V280

TK 50561-1-MM (Rev. 9/99)

The maintenance information in this manual covers unit models:

V280 (914507)

V280 10 UK R-404a (918361)

For further information, refer to…

V280/V280 Parts Manual	**TK 50610**
Diagnosing Thermo King Refrigeration Systems	**TK 5984**
Tool Catalog	**TK 5955**
V280/V280 Operating Manual	**TK 50562**
Installation Manual	**TK 50611**

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

This manual is published for informational purposes only and the information so provided should not be considered as all-inclusive or covering all contingencies. If further information is required, Thermo King Corporation should be consulted.

Sale of product shown in this manual is subject to Thermo King's terms and conditions including, but not limited to, the Thermo King Limited Express Warranty. Such terms and conditions are available upon request.

Thermo King's warranty will not apply to any equipment which has been "so repaired or altered outside the manufacturer's plants as, in the manufacturer's judgment, to effect its stability."

No warranties, express or implied, including warranties of fitness for a particular purpose or merchantability, or warranties arising from course of dealing or usage of trade, are made regarding the information, recommendations, and descriptions contained herein. Manufacturer is not responsible and will not be held liable in contract or in tort (including negligence) for any special, indirect or consequential damages, including injury or damage caused to vehicles, contents or persons, by reason of the installation of any Thermo King product or its mechanical failure.

Recover Refrigerant

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

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

In addition, service personnel must be aware of Federal regulations concerning the use of refrigerants and the certification of technicians. For additional information on regulations and technician certification programs, contact your local THERMO KING dealer.

R-404A R-134a

WARNING: Use ONLY Polyol Ester based refrigeration compressor oil (TK P/N 203-413) in R-404A and R-134a units.

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

DO NOT mix Polyol Ester and standard synthetic compressor oils.

Keep Polyol Ester compressor oil in tightly sealed containers. If Polyol Ester oil becomes contaminated with moisture or standard oils, dispose of properly—DO NOT USE!

WARNING: When servicing Thermo King R-404A and R-134a units, use only those service tools certified for and dedicated to R-404A or R-134a refrigerant and Polyol Ester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-404A and R-134a systems.

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Safety Precautions

GENERAL PRACTICES

1. ALWAYS WEAR GOGGLES OR SAFETY GLASSES. Refrigerant liquid, refrigeration oil, and battery acid can permanently damage the eyes (see First Aid under Refrigeration Oil).
2. Never operate the unit with the compressor discharge valve closed.
3. Keep your hands, clothing and tools clear of the fans and belts when the unit is running. This should also be considered when opening and closing the compressor service valves.
4. Make sure gauge manifold hoses are in good condition. Never let them come in contact with a belt, fan motor pulley, or any hot surface.
5. Never apply heat to a sealed refrigeration system or container.
6. Fluorocarbon refrigerants, in the presence of an open flame or electrical short, produce toxic gases that are severe respiratory irritants capable of causing death.
7. Make sure all mounting bolts are tight and are of correct length for their particular application.
8. Use extreme caution when drilling holes in the unit. The holes may weaken structural components, and holes drilled into electrical wiring can cause fire or explosion.
9. Use caution when working around exposed coil fins. The fins can cause painful lacerations.
10. Use caution when working with a refrigerant or refrigeration system in any closed or confined area with a limited air supply (for example, a truck box or garage). Refrigerant tends to displace air and can cause oxygen depletion resulting in suffocation and possible death.
11. EPA Section 608 Certification is needed to work on refrigeration systems.

REFRIGERANT

Although fluorocarbon refrigerants are classified as safe refrigerants, certain precautions must be observed when handling them or servicing a unit in which they are used. When exposed to the atmosphere from the liquid state, fluorocarbon refrigerants evaporator rapidly, freezing anything they contact.

First Aid

In the event of frost bite, the objectives of First Aid are to protect the frozen area from further injury, to warm the affected area rapidly and to maintain respiration.

- EYES: For contact with liquid, immediately flush eyes with large amounts of water and get prompt medical attention.
- SKIN: Flush area with large amounts of lukewarm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection/injury. Get medical attention. Wash contaminated clothing before reuse.
- INHALATION: Move victim to fresh air and use CPR if necessary. Stay with victim until arrival of emergency medical personnel.

REFRIGERATION OIL

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

First Aid

In case of eye contact, immediately flush with plenty of water for at least 15 minutes. Wash skin with soap and water. CALL A PHYSICIAN.

ELECTRICAL HAZARDS

High Voltage

When servicing or repairing a refrigeration unit, the possibility of serious or even fatal injury from electrical shock exists. Extreme care must be used when working with an operating refrigeration unit. Lethal voltage potentials can exist on connections in the high voltage tray control box.

Precautions

1. When working on high voltage circuits on the refrigeration unit, do not make any rapid moves. If a tool drops, do not grab for it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
2. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.
3. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
4. Never work alone on high voltage circuits on the refrigeration unit, another person should always be standing by in the event of an accident to shut off the refrigeration unit and to aid a victim.
5. Have electrically insulated gloves, cable cutters and safety glasses available in the immediate vicinity in the event of an accident.

First Aid

IMMEDIATE action must be initiated after a person has received an electrical shock. Obtain immediate medical assistance if available.

The source of shock must be immediately removed by either shutting down the power or removing the victim from the source. If it is not possible to shut off the power, the wire should be cut with either an insulated instrument (e.g., a wooden handled axe or cable cutters with heavy insulated handles) or by a rescuer wearing electrically insulated gloves and safety glasses. Whichever method is used do not look at the wire while it is being cut. The ensuing flash can cause burns and blindness.

If the victim has to be removed from a live circuit, pull the victim off with a non-conductive material. Use the victim's coat, a rope, wood, or loop your belt around the victim's leg or arm and pull the victim off. DO NOT TOUCH the victim. You can receive a shock from current flowing through the victim's body. After separating the victim from power source, check immediately for the presence of a pulse and respiration. If a pulse is not present, start CPR (Cardio Pulmonary Resuscitation) and call for emergency medical assistance. If a pulse is present, respiration may be restored by using mouth-to-mouth resuscitation, but call for emergency medical assistance.

Low Voltage

Control circuits used in the refrigeration unit are low voltage (12 volts dc). This voltage potential is not considered dangerous, but the large amount of current available (over 30 amperes) can cause severe burns if shorted or ground.

Do not wear jewelry, watch or rings. These items can short out electrical circuits and cause severe burns to the wearer.

Specifications

GENERAL

Compressor		Belt driven, multi cylinder, wobble plate type driven by the truck engine (Model 10) and by the truck engine or electric motor. (Model 20 optional)
Engine Compressor Oil Charge		6 oz (177 ml) in compressor Total system: 12 oz (355 ml)
Electric Standby Compressor Oil Charge		6 oz 177 ml) in each compressor Total system: 24 oz (710 ml)
Compressor Oil Type		Polyol Ester P/N 203-413
Defrost Method:		
Truck Engine Operation	Model 10	Hot gas
Electric Standby	Model 20 (Optional)	Hot gas
Defrost Timer: (Part of Micro Software)		
	Initiation Interval	Adjustable, 1 hour to 8 hours - Default 3 hours
	Termination Interval	Adjustable, 20 to 50 minutes - Default 45 minutes

R-404A REFRIGERATION SYSTEM

Refrigerant Charge and Type		5 lb (2.3 kg) R-404A
Thermostat Switch:	Opens	200 ± 5 F (93 ± 3 C)
	Closes	230 ± 5 F (110 ± 3 C)
High Pressure Cutout Switch:	Opens	470 ± 7 psi (3241 ± 48 kPa)
	Closes	375 ± 38 psi (2585 ± 262 kPa)
Pressure Bypass Switch:	Opens	410 psi (2827 kPa)
	Closes	420 psi (2896 kPa)
Condenser Fan Pressure Switch:	Opens	130 ± 10 psi (896 ± 69 kPa)
	Closes	180 ± 10 psi (1241 ± 69 kPa)

R-134a REFRIGERATION SYSTEM

Refrigerant Charge and Type		5 lb (2.3 kg) R-134a
Defrost Termination Switch:	Opens	52 F (11.1 C)
	Closes	42 F (5.6 C)
Liquid Line Injection Switch:	Opens	200 ± 5 F (93 ± 3 C)
	Closes	230 ± 5 F (110 ± 3 C)
High Pressure Cutout Switch:	Opens	350 + 25/-0 psi (2413 + 172/-0 kPa)
	Closes	200 ± 20 psi (1379 ± 138 kPa)
Low Pressure Cutout:	Opens	5 to 11 in. Hg vacuum (-17 to -34 kPa)
	Closes	4 to 7 psi (28 to 48 kPa)
Condenser Fan Pressure Switch:	Opens	130 ± 10 psi (896 ± 69 kPa)
	Closes	180 ± 10 psi (1241 ± 69 kPa)

ELECTRICAL SYSTEM

FUSES

F1	Standby Clutch	7.5 amps
F2	Evaporator Fan Motor No. 1	15 amps
F3	Evaporator Fan Motor No. 2 (Not Used)	15 amps
F4	Evaporator Fan Motor No. 3 (Not Used)	15 amps
F5	Evaporator Fan Motor No. 4 (Not Used)	15 amps
F6	Motor Contactor	3 amps
F7	Heater Contactor	1 amps
F8	Hot Gas Solenoid & Drain Tube Heaters	7.5 amps
F9	Vehicle Compressor Clutch	7.5 amps
F10	Vehicle Heater	5 amps
F11	HPCO & LPCO	10 amps
F12	Condenser Fan Motor No. 1	15 amps
F13	Condenser Fan Motor No. 2 (Not Used)	15 amps
F14	Accessory	3 amps
F15	Battery	30 amps
F16	Power Pack To Protect Transformer	10 amps (115V power pack) or 4 amps (230 and 400V power packs)
F17	Power pack to protect “2R1” controller power supply	2 amps

CONDENSER FAN MOTORS

Voltage	Horsepower	Power Rating in Kilowatts	rpm	Full Load Current
12 Vdc	0.17	0.12	1750-2000	6-9 amps

EVAPORATOR FAN MOTORS

Voltage	Horsepower	Power Rating in Kilowatts	rpm	Full Load Current
12 Vdc	0.17	0.12	1750-2000	6-9 amps

HOT GAS SOLENOID AND LIQUID INJECTION SOLENOID COILS

Voltage	Current	Resistance
12 Vdc	0.6-0.8 amps	15-19 ohms

ELECTRICAL STANDBY COMPRESSOR MOTORS

Voltage	Phase	Frequency	Horsepower	Kilowatts	Full Load rpm	Full Load Current (amps)	Overload Relay Setting (amps)
115 Vac	1	60 Hz	1.5	1.1	1750	15.0	—
230 Vac	1	60 Hz	2.0	1.5	1755	8.6	—
230 Vac	1	50 Hz	1.6	1.2	1465	7.1	—
230 Vac*	3	60 Hz	2.0	1.5	1695	6.8	3.5**
400 Vac*	3	50 Hz	1.6	1.2	1405	3.2	3.5

* Motor can be wired for both voltages.
** Overload relay monitors 1/2 motor windings on 230.

OPTIONAL ELECTRIC HEATERS

Voltage	Power Rating Watts	Current	Resistance
230 Vac	1500	6.5 amps	35.3 ohms
400 Vac	1134	2.8 amps	141.1 ohms
115 Vac	1500	13.0 amps	8.8 ohms

BELT TENSION (Using Tool P/N 204-427)

	Field Reset
Engine/Compressor	35
Electric Motor/Compressor	57

Maintenance Inspection Schedule

First Week Inspection and Maintenance

AFTER FIRST WEEK OF OPERATION:

- Check the belt tension
- Tighten the unit mounting bolts
- Check the refrigerant level

Pre-trip	Bi-monthly	Annually	Inspect/Service These Items
			ELECTRICAL
•			Check display operation.
•			Check setpoint temperature.
	•	•	Check defrost initiation and termination.
	•	•	Check unit shutoff switch operation.
		•	Check return air operation.
		•	Check coil sensor.
		•	Inspect wire harness for damaged wires or connections.
			REFRIGERATION
	•	•	Check refrigerant level.
		•	Replace dehydrator.
			STRUCTURAL
	•	•	Visually inspect unit and refrigerant hoses for fluid leaks.
	•	•	Visually inspect unit for damaged, loose or broken parts.
	•	•	Clean defrost drains.
	•	•	Inspect belts for condition and proper tension (belt tension tool P/N 204-427).
	•	•	Clean entire unit including evaporator coil and condenser coil.
	•	•	Check all unit mounting bolts, brackets, lines, hoses, etc.

Unit Description

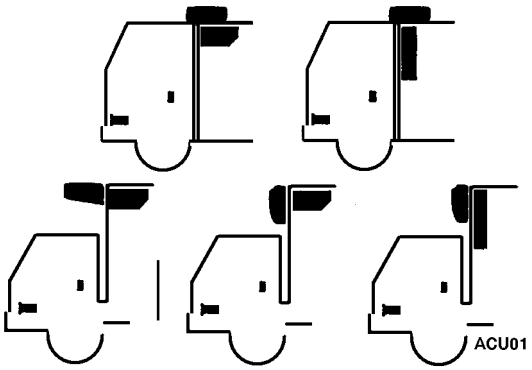
The Thermo King V280 is a truck refrigeration system that is designed for low and medium temperature applications on medium-sized trucks. There are two basic models:

- Model 10: Cool and defrost on vehicle-driven compressor operation.
- Model 20 (Optional Electrical Standby): Cool and defrost on both vehicle-driven and electric standby compressor operation.

The system consist of three separate assemblies: the condenser, the evaporator, and the compressor.

The condenser has a unique design that allows it to be mounted horizontally or vertically, on the roof or on the front of the truck box. See “Condenser and Evaporator Configurations” on page 7.

The evaporator is mounted inside the truck box. See “Funnel Evaporator” on page 15. Funnel and thin-line evaporators are available. The funnel evaporator mounts on the ceiling or the front wall. The thin-line evaporator mounts on the front wall.



Condenser and Evaporator Configurations

The compressor is mounted on and driven by the truck engine. Refrigeration hoses or lines are used to connect the condenser, the evaporator and the compressor. Model 20 (Optional Electrical Standby) units have another compressor and an electric motor mounted in the condenser section for electric standby operation.

The electric standby compressor is connected in parallel with the vehicle-driven compressor. The engine compressor is driven by a belt from the engine. The standby compressor is driven by a belt from the electric motor. Both compressors use the same refrigeration system circuit. A check valve isolate one compressor from the other during operation. Compressor operation is controlled by the microprocessor, which energizes the compressor clutch during engine operation or starts the electric motor and energizes the compressor clutch on electric standby operation. The refrigeration system is protected by a high pressure cutout switch and a low pressure cutout switch.

The control circuits operate on 12 Vdc supplied by the truck battery for over-the-road operation. On standby operation, the power is rectified from an AC transformer.

The µP-VP cab control unit (In-Cab Controller) is mounted in the truck cab, and is used to program the microprocessor. See “In-Cab Controller Keypad/Display Unit Front View” on page 19. The microprocessor is located on the PC board, in the low voltage box. See “Low Voltage Box” on page 17.

NOTE: Once the microprocessor is programmed, the In-Cab Controller may be removed from the cab.

The In-Cab Controller contains an ON-OFF key, SELECT key (cycling arrows), ENTER key (equals sign), UP and DOWN keys and the LCD display screen. See “In-Cab Controller Keypad/Display Unit Front View” on page 19.

Liquid Injection System

If the discharge gas leaving the engine driven compressor reaches a temperature of 230 ± 5 F (110 ± 3 C), the liquid injection switch closes, providing voltage to the liquid injection solenoid. The solenoid opens a valve, allowing liquid refrigerant to flow from the liquid line near the receiver outlet valve to the metering orifice attached to the suction fit-

ting at the compressor. As the refrigerant passes through the metering orifice it expands and evaporates, cooling the suction gas entering the compressor. This cooling effect is transferred to the discharge gas leaving the compressor from the adjacent cavity in the compressor head. When the discharge gas is cooled to 200 ± 5 F (93 ± 3 C), the liquid injection switch opens, the liquid injection solenoid valve closes and refrigerant no longer flows through the liquid injection system.

Oil Separator

An oil separator is a standard feature. It separates compressor oil from refrigerant vapor and returns the oil to the compressor through the suction line. The oil separator helps provide positive oil return at high compressor speeds and low operating temperatures. This feature enhances compressor lubrication and extends compressor life.

UNIT OPERATION

Unit operation is fully automatic once the microprocessor is programmed. The unit will shift from cool, null, and heat (optional) to maintain the box temperature at the desired setpoint. The operating modes include: cool, null, heat (optional), and defrost.

The unit operates in the same way on engine power as it does on standby electric power. The microprocessor controls unit operations by energizing and de-energizing the power outputs. The microprocessor places the unit in cool by energizing the required outputs, and places the unit in null by de-energizing all of the solid state outputs. The microprocessor places the unit in heat by energizing the heat output.

When the heat output is energized, it energizes the evaporator fan relay, the water pump, and the water valve.

When the fan relay is energized, it closes contacts that energize the evaporator fan.

Cool

During engine operation the engine compressor and the evaporator and condenser fans operate while the unit is in cool. The condenser fan is also controlled by the condenser fan pressure switch. This normally open switch monitors the compressor discharge pressure. When the discharge pressure rises to 180 ± 10 psi (1241 ± 69 kPa), the switch closes and energizes the condenser fan relay. When the discharge pressure drops to 130 ± 10 psi (896 ± 69 kPa), the switch opens and de-energizes the condenser fan relay. During electric operation, the electric motor, the electric standby compressor, and the evaporator and condenser fans operate while the unit is in cool.

Null

The microprocessor shifts the unit from cool to null at the setpoint. The microprocessor shifts the unit from null to heat at 3 F (1.7 C) below the setpoint if heat lockout is set to off. The microprocessor shifts the unit from heat to null at setpoint. The microprocessor shifts the unit from null to cool at 3 F (1.7 C) above the setpoint. This differential is adjustable from 2 F (1 C) to 9 F (5 C). The default is 4 F (2 C).

NOTE: The unit will not go into heat unless the "Heat Lockout Enable" is set to off. The default for "Heat Lockout Enable" is on, meaning that the heat will not come on.

Heat (Optional)

The microprocessor shifts the unit to heat at temperatures more than 4 F (2 C) below the setpoint. The microprocessor keeps the unit running in heat until the temperature rises to the setpoint. During engine operation, the water pump and the evaporator fans operate while the unit is in heat.

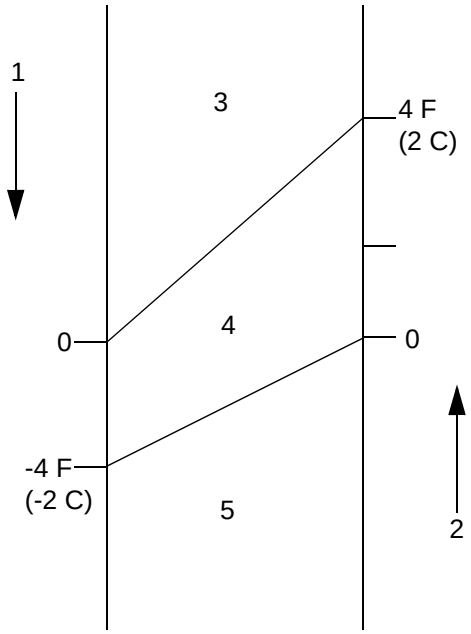
During electric operation, the evaporator heaters and the evaporator fans operate while the unit is in heat.

Defrost

The defrost cycle can be initiated any time the evaporator coil temperature is below 35 F (1.7 C). Defrost is initiated automatically by the microprocessor, or it may be initiated manually by an optional switch or by using the In-Cab Controller.

Initiating defrost energizes the hot gas solenoid. The defrost outputs de-energize the fan outputs to stop the evaporator and condenser fans.

The unit runs in defrost until the evaporator coil temperature rises to 58 F (14.5 C), terminating defrost.



0	Setpoint
1	Temperature Drop
2	Temperature Rise
3	Cool
4	Null
5	Heat (Optional)

(1) Shifts from Cool to Null
(2) Shifts from Heat to Null

Thermostat Algorithm

UNIT FEATURES

- Digital Temperature Display
- Electronic Thermostat
- Programmable Defrost
- Hot Gas Defrost
- Dual Temperature Sensor
- Liquid Injection System
- Suction Pressure Regulator
- Oil Separator
- Six Cylinder Compressor
- R-134a or R-404A
- Standby Electric Motor and Six Cylinder Standby Compressor (Model 20 only)
- Refrigerant Flow Controlled Between Compressors by Discharge Check Valve (Model 20 only)
- Service Switch

PROTECTION FEATURES

- Control Circuit Fuses
- Refrigerant High Pressure Cutout
- Refrigerant Low Pressure Cutout
- Refrigerant High Pressure Relief Valve
- Power Connection Indicator Icon (Electric Standby)
- Overload Relay Protection for Electric Standby Motor (Model 20 only)
- Transformer Fuses (Model 20 only)

OPTIONAL FEATURES

- Electric Motors (Model 20 only)

  115 Volt/1 Phase/60 Hz

  230 Volt/1 Phase/50 Hz

  230 Volt/1 Phase/60 Hz

  230 Volt/3 Phase/60 Hz

  400 Volt/3 Phase/50 Hz
- Heat, Truck Engine (Model 10)
- Heat, Truck Engine and Electric Standby Heater Strips (Model 20)
- External Manual Defrost Input (Not used at this time)
- R-404A Dealer Installed

SERIAL NUMBER LOCATIONS

Condenser: Roadside.

Evaporator: Roadside panel.

Compressor: Nameplate on compressor body.

Standby Motor: Nameplate on motor.

AKB73

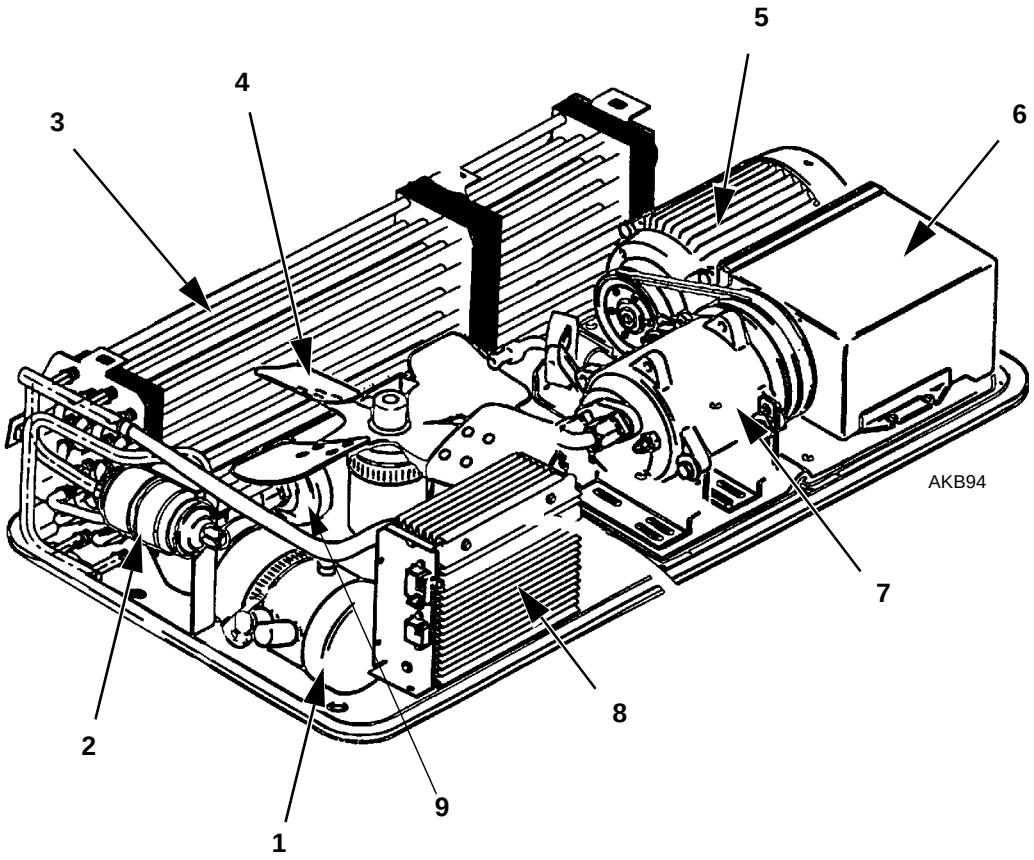
Vertical Mounted Condenser

AKB74

Roof Mounted Condenser

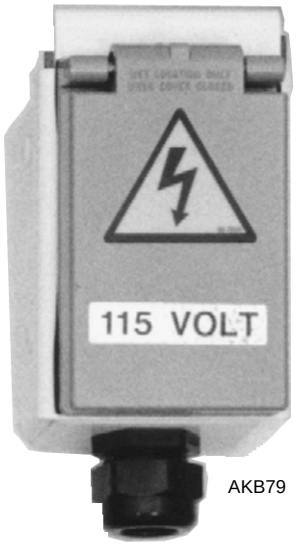
AKB75

Back View



Components

1.	Receiver Tank	6.	High Voltage Box
2.	Oil Separator	7.	Standby Compressor
3.	Condenser Coil	8.	Low Voltage Box
4.	Condenser Fan	9.	Drier
5.	Electrical Standby Motor		

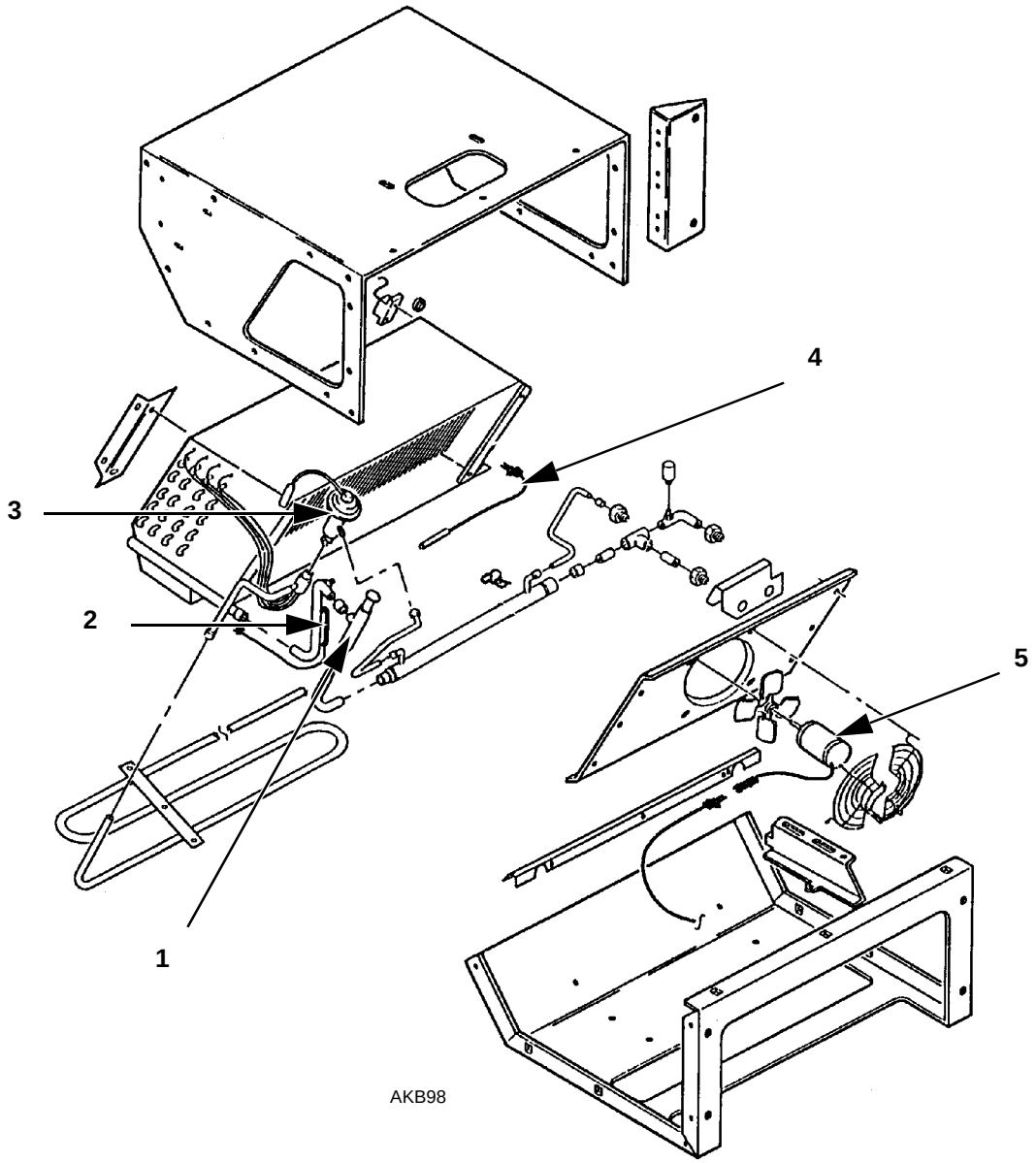


AKB79

External Power Connector

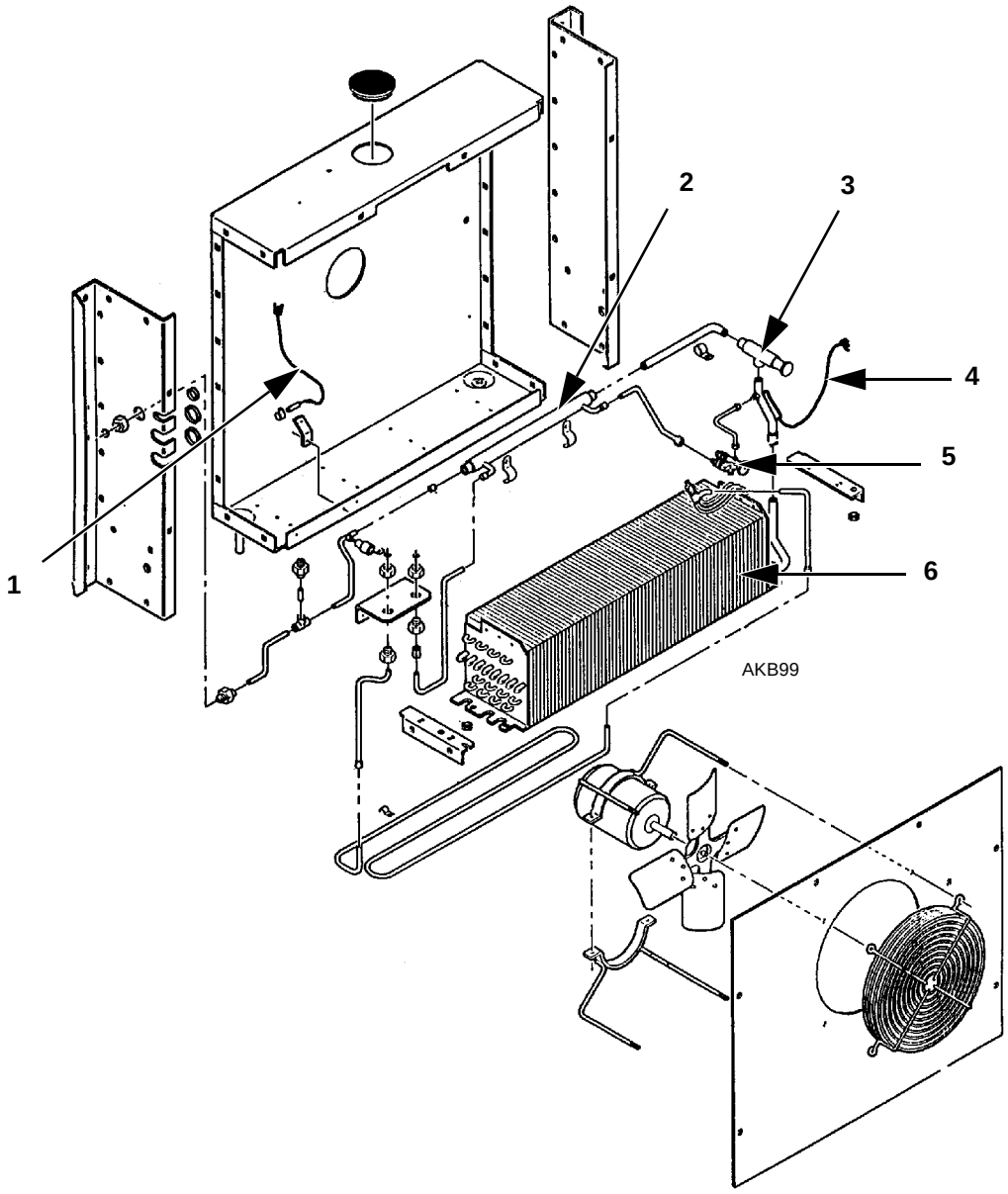
AKB81

Compressor



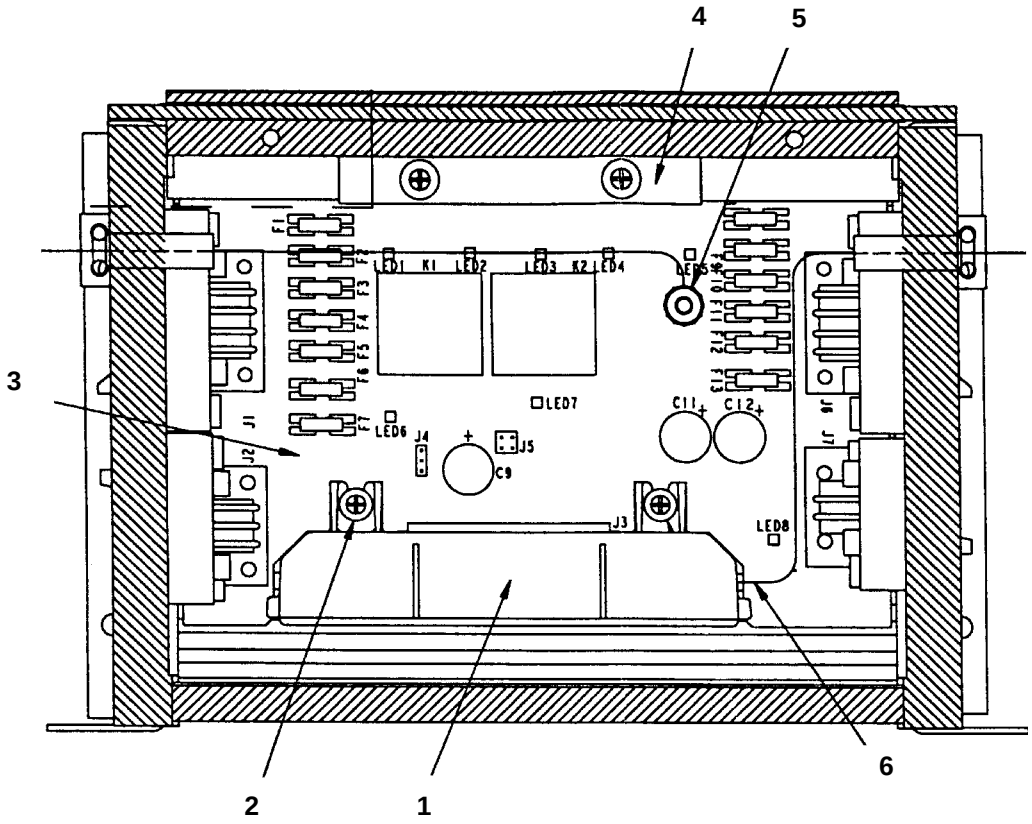
1.	Suction Pressure Regulator	4.	Return Air Temperature Sensor
2.	Coil Temperature Sensor	5.	Fan Motor
3.	Expansion Valve		

