Checking High Pressure Switch

WARNING

Do not use a nitrogen cylinder without a pressure regulator. Cylinder pressure is approximately 165 kg/cm^2 (2350 psi). Do not use oxygen in or near a refrigerant system as an explosion may occur. (See Figure 4-11)



1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge (0 to 400 psig = 0 to 28 kg/cm^2)
5. Bleed-Off Valve
6. 1/4 inch Connection

Figure 4-11. Typical Setup for Testing High Pressure Switch

a. Remove switch as outlined in section 4.14.1.

b. Connect ohmmeter or continuity light across switch terminals. Ohmmeter will indicate resistance and continuity light will be lighted if switch closed after relieving pressure.

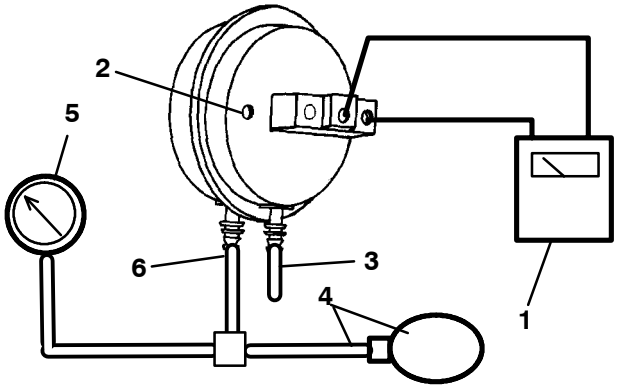
c. Connect switch to a cylinder of dry nitrogen. (See Figure 4-11)

d. Set nitrogen pressure regulator higher than cutout point on switch being tested. Pressure switch cutout and cut-in points are shown in sections 1.3.

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

f. Open cylinder valve. Slowly close bleed-off valve and increase pressure until the switch opens. If light is used, light will go out and if an ohmmeter is used, the meter will indicate open. Open pressure on gauge. Slowly open bleed-off valve (to decrease pressure) until switch closes (light will light or ohmmeter will move).

4.15 CHECKING CALIBRATION OF THE DEFROST AIR SWITCH



1. Ohmmeter or Continuity Device
2. Adjustment Screw (0.050 socket head size)
3. Low Side Connection
4. Pressure Line or Aspirator Bulb (P/N 07-00177-01)
5. Magnehelic Gauge (P/N 07-00177)
6. High Side Connection

Figure 4-12. Defrost Air Switch Test Setup

a. Make sure magnehelic gauge is in proper calibration.

NOTE

The magnehelic gauge may be used in any position, but must be re-zeroed if position of gauge is changed from vertical to horizontal or vice versa. USE ONLY IN POSITION FOR WHICH IT IS CALIBRATED.

b. With air switch in vertical position, connect high pressure side of magnehelic gauge to high side connection of air switch. (See Figure 4-12)

c. Install tee in pressure line to high side connection. Tee should be approximately half-way between gauge and air switch or an improper reading may result.

d. Attach an ohmmeter to the air switch electrical contacts to check switch action.

NOTE

Use a hand aspirator (P/N 07-00177-01), since blowing into tube by mouth may cause an incorrect reading.

e. With the gauge reading at zero, apply air pressure very slowly to the air switch. An ohmmeter will indicate continuity when switch actuates.

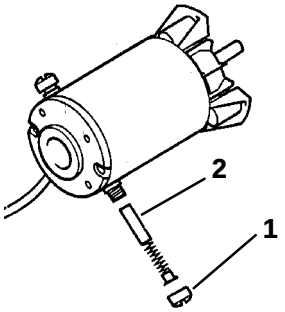
f. Refer to section 1.3 for switch settings. If switch fails to actuate at correct gauge reading, adjust switch by turning adjusting screw clockwise to increase setting or counterclockwise to decrease setting.

g. Repeat checkout procedure until switch actuates at correct gauge reading.

h. After switch is adjusted, place a small amount of paint or glycerol on the adjusting screw so that vibration will not change switch setting.

4.16 CHECKING AND REPLACING EVAPORATOR FAN MOTOR BRUSHES & COMMUTATOR

The fan motor commutator and brushes should be checked periodically for cleanliness and wear to maintain proper operation of the the fan motors.



1. Brush Cap
2. Brush

Figure 4-13. Fan Motor Brushes

To check brushes proceed as follows.

a. With unit off and battery disconnected, remove brush cap (item 1; 2 per motor). See Figure 4-13.

b. Remove brushes (item 2; 2 per motor) and check the length of the brush. If the length is less than 1/4 inch the brushes should be replaced (after checking commutator).

c. Blow out the brush holder with low pressure air to remove any carbon dust in the holder. This dust could prevent a good contact between the brushes and commutator.

d. Remove the back cover of the motor and inspect the commutator. If the commutator is heavily grooved, polish it using fine sandpaper; do not use emery cloth. Wipe out any accumulation of greasy material using a clean rag dampened with solvent. Reassemble the motor; install new brushes and replace cap.

4.17 EVAPORATOR COIL CLEANING

The use of recycled cardboard cartons is increasing across the country. The recycled cardboard cartons create much more fiber dust during transport than "new" cartons. The fiber dust and particles are drawn into the evaporator where they lodge between the evaporator fins. If the coil is not cleaned on a regular basis, sometimes as often as after each trip, the accumulation can be great enough to restrict air flow, cause coil icing, repetitive defrosts and loss of unit capacity. Due to the "washing" action of normal defrost the fiber dust and particles may not be visible on the face of the coil but may accumulate deep within.

It is recommended to clean the evaporator coil on a regular basis, not only to remove cardboard dust, but to remove any grease or oil film which sometimes coats the fins and prevents water from draining into the drain pan.

Cardboard fiber particles after being wetted and dried several times can be very hard to remove. Therefore, several washings may be necessary.

a. Remove rubber check valves (Kazoo) from drain lines.

b. Spray coil with a mild detergent solution such as Oakite 164 or any good commercial grade automatic dish washer detergent such as Electrosol or Cascade and let the solution stand for a few minutes and reverse flush (opposite normal air flow) with clean water at mild pressure. A garden hose with spray nozzle is usually sufficient. Make sure drain lines are clean.

c. Run unit until defrost mode can be initiated to check for proper draining from drain pan.

4.18 CONDENSER COIL CLEANING

Remove all foreign material from the condenser coil by reversing the normal air flow. (Air is pulled in through the front and discharges over the engine.) Compressed air or water may be used as a cleaning agent. It may be necessary to use warm water mixed with any good commercial dishwasher detergent. Rinse coil with fresh water if a detergent is used.

4.19 HOT GAS (Three-Way) VALVE

4.19.1 Replacing Solenoid Coil

It is not necessary to pump the unit down to replace the coil (see Figure 4-14).

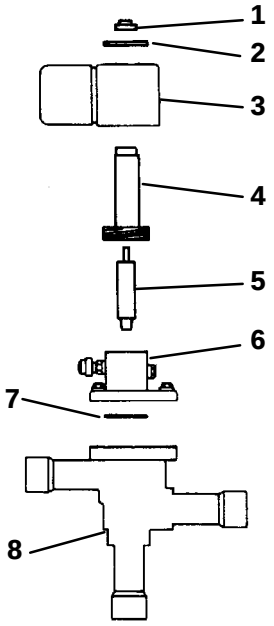
a. Remove coil snap cap, voltage plate and coil assembly. Disconnect leads and remove coil junction box if necessary.

b. Verify coil type, voltage and frequency. This information appears on the coil voltage plate and the coil housing.

c. Place new coil over enclosing tube and then install voltage plate and snap cap.

CAUTION

Do not damage or over tighten the enclosing tube assembly. Also make sure all parts are placed on the enclosing tube in proper sequence to avoid premature coil burnout.



1. Snap Cap
2. Voltage Plate
3. Coil Assembly
4. Enclosing Tube
5. Plunger Assembly
6. Body Head
7. Gasket
8. Valve Body Assembly

Figure 4-14. Hot Gas (Three-Way) Valve

4.19.2 Replacing Solenoid Valve Internal Parts

If the hot gas valve is to be replaced or the internal parts serviced, the refrigerant charge must be removed.

a. Remove and store the refrigerant charge in an evacuated container (refer to section 4.4).

b. Remove coil snap cap, voltage cover and coil assembly. Remove the valve body head.

c. Check for foreign material in valve body.

d. Check for damaged plunger and O-ring. If O-ring is to be replaced, always put refrigerant oil on O-rings before installing.

e. Tighten enclosing tube assembly. If the valve has not been removed from the unit, leak check the valve.

f. Install coil assembly, voltage cover and cap.

g. Evacuate and dehydrate the unit.

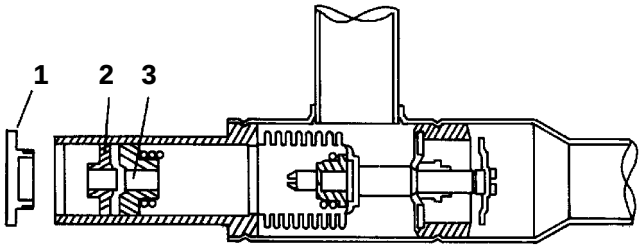
h. Install a complete refrigerant charge.

i. Start unit and check operation.

4.20 ADJUSTING THE COMPRESSOR PRESSURE REGULATING VALVE (CPR)

The CPR valve is factory pre-set and should not need adjustment. If it is necessary to adjust the valve for any reason, proceed with the following outline.

When adjusting the CPR valve, the unit must be running in the high speed heat or defrost. This will ensure a suction pressure above the proper CPR setting.



1. Cap 2. Jam Nut 3. Setting Screw

Figure 4-15. Compressor Pressure Regulating Valve

To adjust the CPR valve, proceed as follows:

a. Install a manifold gauge set.

b. Remove cap (item 1) from CPR valve.

c. With an 8 mm Allen wrench, loosen the jam nut (Figure 4-15, item 2).

d. Using the 8 mm Allen wrench, adjust the setting screw. To raise the suction pressure turn the setting screw (item 3) clockwise; to lower the suction pressure, turn the setting screw counterclockwise. Refer to section 1.4 for CPR valve setting.

e. When the setting has been adjusted, tighten the jam nut securely against the setting screw (item 3). This will prevent any movement of the setting screw due to vibrations in the unit. Replace the cap.

4.21 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.

a. Replacing Expansion Valve

1. Pump down the unit by closing the King valve. (Refer to section 4.4.a)

2. Remove insulation (Presstite) from expansion valve bulb and then remove bulb from suction line.

3. Loosen flare nut and disconnect equalizer line from expansion valve.

4. Remove flange screws and lift off power assembly. Then remove the cage assembly. Check for foreign material in valve body.

5. The thermal bulb is located below the center of the suction line (See Figure 4-17). This area must be clean to ensure positive bulb contact. Strap thermal bulb to suction line and insulate both with Presstite.

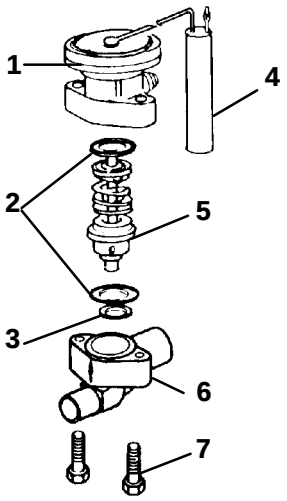
6. Install new gaskets and insert cage assembly and install power assembly.

