THERMO KING

Maintenance Manual

V-520
V-520 MAX

TK 54343-1-MM (Rev 3, 03/15)

Ingersoll Rand

V-520
V-520 MAX

TK 54343-1-MM (Rev 3, 03/15)

The maintenance information in this manual covers unit models:

V-520 10 (900829)	**V-520 MAX 30 (902053)**
V-520 20 (900830)	**V-520 MAX 50 (902054)**
V-520 30 (902041)	**V-520 SPECTRUM 10 (900834)**
V-520 50 (902049)	**V-520 SPECTRUM 20 (900835)**
V-520 MAX 10 (900831)	**V-520 SPECTRUM 50 (902235)**
V-520 MAX 20 (900833)	

For further information, refer to:

V-520 Series Operating Manual	**TK 54342**
V-520 Series Parts Manual	**TK 53990**
V-520 SPECTRUM Parts Manual	**TK 54016**
V-520 Series Installation Manual	**TK 54014**
Direct Smart Reefer Microprocessor Control System Diagnostic Manual	**TK 52573**
Diagnosing Thermo King Refrigeration Systems	**TK 5984**
Evacuation Station Operation and Field Application	**TK 40612**
Tool Catalog	**TK 5955**

The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units. The above manuals may be purchased from your local Thermo King dealer.

Revision History

Rev. 0 – TK 54343-1-MM (Rev. 0, 12/09) Original release.

Rev. 1 – TK 54343-1-MM (Rev. 1, 04/14) Update Compressor Maintenance and overall general updates.

Rev. 2 – TK 54343-1-MM (Rev. 2, 04/14) Correct Fuse 11 on page 24.

Rev. 3 – TK 54343-1-MM (Rev. 3, 03/15) Add compressor ground wire information to page 61.

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-134a/R-404A

WARNING: Use only Polyol Ester-based refrigeration compressor oil in R-134a/R-404A units. See Thermo King Parts Manual for part number.

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.

When servicing Thermo King R-134a or R-404A units, use only those service tools certified for and dedicated to R134a/R-404A refrigerant and Polyol Ester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-134a and R-404A systems.

CHANGES, COMMENTS and SUGGESTIONS

You are invited to comment on this manual so it can be updated and improved to better meet you needs. Any corrections, comments or suggestions are welcome. Please complete the following information:

Manual Form Number _____

Section and Page # _____

Your Name _____

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Corrections, Comments and Suggestions _____

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Return to:

NORTH AMERICA

THERMO KING CORPORATION
314 West 90th Street
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Attn: Service Department

EUROPEAN SERVED AREA

THERMO KING CORPORATION
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Mervue, Galway, Ireland
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About This Manual

Purpose

The purpose of this manual is to provide general maintenance information necessary to maintain the climate control unit at peak operating standards. This includes system and bill of material numbers, safety information, general unit information, maintenance procedures and related information (such as wiring and schematic diagrams), and some diagnostic and troubleshooting information.

This manual may cover more than one unit. Therefore, it may contain information not applicable to your unit.

Contents

This manual is organized into the following chapters:

Chapter	Purpose
Safety Precautions	Provides detailed safety information. You should be familiar with the safety precautions before working on any unit.
Model Systems (Systems Designations) Table	This table lists the bills of material and kit options that apply to the Thermo King units covered in this manual. Use this information to: 1. Determine if you have the right manual for your unit: the bill of material (B/M) number on your unit serial plate should match one of the bill of material numbers listed in this section. If you cannot find your unit in the table, call TK Service for more information. 2. Communicate with TK Service Department: If you need to call TK Service, you must know your model number so that the service representative can help you.
Specifications	Lists unit specifications.
General Description	Gives an overview description of the unit including standard and optional features, general information, and unit photographs or illustrations.
Operating Instructions	Provides unit operating instructions.
Maintenance Inspection Schedule	Table of routine maintenance procedures.
Maintenance Chapters	Provides detailed maintenance procedures required for your unit. (Electrical, Refrigeration, Compressor, Clutch, Structural)
Diagnosis Chapters	Provides troubleshooting information for diagnosing problems.
Diagrams	Includes diagrams such as refrigeration, schematic, and wiring diagrams applicable to units covered in this manual.

Before you Call Thermo King Service!

Who to call: Your Thermo King Service Representative.

Before you call Thermo King Service, have the following information on hand:

- Bill of Material (usually located on the unit serial plate)
- Model Number - found on side of the unit

Blank Pages

This manual may contain blank pages at the end of chapters. This is normal. There is no information missing from the manual.