Funnel Evaporator



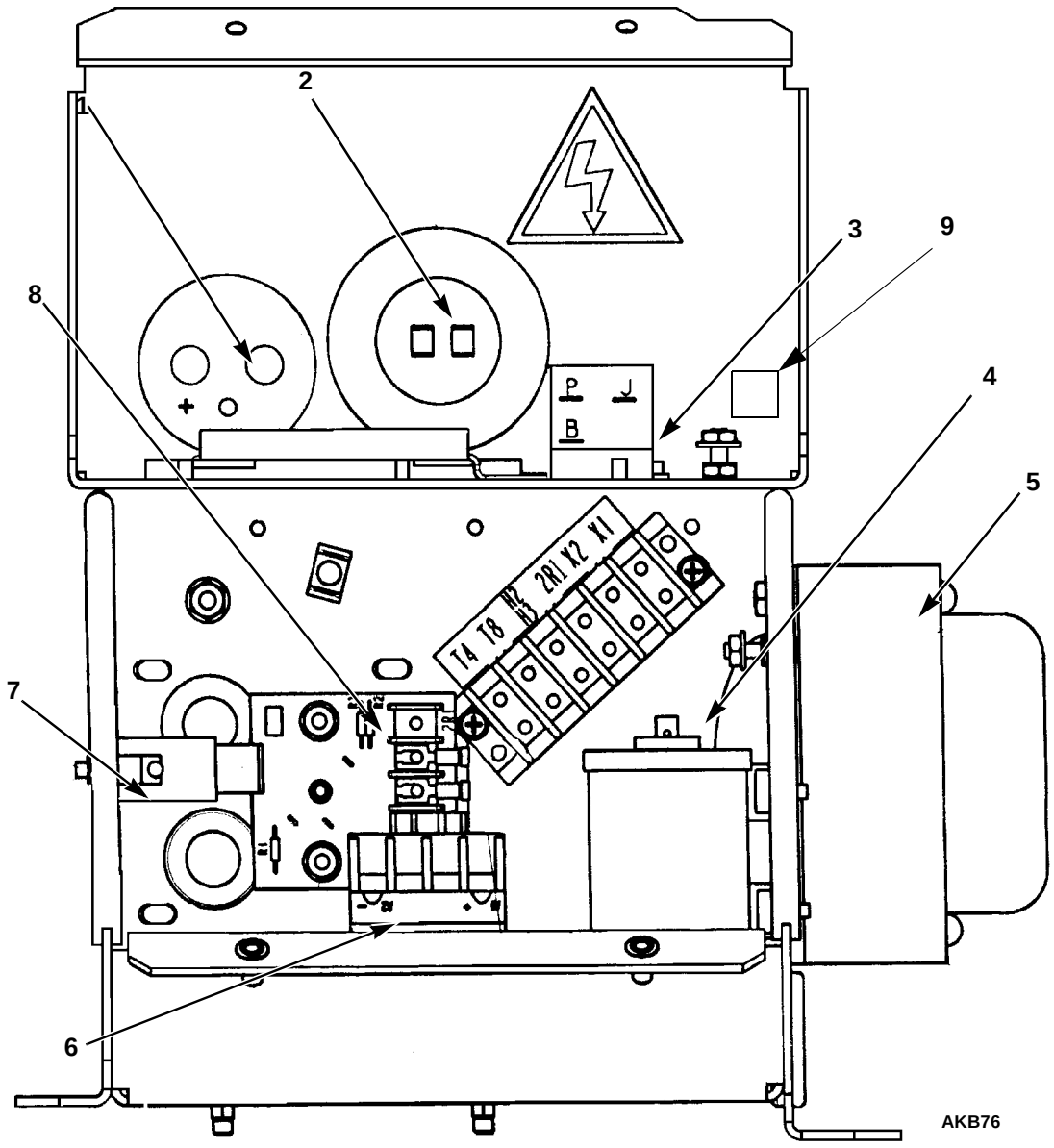
1.	Return Air Sensor	4.	Coil Temperature Sensor
2.	Heat Exchanger	5.	Expansion Valve
3.	Suction Pressure Regulator	6.	Evaporator Coil

Thin-Line Evaporator



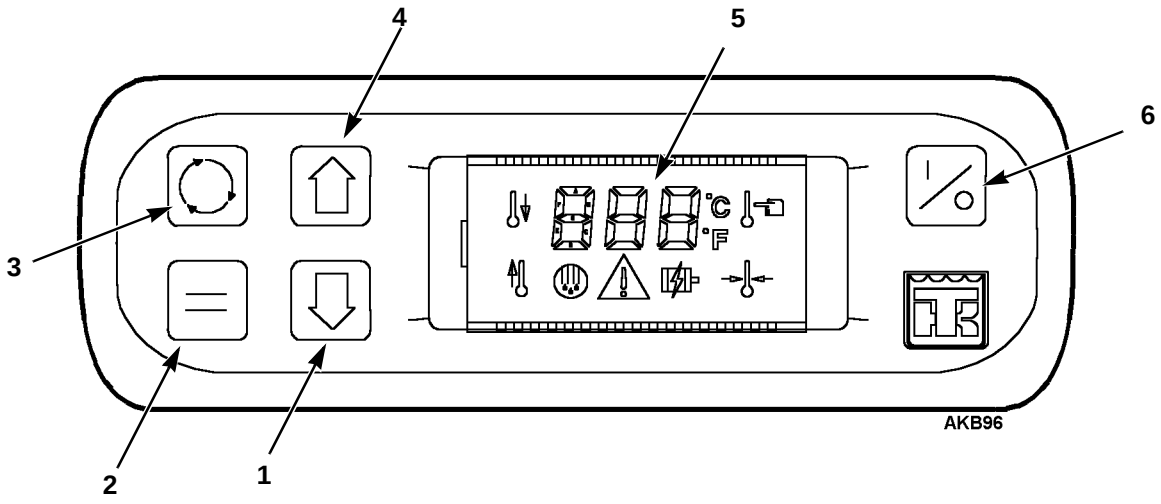
1.	µP VP Microprocessor	4.	F.E.T. Retainer
2.	Mounting Screw	5.	Switch Connection
3.	PC Board	6.	In-Cab Controller Harness

Low Voltage Box



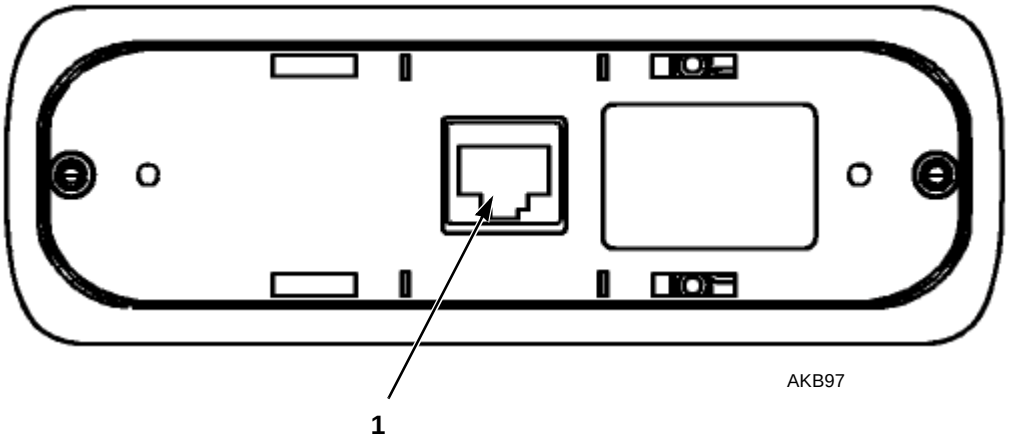
1.	D.C. Power Filter Capacitor	6.	Motor Contactor
2.	Motor Starting Capacitor	7.	Fuse and Fuseholder
3.	Motor Start Relay	8.	Motor Protector
4.	Motor Run Capacitor	9.	Electric Changeover Relay
5.	Transformer		

High Voltage Box - Typical for Single Phase 115 Volt/60 Hz



1.	DOWN Arrow Key	4.	UP Arrow Key
2.	ENTER Key	5.	LCD Screen
3	SELECT Key	6.	ON/OFF Key

In-Cab Controller Keypad/Display Unit Front View



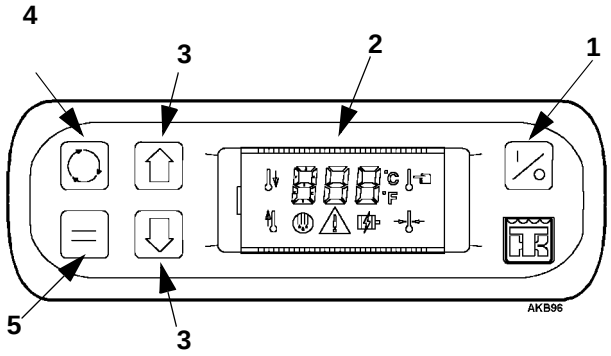
1.	Socket for Microprocessor Cable

In-Cab Controller Rear View

UNIT CONTROLS

In-Cab Controller Keypad/Display Unit

1. ON-OFF Key. Used to turn the unit ON and OFF, located in the upper right corner of the In-Cab Controller.
2. LCD DISPLAY. This display is active only when the unit is turned on. The return air sensor temperature normally appears on the display.
3. Up and DOWN Arrow Keys. Used to select data before entering it into the controller.
4. SELECT Key (cycling arrows). Used to select the various displays which can appear on the display screen.
5. ENTER Key (equals sign). Used to enter new information into the controller.



In-Cab Controller Display Unit

1.	ON-OFF Key.
2.	LCD DISPLAY.
3.	Up and DOWN Arrow Keys.
4.	SELECT Key (cycling arrows).
5.	ENTER Key (equals sign).

Low Voltage Box

1. DEFROST TIMER. The defrost timer is part of the controller software. It can automatically initiate or terminate a defrost cycle if necessary. The initiation interval is adjustable from 1 hour to 8 hours. The termination interval is adjustable from 20 to 50 minutes, the default setting is 45 minutes. Refer to the Electrical Maintenance section in default for more information about the defrost timer.
2. CONTROL OUTPUTS. All control circuitry is located on the PC board. The microprocessor controls the relays and solid state outputs.

High Voltage Box (Model 20)

1. MOTOR CONTACTOR. The motor contactor is used to control the operation of the electric motor that drives the electric standby compressor.
2. HEATER CONTACTOR (Optional). The heater contactor is used to control the operation of the optional electric evaporator heaters.

Other Controls

1. CONDENSER FAN PRESSURE SWITCH. This pressure sensitive switch is located on the receiver tank. When the pressure in the receiver tank rises above 180 psi (1241 kPa), the switch closes to energized the condenser fan relay. When the pressure in the receiver tank falls below 130 psi (896 kPa), the switch opens to de-energize the condenser fan relay.
2. LIQUID INJECTION SWITCH. This temperature sensitive switch is located on the discharge fitting of the truck engine compressor. When the discharge temperature rises above 230 F (110 C), the switch closes to open the liquid injection solenoid. When the discharge temperature falls below 200 F (93 C), the switch opens to close the liquid injection solenoid.
3. SUCTION PRESSURE REGULATOR VALVE. This valve is located in the suction line in the evaporator. It limits the suction pressure at the compressor. The normal pressure setting for this valve is 18 to 20 psi (124 to 138 kPa).

UNIT PROTECTION DEVICES

1. PC BOARD FUSES. The following fuses are located on the PC board in the low voltage box.

   F1 This 7.5 amp fuse protects the circuit to the electric standby compressor clutch.

   F2 to F5 These 15 amp fuses protect the circuits to the evaporator fan motors. Only F2 is used on the V280.

   F6 This 3 amp fuse protects the circuit to the motor contactor (electric standby).

   F7 This 1 amp fuse protects the circuit for the electric heat output.

   F8 This 7.5 amp fuse protects the hot gas and drain tube heaters output circuit.

   F9 This 7.5 amp fuse protects the compressor clutch (on vehicle power).

   F10 This 5 amp fuse protects the heat circuit (vehicle power). (Water pump and valve)

   F11 This 10 amp fuse protects the 8A line to HPCO and LPCO switches.

   F12 and F13 This 15 amp fuse protects the condenser fan circuits. (Only F12 is used on the V280)

   F14 This 3 amp fuse protects the accessory circuit from the vehicle ignition switch.

   F15 This 30 amp fuse protects the circuit from the vehicle battery to the unit.

   F16 This 10 amp fuse in 115V power pack or 4 amp fuse in 230 and 400V power packs protects the transformer.

   F17 A 2 amp fuse in power pack protects “2R1” controller power supply.

2. HIGH PRESSURE CUTOUT SWITCH. This pressure sensitive switch is located on the receiver tank. If the pressure in the receiver tank rises above 350 psi (2413 kPa) for R-134a systems or 470 psi (3241 kPa) for R-404A systems, the switch opens the circuit to the clutches, stopping the compressor.

3. LOW PRESSURE CUTOUT SWITCH. This pressure sensitive switch is located on the suction line in the evaporator. If the pressure in the suction line falls below 5 to 11 in. Hg of vacuum (-17 to -37 kPa), the switch opens the circuit to the clutches, stopping the compressor.

4. FUSE PLUG. The fuse plug is located on the receiver tank. It opens to relieve the pressure in the refrigeration system if the pressure becomes excessive. If the fuse plug has opened, it must be replaced. It cannot be reused.

5. OVERLOAD RELAY (3 Phase only) (Model 20). This auto reset relay protects the electric motor that drives the electric standby compressor. The overload relay opens the circuit to the micro processor, which de-energizes the motor contactor and the electric motor if the motor overloads for any reason (e.g., low line voltage or improper power supply) during electric standby operation.

6. SINGLE PHASE MOTOR PROTECTOR (1 Phase Model 20). This protector is a PC Board accessory which opens the circuit to the micro processor which de-energizes the motor contactor and the electric motor if the motor overloads for any reason or fails to come up to speed on startup.

7. TRANSFORMER FUSE (Model 20). This fuse is located in the high voltage box. The 115 volt, single phase, 60 Hz unit has a 10 amp fuse. All other units use a 4 amp fuse.

UNIT OPERATION

Bi-monthly Pre-Trip Checks

The following bi-monthly pre-trip inspection should be completed before loading the truck. While the bi-monthly inspection is not a substitute for regularly scheduled maintenance inspections, it is an important part of the preventive maintenance program designed to head off operating problems before they happen.

1. LEAKS. Inspect for refrigerant leaks and worn refrigerant lines.

2. BELTS. Inspect for cracks, wear and proper tensions.

3. ELECTRICAL INSPECTION. The electrical connections should be securely fastened. Wires and terminals should be free of corrosion, cracks or moisture.

4. DEFROST DRAINS. Check the defrost drain hoses and fittings to make sure that they are open so condensate can run out during defrost. Check the bottom end of each drain hose to make sure that it is not plugged or crushed.

5. STRUCTURAL INSPECTION. Visually check for physical damage.

6. REFRIGERANT CHARGE. Check the receiver tank sight glass for the proper charge level.

Starting the Unit

Vehicle Operation Only)

NOTE: Once the microprocessor has been programmed, unit operation is fully automatic.

1. Start the vehicle engine.
2. If the display is blank, press the ON-OFF key to prompt the microprocessor.
3. Check the setpoint, and adjust if needed. See "Vehicle and Electric Standby Operation" on page 24, Step 6.

Vehicle and Electric Standby Operation

1. If not operating in electric standby, start the vehicle (vehicle operation only). Skip to step 6.
2. If operating in electric standby, turn OFF the vehicle, and turn OFF the external power source.

WARNING: HIGH VOLTAGE. Always turn off the external power source before handling, connecting or disconnecting cables to external power.

3. Connect the power cable to the external power source.
4. Connect the opposite end of the power cable to the External Power Connector.
5. Turn ON the external power source. The electric standby icon will appear on the display and remain steadily lit.

***CAUTION: Always** disconnect the power cable before starting the vehicle. This practice will reduce the chances of driving away while the vehicle is still plugged in.*

NOTE: The electric standby icon will flash to warn the operator when the vehicle is started while the unit is connected to external power.

6. Check the setpoint. To check the setpoint, press the SELECT Key once.
   a. If a number appears on the screen with the alarm icon, an alarm condition exists, and must be cleared. See "Alarms" on page 25.
   b. If "dEF" appears on the screen, press the SELECT key again. The setpoint will appear on the display.
7. Change the setpoint if desired. See "Enter The Setpoint" on page 24.

NOTE: You will know when the setpoint is displayed because the setpoint icon (finger pointing at thermometer) will appear to the right of the setpoint temperature.

Enter The Setpoint

The setpoint can be quickly and easily entered. Make sure the In-Cab Controller is ON and the setpoint appears on the screen.

NOTE: You will know when the setpoint is displayed because the setpoint icon (finger pointing at thermometer) will appear next to the setpoint temperature.

1. To display the setpoint, press the SELECT Key once.
   a. If a number appears on the screen with the alarm icon, an alarm code exists, and must be cleared. See "Alarms" on page 25.
   b. If "dEF" appears on the screen, press the SELECT key again. The setpoint will appear on the display.
2. Once the setpoint is displayed on the screen, press the ENTER key. The setpoint temperature will flash. Use the UP and DOWN arrow keys to select the new setpoint.

3. Press the ENTER key to load the new setpoint into memory. “Lod” will appear on the screen for a few seconds, then the new setpoint will flash for a few seconds. The display will cycle back to the default display (usually return air temperature), and operate using the new setpoint.

CAUTION: Make sure to press the ENTER key after selecting the new setpoint or the microprocessor will operate using the original setpoint.

4. When complete, double-check to insure new setpoint has been entered by pressing the SELECT key twice to bring up the new setpoint reading.

Alarms

When the unit is not functioning properly, the microprocessor records the alarm code, alerts the operator by displaying alarm codes and/or shuts the unit down. There are three alarm categories: log, check and shutdown.

1. LOG: At this level, the alarm will turn ON the alarm icon for 30 seconds after the unit is turned ON. The unit will still operate normally.
2. CHECK: At this level, the alarm icon will be full ON and notifies the operator that something has happened to the system and operation may be impaired.
3. SHUTDOWN: At this level, the alarm will flash, along with the rest of the display, and the unit will be shutdown.

Alarm Descriptions

Alarms are displayed by two-digit code numbers. The following alarm codes coincide with the following conditions.

02 There has been no valid reading from the coil sensor for 10 consecutive seconds. Check. Clearable on any alarm screen.

03 There has been no valid reading from the return air sensor for 10 consecutive seconds. Check. Clearable on any alarm screen.

08 The unit is operating off of the coil sensor because the return air sensor failed. Check. Clearable on any alarm screen.

09 The coil sensor reading exceeded 155 F and stayed above 150 F for 10 minutes. Shutdown. Clearable on any alarm screen.

12 The digital inputs have not stabilized after 100 consecutive readings (10 seconds). Shutdown. Clearable on any alarm screen.

12 Both the return air and the coil sensors have failed for two minutes on a fresh load. Shutdown. Clearable on any alarm screen.

38 The electric overload input is high for two seconds when the electric motor should be ON. Shutdown. This alarm will self-clear when the ON/OFF switch is cycled or the main power to the control is cycled.

70 Any of the hourmeter values has exceeded 99,999 hours. Log. Clearable on any alarm screen.

70 An unsuccessful write to an hourmeter EEPROM location occurred. Log. Clearable on any alarm screen.

74 An initialization start has occurred. This can occur when software is changed, the unit has an EEPROM checksum error, the cold start digital input is low on a reset or a factory initialization start serial command is sent. Check. Clearable only on super guarded access alarm screen.

77 An unsuccessful write to the EEPROM location, other than an hourmeter, occurred. Factory. Clearable only with a cold start.

Clear Alarms

The In-Cab Controller will only display the alarm(s) when an alarm condition(s) exists.

a. If the alarm icon and a code number appears on the screen, when the SELECT key is pressed, an alarm condition exists, and must be cleared.

NOTE: If there are multiple alarms, each alarm will be displayed for two seconds.

b. Press the ENTER key to clear the alarm that is displayed. The display digits will blank-out for one second, and if no other alarms exist, “00” will be shown.

NOTE: Some alarms are only clearable in super guarded access, or must be cleared by a certified Thermo King technician.

Initiate Manual Defrost

NOTE: Before initiating a manual defrost, make sure that the unit is not already in a defrost cycle.

The defrost icon (coil with water drops) will appear on the screen when the unit is in a defrost cycle.

1. Press the SELECT key once. If there are no alarms to clear, “dEF” will appear on the screen.
2. Press the ENTER key, “Lod” will appear for a few seconds. The unit will begin a defrost cycle.

After Start Inspection

1. SETPOINT. Adjust the setpoint above and below the box temperature to check operation. The unit should heat when the setpoint is raised, and should cool the setpoint is lowered.
2. PRECOOLING. With the setpoint at the correct temperature, allow the unit to run for 30 minutes (longer if possible) before loading the truck. Precooling will remove residual body heat and moisture from the box interior and provide a good test of the refrigeration system.
3. DEFROST. When the unit has finished pre-cooling the truck interior (the evaporator temperature has dropped below 35 F, initiate a manual defrost. See “Initiate Manual Defrost” on page 26.

Loading Procedure

1. Make sure that the unit is OFF before opening the doors to minimize frost accumulation on the evaporator coil and heat gain in the truck.

   NOTE: An optional external door switch will turn unit off when the doors are opened.

   NOTE: The unit may be running when the truck is being loaded from a warehouse with door seals.

2. Spot check and record the load temperature while loading. Especially note any off-temperature product.
3. Load the product so there is adequate space for air circulation completely around the load. DO NOT block the evaporator inlet or outlet.
4. Products should be precooled before loading. Thermo King units are designed to maintain loads at the temperature at which they are loaded. Transport refrigeration units are not designed to pull hot loads down to temperature.

Post Loading Procedure

1. Make sure that all the doors are closed and locked.
2. Adjust the setpoint to the desired temperature.
3. Start the unit.
4. Thirty minutes after loading, initiate a manual defrost. See “Initiate Manual Defrost” on page 26. If the coil temperature has dropped below 35 F, the unit will defrost. The defrost cycle should stop automatically.

Bi-monthly Post Trip Checks

1. Wash the unit.
2. Check for leaks.
3. Check for loose or missing hardware.
4. Check for physical damage to the unit.

µP-VP MICROPROCESSOR

The µP-VP contains all of the programming to automatically operate the unit. The programming can be changed by loading new data using the In-Cab Controller.

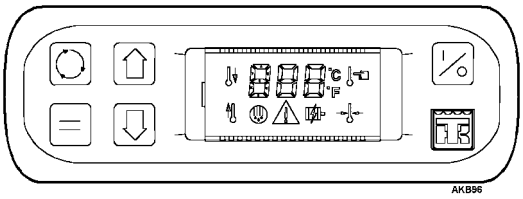
It is very important to understand that the µP-VP microprocessor is not the In-Cab Controller Keypad/Display Unit. The µP-VP is located on the PC board inside the low voltage box. See “Low Voltage Box” on page 17.

IN-CAB CONTROLLER KEYPAD/DISPLAY UNIT

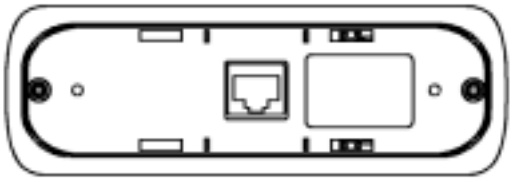
The In-Cab Controller is a detachable display unit that mounts inside of the cab.

The In-Cab Controller contains all of the keys to program the µP-VP microprocessor, and it is connected to the µP-VP via a cable. Once the µP-VP is programmed, the In-Cab Controller may be removed from the cab if desired, and the unit will operate automatically.

It is very important to understand that the In-Cab Controller Display unit is not the µP-VP microprocessor.



In-Cab Controller Keypad/Display Unit



In-Cab Controller Keypad/Display Unit Rear View

View All Display Icons

To view all display icons press the Up arrow key and the ENTER key at the same time and hold down for three seconds. All of the icons will appear on the screen for two seconds, followed by the software version code.

Contact a certified Thermo King technician if there are any blank spaces on the display. The display icons are described in the following paragraphs:

Heat Icon

This icon will be on whenever the unit is in the heat mode. On the coil temperature view screen, this icon will be off.

Cool Icon

This icon will be on whenever the unit is in the cool mode. On the coil temperature view screen, this icon will be off.

In-Range Icon

This icon will only be shown when the return air temperature is ’In Range’ and the unit is in the temperature control mode and the return air sensor is good and the ’orA’ setting is greater than 0.

Setpoint Icon

This icon will only be shown on the setpoint view screen and the setpoint set screen.

Electric Icon

This icon will be shown whenever the unit electric standby input is high. If both the electric standby and the accessory input are high, this icon will be flashing 1 second on / 1 second off.

Defrost Icon

This icon will be shown whenever the unit is performing a defrost.

Degrees C Icon

This icon will be shown whenever a temperature value is put on the display and the 'dE' setting in super guarded access is 'C'.

Degrees F Icon

This icon will be shown whenever a temperature value is put on the display and the 'dE' setting in super guarded access is 'F'.

Normal Key Flow

The backlighting will be on for all of the following displays. Each of the following displays, except the Power Up and Return Air Temperature, will have a time-out of 10 seconds back to the Default Display if not specified otherwise. The individual displays will be described in the following paragraphs.

Power Up (Initial Display)

This display will be shown on every power up. All segments and icons will be turned off. After the ON/OFF key has been pressed once, the display will go to the default display.

Return Air Temperature (Default Display)

This display will show the measured return air temperature in whole degrees from -40C to 70C (-40F to 158F.) If no reading is obtained from the sensor, then "---" will be shown on the display. Any of the icons except the setpoint icon can be active on this display.

Alarm

This display will only be shown if an alarm condition exists See "ALARMS" on page 48. Any of the icons except the setpoint icon can be active on this display. If there are multiple alarms, each alarm (with a maximum of 5) will be shown for 2 seconds.

To clear an alarm press the ENTER key to clear the alarm that is displayed. The display digits will blank-out for one second, and if no other alarms exist, "00" will be shown.

NOTE: If there are multiple alarms, each alarm will be displayed for two seconds.

NOTE: Some alarms are only clearable by a certified Thermo King technician.

Defrost

This display will show "dEF" and be used to enter a defrost. Pressing the ENTER key will initiate a defrost, if the conditions for initiating a manual defrost are valid, and "Lod" will be shown for 3 seconds. Any of the icons except the setpoint icon can be active on this display.

Setpoint

This display will show the Setpoint Setting in whole degrees.

1. Press the SELECT Key once to display the setpoint.
2. If "dEF" appears on the screen, press the SELECT key again. The setpoint will appear on the display.
3. Press the ENTER key. The setpoint temperature will flash.
4. Press the UP and DOWN arrow keys to select the new setpoint.

Back Light Control

This display will show "blt" and be used to enter the view/set Back Light Intensity Setting display. This display will show the Back Light Intensity with "Hi" or "Lo" as options.

To Change In-Cab Controller Backlight Intensity:

1. The In-Cab Controller backlighting may be set to high or low. To change the setting, Press the SELECT key three times (if there are no alarms) until you see “bLt.”
2. Press the ENTER key. “HI” or “LO” will flash on the display screen.
3. Use the UP and DOWN arrow keys to change the setting.
4. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 10 seconds.

Total On Hours

This display will show “tLH” and be used to enter the view total on hours display.

To View Total On Hours:

1. To view total On hours, Press the SELECT key four times (if there are no alarms) until you see “tLH.”
2. Press the ENTER key. Total hours will appear on the display screen. Hours are shown one digit at a time starting with the most significant digit (5 digits total). The default display screen will appear after 10 seconds.

Engine Clutch Hours

This display will show “EnH” and be used to enter the view engine clutch hours display.

To View Engine Clutch Hours:

1. To view engine clutch hours, Press the SELECT key five times (if there are no alarms) until you see “EnH.”
2. Press the ENTER key. Total hours will appear on the display screen. Hours are shown one digit at a time starting with the most significant digit. (5 digits total) The default display screen will appear after 10 seconds.

Electric Clutch Hours

This display will show “ELH” and be used to enter the view electric clutch hours display.

To View Electric Clutch Hours:

1. To view engine clutch hours, Press the SELECT key six times (if there are no alarms) until you see “ELH.”
2. Press the ENTER key. Total hours will appear on the display screen. Hours are shown one digit at a time starting with the most significant digit. (5 digits total) The default display screen will appear after 10 seconds.

Coil Temperature

This display will show “coL” and be used to enter the view coil temperature display.

To View Coil Temperature:

1. To view the coil temperature, Press the SELECT key seven times (if there are no alarms) until you see “CoL.”
2. Press the ENTER key. The coil temperature will appear on the display screen. The default display screen will appear after 10 seconds.

GUARDED ACCESS MODE

Once in the Guarded Access Mode, you can move between the four screens without exiting and reentering. The following 4 display screens can be accessed from the Guarded Access Mode:

- Out Of Range Display
- Alarm
- Defrost Interval Display
- Defrost Duration Display

These four display screens will be explained in detail in the following paragraphs.

The backlighting will be on for all of the following displays. Each of the following displays will have a time-out of 30 seconds back to the Default Display if not specified otherwise. The only icons that can be active are the “C”, “F”, Alarm and Electric Standby.

Out Of Range

This display will show “orA” and be used to enter an Out of Range Setting. This display will show the Out of Range Setting in whole degrees (0 - 10 C or 0 - 18 F where 0 = Off).

To select the Out of Range Setting:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the ENTER key. The out of range setting will flash on the display screen.
4. Use the UP and DOWN arrow keys to change the setting.
5. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds. Default is set to “0” with this setting, the out of range feature is disabled.

Alarm

This display will only be shown if an alarm condition exists. See “ALARMS” on page 48. If there are multiple alarms, each alarm (with a maximum of 5) will be shown for 2 seconds. Pressing the ENTER key will clear the alarm that is currently showing, unless the alarm is only clearable in super guarded access or is a factory clearable only alarm. A complete list of all Alarm Faults and their description is located at the end of this section.

Defrost Interval

This display will show “dFi” and be used to enter a Defrost Interval Setting. The defrost interval may be set at 1, 2, 3, 4, 6 or 8 hours.

To select the Defrost Interval:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key once. ”dFi” will appear on the display screen. (If no alarm codes are present)
4. Press the ENTER key. The defrost interval number will flash.
5. Use the UP and DOWN arrow keys to change the setting.
6. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Defrost Duration

This display will show “ddr” and be used to enter the Defrost Duration Setting. The defrost duration may be set at 20, 25, 30, 35, 40, 45 or 50 minutes.

To select the defrost Duration:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. ”ddr” will appear on the display screen. (If no alarm codes are present)
4. Press the ENTER key. The defrost duration setting will flash.
5. Use the UP and DOWN arrow keys to change the setting.
6. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

SUPER GUARDED ACCESS MODE

The following 18 screens can be accessed from the Super Guarded Access Mode:

- Temperature Display Format
- Alarm
- Refrigerant Type
- Setpoint High Limit
- Setpoint Low Limit
- Demand Defrost Enable
- Demand Defrost Slope
- Demand Defrost Offset
- Evaporator Fan Delay
- Compressor Protection Enable
- Clutch Delay Timer
- Control Band Differential
- Heat Lockout Enable
- Hot Gas Heat Enable
- Evaporator Fan Null Setting
- Settable Total On Hours
- Settable Engine Clutch Hours
- Settable Electric Clutch Hours

These 18 screens will be explained in detail on the following pages.

The backlighting will be on for all of the following displays. Each of the following displays will have a time-out of 30 seconds back to the Default Display if not specified otherwise. The only icons that can be active are the “C”, “F”, and the Alarm and Electric Standby.

Temperature Scale

The temperature readings can be displayed in the Celsius or Fahrenheit. Celsius is the default temperature scale.

To view/change the Temperature Scale:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the display screen.
5. Press the ENTER key. A “C” or “F” will flash on the screen. Press the UP or DOWN arrow keys to select the desired temperature scale.
6. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing letter of the new setting. The default display screen will appear after 30 seconds in the new temperature scale.

Alarm

This display will only be shown if an alarm condition exists. See “ALARMS” on page 48. If there are multiple alarms, each alarm (with a maximum of 5) will be shown for 2 seconds. Pressing the ENTER key will clear the alarm that is currently showing, unless the alarm is a factory clearable only alarm.

Refrigerant Type

The µP-VP controller is designed for use with R-404a and R-134a refrigerants.

CAUTION: Do not change this setting unless the system has been converted by a certified Thermo King technician.

To view/select the Refrigerant Type:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the display screen.
5. Press the SELECT key once. (If no alarm codes) ”reF” will appear on the display screen.
6. Press the ENTER key. “134” or “404” will flash on the screen. Press the UP or DOWN arrow keys to select the desired refrigerant type.
7. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing numbers of the new setting. The default display screen will appear after 30 seconds.

High Setpoint Limit

The setpoint range is variable. Follow the steps below to set the high and low setpoint limits.

To set the High Setpoint Limit:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key twice. (If no codes) “stH” appears on the display screen.
6. Press the ENTER key. The high setpoint limit temperature will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Low Setpoint Limit

The setpoint range is variable. The Default Display is -20 C (-4 F) when the “stL” screen is set to 134. The Default Display is -30 C (-22 F) when the “stL” screen is set to 404.

