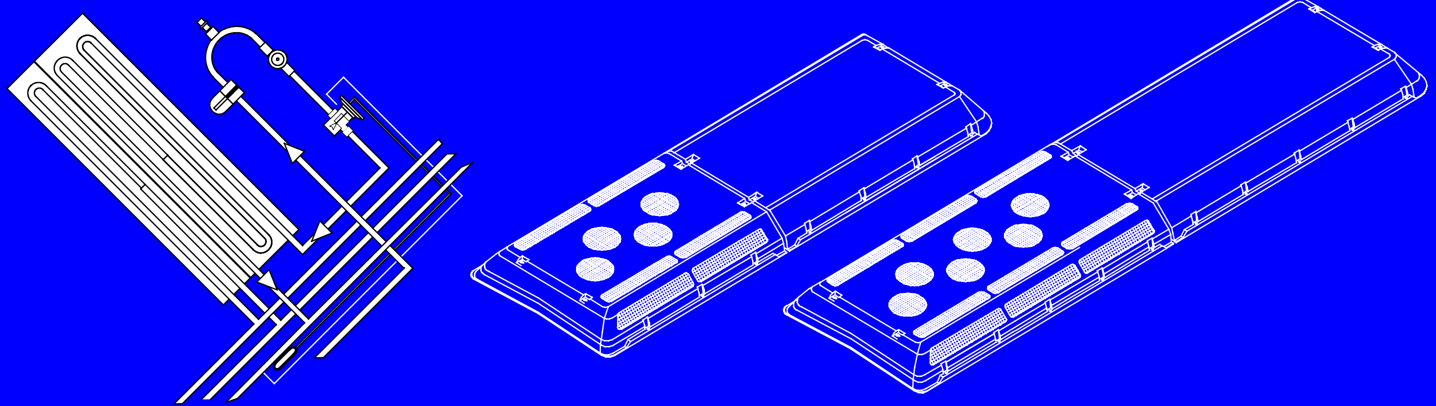
Transport Air Conditioning



OPERATION AND SERVICE
for
MODELS AC310 & AC350
Rooftop Air Conditioning Units

With

BT324 Carrier Sutrak Digital Display (CSDD)

or

280P/282P Electronic Thermostat

T–304 Rev A Change 07/09

Carrier

TRANSICOLD

OPERATION AND SERVICE MANUAL

TRANSPORT AIR CONDITIONING UNIT

MODELS

AC310 & AC350

ROOFTOP AIR CONDITIONING UNITS

***CSDD – BT324 (*Carrier Sutrak Digital Display)**

Electronic Thermostat – 280P & 282P

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SAFETY SUMMARY

GENERAL SAFETY NOTICES

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. A listing of the specific warnings and cautions appearing elsewhere in the manual follows the general safety notices.

FIRST AID

An injury, no matter how slight, should never go unattended. Always obtain first aid or medical attention immediately.

OPERATING PRECAUTIONS

Always wear safety glasses.

Keep hands, clothing and tools clear of the evaporator and condenser fans.

No work should be performed on the unit until all start-stop switches are placed in the OFF position, and power supply is disconnected.

Always work in pairs. Never work on the equipment alone.

In case of severe vibration or unusual noise, stop the unit and investigate.

MAINTENANCE PRECAUTIONS

Beware of unannounced starting of the evaporator and condenser fans. Do not open the unit cover before turning power off.

Be sure power is turned off before working on motors, controllers, solenoid valves and electrical controls. Tag circuit breaker and power supply to prevent accidental energizing of circuit.

Do not bypass any electrical safety devices, e.g. bridging an overload, or using any sort of jumper wires. Problems with the system should be diagnosed, and any necessary repairs performed by qualified service personnel.

When performing any arc welding on the unit, disconnect all wire harness connectors from the modules in the control box. Do not remove wire harness from the modules unless you are grounded to the unit frame with a static-safe wrist strap.

In case of electrical fire, open circuit switch and extinguish with CO_2 (never use water).

SPECIFIC WARNINGS AND CAUTIONS

WARNING

Be sure to observe warnings listed in the safety summary in the front of this manual before performing maintenance on the hvac system

WARNING

Read the entire procedure before beginning work. Park the vehicle on a level surface, with parking brake applied. Turn main electrical disconnect switch to the off position.

WARNING

Do Not Use A Nitrogen Cylinder Without A Pressure Regulator

WARNING

Do Not Use Oxygen In Or Near A Refrigeration System As An Explosion May Occur.

WARNING

The Filter-drier May Contain Liquid Refrigerant. Slowly Loosen The Connecting Nuts And Avoid Contact With Exposed Skin Or Eyes.

CAUTION

The AC310 & AC350 Rooftop Systems have R134a service port couplings installed on the compressor and 1/4 inch flare (Acme) fittings installed on the unit piping.

CAUTION

To prevent trapping liquid refrigerant in the manifold gauge set be sure set is brought to suction pressure before disconnecting.

SECTION 1

DESCRIPTION

1.1 INTRODUCTION

This manual contains Operating Instructions, Service Instructions and Electrical Data for the Model AC310 and AC350 Air Conditioning and Heating equipment furnished by Carrier Transport Air Conditioning as shown in Table 1-1 and Table 1-2.

Model AC310/350 systems consists of a Rooftop unit containing the condensing section, the evaporator section and engine compartment mounted compressor(s). To complete the system, the air conditioning and heating equipment interfaces with an optional drivers evaporator (dash-air), electrical cabling, refrigerant piping, engine coolant piping (for heating), duct work and other components furnished by Carrier Transport Air Conditioning and/or the bus manufacturer.

Additional support manuals are shown in Table 1-3.

Operation of the unit is controlled automatically by an electronic thermostat. The controlls maintain the vehicle's interior temperature at the desired set point.

Table 1-1 AC310 Models

Model AC310	Voltage	Controller	With Heat	Dual Loop	Single Loop	W/Covers
77-62031-00	12 VDC	Manual (280P)	Yes		X	X
77-62031-01	24 VDC	Manual (280P)	Yes		X	X
77-62031-02	12 VDC	BT324	Yes		X	X
77-62031-03	24 VDC	BT324	Yes		X	X
77-62032-00	12 VDC	Sytronic System & Manual (280P)	Yes	X		X
77-62032-01	24 VDC	Manual (280P)	Yes	X		X
77-62032-02	-	-	-	-	-	-
77-62032-03	12 VDC	Manual (280P)	Yes	X		X
77-62032-04	12 VDC	Manual (280P)	Yes	X		X
77-62032-05	12 VDC	BT324	Yes	X		X
*77-62032-06	12 VDC	BT324 (Tropic)	Yes	X		X

***NOTE:** 77-62032-06 (Tropic) - Has an AC310 Evaporator Section & an AC350 Condenser Section.

Table 1-2 AC 350 Models

Part Number	Voltage	Controller	With Heat	Dual Loop	Single Loop	W/Covers
77-62041-00	24 VDC	-	-	-	X	-
77-62041-01	24 VDC	Manual	Yes		-	Yes
77-62041-02	24 VDC	Manual	Yes		X	No
77-62041-03	24 VDC	-	-	-	-	-
77-62041-04	24 VDC	BT324	No		X	No
77-62041-05	24 VDC	BT324	No		X	Yes
77-62041-06	24 VDC	BT324	Yes		X	Yes
77-62041-07	24 VDC	BT324	Yes		X	No
77-62041-10	24 VDC	BT324	Yes		X	Yes

Table 1-3 Additional Support Manuals

MANUAL NUMBER	EQUIPMENT COVERED	TYPE OF MANUAL
T-304PL	AC-310/350	Service Parts List
T-200PL	05G Compressor	Service Parts List
62-02756	05G Compressor	Operation & Service
62-11052	05G Compressor - Twin Port	Workshop Manual
62-11053	05G Compressor - Twin Port	Service Parts List
62-02460	05K Compressor	Service Parts List
62-02491	05K Compressor	Operation & Service

1.2 GENERAL DESCRIPTION

1.2.1 Rooftop Unit

The rooftop unit includes the condenser section and the evaporator section (See Figure 1–1).

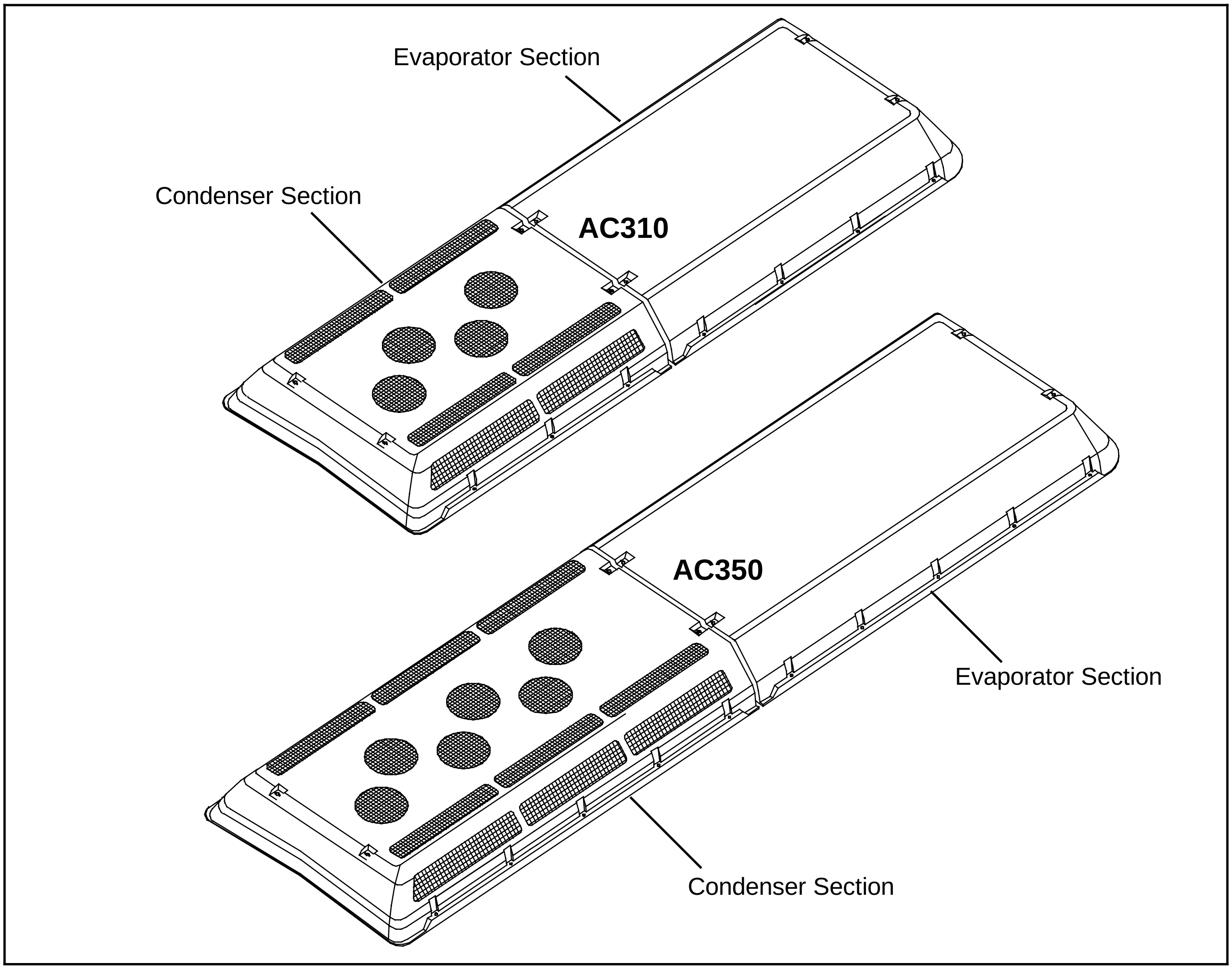


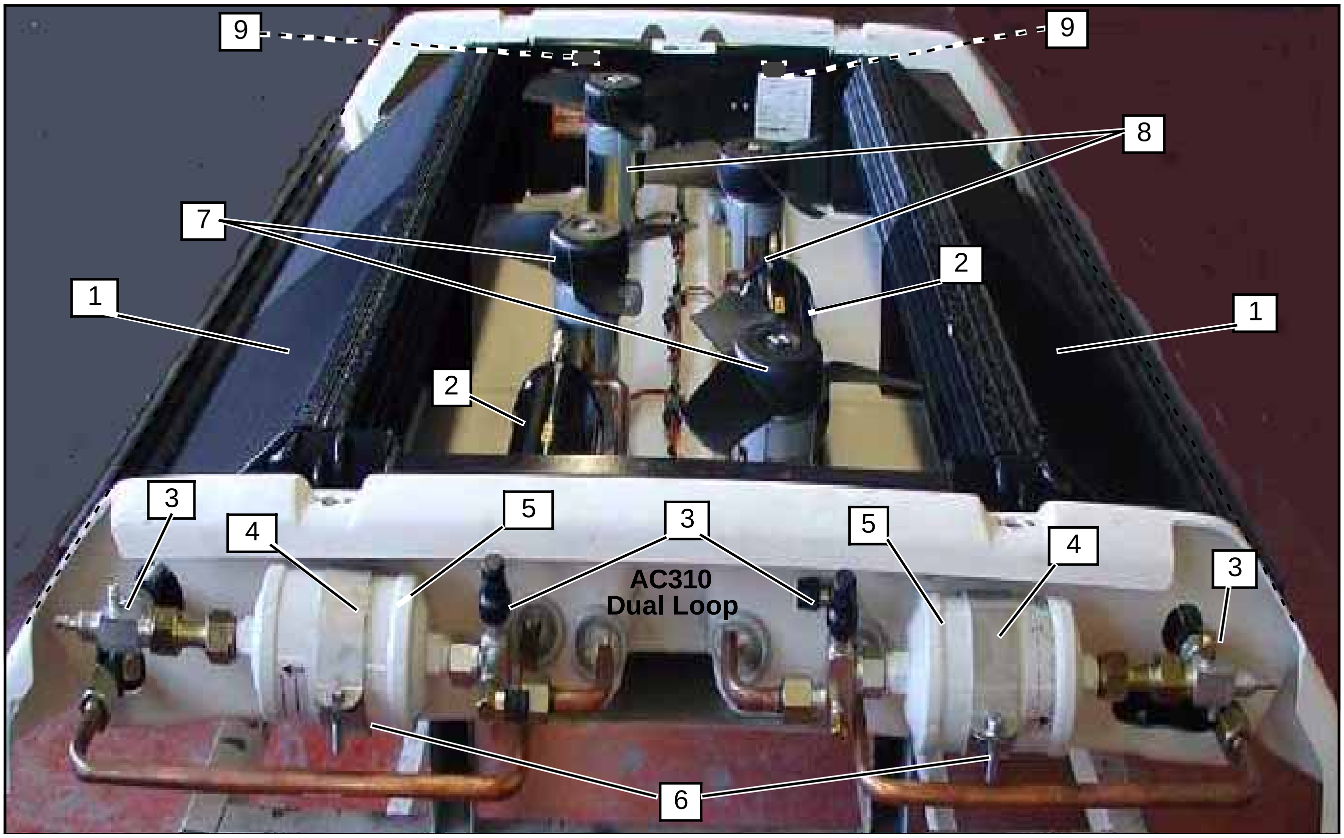
Figure 1–1 AC310/350 Rooftop Units

1.2.2 Condensing Section

The dual (See Figure 1–2) and single loop (See Figure 1–3) condensing sections include the condenser coils, four (4) or six (6) fan and motor assemblies, filter-driers, receivers, and filter drier service valves.

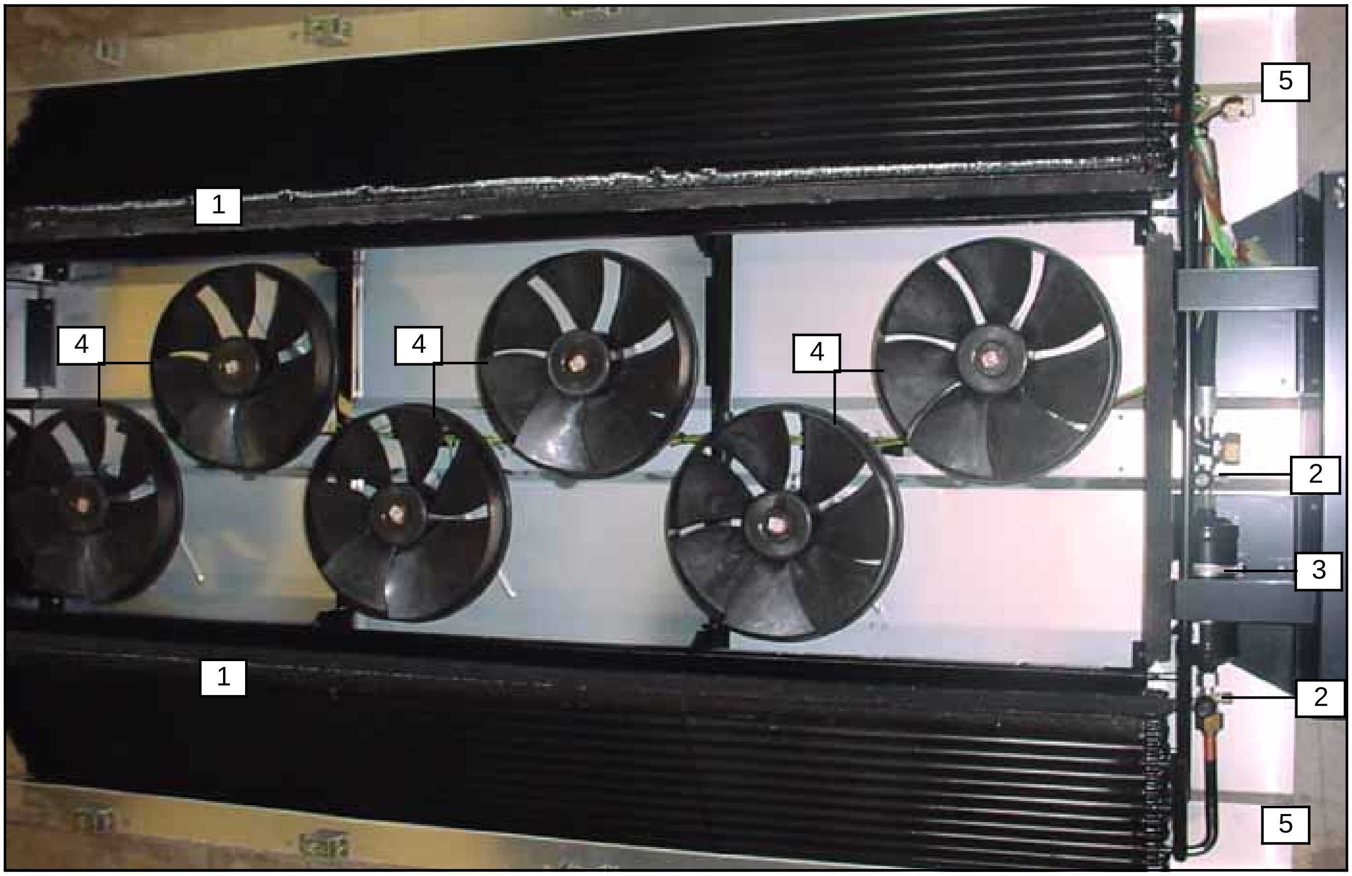
The condenser coils provide heat transfer surface for condensing refrigerant gas at a high temperature and pressure into a liquid at high temperature and pressure. The condenser fans circulate ambient air across the outside of the condenser tubes at a temperature lower than refrigerant circulating inside the tubes; this results in condensation of the refrigerant into a liquid. The filter-drier removes moisture and debris from the liquid refrigerant before it enters the thermostatic expansion valve in the evaporator assembly. The service valves enable isolation of the filter-drier for service.

The receiver collects and stores liquid refrigerant. The receiver is also fitted with a pressure relief valve which protects the system from unsafe high pressure conditions.



1. Condenser Coil Assembly
2. Receiver
3. Service Valve (High Side)
4. Filter Drier Upper Support
5. Filter Drier
6. Filter Drier Lower Support
7. Condenser Fan and Motor Assembly
8. Condenser Motor Support
9. Discharge Line Check Valve (Location)

Figure 1–2 Condensing Section Components (AC310 – Dual Loop – GEN I)



1 Condenser Coil Assembly
Receiver Tank (Part Of Coil Assembly)
2 Service Valve
3 Filter Drier
4 Fan & Motor
5 Frame (Aluminum)

Figure 1-3 Condensing Section Components (AC350 Single Loop - GEN II)

1.2.3 Evaporator Section

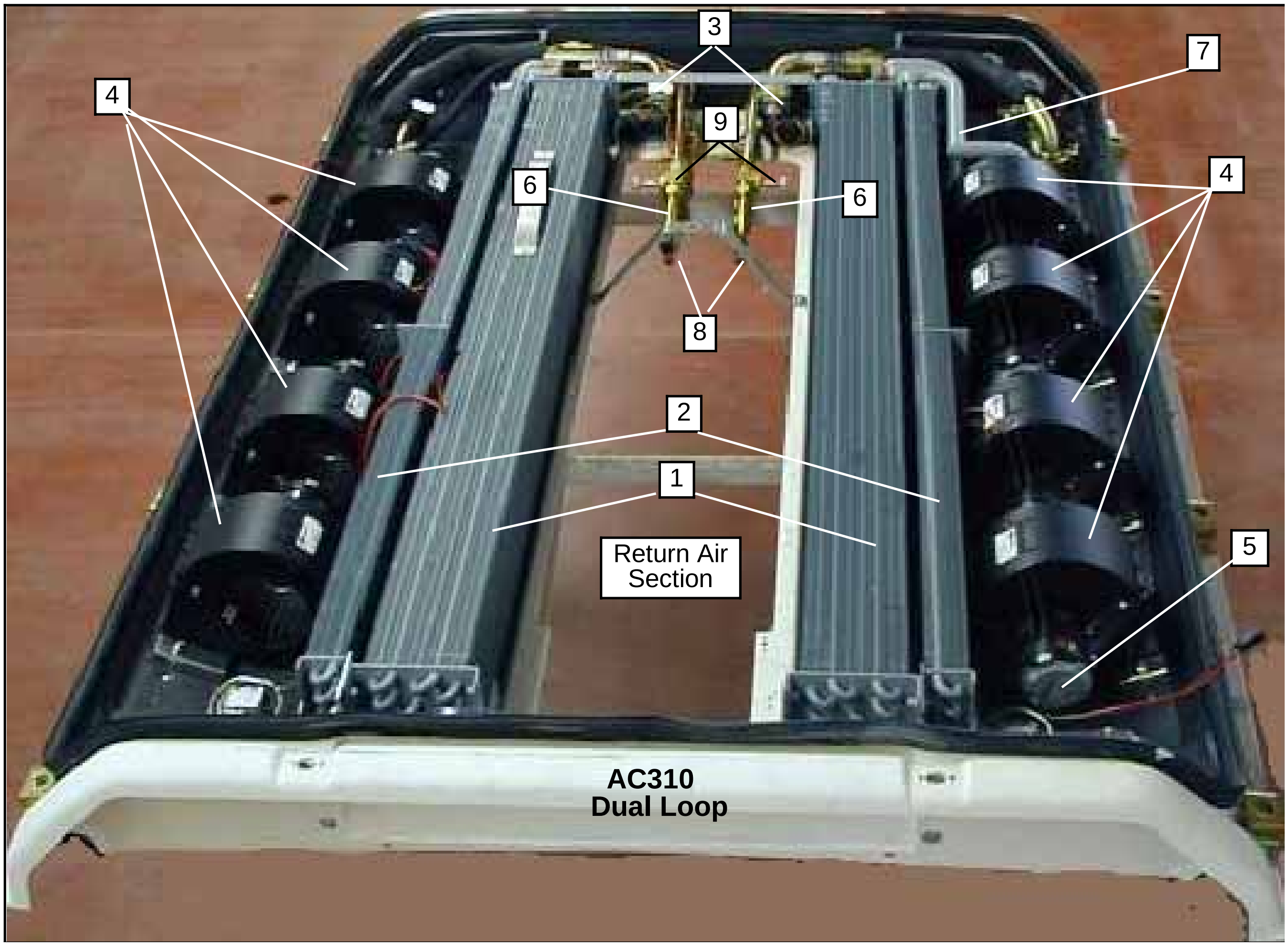
The dual loop AC310 & AC350 (GEN I) evaporator section (See Figure 1-4) includes the evaporator coils, eight (8) or twelve (12) single-shafted blower/motor assemblies, two heater coil assemblies, two thermostatic expansion valves, two liquid line solenoid valves, and condensate drain connections.

NOTE

The GEN I series of AC310 & AC350 evaporators are supplied with single shaft blower/motor assemblies. The GEN II series have dual shaft blower/motor assemblies.