7. Fasten equalizer tube to expansion valve.

8. Evacuate by placing vacuum pump on suction service valve.

9. Open King valve and then check refrigerant level. (Refer to section 4.7.3)

10. Check superheat. (Refer to section 1.4)



1. Power Assembly
2. Body Flange Gaskets
3. Seat Gasket
4. Bulb
5. Cage Assembly
6. Body Flange
7. Body Flange Screws

Figure 4-16. Thermostatic Expansion Valve

b. Checking Superheat

NOTE

It is not recommended adjusting expansion valves unless absolutely necessary.

Due to the time involved in adjusting the superheat, replace the valve rather than adjusting it.

c. To Measure Superheat

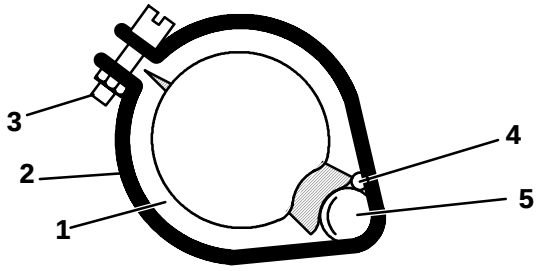
NOTE

The expansion valve and bulb location are shown in Figure 1-2.

1. Remove Presstite from expansion valve bulb and suction line.

2. Loosen one TXV bulb clamp and make sure area under clamp (above TXV bulb) is clean.

3. Place thermocouple above (parallel) TXV bulb and then secure loosened clamp making sure both bulbs are firmly secured to suction line as shown in Figure 4-17.



1. Suction Line (end view)
2. TXV Bulb Clamp
3. Nut and Bolt (clamp)
4. Thermocouple
5. TXV Bulb

Figure 4-17. Thermostatic Expansion Valve Bulb and Thermocouple

NOTE

When conducting this test the suction pressure must be 0.4 kg/cm@ (6 psig) below expansion valve maximum operating pressure (MOP). For example: R-22 units use an expansion valve with a 55 MOP. The recommended test pressure should be below 3.44 kg/cm@(49 psig).

4. Connect an accurate gauge to the 1/4" port on the suction service valve.

5. Run unit until stabilized. Set controller 5.5_C (10_F) below box temperature.

6. From the temperature/pressure chart, determine the saturation temperature corresponding to the evaporator outlet pressure.

7. Note the temperature of the suction gas at the expansion valve bulb.

Subtract the saturation temperature determined in Step 6 from the average temperature measured in Step 7. The difference is the superheat of the suction gas.

4.22 MICROPROCESSOR

NOTE

The erasable, programmable, read only memory (EPROM) chip (component U3 on the microprocessor logic board) has a window on it which is covered with a label listing the revision level of the software. The window is used to erase the chip's memory with the use of ultraviolet light. the label prevents light from entering the chip and erasing the memory. Under NO circumstances should this label be removed.

CAUTION

Under no circumstances should a technician electrically probe the processor at any point, other than the connector terminals where the harness attaches. Microprocessor components operate at different voltage levels and at extremely low current levels. Improper use of voltmeters, jumper wires, continuity testers, etc. could permanently damage the processor.

As mentioned above, some microprocessor inputs operate at voltage levels other than the conventional 12 vdc. Connector points and the associated approximate voltage levels are listed below for reference only. Under no circumstances should 12 vdc be applied at these connection points.

Grounded wrist cuffs are available at most radio, computer and electronic supply stores. It is recommended that these be worn whenever handling a microprocessor.

Table 4-3. Connection Point Voltage

Connection Point	Approximate Voltage
CDT, RAS, SAS, WTS	2.5 vdc (Variable)
MPF1	5.0 vdc

CAUTION

Most electronic components are susceptible to damage caused by electrical static discharge (ESD). In certain cases, the human body can have enough static electricity to cause resultant damage to the components by touch. This is especially true of the integrated circuits found on the truck/trailer microprocessor.

Although there is less danger of electrical static discharge ESD damage in the outdoor environment, where the processor is likely to be handled, proper board handling techniques should always be stressed. Boards should always be handled by their edges, in much the same way one would handle a photograph. This not only precludes the possibility of ESD damage, but also lowers the possibility of physical damage to the electronic components. Although the microprocessor boards are fairly rugged when assembled, they are more fragile when separated and should always be handled carefully.

During emergency situations, the test board may be used to keep a unit running and prevent a critical load from spoiling. Since the microprocessor is totally disconnected from the unit, it cannot monitor the

engine's safety switches for oil pressure and coolant temperature. *Since the engine is running unprotected when the test board is used,* it is imperative that should a problem develop with the microprocessor, it be replaced immediately. *The test board is intended to be a trouble-shooting tool only.*

When using the test board to troubleshoot, the unit should be started in low speed, unloaded cool in the same way as the processor would start the unit. *Good judgment should also be used when cycling any unit with the test board. Rapid cycling should be avoided.*

When welding is required on the unit frame, or on the front area of the trailer, ALL wiring to the microprocessor MUST be disconnected. When welding is performed on other areas of the trailer, the welder ground connection MUST be in close proximity to the area being welded. It is also a good practice to remove both battery cables before welding on either the unit frame or the truck to prevent possible damage to other components such as the alternator and voltage regulator.

a. Hour Meter

The hour meter can be set to any value via the serial port, if the meter has less then 5 hours on it. This allows a replacement microprocessor to be set to the same hours as the microprocessor it is replacing.

The microprocessor has 2 programmable registers which are set via the serial port. These registers are compared to one of the hour meters (diesel, standby, or switch on). If the hour meter is greater than the register then the proper alarm is set.

4.23 CONFIGURATION of MICROPROCESSOR

When replacing a microprocessor it is important to check that the configurations are compatible for the unit into which it will be installed. (This same board fits both trailer and truck model units.) All configuration fields should be viewed before starting the unit.

To reach the configuration fields:

1. Turn the Run/Stop switch to the Stop position.

2 With the unit off, locate the serial port plug located below the control panel. Remove the protective plug to gain access to the wire terminals. Place an insulated jumper wire between wires SPA and SPB at the serial port plug.

CAUTION

Do not allow jumper wire to touch any ground.

3. Turn the Run/Stop switch to the Run position. The FAULT light will come on, and the micro display will read "CNF1 TV" or "CNF1 DI". Remove the jumper wire from the serial port and reinstall the protective plug. The configuration screen will now remain available for 5 minute. Scroll through the configuration list using the FUNCTION key and compare the settings with those shown on the table in the next column. If any of the configurations need to be changed continue with step (4) below.

4. To change the configuration selection:

a. Bring the configuration to be changed onto the display. Press the ENTER key to allow change access to the displayed configuration.

b. Press either the UP or DOWN keys to display available selections for that configuration. Leave the correct selection on the screen. The selection display will flash warning the operator that the displayed value has not been entered. Press the ENTER key to enter the new selection into memory. (The display will revert to the original selection if no further action is taken for the next 5 seconds.)

c. Continue to scroll through the configuration list by pressing the FUNCTION key. Change any other configurations as required.

d. When finished turn the Run/Stop switch to the Stop position, then back to the Run position to start the unit.

SETTINGS	CONFIGURATION		DESCRIPTION
TV	CNF1	DI	Long glow cycle
		TV	Short glow cycle
	CNF2	OFF	844 ONLY
		ON	622/644/722/744 Only
OFF*	CNF3 Note 2	OFF	Max Set Point +86°F (30°c) (All functions locked)
		ON	Max Set Point +90°F (32.2C°)Modified function lock)
Single Temp OFF Multitemp = ON	CNF4	OFF	Heat Lockout On At 10°F (-12.2°C)
		ON	Heat Lockout Off
ON	CNF5	OFF	(R-502)
		ON	(R-22/R-404A)
ON	CNF6	OFF	***Do Not Turn Off!***
		ON	All Supra Units
OFF	CNF7	OFF	All Supra Units
		ON	***Do Not Turn On!***
ON	CNF8	OFF	922/944 Only
		ON	All Other Supra Units
OFF*	CNF9 Note 1	OFF	Out-of-range alarm only
		ON	Out-of-range alarm and unit shut down
OFF	CNF10	OFF	Standby Diesel Backup is disabled. And All Units Prior to Rev. 3.23
		ON	Enables Standby Diesel Backup. Rev. 3.23 and higher
OFF*	CNF11 Note 2	OFF	Functions change normally
		ON	Functions & Start Stop locked
OFF	CNF12	OFF	Supra Units 422/522/622/722/822/922
		ON	Supra Units 644/744/844/944
OFF	CNF13	OFF	All Supra Units
		ON	***Do Not Turn On!***
OFF	CNF14	OFF	All Supra Units
		ON	***Do Not Turn On!***
OFF	CNF15	OFF	All Supra Units
		ON	***Do Not Turn On!***
OFF*	CNF16	OFF	Alt Aux alarm only
		ON	Alt Aux alarm shuts unit down
OFF	CNF17	OFF	All Supra Units
		ON	***Do Not Turn On!***
ON*	CNF18	OFF	SYSTEM CK alarm Off
		ON	SYSTEM CK alarm On
OFF	CNF19	OFF	All Supra Units
		ON	***Do Not Turn On!***
OFF*	CNF20 Note 3	OFF	Display Units Unlocked
		ON	Display Units Locked (Not applicable with Revisions lower Than 3.23)
OFF	CNF21	OFF	All Supra Units
		ON	***Do Not Turn On!***
OFF	CNF22	OFF	For future use. Do not turn on.
OFF	CNF23	OFF	For future use. Do not turn on.
OFF	CNF24	OFF	For future use. Do not turn on.
OFF	CNF25	OFF	For future use. Do not turn on.
OFF	CNF26	OFF	For future use. Do not turn on.
OFF	CNF27	OFF	For future use. Do not turn on.
OFF	CNF28	OFF	For future use. Do not turn on.
OFF	CNF29	OFF	For future use. Do not turn on.
OFF	CNF30	OFF	For future use. Do not turn on.
OFF	CNF31	OFF	For future use. Do not turn on.
OFF	CNF32	OFF	For future use. Do not turn on.

NOTES

* These settings are optional and can be set to customer specifications, or left at default values. All other settings (not marked with *) **MUST** be set as shown for proper unit operation.

1. **CNF9** allows selection of how the unit will react under an Out-Of-Range condition. An Out-Of-Range condition is described as the box temperature having arrived at setpoint, then drifting away from setpoint. With this CNF in the OFF position, once the box temperature has been Out-Of-Range for 15 minutes, the ALARM light will be turned on and the alarm display "OUT RANGE" will be displayed alternately with the default display of the setpoint and box temperature. With this CNF in the ON position, once the box temperature has been Out-Of-Range for 45 minutes, the unit will shut down, and the same alarms as described above will be displayed.
2. **CNF3 & CNF11**
   Standard Function Lock allows the Function Key and the Start/Stop-Continuous Run Key to be locked so that no changes can be made.