To set the Low Setpoint Limit:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key three times. (If no codes) “stL” appears on the display screen.
6. Press the ENTER key. The low setpoint limit temperature will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Demand Defrost Enable

This display will show “ddE” and be used to enter the Demand Defrost Enable Setting. This display will show the Demand Defrost Enable with “on” or “oFF” as options. The default value will be “on”.

To set the Demand Defrost Enable:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key four times. (If no alarm codes) “ddE” appears on the display screen.
6. Press the ENTER key. The Demand Defrost Enable setting will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Demand Defrost Slope

This display will show “dSL” and be used to enter the Demand Defrost Slope Setting. This display will show the Demand Defrost Slope Setting in whole numbers (2 - 13). This display will only be shown if the Demand Defrost Enable setting is set to “on”. The default value will be 7 for 134a refrigerant and 6 for 404A refrigerant. The value for this display will be affected when the “rEF” setting is changed.

To set the Demand Defrost Slope Setting:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key five times. (If no alarm codes) “dSL” appears on the display screen.
6. Press the ENTER key. The Demand Defrost Slope Setting will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Demand Defrost Offset

This display will show “doF” and be used to enter the Demand Defrost Offset Setting. This display will show the Demand Defrost Offset Setting in whole degrees (3 - 13 C, 6 - 23 F). This display will only be shown when the Demand Defrost Enable setting is set to “on”. The default value will be 5 C (9 F) for 134a refrigerant and 11 C (19 F) for 404A refrigerant. The value for this display will be affected when the “rEF” setting is changed.

To set the Demand Defrost Offset Setting:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key six times. (If no alarm codes) “doF” appears on the display screen.
6. Press the ENTER key. The Demand Defrost Offset Setting will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Evaporator Fan Delay

This display will show “EFd” and be used to enter the Evaporator Fan Delay Setting. This display will show the Evaporator Fan Delay Setting in seconds (0, 30, 60, 120). The default value will be 30 seconds.

To set the Evaporator Fan Delay Setting:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key seven times. (If no alarm codes) “EFd” appears on the display screen.
6. Press the ENTER key. The Evaporator Fan Delay Setting will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Compressor Protection Enable

This display will show “CPE” and be used to enter the Compressor Protection Enable Setting. This display will show the Compressor Protection Enable with “on” or “oFF” as options. The default value will be “off”.

To set the Compressor Protection Enable Setting:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key eight times. (If no alarm codes) “CPE” appears on the display screen.
6. Press the ENTER key. The Compressor Protection Enable Setting will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Clutch Delay Timer

This display will show “Cdt” and be used to enter the Clutch Delay Timer Setting. This display will show the Clutch Delay Timer Setting in seconds (0, 5, 10, 15).The default value will be 5 seconds.

To set the Clutch Delay Timer Setting:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key nine times. (If no alarm codes) “Cdt” appears on the display screen.
6. Press the ENTER key. The Clutch Delay Timer Setting will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Control Band Differential

This display will show “Cbd” and be used to enter the Control Band Differential Setting. This display will show the Control Band Differential Setting in whole degrees (1 - 5 C or 2 - 9 F). The default value will be 2C (4F).

To set the Control Band Differential Setting:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key ten times. (If no alarm codes) “Cbd” appears on the display screen.
6. Press the ENTER key. The Control Band Differential Setting will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Heat Lockout Enable

This display will show “HLo” and be used to enter the Heat Lockout Enable Setting. This display will show the Heat Lockout Enable with “on” or “oFF” as options. The default value will be “on”.

To set the Heat Lockout Enable Setting:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key eleven times. (If no alarm codes) HLo” appears on the display screen.
6. Press the ENTER key. The Heat Lockout Enable Setting will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Hot Gas Heat Enable

This display will only be shown if the Heat Lockout Enable is set to “oFF”. This display will show “HgE” and be used to enter the Hot Gas Heat Enable Setting. This display will show the Hot Gas Heat Enable with “on” or “oFF” as options. The default value will be “oFF”.

To set the Hot Gas Heat Enable Setting.:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key twelve times. (If no alarm codes) “HgE” appears on the display screen.
6. Press the ENTER key. The Hot Gas Heat Enable Setting will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Evaporator Fan Null Setting

This display will show “EFn” and be used to enter the Evaporator Fan Null Setting. This display will show the Evaporator Fan Null Setting with “on” or “oFF” as options. The default value will be “oFF”.

To set the Evaporator Fan Null Setting:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key thirteen times. (If no alarm codes) “EFn” appears on the display screen.
6. Press the ENTER key. The Evaporator Fan Null Setting will flash.
7. Use the UP and DOWN arrow keys to change the setting.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Settable Total On Hours

This display will show “tLH” and be used to enter the settable total on hours display. The default value will be 00000. The value range that can be entered is from 00000 to 65000. Once a value of 500 hours or greater has been entered, no further changing of this value is allowed.

To set the settable total on hours:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key fourteen times. (If no alarm codes) “tLH” appears on the display screen.
6. Press the ENTER key. The settable total on hours will flash.
7. Use the UP and DOWN arrow keys to change the setting. Pressing the SELECT key will highlight other digits in the row. Use the UP and Down keys to change these digits if required.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Settable Engine Clutch Hours

This display will show “EnH” and be used to enter the settable engine clutch hours display.The default value will be 00000. The value range that can be entered is from 00000 to the value of “tLH”.

To set the settable engine clutch hours:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key fifteen times. (If no alarm codes) “EnH” appears on the display screen.
6. Press the ENTER key. The settable engine clutch hours will flash.
7. Use the UP and DOWN arrow keys to change the setting. Pressing the SELECT key will highlight other digits in the row. Use the UP and Down keys to change these digits if required.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

Settable Electric Clutch Hours

This display will show “ELH” and be used to enter the settable electric clutch hours. The default value will be 00000. The value range that can be entered is from 00000 to the value of “tLH”.

To set the settable electric clutch hours:

1. Press the SELECT key repeatedly (seven times if there are no alarms to clear) until you see “CoL.”
2. Hold down the Up arrow key and the ENTER key at the same time for three seconds. “orA” will appear on the display screen.
3. Press the SELECT key twice. (If no alarm codes) ”ddr” will appear on the display screen.
4. Hold down the UP arrow key and the ENTER key at the same time for three seconds. “dE” appears on the screen.
5. Press the SELECT key sixteen times. (If no alarm codes) “ELH” appears on the display screen.
6. Press the ENTER key. The settable electric clutch hours will flash.
7. Use the UP and DOWN arrow keys to change the setting. Pressing the SELECT key will highlight other digits in the row. Use the UP and Down keys to change these digits if required.
8. Press the ENTER key. ”Lod” will appear on the screen for two seconds, followed by the flashing new setting. The default display screen will appear after 30 seconds.

CHECK POWER—VEHICLE OPERATION

WARNING: This unit may start at any time. Stay clear of fans and belts when condenser cover is removed.

1. Remove the condenser cover.
2. Remove the cover from the low voltage box. See “Low Voltage Box” on page 17.

WARNING: Stay clear of fans and belts when condenser cover is removed.

3. Check that service switch is pulled out (ON).
4. Start the vehicle and press the ON-OFF key. If the display does not light up, there is a problem with the power, and the µP-VP needs troubleshooting. See “PC BOARD Troubleshooting” on page 43.

CHECK POWER—ELECTRIC STANDBY OPERATION

WARNING: This unit may start at any time. Stay clear of fans and belts when condenser cover is removed.

1. Remove the condenser cover.
2. Remove the cover from the low voltage box. See “Low Voltage Box” on page 17.

WARNING: Stay clear of fans and belts when condenser cover is removed.

3. Turn OFF the external power source.

WARNING: HIGH VOLTAGE. Always turn off the external power source before handling, connecting or disconnecting cables to external power.

WARNING: DO NOT operate unit more than a few minutes with cover removed. Head pressure will rise when no air is moving through condenser coil.

4. Connect the power cable to the external power source.

5. Connect the opposite end of the power cable to the External Power Connector.
6. Turn ON the external power source.
7. Check that service switch is ON (Pulled out).
8. The In-Cab Controller should light up. If it doesn't, there is a problem with the power, and the µP-VP needs troubleshooting. See "PC BOARD Troubleshooting" on page 43.

PC BOARD TROUBLESHOOTING

WARNING: To troubleshoot this unit, it must be operating. Stay clear of fans. Fans may start at any time.

In-Cab Controller Will Not Light Up

1. Inspect the PC board. The LED 8 should be lit. If it is not lit, check the ACC wire and fuse F14 at the ignition switch end of the ACC wire.

NOTE: Use a standard voltmeter to check voltages.

2. Check the voltage from the CH circuit to J6 pin 6 (ACC input). There should be 12 volts.

   NOTE: Troubleshooting is the same for electric standby except that you need to test J2 pin 3 on the 2R1 line instead of J6 pin 6 and check fuses F16 and F17 in high voltage box.

3. Check the wiring and connectors, and check fuses F16 and F17 in high voltage box to the vehicle accessary terminal, ACC. If there is power to the ACC, make sure there is also power to the Micro by checking J3 pin 2.
4. Measure the voltage from CH to J3 pin 2. If there is 9.3 volts is present at J3 pin 2, the LED is burned out.
5. At this point, there are three possible reasons the display is not lit:
   - Faulty or damaged connections between the µP-VP and the In-Cab Controller.
   - Faulty In-Cab Controller.
   - Faulty µP-VP.

   To remedy the situation, make sure the connections are tight and clean. If the problem persists, replace the In-Cab Controller. If the problem still persists, replace the µP-VP or replace In-Cab Controller harness or PC board.

Unit Not Cooling Under Vehicle Power.

1. Make sure the unit is in the cool mode of operation, the vehicle is operating and the controller is operating.
2. Check if vehicle clutch is engaged. If the vehicle clutch is engaged check:
   - Refrigerant charge.
   - Evaporator fan operation.
   - Condenser fan operation.
3. If clutch is not engaged, check in low voltage section. Make sure LED3 is turned "ON." If LED3 is "ON" make sure fuse F9 is good.

Unit Not Heating Under Vehicle Power.

Use Caution During The Next Measurement. Do Not Short Pins Together. Damage May Occur To The Controller.

1. Check that heat enable screen is on and water valve is open. Make sure unit is in the heat mode of operation, the vehicle is operating and the controller is operating. Check to see if the water valve is open and the water pump is operating. If the water pump is operating check:
   - Coolant level of vehicle.

- Check for evaporator fan operation.

2. If water pump and valve are not operating check in low voltage section, check if LED4 is turned “ON.”
3. If LED4 is “ON” check the following:
   - That fuse F10 is good.
   - The vehicle wiring from J6-3 to water pump and valve, this is the 26A wire.
   - That water valve and pump are properly ground.
4. If there is power at the pump and valve replace the pump or valve.
5. If LED4 is not “ON,” measure the voltage at the battery wiring stud on PCB to chassis (CH), this should be 12 volts, this the “8” wire.
6. If the voltage is not 12 volts check:
   - Service switch in “ON” position.
   - Check fuse in battery line F15.
   - Check wiring and connections.

   Use Caution During The Next Measurement. Do Not Short Pins Together. Damage May Occur To The Controller.
7. If there is 12 volts, measure the voltage at J3-31 to CH, this should be less than 1 volt.
   a. If over 1 volt, replace micro controller.
   b. If under 1 volt, replace interface board.

Unit Not Cooling Under Electric Standby Power

Use Caution During The Next Measurement. Do Not Short Pins Together. Damage May Occur To The Controller.

1. Make sure unit is in the cool electric standby mode of operation, AC power cord is plugged in and the controller is operating. Check if Electric motor is operating.
2. If electric motor is operating, check:
   - Electric standby clutch.
   - High and low pressure cut off switches.
   - Refrigerant charge.
   - Evaporator fan operation.
   - Condenser fan operation.
3. If electric motor is not operating, check if LED2 is turned “ON” in low voltage box. If LED2 is “ON” check the following:
   - That fuse F6 is good.
   - The vehicle wiring from J2-1 to electric motor contactor, this is the 7E wire.
4. Measure voltage at motor contactor 7E wire to chassis (CH), it should be 12 volts. If 12 volts, replace the motor contactor if not operating.
5. If contactor operating, check wiring to motor. Replace motor.
6. On single phase units check motor protector PCB. If high voltage is present on TIA, but not on T1, replace protector board.
7. If T1 has power, check start relay and capacitor.
8. Measure the voltage at the battery wiring stud on PCB to chassis (CH), this should be 12 volts, this the “8” wire. If not 12 volts, check:
   - Service switch in “ON” position.
   - Electric Relay in High Voltage Box.
   - Wiring and connections.

Use Caution During The Next Measurement. Do Not Short Pins Together. Damage May Occur To The Controller.

9. If it has 12 volts, measure the voltage at J3-30 to CH, this should be less than 1 volt.
   a. If over 1 volt, replace micro controller.
   b. If under 1 volt, replace interface board.
10. Check if standby electric clutch is engaged. If clutch is energized, check:
   - That electric standby motor contactor is energized.
   - Refrigerant charge.
   - Evaporator fan operation.
   - Condenser fan operation.
11. If clutch not energized, check if LED1 is turned "ON" in low voltage box. If LED1 is "ON" check the following:
   - That fuse F1 is good.
   - The vehicle wiring from J2-6 to electric standby clutch, this is the 7C wire.
12. Measure voltage at the standby clutch, the 7C wire to chassis (CH), it should be 12 volts.
   a. If there is 12 volts, replace the clutch.
   b. If there is not 12 volts, check the voltage from J2-6 to chassis (CH), it should be 12 volts. If not replace interface board.
13. If LED1 is not "ON," measure the voltage at the battery wiring stud on PCB to chassis (CH), this should be 12 volts, this is the "8" wire. If not 12 volts, check:
   - System shut off switch in "ON" position.
   - Electric Relay in High Voltage Box.
   - Wiring and connections.
14. If you have 12 volts, check if high and low pressure cut off switches are closed.
15. Measure voltage on 8L line to chassis (CH), it should be 12 volts. If not 12 volts, check system refrigerant charge. Replace bad pressure switch.

Use Caution During The Next Measurement. Do Not Short Pins Together. Damage May Occur To The Controller.

16. Measure voltage at J3-39 to CH, this should be less than 1 volt.
   a. If over 1 volt, replace micro controller.
   b. If under 1 volt, replace interface board.

Unit Not Heating Under Electric Standby

1. Make sure unit is in the heat mode of operation that heat is enabled, AC power cord plugged in and the controller is operating. Check if the heat relay is operating in the high voltage section. If the relay is operating, check:
   - Wiring to heaters.
   - Evaporator fan operation.
2. If relay is not operating, measure voltage at the relay on the 14E line to chassis (CH), it should be less than 1 volt. If over 1 volt, measure voltage in low voltage box at J3-34 to CH, this should be less than 1 volt. If over 1 volt, replace micro controller.
3. If under 1 volt:
   - Check F7 fuse.
   - Check wiring from J2-2 to heat relay.
   - Check 2R1 circuit to heat relay. Should be >12V.
   - Replace relay.

Evaporator Fan Not Operating

1. Make sure unit is in mode of operation calling for this fan to be on. Operate in either standby or vehicle operation.
2. If the controller is operating, check if LED6 is turned “ON” in low voltage box:
3. If LED6 “ON” check the following:
   - Wiring to fan, the V280 fan is wired to J1-1.
   - Check output fuse, the V280 fan is fused by F2.
4. Measure voltage at fan, it should be 12 volts.
   a. If not 12 volts.Check wiring and replace interface board.
   b. If 12 volts, replace motor.
5. If LED6 is not “ON,” measure the voltage at the battery wiring stud on PCBD to chassis (CH), this should be 12 volts, this the “8” wire.
6. If not 12 volts, check:
   - System shut off switch in “ON” position.
   - Check electric relay and fuse in battery line F15.
7. If you have 12 volts, check fuse F11.

   Use Caution During The Next Measurement. Do Not Short Pins Together. Damage May Occur To The Controller.

8. Measure voltage at J3-37 to CH, this should be less than 1 volt.
   a. If over 1 volt, replace micro controller.
   b. If under 1 volt, replace interface board.

Condenser Fan Not Operating

1. Make sure unit is in mode of operation calling for this fan to be on and the controller is operating. Operate in either standby or vehicle operation.
2. Check if LED7 is turned “ON” in low voltage box. If LED7 “ON” check the following:
   - Wiring to fan, the V280 fan is wired to J6-1.
   - Check output fuse, the V280 fan is fused by F12.
3. Measure voltage at fan, it should be 12 volts. If not 12 volts.
   - Check wiring.
   - Replace interface board.
4. If 12 volts, replace motor.
5. If LED7 is not “ON,” measure the voltage at the battery wiring stud on PCB to chassis (CH), this should be 12 volts, this the “8” wire. If not 12 volts, check:
   - System shut off switch in “ON” position.
   - Check electric relay and fuse in battery line F15.
6. If you have 12 volts, check:
   - Fuse F11.
   - Fan pressure switch operation.

   Use Caution During This Measurement.

7. Measure voltage at J3-35 to CH, this should be less than 1 volt.
   a. If over 1 volt, replace micro controller.
   b. If under 1 volt, replace interface board.

No Defrost

Make sure unit is calling for defrost and the controller is operating. Operate in either standby or vehicle operation.

1. Check if LED5 is turned “ON” in low voltage box. If LED5 “ON” check the following:
   - Check fuse F8.
   - Wiring to the hot gas solenoid.
2. Measure voltage at the hot gas solenoid, it should be 12 volts. If not 12 volts.

- Check wiring.
- Replace interface board.

3. If 12 volts, replace hot gas solenoid
4. If LED5 not “ON,” measure the voltage at the battery wiring stud on PCB to chassis (CH), this should be 12 volts, this the “8” wire. If not 12 volts, check:

   - System shut off switch in “ON” position.
   - Check electric relay and fuse in battery line F15.

Use Caution During The Next Measurement. Do Not Short Pins Together. Damage May Occur To The Controller.

5. If you have 12 volts, measure voltage at J3-33 to CH, this should be less than 1 volt.

   a. If over 1 volt, replace micro controller board.

   b. If under 1 volt, replace interface board.This unit will always run in the electric standby mode if AC power is connected.

ALARMS

Alarms are divided into 3 categories: Log, Check and Shutdown.

- A log level alarm will only turn on the ALARM icon for 30 seconds after the unit is turned on. The unit will still operate normally.
- A check level alarm will turn the ALARM icon full on. This type of alarm notifies the operator that something has happened to the system and that operation may be impaired.
- A shutdown level alarm will flash the ALARM icon (as well as the rest of the display) and put the unit into shutdown mode. All outputs will be off.

Code	Description
02	There has been no valid reading from the coil sensor for 10 consecutive seconds. CHECK. Can be cleared in any alarm screen.
03	There has been no valid reading from the return air sensor for 10 consecutive seconds. CHECK. Can be cleared in any alarm screen.
08	The unit is running off of the coil sensor because the return air sensor failed. CHECK. Can be cleared in any alarm screen.
09	The coil sensor reading exceeded 155F and stayed above 150F for 10 minutes. SHUTDOWN. Can be cleared in any alarm screen.
12	The digital inputs have not stabilized after 100 consecutive readings (10 seconds). SHUTDOWN. Can be cleared in any alarm screen. -OR- Both the return air and coil sensors have failed for 2 minutes on a fresh load. SHUTDOWN. Can be cleared in any alarm screen.
38	The electric overload input is low for 2 seconds when the electric motor should be on. SHUTDOWN. (This alarm will self clear when the on/off switch is cycled or the main power to the control is cycled.) Can be cleared in any alarm screen.
70	Any of the hour meter values has exceeded 99,999 hours. LOG. Can be cleared in any alarm screen. -OR- An unsuccessful write to an hour meter EEPROM location occurred. LOG. Can be cleared in any alarm screen.
74	An initialization start has occurred. This can occur when software is changed, the unit has an EEPROM checksum error, the cold start digital input is low on a reset or a factory initialization start serial command is sent. CHECK. Can be cleared only in the super guarded access alarm screen.
77	An unsuccessful write to an EEPROM location, other than an hour meter, occurred. FACTORY. Can be cleared only in the super guarded access alarm screen.

NOTE: The following procedures involve servicing the refrigeration system. Some of these service procedures are regulated by Federal, and in some cases, by State and Local laws.

All regulated refrigeration service procedures must be performed by an EPA certified technician, using approved equipment and complying with all Federal, State and Local laws.

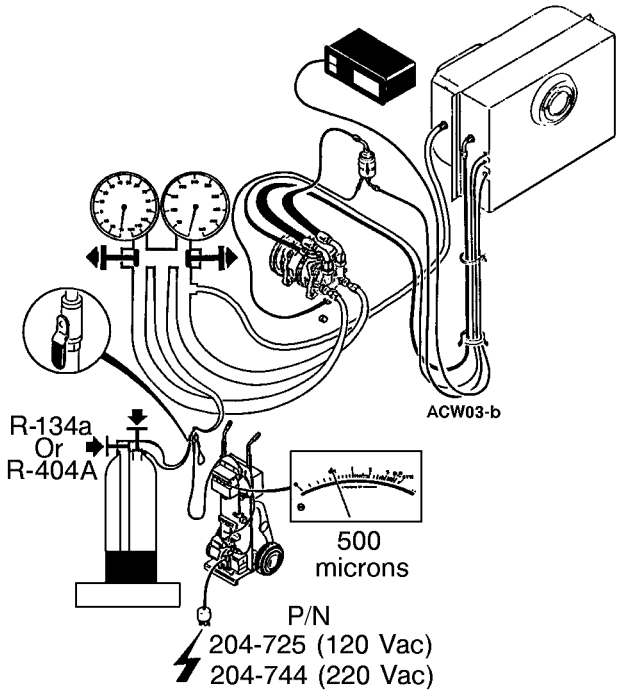
REFRIGERANT CHARGE

Charging the Refrigeration System

The receiver tank sight glass allows the operator to determine the amount of charge under established operating conditions. These units can be damaged by an over-charge of refrigerant. The amount of refrigerant the system can hold depends on circuit volume which is affected by hose length. The most satisfactory method of charging the engine-driven compressor circuit and the electric standby driven compressor circuit is:

1. Connect a gauge manifold to the engine-driven compressor and receiver tank.
2. Connect the center hose of the gauge manifold to the manifold of an evacuation station.
3. Connect the hose from a drum of refrigerant to the manifold of the evacuation station. Make sure the valve on the refrigerant drum is closed.
4. Open the valves on the gauge manifold and the valves on the evacuation station.
5. Start the vacuum pump and evacuate the system to 500 microns. After the system reaches 500 microns, evacuate the system for an additional hour.

   NOTE: If the system will not come down to 500 microns, there is probably a leak in the system or in the evacuation and charging equipment hoses. Find and repair the leak.



Evacuate System

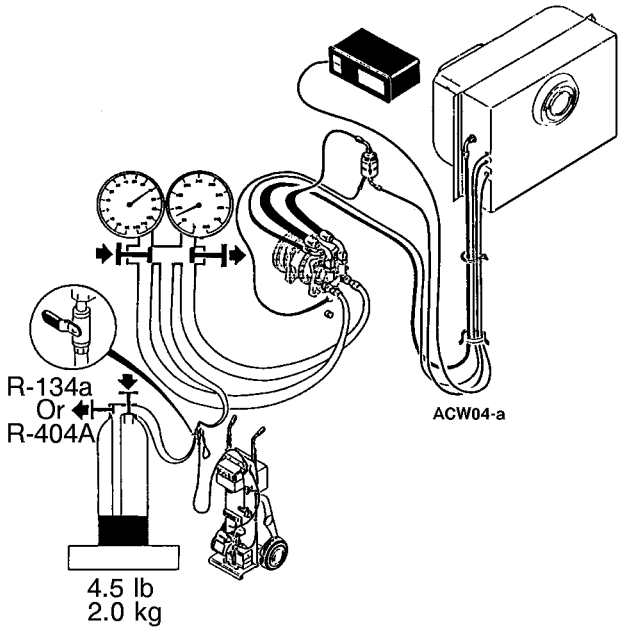
6. After the additional hour of evacuation, close the valve at the evacuation pump, stop the vacuum pump, and observe the reading on the vacuum gauge for 5 minutes. The pressure should not exceed 2000 microns.

   NOTE: If it does, repeat steps 4 and 5. This time if the pressure exceeds 2000 microns within 5 minutes, look for a leak in the system or in the evacuation and charging equipment hoses. Find and repair the leak.

7. Open the vacuum valve at the vacuum pump, start the vacuum pump, and evacuate the system to 500 microns.
8. When the system reaches 500 microns, close the vacuum valve at the evacuation station manifold. The system is now ready to charge.

9. Close the low side valve on the gauge manifold, leave the high side valve on the gauge manifold open, and open the valve on the refrigerant drum to deliver liquid.

10. Allow 5 lb (2.3 kg) of refrigerant to enter the system. Then close the valve on the refrigerant drum and the high side valve on the gauge manifold.

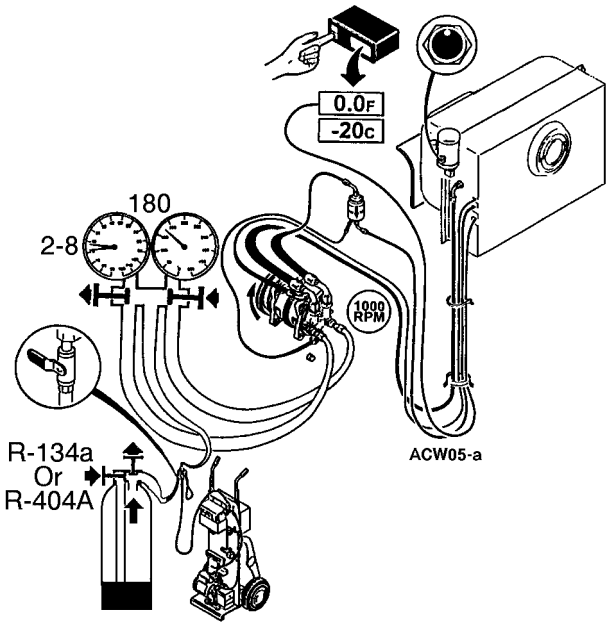


Add Liquid Refrigerant

11. Start the unit on engine operation, set the thermostat at 0 F (-20 C), and run the unit in cool until the box temperature approaches 0 F (-20 C).

12. Make sure that the unit is running in cool, the compressor is running at approximately 1000 rpm, the suction pressure is 2 to 8 psi (14 to 55 kPa), and the head pressure is at least 180 psi (1241 kPa) for R-134a systems and 275 psi (1896 kPa) for R-404A. If necessary, raise the head pressure by covering the condenser.

13. With these conditions established, open the low side valve on the gauge manifold and open the valve on the refrigerant drum to deliver liquid.



Finish Charging With Liquid

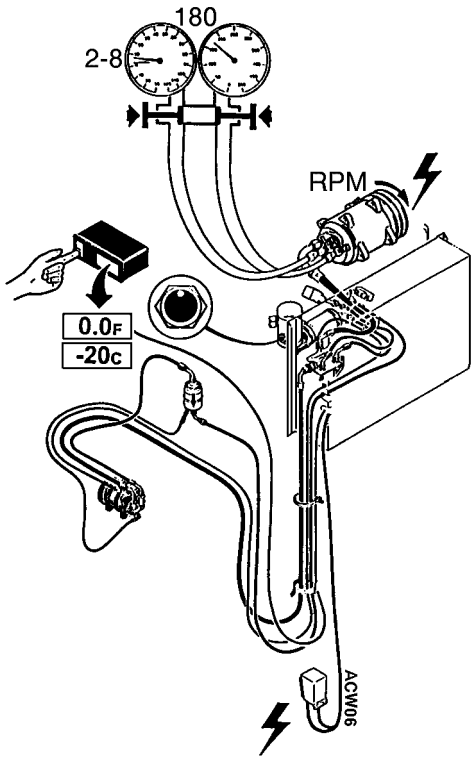
14. Observe the receiver tank sight glass. When the ball in the receiver tank sight glass reaches the top of the sight glass, close the valve on the refrigerant drum.

15. Close the low side valve on the gauge manifold and operate the unit for 15 minutes.

16. Model 20 only.

    a. Turn the unit OFF and shut off the truck engine.

    b. Connect the electric power receptacle to an appropriate electric power supply. Start and run the unit in cool on electric operation for a minimum of 15 minutes.



Run On Electric Operation

c. Turn the unit OFF and disconnect the electric power supply. Start the truck and run the unit in cool on engine operation for a minimum of 15 minutes.

17. Check the receiver tank sight glass with the unit running in cool, the box temperature at 0 F (-20 C), and a head pressure of at least 180 psi (1241 kPa) for R-134a systems and 275 psi (1896 kPa) for R-404A systems. The ball should be at the top of the sight glass.

    If not, open the valve on the refrigerant drum to delivery liquid and open the low side valve on the gauge manifold. Add refrigerant liquid until the ball in the receiver tank sight glass reaches the top of the sight glass, then close the valve on the refrigerant drum and close the low side valve on the gauge manifold.

18. Stop the unit, shut OFF the truck engine and remove the gauge manifold set.

19. The above conditions MUST be established each time the refrigerant level is checked or if refrigerant needs to be added for any reason.

NOTE: To prevent oil migration from one compressor to another, and for proper oil return when a compressor is operating, operate a compressor for a minimum of 15 minutes. Do not operate the compressor for shorter intervals.

Checking the Refrigerant Charge

If the unit has an insufficient charge of refrigerant, the evaporator will be “starved” and the box temperature will rise even though the unit is operating. Also, an insufficient charge does not circulate enough oil to properly lubricate the compressor. The charge may be determined by inspection of the refrigerant through the receiver tank sight glass with the following conditions established:

Testing the Refrigerant Charge with an Empty Box

1. Place a test box over the evaporator.
2. Install a gauge manifold set.
3. Run the unit in cool on engine operation until the thermometer reads 0 F (-18 C). By allowing the box to leak a small amount, you will be able to maintain 0 F (-18 C).
4. The discharge or head pressure gauge should be at least 180 psi (1241 kPa) on the gauge manifold for R-134a systems and 275 psi (1896 kPa) for R-404A systems.

   If the pressure is below this, it can be raised by covering a portion of the condenser grille with a piece of cardboard.
5. Under these conditions the ball should be at the top of the sight glass to indicate a full charge.

Testing the Refrigerant Charge with a Loaded Box

1. Install a gauge manifold.
2. Run the unit in cool on engine operation.
3. Cover the condenser to drive any excess refrigerant from the condenser into the receiver tank.
4. As the head pressure rises, check the receiver tank sight glass. If there is no indication of refrigerant in the receiver tank sight glass, indicated by the float ball being down in the bottom sight glass, the unit contains less than a full charge and more refrigerant MUST be added. Refer to Charging the Refrigeration System to add refrigerant.

CHECKING COMPRESSOR OIL CHARGE

The compressors are furnished with the amount of oil shown in the Specifications chapter. The oil level in the compressor will change after the compressor is initially run, making any level measurements inaccurate.

To ensure an adequate oil supply, the following procedure must be followed whenever the refrigerant charge is lost or removed from a unit:

1. Install a compressor on the system having a residual oil supply and self-lubricating system such as a TK 214 model. Connect an oil separator on the discharge or suction line to collect and drain out circulated oil.

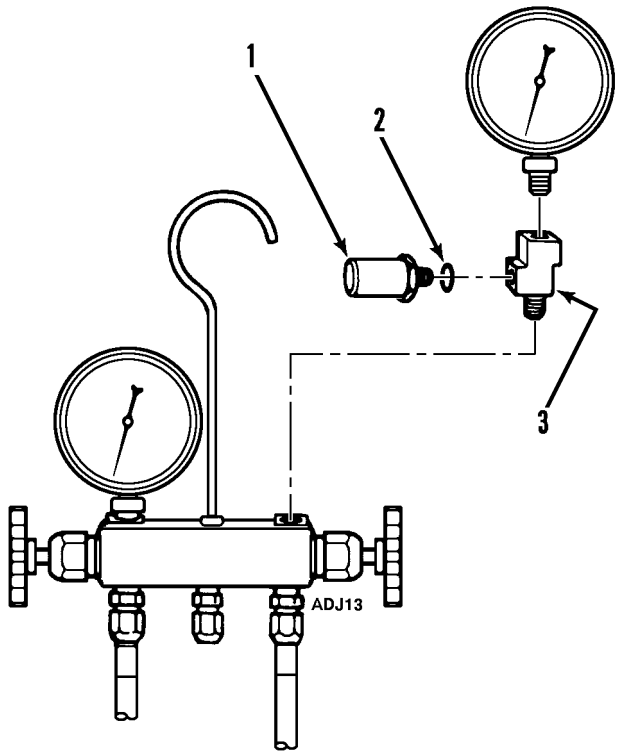
   NOTE: A suction line oil separator can be improvised by installing a suction filter upside down in the suction line near the compressor. Cap off both access ports, and use the lower one to drain off the accumulated oil.

2. Place a normal amount of oil in the cleanup compressor before operating.
3. Charge with 6.0 to 7.0 lb (2.7 to 3.2 kg) of refrigerant.
4. Operate at a low speed (600 to 800 rpm) for 2 hours, or until the compressor oil level reaches a minimum allowable level, whichever occurs first. Drain the collected oil from the oil separator as it fills, taking care to not allow any collected oil to recirculate.
5. Prepare the original compressor that was removed from the unit (or a replacement) by draining out any existing oil and replacing the oil with the amount of oil shown in the Specifications chapter.
6. Install the original compressor (or its replacement), and proceed with the manual evacuation and refrigerant charging procedure. Charge to normal amount of refrigerant 5 lb (2.3 kg).

HIGH PRESSURE CUTOUT SWITCH (HPCO)

The HPCO is located on the receiver tank. If the discharge pressure rises above 350 psi (2413 kPa) for R-134a systems or 470 psi (3241kPa) for R-404A systems, the HPCO de-energizes the clutch circuits.

To test the HPCO, rework a gauge manifold per the High Pressure Cutout Manifold illustration.



1.	Relief Valve (66-7392)
2.	O-Ring (33-1015)
3.	Adapter Tee Weather Head (No. 552X3)

High Pressure Cutout Manifold

1. Connect the gauge manifold to the compressor discharge service valve.

   NOTE: Service manifold hoses must have Schrader valve (tire valve) depressors.

2. Set the thermostat well below the box temperature so that the unit will be in cool.

3. Raise the discharge pressure of the compressor first by blocking the condenser coil air flow.

   NOTE: The discharge pressure should never be allowed to exceed a pressure of 400 psi (2758 kPa) when using R-134a and 475 psi when using R-404A.