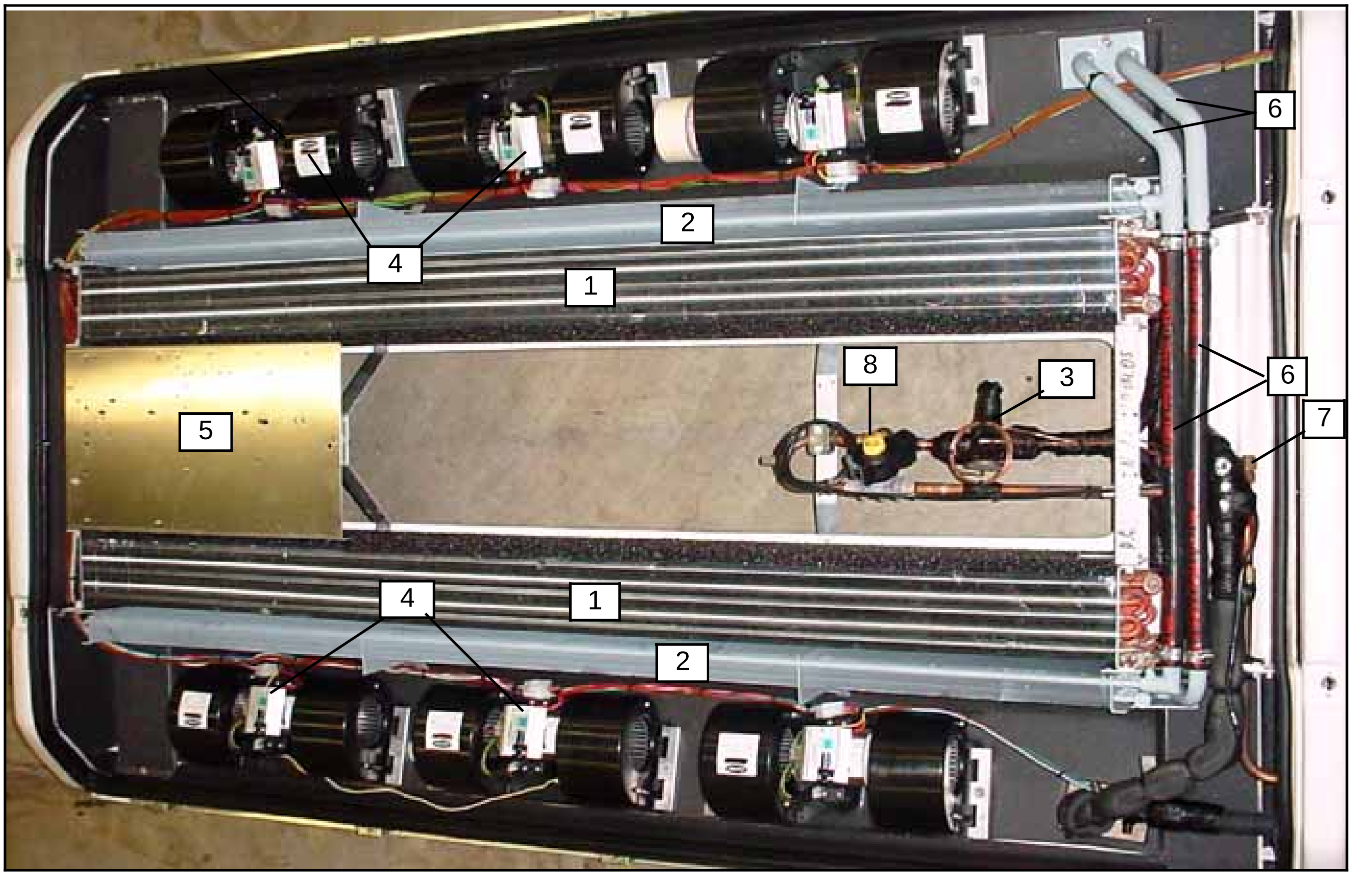
The single loop AC310 & AC350 evaporator section (See Figure 1-5) includes the evaporator coils, four (4) or six (6) double-shafted blower/motor assemblies, heater coil assemblies, one thermostatic expansion valve, one liquid line solenoid valve (to add in-dash service port), and condensate drain connections.

The liquid line solenoid valve closes when the system is shut down to prevent flooding of coils and the compressor with liquid refrigerant. The evaporator coils provide heat transfer surface for transferring heat from air circulating over the outside of the coil to refrigerant circulating inside the tubes; thus providing cooling. The heating coils provide a heat transfer surface for transferring heat from engine coolant water circulating inside the tubes to air circulating over the outside surface of the tubes, thus providing heating. The fans circulate the air over the coils. The air filters remove dirt particles from the air before it passes over the coils. The thermostatic expansion valve meters the flow of refrigerant entering the evaporator coils. The heat valve controls the flow of engine coolant to the heating coils upon receipt of a signal from the controller. The condensate drain connections provide a means for connecting tubing for disposing of condensate collected on the evaporator coils during cooling operation.



1. Evaporator Coil Assembly
2. Heater Coil
3. Expansion Valve
4. Evaporator Blower Assembly
5. Evaporator Motor
6. Sight Glass
7. Heating Line
8. Access Port
9. Liquid Line Solenoid

Figure 1-4 Evaporator Section Components (AC310 -Dual Loop - GEN I)



1. Evaporator Coil Assembly
2. Heater Coil
3. Expansion Valve
4. Evaporator Blower/Motor Assembly
5. Control Panel
6. Heater Line
7. Front Evaporator Port
8. Liquid Line Solenoid

Figure 1-5 Evaporator Section Components (AC350 Single Loop - GEN II)

1.2.4 Drivers Evaporator (Optional)

The drivers evaporator assembly is normally installed in the vehicle dash area and interfaces with the rooftop unit electrical cabeling and refrigerant piping.

The drivers evaporator assembly includes an evaporator coil, thermal expansion valve, blower motor assembly and a condensate drain connection. Refer to the OEM technical literature for driver's evaporator information.

1.2.5 Compressor Assembly

a. Dual Loop Compressors A-6 & TM-21

The standard AC310 dual loop compressor assembly includes the refrigerant compressor, clutch assembly, in-line high & low pressure switches, suction accumulator and in-line suction and discharge servicing (charging) ports.

b. Single Loop Compressor TM-31

The TM-31 compressor assembly used only with the AC310 Single Loop Unit includes the refrigerant compressor, clutch assembly, suction & discharge service valves, high pressure switch, low pressure switch, suction accumulator and suction and discharge servicing (charging) ports.

c. Single Loop Compressors 05G & 05K

The 05G (AC350) & 05K (AC310) compressor assemblies used with the single loop units, includes the clutch assembly, suction & discharge service valves, high pressure switch, low pressure switch, suction and discharge servicing (charging) ports and electric solenoid unloaders.

The compressor raises the pressure and temperature of the refrigerant and forces it into the condenser coil tubes. The clutch assembly provides a means of driving the compressors by the vehicle engine. Suction and discharge servicing (charging) ports mounted on the compressor fittings enable connection of charging hoses for servicing of the compressor, as well as other parts of the refrigerant circuit. The high pressure switch contacts open on a pressure rise to shut down the system when abnormally high refrigerant pressures occur.

The electric unloaders (05G & 05K) provide a means of controlling compressor capacity, which enables control of temperature inside the vehicle. The suction and discharge service valves enable servicing of these compressors.

1.2.6 System Operating Controls And Components

The system is operated by an electronic thermostat type controller and/or manually operated switches. The manually operated switches are located on the drivers control and may consist of a single ON/OFF switch or additional switches. The controller regulates the operational cycles of the system by energizing or de-energizing relays on the relay board in response to deviations in interior temperature. Modes of operation include Cooling and Heating. On systems fitted with only an ON/OFF switch, the controller will cycle the system between the operating modes as required to maintain desired set point temperature (See Section 6 for wiring diagrams).

In the heat mode the heat valves are opened to allow a flow of engine coolant through the heat coils located in the evaporator section. The evaporator fans operate to circulate air over the heat coils in the same manner as the cooling mode.

In the cooling mode the compressor is energized while the evaporator and condenser fans are operated to provide refrigeration as required. The compressor (s) capacity is matched to the bus requirements. Once interior temperature reaches the desired set point, the compressor(s) is deenergized.

1.2.7 280P & 282P (PWM) Electronic Thermostat Controller

This type controller has three (3) modes, Cool, Vent and Heat.

The range on the potentiometer is 62.6° - 86° F (17-30° C).

1.2.8 CSDD BT-324 (Carrier-Sutrak Digital Display) Microprocessor

This Carrier Sutrak Digital Display (BT-324) controller has three (3) modes, Auto, Vent (Cycle clutch type) and Heat.

1.2.9 Motor Fault Board (Optional)

The motor fault board (See Figure 1-11) consists of red and green LED's, which when illuminated, will reflect each motors state of condition. When the evaporator and condenser motors are energized, the green LED's will be illuminated. If a red LED is energized, it will show an "open circuit" condition, indicative of a motor failure. The green LED will not be illuminated at this time. The motor fault board is a seperate circuit board that is located at the return air section. The return air grill is oppened to view the LED indicators.

1.3 REFRIGERATION SYSTEM COMPONENT SPECIFICATIONS

a. Refrigerant Charge R-134a (Approximate)

NOTE

Refrigerant charge will depend on hose lengths and diameters; or if there is an In-Dash unit (front evaporator). The following should only be used as a guideline.

AC310 Dual Loop A-6 or TM-21 Compressor
6 Pounds (2.7 kg) - Curbside
8 Pounds (3.6 kg) - Roadside

AC310 - Single Loop TM-31 Compressor
12 Pounds (5.4 kg) without In-Dash unit

AC310 - Single Loop 05G or 05K Compressor
13.2 to 15.4 Pounds (6.0 to 7.0 kg) without In-Dash unit

AC350 - Single Loop 05G or 05K Compressor
16.5 to 18.7 Pounds (7.5 to 8.5 kg) without In-Dash unit

For systems with In-Dash unit (Optional)
Add 2 pounds (0.9 kg) to above listed charge.

b. Compressors

Compressor	**A6** (No longer Available)
Weight, (Dry)	34.5 Lbs.
Oil Charge	10 Oz. PAG (07-00333-00)
Compressor	**TM-21**
Weight, (Dry)	7.5 Lbs. (3.4 kg)
Oil Charge	6.1 Oz. (180 cc) PAG (46-50006-00)
Compressor	**TM-31**
Weight, (Dry)	21 Lbs.
Oil Charge	16.9 Oz. (500cc) PAG (46-50006-00)
Compressor	**Carrier 05K**
Weight, (Dry)	108 Lbs.
Oil Charge	5.5 Pints POE (07-00317-00pk6)
Compressor	**Carrier 05G**
Weight, (Dry)	146 Lbs. W/Clutch
Oil Charge	7.75 Pints POE (07-00317-00pk6)

c. Thermostatic Expansion Valve:

Superheat Setting (Externally Adjustable) Factory Set at 9 to 18°F (±4°F) MOP Setting: 55 ±4 psig (3.74 ±2.27 bar)

d. High Pressure Switch (HPS) *Normally Closed*

Opens at: 360 ±10 psig (20.41 ±0.68bar)
Closes at: 280 ±10 psig (13.61 ±0.68bar)

e. Low Pressure Switch (LPS) *Normally Open*

Opens at: 6 ±3psig (0.41 ±0.20 bar)
Closes at: 25 ±3 psig (1.7 ±0.20 bar)

f. Water Temperature Switch (WTS)

[Bus Manufacturer Supplied - Suggested close on temperature rise at 105°F (41°C)]

1.4 ELECTRICAL SPECIFICATIONS - MOTORS

a. Evaporator Blower/Motor

Evaporator Motor	**Permanent Magnet**	
	24 VDC	**12 VDC**
Horsepower (kW)	1/8 (.09)	
Full Load Amps (FLA)	9.5	19
Operating Speed High/ Low (RPM)	4200 1850	
Bearing Lubrication	Factory Lubricated (additional grease not required)	

b. Condenser Fan Motor

Condenser Motor	Permanent Magnet	
	24 VDC	12 VDC
Horsepower (kW)	1/8 (.09)	
Full Load Amps (FLA)	9	18
Operating Speed (RPM)	2950	
Bearing Lubrication	Factory Lubricated (additional grease not required)	

c. Temperature Sensors (Return Air Sensor)

Input Range: –52.6 to 158° F (–47 to 70°C)
Output: NTC 10K ohms at 77° F (25°C)

d. Ambient Sensor (Optional)

Opens at: 25° F (10°C)
Closes at: 35° F (1.7°C)

1.5 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions with safety devices. Safety devices with Carrier Transport Air Conditioning supplied equipment include high pressure switch (HPS), low pressure switch (LPS), circuit breakers and fuses.

a. Pressure Switches

High Pressure Switch (HPS)

During the air conditioning cycle, compressor clutch operation will automatically stop if the HPS switch contacts open due to an unsafe operating condition. Opening HPS contacts de-energizes the compressor clutch shutting down the compressor. The high pressure switch (HPS) is installed at the compressor assembly (05G, 05K & TM–31).

Low Pressure Switch (LPS)

The low pressure switch is installed close to the compressor and opens on a pressure drop to shut down the system when a low pressure condition occurs. The low pressure switch is installed at the compressor (05G, 05K & TM–31).

NOTE

On dual loop systems that use the A–6, TM–21 & some TM31's, the pressure switches are not located on the compressors. They are installed in–line.

b. Fuses and Circuit Breakers

The Relay Board is protected against high current by an OEM supplied circuit breaker or fuse located in the bus battery compartment (150 Amp for 12 VDC & 125 Amp for 24 VDC systems). Independent 15 Amp, 24 VDC or 20 Amp, 12 VDC fuses protect each motor while the output circuits are protected by an additional 5 Amp circuit breaker. During a high current condition, the fuse may open.

1.6 AIR CONDITIONING REFRIGERATION CYCLE

When air conditioning (cooling) is selected by the controller, the unit operates as a vapor compression system using R-134a as a refrigerant (See Figure 1–6 Dual Loop & Figure 1–8 Single Loop flow diagrams). The main components of the system are the A/C compressor, air-cooled condenser coils, receiver, filter-drier, thermostatic expansion valve, liquid line solenoid valve and evaporator coils.

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

The refrigerant leaves the receiver and passes through the receiver outlet/service valve, through a filter-drier where a descecant keeps the refrigerant clean and dry.

From the filter-drier, the liquid refrigerant then flows through the liquid line solenoid valve to the sight–glass and then to the thermostatic expansion valve. The thermal expansion valve reduce pressure and temperature of the liquid and meters the flow of liquid refrigerant to the evaporator to obtain maximum use of the evaporator heat transfer surface.

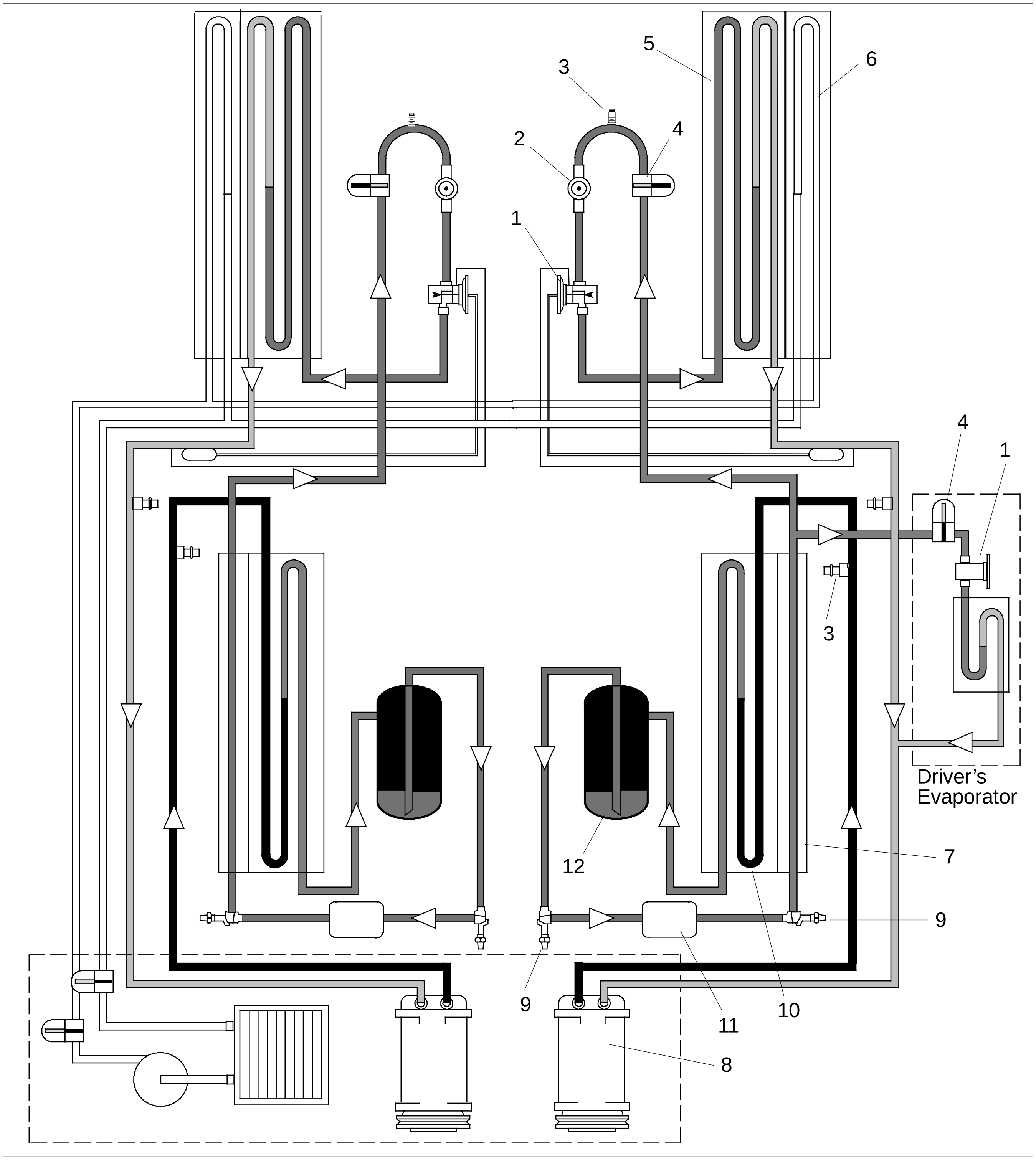
The low pressure, low temperature liquid that flows into the evaporator tubes is colder than the air that is circulated over the evaporator tubes by the evaporator fans (fans). Heat transfer is established from the evaporator air (flowing over the tubes) to the refrigerant (flowing inside the tubes). The evaporator tubes have aluminum fins to increase heat transfer from the air to the refrigerant; therefore the cooler air is circulated to the interior of the bus. Liquid line solenoid valve closes during shutdown to prevent refrigerant flow.

The transfer of heat from the air to the low temperature liquid refrigerant in the evaporator causes the liquid to vaporize. This low temperature, low pressure vapor passes through the suction line and returns to the compressor where the cycle repeats.

1.7 HEATING CYCLE

Heating circuit (See Figure 1–7) components furnished by Carrier Transport Air Conditioning include the heater cores and solenoid operated heat valves. Components furnished by the bus manufacturer may include a water temperature switch (WTS) and boost water pump.

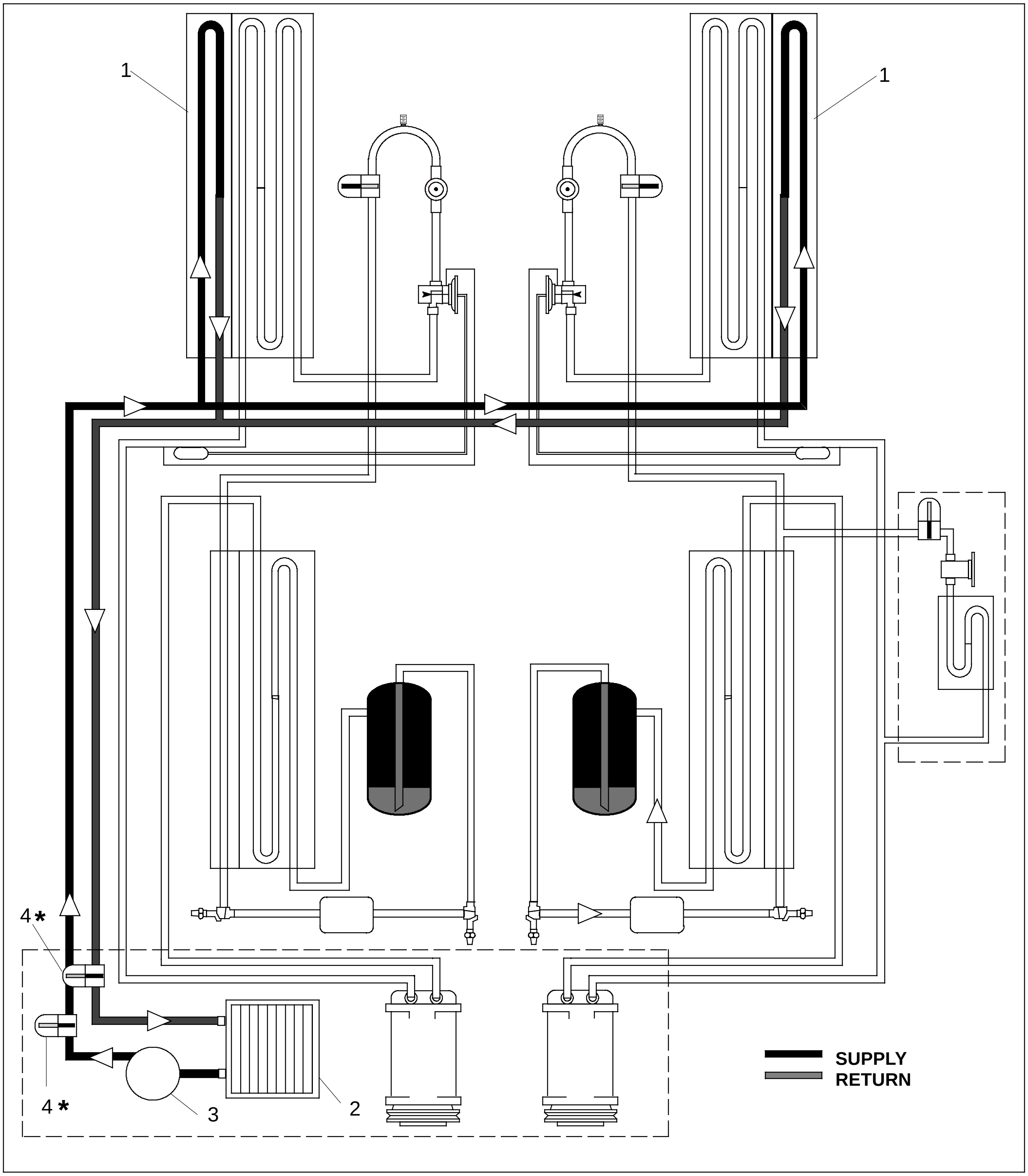
The controller automatically controls the heat valves during the heating mode to maintain required temperatures inside the bus. Engine coolant (glycol solution) is circulated through the heating circuit by the engine and an auxiliary boost water pump. When the heat valve solenoids are energized, the valves will open to allow engine coolant to flow through the heater coils. The valves are normally closed so that if a failure occurs, the system will be able to cool.



1 Thermal Expansion Valve
2 Liquid Line Sight Glass
3 Service Port
4 Liquid Line Solenoid
5 Evaporator Coil
6 Heat Coil
7 Subcooler
8 Compressor (TM-21 or A-6)
9 Service Valve
10 Condenser Coil
11 Filter-Drier
12 Receiver

Note: Items 1 through 12 are typical, both systems.

Figure 1-6 Refrigerant Flow Diagram - Cooling (Dual Loop)



1. Heat Coil
2. Vehicle Radiator
3. Boost Pump
4. Heat Solenoid Valve

* Optional Hand Valve

Figure 1-7 Flow Diagram - Heating

NOTE: In order to ensure water is entering the heater coils sufficiently heated, it is suggested that the OEM supplied Water Temperature Switch (WTS) close on temperature rise at 150°F (65.5°C).