   Modified Function Lock is the same as Standard Function Lock except that with the setpoint at or between +32°F and +42°F, the unit will always operate in Continuous Run. If the setpoint is outside this range, either Start/Stop or Continuous Run can be selected. The maximum setpoint and function lock are controlled via a combination of CNF3 and CNF11:

CNF11 OFF / CNF3 OFF:	Maximum set point 86°F. No function lock
CNF11 ON / CNF3 OFF:	Maximum set point 86°F. Standard function lock
CNF11 OFF / CNF3 ON:	Maximum set point 90°F. No function lock
CNF11 ON / CNF3 ON:	Maximum set point 90°F Modified function lock

3. **CNF20** allows the Fahrenheit / Celsius function to be locked. In order to change the units setting, CNF20 must be OFF. The units setting can then be changed in the functional parameters list. If CNF20 is ON, the units setting cannot be changed from the functional parameters list.

Table 4-4. Microprocessor Configuration

4.24 CONTROLLER SENSOR CHECKOUT

An accurate ohmmeter must be used to check resistance values shown in Table 4-5 or Table 4-6.

Due to 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 bad, the resistance reading will usually be much higher or lower than the resistance values given in Table 4-5 or Table 4-6.

At least one lead from the sensor (RAS, terminals D1 and E1 or SAS, terminals D2 and E2) must be disconnected from the unit electrical system before any reading is taken. Not doing so will result in a false reading. Two preferred methods of determining the actual test temperature at the sensor, is an ice bath at 0_C (32_F) or a calibrated temperature tester.

Table 4-5. Sensor Resistance -- Micro Units (ATS,CDT, RAS, SAS & WTS)

Temperature		RAS, SAS & WTS Resistance In Ohms	CDT Resistance In Ohms
_F	_C		
−20	−28.9	165,300	1,653,000
−10	−23.3	117,800	1,178,000
0	−17.8	85,500	855,000
10	−12.2	62,400	624,000
20	− 6.7	46,300	463,000
30	− 1.1	34,500	345,000
32	0	32,700	327,000
40	4.4	26,200	262,000
50	10.0	19,900	199,000
60	15.6	15,300	153,000
70	21.1	11,900	119,000
77	25	10,000	100,000
80	26.7	9,300	93,000
90	32.2	7,300	73,000
100	37.8	5,800	58,000
110	43.3	4,700	47,000
120	48.9	3,800	38,000
194	90	915	9,150
212	100	680	6,800
266	130	301	3,010
302	150	186	1,860
325	163	–	1,358
350	177	–	1,202

Table 4-6. Sensor Resistance -- Solid State Units (RAS & SAS)

Temperature		RAS & SAS Resistance In Ohms
_F	_C	
−67	−55	495
−58	−50	514
−40	−40	568
−22	−30	625
−4	−20	686
14	−10	750
32	0	817
50	10	887
68	20	961
77	25	1000
86	30	1039
104	40	1120

4.25 SUCTION PRESSURE TRANSDUCER

Before installing a new suction pressure transducer it must be calibrated.

The calibration will not be performed if the run relay is energized. This prevents the operator from calibrating the unit with the sensor in the system. The reading of the sensor must be at atmospheric pressure (0 psig or 14.7 psi). If the sensor reading is greater than 20 psig (34.7 psi) or less than −6.7 psig (8 psi) it can not be calibrated. Once the micro is calibrated, the display will readout the actual value.

a. Turn power off and remove starter solenoid wire, then let unit fail to start. This will de-energize run relay.

b. Connect wiring to new suction pressure transducer. Before installing suction pressure transducer into unit, display the suction pressure via the unit status display. While the suction pressure is being displayed press *Enter Key* for 3 seconds, the display should read “0”. If display reads “0” install suction pressure transducer into unit.

4.26 SERVICING DEFROST DAMPER SOLENOID (DDS) -- OPTIONAL

a. Replacing Solenoid

1. Disconnect wiring to solenoid. Remove clip from linkage rod. Remove mounting hardware from defective solenoid and replace.

2. Attach linkage to new solenoid and install the clip to the linkage rod.

3. Energize the damper solenoid to close shutter blade.

4. If the damper does not close tightly (eyebolt adjustment not adequate), tighten eyebolt against the blade. Slide the solenoid boot so you can see the snap ring. Loosen the four bolts mounting the solenoid. Move the solenoid until the blade is just touching one of the rubber bumpers and the plunger is just touching the snap ring.

5. Tighten solenoid mounting bolts, replace solenoid boot and energize solenoid.

b. Replacing Bearings, Bushings or Damper Blade

1. Remove damper return spring from damper.

2. Remove clip from eyebolt end of linkage rod.

3. Remove mounting hardware from bearing flange assembly. Remove blade and bearings. Replace parts as necessary.

Table 4-7. R-404A Temperature--Pressure Chart

Temperature		Pressure				Temperature		Pressure		
_F	_C	Psig	Kg/cm@	Bar		_F	_C	Psig	Kg/cm@	Bar
−40	−40	4.5	0.32	0.31		32	0	72.5	5.10	5.00
−35	−37	7.1	0.50	0.49		34	1	75.6	5.32	5.21
−30	−34	9.9	0.70	0.68		36	2	78.8	5.54	5.43
−25	−32	12.9	0.91	0.89		38	3	82.1	5.77	5.66
−20	−29	16.3	1.15	1.12		40	4	85.5	6.01	5.90
−18	−28	17.7	1.24	1.22		42	6	89.0	6.26	6.14
−16	−27	19.2	1.35	1.32		44	7	92.5	6.50	6.38
−14	−26	20.7	1.46	1.43		46	8	96.2	6.76	6.63
−12	−24	22.3	1.57	1.54		48	9	99.9	7.02	6.89
−10	−23	23.9	1.68	1.65		50	10	103.7	7.29	7.15
−8	−22	25.6	1.80	1.77		55	13	115.4	8.11	7.96
−6	−21	27.3	1.92	1.88		60	16	126.1	8.87	8.69
−4	−20	29.1	2.05	2.01		65	18	137.4	9.66	9.47
−2	−19	30.9	2.17	2.13		70	21	149.4	10.50	10.30
0	−18	32.8	2.31	2.26		75	24	162.1	11.40	11.18
2	−17	34.8	2.45	2.40		80	27	175.5	12.34	12.10
4	−16	36.8	2.59	2.54		85	29	189.6	13.33	13.07
6	−14	38.9	2.73	2.68		90	32	204.5	14.38	14.10
8	−13	41.1	2.89	2.83		95	35	220.2	15.48	15.18
10	−12	43.3	3.04	2.99		100	38	236.8	16.65	16.33
12	−11	45.6	3.21	3.14		105	41	254.2	17.87	17.53
14	−10	48.0	3.37	3.31		110	43	272.4	19.15	18.78
16	−9	50.4	3.54	3.47		115	46	291.6	20.50	20.11
18	−8	52.9	3.72	3.65		120	49	311.8	21.92	21.50
20	−7	55.5	3.90	3.83		125	52	332.9	23.41	22.95
22	−6	58.1	4.08	4.01		130	54	355.0	24.96	24.48
24	−4	60.9	4.28	4.20		135	57	378.1	26.58	26.07
26	−3	63.7	4.48	4.39		140	60	402.3	28.28	27.74
28	−2	66.5	4.68	4.59		145	63	427.6	30.06	29.48
30	−1	69.5	4.89	4.79		150	66	454.0	31.92	31.30

Table 4-8. R-22 Pressure -- Temperature Chart

TEMPERATURE		PRESSURE			TEMPERATURE		PRESSURE		
_F	_C	Psig	Kg/cm@	Bar	_F	_C	Psig	Kg/cm@	Bar
−40	−40	.6	.04	.04	34	1	60.5	4.25	4.17
−36	−38	2.3	.16	.16	36	2	63.3	4.45	4.36
−32	−36	4.1	.29	.28	38	3	66.1	4.65	4.56
−28	−33	6.0	.42	.41	40	4	69	4.85	4.76
−26	−32	7.0	.49	.48	44	7	75.0	5.27	5.17
−24	−31	8.1	.57	.56	48	9	81.4	5.72	5.61
−22	−30	9.2	.65	.63	52	11	88.1	6.19	6.07
−20	−29	10.3	.72	.71	54	12	91.5	6.43	6.31
−18	−28	11.5	.81	.79	60	16	102.5	7.21	7.07
−16	−27	12.7	.89	.88	64	18	110.2	7.75	7.6
−14	−26	14.0	.98	.97	68	20	118.3	8.32	8.16
−12	−24	15.2	1.07	1.05	72	22	126.8	8.91	8.74
−10	−23	16.6	1.17	1.14	76	24	135.7	9.54	9.36
− 8	−22	18.0	1.27	1.24	80	27	145	10.19	10.0
− 6	−21	19.4	1.36	1.34	84	29	154.7	10.88	10.67
− 4	−20	21.0	1.48	1.45	88	31	164.9	11.59	11.37
− 2	−19	22.5	1.58	1.55	92	33	175.4	12.33	12.09
0	−18	24.1	1.69	1.66	96	36	186.5	13.11	12.86
2	−17	25.7	1.81	1.77	100	38	197.9	13.91	13.64
4	−16	27.4	1.93	1.89	104	40	209.9	14.76	14.47
6	−14	29.2	2.05	2.01	108	42	222.3	15.63	15.33
8	−13	31.0	2.18	2.14	112	44	235.2	16.54	16.22
10	−12	32.9	2.31	2.27	116	47	248.7	17.49	17.15
12	−11	34.9	2.45	2.41	120	49	262.6	18.46	18.11
14	−10	36.9	2.59	2.54	124	51	277.0	19.48	19.10
16	− 9	39.0	2.74	2.69	128	53	291.8	20.52	20.12
18	− 8	41.1	2.89	2.83	132	56	307.1	21.59	21.17
20	− 7	43.3	3.04	2.99	136	58	323.6	22.75	22.31
22	− 6	45.5	3.2	3.14	140	60	341.3	24.0	23.53
24	− 4	47.9	3.37	3.3	144	62	359.4	25.27	24.78
26	− 3	50.2	3.53	3.46	148	64	377.9	26.57	26.06
28	− 2	52.7	3.71	3.63	152	67	396.6	27.88	27.34
30	− 1	55.2	3.88	3.81	156	69	415.6	29.22	28.65
32	0	57.8	4.06	3.99	160	71	434.6	30.56	29.96

SECTION 5

TROUBLESHOOTING

CAUTION

Under no circumstances should anyone attempt to service the microprocessor!(see section 4.22) Should a problem develop with the microprocessor, contact your nearest Carrier Transicold dealer for replacement.