4. Failure of the high pressure cutout system to stop compressor operation should be investigated first by checking the control circuit operation and second by replacing the HPCO.

LOW PRESSURE CUTOUT SWITCH (LPCO)

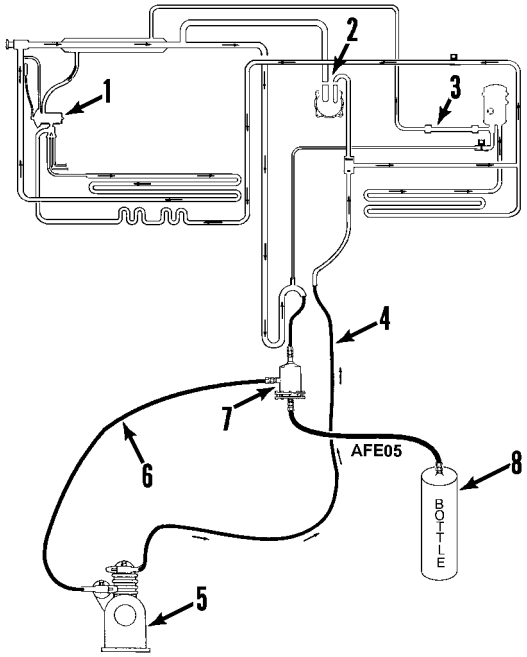
The low pressure cutout switch is located on the suction line in the evaporator. If the suction pressure drops below 5 to 11 in. Hg of vacuum (-17 to -37 kPa), it opens the circuit to the clutches to stop the compressors. To check the low pressure cutout:

1. Install a gauge manifold at the compressor.

2. Close the receiver tank outlet valve and run the unit in cool.

3. When the suction pressure drops below 5 to 11 in. Hg of vacuum (-17 to -37 kPa), the LPCO should open and the compressor should stop.

CLEANUP PROCEDURE FOR SMALL TRUCK UNITS



1.	Remove Internal Parts From Expansion Valve
2.	Disconnect and Cap (If So Equipped)
3.	Replace Drier With Tube
4.	Discharge Line
5.	Flushing Compressor
6.	Suction Line
7.	Suction Oil
8.	Recovered Oil

Connecting Flushing Compressor to Unit

NOTE: If a Van Steenburgh reclaimer is available, do not use this procedure. Follow procedure described in Service Bulletin T&T 134.

Tools Required:

- Motor-driven TK 214 “Flushing Compressor”
- Suction Line Filter (P/N 204-498 with Filter P/N 66-2988)
- Pipes (In Place of Oil Separator, Check Valve, Oil Separator and Standby Compressor)

Clean-up Procedure

1. Make sure all hose routing is correct.
2. Make sure that the oil trap is correctly installed.
3. Recover contaminated refrigerant from system.
4. Remove lines from compressors roadside and standby.
5. Flush each compressor using the flushing compressor and an HFC refrigerant. (Always recover the refrigerant before disconnecting flushing compressor.)
6. Remove check valve (or check valve seats) from system to ensure flow in all directions.
7. Remove oil separator and install a connecting pipe.
8. Remove internals from expansion valve.
9. Open suction pressure regulator (CPR) valve to highest setting.
10. Install temporary suction line filter (P/N 204-498 and P/N 66-2988) in suction line.
11. Install connecting pipe in place of standby compressor.
12. Connect flushing system to **roadside** discharge and suction line (see illustration).
13. Evacuate the system and check for leaks. Continue to evacuate to remove moisture and air.
14. Install HFC refrigerant and flush the system. (Energize defrost solenoid during 30% to 40% of the clean-up. Solid contaminants will collect in the suction line filter. Oil from the system and from the flushing compressor

will drain out of the suction line filter. (Add compressor oil as required.) Refrigerant oil in the flushing compressor will absorb acids from the system.

15. Test compressor oil for acid contamination.
16. Continue flushing until compressor oil is clean.

Putting the Unit Back Into Operation

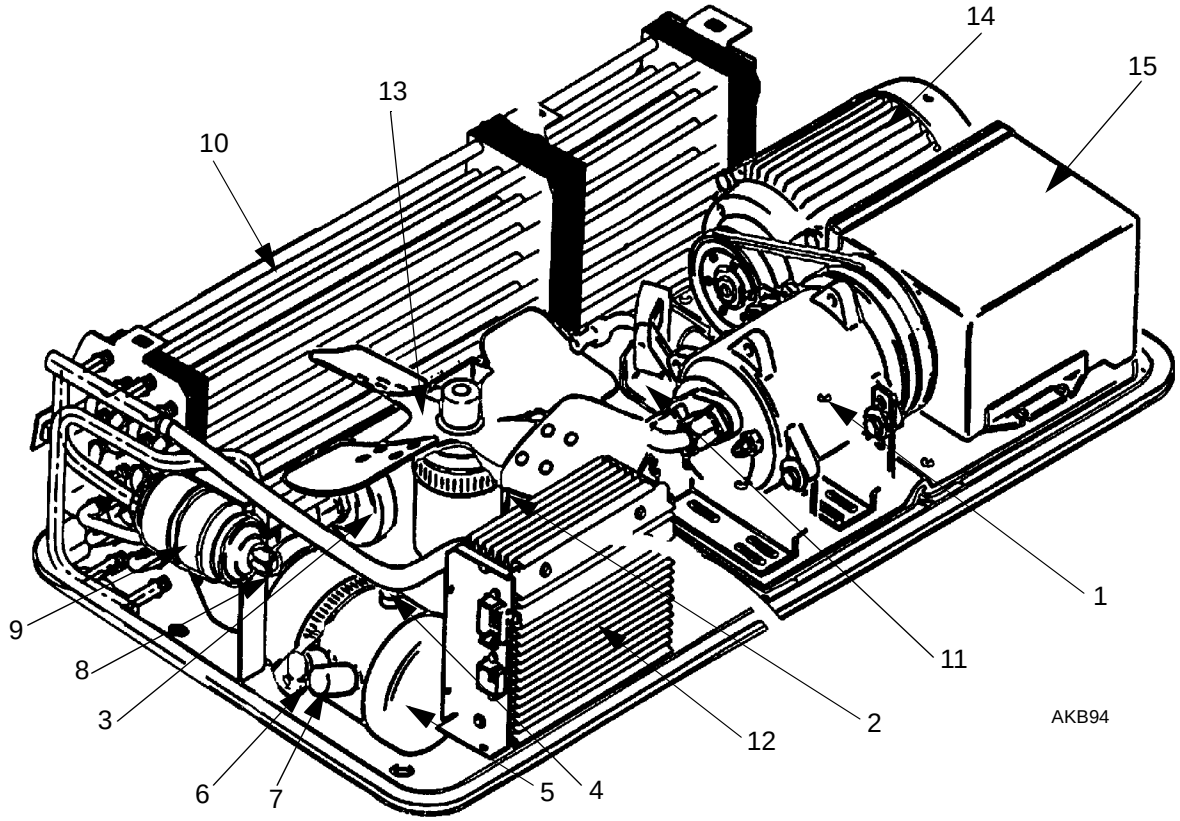
1. Replace check valve (or check valve seats).
2. Install new oil separator.
3. Install new liquid injection orifice.
4. Install new drier.
5. Install new expansion valve.
6. Install compressors and lines.
7. Use dry nitrogen to pressurize system to 150 psi (1034 kPa).
8. Use bubble solution to check for leaks.
9. Install correct amount of oil.
10. If no leaks, evacuate unit. A leak-free and dry unit will maintain a 1000 micron vacuum for five minutes or longer.
11. Charge unit with proper amount of the correct refrigerant.
12. Operate and check for proper operation. (Adjust suction pressure regulator.)
13. After two weeks of operation, change the drier.

NOTE: It is generally good practice to replace the filter drier whenever the high side is opened or when the low side is opened for an extended period of time.

COMPRESSOR

Removal

1. Remove the refrigerant charge from the system.
2. Loosen the drive belt adjuster and remove the compressor drive belt.
3. Disconnect the discharge, suction and liquid injection hoses.



1.	Electric Standby Compressor (Model 20 Only)	9.	Oil Separator
2.	Hot Gas Solenoid (Not shown)	10.	Condenser Coil
3.	Drier	11.	Check Valve Assembly (Model 20 Only) (Not shown)
4.	Fuse Plug and Oil Fill Hole	12.	Low Voltage Box
5.	Receiver Tank	13.	Condenser Fan
6.	High Pressure Cutout Switch	14.	Electric Standby Motor
7.	Condenser Pressure Switch	15.	High Voltage Box
8.	Liquid Injection Solenoid (Not shown)		

Condenser Components

4. Keep the compressor ports and the suction and discharge lines for the compressor covered to prevent contamination of system components.
5. Remove the compressor mounting screws. Remove the compressor.

Installation

NOTE: Any compressor installed in this system must contain the proper amount of compressor oil (see the Specifications section). Always check to make sure that the compressor contains the proper amount of oil. Follow the system cleanup procedures to remove old oil from the system.

1. Place the compressor in position and install the mounting screws and the belt.
2. Use belt tension tool P/N 204-427 to adjust belt tension. The engine/compressor belt tension should be adjusted to 58 on the gauge; the electric motor/compressor belt should be adjusted to 57.
3. Connect the refrigeration hoses. Pour 2 oz (59 ml) of compressor oil into the suction hose before installation.
4. Pressurize the system and test for leaks.
5. Evacuate the system and recharge.

CONDENSER COIL

Removal

1. Remove the refrigerant charge.
2. Remove the condenser cover.
3. Unsolder the inlet and liquid lines.
4. Remove the mounting hardware.
5. Remove the condenser coil.

Installation

1. Clean the tubes for soldering.
2. Place the coil in the unit and install the mounting hardware.
3. Solder the inlet and liquid line connections.
4. Pressurize the system and test for leaks.
5. Evacuate the system.
6. Recharge the unit.
7. Reinstall the cover.

DRIER

Removal

1. Pump down the refrigeration system and equalize the pressure to slightly positive.
2. Disconnect the ORS nuts at the ends of the drier.
3. Loosen the mounting hardware and remove the drier.

Installation

1. Place new O-rings in the ORS fittings on the ends of the drier.
2. Install the new drier and tighten the mounting screws and nuts.
3. Install and tighten the inlet ORS nut. Hold the drier with a back-up wrench on the hex behind the ORS fitting.
4. Release a small amount of refrigerant to purge the air through the drier, and then tighten the outlet ORS nut.
5. Pressurize the system and inspect for leaks. If no leaks are found, open the refrigeration valves and place the unit in operation.

RECEIVER TANK

Removal

1. Remove the refrigerant charge.
2. Disconnect the refrigerant lines from the receiver tank.
3. Remove the mounting clamp.
4. Remove the receiver tank.

Installation

1. Position the receiver tank in the unit and install the mounting clamp.
2. Connect the refrigerant lines to the receiver tank.
3. Pressurize the refrigeration system and check for leaks.
4. If no leaks are found, evacuate the system.
5. Recharge the unit.

HIGH PRESSURE CUTOUT AND CONDENSER FAN PRESSURE SWITCHES

Removal

1. Remove the refrigerant charge.
2. Disconnect the wires and remove the switch.

Installation

1. Apply a refrigerant locktite to the threads of the switch.
2. Install and tighten the switch and reconnect the wires.
3. Pressurize the refrigeration system and test for leaks.
4. If no leaks are found, charge the system.

HOT GAS SOLENOID VALVE

NOTE: Valves that have nylon seats must be disassembled before soldering.

Removal

1. Remove the refrigerant charge.
2. Remove the coil and disassemble the valve.
3. Unsolder the hot gas lines from the valve, and remove the valve from the unit.

CAUTION: Use a heat sink to prevent damaging the valve.

Installation

1. Clean the tubes for soldering.
2. Remove the coil, disassemble the valve, and place the valve in position.
3. Solder the inlet and outlet connections. After the valve cools, assemble the valve and install the coil.

CAUTION: Use a heat sink to prevent damaging the valve.

4. Pressurize the refrigeration system and test for leaks.
5. If no leaks are found, evacuate the system.
6. Recharge the unit with the proper refrigerant.

LIQUID INJECTION SOLENOID VALVE

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the coil from the solenoid valve.
3. Remove the solenoid valve from the receiver tank.

Installation

1. Remove the coil from the solenoid valve.
2. Install the solenoid valve on the receiver tank.
3. Connect the refrigerant line to the solenoid valve.

4. Install the coil on the solenoid valve and connect the wires.
5. Open the refrigeration valves.

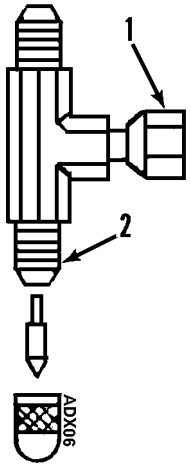
OIL SEPARATOR

Removal

1. Remove the refrigerant charge.
2. Disconnect the ORS nuts at the end of the oil separator.
3. Loosen the mounting hardware and remove the oil separator.

Installation

1. Soak new o-rings in refrigerant oil (same type that is used in the system) and place the new rings in the ORS fittings on the ends of the oil separator.
2. Install and tighten the inlet and outlet ORS nut.
3. Hold the oil separator with a backup wrench on the hex behind the ORS fitting.
4. Pressurize the refrigerant system and check for leaks.
5. If no leaks are found, evacuate the system.
6. Recharge the unit.



1.	1/4 Flare (w/Permanent Depressor)
2.	1/4 Flare SAE 45° Flare (TYP)

NOTE: Used when oil separator is routed to evaporator section for testing. Use as a tool only. do not leave in unit.

Tee-Fitting for V250 Suction Line Access

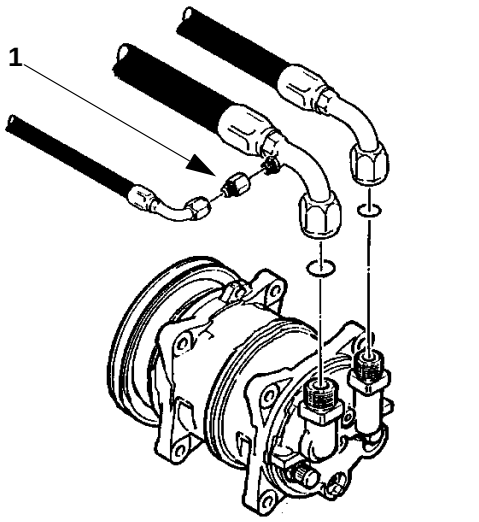
LIQUID INJECTION METERING ORIFICE

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Disconnect the refrigeration hose from the metering orifice and remove the metering orifice from the suction hose fitting.

NOTE: Take caution to avoid the danger of liquid refrigerant escaping when the line is disconnected.

NOTE: This orifice may become plugged with dirt unless the refrigeration hose and solenoid valve are kept clean.



1.	Liquid Injection Metering Orifice

Engine Compressor

Installation

1. Install the metering orifice on the suction hose fitting.
2. Connect the refrigeration hose to the metering orifice fitting.
3. Open the refrigeration valves.

Testing the Liquid Injection Solenoid Valve and Metering Orifice

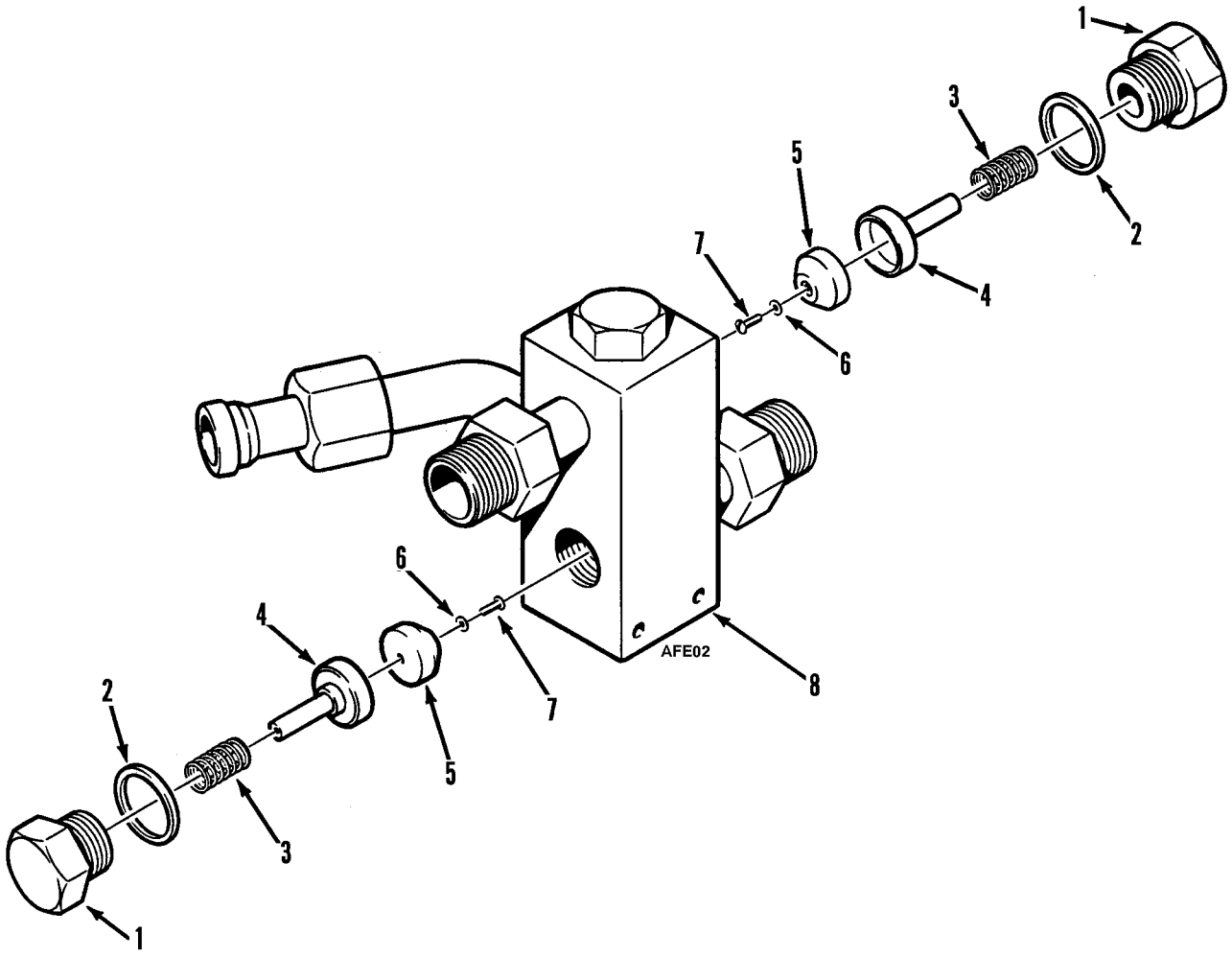
1. Disconnect the LIS wire from the liquid injection solenoid.
2. Install a gauge manifold set on the engine-driven compressor.
3. Set the thermostat on the lowest setting.
4. Start the truck and run the unit on the engine-driven compressor until the suction pressure stabilizes.
5. Place a jumper wire between 7V and the LIS on the liquid injection switch.
6. With the jumper wire in place the suction pressure should rise.
7. With the jumper wire removed the suction pressure should return to the stabilized pressure in step 4.
8. If the suction pressure does not change, check the 7V wire for voltage, the liquid injection solenoid valve, or the metering orifice.
9. Shut off the unit and the truck, remove the gauge manifold set and replace the LIS wire.

CHECK VALVE REPAIR (Model 20 Only)

Testing the Check Valve

The check valve is a very important part of the Model 20 system. The check valve isolates the engine-driven compressor from the electric standby compressor, ensuring the compressor oil and refrigerant do not migrate between compressors. The check valve should be tested when the system is initially charged and operating and anytime the system has been opened for service or repair. Testing the check valve requires two gauge manifold sets.

1. Disconnect the liquid injection solenoid valve wires.



1.	Cap Nut	5.	Piston Seat
2.	Sealing Washer	6.	Washer
3.	Spring	7.	Screw
4.	Piston	8.	Valve Body

Check Valve Assembly

NOTE: Illustration only, no service parts available.

2. With the unit off, install a gauge manifold set on each compressor.
3. Observe the gauge manifold readings of the electric standby compressor. If the high side and low side readings are not the same, open the gauge manifold valves and equalize the pressures. Close the gauge manifold valves.
4. Adjust the thermostat so the unit will run in cool. Start the truck and run the unit with the engine-driven compressor.
5. Observe the gauge manifold readings of the engine-driven compressor. The head pressure should increase and the suction pressure should decrease.
6. Observe the gauge manifold readings of the electric standby compressor. The high side pressure should remain the same as the pressure in step 3 after the high and low sides were equalized. If the high side pressure is increasing or has increased noticeably, the discharge check valve is leaking internally.
7. Turn the unit off and shut off the truck engine. Plug in the power cord to an appropriate electric power source.
8. Observe the gauge manifold reading of the engine-driven compressor. If the high side and low side readings are not the same, open the gauge manifold valves and equalize the pressures. Close the gauge manifold valves.
9. Adjust the thermostat so the unit will run in cool. Start the unit and run on electric standby.
10. Observe the gauge manifold readings of the electric standby compressor. The head pressure should increase and the suction pressure should decrease.
11. Observe the gauge manifold readings of the engine-driven compressor. The high side pressure should remain the same as the pressure in step 8 after the high and low sides were equalized. If the high side pressure is increasing or has increased noticeably, the discharge check valve is leaking internally. Stop the unit.
12. Remove the gauge manifold sets and the electric standby power source. Connect the wires to the liquid injection solenoid valve.

    If the check valve is leaking internally, refer to the repair procedures.

Check Valve Repair

Disassembly

1. Remove the refrigerant charge.
2. Loosen the cap nut and remove the cap nut, sealing washer, spring, and piston assembly.
3. Check the spring. The free length should be 0.57 in. (14.4 mm). Replace the spring if the free length is less than 0.51 in. (13.0 mm).
4. Inspect the pistons and the piston seats. Replace the pistons or the piston seats if they are worn or damaged.
5. Inspect the valve body. The piston bores and the valve body seats should be clean and undamaged. The pistons should move freely in the piston bores. Clean or replace if necessary.

Assembly

NOTE: Coat all parts with compressor oil before assembly.

1. Place the sealing washer on the cap nut.
2. Place the spring on the piston assembly.
3. Place the piston and spring in the cap nut.
4. Carefully place the piston and cap nut in the valve body.
5. Tighten the cap nut.

Check Valve Replacement

Removal

1. Remove the refrigerant charge.
2. Disconnect the refrigeration line connections.
3. Remove the mounting hardware and remove the check valve.

Installation

1. Place the check valve in position and install the mounting hardware.
2. Connect the refrigeration lines.
3. Pressurize the refrigeration system and test for leaks.
4. If no leaks are found, evacuate the system.
5. Recharge the unit with refrigerant and check compressor oil.

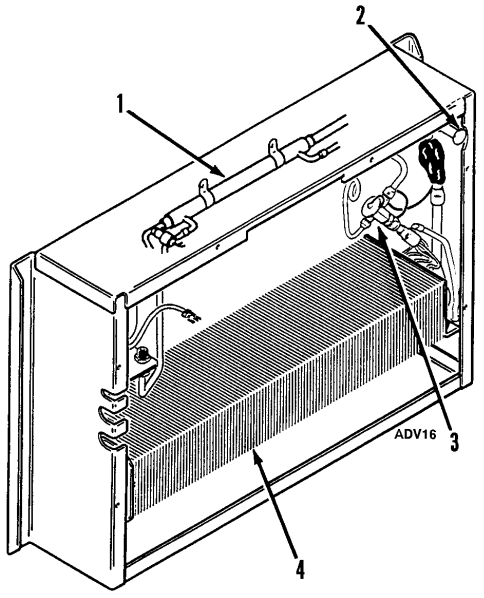
EVAPORATOR COIL

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator panel. Disconnect the evaporator fan motor wires.
3. Disconnect the expansion valve from the distributor.
4. Disconnect the hot gas line from the distributor.
5. Unsolder the suction line from the evaporator coil.
6. Remove the mounting bolts and slide the coil from the unit.

Installation

1. Place the coil in the housing.
2. Install the mounting bolts and tighten them.
3. Clean the tubes for soldering.
4. Solder the suction line to the evaporator coil.
5. Connect the hot gas line to the distributor.
6. Connect the expansion valve to the distributor.
7. Install the expansion valve on the mounting bracket.
8. Pressurize the system and test for leaks. If no leaks are found, evacuate the system.
9. Connect the evaporator fan motor wires. Install the evaporator panel.
10. Open the refrigeration valves and place the unit in operation. Check the refrigerant charge and the compressor oil and add as required.



1.	Heat Exchanger
2.	Suction Pressure Regulator Valve
3.	Expansion Valve
4.	Evaporator Coil

Evaporator Components
(Thinline Shown Standard Is Similar)

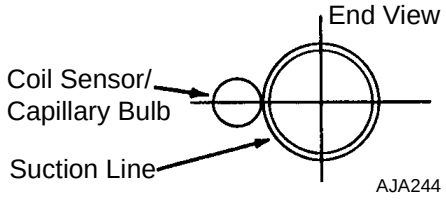
EXPANSION VALVE ASSEMBLY

Removal

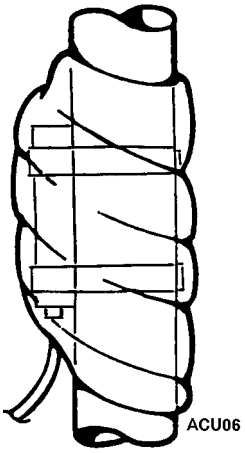
1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the feeler bulb and coil sensor from the suction line clamps. Note the position of the feeler bulb sensor on the suction line.
3. Disconnect the equalizer line from the expansion valve.
4. Disconnect the liquid line and the distributor from the expansion valve.
5. Remove the expansion valve from the unit.

Installation

1. Install the expansion valve assembly in the unit.
2. Connect the liquid line and the distributor to the expansion valve.
3. Connect the equalizer line to the expansion valve.
4. Clean the suction line to a bright, polished condition. Install the feeler bulb clamps and the feeler bulb and core sensor on the side of the suction line in their former positions. The feeler bulb and sensor must make good contact with the suction line or operation will be faulty. Wrap the bulb and sensor with insulating tape.



Location of Expansion Valve Bulb and Coil Sensor



Completely Wrap Bulb and Sensor with Tape

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

LOW PRESSURE CUTOUT SWITCH

Removal

1. Pump down the low side and stop the unit.
2. Disconnect the wires and remove the switch.

Installation

1. Apply a refrigerant locktite to the threads of the switch.
2. Install and tighten the switch and reconnect the wires.
3. Pressurize the refrigeration system and test for leaks.
4. If no leaks are found, evacuate the low side.
5. Open the receiver tank outlet valve, start the unit and check the refrigerant charge.

SUCTION PRESSURE REGULATOR VALVE

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Release the remaining pressure and unsolder the suction pressure regulator valve from the suction tubes.

Installation

1. Clean the tubes for soldering.
2. Place the valve in position and solder the connections.
3. Pressurize the low side and check for leaks.
4. If no leaks are found, evacuate the low side.
5. Open the refrigeration valves, and place the unit in operation. Check refrigerant charge and add refrigerant as required.

REPLACING REFRIGERANT HOSES

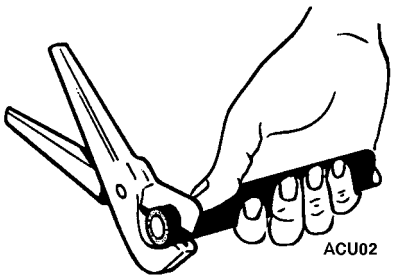
Disassembly

1. Remove the refrigerant charge or pump down the low side.
2. Use two wrenches to loosen the fittings.
3. Remove the hose and remove the fittings from the hose.

Assembly

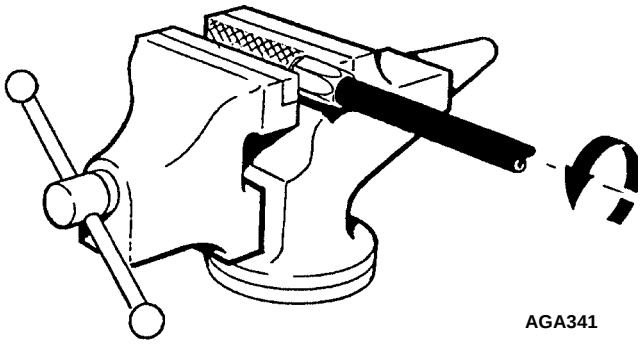
1. Measure the hose, and using a sharp knife or suitable plastic tube and hose cutter tool, cut to length. Make sure the cut is clean and square. Wipe the inside of the hose clean.

NOTE: DO NOT use a saw to cut the hose.



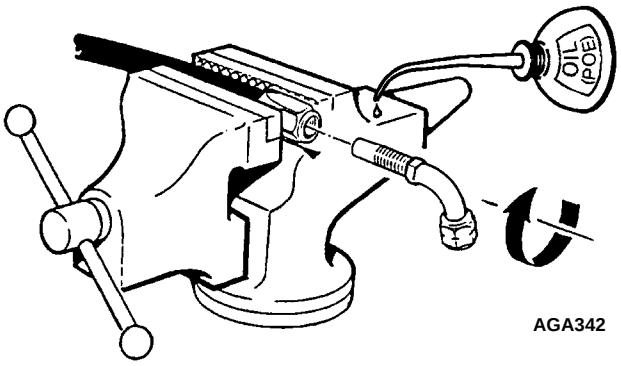
Cut Hose

2. Place the socket on the hose and turn it counterclockwise until the hose bottoms out. Then back it out 1/4 of a turn.



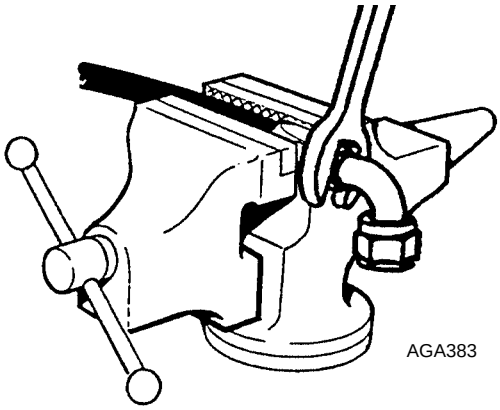
Install Socket

3. Lubricate the nipple threads and the inside of the hose with oil.



Lubricate With Oil

4. Screw the nipple into the socket.

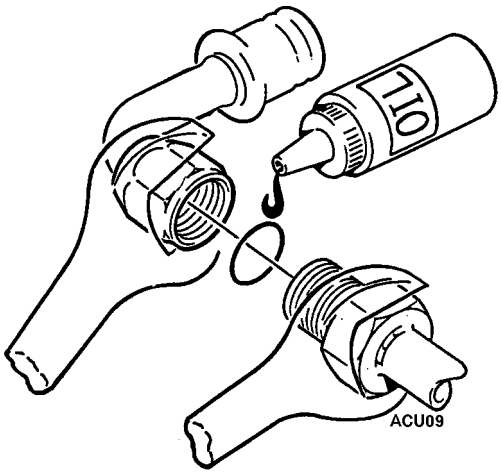


Flare Fittings

The flare fittings on the liquid injection line should first be tightened finger tight, then they should be turned 3/4 of a turn.

ORS Fittings

Lubricate the ORS fittings with refrigeration oil (same type of oil that is used in the system) and tighten them until they bottom out.



ORS Fitting

UNIT INSPECTION

Inspect the unit during the pre-trip inspection and during scheduled maintenance inspections for loose or broken wires or hardware, compressor oil leaks, or other physical damage which might affect the unit performance and require the repair or replacement of parts.

EVAPORATOR COIL

Clean the evaporator coil during scheduled maintenance inspection by blowing compressed air down through the coil out into the box (direction opposite the normal air flow). Inspect the coil and fins for damage and repair if necessary (requires removing the evaporator fan and front cover).

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

CONDENSER COIL

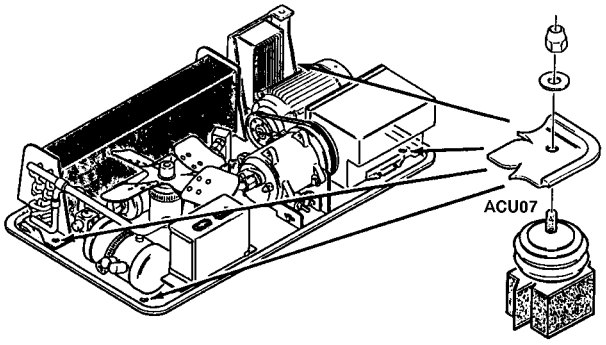
Clean the condenser coil during scheduled maintenance inspections by blowing compressed air from the back side of the coil out toward the front of the unit (the direction opposite normal air flow). Inspect the coil and fins for damage and repair if necessary.

CONDENSER FAN LOCATION

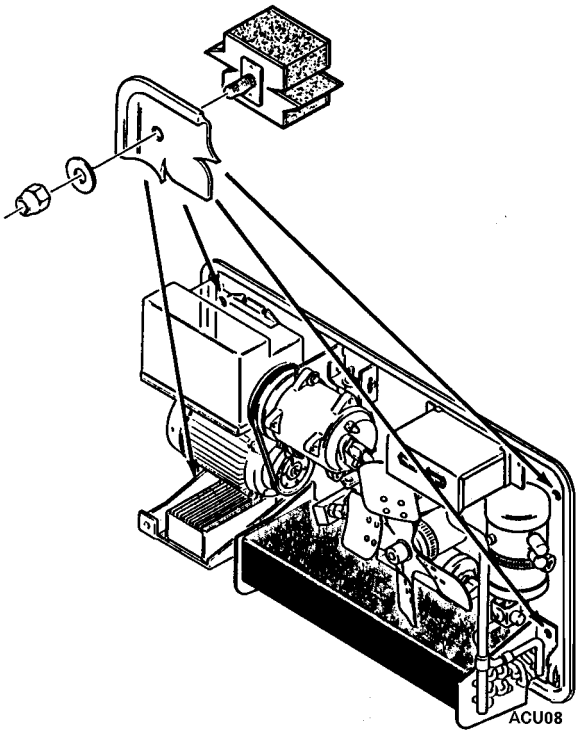
Mount the condenser fan so the hub is flush with the end of the shaft.

UNIT MOUNTING BOLTS

Periodically check and torque the unit mounting bolts to 60 ft-lb (81 N•m).