Roadside/Curbside Terminology

Roadside/Curbside terminology: These terms can be confusing because of differences between North America and Europe. Please note:

Curbside:	The side to the driver’s right when the driver is in his seat and facing forward.
Roadside:	The side to the driver’s left when the driver is in his seat and facing forward.

Table of Contents

Safety Precautions

General Practices

1. *Always wear goggles or safety glasses.* Refrigerant liquid, refrigeration oil, and battery acid can permanently damage the eyes.
2. Never close the compressor discharge service valve with the unit operating.
3. Never operate the unit with the compressor discharge valve closed.
4. 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.
5. 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.
6. Never apply heat to a sealed refrigeration system or container.
7. Fluorocarbon refrigerants in the presence of an open flame produce toxic gases that are severe respiratory irritants capable of causing death.
8. Make sure all mounting bolts are properly torqued and are of correct length for their particular application.
9. 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. Holes drilled into the refrigeration system will release refrigerant.
10. Use caution when working around exposed coil fins. The fins can cause painful lacerations.
11. 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 body or garage). Refrigerant tends to displace air and can cause oxygen depletion resulting in suffocation and possible death.
12. When using ladder or scaffolding, use caution and follow manufacturer recommendations.

Auto Start/Stop

CAUTION: The unit may start automatically and at any time when the unit On/Off switch is in the On position. Units with CYCLE-SENTRY™ start automatically in both CYCLE-SENTRY mode and Continuous mode. Be sure to turn the On/Off switch Off before opening doors or inspecting or working on any part of the unit.

Refrigerant

When removing refrigerant from a unit, a recovery process that prevents or minimizes refrigerant loss to the atmosphere is required by law.

When a refrigerant is exposed to the atmosphere in the liquid state, it evaporates rapidly, freezing anything it contacts. If refrigerant contacts the skin, severe frostbite can result.

First Aid

In the event of frostbite, 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 cardiopulmonary resuscitation (CPR) or mouth-to-mouth ventilation if necessary. Stay with victim until arrival of emergency medical personnel.

Refrigeration Oil

Observe the following precautions when working with or around synthetic or polyol ester refrigerant oil:

- Do not allow refrigerant oil to contact your eyes.
- Do not allow prolonged or repeated contact with skin or clothing.
- To prevent irritation, you should wash thoroughly immediately after handling refrigerant oil. Rubber gloves are recommended when handling polyol ester oil.

First Aid

- *Eyes*: Immediately flush eyes with large amounts of water for at least 15 minutes while holding the eyelids open. Get prompt medical attention.
- *Skin*: Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.
- *Inhalation*: Move victim to fresh air and restore breathing if necessary. Stay with victim until arrival of emergency personnel.
- *Ingestion*: Do not induce vomiting. Contact a local poison control center or physician immediately.

Electrical Hazards

Microprocessor Service

Precautions must be taken to prevent electrostatic discharge when servicing the microprocessor controller and related components. Potential differences considerably lower than those which produce a small spark from a finger to a door knob can severely damage or destroy solid-state integrated circuit components.

The following procedures must be rigidly adhered to when servicing units to avoid microprocessor damage or destruction.

1. Disconnect all power to the unit.
2. Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
3. Do wear a static discharge wrist strap (see Tool Catalog) with the lead end connected to the microprocessor's ground terminal. These straps are available at most electronic equipment distributors. Do not wear these straps with power applied to the unit.
4. Avoid contacting the electronic components on the circuit boards of the unit being serviced.
5. Leave the circuit boards in their static proof packing materials until ready for installation.
6. If a defective controller is to be returned for repair, it should be returned in the same static protective packing materials from which the replacement component was removed.
7. After servicing the controller or any other circuits, the wiring should be checked for possible errors before restoring power.
8. Never use testers consisting of a battery and a light bulb to test circuits on any microprocessor based equipment.
9. Before connecting or disconnecting the battery, the Microprocessor Power On/Off switch must be turned to the Off position. It is located on the roadside of the unit, lower left corner.

Welding of Units or Truck Bodies

When electric welding is to be performed on any portion of the temperature control unit, truck or truck chassis when the temperature control unit is attached, it is necessary to ensure that welding currents are *not* allowed to flow through the electronic circuits of the unit.

These procedures must be rigidly adhered to when servicing units to avoid damage or destruction of the controller.

1. Disconnect all power to the unit.
2. Disconnect all wire harnesses from the controller.
3. Switch all of the electrical circuit breakers in the control box to the Off position.
4. Weld unit or container per normal welding procedures. Keep ground return electrode as close to the area to be welded as practical. This will reduce the likelihood of stray welding currents passing through any electrical or electronic circuits.
5. When the welding operation is completed, the unit power cables, wiring and circuit breakers must be restored to their normal condition.