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.1 DIESEL ENGINE **5.1.1 Engine Will Not Start**		
Starter motor will not crank or low cranking speed	Battery insufficiently charged Battery terminal post dirty or defective Bad electrical connections at starter Starter motor malfunctions Starter motor solenoid defective Open starting circuit Incorrect grade of lubricating oil	Check Check Check 5.1.3 Engine Manual 5.1.4 1.2
Starter motor cranks but engine fails to start	No fuel in tank Air in fuel system Water in fuel system Plugged fuel filters Plugged fuel lines to injector (s) Fuel control operation erratic Glow plug(s) defective Run solenoid defective Fuel pump (FP) malfunction	Check Check Drain Sump Replace Check Engine 4.2.6 4.2.3 4.2.5
Starter cranks, engages, but dies after a few seconds	Engine lube oil too heavy Voltage drop in starter cable(s)	1.2 Check
5.1.2 Engine Starts Then Stops		
Engine stops after several rotations	Fuel supply restricted No fuel in tank Leak in fuel system Faulty fuel control operation Fuel filter restricted Injector nozzle(s) defective Injection pump defective Air cleaner or hose restricted Safety device open Open wiring circuit to run solenoid Fuel pump (FP) malfunction	Check Check Check Engine Replace Engine Manual Engine Manual 4.2.4 1.7 Check 4.2.5
5.1.3 Starter Motor Malfunction		
Starter motor will not crank or turns slowly	Battery insufficiently charged Battery cable connections loose or oxidized Battery cables defective Starter brushes shorted out Starter brushes hang up or have no contact Starter solenoid damaged Run-Stop or Start-Run-Stop switch defective Engine lube oil too heavy	Check Check Replace Engine Manual Engine Manual Engine Manual Replace 1.2

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.1.3 Starter Motor Malfunction (CONTINUED)		
Starter motor turns but pinion does not engage	Pinion or ring gear obstructed or worn	Clean both, remove burrs, or replace; apply grease
Starter motor does not disengage after switch was depressed	Run-Stop or Start-Run-Stop switch defective Starter motor solenoid defective	Replace Engine Manual
Pinion does not disengage after engine is running	Defective starter	Engine Manual
5.1.4 Malfunction In the Engine Starting Circuit		
No power to starter motor solenoid (SS)	Battery defective Loose electrical connections	Check Tighten
Run solenoid does not energize or does not remain energized	Battery defective Loose electrical connections Oil pressure safety switch (OP) defective Run relay (RR) defective Water temperature safety switch open Water temperature sensor (WTS) defective Run solenoid defective Run-Stop or Start-Run-Stop switch defective	Check Tighten Replace Replace 1.2 Replace 4.2.3 Replace
5.2 ALTERNATOR (AUTOMOTIVE TYPE)		
Alternator fails to charge	Limited charging system operating time Battery condition Alternator belt loose/broken Loose, dirty, corroded terminals, or broken leads Excessively worn, open or defective brushes Open blocking diode Regulator faulty Open isolation diode Open rotor (field coil)	Check Check 4.3 Check/Repair Check Check Check Check Replace
Low or unsteady charging rate	Alternator belt loose Loose, dirty, corroded terminals, or broken leads Excessively worn, sticky or intermittent brushes Faulty regulator Grounded or shorted turns in rotor Open, grounded or shorted turns in stator	4.3 Check/Repair Check Check Check Replace
Excessive charging rate (as evidenced by battery requiring too frequent refilling) or charge indicator shows constant “charge with engine idling”	Regulator leads loose, dirty, corroded terminals, or wires broken Defective regulator	Clean/Repair Check
Noisy alternator	Defective or badly worn V-belt Worn bearing(s) Misaligned belt or pulley Loose pulley	4.3 Replace 4.3 Tighten

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3 REFRIGERATION **5.3.1 Unit Will Not Cool**		
Diesel engine	Malfunction(s)	5.1
Compressor malfunction	Compressor drive defective Compressor defective	4.8 4.8
Refrigeration system	Defrost cycle did not terminate Abnormal pressure Hot Gas (three-way) valve malfunction	5.3.5 5.3.6 5.3.11
5.3.2 Unit Runs But Has Insufficient Cooling		
Compressor	Compressor valves defective Unloader malfunction	4.8 4.12
Refrigeration system	Abnormal pressure Expansion valve malfunction No or restricted evaporator airflow Unloader malfunction	5.3.6 5.3.10 5.3.9 4.12
Engine does not develop full rpm	Speed control linkage Engine malfunction	4.2.3 5.1
5.3.3 Unit Operates Long or Continuously in Cooling		
Container	Hot Load Defective box insulation or air leak	Allow time to pull down Correct
Refrigeration system	Abnormal pressure Temperature controller malfunction	5.3.6 5.3.8
Compressor	Defective	4.8
5.3.4 Unit Will Not Heat or Has Insufficient Heating		
Refrigeration	Abnormal pressure Temperature controller malfunction Hot Gas (three-way) valve malfunction	5.3.6 5.3.8 5.3.11
Compressor	Compressor drive defective Compressor defective	4.8 4.8
Engine does not develop full rpm	Speed control linkage Engine malfunction	4.2.3 5.1

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.5 Defrost Cycle Malfunction		
Will not initiate defrost automatically	Defrost air switch (DA) out of calibration Defrost thermostats (DTT) open or defective Defrost air switch (DA) defective Loose terminal connections Air sensing tubes defective or disconnected Defrost timer defective Defrost Damper relay (DPR) defective	4.15 Replace 4.15 Tighten Check 1.10.2/Replace Replace
Will not initiate defrost manually	Microprocessor defective Loose terminal connections Defrost thermostats (DTT) open or defective Glow/Defrost switch defective Defrost Damper relay (DPR) defective	Replace Tighten Replace Replace Replace
Initiates but does not defrost	Hot Gas (three-way) valve malfunction Defrost relay (DR) defective Evaporator Clutch defective Defrost damper solenoid (DDS) or linkage defective Damper open or defective	5.3.11 Replace Replace 4.26 4.26
Frequent defrost	Defrost air switch (DA) out of adjustment Wet load	4.15 Normal
Damper blade does not close	Defrost damper solenoid (DDS) defective Damper defective	4.26 4.26
Does not terminate or cycles on defrost	Defrost thermostats (DTT) shorted closed Defrost timer defective Glow/Defrost switch defective Defrost air switch (DA) out of adjustment	Replace 1.10.2/Replace Replace 4.15
5.3.6 Abnormal Pressure **5.3.6.1 Cooling**		
High discharge pressure	Quench valve malfunction Condenser coil dirty Condenser fan defective V-belt broken or loose Discharge check valve restricted Noncondensibles or refrigerant overcharge	Replace 4.18 Check 4.3 Replace Replace
Low discharge pressure	Compressor valves(s) worn or broken Hot Gas (three-way) valve malfunction	4.8 4.19
High suction pressure	Compressor valves(s) worn or broken Compressor gasket(s) defective Hot Gas (three-way) valve malfunction	4.8 4.8 4.19
Low suction pressure	Suction service valve partially closed King valve partially closed Filter-drier partially plugged Low refrigerant charge Expansion valve malfunction No evaporator air flow or restricted air flow Excessive frost on coil	Open Open 4.13 4.7 5.3.10 5.3.9 Check
Suction and discharge pressures tend to equalize when unit is operating	Compressor valves defective Hot Gas (three-way) valve malfunction	4.8 4.19

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.6.2 Heating		
High discharge pressure	Overcharged system Condenser fan defective V-belts broken or loose Noncondensibles in system	4.7.3 Check 4.3 Check
Low discharge pressure	Compressor valve(s) worn or broken Hot Gas (three-way) valve malfunction Low refrigerant charge	4.8 4.19 4.7
Low suction pressure	Refrigerant shortage Compressor pressure regulating valve malfunction Suction service valve partially closed	4.7 4.20 Open
5.3.7 Abnormal Noise		
Compressor	Loose mounting bolts Worn bearings Worn or broken valves Liquid slugging Insufficient oil	Tighten 4.8 4.8 5.3.10 4.9
Condenser or evaporator fan	Loose or striking shroud Bearings defective Bent shaft	Check Check Check
V-belts	Cracked or worn	4.3
5.3.8 Control System Malfunction		
Will not control	Sensor defective Relay(s) defective Microprocessor controller malfunction Solid State controller malfunction	4.24 Check 4.22 Replace
5.3.9 No Evaporator Air Flow or Restricted Air Flow		
Evaporator coil blocked	Frost on coil Dirty coil Fan motor(s) malfunction	Check 4.17 4.16
No or partial evaporator air flow	V-belt broken or loose Clutch defective Evaporator fan loose or defective Evaporator fan rotating backwards Evaporator air flow blocked in trailer (box) Fan motor(s) malfunction	4.3 Replace Check 4.3 Check 4.16

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.10 Expansion Valve Malfunction		
Low suction pressure with high superheat	Low refrigerant charge External equalizer line plugged Ice formation at valve seat Wax, oil or dirt plugging valve or orifice Broken capillary Power assembly failure or partial Loss of element/bulb charge Superheat setting too high	4.5/4.7 Clean 4.6 4.21 4.21 Replace Replace 4.21
Low superheat and liquid slugging in compressor	Superheat setting too low External equalizer line plugged Ice holding valve open Foreign material in valve Pin and seat of expansion valve eroded or held open by foreign material	4.21 Open 4.6 Clean 4.21
Fluctuating suction pressure	Improper bulb location or installation Low superheat setting	4.21 4.21
High superheat	Broken capillary	4.21
5.3.11 Hot Gas (Three-Way) Valve Malfunction		
Valve does not function properly	No power to valve Improper wiring or loose connections Coil defective Valve improperly assembled Coil or coil sleeve improperly assembled Temperature controller malfunction Movement of plunger restricted due to: a. Corroded or worn parts b. Foreign material lodged in valve c. Bent or dented enclosing tube	Check Check 4.19 4.19 4.19 Replace 4.19
Valve shifts but refrigerant continues to flow	Foreign material lodged under seat Defective seat	4.19 4.19
5.4 Standby Motor Malfunction		
Standby motor fails to start	Motor contactor (MC) defective Motor Overload (OL) open Improper power supply Oil pressure switch (OPS) open Selector switch (SSW) defective	Replace Replace motor 1.5 Check Replace
Standby motor starts, then stops	Motor Overload (OL) open High amperage draw	1.5 Check

SECTION 6
ELECTRICAL SCHEMATIC WIRING DIAGRAM

6.1 INTRODUCTION

This section contains Electrical Schematic Wiring Diagram 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

Beware of unannounced starting of the fans and V-belts caused by the thermostat and the start/stop cycling of the unit.

WARNING

Under no circumstances should ether or any other starting aids be used to start engine.

CAUTION

Under no circumstances should anyone attempt to repair the Logic or Display Boards! (see section 4.22) Should a problem develop with these components, contact your nearest Carrier Transicold dealer for replacement.

CAUTION

Observe proper polarity when installing battery, negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator. As a precautionary measure, disconnect positive battery terminal when charging battery in unit. Connecting charger in reverse will destroy the rectifier diodes in alternator.

CAUTION

Under no circumstances should a technician electrically probe the processor at any point, other than the connector terminals where the harness attaches. Microprocessor components operate at different voltage levels and at extremely low current levels. Improper use of voltmeters, jumper wires, continuity testers, etc. could permanently damage the processor.

CAUTION

Most electronic components are susceptible to damage caused by electrical static discharge (ESD). In certain cases, the human body can have enough static electricity to cause resultant damage to the components by touch. This is especially true of the integrated circuits found on the truck/trailer microprocessor.