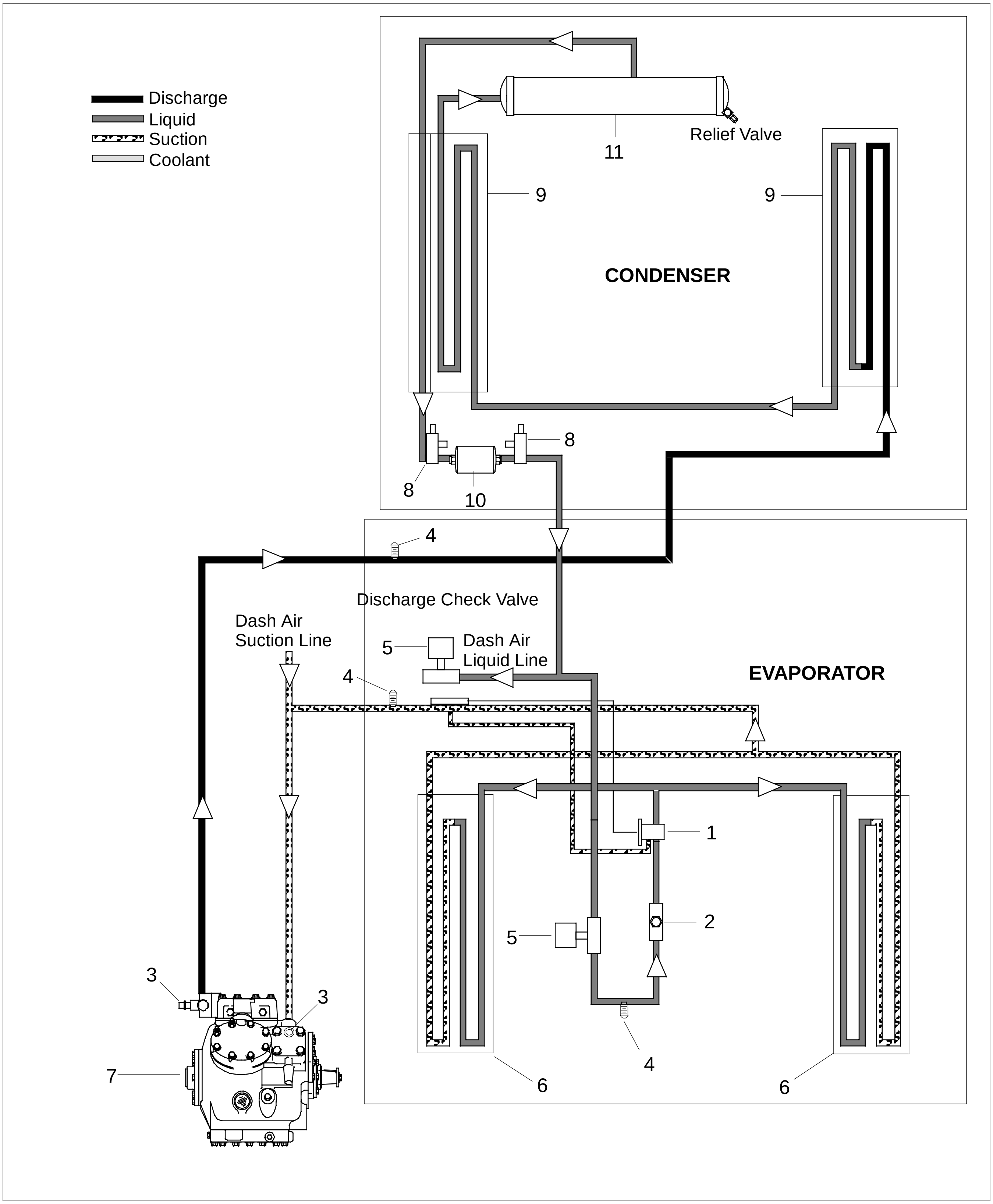


Figure 1-8 Refrigerant Flow Diagram, Cooling (Single Loop) AC350

1. Thermal Expansion Valve
2. Liquid Line Sight Glass
3. Service Port R134a
4 Service Port 1/4 Flare (Acme)
5. Liquid Line Solenoid
6. Evaporator Coil
7. Compressor
8. Service Valve
9. Condenser Coil
10. Filter-Drier
11. Receiver

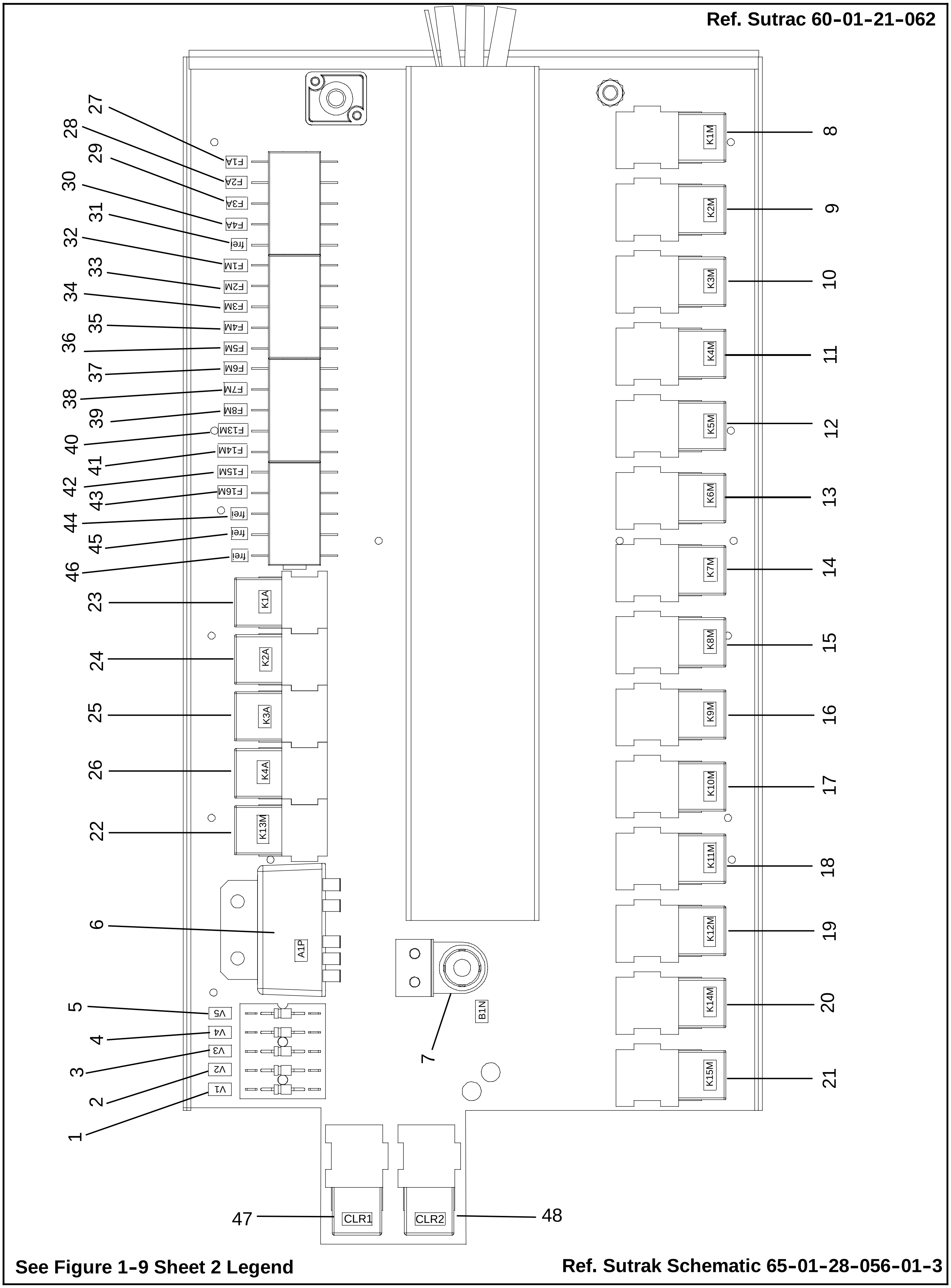


Figure 1–9 Sheet 1 – Electrical Control Board (280P)

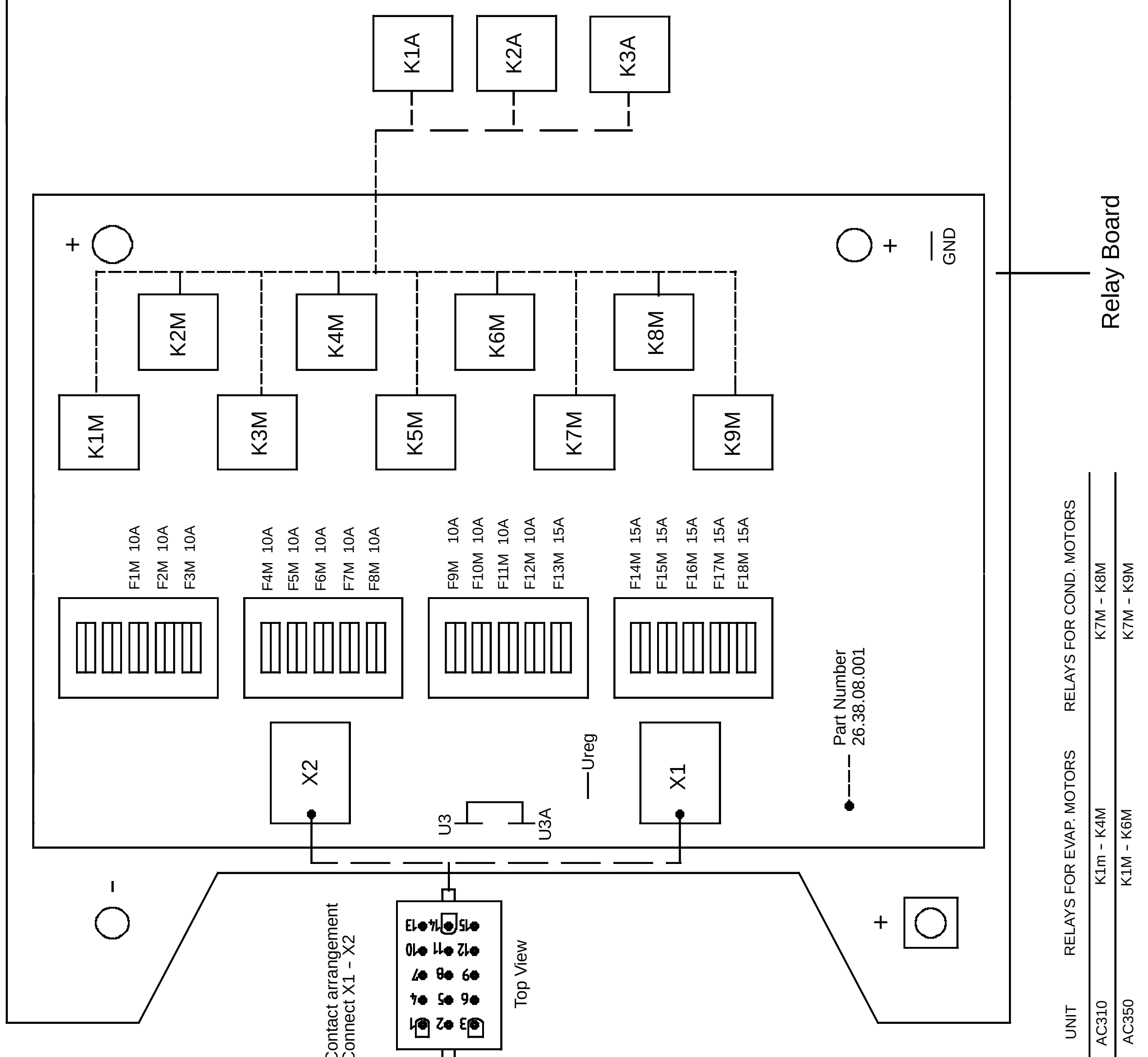
LEGEND

1 V1, Diode, Dash Switch
2 V2, Diode, Dash Switch
3 V3, Diode, Dash Switch
4 V4, Diode, Thermostat, Cooling
5 V5, Diode, Thermostat, Heating
6 Thermostat
7 Return Air Sensor
8 K1M, Relay, Evaporator Low Speed
9 K2M, Relay, Evaporator High Speed
10 K3M, Relay, Evaporator High speed
11 K4M, Relay, Evaporator Low Speed
12 K5M, Relay, Evaporator High Speed
13 K6M, Relay, Evaporator High Speed
14 K7M, Relay, Evaporator Low Speed
15 K8M, Relay, Evaporator High speed
16 K9M, Relay, Evaporator High Speed
17 K10M, Relay, Evaporator Low Speed
18 K11M, Relay, Evaporator High Speed
19 K12M, Relay, Evaporator High Speed
20 K14M, Relay, Evaporator Main, High speed
21 K15M, Relay, Condenser Motors
22 K13M, Relay, Condenser Motors
23 K1A, Relay, Alternator Power
24 K2A, Relay, Compressor Clutch
25 K3A, Relay, Heat Valve and Water Pump
26 K4A, Relay, Evaporator Speed
27 F1A, Fuse, Alternator Output
28 F2A, Fuse, Heat Valve and Water Pump
29 F3A, Fuse, Compressor Clutch
30 F4A, Fuse, Compressor Clutch
31 SPARE
32 F1M, Fuse, Evaporator Motor
33 F2M, Fuse, Evaporator Motor
34 F3M, Fuse, Evaporator Motor
35 F4M, Fuse, Evaporator Motor
36 F5M, Fuse, Evaporator Motor
37 F6M, Fuse, Evaporator Motor
38 F7M, Fuse, Evaporator Motor
39 F8M, Fuse, Evaporator Motor
40 F13M, Fuse, Evaporator Motor
41 F14M, Fuse, Evaporator Motor
42 F15M, Fuse, Condenser Motor
43 F16M, Fuse, Condenser Motor
44 SPARE
45 SPARE
46 SPARE
47 CLR1, Clutch Lockout Relay #1
48 CLR2, Clutch Lockout Relay #2
Ambient Sensor – (Condenser)
Humidity Control Sensor – (Return Air)
OEM Installed Controls
CR1 & CR2, Clutch Relays

See Figure 1–9 Sheet 1 – Electrical Control Board

Figure 1–9 Sheet 2 Legend

1....K1A = Compressor Clutch – Liquid Line Solenoid – Condenser Fans
2....K2A = Heat Valve – Boost Pump
3....K3A = Evaporator Fans
4....K1M – K6M = Individual Evaporator Fans (M1M – M6M)
5....K7M – K9M = Individual Condenser Fans (M21M – M26M)
6....Fuse = Boost Pump & Heat Valve
7....F13M – F18M = Individual Condenser Fans
8....F1M – F12M = Individual Evaporator Fans
9....U Reg = Evaporator Speed Regulation
10...X1 = Condenser Fans
11...X2 = Evaporator Fans
12...X3 – X4 (Not Shown On Drawing) = Dash To Unit Interface Plug



SUTRAK SCHEMATIC #65, 01, 28, 056–01–3

Figure 1–10 AC350 With BT324 Control

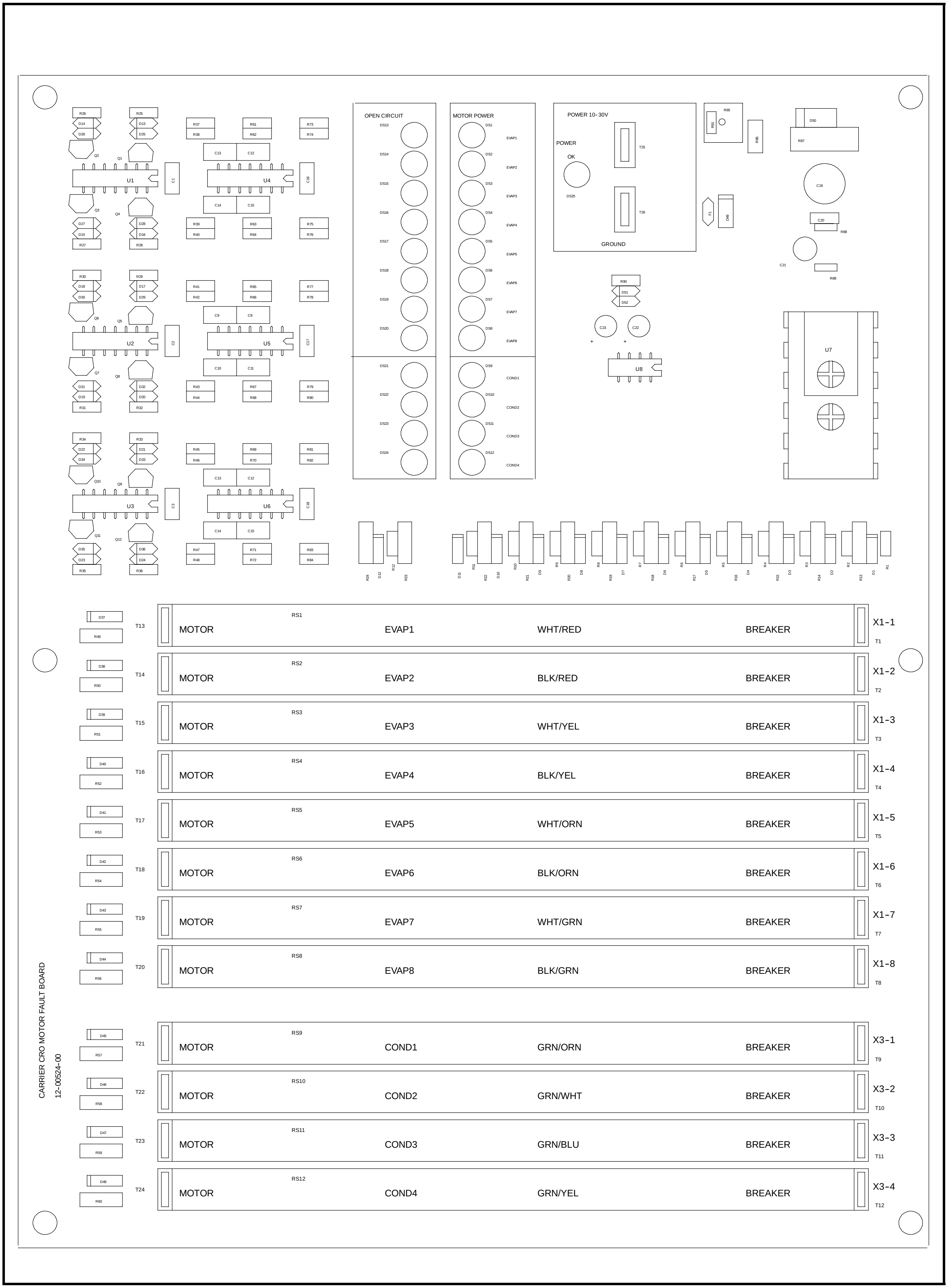


Figure 1-11 Motor Fault Board (Optional)

SECTION 2

OPERATION (MANUAL CONTROLLER)

2.1 STARTING, STOPPING AND OPERATING INSTRUCTIONS

The control switches supplied by Carrier Transport Air Conditioning will be marked with international symbols (See Figure 2.1).

Before starting, electrical power must be available from the bus power supply.

150 Amp @12 VDC or125 Amp @ 24 VDC from a fuse in the battery compartment supplies power for the clutch, evaporator and condenser assemblies.

2.1.1 Starting

a. If the engine is not running, start the engine.

b. Actual start sequence depends on the operating cotrol supplied. If only an ON/OFF switch is supplied, place the switch in the ON (fan symbol) position to start the system in the automatic mode.

c. After the pre-trip inspection is completed, the switches may be set in accordance with the desired control modes.

d. If low or high speed evaporator fan speed is desired, press the FAN SPEED (fan symbol) button to bring speed to the desired level.

2.1.2 Stopping

Placing the ON/OFF (Snowflake) switch in the OFF position will stop the system operation by removing power to the Logic Board.

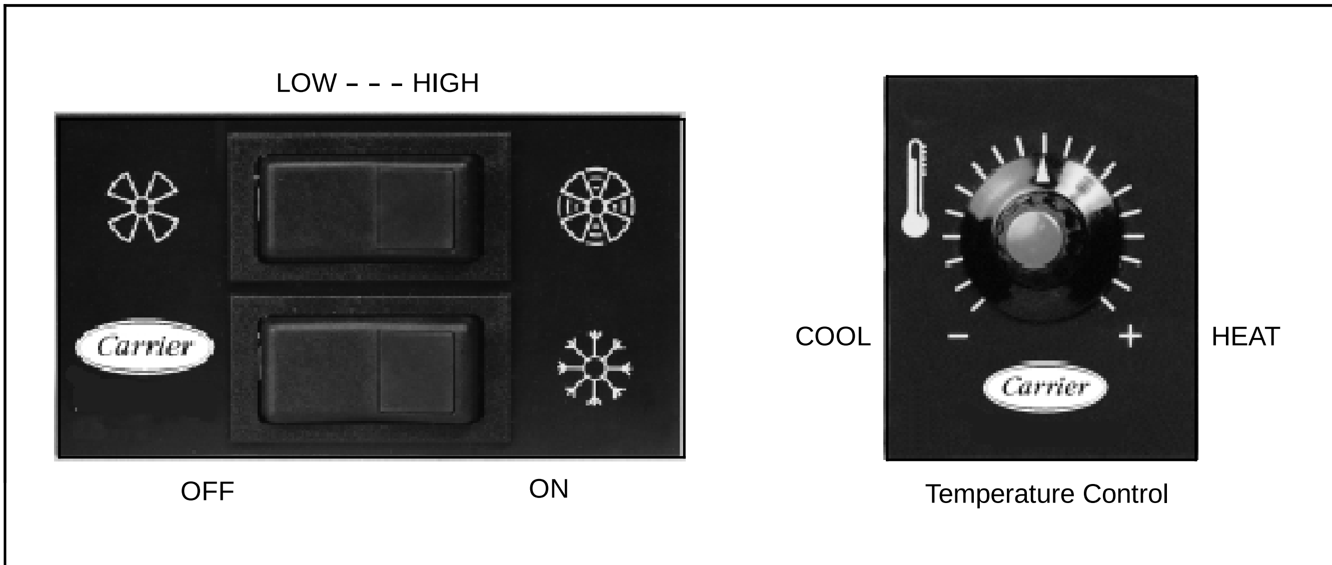


Figure 2.1 Control Switches (Typical)

2.2 PRE-TRIP INSPECTION

After starting system, allow system to stabilize for ten to fifteen minutes and check for the following:

a. Listen for abnormal noises in compressor or fan motors.

b. Check compressor oil level (05G Compressor only).

c. Check refrigerant charge. (Refer to section 5.8.1)

2.3 MODES OF OPERATION

2.3.1 Temperature Control

Temperature is controlled by maintaining the return air temperature measured at the return air grille. To maintain cooling, turn the temperature control knob towards the minus (–) symbol. To start heating cycle, turn the temperature control knob towards the plus (+) symbol (See Figure 2.1).

2.3.2 Cooling Mode

Cooling is accomplished by energizing the compressor and condenser fans, opening the liquid line solenoid valve and closing the heating valve. Once interior temperature reaches the desired set point, the system will de–energize the compressor clutch and allow the system to operate in the vent mode until further cooling is required. The temperature will be maintained within 2° C. or 3.6° F.

A controller programed for reheat will mantain compressor operation and cycle the heat valve to allow reheating of the return air. In the reheat mode interior temperature is maintained at the desired set point while additional dehumidification takes place.

2.3.3 Heating Mode

In the heat mode the liquid line solenoid is closed and the compressor and condenser fans are shut down. The heat valve is opened to allow a flow of engine coolant through the heat section of the evaporator coil. The evaporator fans speed is varied as required to circulate air over the evaporator coil based on the temperature difference from setpoint.

Operating in the heating mode is controlled by the water temperature switch (WTS). The WTS is located on the engine block of the vehicle and is provided by the OEM. It senses the engine collant temperature and reverses its contacts on temperature rise at 105° F. The switch prevents the circulation of cooler air throughout the vehicle as the engine comes up to temperature.

2.3.4 Boost Pump (Optional)

When the unit is in the heat mode, and if a boost pump is supplied by the coach manufacturer, the boost pump relay is energized, providing 24 VDC to activate the boost pump.

2.3.5 Vent Mode

Once the temperature is satisfied, there is a window when the unit will go into a vent mode. This is when there is neither heating or cooling. Only the evaporator fans are operating. The range of the Vent mode is 2°C. or 3.6°F. from the set point. The compressor clutch is disengaged at this time.

2.3.6 Compressor Unloader Control (Only with 05G or 05K Compressors)

When operating in cooling, the unloaders are used to reduce system capacity as return air temperature approaches set point. Operation of the unloaders balances system capacity with the load and thereby prevents overshoot from set point.

Relay Board mounted unloader outputs control the capacity of the compressor by energizing or de–energizing unloader solenoid valves. The model 05G compressor has three banks of two cylinders each. Enercizing a valve de–activates a bank of cylinders. The outboard cylinder banks of the 05G are equipped with unloader valves (UV1 and UV2), each controlling two cylinders; this allows the 05G to be operated with two, four or six cylinders.

The unloaders are used to control system capacity by controlling compressor capacity.

Control of the unloaders is with the pressure switches.

a. Suction Pressure

The unloaders are used to control suction pressure and thereby prevent coil frosting:

1. Compressor Unloader UV1 Relay – When the suction pressure decreases below 26 psig (R–134a), unloader UV1 is energized, unloading a cylinder bank (2 cylinders); this output will remain energized until the pressure increases to above 34 psig (R–134a).
2. Compressor Unloader UV2 Relay – When suction pressure decreases below 23 psig (R–134a), unloader UV2 is energized, unloading the second compressor cylinder bank; this output will remain energized until the pressure increases to above 31 psig (R–134a).

b. Discharge Pressure

Discharge pressure is also controlled by the unloaders:

1. Compressor Unloader UV1 Relay – When the discharge pressure increases above setpoint A (see Table 2.1), unloader UV1 is energized; this unloader will remain energized until the pressure decreases below set point B (see Table 2.1).

Table 2.1 Unloader UV1 Relay

HP Switch (PSIG)	Set Point A (PSIG)	Set Point B (PSIG)
300 (R–134a)	275	220
350 (R–134a) (High Ambient)	325	270

2. Compressor Unloader UV2 Relay – On R–134a systems when the discharge pressure increases above setpoint A (see Table 2.2), unloader UV2 is energized; this unloader will remain energized until the pressure decreases below set point B (see Table 2.2).

Table 2.2 Unloader UV2 Relay

HP Switch (PSIG)	Set Point A (PSIG)	Set Point B (PSIG)
300 (R–134a)	285	225
350 (R–134a) (High Ambient)	330	275

2.3.7 Override Mode – AC310 (Dehumidification)

When in the heat mode the compressor will not operate. The thermostat will allow only COOL, VENT or HEAT modes independently. An override switch has been installed in the return air area to allow the compressors to run when in the HEAT mode. Moving the switch to the ON position will energize both clutch relays energizing the clutches. There are two temperature sensors that are in series with the clutch relay circuit, Ambient Sensor (mounted in the condenser) and Humidity Control Sensor (mounted in the return air area). As long as the return air temperature is above 60° F and the ambient is above 25° F, the override circuit will function when energized, providing dehumidification. (See section 1.4 for sensor specs)

2.3.8 Evaporator Fan Speed Selection

Evaporator fan speed(s) selection is one method of controlling the cooling and heating throughout the bus passenger compartment. The thermostat control is the other.

2.3.9 Compressor Clutch Control

(A–6, TM–16, TM–21)

A belt driven electric clutch is employed to transmit engine power to the air conditioning compressor. De-energizing the clutch's electric coil disengages the clutch and removes power from the compressor. The clutch will be engaged when in cooling and disengaged when the system is off, in heating or during high and low pressure conditions.