High Voltage

When servicing or repairing a temperature control unit, the possibility of serious or even fatal injury from electrical shock exists. Extreme care must be used when working with a refrigeration unit that is connected to a source of operating power, even if the unit is not operating. Lethal voltage potentials can exist at the unit power cord, inside the control box, at the motors and within the wiring harnesses.

Precautions

1. Be certain the Unit On/Off switch is turned Off before connecting or disconnecting the standby power plug. Never attempt to stop the unit by disconnecting the power plug.
2. Be certain the unit power plug is clean and dry before connecting it to a power source.
3. When working on high voltage circuits on the temperature control 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.
4. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.
5. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
6. Never work alone on high voltage circuits on the temperature control unit. Another person should always be present to shut off the temperature control unit and to provide aid in the event of an accident.
7. 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 must 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 the power source, check immediately for the presence of a pulse and respiration. If a pulse is not present, start CPR (Cardiopulmonary 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 temperature control unit are low voltage (12 and 24 Vdc). This voltage potential is not considered dangerous, but the large amount of current available (over 30 amps) can cause severe burns if shorted or ground.

Do not wear jewelry, watch or rings when working on the unit. If these items contact an electrical circuit, severe burns may result.

Battery Installation and Cable Routing

WARNING: Improperly installed battery could result in a fire or explosion! A Thermo King approved battery must be installed and properly secured to the battery tray.

WARNING: Improperly installed battery cables could result in fire or explosion! Battery cables must be installed, routed and secured properly to prevent them from rubbing, chaffing or making contact with hot, sharp or rotating components.

WARNING: Do not attach fuel lines or any additional wiring harnesses to the battery cables as this could cause an electrical fire!

CAUTION: Do not connect other manufacturer's equipment or accessories to the Thermo King unit. This could result in severe damage to equipment and void the warranty!

CAUTION: Set all unit electrical controls to the OFF position before connecting battery cables to the battery to prevent unit from starting unexpectedly and causing personal injury.

CAUTION: Always wear protective clothing, gloves and eye wear when handling and installing batteries. Battery acid can cause serious burns when exposed to eyes or skin. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters your eye, immediately flood it with running cold water for at least twenty minutes and get medical attention immediately.

CAUTION: Always cover battery terminals to prevent them from making contact with metal components during battery installation. Battery terminals grounding against metal could cause the battery to explode.

Model Systems (System Designations)

Thermo King Model V-520 Truck Refrigeration Systems

System Designation	System Number	Install Kit	Refrigerant	Schematic, Wiring Diagrams
V-520 10	900829	800319	R-134a	2E54898, 2E54899
V-520 20	900830	800319	R-134a	1PH = 2E54900, 2E54901 3PH = 2E54902, 2E54903
V-520 30	902041	800319	R-134a	2E54898, 2E54899
V-520 50	902049	800319	R-134a	1PH = 2E54900, 2E54901 3PH = 2E54902, 2E54903
V-520 MAX 10	900831	800319	R-404A	2E54898, 2E54899
V-520 MAX 20	900833	800319	R-404A	1PH = 2E54900, 2E54901 3PH = 2E54902, 2E54903
V-520 MAX 30	902053	800319	R-404A	2E54898, 2E54899
V-520 MAX 50	902054	800319	R-404A	1PH = 2E54900, 2E54901 3PH = 2E54902, 2E54903
V-520 SPECTRUM 10	900834	800323	R-404A	1E49423, 1E49424
V-520 SPECTRUM 20	900835	800323	R-404A	1PH = 1E49440, 1E49441 3PH = 1E49443, 1E49442
V-520 SPECTRUM 50	902235	800768	R-404A	1PH = 2E54904, 2E54905 3PH = 2E54906, 2E54907

NOTE: When calling the dealer or factory for information or parts please have the Bill of Material number for your particular unit handy.