Roofmount Unit

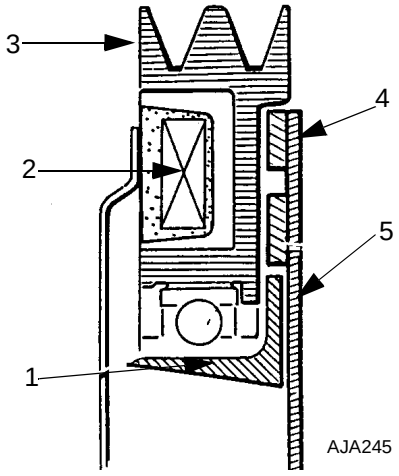


Nosemount Unit

Operation

A stationary field coil is mounted on the compressor body concentric with the shaft. A pulley assembly, consisting of a pulley, a disc and a hub is mounted on the shaft of the compressor. The hub and disc are flexibly connected with flat springs that in the disengaged position, hold the disc slightly away from the pulley web (friction surface).

When an electric current flows through the field coil, a magnetic field is created. The magnetic field pulls the disk against the pulley web and compresses the flat springs. This causes the hub and disk to rotate with the pulley.



1.	Hub	4.	Disk
2.	Stationary Field Coil	5.	Flat Springs
3.	Pulley		

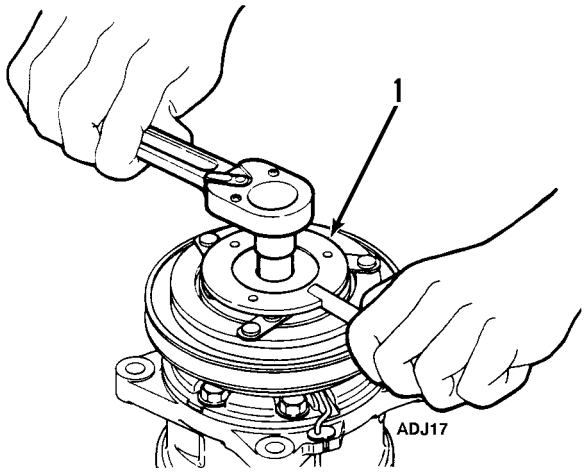
Compressor Clutch Assembly

CLUTCH REMOVAL

NOTE: Make sure the proper tools are available before performing maintenance procedures. Refer to the tool listing at the end of this chapter for tools required. Contact your local Thermo King dealer for further information.

Removal

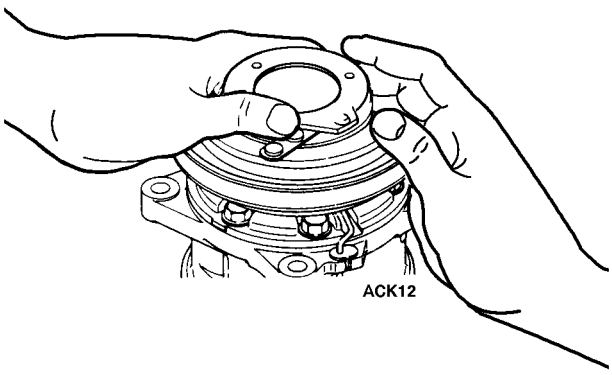
1. Remove the center bolt using the puller arbor (TK 204-804) to prevent drive plate rotation.



1.	Holder

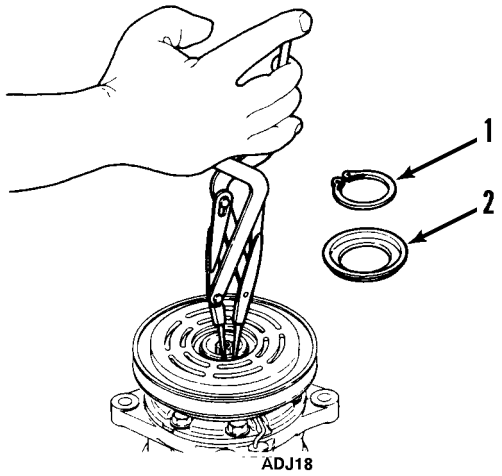
Remove Center Bolt

2. Remove the drive plate using the shaft seal kit (TK 204-805). Then remove the shims from either the drive shaft or the drive plate.



Remove Drive Plate

3. Remove the snap ring using external snap ring pliers (TK 204-808).
4. Remove the cover.

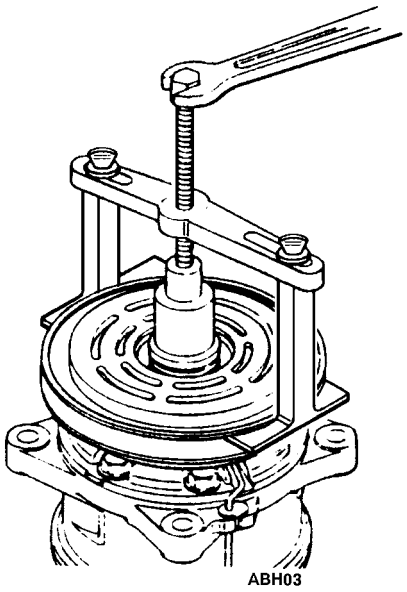


1.	Snap Ring
2.	Cover

Remove Snap Ring and Cover

5. Remove the pulley assembly using the clutch remover (TK No. 204-806) and the spacer positioned on the cylinder head hub.

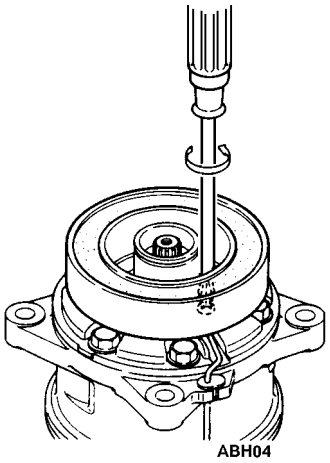
NOTE: To avoid damaging the pulley groove, the pulley claws should be hooked into (NOT UNDER) the pulley groove.



Remove Pulley

6. Remove the coil's lead wire from the holder on the top of the compressor.
7. Remove the three screws that attach the coil to the compressor and remove the coil.

NOTE: DO NOT hold the coil by the lead wire.



Remove Coil

Inspection

1. **Drive Plate**

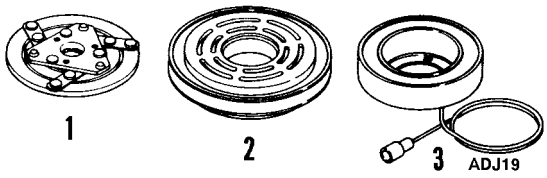
   If the contact surface is scorched, the drive plate and pulley should be replaced.

2. **Pulley Assembly**

   Inspect the appearance of the pulley assembly. If the pulley's contact surface is excessively grooved due to slippage, both the pulley and drive plate must be replaced. There should also be no foreign matter, such as oil or grit, lodged between the clutch plate and pulley. Thoroughly clean these contact surfaces and the drive plate.

3. **Coil**

   Inspect the coil for a loose connector or cracked insulation. If the insulation is cracked, replace the coil. Repair or replace the wire or the connector if either is loose or damaged.



1.	Drive Plate
2.	Pulley Assembly
3.	Coil

Inspect Components

Clutch Installation

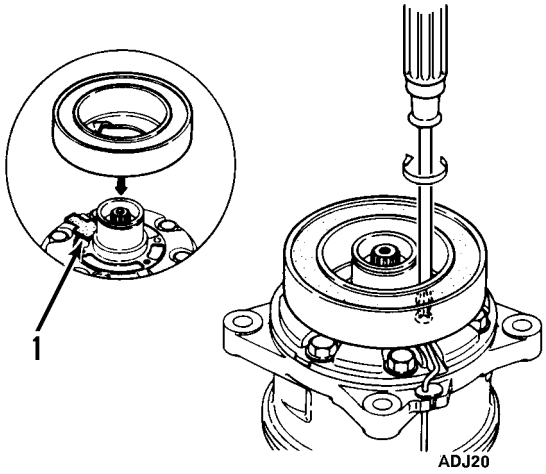
NOTE: Before installation refer to the "Inspection" procedures previously described.

1. Confirm that the felt is installed on the front of the cylinder head.

2. Install the coil on the compressor (with the lead wire on top). At this time, confirm that the coil's concave portion is aligned with the felt and then tighten the mounting screws to the specified torque.

   NOTE: Specified torque: 2.9 to 4.3 ft-lbs (0.4 to 0.6 kgm).

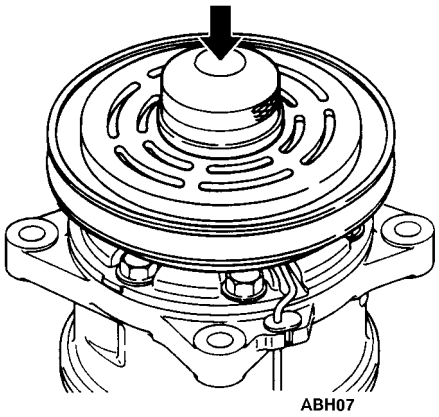
3. Install the lead wire in the wire holder on the compressor.



1.	Felt

Install Coil

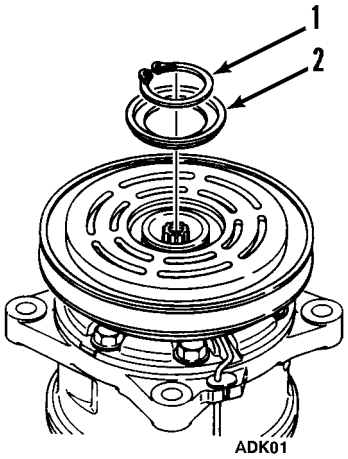
4. Install the pulley assembly using the compressor holder (TK No. 204-807) and a hand press.



Install Pulley

5. Install the cover and the snap ring using external ring pliers.

   NOTE: When installing the snap ring, the chamferred inner edge of the snap ring should face upward.



1.	Snap Ring
2.	Cover

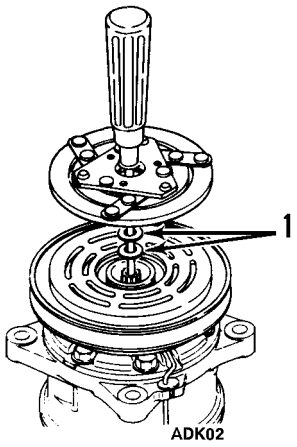
Install Cover and Snap Ring

6. Install the driver plate on the drive shaft, together with the original shim(s). Press the drive plate down by hand.

7. Tighten the bolt to the specified torque using the puller arbor (TK No. 204-804) to prevent drive-plate rotation.

   NOTE: Specified torque: 8.7 to 10.1 ft-lbs (1.2 to 1.4 kgm).

After tightening the bolt, ensure that the pulley rotates smoothly.



1.	Shims

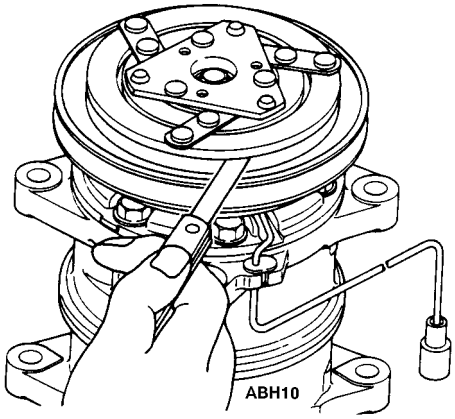
Install Shims and Drive Plate

8. Ensure that the clutch clearance is as specified. If necessary, adjust the clearance using shims.

   Adjusting shims are available in the following thicknesses:

Shim TK P/N	Thickness in. (mm)
TK 11-8031	0.0039 in. (0.1 mm)
TK 11-8032	0.0118 in. (0.3 mm)
TK 11-8033	0.0197 in. (0.5 mm)

NOTE: Specified clearance: 0.01 to 0.02 in. (0.3 to 0.6 mm).



Check Clearance

Electrical Connection

1. Connect the lead wire to the electrical circuit.

   NOTE: The stationary field is grounded at the factory; therefore, it is necessary only to connect the hot (lead) wire.

2. Engage and disengage the clutch several times to check the clutch engagement. The disc should snap firmly against the pulley.

SHAFT SEAL COVER AND SHAFT SEAL: REMOVAL AND INSTALLATION

Removal

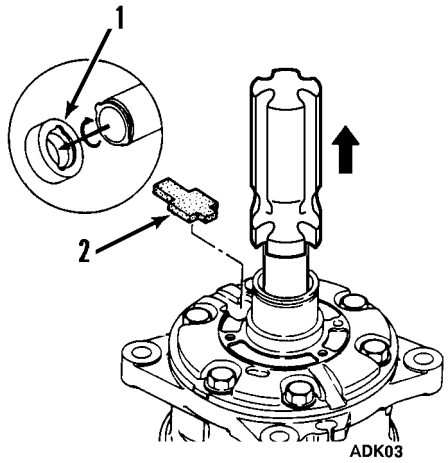
1. Remove the magnetic clutch assembly, as outlined in "Magnetic Clutch Removal" section of this manual.

2. Remove the felt pad.

3. Use the seal remover (from the shaft seal kit P/N 204-805) to remove the shaft seal cover. Turn the seal remover to engage the hook on the seal remover with

the hook on the shaft seal cover, then slowly pull the shaft seal cover out of the cylinder head.

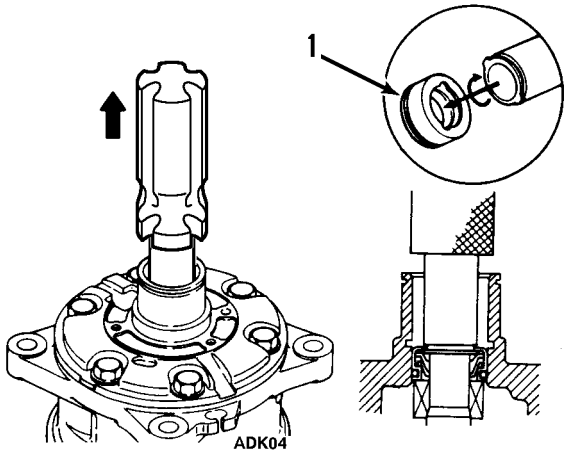
NOTE: The shaft seal cover SHOULD NOT be reused. Always use a new shaft seal cover when reassembling a compressor.



1.	Shaft Seal Cover
2.	Felt Pad

Remove Shaft Seal Cover

4. Use the seal remover (from the shaft seal kit P/N 204-805) to remove the shaft seal. Turn the seal remover to engage the hook on the seal remover with the hook on the shaft seal, then slowly pull the shaft seal out of the cylinder head.

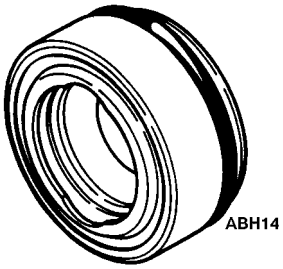


1.	Shaft Seal

Remove Shaft Seal

Inspection

The shaft seal should not be reused. Always use a new shaft seal when reassembling a compressor. Be extremely careful to make sure the lip of the shaft seal that is being installed is not scratched or damaged in any way. Make sure the shaft seal is free from lint and dirt that could damage the shaft seal surface.

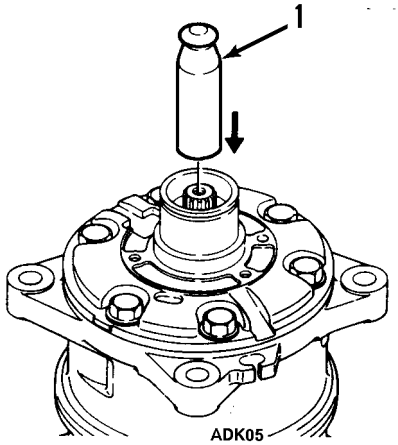


Inspect Shaft Seal

Shaft Seal Installation

Before installing a shaft seal inspect it carefully (see Inspection).

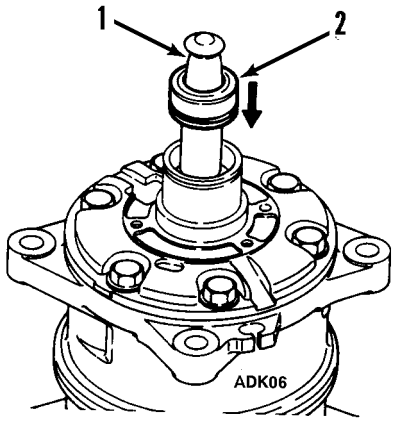
1. Clean the section of the front cylinder head that holds shaft seal.
2. Apply clean compressor oil to the new shaft seal and to the front cylinder head. If the slip surfaces are dirty, clean them with thinners, dry the clean surfaces and apply clean compressor oil.
3. Place the seal guide (from the shaft seal kit P/N 204-805) on the end of the shaft.



1.	Seal Guide

Place Guide on Shaft

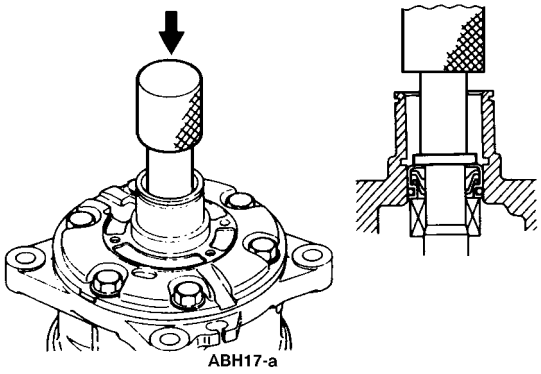
4. Place the shaft seal on the seal guide and slide the seal into the cylinder head.



1.	Seal Guide
2.	Shaft Seal

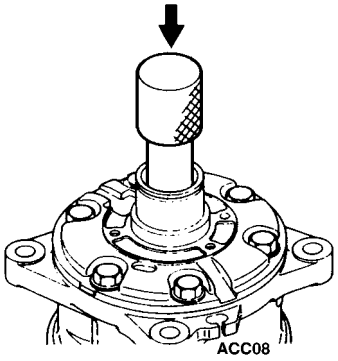
Place Shaft Seal on Guide

5. Use the seal installer (from the shaft seal kit P/N 204-805) to press the shaft seal into the cylinder head as far as possible.
6. Remove the seal guide from the shaft.



Press Seal Into Cylinder Head

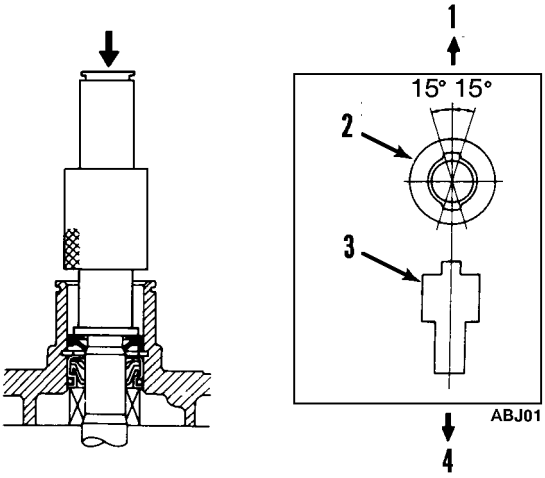
7. Place the seal guide (from the shaft seal kit P/N 204-805) on the end of the shaft.
8. Place the shaft seal cover on the seal guide and slide the shaft seal cover into the cylinder head.



Install Shaft Seal Cover

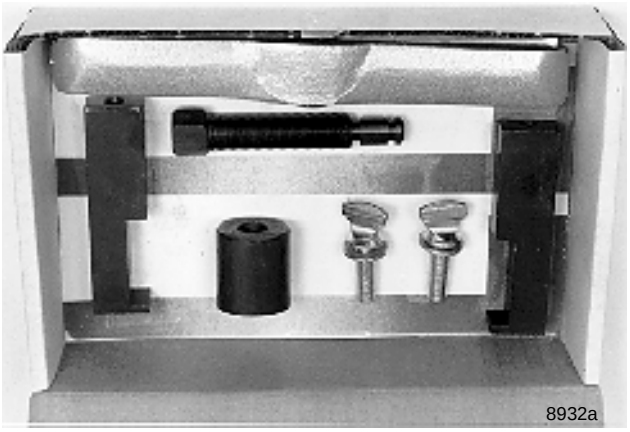
9. Use the seal installer (from the shaft seal kit P/N 204-805) to press the shaft seal cover into the cylinder.
10. Remove the seal guide from the shaft.

NOTE: Position the shaft seal cover as shown in the illustration. The felt pad should also be replaced with a new one when the shaft seal is replaced.

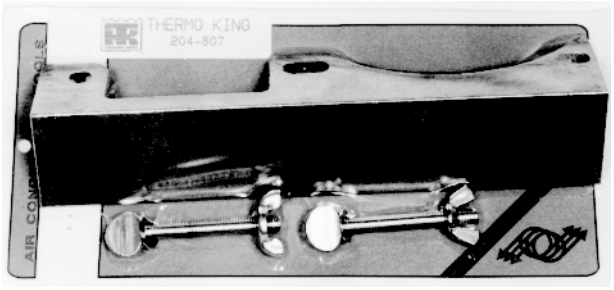


Proper Shaft Seal Cover Position

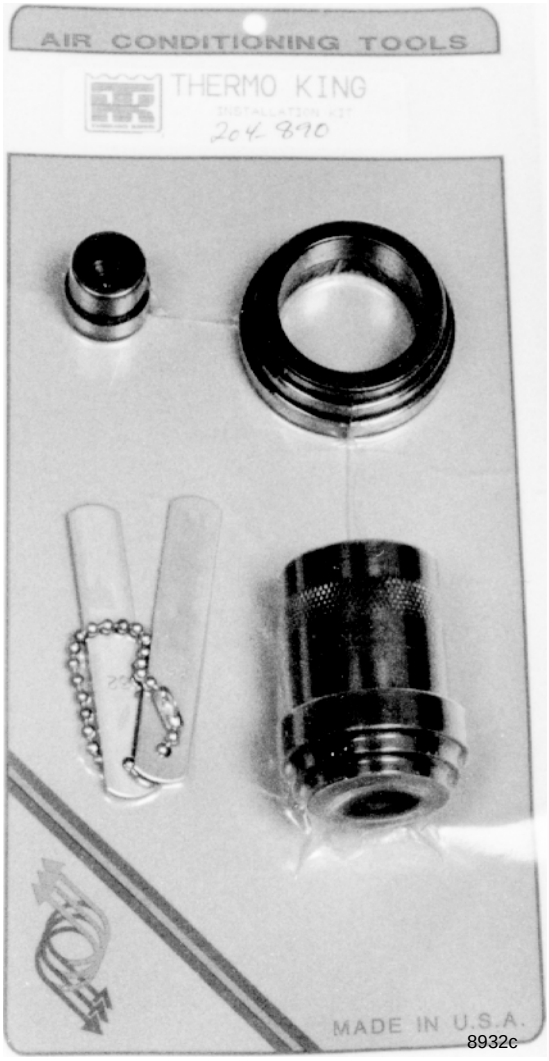
Special Tools



Clutch Remover P/N 204-806



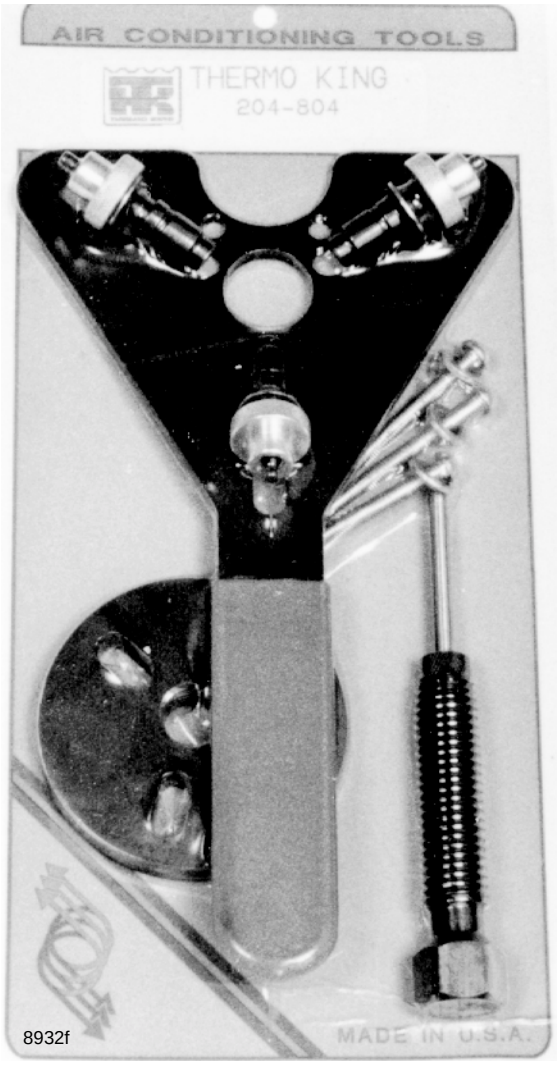
Compressor Holder P/N 204-807



Clutch Installation Kit P/N 204-890

Shaft Seal Kit P/N 204-805

Snap Ring Pliers P/N 204-808



Pulley Arbor P/N 204-804

SYSTEM COMPRESSOR AND OIL

Installation of the Compressor

The compressor is mounted in the condenser section. The side to side mounting angle of the compressor must remain ± 45 from the horizontal. The forward to backward angle must be within ± 10 of horizontal. Access to the air conditioning system service ports is from the top of the unit.

Each compressor comes with a standard charge of Polyol Ester (POE) oil inside. This quantity of oil is enough to supply the compressor lubrication when it is installed into an already “oil wet” system. New systems require an extra quantity of oil be added to “wet” all the interior surfaces of the system.

During normal operation there is always a quantity of oil that travels around inside the system. This oil lubricates all the components, returns to the compressor for a while, and again travels around the system.

Adding Extra Oil to the System

The initial oil charge into a new system is based on the size of the system and the amount of oil, which remains in the compressor during operation.

The correct oil to use in the V250 using R-134a and R-404A is Polyol Ester (POE) oil (TK No. 203-413). Any extra or replacement oil should be placed into the system at the receiver tank port.

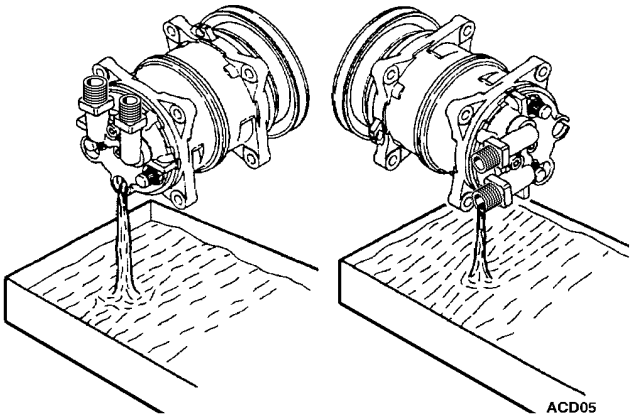
CAUTION: Keep all oil containers tightly sealed from the air. Oil tends to absorbed moisture from the air and can become contaminated if left open. If contaminated oil is put into a system, it may damage the components of the system.

Major Loss of Refrigerant

In case of a major loss of refrigerant, it must be assumed that some system oil is lost also. The oil level should be verified by the “Checking the Oil Level” method in this manual.

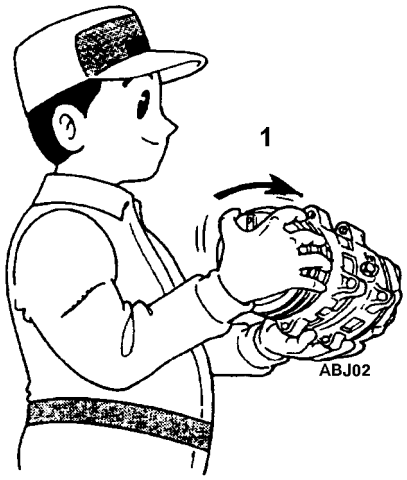
Checking the Oil Level

Drain the Oil



Draining the Oil

Remove the compressor from the unit and drain the oil from the compressor drain plug and all other ports. Turn the clutch (rotating the internal compressor parts) by hand and drain oil again. Repeat until all oil is removed from the compressor. Measure the oil in liquid ounces. Also, inspect the oil for signs of contamination.



Oil contamination.

1. Dirt in the oil.
2. Color changed to a varnish color.
3. Presence of foreign substances, metal shavings, etc. in the oil.

NOTE: Always replace oil with new fresh oil taken from a sealed container only.

NOTE: Always replace the system filter-drier anytime the system has been opened for service.

When a System Becomes Contaminated

A severely contaminated system may be indicated by black oil in the compressor. If severe contamination occurs, it will be necessary to flush the complete system. If flushing is required, use industry approved materials.

In all cases when this occurs you must determine the extent of contamination. Do this by removing the filter-drier and determine if the darker colored oil is present at that point of the system too. If it is, flushing the system is recommended.

If the oil appears clean at the filter-drier, install a new filter-drier and replace the compressor with clean new oil. Refer to checking and draining the compressor oil section for details.

CAUTION: Any extra or replacement oil should be placed into the system at the receiver tank port.

Electrical Connection

1. Connect the lead wire to the electrical circuit.

   NOTE: The stationary field is grounded at the factory; therefore, it is necessary only to connect the hot (lead) wire. A wire labelled "CH" is also connected to one of the compressor mounting bolts.

2. Engage and disengage the clutch several times to check the clutch engagement. The disc should snap firmly against the pulley.

Clutch Test

1. If the field coil lead wire is broken, replace the field coil.
2. Check the amperage and voltage. The amperage range should be 3.6 to 4.2 amps at 12 volts. Note the following symptoms and conditions.
   a. A very high amperage reading—a short within the field coil.
   b. No amperage reading—an open circuit in the winding.
   c. An intermittent or poor system ground results in lower voltage at the clutch. Check for tight fit of the coil retaining snap ring or coil retaining screws for good ground.
   d. Replace field coil if it has an open or short circuit.
3. Air Gap—An incorrect air gap could cause erratic engagement or disengagement and/or clutch rattle. Check the air gap with a feeler gauge (0.01 to 0.02 in. [0.3 to 0.6 mm]). Adjust per the Clutch Installation chapter.

BELT TENSIONS

Engine/Compressor Belt and Pulleys

Correct pulley alignment and proper belt tension are very important factors in compressor installation. The compressor clutch must be perfectly aligned with the engine pulley and any auxiliary idler or belt adjustment pulley components. When installing the clutch, be sure the shaft drive key is in place and the shaft bolt is properly tightened. Check the pulley alignment by holding a 24 to 35 in. (60 to 90 cm) long rod, 0.5 in. (13 mm) in diameter firmly into the V-groove of the clutch pulley and make sure the rod aligns squarely with the engine drive pulley groove. Double check by making sure the belt goes from pulley to pulley in perfect alignment with no indication of a sideward bend.

Adjust the belt tension to 58 to 60 on TK Gauge P/N 204-427. Check the belt tension again after 36 to 48 hours of initial operation of the unit because the belt may stretch slightly during the first hours of use. Remember, good alignment and proper belt tension ensure long belt life.

Troubleshooting: Over-the-Road

Use the following information to troubleshoot your unit. If the desired box temperature cannot be obtained, any of the following may be indicated:

1. EXCESSIVE HEAT LOAD. An excessive heat load on the system will be caused by too many, or excessively long, stops with the doors open. Excessive heat loads will also be caused by loose doors, loose body panels, warm loads and poor insulation.

2. DIRT ON COILS. Dirt on the condenser or evaporator coils acts as an insulator reducing the capacity of the unit.

3. INCORRECT BELT TENSION. If the drive belt is not correctly tensioned, the compressor will not be driven at the proper speed, and unit efficiency will be reduced. By contrast, too much tension will place an additional load on the bearings causing rapid wear.

4. SHORTAGE OF REFRIGERANT. Shortage of refrigerant reduces the capacity of the unit. Find and remedy the cause of the shortage and recharge the system. DO NOT operate the unit if there is an indication of low charge. DO NOT operate below 30 F (-1 C) box temperature if the refrigerant level is below the sight glass on the receiver tank.

5. FAULTY EXPANSION VALVE ADJUSTMENT. High superheat settings will starve the evaporator causing low suction pressure. Low superheat settings will flood the coil causing high suction pressure. The superheat setting should be adjusted ONLY by a trained refrigeration service technician.

   The superheat setting is 8 F (4.4 C) at 0 F (-18 C) box temperature.

6. EXCESSIVE OIL. Too much compressor oil in the system may result in lower than normal suction pressure as well as lowered capacity.

7. MOISTURE IN THE SYSTEM. Symptom: Expansion valve freeze-up—will not refrigerate. Usually this can be checked by warming the expansion valve with either a hand or hot towels to see if the valve opens. Evacuate the system in the same manner used during installation. Install a new drier.

8. EXPANSION VALVE LOSES ITS CHARGE. If the expansion valve loses its charge, the valve will close causing the system to go into vacuum. Replace the valve.

9. AIR IN THE SYSTEM. Air is not condensable. Its presence in the system increases head pressure. When the compressor is stopped, air will gather at the high point of the high side. Evacuate the system.

10. TEMPERATURE OF THE LIQUID LINE. During normal operation, the liquid line will be slightly warmer than the surrounding air. An extremely hot line indicates either a shortage of refrigerant or a lack of a liquid seal at the receiver outlet. A cold line indicates a restriction, and some flashing takes place in the liquid line sight glass.

11. DIRTY OR WET DRIER. If the outlet line of the drier is colder than the inlet line, the drier is either saturated with moisture or is dirty and must be replaced.

12. DIRT IN THE EXPANSION VALVE SCREEN. Recover the refrigerant charge, remove the screen and clean. If the moisture is in the refrigeration system, it will collect at the expansion valve and freeze. This is indicated by abnormally low suction pressure. Clean the system, replace the drier, evacuate the system pressurize and check for leaks. If no leaks are found, charge the system.

13. ICE ON THE EVAPORATOR COIL. Run the unit through a defrost cycle to remove the ice.

14. AIR FLOW. Do not load product directly in front of the air return or discharge. Ensure that the fan is correctly positioned in the orifice to achieve maximum air flow.