LOCATION	SYMBOL	DESCRIPTION	LOCATION
P-2,R-11,12	ALT	ALTERNATOR	MID FRAME
O-5	ARL	AUTOSTART LIGHT (LIGHT BAR)	LIGHT BAR
H-7/L-5	ARR	AUTO RESTART RELAY	CONTROL BOX
B-7	ATS	AMBIENT TEMPERATURE SENSOR	CONDENSER
K-9	B	BUZZER	CONTROL BOX
N-1	BTY	BATTERY	
B-8	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR	COMPRESSOR
S-5	CL	COOL LIGHT (LIGHT BAR)	LIGHT BAR
H-4	DA	DEFROST AIR SWITCH	FRAME
H-8/Q-3	DER	DIESEL ELECTRIC RELAY	CONTROL BOX
S-6	DL	DEFROST LIGHT (LIGHT BAR)	LIGHT BAR
S-7	DDS	DEFROST DAMPER SOLENOID	EVAPORATOR
H-9/Q-7	DPR	DAMPER RELAY (OPTION 922)	CONTROL BOX
A-2	DPS	DETECTOR POWER SUPPLY	CONTROL BOX
H-9/Q-6,7	DR	DEFROST RELAY	CONTROL BOX
H-4	DTT	DEFROST THERMOSTAT	EVAPORATOR
S-7,M-7	EFM 1,2,3	ELECTRIC FAN MOTOR	EVAPORATOR
S-7/M-7	EFMR 1,2,3	ELECTRIC FAN MOTOR RELAY	CONTROL BOX
R-4	EHC	EVAPORATOR HEAT CONTACTOR	
H-7/Q-4	EHR	EVAPORATOR HEAT RELAY	CONTROL BOX
K-2	F1	FUSE (MAXI FUSE 80A)	CONTROL BOX
K-3/K-8	F3,F10	FUSE 25A	CONTROL BOX
K-4	F4	FUSE 15A	CONTROL BOX
K-5	F5	FUSE 7.5A	CONTROL BOX
D-1/K-8	F2,F6	FUSE 5A	CONTROL BOX
K-7	F7,F8,F9	FUSE 20A	CONTROL BOX
0-8	FL	FAULT LIGHT (LIGHT BAR & DOOR)	LIGHT BAR
0-8,9	FH	FUEL HEATER (OPTION)	ENGINE
R-2/L-8	FHR	FUEL HEATER RELAY (OPTION)	CONTROL BOX
0-9,T-2	FHTH	FUEL HEATER THERMOSTAT (OPTION)	ENGINE
H-9/H-8	FR	FAULT RELAY	CONTROL BOX
S-3	FP	FUEL PUMP	FUEL TANK
0-4	GP	GLOW PLUG	ENGINE
H-6/L-4	GPR	GLOW PLUG RELAY	CONTROL BOX
S-5	HGS	HOT GAS SOLENOID	FRAME
S-6	HL	HEAT LIGHT (LIGHT BAR)	LIGHT BAR
S-6/Q-4,5	HLR	HEAT LIGHT RELAY	CONTROL BOX
H-5	HP1	HIGH PRESSURE CUT-OUT SWITCH	COMPRESSOR
H-8/Q-5	HR1	HEAT RELAY	CONTROL BOX
L-1	IP1	INSULATING PLUG 1	CONTROL BOX
R-3	IP2	INSULATING PLUG 2	FRAME
J-10	MGC	MANUAL GLOW/CRANK	CONTROL BOX
D-11/D-2	MP	MICROPROCESSOR BOARD	CONTROL BOX
N-12	MC	MOTOR CONTACTOR	CONTROL BOX
N-13	OL	OVERLOAD PROTECTOR	CONTROL BOX
G-2	OP	OIL PRESSURE SAFETY SWITCH (NO)	ENGINE
H-6/H-7	OR	OUT OF RANGE RELAY	CONTROL BOX
N-6	ORL	OUT OF RANGE LIGHT (LIGHT BAR)	LIGHT BAR
B-3	P1	CAB COMMAND PLUG CONNECTOR	CONTROL BOX
D-3	P2	MICROPROCESSOR-CAB COMMAND PLUG CONNECTOR	CONTROL BOX
S-4	PL	POWER LIGHT	LIGHT BAR
L-10,12	PSR	POWER SUPPLY RECEPTACLE	
B-6	RAS	RETURN AIR SENSOR	EVAPORATOR
C-2/D-1	RCR	RUN CONTROL RELAY	CONTROL BOX
H-5/L-3	RR	RUN RELAY	CONTROL BOX
S-3	RS	RUN SOLENOID	ENGINE
C1	RSS	RUN STOP SWITCH	CONTROL BOX
B-7	SAS	SUPPLY AIR SENSOR (OPTIONAL)	EVAPORATOR
P-10,12	SBM	STANDBY MOTOR	FRAME
0-4	SCS	SPEED CONTROL SOLENOID	ENGINE
Q-2	SM	STARTER MOTOR	ENGINE
F-2	SP	SERIAL PORT	CONTROL BOX
B-5	SPT	SUCTION PRESSURE TRANSDUCER	COMPRESSOR
H-8/L-4	SR	SPEED RELAY	CONTROL BOX
0-3	SS	STARTER SOLENOID	STARTER
P-2	SSC	STARTER SOLENOID CONTACTOR	STARTER
H-6/L-3	SSR	STARTER SOLENOID RELAY	CONTROL BOX
B-5	UFR	UNLOADER FRONT RELAY	CONTROL BOX
B-5	UF	UNLOADER FRONT	COMPRESSOR
B-5	WTS	WATER TEMPERATURE SENSOR	ENGINE

NOTES :

1. UNIT SHOWN "OFF" POSITION.
2. WIRE IDENTIFICATION SYSTEM:
   COLOR: WHITE - DC CONTROL CIRCUITS
   BLACK - DC GROUNDS
   RED - AC CIRCUITS
   GREEN - AC GROUNDS
3. ADDRESS SYSTEM: EXAMPLE: HCD2-MPW2
   INDICATES A WIRE BETWEEN PLUG HC-PIN D2
   AND MICROPROCESSOR MP AND PIN W2
4. * VOLTAGE BELOW 12 VOLTS.
5. ENGINE CT2-29 2 GLOW PLUG
   ENGINE CT3-44 3 GLOW PLUG
6. NO CONNECTION OF STANDBY PANEL (OL,MC)
   AND DPS
7. SUPRA 422: 2 ELECTRIC FANS ONLY
8. ATS,UFR,UF AND THE 3 WIRE FOR RS
   ONLY FOR SUPRA 922

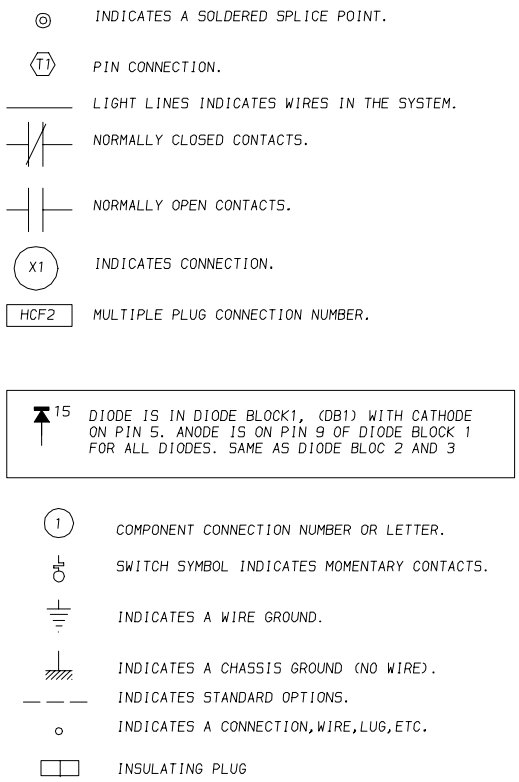


Figure 6-1. Electrical Schematic Wiring Diagram - MICROPROCESSOR CONTROLLER Dwg. No. 62-60017 Rev C (Sheet 1 of 2)

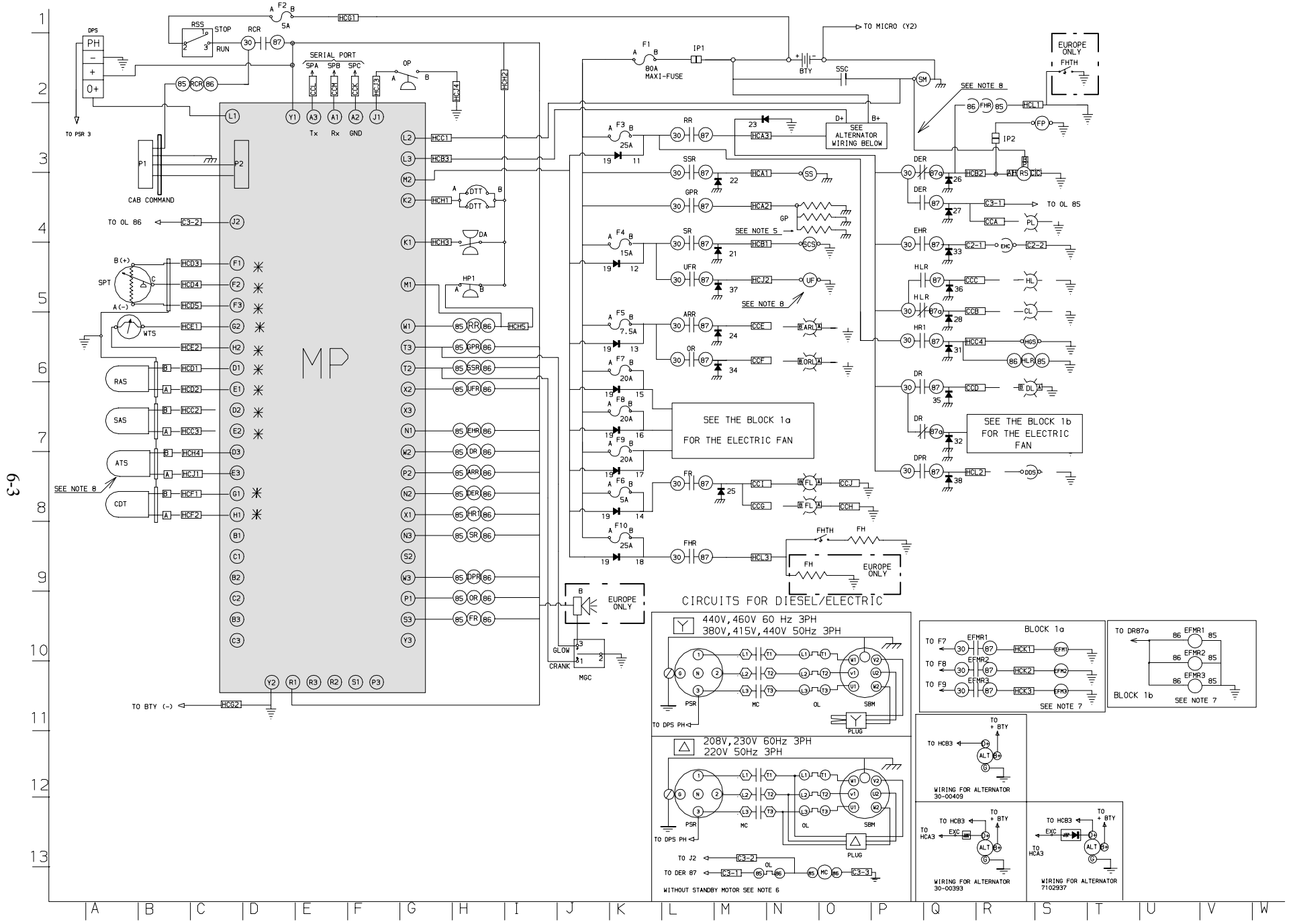


Figure 6-1. Electrical Schematic Wiring Diagram - MICROPROCESSOR CONTROLLER Dwg. No. 62-60017 Rev C (Sheet 2 of 2)