The clutch coil will be de-energized if the discharge pressure rises to the 365 ±10 psig (19.42 bar) cutout setting of the compressor mounted high pressure switch. The clutch coil will energize (Automatic Re–Set) when the discharge pressure falls to 280 ± 10 psig (11.41 bar).

The clutch coil will be de-energized (open) if the suction pressure (LP) decreases below 6 ± 3 psig (0.45 bar). The clutch coil will energize (Automatic Re–Set) when suction pressure rises (close) to 25 ± 3 psig (1.7 bar).

2.4 SEQUENCE OF OPERATION (280P / 282P)

2.4.1 Electronic Thermostat

With a signal from the Hydraulic Brake Module (or other 12 VDC source) the A/C Power Relay is grounded, sending 12 VDC to the K1A relay. K1A relay energizes sending battery power (Line B+) to the Dash Control switches (S1A & S2A).

Begining with the Fan Speed Switch (S1A) in the low speed position (vent 1) the following actions take place:

a. Power flows from the Fan Speed Switch (S1A) through relay K4A normally closed contacts. Line U2 energizes evaporator fan motor low speed relays (K1M, K4M, K7M & K10M). Closing these relays allows power to flow from the battery (line B+) through the fan motors with two motors in series, operating the motors at low speed.

b. The ON/OFF switch (S2A) is then placed in the ON position. Power flows from the switch to energize the Thermostat. With the Thermostat calling for cooling, power also flows from the cooling switch:

1. Thorugh the Humidity Control Sensor and the Ambient Sensor Switches located in the return air and condenser respectively. If both of these switches are in the closed position the following sequence will take place.

2. Power will flow to the Clutch Lockout Relays (CLR1 & CLR2) allowing power to energize the Clutch Relays (CR1 & CR2). Relays CR1 & CR2 are poweredon terminal 30 from an OEM breaker, (A/C Low Voltage Breaker). Energizing these relays will send power through the high and low pressure switches and to both compressor clutches energizing the clutch coils and starting the compressor.

3. To the liquid line solenoids (Y1A & Y2A) to start the flow of refrigerant.

4. Through line U3, to energize the condenser fan relays (K14M & K15M). Energizing these relays will send B+ power to start the condenser fan motors.

The unit is now in low speed cooling.

5. To bring the evaporator fans to high speed the fan speed switch (S1A) is placed in the HIGH (Vent 2) position. Power flows from the switch through line U5 to energize the high speed relay (K13M). The normally closed low speed relay (K4A) is de–energized opening the low speed circuit. Power flows from the high speed relay (K13M) to energize the high speed fan relays (K2M, K3M, K5M, K6M, K8M, K9M, K11M, & K12M). Energizing these relays individually grounds each evaporator fan motor separately placing them in high speed operation.

c. With the thermostat calling for heating, power flows from the heat switch:

1. Through line UH to energize the heat relay (K3A). With the heat realy energized, power flows from the battery (line B+) to start the water pump and open the heat valve. The unit is now in the heat mode. Fan speeds can be adjusted the same as in the cooling mode.

d. With the Thermostat calling for Heating and the need for Dehumidification is required:

1. The override switch, located in the return air inlet is switched to the ON position.

2. Power will flow through the ambient and humidity control switch, if closed, and energize the cooling circuits at the same time as heating.

This will put the system in a Reheat Mode of operation. The thermostat will only cycle the heat valve and pump. The cooling circuit will stay energized as long as the override switch is in the ON position and both sensor switches are closed.

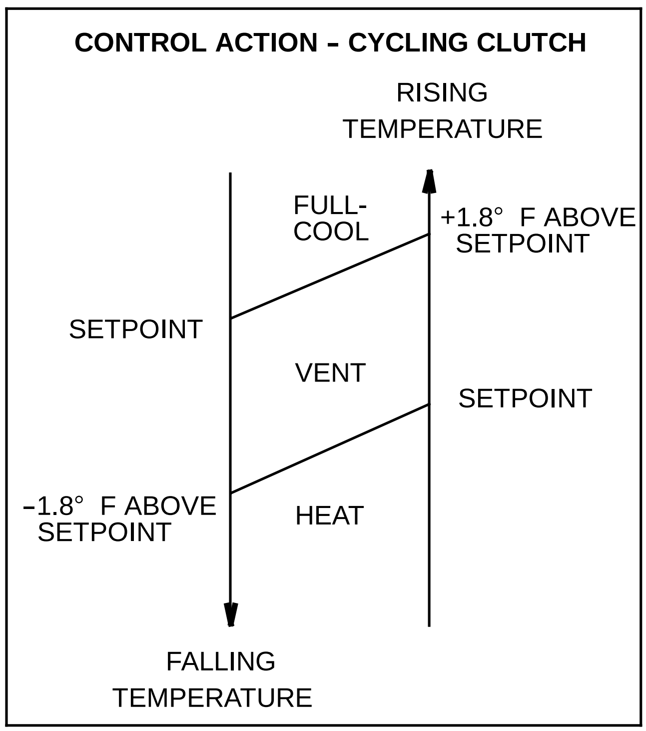


Figure 2.2 280P / 282P Thermostat

SECTION 3

OPERATION BT324 CONTROLLER

3.1 STARTING, STOPPING AND OPERATING INSTRUCTIONS

The BT324 Carrier Sutrak Digital Display (CSDD) is marked with international symbols (See Figure 3-2).

Before starting, electrical power must be available from the bus power supply (See Figure 3-1).

A 150 Amp @12 VDC or a125 Amp @ 24 VDC fuse in the battery compartment passes power for the clutch, evaporator and condenser assemblies.

Figure 3-1 Bus Dash With A/C Switch & BT324 CSDD Controller

3.1.1 Starting

a. If the engine is not running, start the engine.

b. When the 12/24VDC power is applied, the driver display will illuminate and show return air set point. Press the A/C key (Item 5 Figure 3-2) on the display to trigger the start up sequence.

c. After the pre-trip inspection is completed, the switches may be set in accordance with the desired control modes.

3.1.2 Stopping

Toggling the A/C key (Item 5 Figure 3-2) on the display again will stop the system operation.

3.2 PRE-TRIP INSPECTION

After starting system, allow system to stabilize for ten to fifteen minutes and check for the following:

a. Listen for abnormal noises in compressor or fan motors.

b. Check compressor oil level (05G Compressor only).

c. Check refrigerant charge. (Refer to section 5.8.1)

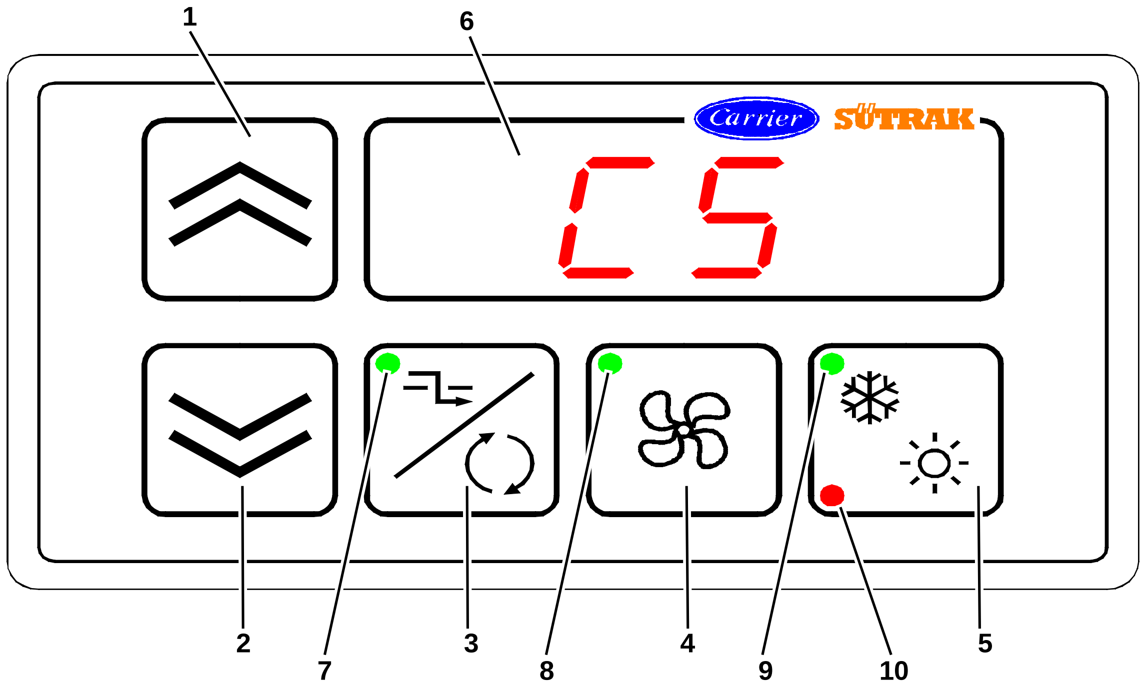


Figure 3-2 BT324 CSDD Controller

KEYS

1. Plus Key
2. Minus Key
3. Recirculate/Fresh Air Key
4. Blower Control Key
5. Automatic Climate Control (A/C)

LEDS

6. Display
7. Fresh Air Operation (Green)
8. Manual Blower Control 'ON' (Green)
9. Heating Mode (Green)
10. Malfunction Light (Red)

3.3 SEQUENCE OF OPERATION BT324 CSDD

3.3.1 Function of Keys when "Engine On" and controller active:

a. Plus Key – Increases interior temperature setpoint by 1° per stroke or increases manual blower speed, depending on displayed mode.

b. Minus Key – Decreases interior temperature setpoint by 1° per stroke or decreases manual blower speed, depending on displayed mode.

c. Recirculating Air/Fresh Air – Switches from Recirculating Air to Fresh Air and vice–versa.

d. Blower Control – Switches on the manual blower control.

e. Automatic Climate Control – Switches on the Automatic Temperature Control.

f. Temperature Indicator **(Key 2 + Key 3)** – Shows the inside temperature for 10 seconds. If pressed a second time shows the outside temperature for 10 seconds (optional).

g. Reheat (optional) **(Key 3 + Key 5)** – Starts Reheat mode for 3 minutes (duration adjustable).

h. Controller Off **(A/C Switch To Off)** – Switches off all control functions and the display.

NOTE

The following blower steps are disabled when the automatic climate control is on:

2–, 3–step blower: Off

Continuously adjustable blower: Off

3.3.2 Illuminating Indications (Display)

With "Engine–On" and Controller active

3.4 Operating Instructions BT324

When the engine is running, toggle the A/C Switch to on to activate the Air Conditioning Unit.

3.4.1 Display

When the unit is ON, the display shows the interior setpoint temperature. When selecting individual functions, the display shows the corresponding information for a short period of time. The display is dark when the engine and control unit are OFF.

3.4.2 Interior Temperature Control

Press the Plus (1) or Minus (2) keys to set the desired interior temperature.

The temperature can be adjusted between 64° F (18° C) and 82° F (28° C).

When the outside temperatures are below 35° F (2° C) (adjustable parameter), the cooling function remains disabled.

3.4.3 Ventilation

When the unit is operating in Automatic Climate Control mode, the blower speed is controlled based on the room temperature.

However, the blowers may be switched to manual mode of operation by pressing the blower key.

Press the Plus or Minus keys to define one of 5 different blower steps. The blowers can not be switched OFF when Automatic Climate Control is ON.

When Automatic Climate Control is OFF, the blowers stop when the manual control is turned to zero.

3.4.4 Reheat (optional)

The Reheat mode is used to remove air humidity and to help defog the windshield. Press **Key 3** (Recirculating Air/Fresh Air) and **Key 5** (Automatic Climate Control) at the same time to activate Reheat. Heating and cooling will be energized on for 3 minutes (adjustable parameter). In addition, the blowers are switched to maximum speed and the fresh air flap is closed. At the end of the pre-set duration of time, the functions return to the previously selected settings.

Reheat mode is disabled with the outside temperature is below 35° F (2° C) (adjustable parameter), when the sensor is not installed, or when there is a sensor failure.

3.4.5 Temperature Indication

Press **key 2** (minus) **and key 3** (Recirculating Air/Fresh Air) at the same time to display the inside temperature for 10 seconds.

Optionally, the outside temperature may be displayed when pressing the keys a second time.

A sensor malfunction is displayed by **"i --"** or **"o --"**.

3.5 CHANGING BETWEEN °F (FAHRENHEIT) AND °C (CELCIUS)

Procedures for changing the BT324 Controller between Fahrenheit and Celcius is as follows:

a. Engine "OFF" & Ignition "ON".

b. Press **Key 1** (plus) **and Key 2** (minus) at the same time until the display shows the word **"Code"**.

NOTE

After the display shows the word "Code" you have 5 seconds to enter the correct access code.

c. Press **Key 1** (Plus Key) one time and release.

d. Press **Key 3** (Recirculating Air/Fresh Air) one time and release.

e. Press **Key 4** (blower control) one time and release.

The display will show the mode "Fah" for temperatures in °F or the mode "Cel" for temperatures in °C.

f. Press **Key 1** (plus) or **Key 2** (minus) to change the temperature mode.

g. Press **Key 5** (automatic climate control) one time to end the program.

SECTION 4

TROUBLESHOOTING

Table 4-1 General System Troubleshooting Procedures

INDICATION - TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
4.1 System Will Not Cool		
Compressor will not run	Drive-Belt loose or defective Clutch coil defective Clutch malfunction Compressor malfunction	Check Check/Replace Check/Replace See Table 1-3
Electrical malfunction	Coach power source defective Circuit Breaker/safety device open	Check/Repair Check/Reset
4.2 System Runs But Has Insufficient Cooling		
Compressor	Drive-Belt loose or defective Compressor valves defective	Check See Table 1-3
Refrigeration system	Abnormal pressures No or restricted evaporator air flow Expansion valve malfunction Restricted refrigerant flow Low refrigerant charge Service valves partially closed Safety device open Liquid solenoid valve stuck closed	4.3 4.5 4.6 5.11 5.8 Open 1.5 5.13
Restricted air flow	No evaporator air flow or restriction	4.5
Heating system	Heat valve stuck open	4.7
4.3 Abnormal Pressures		
High discharge pressure	Refrigerant overcharge Noncondensable in system Condenser motor failure Condenser coil dirty	5.8.1 Check Check Clean
Low discharge pressure	Compressor valve(s) worn or broken Low refrigerant charge	See Table 1-3 5.8
High suction pressure	Compressor valve(s) worn or broken	See Table 1-3
Low suction pressure	Suction service valve partially closed Filter-drier inlet valve partially closed Filter-drier partially plugged Low refrigerant charge Expansion valve malfunction Restricted air flow	Open Check/Open 5.11 5.8 4.6 4.5
Suction and discharge pressures tend to equalize when system is operating	Compressor valve defective	See Table 1-3
4.4 Abnormal Noise Or Vibrations		
Compressor	Loose mounting hardware Worn bearings Worn or broken valves Liquid slugging Insufficient oil Clutch loose, rubbing or is defective Drive-Belt cracked, worn or loose Dirt or debris on fan blades	Check/Tighten See Table 1-3 SeeTable 1-3 4.6 1.3 Repair/Replace Adjust/Replace Clean

Table 4–1 General System Troubleshooting Procedures – Continued

INDICATION – TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
4.4 Abnormal Noise Or Vibrations – Continued		
Condenser or evaporator fans	Loose mounting hardware Defective bearings Blade interference Blade missing or broken	Check/Tighten Replace Check Check/Replace
4.5 No Evaporator Air Flow Or Restricted Air Flow		
Air flow through coil blocked	Coil frosted over Dirty coil Dirty filter	Defrost coil Clean Clean/Replace
No or partial evaporator air flow	Motor(s) defective Motor brushes defective Evaporator fan loose or defective Fan damaged Return air filter dirty Icing of coil Fan relay(s) defective Safety device open Fan rotation incorrect	Repair/Replace Replace Repair/Replace Repair/Replace Clean/Replace Clean/Defrost Check/Replace 1.5 Check
4.6 Expansion Valve Malfunction		
Low suction pressure with high superheat	Low refrigerant charge Wax, oil or dirt plugging valve orifice Ice formation at valve seat Power assembly failure Loss of bulb charge Broken capillary tube	5.8 Check 4.6 Replace Replace 5.16
Low superheat and liquid slugging in the compressor	Bulb is loose or not installed. Superheat setting too low Ice or other foreign material holding valve open	5.16 5.16
Side to side temperature difference (Warm Coil)	Wax, oil or dirt plugging valve orifice Ice formation at valve seat Power assembly failure Loss of bulb charge Broken capillary	Check 5.7 Replace Replace 5.16
4.7 Heating Malfunction		
Insufficient heating	Dirty or plugged heater core Coolant solenoid valve(s) malfunctioning or plugged Low coolant level Strainer(s) plugged Hand valve(s) closed Water pumps defective Auxiliary Heater malfunctioning.	Clean Check/Replace Check Clean Open Repair/Replace Repair/Replace
No Heating	Coolant solenoid valve(s) malfunctioning or plugged Controller malfunction Pump(s) malfunctioning Safety device open	Check/Replace Replace Repair/Replace 1.5
Continuous Heating	Coolant solenoid valve stuck open	5.12

SECTION 5

SERVICE

⚠ WARNING

Be sure to observe warnings listed in the safety summary in the front of this manual before performing maintenance on the hvac system

⚠ WARNING

Read the entire procedure before beginning work. Park the coach on a level surface, with parking brake applied. Turn main electrical disconnect switch to the off position.

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. The refrigerant recovery system is available from Carrier Transicold (Carrier Transicold P/N MVSII-115 or MVSII-240). When working with refrigerants you must comply with all local goverment environmental laws.

5.1 MAINTENANCE SCHEDULE

SYSTEM		SYSTEM	REFERENCE SECTION
ON	OFF		
a. Daily Maintenance			
X		Pre-trip Inspection – after starting	2.2
	X	Check tension and condition of drive belts.	None
b. Weekly Inspection			
	X	Perform daily inspection	See above
	X	Check condenser, evaporator coils and air filters for cleanliness	None
	X	Check refrigerant hoses, fittings and component connections for leaks	5.6
X		Feel filter-drier for excessive temperature drop across drier	5.11
c. Monthly Inspection and Maintenance			
	X	Perform weekly inspection and maintenance	See above
	X	Clean evaporator drain pans and hoses	None
	X	Check wire harnesses for chafing and loose terminals	Replace/Tighten
	X	Check fan motor bearings	None
	X	Check compressor mounting bolts for tightness	None

5.2 REMOVING EVAPORATOR COVER

To remove the evaporator cover do the following:

1. Turn all the 1/4 turn cam locks counterclockwise.
2. Using two people carefully grasp the cover under the bottom edge and lift up.
3. Place the evaporator cover on top of the condenser section.

5.3 REMOVING CONDENSER COVER

To remove the condenser cover do the following:

1. Turn all the 1/4 turn cam locks counterclockwise.
2. Using two people carefully grasp the cover under the bottom edge and lift up.
3. Place the condenser cover on top of the evaporator section.

5.4 INSTALLING MANIFOLD GAUGE SET

A manifold gauge set can be used to determine system operating pressures, add charge, equalize or evacuate system.

When the suction pressure hand valve is frontseated (turned all the way in), the suction (low) pressure can be read. When the discharge pressure hand valve is frontseated, discharge (high) pressure can be read. When both valves are open (turned counterclockwise), high pressure vapor will flow into the low side. When only the low pressure valve is open, the system can be charged or evacuated.

⚠ CAUTION

The AC310 & AC350 Rooftop Systems have R134a service port couplings installed on the compressor and 1/4 inch flare (Acme) fittings installed on the unit piping.

5.4.1 Installing R-134a Manifold Gauge/Hose SET

An R-134a manifold gauge/hose set with self-sealing hoses is pictured in Figure 5-1. The manifold gauge/hose set is available from Carrier Transicold. (Carrier Transicold P/N 07-00294-00, which includes items 1 through 6, Figure 5-1). To perform service using the manifold gauge/hose set, do the following:

a. Preparing Manifold Gauge/Hose Set for use.

1. If the manifold gauge/hose set is new or was exposed to the atmosphere it will need to be evacuated to remove contaminants and air as follows:
2. Back-seat (turn counterclockwise) both field service couplers (see Figure 5-1) and mid-seat both hand valves.
3. Connect the yellow hose to a vacuum pump and an R-134a cylinder.
4. Evacuate to 10 inches of vacuum and then charge with R134a to slightly positive pressure of 1.0 psig.
5. Front-seat both manifold gauge set hand valves and disconnect from cylinder. The gauge set is now ready for use.

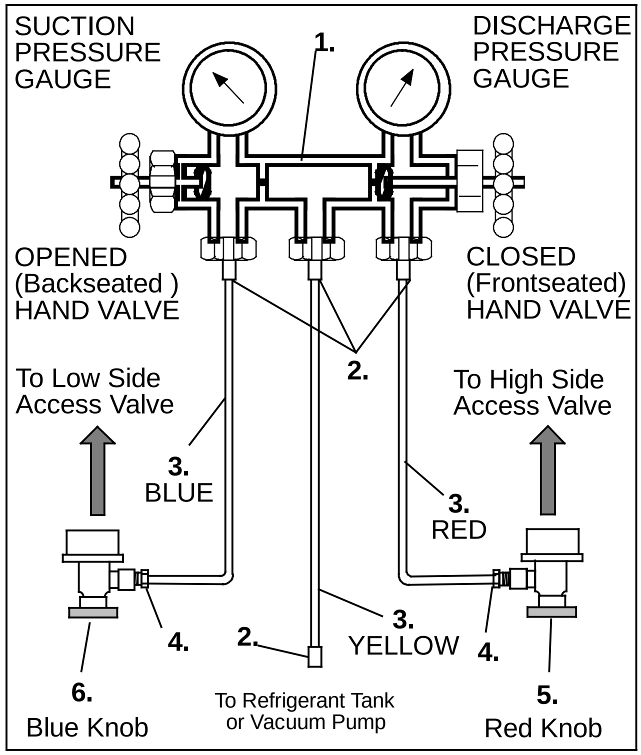


Figure 5-1 Manifold Gauge Set (R-134a)

1. Manifold Gauge Set
2.. Hose Fitting (0.5-16 Acme)
3.. Refrigeration and/or Evacuation Hose
. (SAE J2196/R-134a)
4.. Hose Fitting w/O-ring (M14 x 1.5)
5.. High Side Field Service Coupling
6.. Low Side Field Service Coupling

b. Connecting the Manifold Gauge Gauge/Hose Set.

To connect the manifold gauge/hose set for reading pressures, do the following:

1. Connect the field service couplers (see Figure 5-1) to the high and low in-line service ports.
2. Turn the field service coupling knobs clockwise, which will open the system to the gauge set.
3. Read the system pressures.

c. Removing the Manifold Gauge Set.

1. While the compressor is still ON, mid-seat both hand valves on the manifold gauge set and allow the pressure in the manifold gauge set to be drawn down to low side pressure. This returns any liquid that may be in the high side hose to the system.

⚠ CAUTION

To prevent trapping liquid refrigerant in the manifold gauge set be sure set is brought to suction pressure before disconnecting.

2. Back-seat both field service couplers and front-seat both manifold set hand valves. Remove the couplers from the in-line access valves.
3. Install both in-line access valve caps.

5.5 PUMPING THE SYSTEM DOWN OR REMOVING THE REFRIGERANT CHARGE

NOTE

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

5.5.1 System Pump Down For Low Side Repair

To service or replace the filter-drier, pump the refrigerant to the condenser and receiver as follows:

a. Remove evaporator and condenser covers.

b. Install manifold gauge/hose set. (Refer to Section 5.4.1).

c. Frontseat the filter-drier inlet service valve by turning clockwise. It will be necessary to install a jumper across the low pressure switch (LPS) contacts at the compressor in order to reach 0 PSIG.

d. Start the system and run in cooling. Stop the unit when suction reaches 10 "/hg (25.4 cm/hg) vacuum.

e. Frontseat filter/drier outlet service valve to trap refrigerant in the high side of the system between the compressor and the filter-drier inlet valve. Wait 5 minutes to verify that system remains in a vacuum.

f. Service or replace filter-drier.

g. Leak check connections after replacing filter-drier. Refer to paragraph 5.6.

h. Using refrigerant hoses designed for vacuum service, evacuate and dehydrate the filter-drier by connecting a vacuum pump to center connection of manifold gauge set. Evacuate system to 500 microns. Close off pump valve, isolate vacuum gauge and stop pump. Wait 5 minutes to verify that vacuum holds.

i. Read Micron Gauge again to verify that the pressure did not rise more than 500 microns within that 5-minute timeframe.

If the Micron Gauge rises more than 500 microns (to excede a gauge reading of 500 + 500 = 1000 microns) at the end of 5 minutes, either a leak is present or an unacceptable level of moisture remains in the circuit. If the gauge reads a gain of less than 500 microns during the 5-minute wait, the circuit is acceptably tight and dry.

j. Once vacuum is maintained, recharge system by admitting vapor from the refrigerant cylinder.

k. Remove manifold gauges. Backseat both filter drier service valves.

5.5.2 Removing Entire System Charge

To remove the entire refrigerant charge, do the following:

a. Connect a manifold gauge set to the system as shown in Figure 5-2 .

b. Connect a reclaimer to the center manifold gauge set connection.

c. Recover refrigerant in accordance with reclaimer manufacturers instructions.