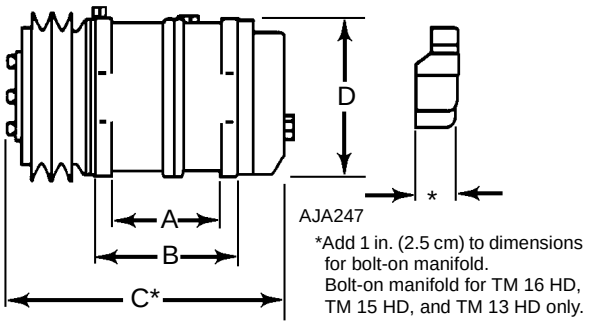
15. COMPRESSOR LIFE. The following will shorten the life of a compressor:

- Operating a contaminated system
- No oil trap
- Clogged oil separator (JetLube™)
- Clogged liquid injection orifice (JetCool™)
- Defective temperature switch (JetCool™)
- Insufficient oil charge
- Wrong oil or mixed oil
- Lack of compressor lubrication on installation-startup
- Excess compressor speed (refer to the chart below)

Road Compressors

Specifications

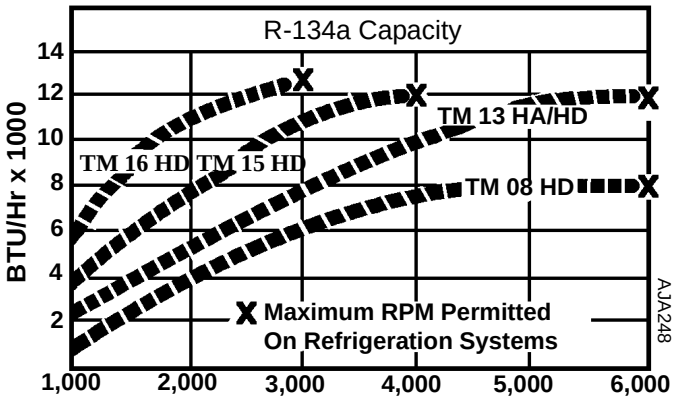
Model	Displ.	Dimensions			
MAX RPM	(Metrics)	A	B	C*	D
TM 16HD	10.5 cid	3.28in.	4.41 in.	8.77 in.	4.09 in.
3000 rpm	(163 cc)	(83.3 mm)	(112 mm)	(222.8 mm)	(104 mm)
TM 15 HD	9.0 cid	3.28 in.	4.41 in.	8.55 in.	4.09 in.
4000 rpm	(147 cc)	(83.3 mm)	(112 mm)	(217.3 mm)	(104 mm)
TM 13 HD	8.0 cid	3.28 in.	4.41 in.	8.55 in.	4.09 in.
6000 rpm	(131 cc)	(83.3 mm)	(112 mm)	(217.3 mm)	(104 mm)
TM 13 HD	8.0 cid	2.89 in.	3.86 in.	8.23 in.	4.09 in.
6000 rpm	(131 cc)	(73.3 mm)	(98 mm)	(209 mm)	(104 mm)
TM 08 HD	5.0 cid	2.03 in.	3.15 in.	6.85 in.	4.41 in.
6000 rpm	(82 cc)	(515 mm)	(80 mm)	(174 mm)	(112 mm)



*Add 1 in. (2.5 cm) to dimensions for bolt-on manifold. Bolt-on manifold for TM 16 HD, TM 15 HD, and TM 13 HD only.

Relative Performance

Compressor RPM Formula						
Drive Pulley Dia.	÷	Clutch Pulley Dia.	X	High Engine RPM	=	Maximum Compressor RPM
6.5	÷	5.25	X	2500	=	3095



Troubleshooting: Electrical Standby

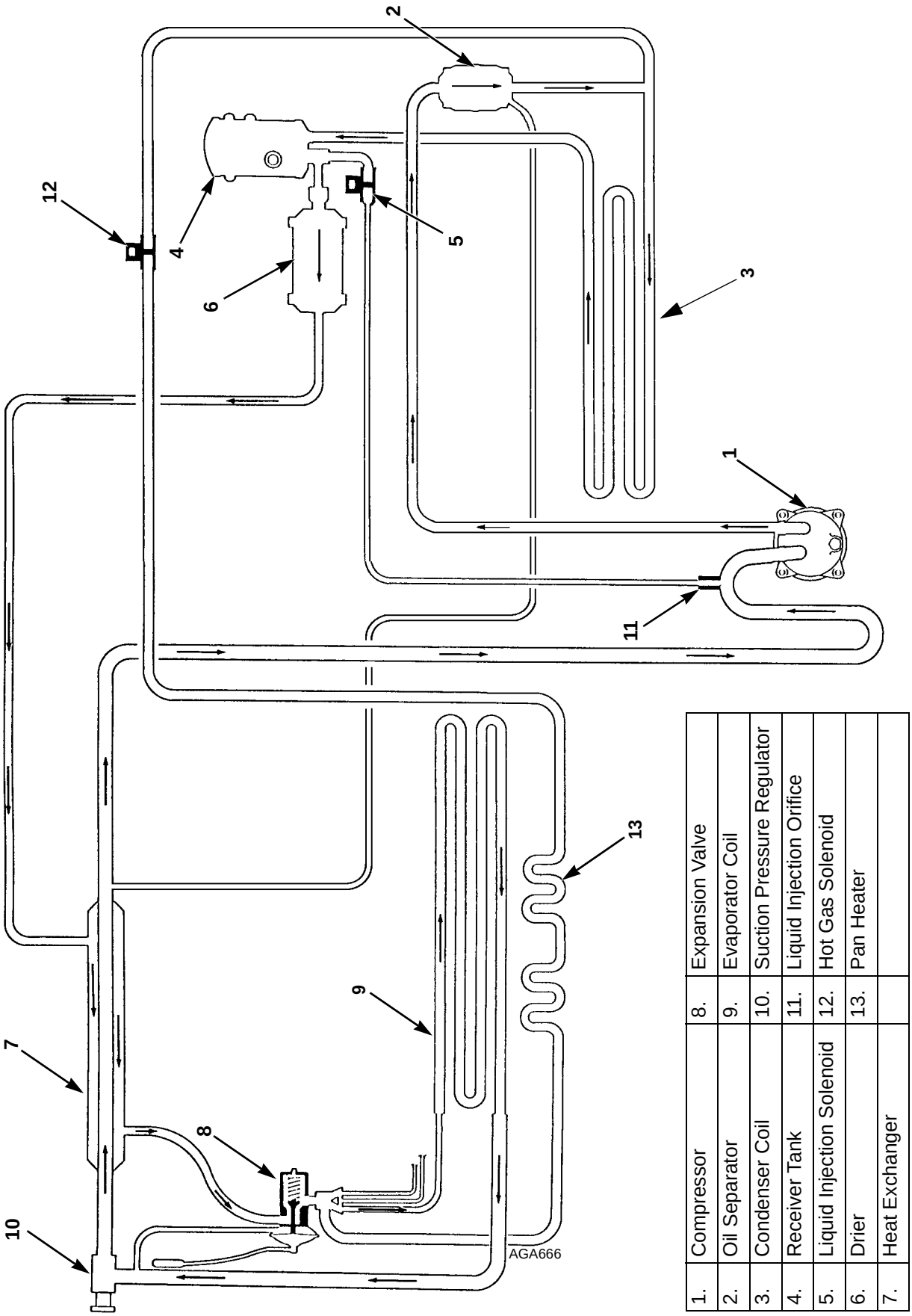
CONDITION	POSSIBLE CAUSE	REMEDY
Compressor does not run	Improperly wired	Check wiring against diagram
	Low line voltage	Check line voltage—determine location of voltage drop
	Relay contacts not closing	Check and replace relay if defective
	Open circuit in motor winding	Check motor leads. If leads OK, replace motor
	High pressure cutout switch open	Eliminate cause of excessive pressure
	Sensors faulty	Repair or replace
	Compressor piston stuck	Replace compressor
	Frozen compressor or motor bearings	Repair or replace
	Shortage of refrigerant	Check for leaks, repair as required, and recharge
	Low pressure cutout switch open	Check and replace if necessary.
	Overload relay open	Turn On-Off switch OFF and back ON
Unit short cycles	Shortage of refrigerant (low pressure cutout)	Repair leak and recharge
	Restricted expansion valve (low pressure cutout)	Replace expansion valve
	Refrigerant overcharge (high pressure cutout)	Remove excess charge
	Cycling on high pressure cutout	Check air flow and fan
	Clogged condenser coil	Clean coil
Motor contactor burnout	Low line voltage	Increase voltage (must be ± 10% of compressor motor rating)
	Excessive line voltage	Reduce voltage (must be ± 10% of compressor motor rating)

CONDITION	POSSIBLE CAUSE	REMEDY
Unit operates long or continuously	Shortage of refrigerant	Repair leak and recharge
	Discharge valve leaking	Replace compressor
	Sensor faulty	Replace sensor
	Dirty condenser	Clean condenser
	Air in system	Purge
	Compressor inefficient	Replace compressor
	Plugged expansion valve	Clean or replace
	Iced or plugged coil	Defrost or clean
	Defective truck body insulation	Correct or replace
	Too many door openings	Keep doors closed
	Load too warm	Precool hot product
	Excessive superheat at expansion valve	Adjust
	Door seals worn	Repair/replace
Box temperature too high	Refrigerant shortage	Repair leak and recharge
	Setpoint set too high	Reset control
	Expansion valve or strainer plugged	Clean or replace
	Restricted lines	Clean restriction. Tubing pinched shut
	Hot load	Precool hot product
	Expansion valve superheat too high or too low	Adjust
Head pressure too high	Refrigerant overcharge	Remove excess
	Air in system	Evacuate system
	Dirty condenser	Clean
	Restricted condenser	Clean condenser
	Condenser fan not running	Check fan motor
	Condenser fan rotating backwards	Check wiring

CONDITION	POSSIBLE CAUSE	REMEDY
Head pressure too low	Refrigerant shortage	Repair leak and recharge
	Compressor suction or discharge valve inefficient	Replace compressor
Noisy unit	Insufficient compressor oil	Add oil to proper level
	Mounting bolts loose	Tighten
	Oil slugging or refrigerant flooding back	Adjust oil level or refrigerant charge. Check expansion valve for proper superheat
Compressor loses oil	Refrigerant leak	Repair leak and recharge
	Plugged expansion valve or strainer	Clean or replace
	Wrong oil viscosity	Use proper oil
	Short cycling	Refer to Unit Short Cycles
	Superheat too high	Adjust expansion valve
Frosted or sweating suction line	Expansion valve set too low, admitting excess refrigerant	Adjust expansion valve
	Heat exchanger internal leak	Replace
Hot liquid line	Shortage of refrigerant	Repair leak and recharge
Frosted liquid line	Restricted dehydrator or strainer	Replace restricted part
Condenser coils cool when unit is in cool	Refrigerant undercharge	Repair leak and recharge
	Compressor inefficient	Replace compressor
Unit in vacuum. Frost on expansion valve only	Ice plugging expansion valve orifice	Apply hot wet cloth to expansion valve. Moisture indicated by increase in suction pressure. Replace drier
	Plugged expansion valve strainer	Clean strainer or replace expansion valve
	Sensor bulb lost charge	Replace expansion valve

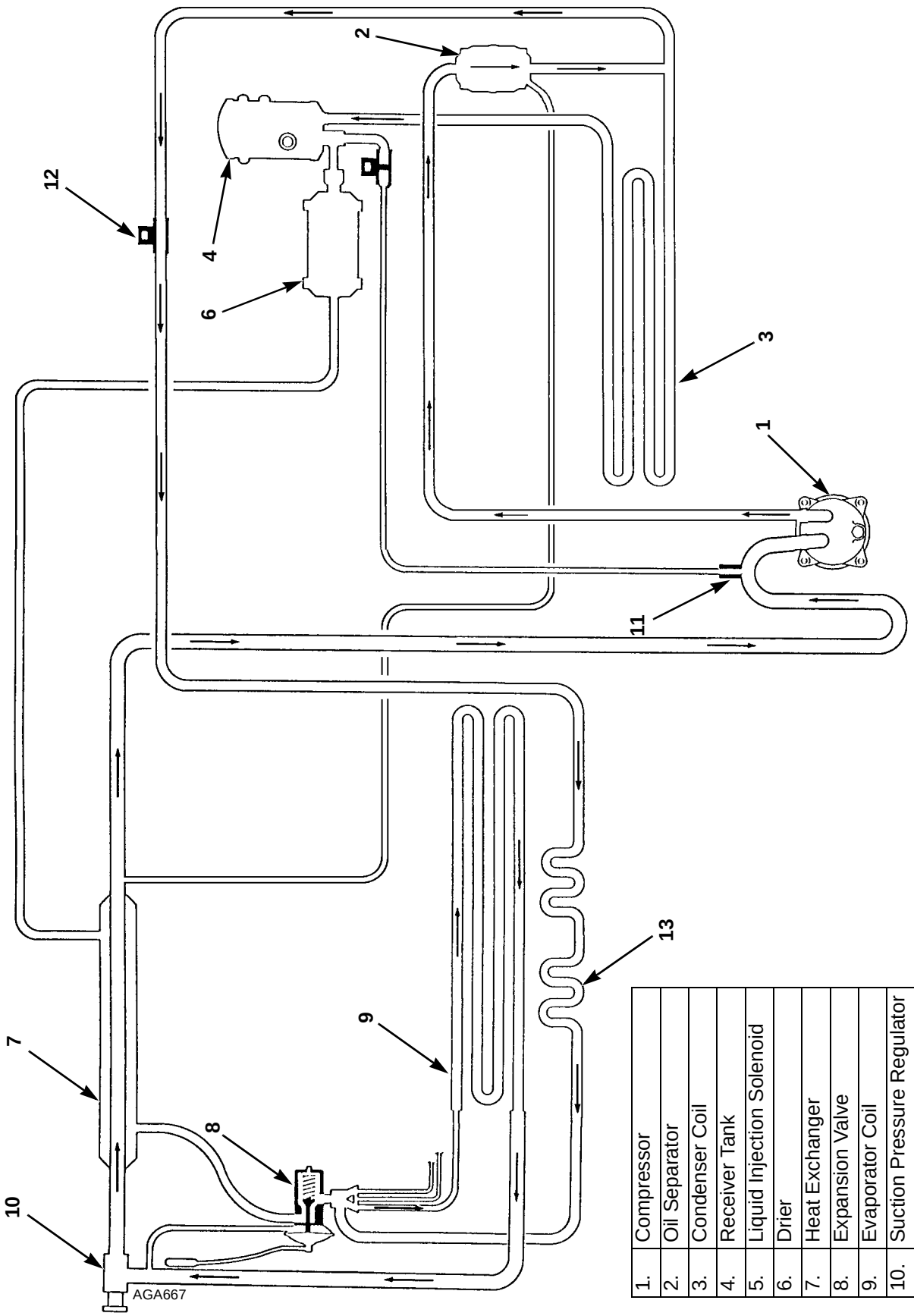
ELECTRIC STANDBY SERVICE CHECKS

1. Motor does not run	1. Check for power at source 2. Check for power at plug 3. Check for power at compressor contactor 4. Check for power at overload terminals (contactor closed) 5. Check for power at motor terminals
2. Power at motor terminals but motor does not run	1. Replace motor
3. Motor hums but does not run	1. Check for locked rotor 2. Check for worn bearings. Replace if necessary 3. Check for locked compressor and repair 4. Power source for single phasing (on 3 phase units) 5. Check capacitors (on single phase units) 6 Check start relay
4. Check transformer	1. Check for power output 12-13 Vdc, 12 volt system
5. Check rectifier	1. Check for rectifier output 13-18 Vdc, 12 volt system



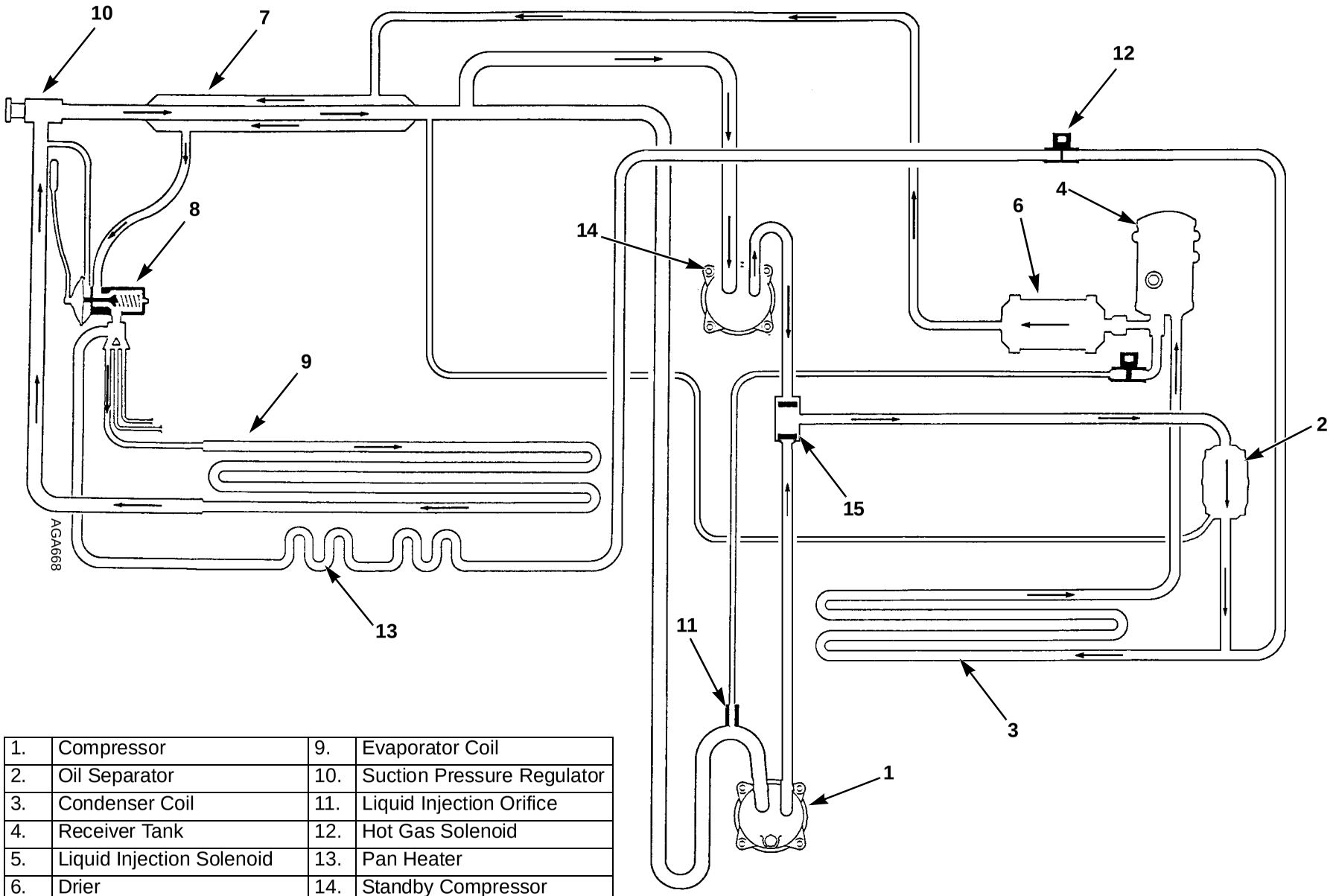
1.	Compressor	8.	Expansion Valve
2.	Oil Separator	9.	Evaporator Coil
3.	Condenser Coil	10.	Suction Pressure Regulator
4.	Receiver Tank	11.	Liquid Injection Orifice
5.	Liquid Injection Solenoid	12.	Hot Gas Solenoid
6.	Drier	13.	Pan Heater
7.	Heat Exchanger		

Model 10 Cool

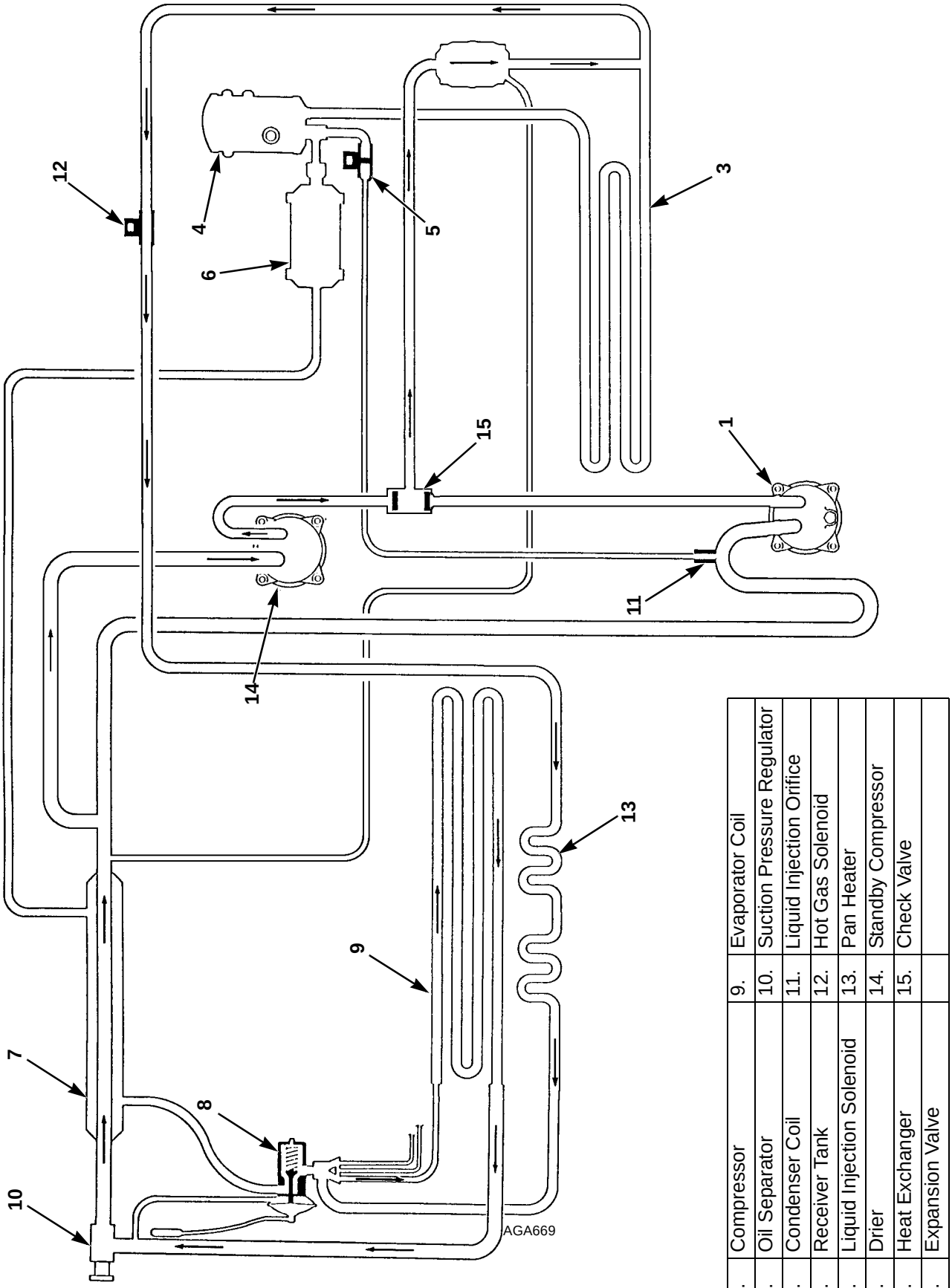


1.	Compressor
2.	Oil Separator
3.	Condenser Coil
4.	Receiver Tank
5.	Liquid Injection Solenoid
6.	Drier
7.	Heat Exchanger
8.	Expansion Valve
9.	Evaporator Coil
10.	Suction Pressure Regulator
11.	Liquid Injection Orifice
12.	Hot Gas Solenoid
13.	Pan Heater

Model 10 in Defrost

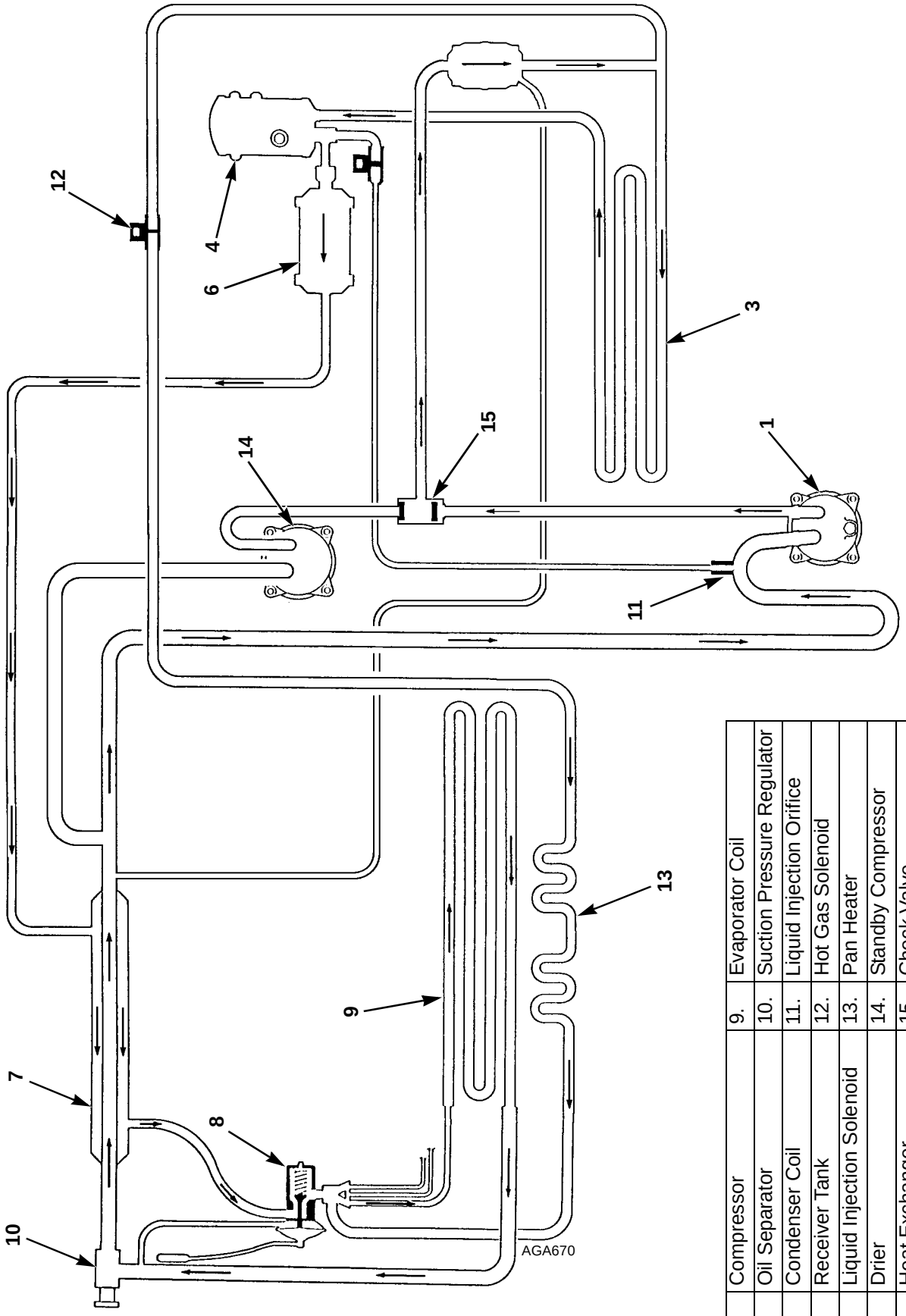


1.	Compressor	9.	Evaporator Coil
2.	Oil Separator	10.	Suction Pressure Regulator
3.	Condenser Coil	11.	Liquid Injection Orifice
4.	Receiver Tank	12.	Hot Gas Solenoid
5.	Liquid Injection Solenoid	13.	Pan Heater
6.	Drier	14.	Standby Compressor
7.	Heat Exchanger	15.	Check Valve
8.	Expansion Valve		



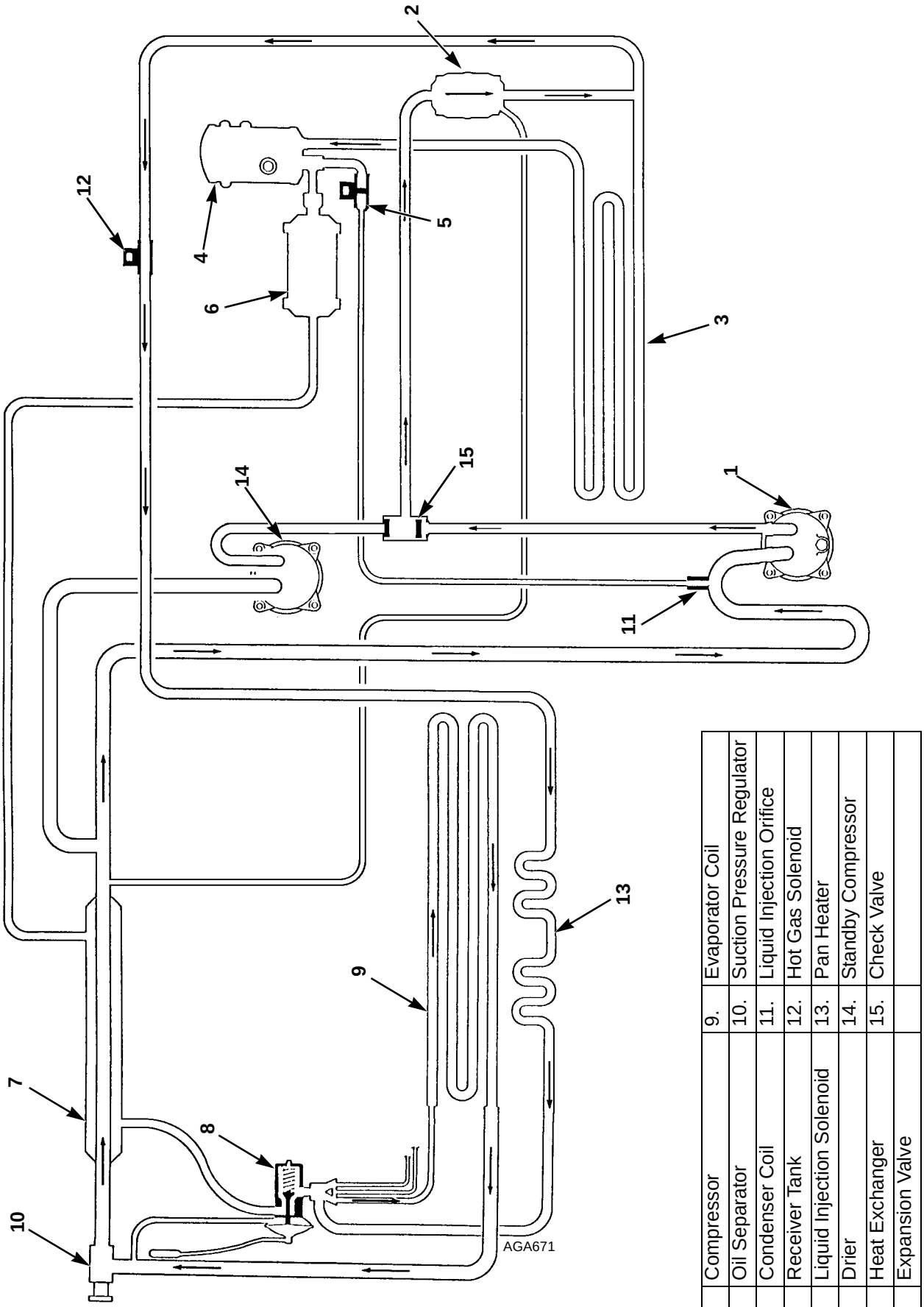
1.	Compressor	9.	Evaporator Coil
2.	Oil Separator	10.	Suction Pressure Regulator
3.	Condenser Coil	11.	Liquid Injection Orifice
4.	Receiver Tank	12.	Hot Gas Solenoid
5.	Liquid Injection Solenoid	13.	Pan Heater
6.	Drier	14.	Standby Compressor
7.	Heat Exchanger	15.	Check Valve
8.	Expansion Valve		

Model 20 in Defrost—Electric Standby Operation



1.	Compressor	9.	Evaporator Coil
2.	Oil Separator	10.	Suction Pressure Regulator
3.	Condenser Coil	11.	Liquid Injection Orifice
4.	Receiver Tank	12.	Hot Gas Solenoid
5.	Liquid Injection Solenoid	13.	Pan Heater
6.	Drier	14.	Standby Compressor
7.	Heat Exchanger	15.	Check Valve
8.	Expansion Valve		

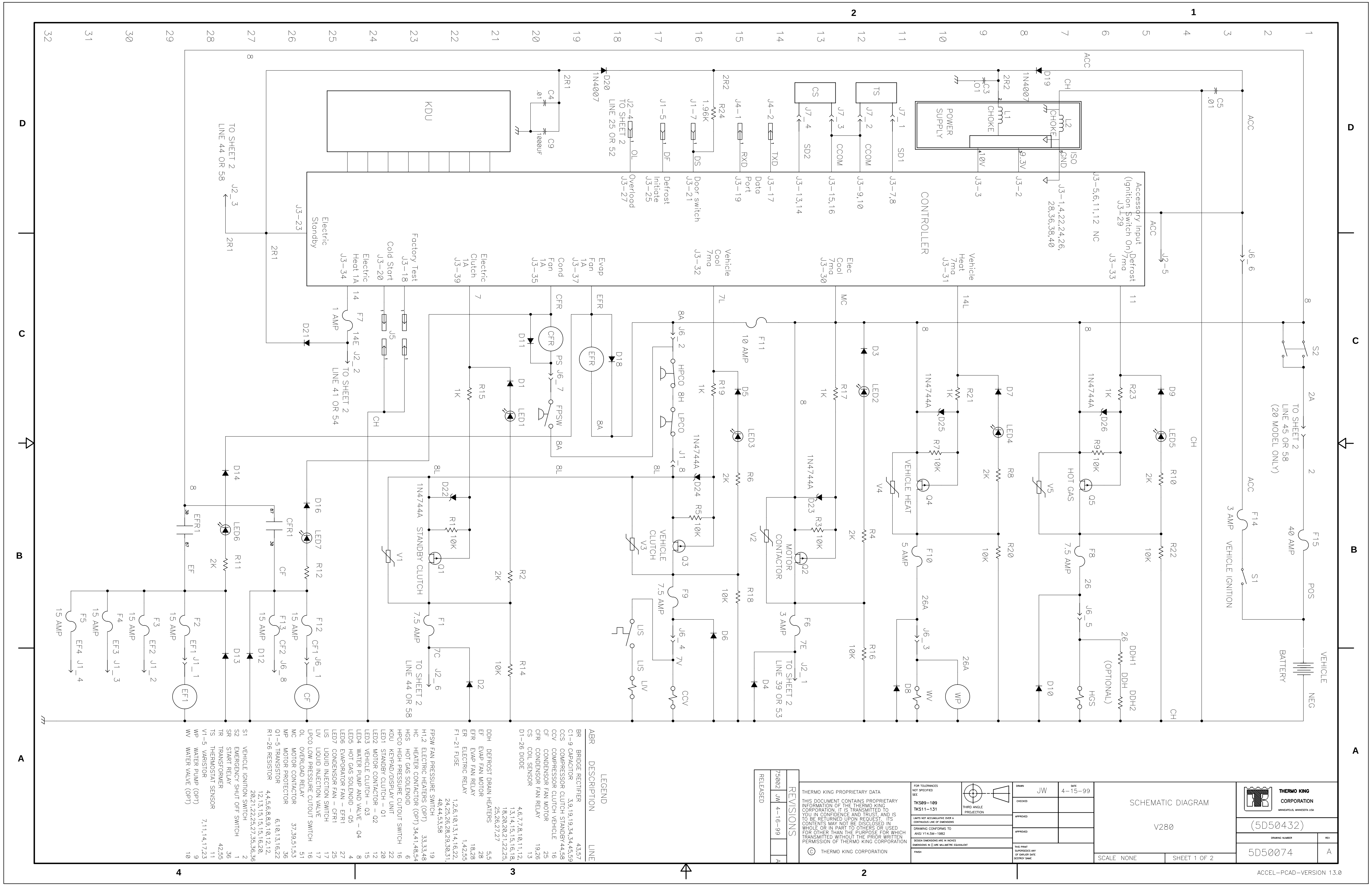
Model 20 in Cool—Vehicle Engine Operation