LOCATION	SYMBOL	DESCRIPTION	LOCATION
D-14,C-16,F-16	ALT	ALTERNATOR	MID FRAME
D-11/E-6	ALTR	ALTERNATOR RELAY	CONTROL BOX
I-2	BTY	BATTERY	
0-9	B	BUZZER (EUROPE ONLY)	CONTROL BOX
F-11	CL	COOL LIGHT (WHITE)	CONTROL PANEL
H-14	DA	DEFROST AIR SWITCH	FRAME
G-9	DL	DEFROST LIGHT (AMBER)	CONTROL PANEL
H-11/C-6	DDR	DEFROST DAMPER RELAY	CONTROL BOX
C-14	DDS	DEFROST DAMPER SOLENOID	EVAPORATOR
H-11/D-5,G-7	DR	DEFROST RELAY	CONTROL BOX
G-11/F-7	DR1	DEFROST RELAY 1	CONTROL BOX
H-5/H-7	DTR	DEFROST TIMER RELAY (OPTION)	CONTROL BOX
G-13/14	DTT	DEFROST THERMOSTAT	EVAPORATOR
A-14	EFM1	ELECTRIC FAN MOTOR 1	EVAPORATOR
B-14	EFM2	ELECTRIC FAN MOTOR 2	EVAPORATOR
B-14	EFM3	ELECTRIC FAN MOTOR 3	EVAPORATOR
D-8/A-6	EFMR1	ELECTRIC FAN MOTOR RELAY 1	CONTROL BOX
D-8/B-6	EFMR2	ELECTRIC FAN MOTOR RELAY 2	CONTROL BOX
E-8/B-6	EFMR3	ELECTRIC FAN MOTOR RELAY 3	CONTROL BOX
H-3	F1	FUSE (80) AMPERE	CONTROL BOX
L-4	F2	FUSE (20) AMPERE	CONTROL BOX
M-4	F3	FUSE (20) AMPERE	CONTROL BOX
O-4	F4	FUSE (25) AMPERE	CONTROL BOX
A-4	F5	FUSE (20) AMPERE	CONTROL BOX
B-4	F6	FUSE (20) AMPERE	CONTROL BOX
B-4	F7	FUSE (20) AMPERE	CONTROL BOX
C-4	F8	FUSE (10) AMPERE	CONTROL BOX
L-11	F9	FUSE (15) AMPERE	CONTROL BOX
L-14	FP	FUEL PUMP	FUEL TANK
0-14	FH	FUEL HEATER (OPTION)	ENGINE
M-10/0-6	FHR	FUEL HEATER RELAY (OPTION)	CONTROL BOX
M-14/N-14	FHT	FUEL HEATER THERMOSTAT (OPTION)	ENGINE
J-5,N-7	GDS	GLOW DEFROST SWITCH	CONTROL PANEL
N-14	GP	GLOW PLUG	ENGINE
M-8/N-6	GPR	GLOW PLUG RELAY	CONTROL BOX
E-14	HGS	HOT GAS SOLENOID	FRAME
E-11	HL	HEAT LIGHT (AMBER)	CONTROL PANEL
K-13	HP	HIGH PRESS. CUT-OUT-SWITCH (N.C.)	COMPRESSOR
G-9/E-10,F-10	HR	HEAT RELAY	MOTHER BOARD
H-2	IP1	INSULATING PLUG 1	CONTROL BOX
L-13	IP2	INSULATING PLUG 2	FRAME
K-14	LP	LOW PRESSURE SWITCH (EUROPE ONLY)	FRAME
J-11/I-16,M-16	MC	MOTOR CONTACTOR	CONTROL BOX
J-9, K-8, L-7	MCP	MOTOR CONTACTOR PILOT RELAY	CONTROL BOX
J-9	MOT	MOTOR OVERLOAD TIMER	CONTROL BOX
I-16,N-16	OL	OVERLOAD PROTECTOR	CONTROL BOX
K-14	OP	OIL PRESS. SAFETY SWITCH (N.O.)	ENGINE
I-14	OPS	OIL PRESS. SAFETY SWITCH S/BY (NC)	ENGINE
H-16,M-16	PSR	POWER SUPPLY RECEPTACLE	
F-2	RAS	RETURN AIR SENSOR	EVAPORATOR
L-14	RS	RUN SOLENOID	ENGINE
K-11/L-5	RR	RUN RELAY	CONTROL BOX
N-10	RTM	RUNNING TIME METER	CONTROL PANEL
J-11	RTMS	RUNNING TIME METER STAND-BY	CONTROL PANEL
J-16,0-16	SBM	STAND-BY MOTOR	FRAME
F-9/I-7	SBR	STAND-BY RELAY	CONTROL BOX
M-14	SCS	SPEED CONTROL SOLENOID	ENGINE
H-6	SDT	SOLID STATE DEFROST TIME (OPTION)	CONTROL BOX
J-2	SM	STARTER MOTOR	ENGINE
F-9/M-10	SR	SPEED RELAY	CONTROL BOX
M-5,N-9	SRS	START-RUN-STOP SWITCH	CONTROL PANEL
L-14	SS	STARTER SOLENOID	STARTER
I-2	SSC	STARTER SOLENOID CONTACTOR (N.O.)	STARTER
M-7	SSW	SELECTOR SWITCH	CONTROL PANEL
F-6	TCM	TEMPERATURE CONTROL MODULE	CONTROL PANEL
K-14	WT	WATER TEMPERATURE SENSOR	ENGINE

NOTES :

1. UNIT SHOWN "OFF" POSITION.
2. WIRE IDENTIFICATION SYSTEM:
   COLOR: WHITE - DC CONTROL CIRCUITS
   BLACK - DC GROUNDS
   RED - AC CIRCUITS
   GREEN - AC GROUNDS
3. ADDRESS SYSTEM, EXAMPLE, HCL1-FHR85
   INDICATES A WIRE BETWEEN PLUG HC-PIN L1
   AND TERMINAL 85 OF RELAY FHR
4. VOLTAGE BELOW 12 VOLTS.
5. ENGINE CT2-29 2 GLOW PLUG
   ENGINE CT3-44 3 GLOW PLUG
6. WITHOUT STANDBY MOTOR

*NO CONNECTION OF SWITCH SSW

*NO CONNECTION STANDBY PANEL (MOT,MCP,MC,OL)

*NO CONNECTION HOURMETER

*NO CONNECTION RELAY SBR

*NO CONNECTION OPS

*SHUNT BETWEEN THE TERMINAL 4 OF THE SWITCH SR5 AND THE TERMINAL 5 OF THE SWITCH GDS

*SHUNT BETWEEN THE TERMINAL 3 OF THE C8 CONNECTOR AND THE TERMINAL 6 OF THE C8 CONNECTOR

DB12 — DIODE IS IN DIODE BLOCK 1 (DB1)
IT'S THE DIODE D2
SAME AS DIODE BLOCK 2 AND 3

SWITCH SYMBOL INDICATES MOMENTARY CONTACTS.

1 — COMPONENT CONNECTION NUMBER OR LETTER.

LIGHT LINES INDICATES WIRES IN THE SYSTEM.

NORMALLY CLOSED CONTACTS.

NORMALLY OPEN CONTACTS.

HCF2 — MULTIPLE PLUG CONNECTION NUMBER.

INDICATES A WIRE GROUND.

INDICATES A CHASSIS GROUND (NO WIRE).

INDICATES STANDARD OPTIONS.

INDICATES A CONNECTION,WIRE,LUG,ETC.

INSULATING PLUG

T1 — PIN CONNECTION.

C8-6 — INDICATES C8 CONNECTOR
EX:C8-6:TERMINAL 6 OF C8 CONNECTOR

Figure 6-2. Electrical Schematic Wiring Diagram - SOLID STATE CONTROLLERDwg. No. 62-60018 Rev C (Sheet 1 of 2)