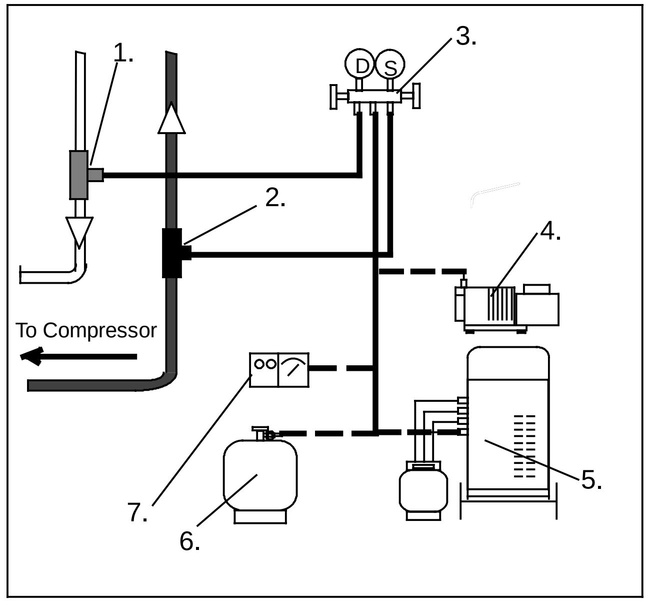


Figure 5-2 In-Line Service Connections

1. Discharge Service Port
2. Suction Service Port
3. Manifold Gauge Set
4. Vacuum Pump
5. Reclaimer
6. Refrigerant Cylinder
7. Thermistor Vacuum Gauge

5.6 REFRIGERANT LEAK CHECK

A refrigerant leak check should always be performed after the system has been opened to replace or repair a component.

To check for leaks in the refrigeration system, perform the following procedure:

NOTE

It must be emphasized that only the correct refrigerant should be used to pressurize the system. Use of any other refrigerant will contaminate the system, and require additional evacuation.

a. Ensure filter drier service and solenoid valves are open.

1. Filter drier service valves should be back seated.

b. If system is without refrigerant, charge system with refrigerant vapor to build up pressure between 20 to 30 psig (1.36 to 2.04 bar).

c. Add sufficient nitrogen to raise system pressure to 150 to 200 psig *(10.21 to 13.61 bar).*

d. Check for leaks. The recommended procedure for finding leaks in a system is with an electronic leak detector. Testing joints with soapsuds is satisfactory only for locating large leaks.

e. Remove test gas and replace filter-drier.

f. Evacuate and dehydrate the system. (Refer to paragraph 5.7.)

g. Charge the unit. (Refer to paragraph 5.8.)

5.7 EVACUATION AND DEHYDRATION

5.7.1 General

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. An evacuation should take place after a system repair (replacement of filter drier. expansion valve, solenoid valve, etc).

5.7.2 Preparation

NOTE

Using a compound gauge (manifold gauge) for determination of vacuum level is not recommended because of its inherent inaccuracy.

a. Evacuate and dehydrate only after pressure leak test. (Refer to paragraph 5.6)

b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump with a minimum of 5 cfm *(8.5 m^3/hr)* volume displacement, (CTD P/N 07-00176-11), and a good vacuum indicator (CTD P/N 07–00414–00).

c. Keep the ambient temperature above 60°F *(15.6°C)* to speed evaporation of moisture. If ambient temperature is lower than 60°F *(15.6°C)*, ice may form before moisture removal is complete.

5.7.3 Procedure for Evacuation and Dehydrating System

a. Remove refrigerant using a refrigerant recovery system. Refer to paragraph 5.5.2

b. The recommended method is connecting 3/8” OD refrigerant hoses designed for vacuum service as shown in Figure 5–3.

c. Make sure vacuum pump valve is open.

d. Start vacuum pump. Slowly open valves halfway and then open vacuum gauge valve.

e. Evacuate unit until vacuum gauge indicates 500 microns Hg vacuum. Close gauge valve, vacuum pump valve, and stop vacuum pump.

f. Close off pump valve, and stop pump. Wait five minutes to see if vacuum holds.

g. Charge system. Refer to paragraph 5.8.2

5.8 ADDING REFRIGERANT TO SYSTEM

5.8.1 Checking Refrigerant Charge

The following conditions must be met to accurately check the refrigerant charge.

a. Bus engine operating at high idle.

b. Unit operating in cool mode for 15 minutes.

c. Compressor discharge pressure at least 150 psig (10.21 bar). (It may be necessary to block condenser air flow to raise discharge pressure.)

NOTE

Ideal charging conditions are with ambient above 86°F (30°C) and interior vehicle temperature above 77°F (25°C). Charging to a full sight glass at lower temperatures may lead to system overcharge.

d. Under the above conditions, the system is properly charged when the liquid line sight glase shows full (no bubbles present).

5.8.2 Adding Full Charge

a. Install manifold gauge set at the in–line suction and discharge service ports.

b. Evacuate and dehydrate system. (Refer to paragraph 5.7)

c. Place appropriate refrigerant cylinder on scales. Prepare to charge liquid refrigerant by connecting charging hose from container to center connection on gage manifold. Purge air from hoses.

d. Note weight of refrigerant and cylinder.

e. Open cylinder valve, backseat discharge valve on gauge manifold and allow liquid refrigerant to flow into the high side of the system

f. When correct charge has been added (refer to paragraph 1.3, refrigerant specifications), close cylinder valve and frontseat manifold discharge valve.

g. Prepare the cylinder as required to allow vapor charging. Backseat the manifold suction valve and charge vapor until the correct charge has been added. Close cylinder valve and frontseat suction manifold set.

h. Check charge level in accordance with the procedures of paragraph 5.8.1.

5.9 CHECKING FOR NONCONDENSIBLES

To check for noncondensibles, proceed as follows:

a. Stabilize system to equalize pressure between the suction and discharge side of the system.

b. Check temperature at the condenser and receiver.

c. Check pressure at the discharge (in–line) service port.

d. Check saturation pressure as it corresponds to the condenser/receiver temperature. See temperature–Pressure chart Table Table 5–1. for R134a.

e. If gauge reading is 3 psig or more than the calculated P/T pressure in step d., noncondensables are present.

f. Remove refrigerant using a refrigerant recovery system.

g. Evacuate and dehydrate the system. (Refer to paragraph 5.7.)

h. Charge the unit. (Refer to paragraph 5.8.2.)

5.10 CHECKING AND REPLACING HIGH OR LOW-PRESSURE CUTOUT SWITCH

5.10.1 Replacing High Or Low Pressure Switches

a. The high and low pressure switches are equipped with schrader valves to allow removal and installation without recovering the refrigerant charge.

b. Disconnect wiring from defective switch.

c. Install new cutout switch after verifying switch settings.

5.10.2 Checking High Or Low Pressure Switches

WARNING

Do not use a nitrogen cylinder without a pressure regulator

WARNING

Do not use oxygen in or near a refrigeration system as an explosion may occur.

a. Disconnect wiring and remove switch from system.

b. Connect an ohmmeter across switch terminals. If the switch is good, the ohmmeter will indicate no resistance, indicating that the contacts are closed.

c. Connect switch to a cylinder of dry nitrogen. (SeeFigure 5-4).

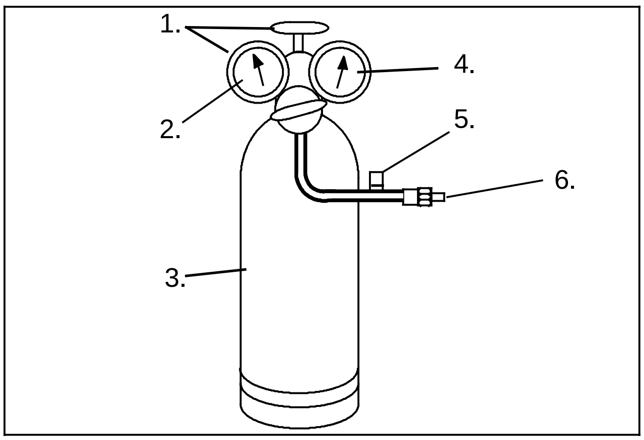


Figure 5-4 Checking High Pressure Switch

1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge (0 to 400 psig = 0 to 27.22 bar)
5. Bleed-Off Valve
6. 1/4 inch Connection

d. Set nitrogen pressure regulator higher than switch cutout setting. (refer to paragraph 1.3.)

e. Open cylinder valve. Slowly open the regulator valve to increase the pressure until it reaches cutout point. The switch should open, which is indicated by an infinite reading on an ohmmeter (no continuity).

f. Close cylinder valve and release pressure through the bleed-off valve. As pressure drops to cut-in point, the switch contacts should close, indicating no resistance (continuity) on the ohmmeter.

g. Replace switch if it does not function as outlined above.

5.11 FILTER-DRIER

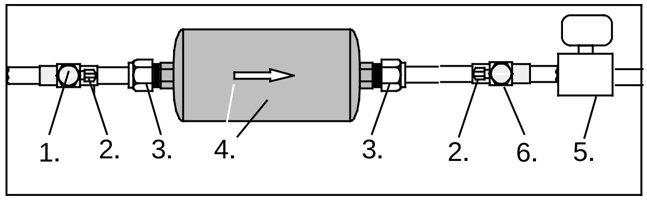


Figure 5-5 Filter-Drier Removal

1. Filter-Drier Inlet Service Valve
2. Valve Service Port
3. Flare Nut
4. Filter-Drier
5. Liquid Line Solenoid Valve
6. Filter-Drier Outlet Service Valve

5.11.1 To Check Filter-Drier

The filter-drier (See Figure 5-5) must be changed if the system has been opened, (for any reason), or the filter drier is partially restricted. Restriction can be identified by either the outlet frosting or a temperature difference between the inlet and outlet.

5.11.2 To Replace Filter-Drier Assembly

Filter Drier replacement can be accomplished by performing either one of the two procedures recommended.

1. System operating, low side pump down (refer to section 3.4.1).
2. System not operating (see below).

a. Turn the driver's A/C switch to “OFF” position.

b. Frontseat the filter-drier service valves on both sides of the filter drier.

c. Place a new filter-drier near the unit for immediate installation.

WARNING

The filter-drier may contain liquid refrigerant. Slowly loosen the connecting nuts and avoid contact with exposed skin or eyes.

d. Using two open end wrenches, slowly crack open the connecting nuts on each side of the filter-drier assembly. Remove the filter-drier assembly.

e. Remove seal caps from the new filter-drier. Apply a light coat of mineral oil to the filter-drier connections.

f. Assemble the new filter-drier to lines ensuring that the arrow on the body of the filter-drier points in the direction of the refrigerant flow (refrigerant flows from the receiver to the evaporator). Finger tighten the connecting nuts.

g. Tighten filter-drier connecting nuts using two open end wrenches.

h. Evacuate system (refer to section 5.7).

i. Backseat (fully close) both service valve ports and replace valve caps.

j. Check refrigerant charge (refer to section 5.8.1).

k. Remove Gauges.

5.12 SERVICING THE HEAT VALVE

The heat valve (Figure 5-6) requires no maintenance unless a malfunction to the internal parts or coil occurs. This may be caused by foreign material such as: dirt, scale, or sludge in the coolant system, or improper voltage to the coil.

NOTE

The OEM supplied heating (hot water) Solenoid Valve is normally located outside of the AC310/350 rooftop air conditioning system.

There are only three possible valve malfunctions: coil burnout, failure to open, or failure to close.

Coil burnout may be caused by the following:

1. Improper voltage
2. Continuous over-voltage, more than 10% or Under-voltage of more than 15%.
3. Incomplete magnetic circuit due to the omission of the coil housing or plunger.
4. Mechanical interference with movement of plunger which may be caused by a deformed enclosing tube.

Failure to open may be caused by the following:

1. Coil burned out or an open circuit to coil connections.
2. Improper voltage.
3. Torn diaphragm.
4. Defective plunger or deformed valve body assembly.

Failure to close may be caused by the following:

1. Defective plunger or deformed valve body assembly.
2. Foreign material in the valve.
3. Torn diaphragm.

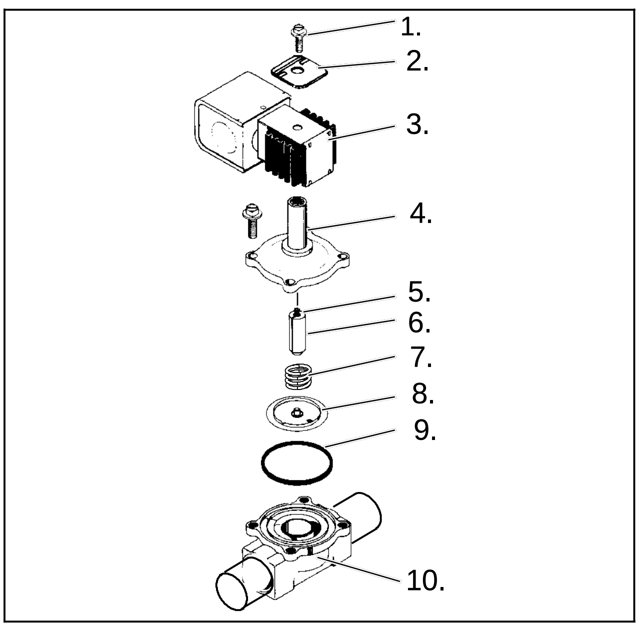


Figure 5-6 Heat Valve

1. Coil Retaining Screw
2. Nameplate
3. Coil Housing Assembly
4. Enclosing Tube & Bonnet Assembly
5. Kick-Off Spring
6. Plunger
7. Closing Spring
8. Diaphragm
9. O-Ring
10. Valve Body

5.12.1 Coil Replacement

a. It is not necessary to drain the coolant from the system.

b. Place main battery disconnect switch in OFF position and lock.

c. Disconnect wire leads to coil.

d. Remove coil retaining screw and nameplate.

e. Lift burned-out coil from enclosing tube and replace.

f. Connect wire leads and test operation.

5.12.2 Internal Part Replacement

a. Disconnect system from bus battery.

b. Open the vent fitting at the top of the outlet header of the heater coil.

c. Drain coil by opening the drain-cock on the inlet tube.

d. Disassemble valve and replace defective parts.

e. Assemble valve, refill and bleed coolant lines.

5.12.3 Replace Entire Valve

a. Disconnect system from bus battery.

b. Drain coolant from lines as previously described and disconnect hoses to valve .

c. Disconnect wire leads to coil.

d. Remove valve assembly from bracket.

e. Install new valve and re-connect hoses. It is not necessary to disassemble the valve when installing.

f. Refill and bleed coolant lines.

g. Connect wire leads and test operation.

5.13 SERVICING THE LIQUID LINE SOLENOID VALVE

The Liquid line solenoid valve (Figure 5-7) is very similar to the heat valve. It requires no maintenance unless a malfunction to the internal parts or coil occurs. This may be caused by foreign material such as: dirt, scale, or sludge in the refrigeration system, or improper voltage to the coil.

There are only three possible valve malfunctions: coil burnout, failure to open, or failure to close.

Coil burnout may be caused by the following:

1. Improper voltage.
2. Continuous over-voltage, more than 10% or under-voltage of more than 15%.
3. Incomplete magnet circuit due to the omission of the coil hosing or plunger.
4. Mechanical interface with movement of plunger which may be caused by a deformed enclosing tube.

Failure to open may be caused by the following:

1. Coil burned out or an open circuit to coil connections.
2. Improper voltage.
3. Defective plunger or deformed valve body assembly.

Failure to close may be caused by the following:

1. Defective plunger or deformed valve body assembly.
2. Foreign material in the valve.

5.13.1 Coil Replacement

a. It is not necessary to remove the refrigerant charge from the system.

b. Disconnect system from bus battery.

c. Disconnect wire leads to coil.

d. Remove coil retaining clip and nameplate.

e. Lift failed coil from enclosing tube and replace.

f. Connect wire leads and test operation

5.13.2 Internal Part Replacement

a. Disconnect system from bus battery.

b. Recover and recycle system refrigerant.

c. Slowly loosen enclosing tube assembly to bleed any remaining pressure from the valve. Disassemble valve and replace defective parts.

d. Assemble valve and leak check.

e. Evacuate and recharge system.

5.13.3 Replace Entire Valve

a. Recover and recycle system refrigerant.

b. Remove valve assembly from bracket.

c. Disconnect wire leads to coil.

d. Disassemble new valve, to protect internal parts, and solder to lines.

e. Assemble and leak check valve.

f. Evacuate and recharge.system.

g. Connect wire leads and test operation.

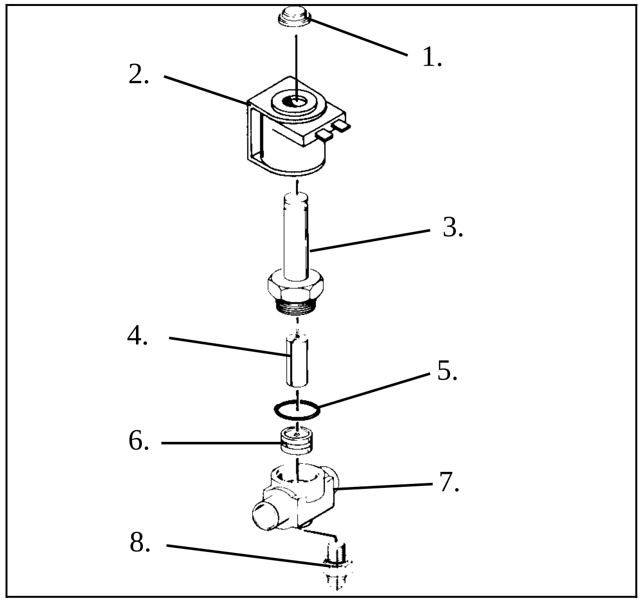


Figure 5–7 Liquid Line Solenoid Valve

1. Snap Cap	5. Gasket
2. Coil Assembly	6. Piston Assembly
3. Enclosing Tube Assembly	7. Body
4. Plunger Assembly	8. Bracket Adapter

5.14 SERVICE VALVES

The filter/drier (High Side) service valves (Figure 5–8) are provided with a double seat and a gauge port, which allows servicing of the filter drier assembly.

Turning the valve stem counterclockwise (all the way out) will *backseat* the valve to open the line to the system and close off the gauge port. In normal operation, the valve is backseated to allow full flow through the valve. The valve should always be backseated before removing the gauge port cap.

Turning the valve stem clockwise (all the way forward) will *frontseat* the valve to isolate the system and open the gauge port.

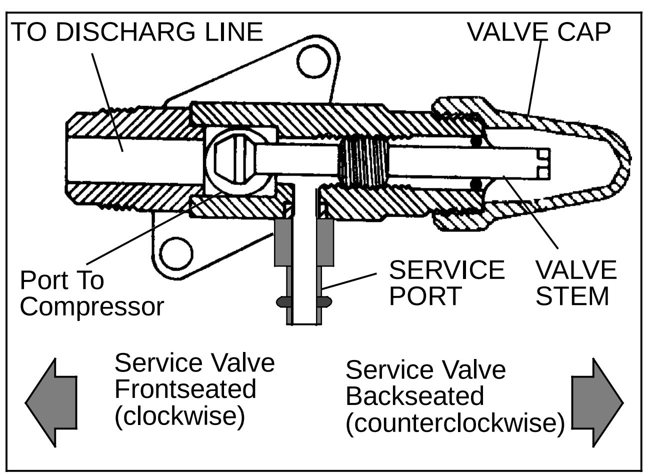


Figure 5–8 Service Valve R134a (High Side)

5.15 REPLACING RETURN AIR FILTERS

The return air filters are located behind the return air grill, inside the vehicle.

The filters should be checked for cleanliness periodically depending on operating conditions. A dirty filter will restrict air flow over the evaporator coil which may cause insufficient cooling or heating and possible frost buildup on the coil. To remove the filters, do the following.

a. Insure air conditioning system is in the off position.

b. Remove the return air grille with the filter-diffuser assembly, by turning the six 1/4 turn fasteners counterclockwise.

Figure 5-9 Return Air Grill Assembly With Air Filter Showing

c. Remove diffuser from the bus composit frame.

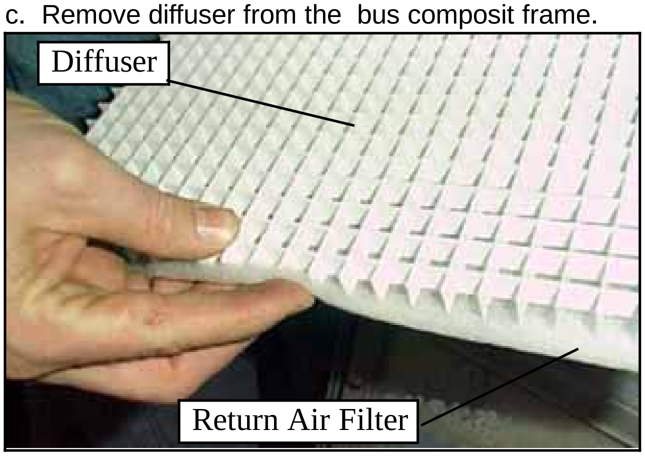


Figure 5-10 Diffuser and Filter Element

d. Remove and replace the filter element.

e. Center diffuser on filter element.

f. Pull filter element approximately 1/4 inch over ends of the diffuser.

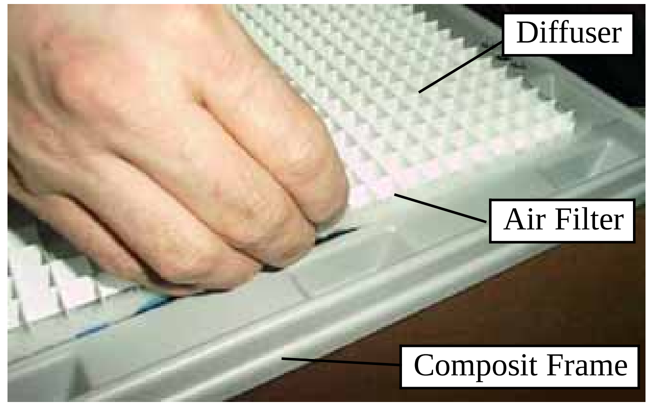


Figure 5-11 Filter, Diffuser and Composit Frame

g. Place filter and diffuser into composit frame, with filter element down (See Figure 5-11).

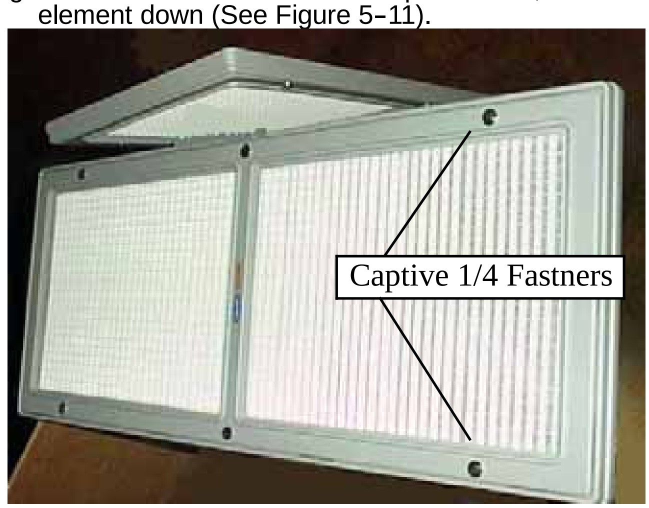


Figure 5-12 Return Air Grill Assembly With Diffuser And Composit Frame Showing

h. Insert filter-diffuser assembly into composit frame on bus with the six captive 1/4 fasteners. (See Figure 5-12)

i. Lock the six captive 1/4 turns in place by rotating clockwise.

5.16 THERMOSTATIC EXPANSION VALVE

The thermostat expansion valve (Figure 5-13) 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 control 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.

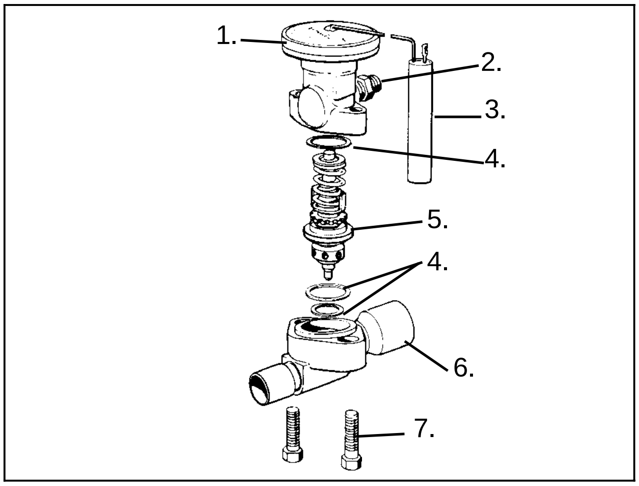


Figure 5-13 Thermostatic Expansion Valve

1.. Power Head Assembly
2.. Equalizer Connection
3.. Bulb
4.. Gasket
5.. Cage Assembly
6.. Body Flange
7.. Cap screw

5.16.1 Valve Replacement

a. If compressor is operative perform low side pump down to replace expansion valve. (refer to 5.5.1) If compressor is inoperative recover and recycle refrigerant from the system.(refer to 5.5.2)

b. Remove insulation from expansion valve bulb. (See Figure 5-13 and Figure 5-14.)

c. Loosen retaining straps holding bulb to suction line and detach bulb from the suction line.

d. Loosen flare nuts on equalizer line and disconnect equalizer line from the expansion valve.

e. Check, clean and remove any foreign material from the valve body, valve seat and mating surfaces. If required, replace valve body.

NOTE

R-134a valves are adjustable. Valves are preset at the factory.

f. Leak check the new valve and evacuate and dehydrate the system. (Refer to paragraph 5.7.)

g. The thermal bulb is installed below the center of the suction line (four or eight o'clock position). This area must be clean to ensure positive bulb contact. Strap thermal bulb to suction line. Ensure that retaining straps are tight and renew insulation.

h. Fasten equalizer line to the expansion valve.

i. Evacuate and recharge the system.

j. Run the coach for approximately 30 minutes on fast idle.

k.Check refrigerant charge. (Refer to 5.8.1)

5.16.2 Superheat Measurement

NOTE

All readings must be taken from the TXV bulb location and out of the direct air stream.