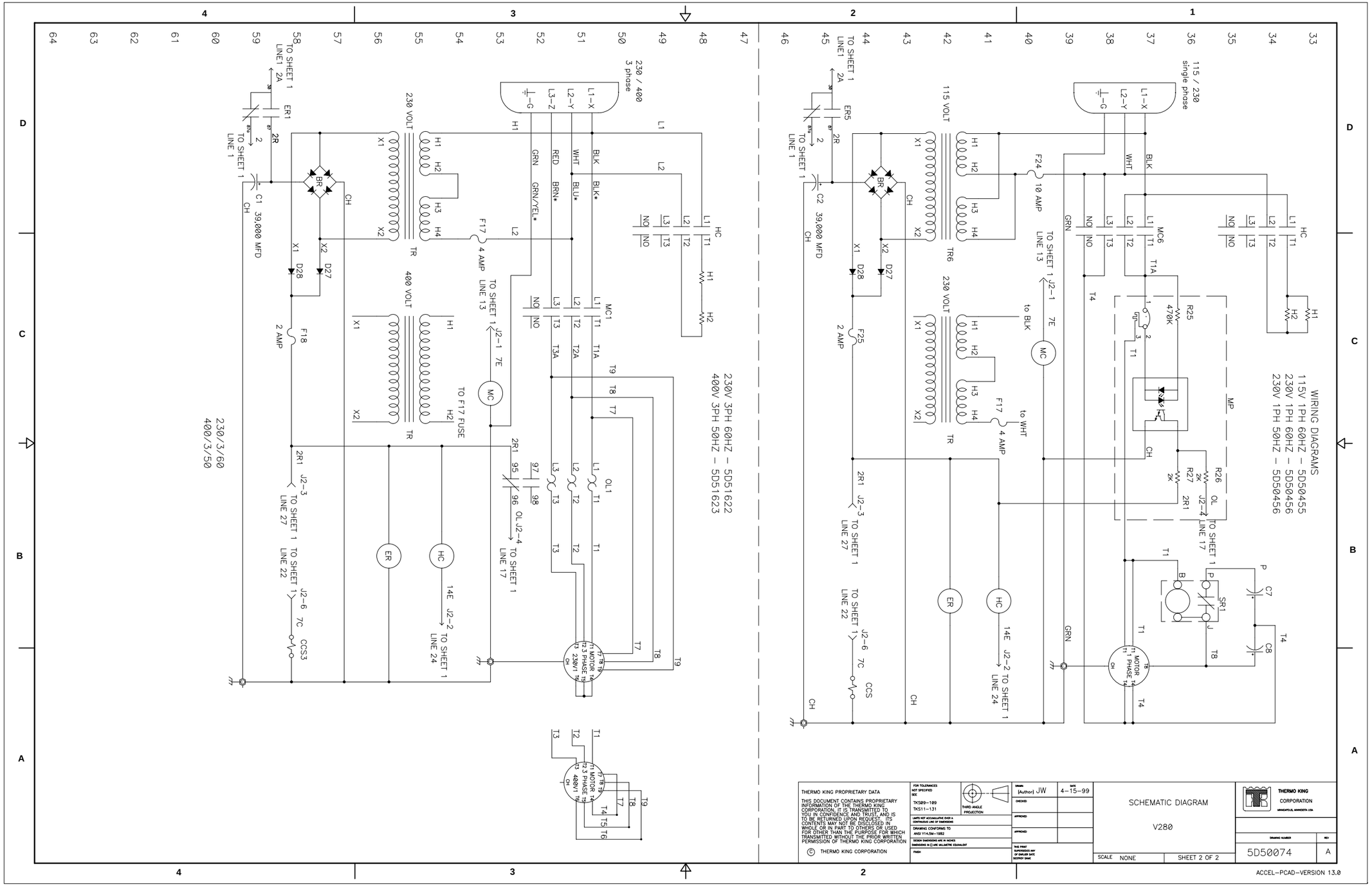
1.	Compressor	9.	Evaporator Coil
2.	Oil Separator	10.	Suction Pressure Regulator
3.	Condenser Coil	11.	Liquid Injection Orifice
4.	Receiver Tank	12.	Hot Gas Solenoid
5.	Liquid Injection Solenoid	13.	Pan Heater
6.	Drier	14.	Standby Compressor
7.	Heat Exchanger	15.	Check Valve
8.	Expansion Valve		

Model 20 in Defrost—Vehicle Engine Operation

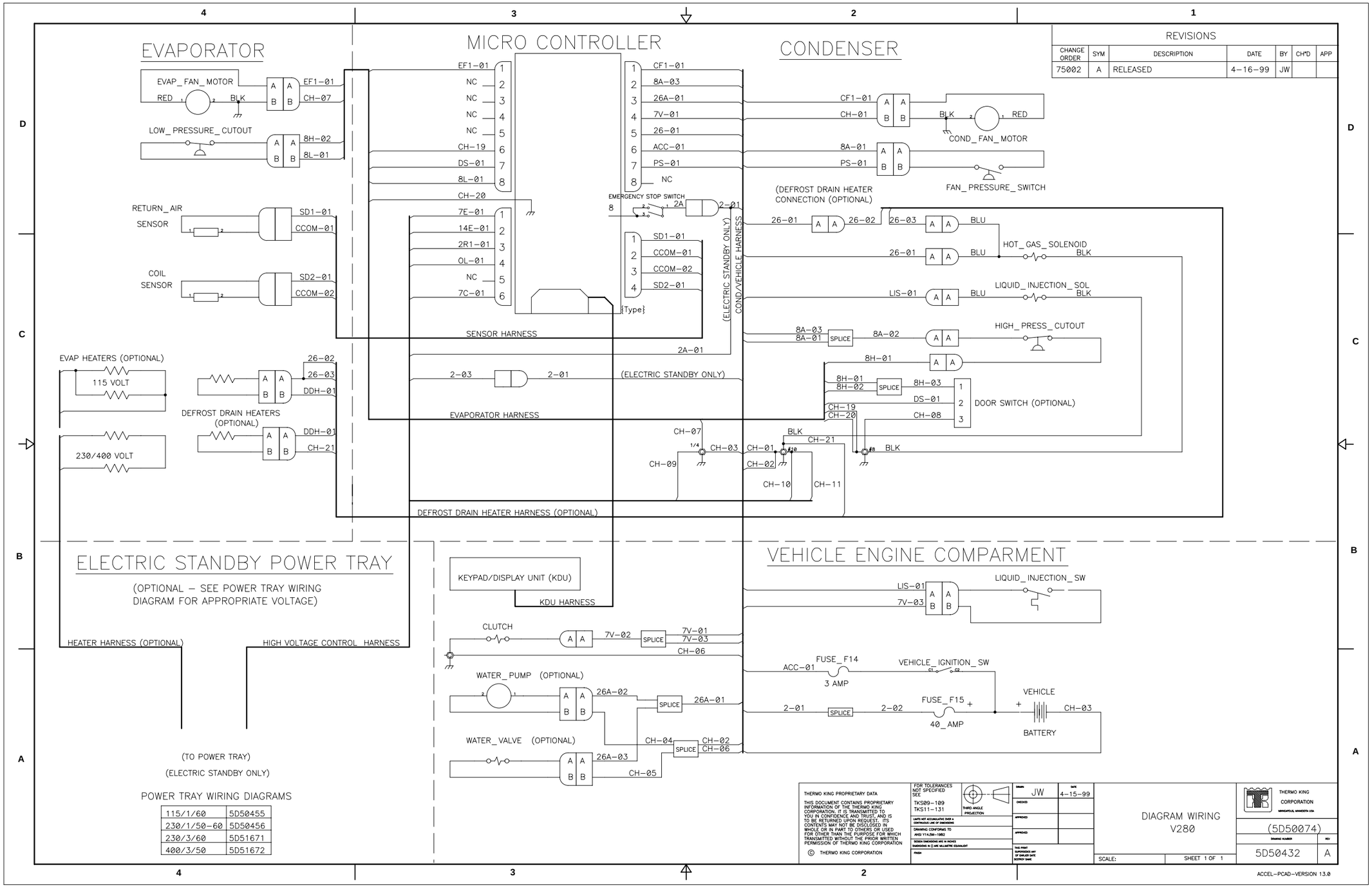
Wiring Diagrams and Schematic Index


SCHEMATIC DIAGRAM
V280
THERMO KING CORPORATION
5D50074
(5D50432)
SCALE NONE
SHEET 1 OF 2
ACCEL-PCAD-VERSION 13.0
CONTROLLER
KDU
LEGEND
REVISIONS

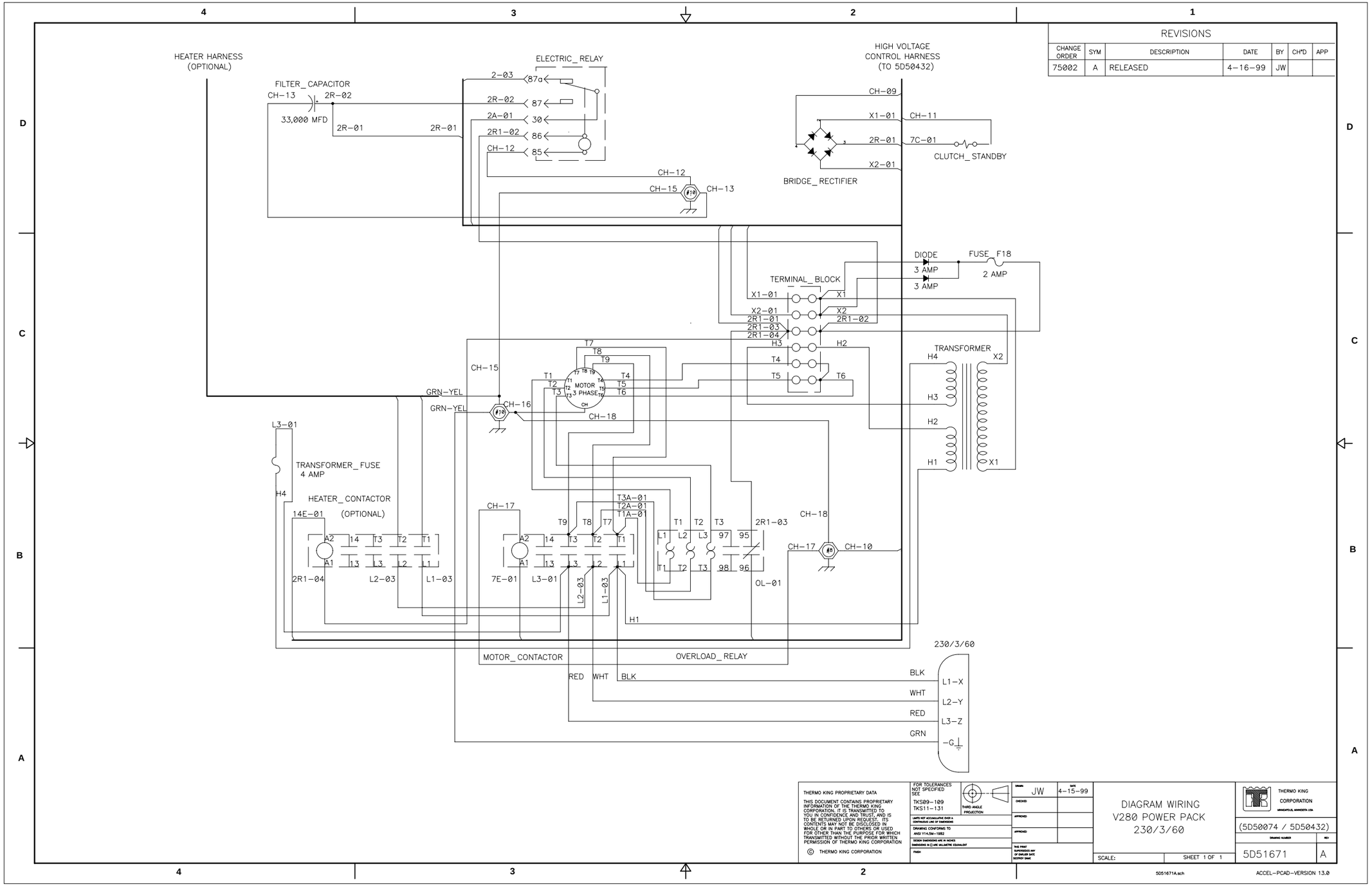
V280 Schematic Diagram—Page 2 of 2



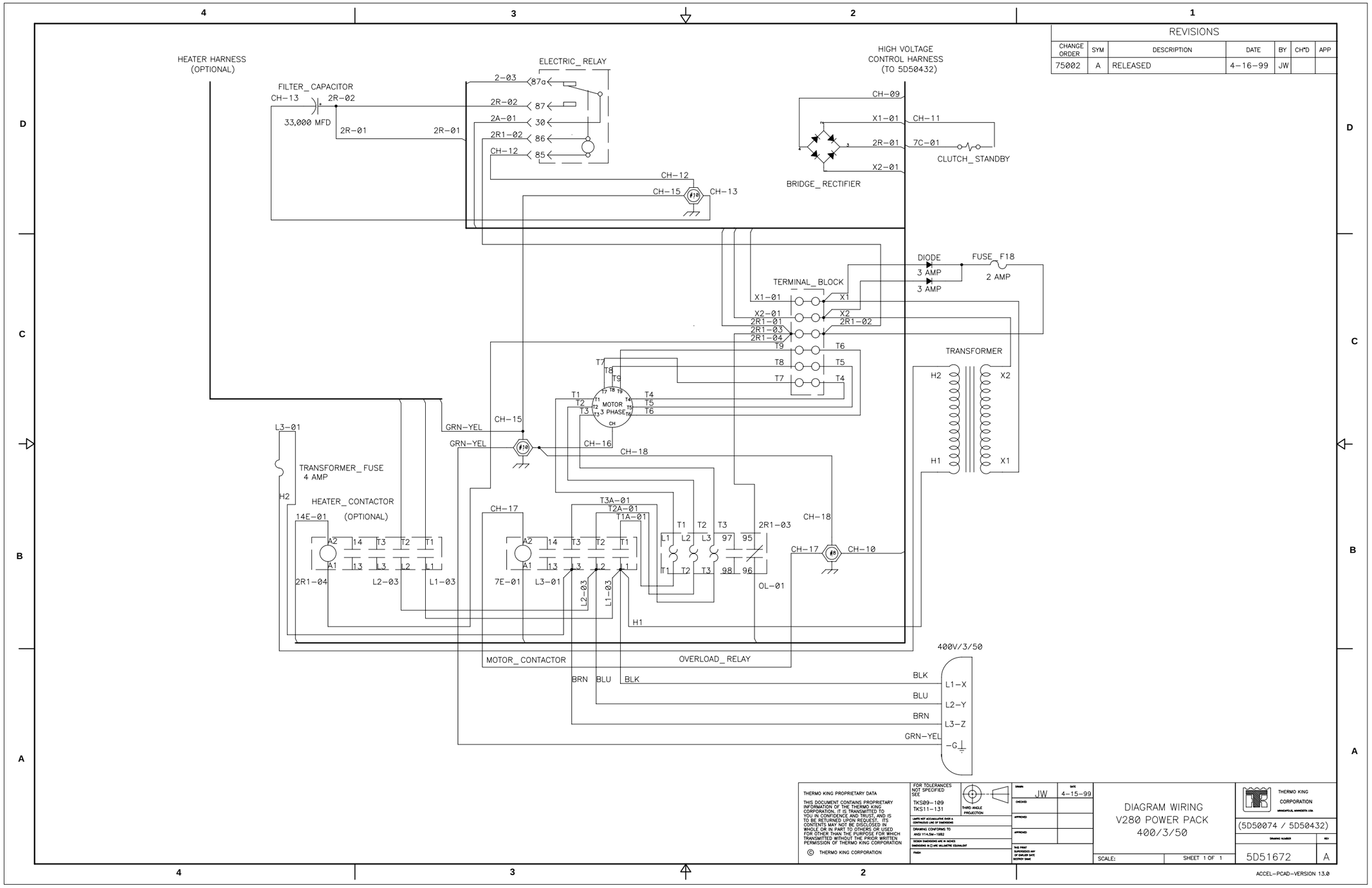
V280 Wiring Diagram



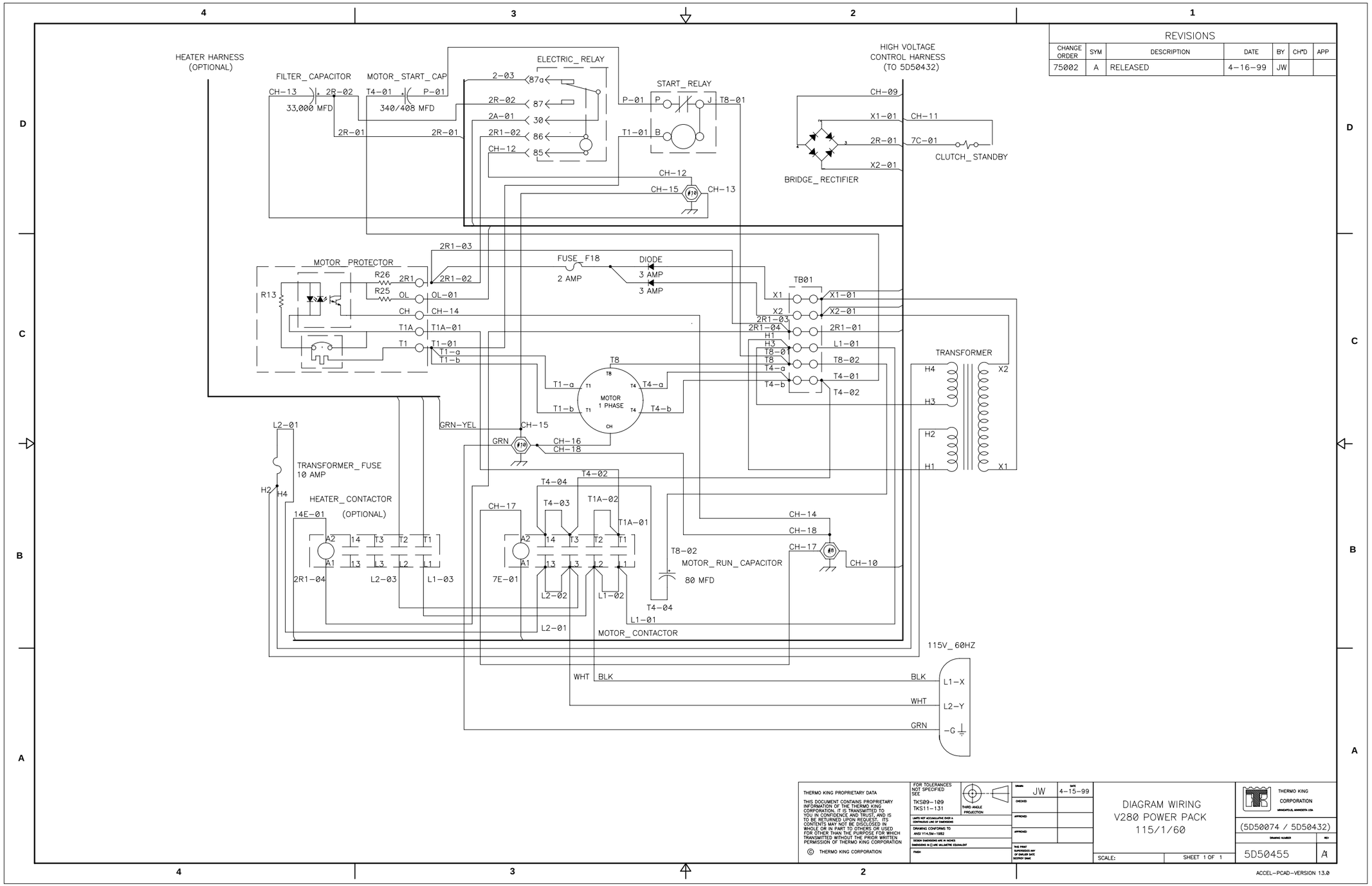
V280 Power Pack 230/3/60 Wiring Diagram



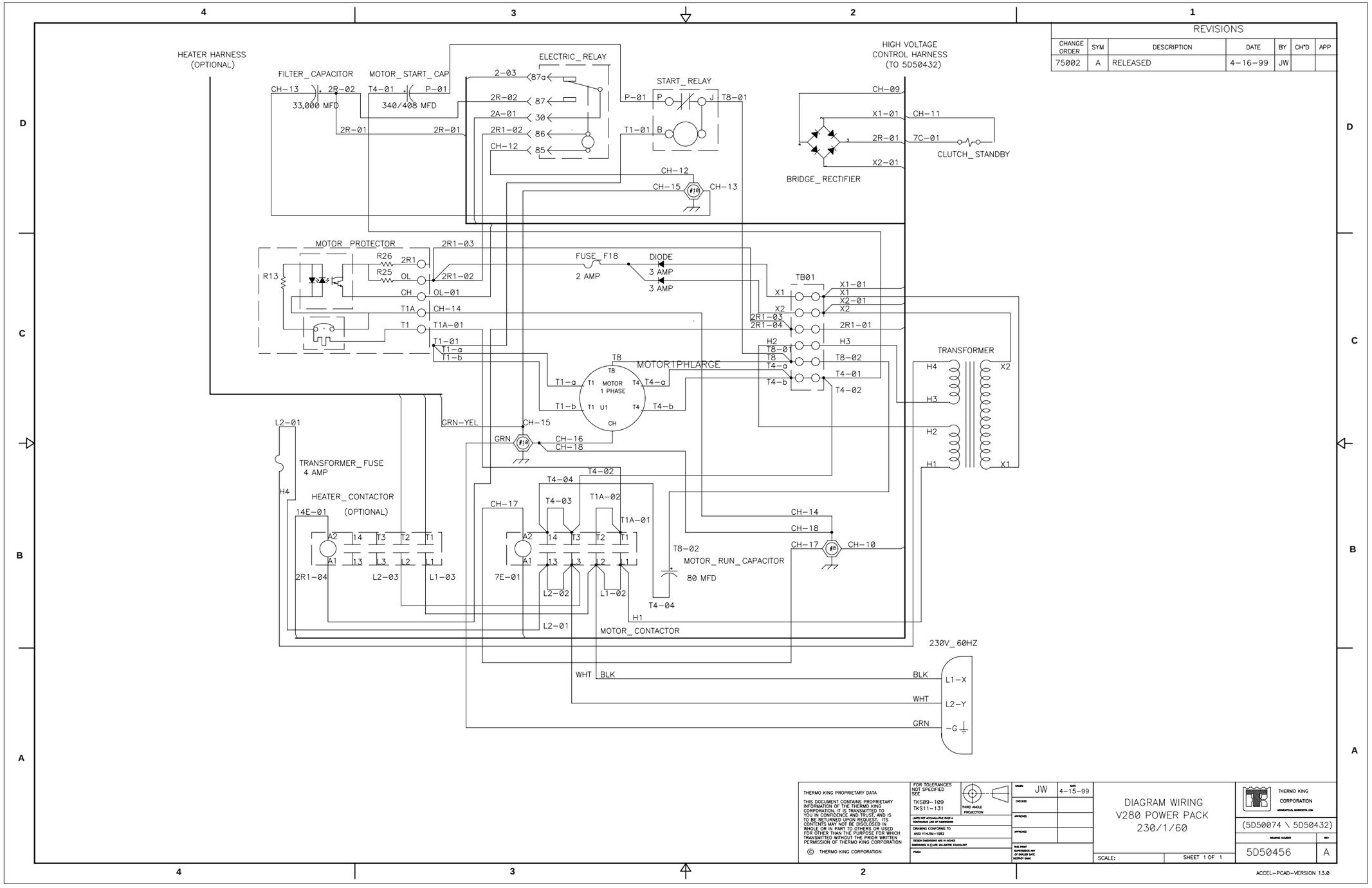
V280 Power Pack 400/3/50 Wiring Diagram



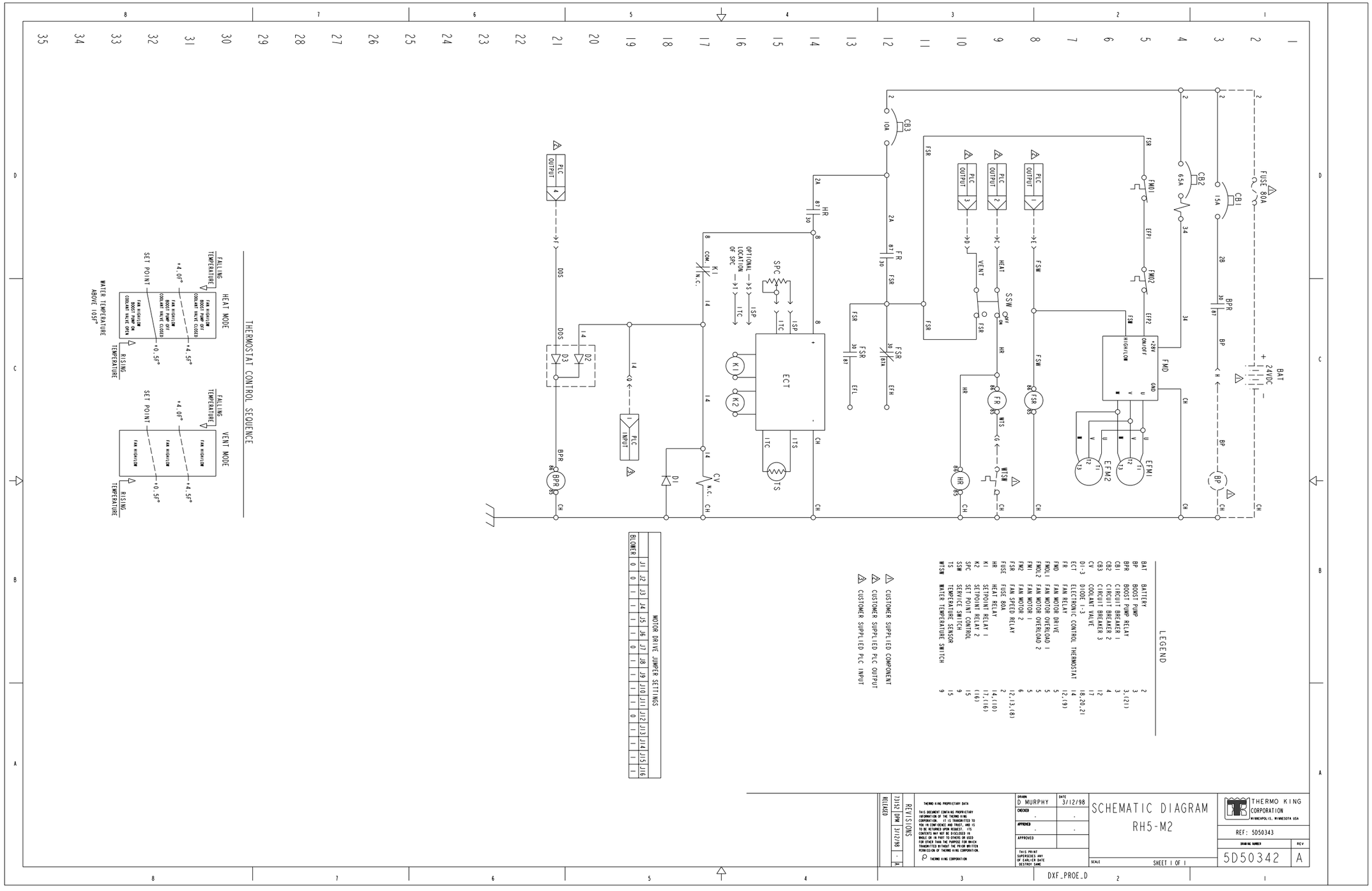
V280 Power Pack 115/1/60 Wiring Diagram



V280 Power Pack 230/1/60 Wiring Diagram



RH5 - M2 Schematic Diagram



Keypad Display

REVISIONS						
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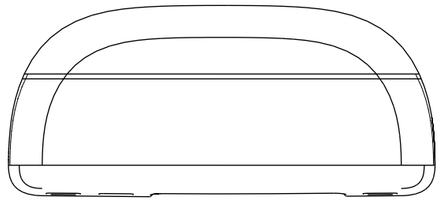
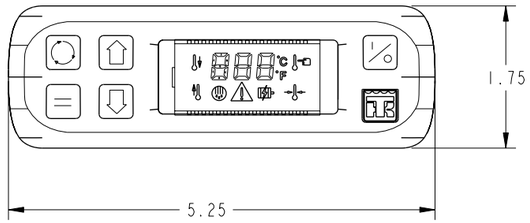
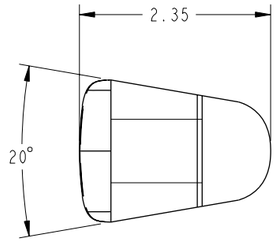
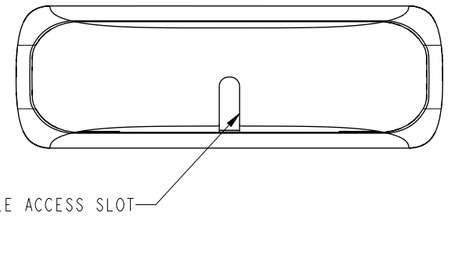








NOTE:
1. SERVICE PART NUMBER: 41-2997.
2. WATLOW PART NUMBER: TKVP-0KDU-0000.

G05	G04	G03	G02	G01	ITEM NO	PART/DWG NUMBER	REV.	DESCRIPTION	MATERIAL SPEC	WEIGHT
				1	2	2C26367H01	.	COWL	.	.
				1	1	2C25858G01	.	DISPLAY-KEYPAD KDU	.	.
				A	REV	LIST OF MATERIAL				

FOR TOLERANCES NOT SPECIFIED SEE TKS09-109 TKS11-131

THIRD ANGLE PROJECTION

LIMITS NOT ACCUMULATIVE OVER A CONTINUOUS LINE OF DIMENSIONS

DRAWING CONFORMS TO ANSI Y14.5M-1982

DESIGN DIMENSIONS ARE IN INCHES DIMENSIONS IN [ ] ARE MILLIMETRE EQUIVALENT

FINISH NONE

		DATE
DRAWN	MSR	16-Apr-99
CHECKED	-	-
APPROVED	-	-
APPROVED	-	-

THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.