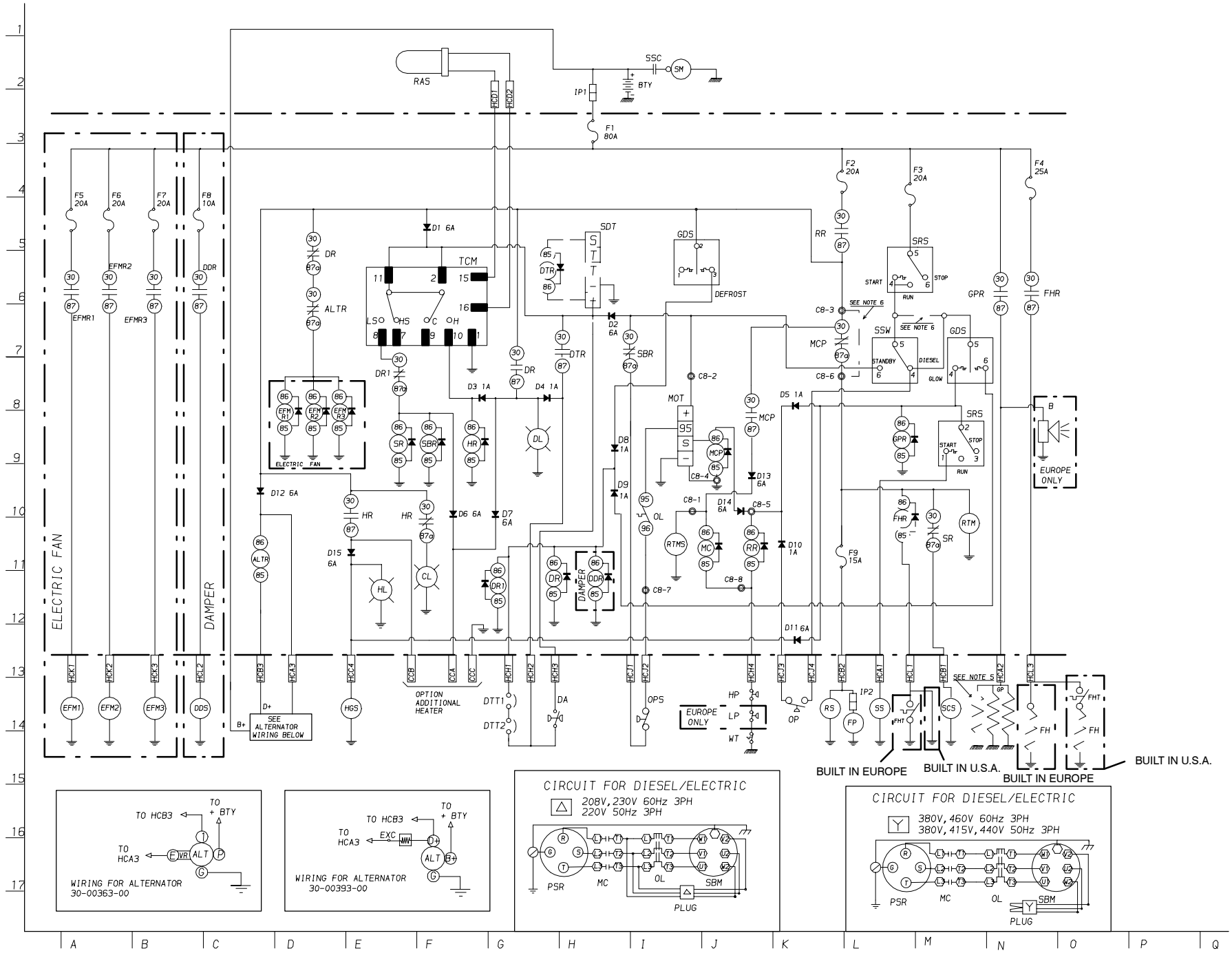
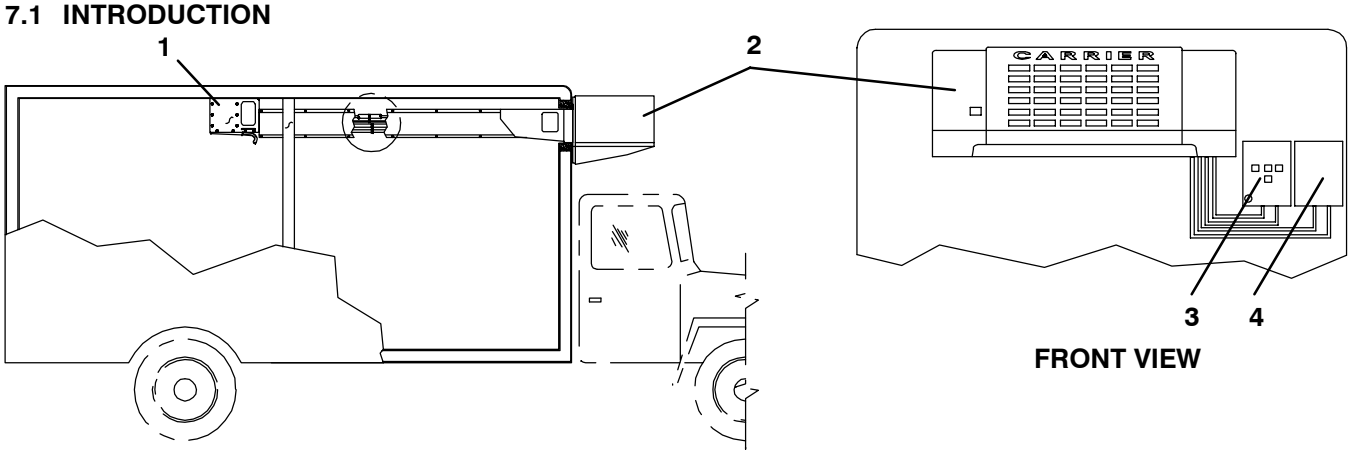


Figure 6-2. Electrical Schematic Wiring Diagram - SOLID STATE CONTROLLER Dwg. No. 62-60018 Rev A (Sheet 2 of 2)

SECTION 7

MULTI-TEMP (BI-TEMP) OPERATION AND SERVICE

7.1 INTRODUCTION



1. Remote Evaporator
2. Main Unit (Supra 722)
3. Remote Control Box
4. Additional Heater Box

Figure 7-1. Multi-Temp Unit

a. System

The Supra Multi-Temp (Bi-Temp), multiple compartment refrigeration system offers two compartment temperature control. The Multi-Temp allows the shipper to ship frozen and perishable commodities in the same load under separate refrigeration control.

The Supra Multi-Temp unit is comprised of the basic Supra diesel nosemount unit with one remote evaporators for a rear compartment.

b. Remote Evaporator and Remote Control Box

The rear compartment of the Multi-Temp system is equipped with a separate evaporator and remote mounted control box.

The remote evaporator is ceiling mounted and includes evaporator coi, drain pan, evaporator fan and motor (12v-dc), defrost termination thermostat, liquid line solenoid, and expansion valve.

The remote control box includes indicating lights, switches and relays.

c. Microprocessor Controller

The Supra nosemount unit microprocessor controller controls all compartments (Refer to sections 7.5 and 1.8).

7.2 ELECTRICAL DATA

a. Remote Evaporator Fan Motors

Volts	12 vdc
Horsepower	.15kw (1/5 hp)
Speed	2250 rpm
Operating Amps	7 to 10

7.3 SAFETY DEVICES

Safety Devices for protection of the Remote Evaporator are listed in Table 7-1

Table 7-1. Safety Devices -- Remote Evaporator

Unsafe Conditions	Safety Device	Device Setting
1. Excessive current draw by 2 compartment	Fuse (F11)	Opens at 30 amps
2. Excessive current draw by Heater	Fuses (F12, F13, F14)	Opens at 10 amps
3. Defrost heater over temperature	High Temperature Klixon	Opens at 120 $\pm$ 5°F

7.4 REMOTE COMPARTMENT OPERATION

a. To start remote evaporator, place the remote compartment switch in the RUN position (See Figure 7-2).

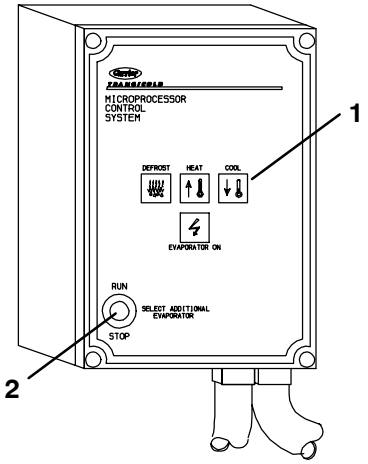
b. Set desired temperature using nosemount unit microprocessor controller (Refer to section 1.8).

c. The function lights for each compartment are on the remote control box.

d. Turn remote compartment switch to STOP when remote evaporator is not required.

NOTE

For starting instructions on the nosemount unit refer to section 2.2.



1. Cool/Heat/Defrost/Power Light
2. Compartment RUN-STOP Switch

Figure 7-2. Remote Control Box

7.5 MICROPROCESSOR CONTROLLER

NOTE

The Supra nosemount unit microprocessor controller controls all compartments (Refer to section 1.8).

The Supra microprocessor controller controls up to two compartments. The 2 compartment is enabled by the compartment ON-OFF switch located on the remote control box. When the compartment is enabled the controller will maintain temperature based on setpoints entered via the keypad function parameter selections. Two temperature thermistor sensors are used to monitor the return air of each evaporator. Temperature control is achieved by switching between 4 modes: high speed cool, low speed cool, null and high speed heat.

When heating is required the microprocessor will energize 2HR and the speed relay at 1.8°F (1°C) below setpoint. The remote heat relays will be de-energized when the temperature rises above 0.9°F (0.5°C) below setpoint. When the heat relay is de-energized the compartment will stay in null mode until the temperature rises greater than 1.8°F (1°C) above setpoint. At this point the controller will energize 2CR. If the temperature continues to rise the speed relay will be energized at 2.5°C above setpoint. If the temperature falls below 3.6°F(2°C) above setpoint the speed relay is de-energized and if it falls below 0.5°C above setpoint the remote cool relays are de-energized.

There are overriding factors which would prevent the remote compartment from cooling or heating. If the main compartment is in heat or defrost, then no cool or heat will be allowed in the remote compartment. In addition if the unit is being forced to run in low speed remote heat will be locked out.

Defrost in the remote compartment will be activated independently from the controller. When a remote compartment is in defrost the controller will energize the speed solenoid.

Start/Stop mode is also available for Multi compartment units. A remote compartment can override shutdown after the minimum run time if the temperature is not within ± 1.8°F (1°C) of setpoint. A remote compartment will cause the unit to restart after the minimum off time if temperature is more than ± 3.6°F (2°C) from setpoint. The minimum off time can be overridden if the remote temperature is more than 6°C from setpoint.

7.6 SERVICING REMOTE EVAPORATOR

WARNING

Before servicing the remote evaporator, remove negative battery cable and tag nosemount start-run-stop switch to prevent starting.

a. Fan Motor or Blade Replacement

1. Remove front panel.

2. Remove fan guard, loosen fan hub set screw (#10-32 x 1/2 lg – cone point) and remove fan. Remove fan motor hardware and fan wiring (if required).

3. Replace fan motor and fan blade before tightening fan setscrew, align fan with 1/3 of the fan blades extending beyond the leaving edge of the housing. Replace fan guard and front panel, test fan operation.

b. Fan Motor Brushes and Commutator

Fan motor brushes should be inspected every 1500 operating hours. Brushes should be replaced when brush is approximately 1/4″ or less in length. Blow out brush holder with low pressure air to remove any carbon dust in holder. Before installing brushes, remove back cover of motor and inspect commutator. If commutator is heavily grooved, polish it using 220 grit sandpaper: do not use emery cloth. Wipe out any accumulation of dust using a clean rag with solvent. Reassemble motor and reinstall brushes.

7.7 SERVICING LIQUID SOLENOID VALVE (LSV)

CAUTION

Do not damage or overtighten the enclosing tube assembly. Torque to 200-inch pounds (2.3 mkg). Also make sure all parts are placed on the enclosing tube in proper sequence to avoid premature coil burnout.

a. Replacing the Coil

NOTE

The coil may be replaced without removing the refrigerant or pumping the unit down.

1. Disconnect leads, remove coil retainer and coil assembly.

2. Verify coil type, voltage and frequency. This information appears on the coil housing.

3. Place new coil over enclosing tube, retainer and connect wiring.

b. Replacing Solenoid Valve Internal Parts (See Figure 7-3)

The liquid line solenoid valve may be serviced by pumping the unit down. (Refer to section 4.4.a)

Remove and store the refrigerant charge in an evacuated container to service hot gas solenoid valve. (Refer to section 4.4.b)

1. Remove coil retainer and coil assembly from valve. Remove enclosing tube assembly and related items.

2. Check for foreign material in valve body.

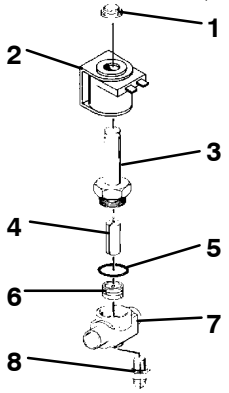
3. Install new parts.

4. Tighten enclosing tube assembly to a torque value of 200 inch pounds (2.3 mkg) and leak check the valve. (Refer to section 4.5)

5. Install coil assembly and retainer.

6. Start unit and check refrigerant charge per section 4.7.f.

7. Check refrigeration cycles.(Refer to section 2)



1. Retainer
2. Coil Assembly
3. Enclosing Tube
4. Plunger Assembly
5. Gasket
6. Piston
7. Body
8. Bracket Adapter

Figure 7-3. Solenoid Valves – Alco

7.8 MULTI-TEMP REFRIGERANT CIRCUIT

The Multi-Temp refrigerant circuit is the same as the Supra but with the addition of a remote evaporator.