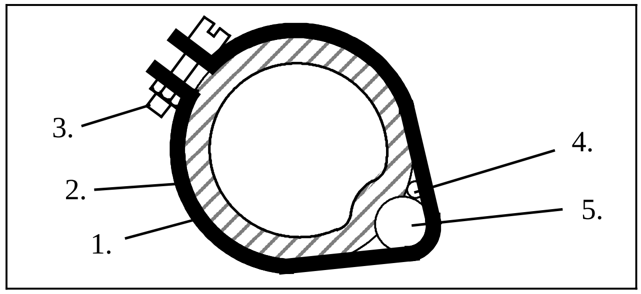


Figure 5-14 Thermostatic Expansion Valve Bulb and Thermocouple

1.. Suction Line (section view)
2.. TXV Bulb Clamp
3.. Nut & Bolt (clamp)
4.. Thermocouple
5.. TXV Bulb (Shown in the 4'clock position)

a. Open top cover.

b. Remove Presstite insulation from expansion valve bulb and suction line.

c. Loosen one TXV bulb clamp and make sure area under clamp is clean.

d. Place temperature thermocouple in contact with the suction tube and parallel to the TXV bulb, and then secure loosened clamp making sure both bulb and thermocouple are firmly secured to suction line. (See Figure 5-14). Reinstall insulation around the bulb.

e. Connect an accurate low pressure gauge to the low pressure port.

f. Close top cover being careful to route thermocouple sensing wire and gauge hose outside the unit.

g. Start bus and run on fast idle until unit has stabilized, about 20 to 30 minutes.

NOTE

When conducting this test, the suction pressure must be at least 6 psig *(0.41 bar)* below the expansion valve maximum operating pressure (MOP). Refer to paragraph 1.3 for MOP.

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

i. Note the temperature of the suction gas at the expansion valve bulb. Subtract the saturation temperature from this temperature. The difference is the superheat of the suction gas.

j. The superheat may cycle from a low to high reading. Monitor the superheat taking readings every 3-5 minutes for a total of 5-6 readings. Calculate the superheats, add the readings and divide by the number of readings taken to determine average superheat. The superheat should be 18 ± 3°F.

k. If superheat is not within tolerance, replace the valve.

Table 5-1. R-134a Temperature - Pressure Chart

Temperature		Vacuum			
°F	°C	"/hg	cm/hg	kg/cm@	bar
−40	−40	14.6	49.4	37.08	0.49
.35	.37	12.3	41.6	31.25	0.42
−30	−34	9.7	32.8	24.64	0.33
−25	−32	6.7	22.7	17.00	0.23
−20	−29	3.5	11.9	8.89	0.12
−18	−28	2.1	7.1	5.33	0.07
−16	−27	0.6	2.0	1.52	0.02

Temperature		Pressure			
°F	°C	psig	kPa	kg/cm@	bar
−14	−26	0.4	1.1	0.03	0.03
−12	−24	1.2	8.3	0.08	0.08
−10	−23	2.0	13.8	0.14	0.14
−8	−22	2.9	20.0	0.20	0.20
−6	−21	3.7	25.5	0.26	0.26
−4	−20	4.6	31.7	0.32	0.32
−2	−19	5.6	36.6	0.39	0.39
0	−18	6.5	44.8	0.46	0.45
2	−17	7.6	52.4	0.53	0.52
4	−16	8.6	59.3	0.60	0.59
6	−14	9.7	66.9	0.68	0.67
8	−13	10.8	74.5	0.76	0.74
10	−12	12.0	82.7	0.84	0.83
12	−11	13.2	91.0	0.93	0.91
14	−10	14.5	100.0	1.02	1.00
16	−9	15.8	108.9	1.11	1.09
18	−8	17.1	117.9	1.20	1.18
20	−7	18.5	127.6	1.30	1.28
22	−6	19.9	137.2	1.40	1.37
24	−4	21.4	147.6	1.50	1.48
26	−3	22.9	157.9	1.61	1.58

Temperature		Pressure			
°F	°C	psig	kPa	kg/cm@	bar
28	−2	24.5	168.9	1.72	1.69
30	−1	26.1	180.0	1.84	1.80
32	0	27.8	191.7	1.95	1.92
34	1	29.6	204.1	2.08	2.04
36	2	31.3	215.8	2.20	2.16
38	3	33.2	228.9	2.33	2.29
40	4	35.1	242.0	2.47	2.42
45	7	40.1	276.5	2.82	2.76
50	10	45.5	313.7	3.20	3.14
55	13	51.2	353.0	3.60	3.53
60	16	57.4	395.8	4.04	3.96
65	18	64.1	441.0	4.51	4.42
70	21	71.1	490.2	5.00	4.90
75	24	78.7	542.6	5.53	5.43
80	27	86.7	597.8	6.10	5.98
85	29	95.3	657.1	6.70	6.57
90	32	104.3	719.1	7.33	7.19
95	35	114.0	786.0	8.01	7.86
100	38	124.2	856.4	8.73	8.56
105	41	135.0	930.8	9.49	9.31
110	43	146.4	1009	10.29	10.09
115	46	158.4	1092	11.14	10.92
120	49	171.2	1180	12.04	11.80
125	52	184.6	1273	12.98	12.73
130	54	198.7	1370	13.97	13.70
135	57	213.6	1473	15.02	14.73
140	60	229.2	1580	16.11	15.80
145	63	245.6	1693	17.27	16.93
150	66	262.9	1813	18.48	18.13
155	68	281.1	1938	19.76	19.37

SECTION 6

ELECTRICAL

6.1 INTRODUCTION

This section includes electrical wiring schematics. The schematics shown in this section provides information for the AC310 and AC350 model rooftop air conditioning units which are fitted with eight (8) and twelve (12) single-shafted or four (4) and six (6) double-shafted evaporator blower/motor assemblies and four (4) or six (6) condenser fan motors. Figure 6-1 through Figure 6-6 shows the Thermostat with manual re-heat. Figure 6-7 thru Figure 6-13 shows the CSDD BT324 controller used with the AC310 single and dual systems and the AC350 single loop with transit compressors. Figure 6-14 thru Figure 6-18 shows Thermostat control with one or two compressors.

UNIT	CONTROLLER	FIGURE NUMBERS
AC 310	Thermostat With Manual Reheat	Figure 6-1 Thru Figure 6-6
AC 350	BT324	Figure 6-7 Thru Figure 6-13
AC 310/AC350	Thermostat One/Two Compressors	Figure 6-14 To Figure 6-18

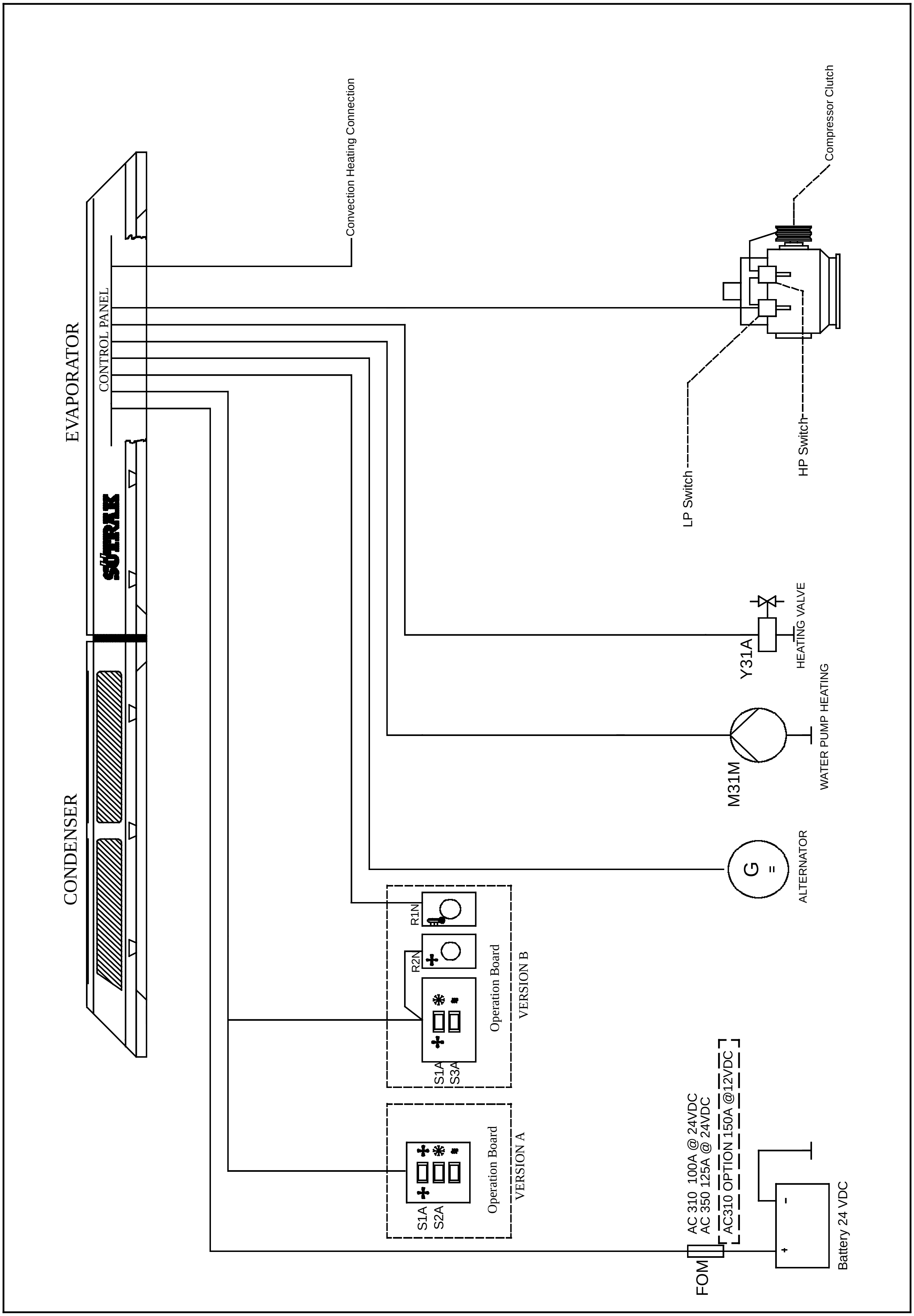


Figure 6-1 System Controls (Typical)

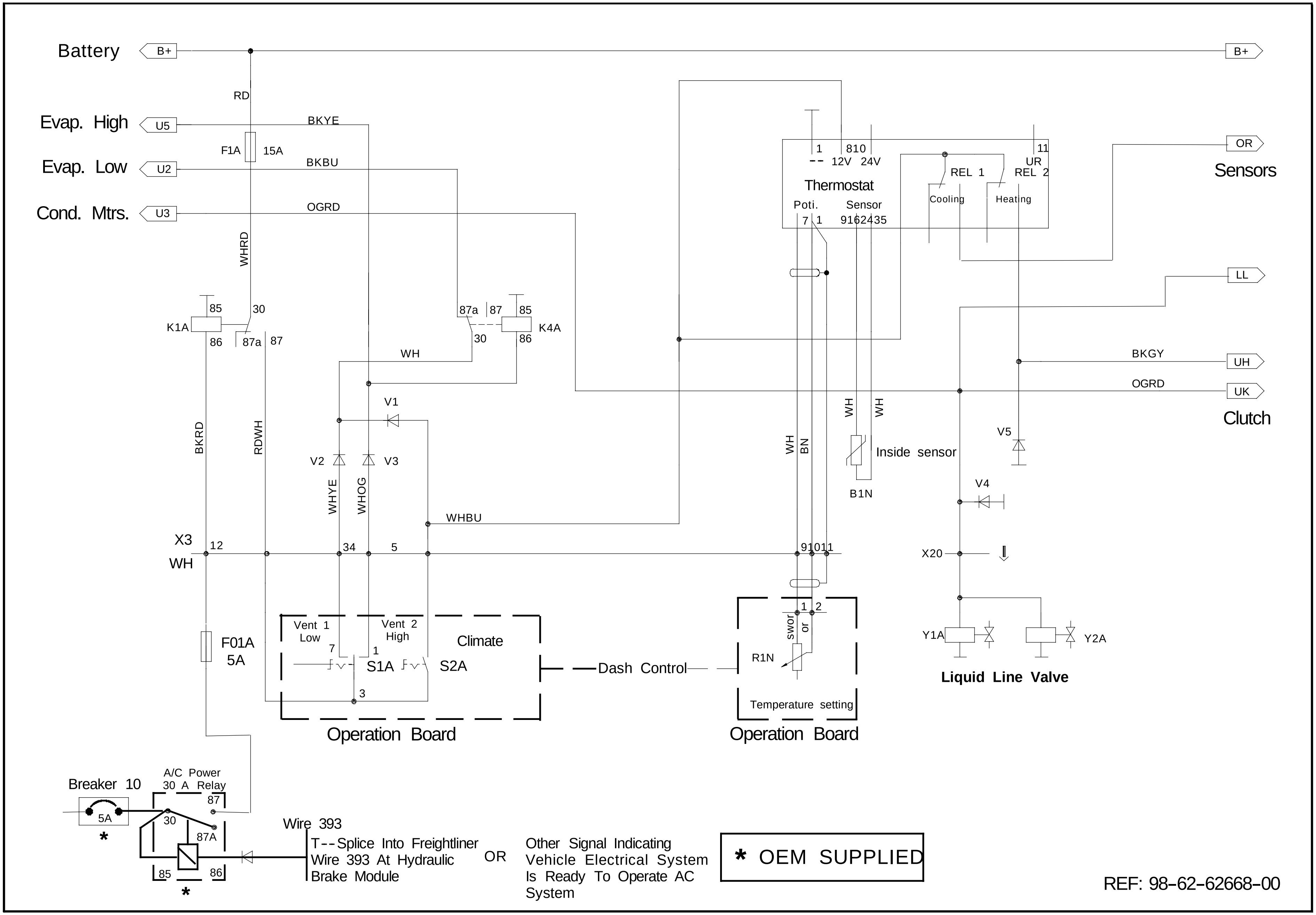


Figure 6-2 Manual Controls With Manual Reheat Control (Sheet 1)

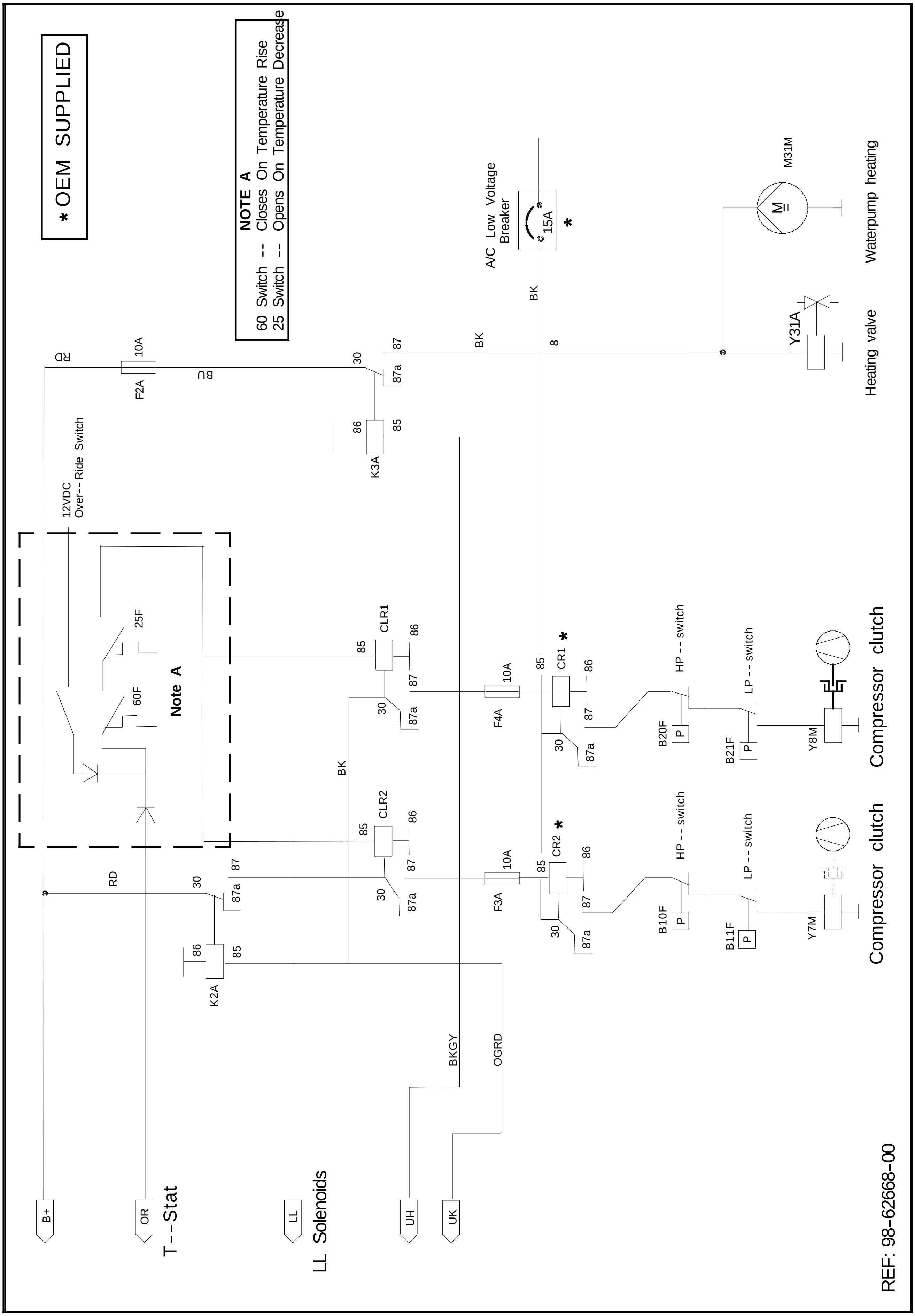


Figure 6-3 Manual Controls With Manual Reheat Control (Sheet 2)