BOX
DISPLAY KEYPAD
COMPL

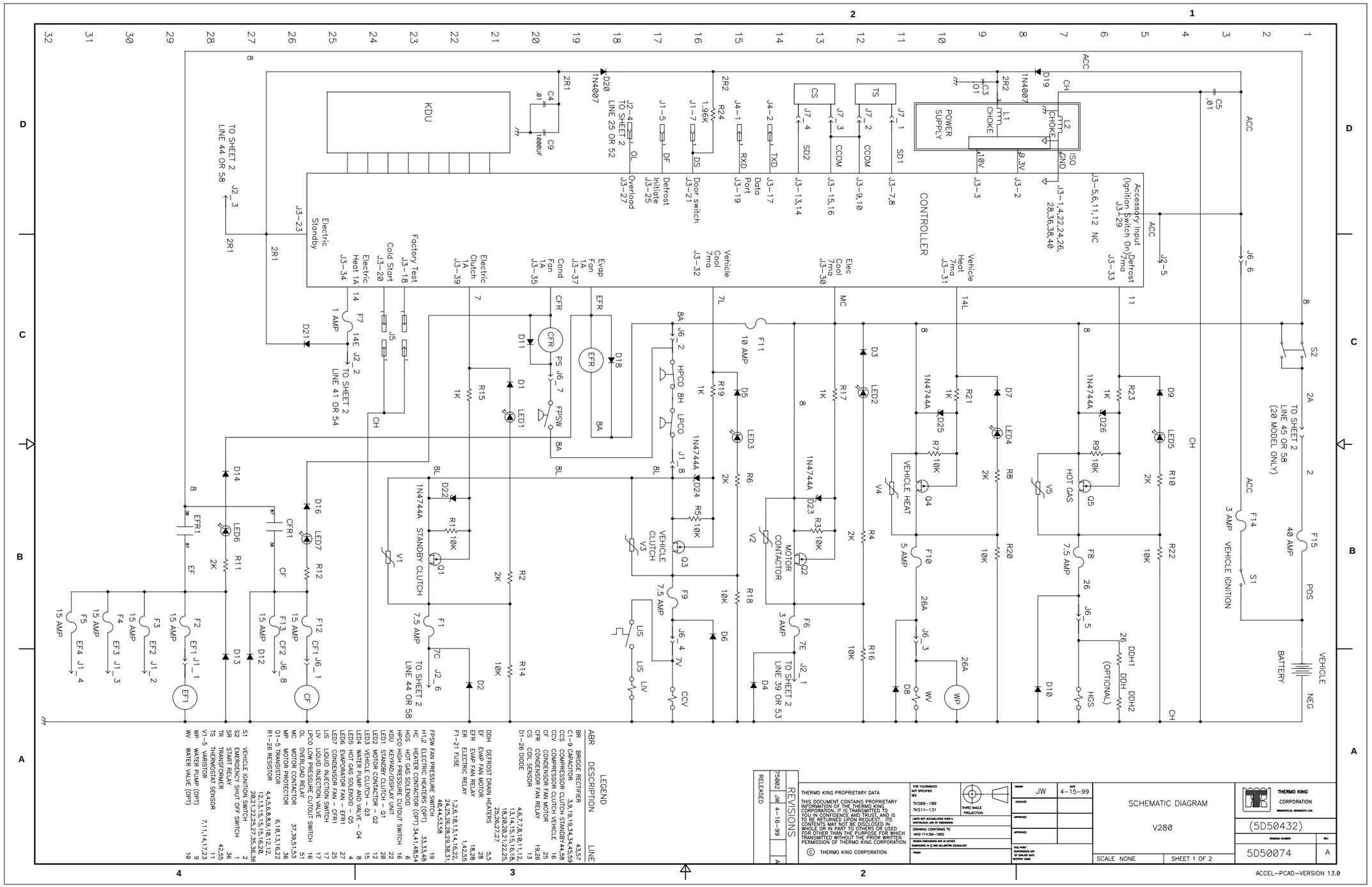
SCALE DRAWING SCALE | SHEET 1 OF 1

THERMO KING CORPORATION
MINNEAPOLIS, MINNESOTA USA

DRAWING NUMBER	REV
2C26664	A

PROE_C

V280 Schematic Diagram—Page 1 of 2



LEGEND

ABR	DESCRIPTION	LINE
BR	BRIDGE RECTIFIER	43,57
C1–9	CAPACITOR	3,9,19,33,34,45,59
CCS	COMPRESSOR CLUTCH STANDBY	44,58
CCV	COMPRESSOR CLUTCH VEHICLE	25
CFR	CONDENSOR FAN MOTOR	19,26
CS	COIL SENSOR	13
D1–26	DIODE	4,6,7,7,8,10,11,12, 13,14,15,15,16,18, 18,20,20,21,22,25, 25,26,27,27
DDH	DEFROST DRAIN HEATERS	5,5
EF	EVAP FAN MOTOR	28
EFR	ELECTRIAN RELAY	18,25
F1–21	FUSE	1,2,6,10,13,14,16,22, 24,25,26,28,29,30,31, 48,44,53,58
FPSW	FAN PRESSURE SWITCH	19
H1,2	ELECTRIC HEATERS (OPT)	33,33,48
HC	HEATER CONTACTOR (OPT)	34,41,48,54
HGS	HOT GAS SOLENOID	6
HPCO	HIGH PRESSURE CUTOUT SWITCH	16
KDU	KEYPAD/DISPLAY UNIT	22
LED1	MOTOR CONTACTOR – Q2	12
LED3	VEHICLE CLUTCH – Q3	9
LED4	WATER PUMP AND VALVE – Q4	15
LED5	HOT GAS SOLENOID – Q5	8
LED6	EVAPORATOR FAN – EFR1	4
LED7	CONDENSOR FAN – CFR1	27
LIS	LIQUID INJECTION SWITCH	25
LIV	LIQUID INJECTION VALVE	17
LPCO	LOW PRESSURE CUTOUT SWITCH	17
OL	OVERLOAD RELAY	16
Q1–5	TRANSISTOR	51
MP	MOTOR PROTECTOR	37,39,51, 35
R1–26	RESISTOR	6,10,13,16,22
		4,4,5,6,8,9,10,12,12, 12,13,15,15,15,16,20, 28,21,22,25,27,35,36,36
S1	VEHICLE IGNITION SWITCH	2
S2	EMERGENCY SHUT OFF SWITCH	1
SR	START RELAY	36
TR	TRANSFORMER	42,55
TS	THERMOSTAT SENSOR	11
V1–5	THERMISTOR	7,11,14,17,21
WP	WATER PUMP (OPT)	9
WV	WATER VALVE (OPT)	10

REVISIONS			
75402	JW	4-16-99	A

RELEASED

FOR TOLERANCES NOT SPECIFIED SEE TKS89–109 TKS11–131
THIRD ANGLE PROJECTION
LIMITS NOT ACCUMULATIVE OVER A CONTINUOUS LINE OF DIMENSIONS
DRAWING CONFORMS TO ANSI Y14.5M–1982
METRIC DIMENSIONS ARE IN INCHES DIMENSIONS IN [] ARE MILLIMETRE EQUIVALENT
FINISH

DRAWN	JW	4-15-99
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APPROVED		
APPROVED		

THIS PRINT SUPERSEDES ANY OF EARLIER DATE BEARING SAME

SCHEMATIC DIAGRAM

V280

SCALE NONE | SHEET 1 OF 2

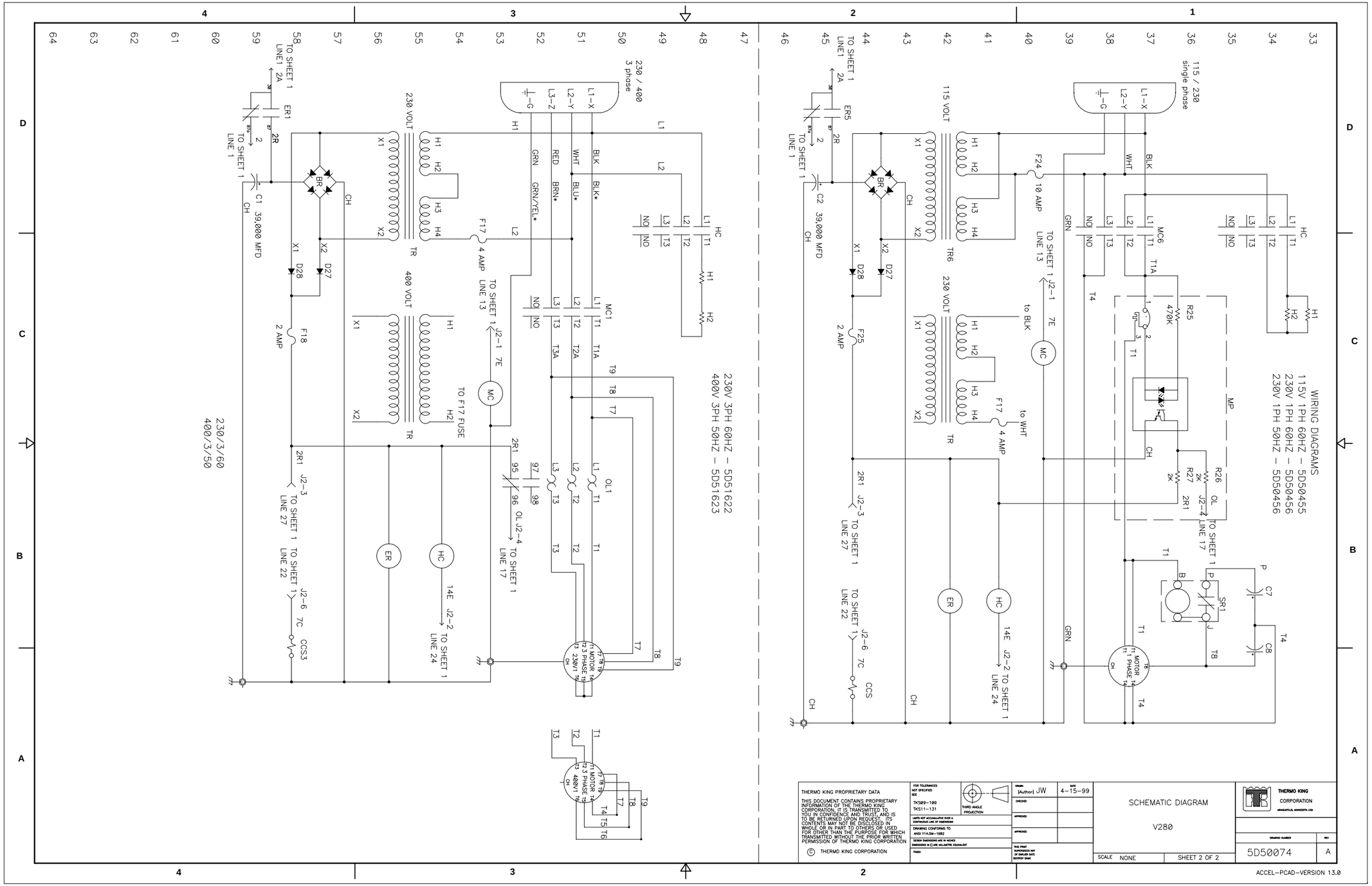
THERMO KING CORPORATION
MINNEAPOLIS, MINNESOTA USA

(5D50432)

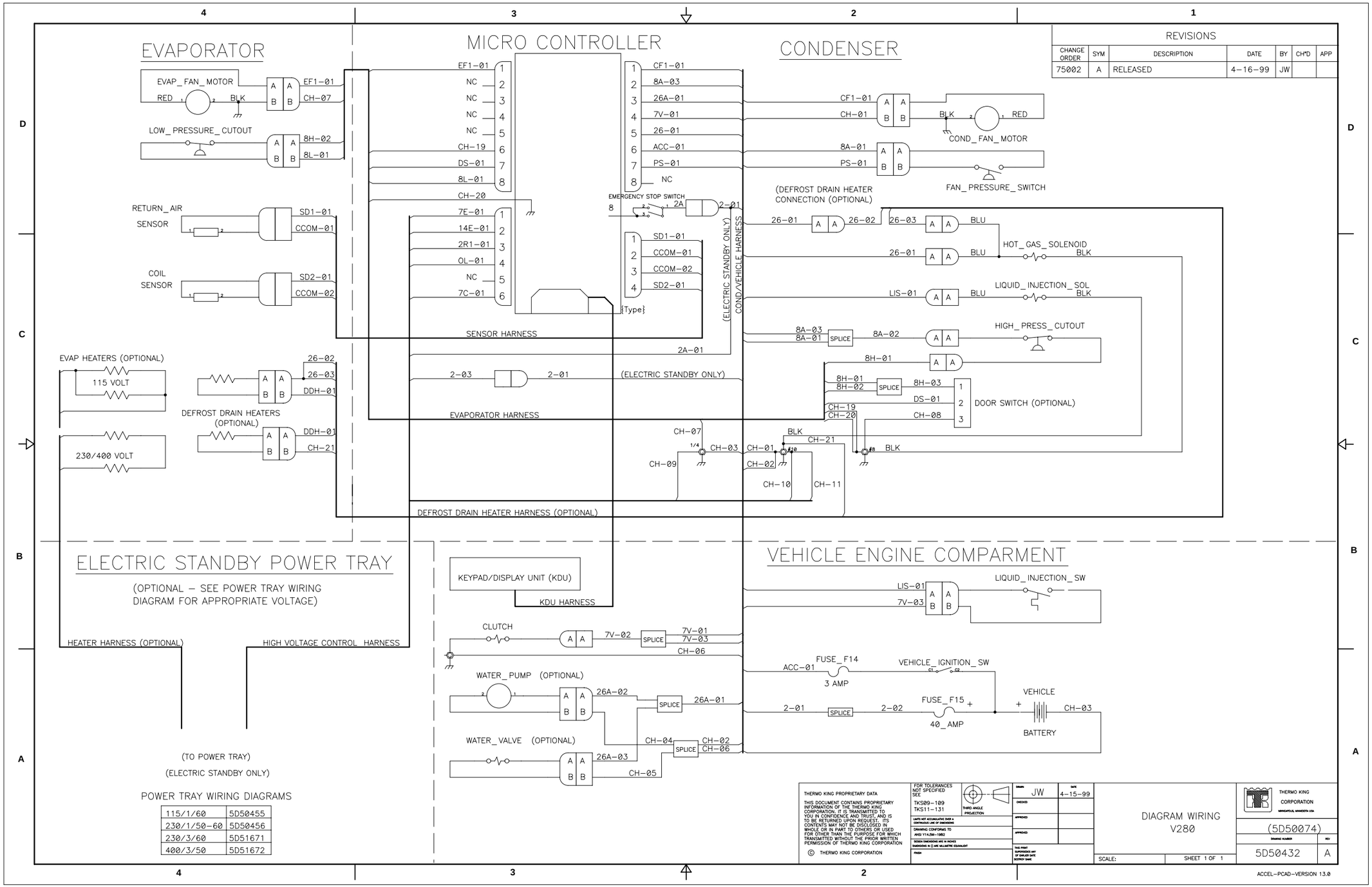
DRAWING NUMBER | REV

5D50074 | A

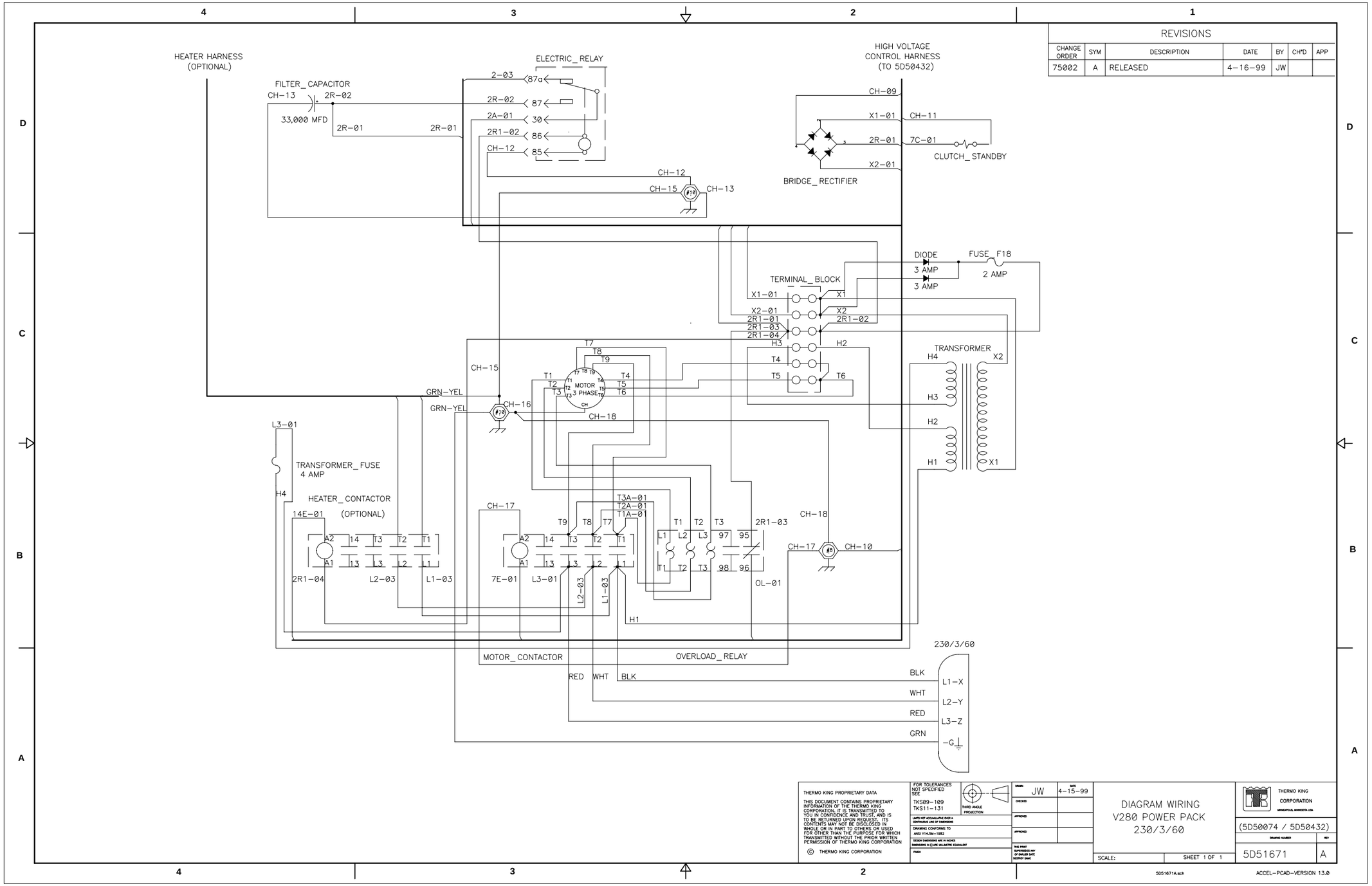
V280 Schematic Diagram—Page 2 of 2



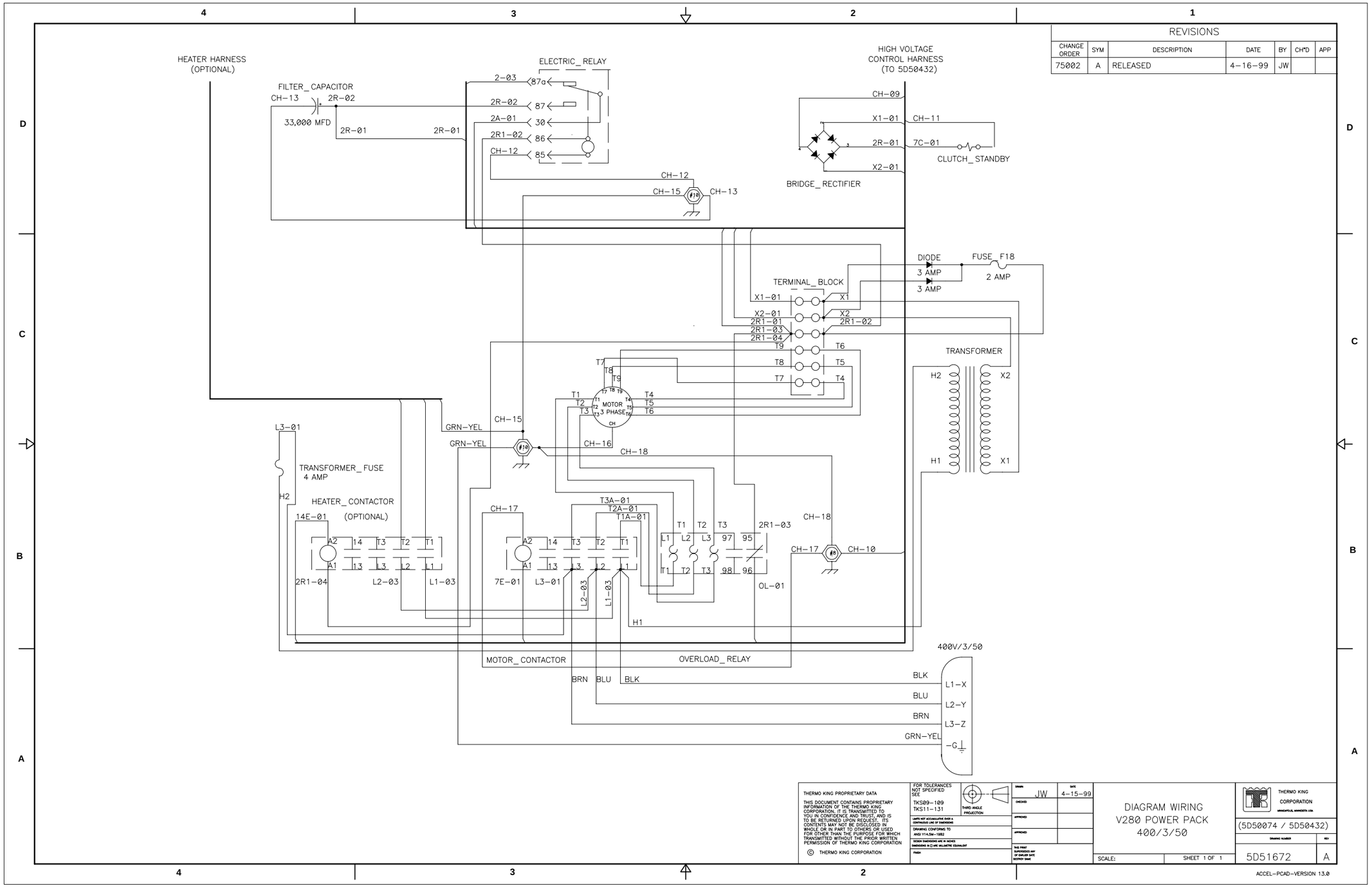
V280 Wiring Diagram



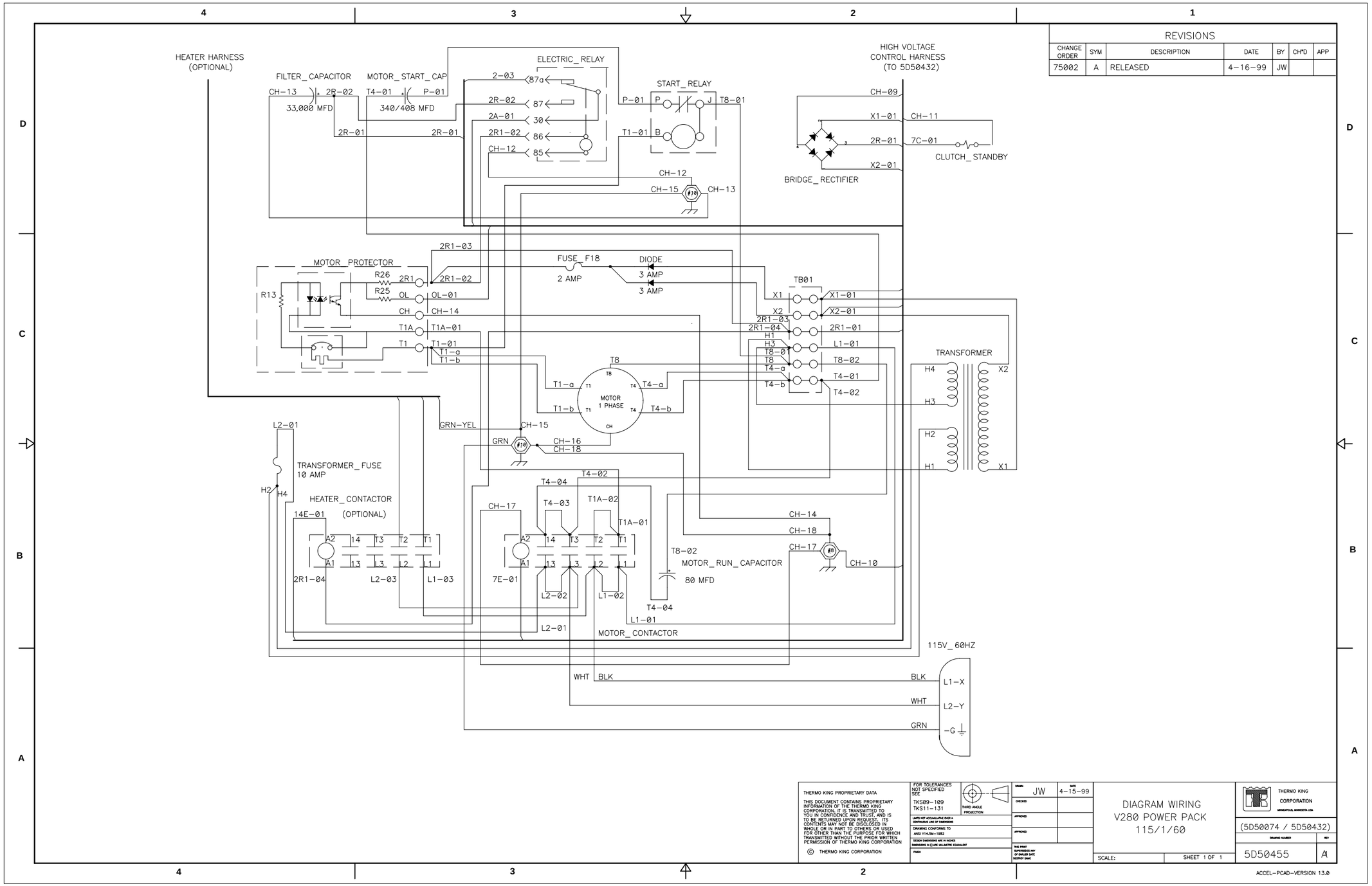
V280 Power Pack 230/3/60 Wiring Diagram



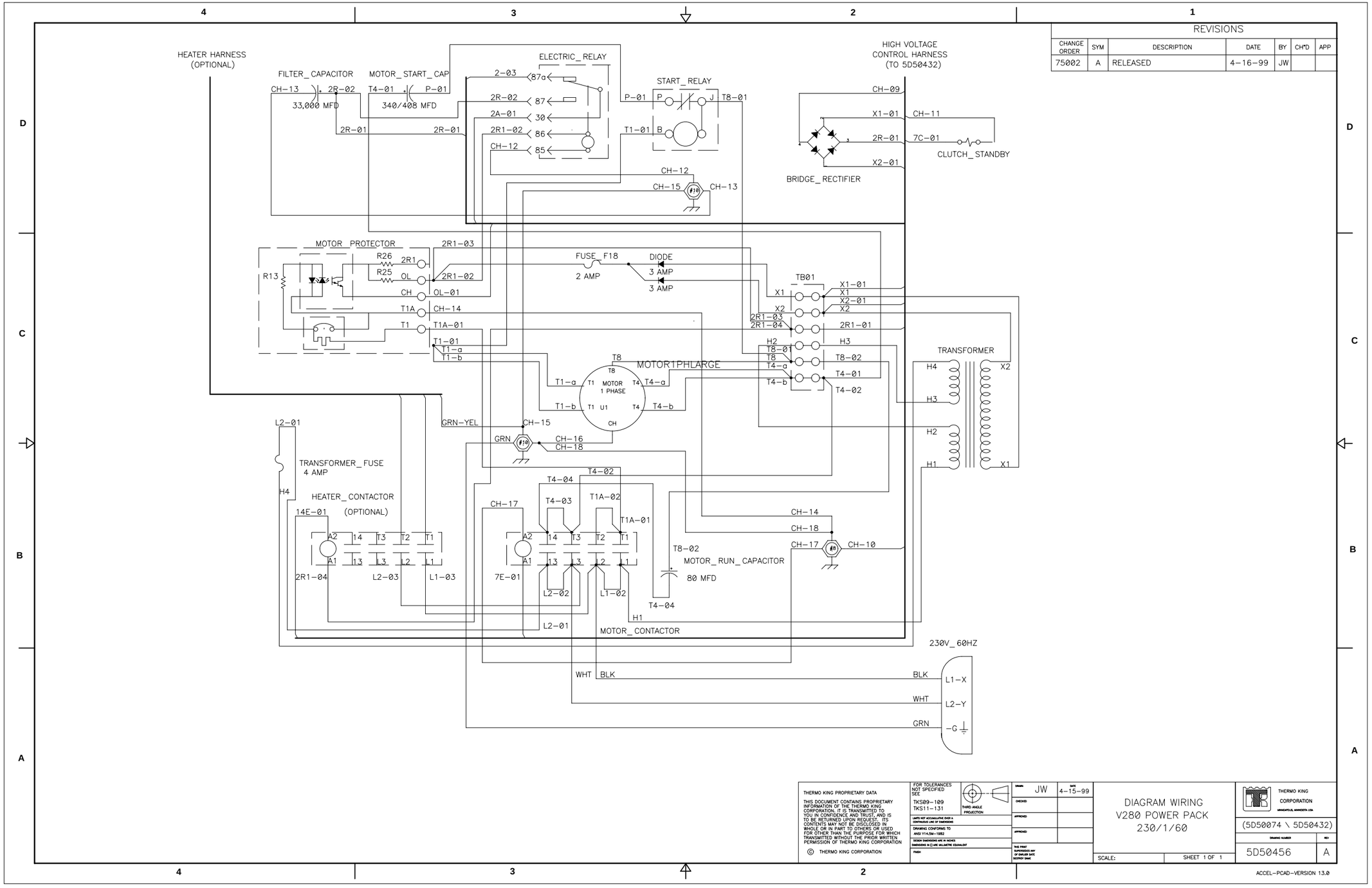
V280 Power Pack 400/3/50 Wiring Diagram



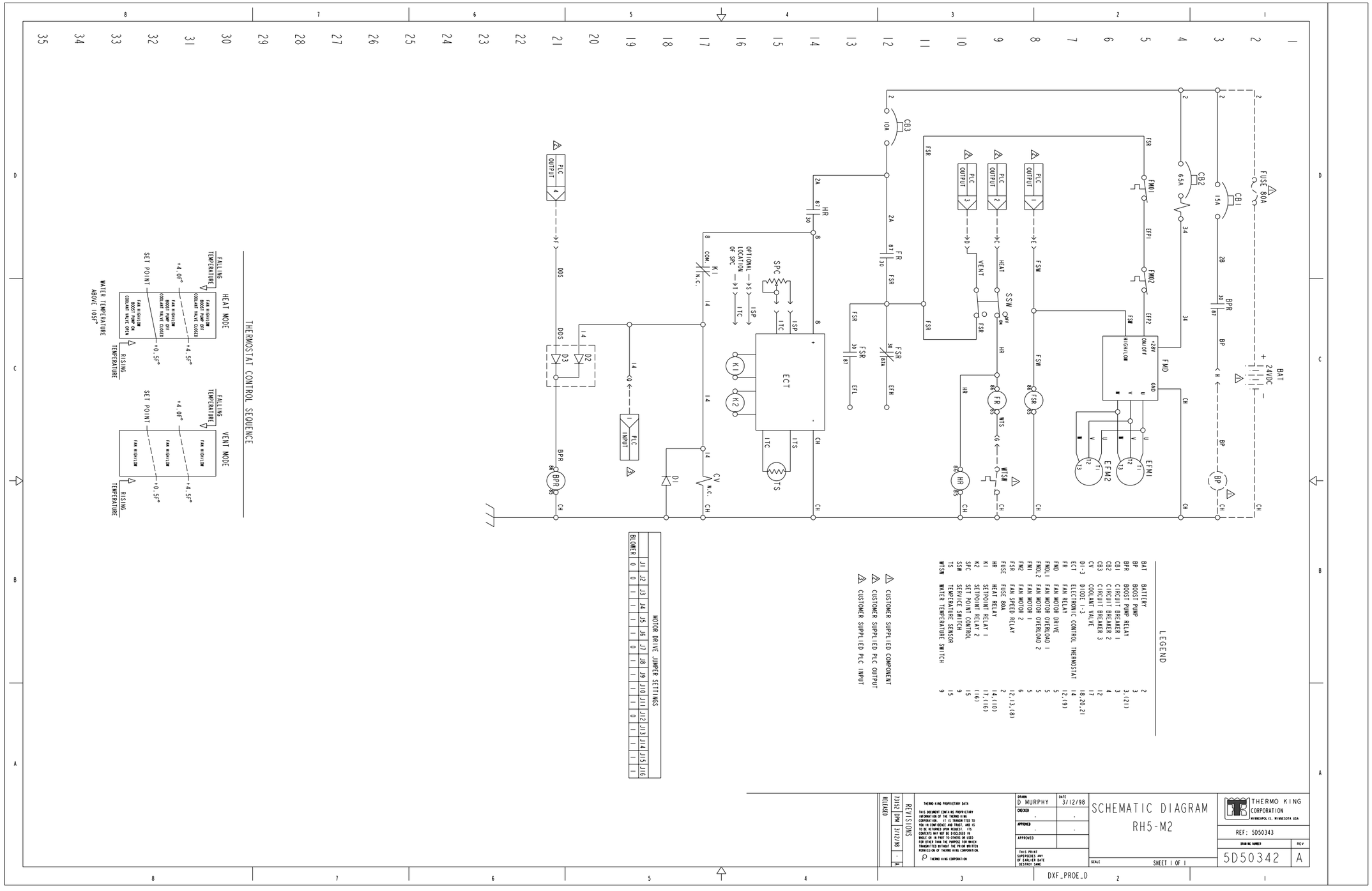
V280 Power Pack 115/1/60 Wiring Diagram



V280 Power Pack 230/1/60 Wiring Diagram

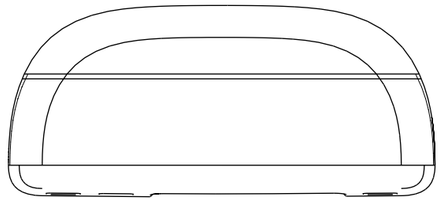


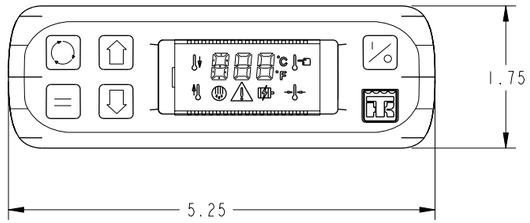
RH5 - M2 Schematic Diagram

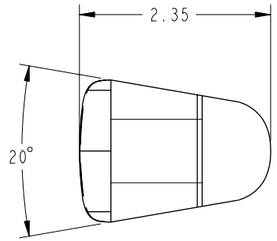


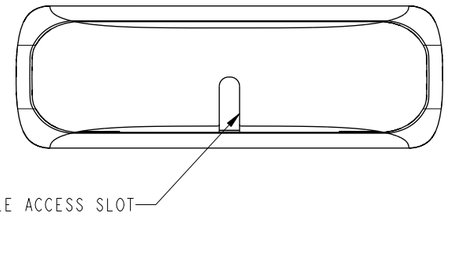
Keypad Display

REVISIONS						
CHANGE ORDER	SYM	DESCRIPTION	DATE	BY	CH'D	APP
75002	A	RELEASED	16-Apr-99	MSR	-	-









NOTE:
1. SERVICE PART NUMBER: 41-2997.
2. WATLOW PART NUMBER: TKVP-0KDU-0000.

G05	G04	G03	G02	G01	ITEM NO	PART/DWG NUMBER	REV.	DESCRIPTION	MATERIAL SPEC	WEIGHT
				1	2	2C26367H01	.	COWL	.	.
				1	1	2C25858G01	.	DISPLAY-KEYPAD KDU	.	.
				A	REV	LIST OF MATERIAL				

FOR TOLERANCES NOT SPECIFIED SEE TKS09-109 TKS11-131

THIRD ANGLE PROJECTION

LIMITS NOT ACCUMULATIVE OVER A CONTINUOUS LINE OF DIMENSIONS

DRAWING CONFORMS TO ANSI Y14.5M-1982

DESIGN DIMENSIONS ARE IN INCHES DIMENSIONS IN [ ] ARE MILLIMETRE EQUIVALENT

FINISH NONE

		DATE
DRAWN	MSR	16-Apr-99
CHECKED	-	-
APPROVED	-	-
APPROVED	-	-

THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.

BOX
DISPLAY KEYPAD
COMPL

SCALE DRAWING SCALE | SHEET 1 OF 1

THERMO KING CORPORATION
MINNEAPOLIS, MINNESOTA USA

DRAWING NUMBER	REV
2C26664	A

PROE_C