The remote evaporator refrigerant flows through the electrically controlled liquid line solenoid valve (LSV) which starts or stops the flow of liquid refrigerant.

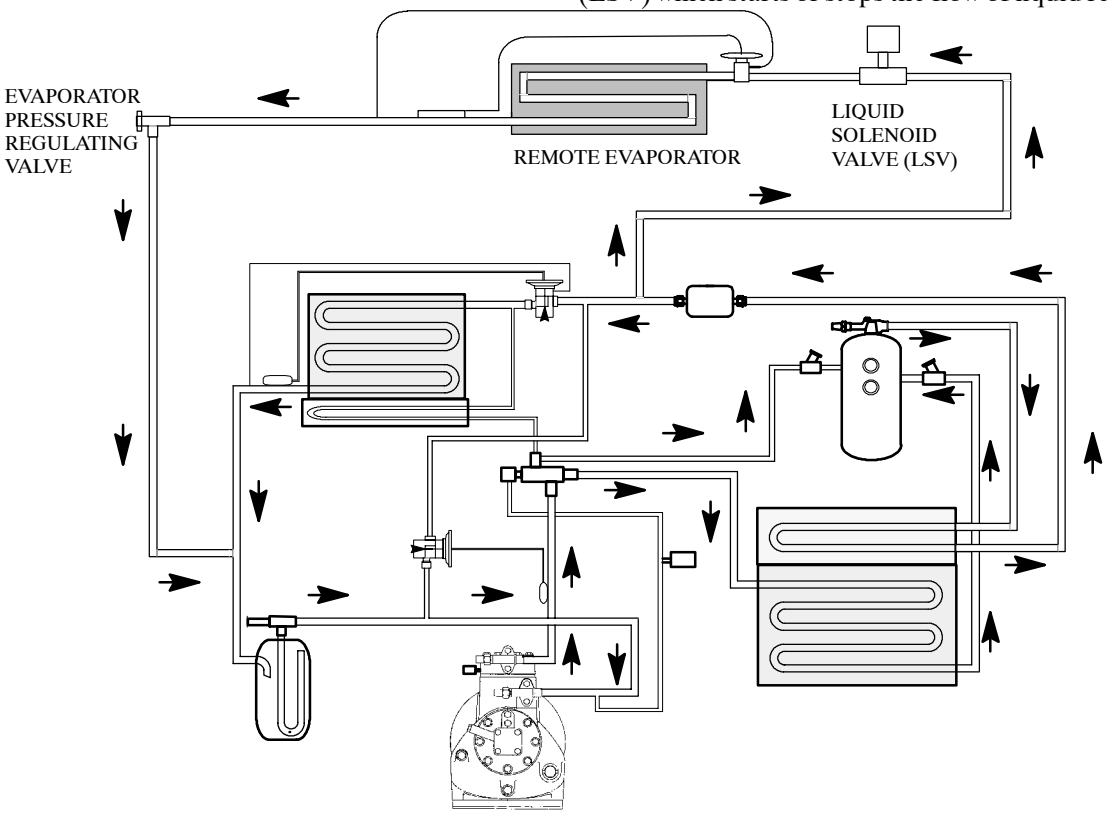


Figure 7-4. Multi-Temp Refrigerant Circuit – Cooling

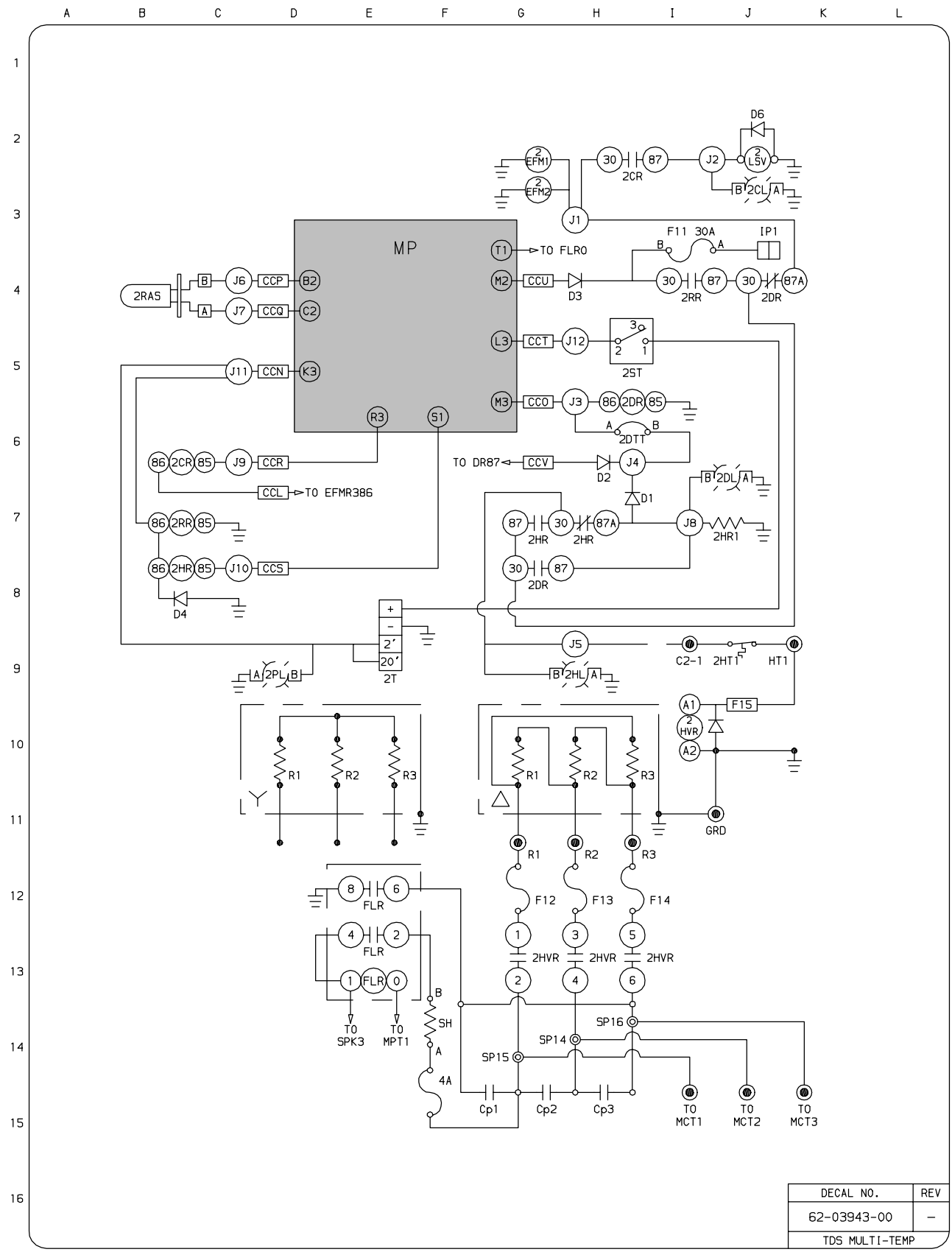


Figure 7-5. Electrical Schematic Wiring Diagram – Multi-Temp (Sheet 1 of 2)

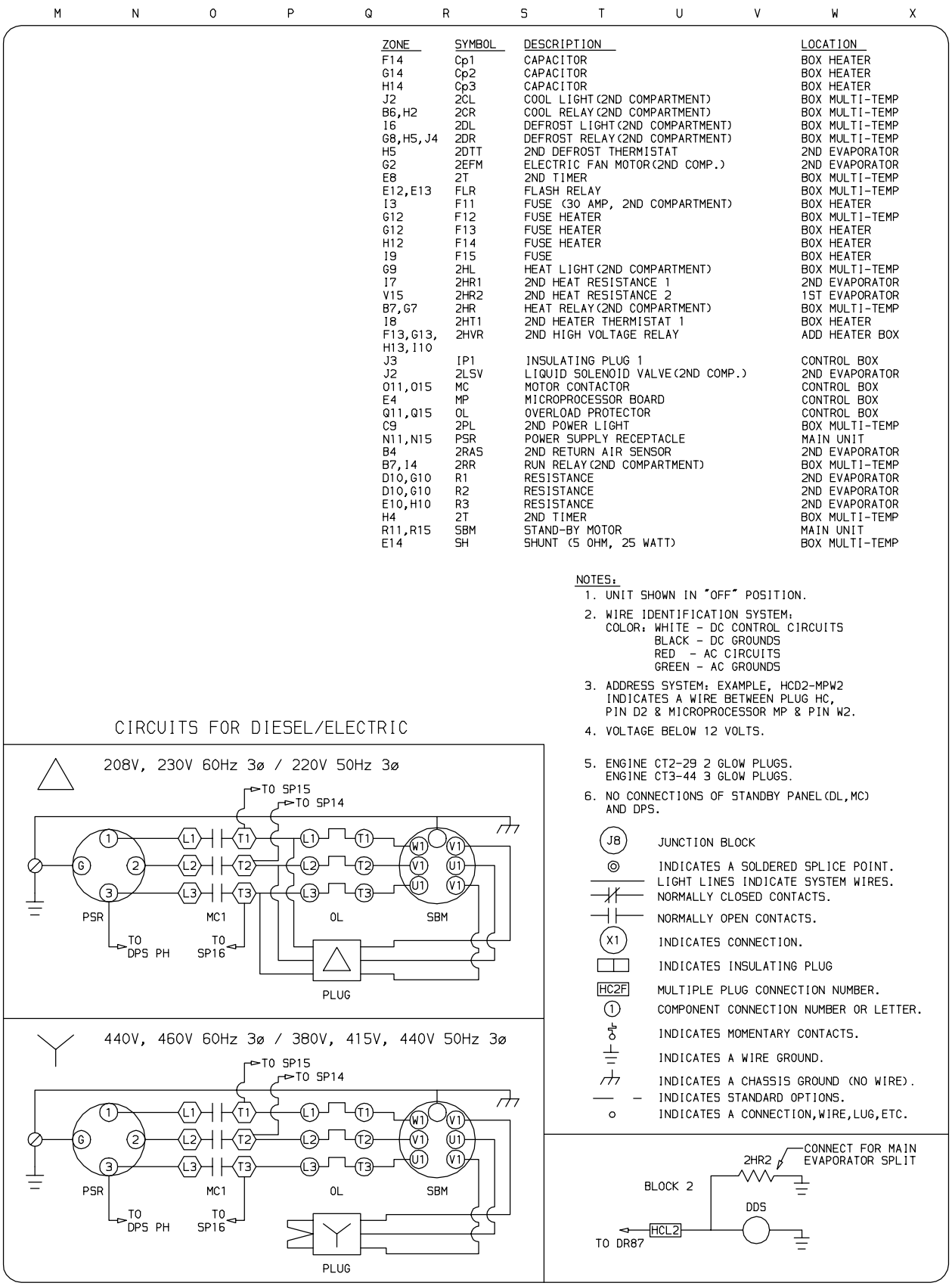


Figure 7-5. Electrical Schematic Wiring Diagram – Multi-Temp (Sheet 2 of 2)