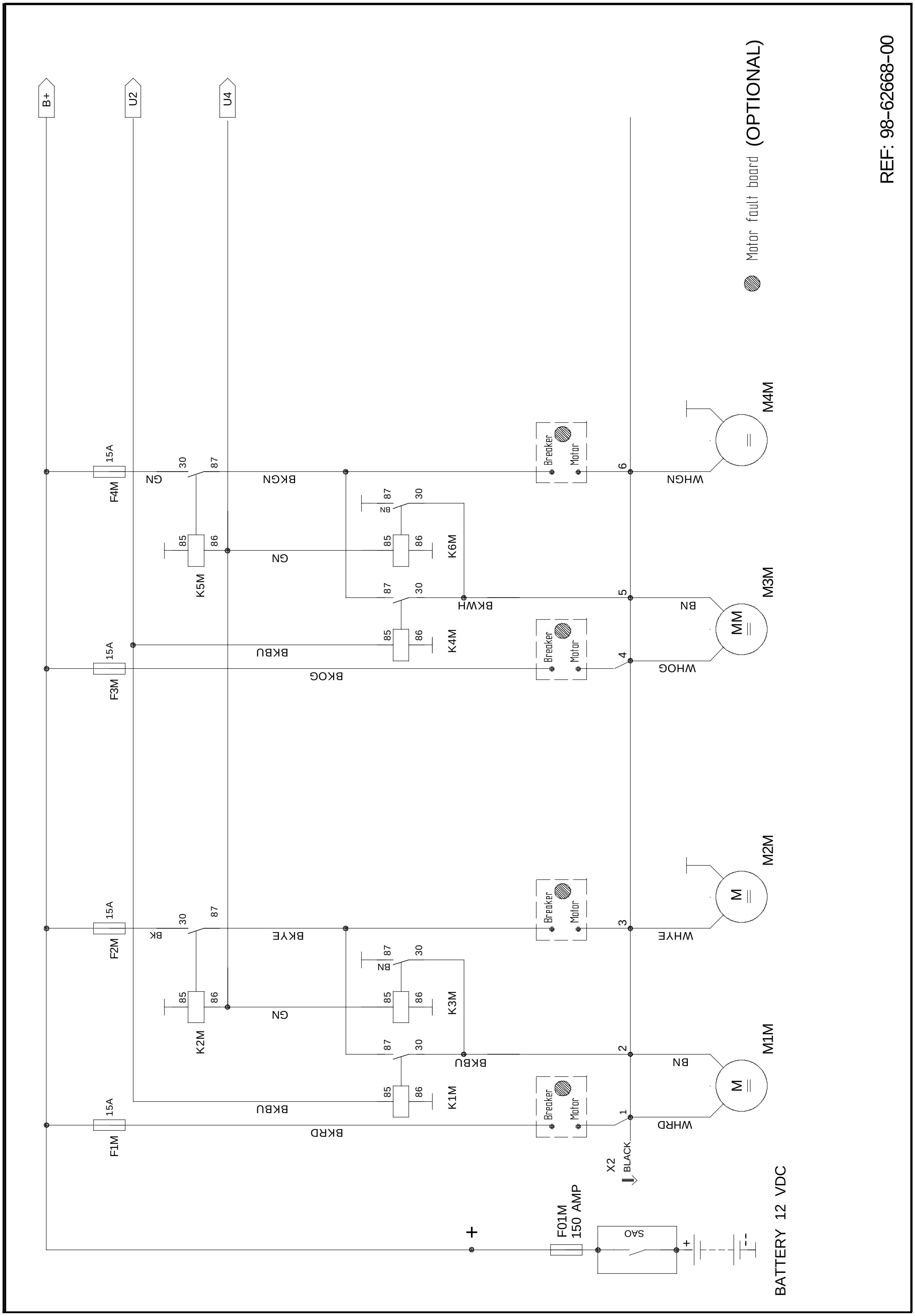


Figure 6-4 Evaporator Motors 1 - 4

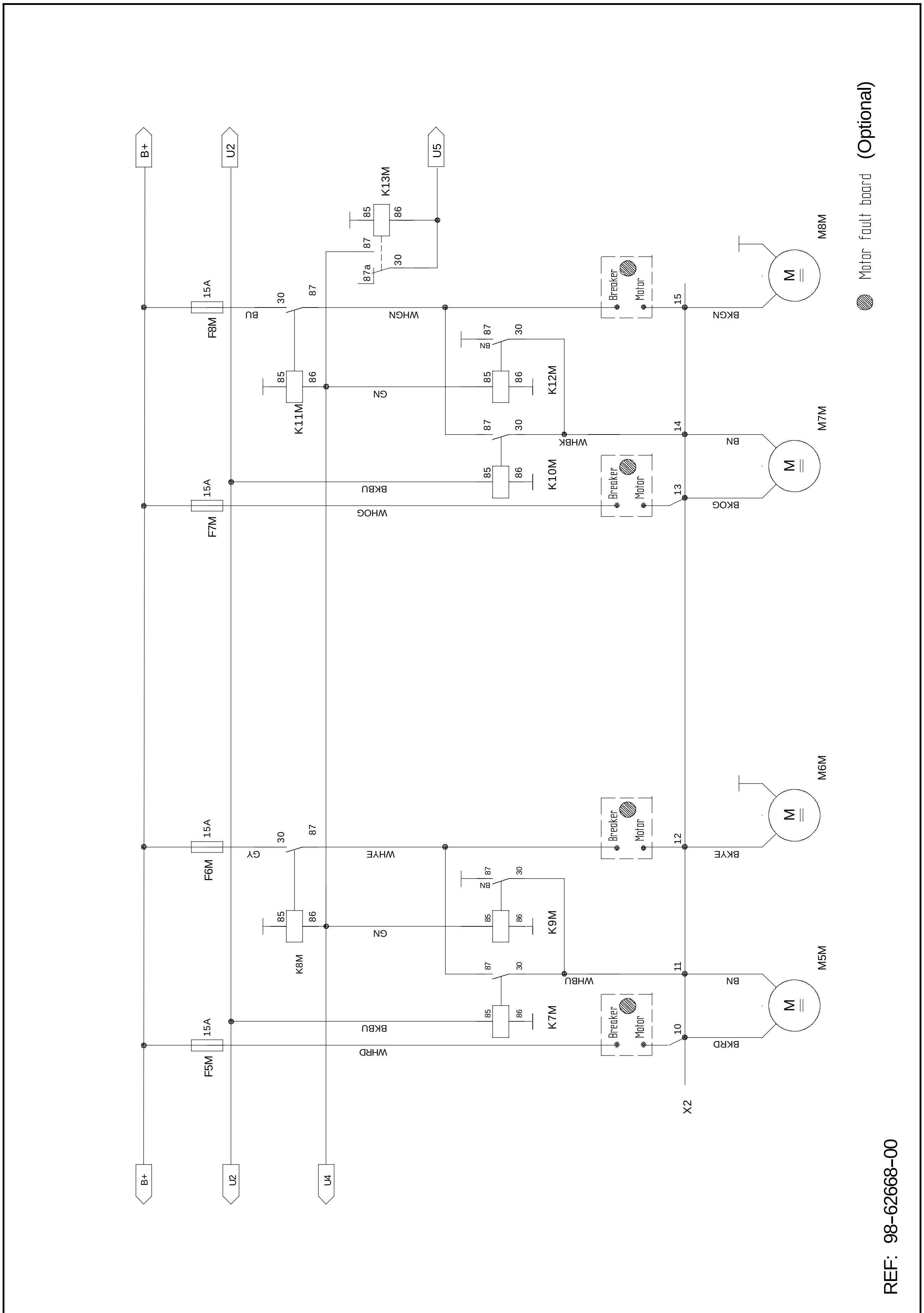


Figure 6–5 Evaporator Motors 5 - 8

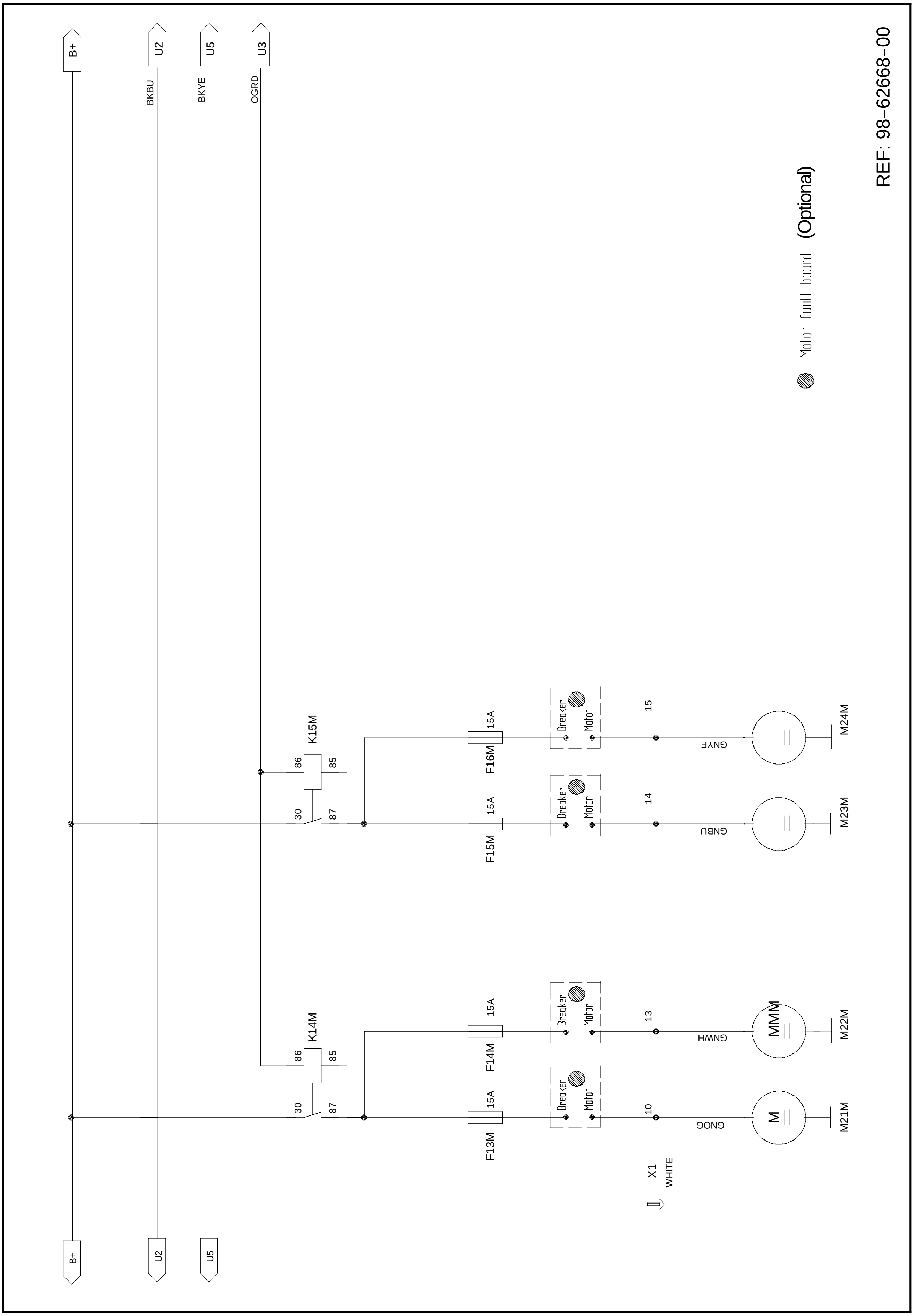


Figure 6-6 Condenser Motors

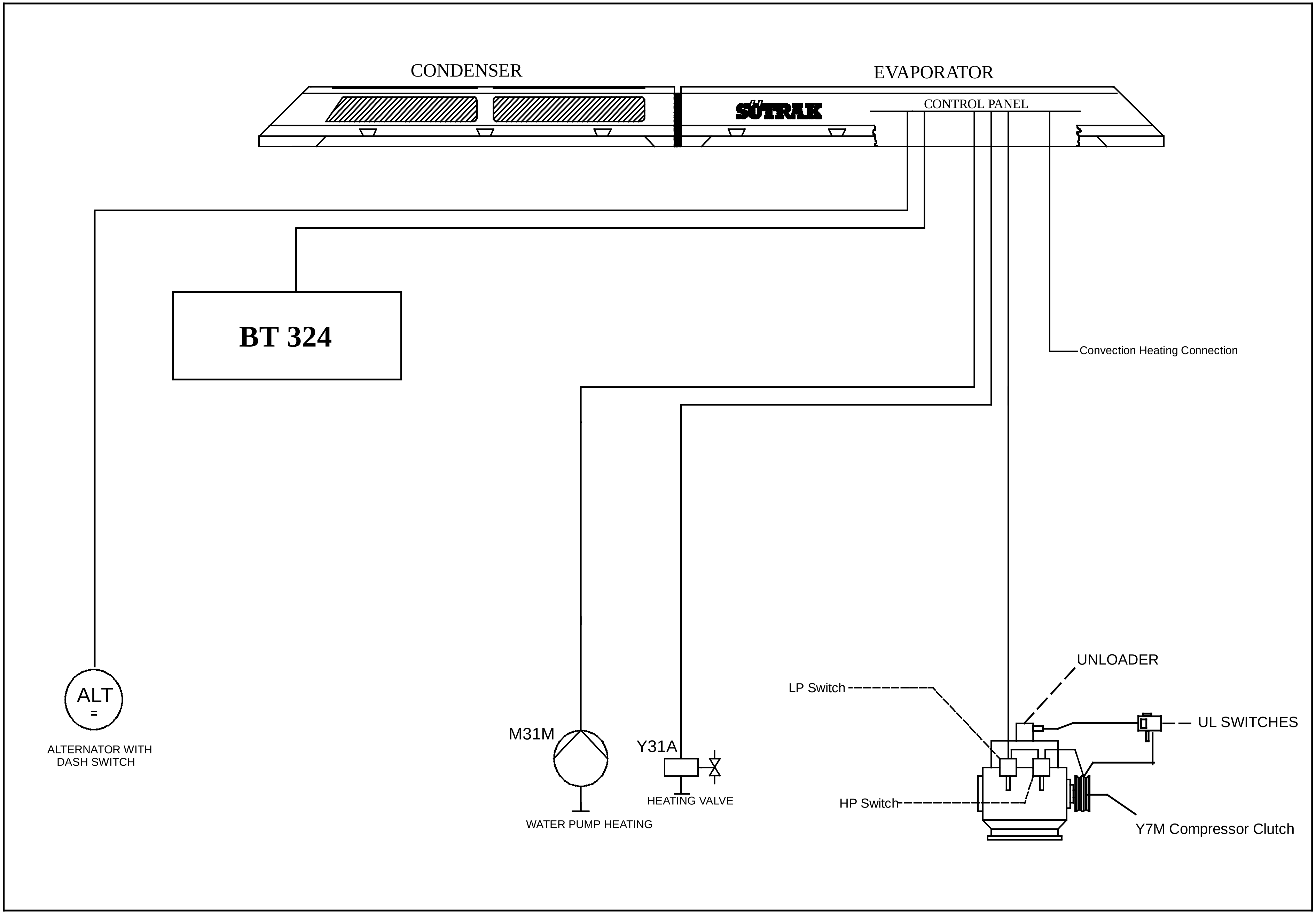


Figure 6-7 BT324 Controls With (1) Compressor (AC350)

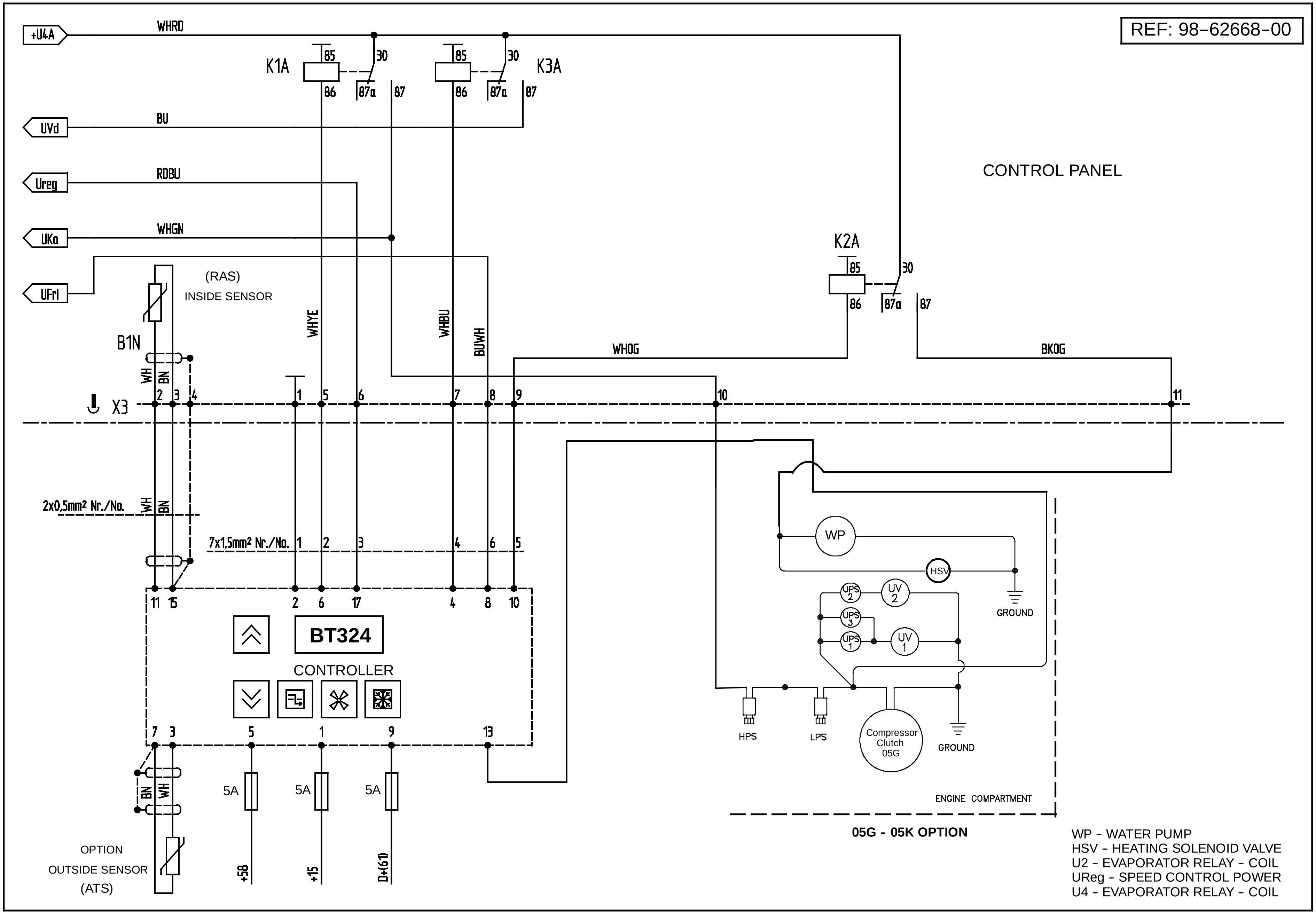


Figure 6-8 BT324 Control Circuit (AC350)

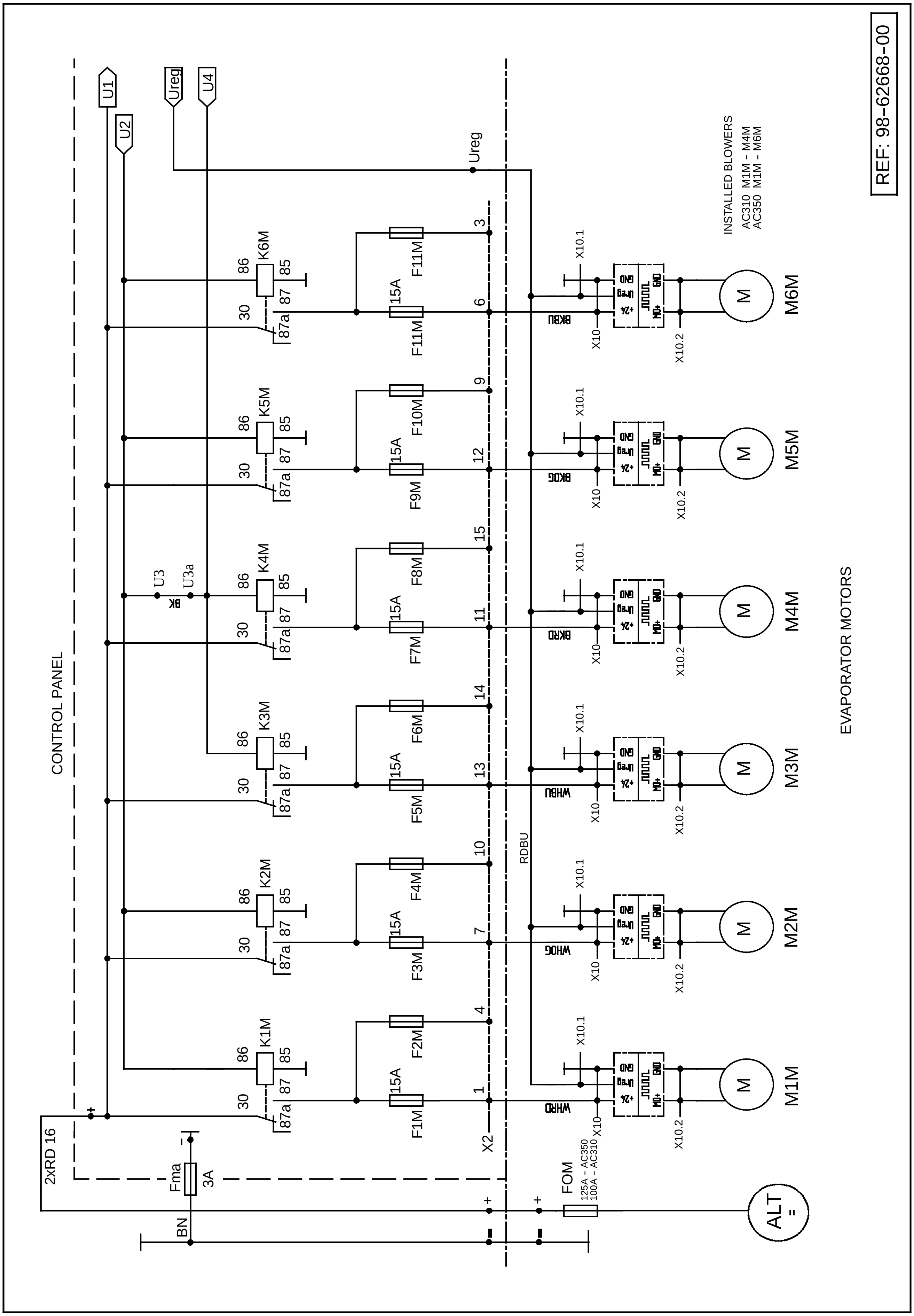


Figure 6-9 BT324 Evaporator Motors (AC350)

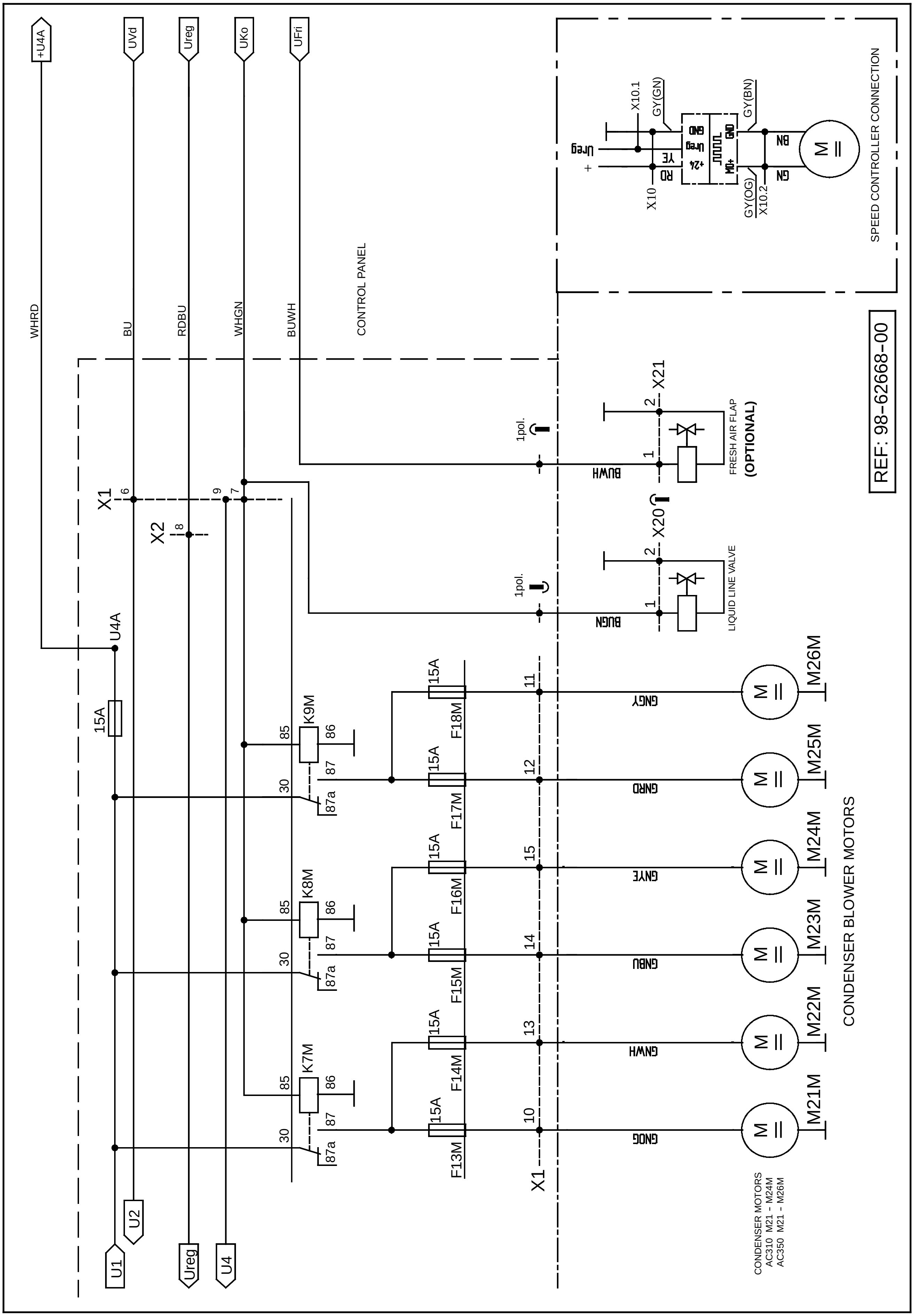
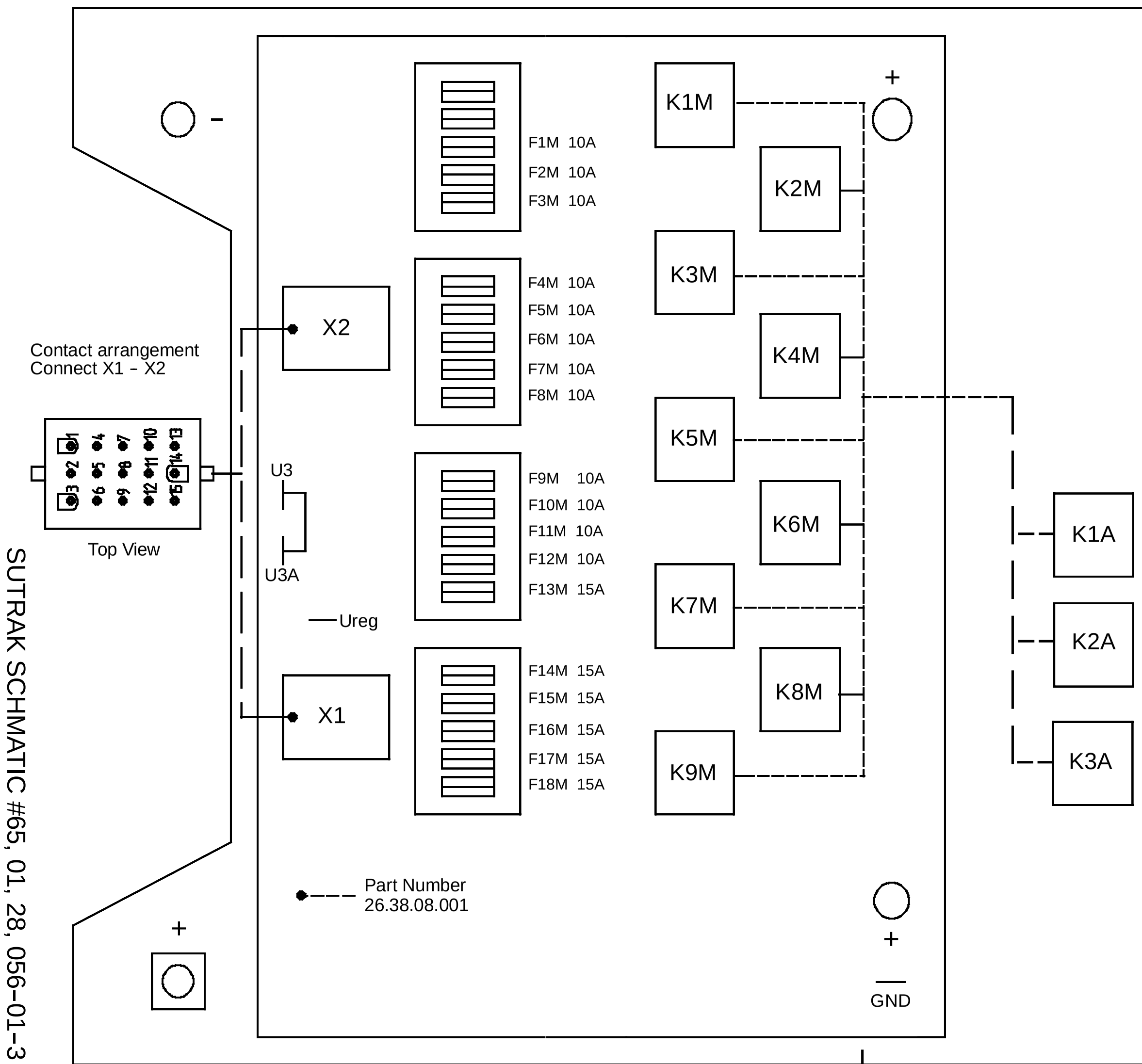


Figure 6-10 CSDD BT324 Condenser Motors



1....K1A = Compressor Clutch – Liquid Line Solenoid – Condenser Fans
2....K2A = Heat Valve – Boost Pump
3....K3A = Evaporator Fans
4....K1M – K6M = Individual Evaporator Fans (M1M – M6M)
5....K7M – K9M = Individual Condenser Fans (M21M – M26M)
6....Fuse = Boost Pump & Heat Valve
7....F13M – F18M = Individual Condenser Fans
8....F1M – F12M = Individual Evaporator Fans
9....U Reg = Evaporator Speed Regulation
10...X1 = Condenser Fans
11...X2 = Evaporator Fans
12...X3 – X4 (Not Shown On Drawing) = Dash To Unit Interface Plug

UNIT	RELAYS FOR EVAP. MOTORS	RELAYS FOR COND. MOTORS
AC310	K1m – K4M	K7M – K8M
AC350	K1M – K6M	K7M – K9M

Relay Board

SUTRAK SCHMATIC #65, 01, 28, 056–01–3

Figure 6–11 AC350 With BT324 Control

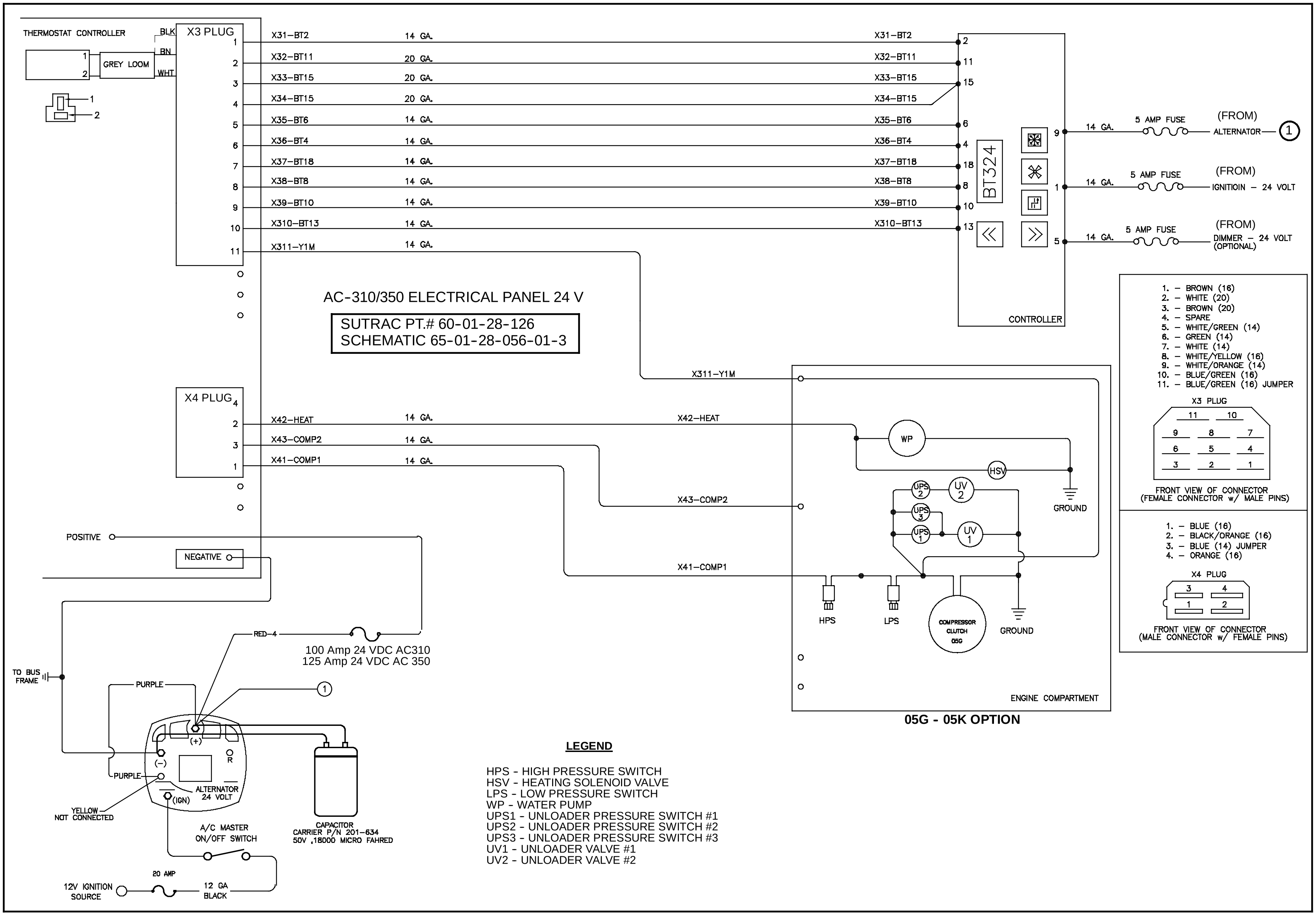
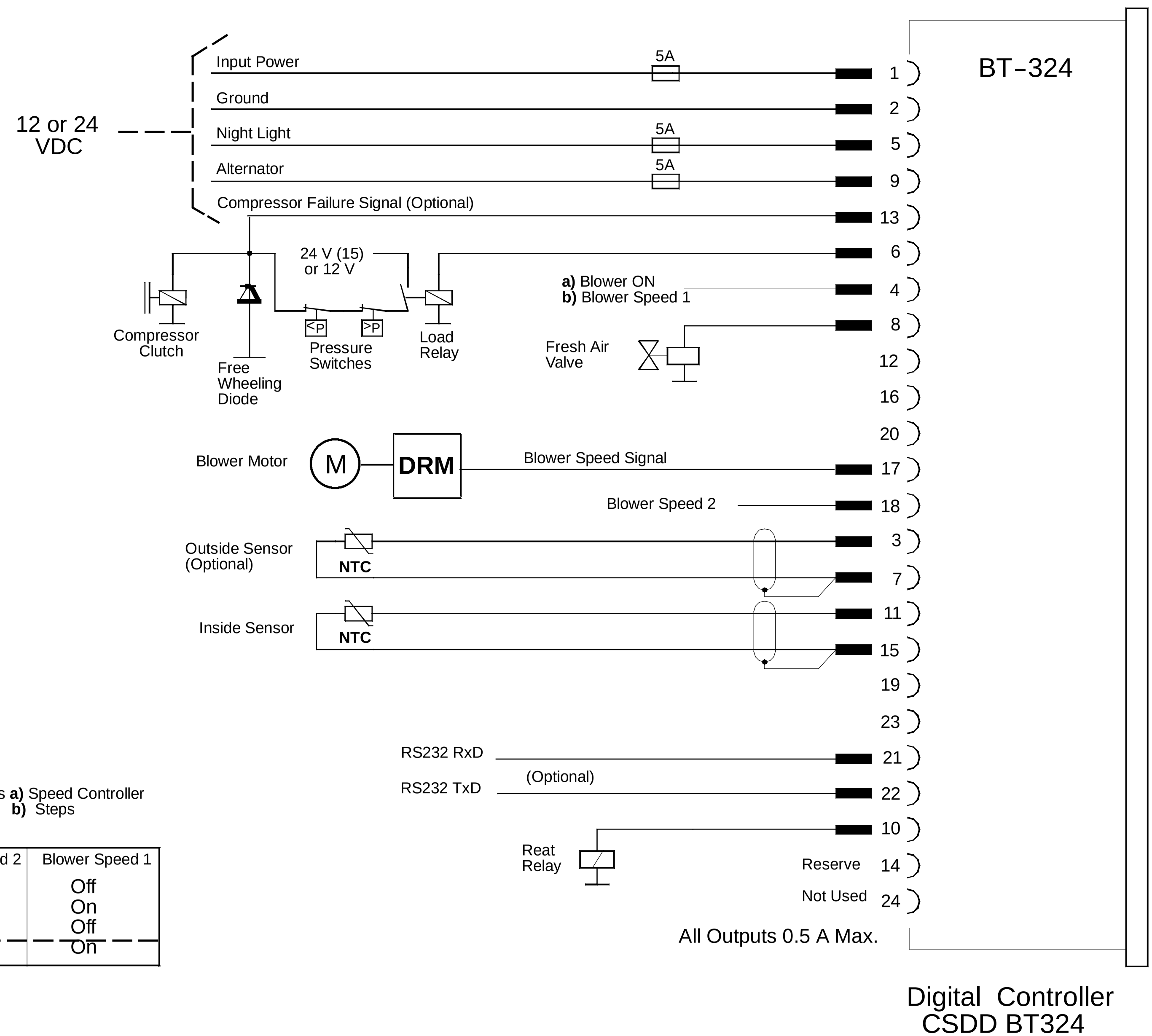


Figure 6-12 CSDD BT324 Control Circuit



Blower Control Options **a)** Speed Controller
(Software Selectable) **b)** Steps

Speed	Blower Speed 2	Blower Speed 1
0	Off	Off
1	Off	On
2	On	Off
3	On	On

Figure 6−13 CSDD BT324

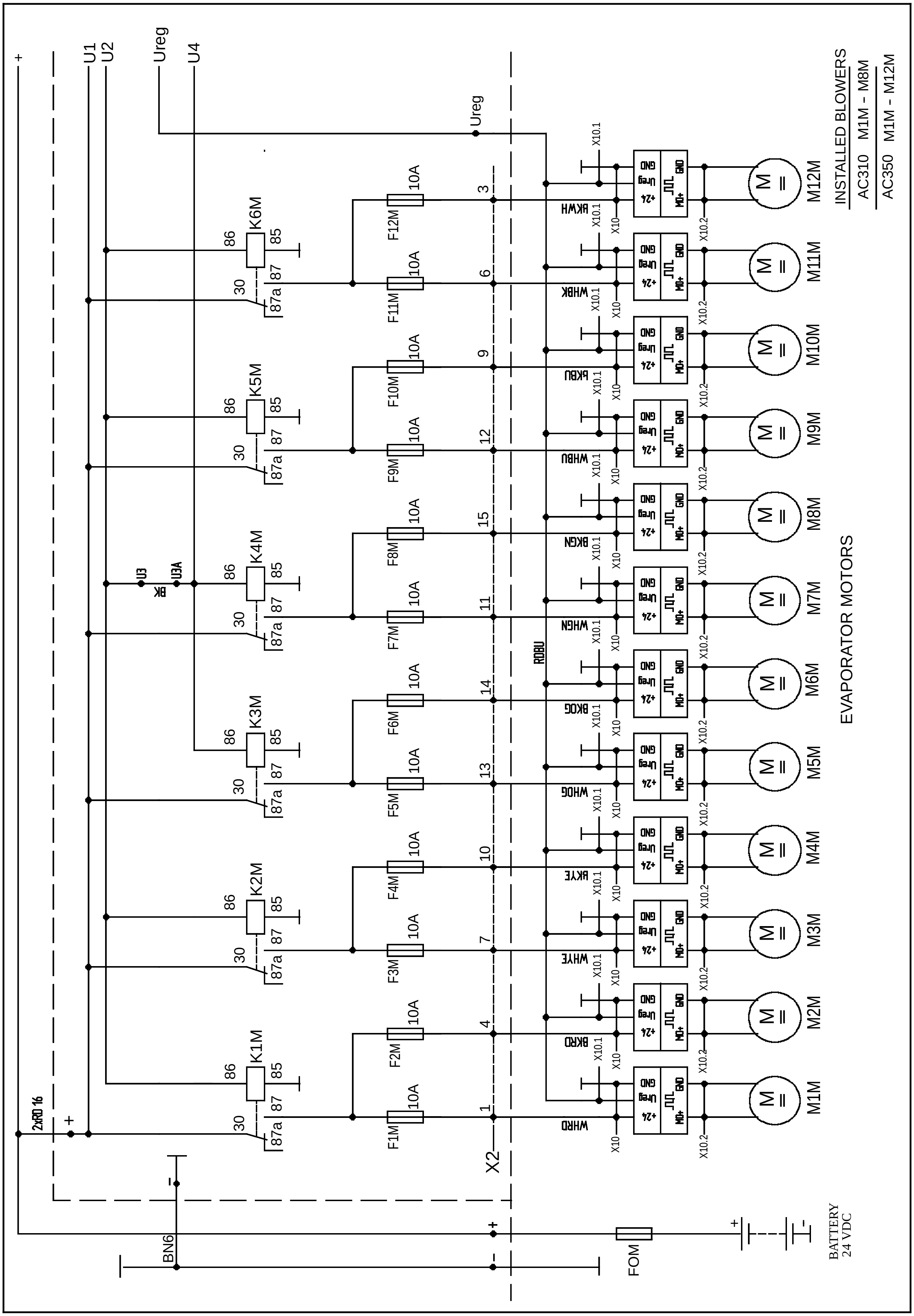
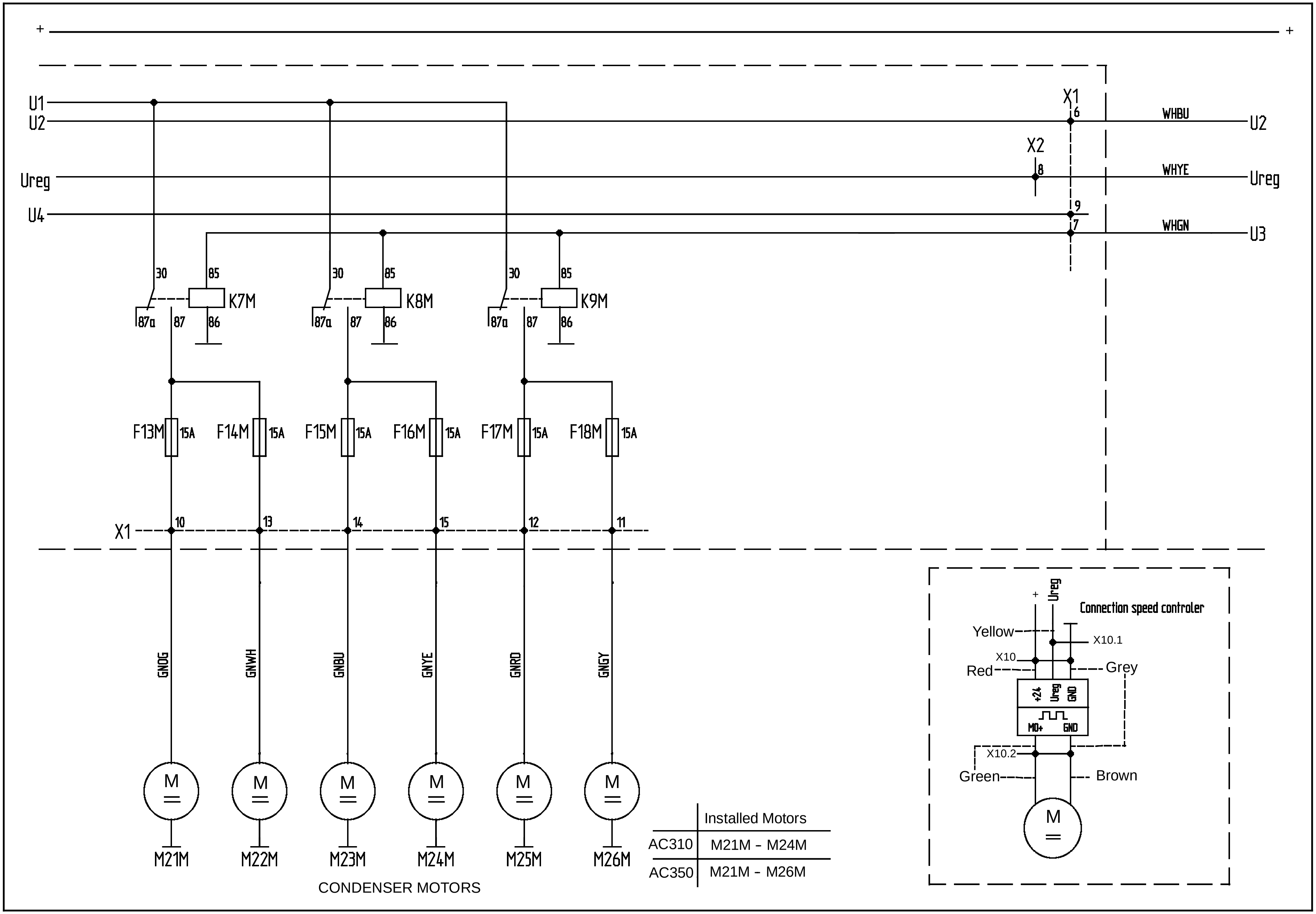


Figure 6-14 Thermostat (One/Two Compressors)



	Installed Motors
AC310	M21M - M24M
AC350	M21M - M26M

Figure 6–15 Thermostat (One/Two Compressors)

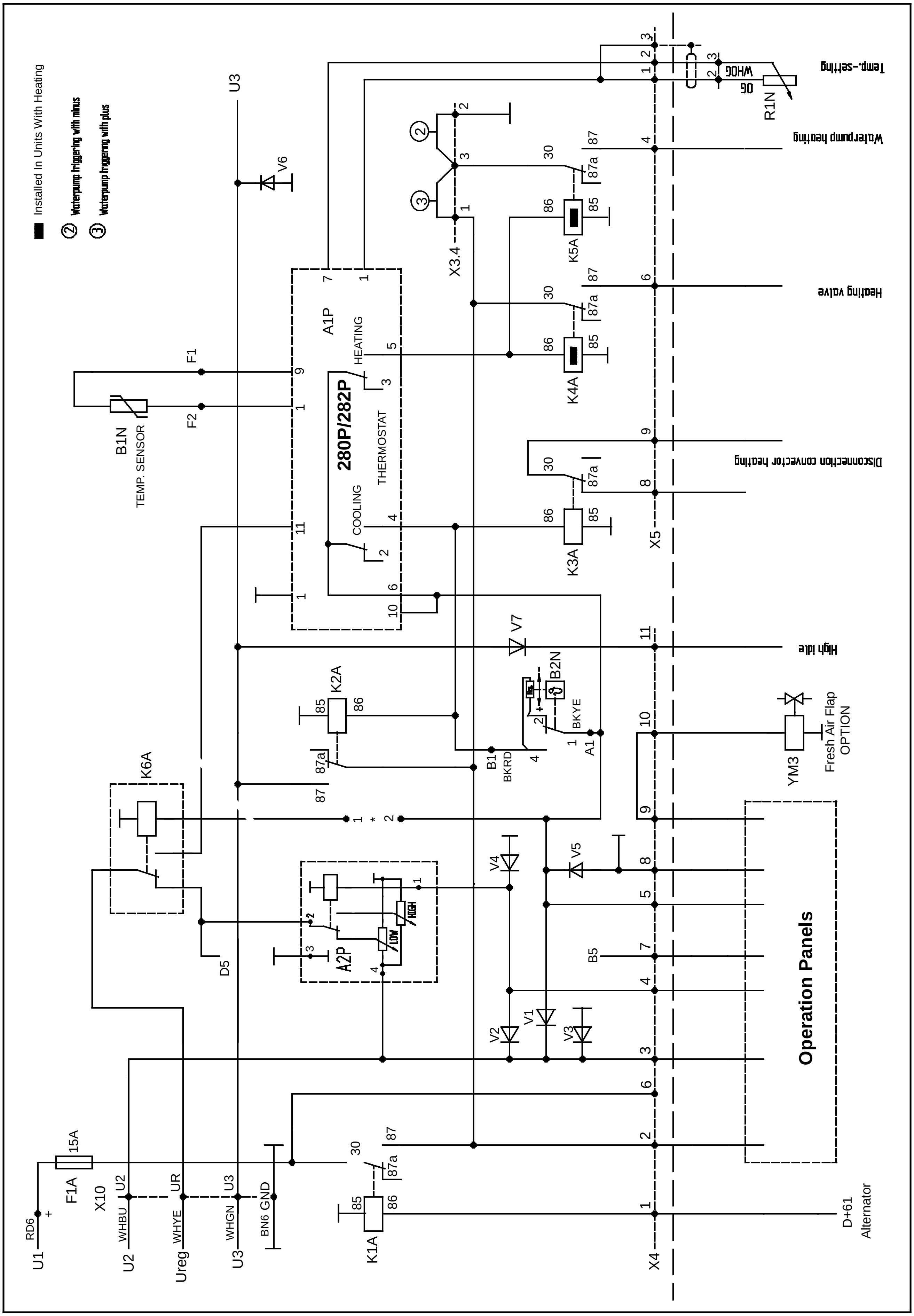


Figure 6-16 Thermostat (One/Two Compressors)

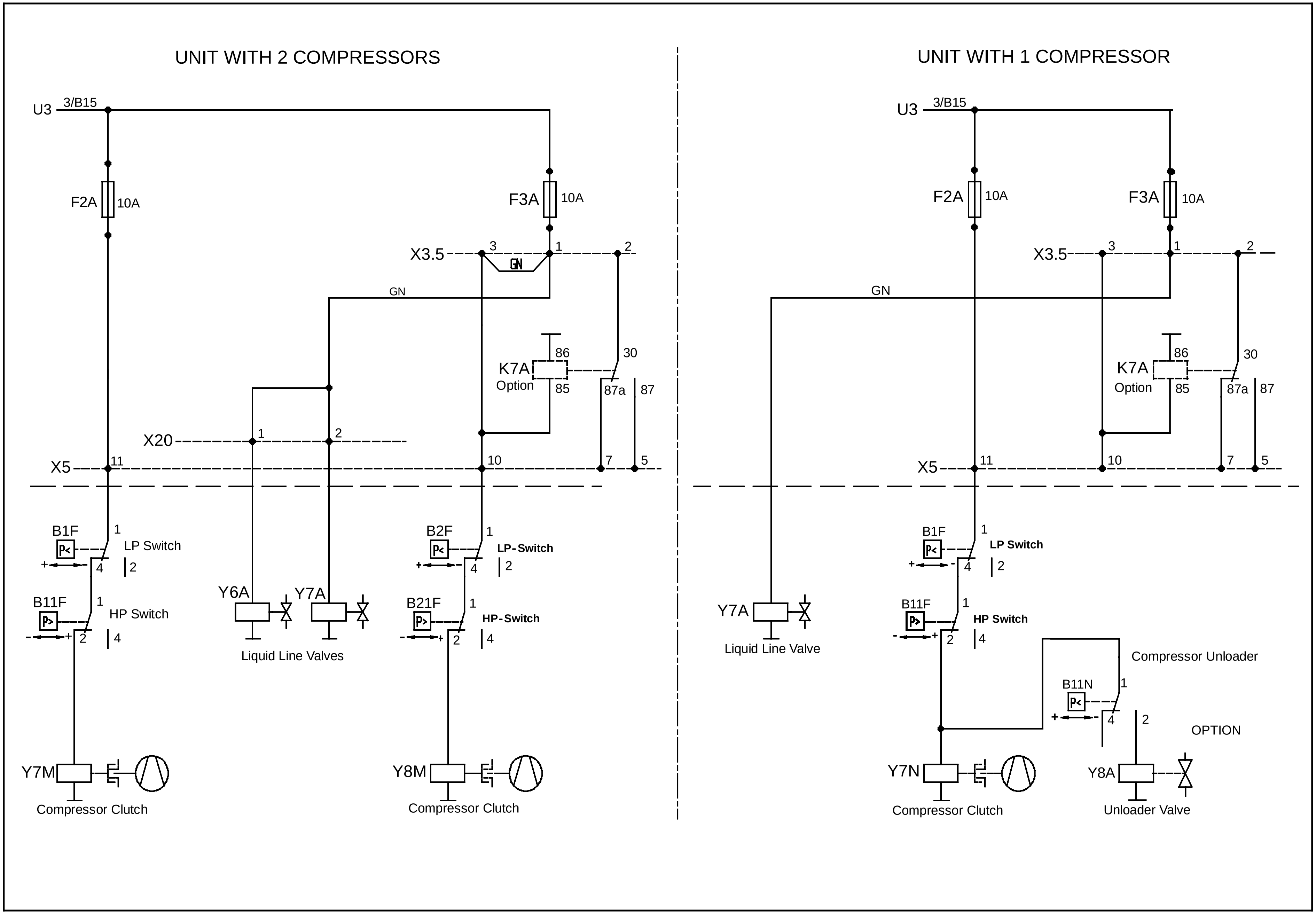


Figure 6-17 Thermostat (One/Two Compressors)

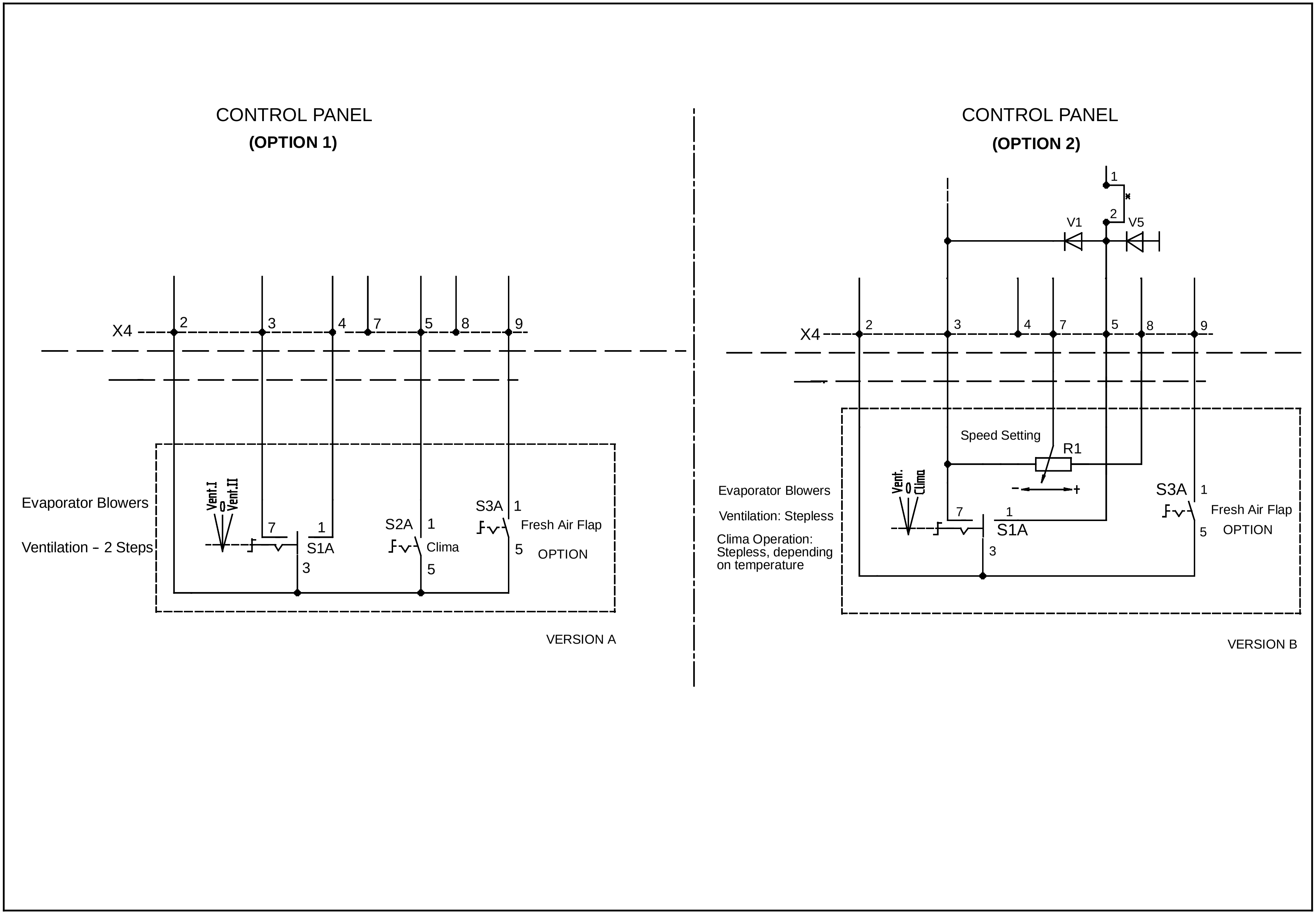


Figure 6–18 Thermostat (One/Two Compressors)

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