Specifications

Electrical System

Fuses	12 Volt	24 Volt
Fuse 1: Power Supply Circuit to PCB1	5 amps	5 amps
Fuse 2: Condenser Fan Motor (CFM1)	15 amps	10 amps
Fuse 3: Evaporator Fan Motor (EF1)	15 amps	10 amps
Fuse 4: Evaporator Fan Motor (EF2)	15 amps	10 amps
Fuse 5: Compressor Clutch 1 (CCL1), Liquid Injection Switch (LIS), Liquid Injection Valve (LIV), Host Hot Gas Defrost Solenoid Valve (PS1), Compressor Motor Contactor (CC), 26A Circuit to Heat Option	20 amps	10 amps
Fuse 6: Condenser Fan 1, 2 (CFM1and CFM2)	2 amps	2 amps
Fuse 7: Condenser Fan Motor (CFM2)	15 amps	10 amps
Fuse 8: Remote Liquid Solenoid Valve (PS2), Host Liquid Solenoid Valve (PS3), Remote Hot Gas Defrost Solenoid Valve (PS4), Suction Bypass Solenoid (PS6)	20 amps	10 amps
Fuse 9: Evaporator Fan Motor (EFM3)	15 amps	10 amps
Fuse 10: Evaporator Fan Motor (EFM4)	15 amps	10 amps
Fuse 11: Defrost Drain Heaters (DH1 and DH2)	2 amps	2 amps
Fuse 20: Transformer Input (L1)	4 amps	4 amps
Fuse 21: Battery Relay (Located in 2 wire near battery)	15 amps	15 amps
Transformer Output Fuses(X1 and X4)	5 amps	5 amps

Condenser Fan Motors		
Voltage	Full Load rpm	Full Load Current
13 Vdc	3000	9.2 Amps
Evaporator Fan Motors		
Voltage	Full Load rpm	Full Load Current
13 Vdc	2700	6.2 Amps
Coils for Hot Gas Defrost, Liquid, Block Off, and Suction Bypass Solenoids		
Voltage	Current	Resistance
12 Vdc	2.3 amps	5.2 ohms
Coil for Liquid Injection Valve Solenoid		
Voltage	Current	Resistance
12 Vdc	0.7 amps	17.0 ohms
Drain Heaters (Each) - MAX Only		
Voltage	Current	Resistance
12 Vdc	0.9 amps	14.0 ohms

Refrigerant System

R-134A REFRIGERATION SYSTEM (V-520)		
Refrigerant Charge:	V-520 - Model 10	7.93 lb (3.60 kg) R-134a
	V-520 - Model 20	7.93 lb (3.60 kg) R-134a
	V-520 - Model 30	8.00 lb (3.63 kg) R-134a
	V-520 - Model 50	8.00 lb (3.63 kg) R-134a
Defrost Termination Switch:	Opens	48.0 ± 5.4 F (8.9 ± 3.0 C)
	Closes	36.0 ± 5.4 F (2.2 ± 3.0 C)
Liquid Injection Switch (LIS):	Opens	200 ± 5 F (93 ± 3 C)
	Closes	230 ± 5 F (110 ± 3 C)
Low Pressure Cutout:	Opens	5 to 11 in. Hg vacuum (-17 to -34 kPa)
	Closes	4 to 7 psig (28 to 48 kPa)
Engine Driven Compressor Pressure Regulator (CPR) Valve Setting - Model 30 and 50 Only		50.0 psig (345 kPa)
Electric Standby Suction Pressure Regulator (SPR) Valve Setting - Model 20 and 50 Only		39.0 psig (269 kPa)
R-404A REFRIGERATION SYSTEM (V-520 Max)		
Refrigerant Charge:	V-520 MAX - Model 10	8.15 lb (3.70 kg) R-404A
	V-520 MAX - Model 20	8.15 lb (3.70 kg) R-404A
	V-520 MAX - Model 30	8.25 lb (3.74 kg) R-404A
	V-520 MAX - Model 50	8.25 lb (3.74 kg) R-404A
	V-520 SPECTRUM - Model 10	9.75 lb (4.42 kg) R-404A
	V-520 SPECTRUM - Model 20	9.75 lb (4.42 kg) R-404A
	V-520 SPECTRUM - Model 50	9.85 lb (4.47 kg) R-404A
Defrost Termination Switch:	Opens	48.0 ± 5.4 F (8.9 ± 3.0 C)
	Closes	36.0 ± 5.4 F (2.2 ± 3.0 C)
Liquid Injection Switch (LIS):	Opens	200 ± 5 F (93 ± 3 C)
	Closes	230 ± 5 F (110 ± 3 C)
Low Pressure Cutout:	Opens	5 to 11 in. Hg vacuum(-17 to -34 kPa)
	Closes	4 to 7 psig (28 to 48 kPa)
Engine Driven Compressor Pressure Regulator (CPR) Valve Setting - Model 30 and 50 Only		50.0 psig (345 kPa)
Electric Standby Suction Pressure Regulator (SPR) Valve Setting - Model 20 and 50 Only		39.0 psig (269 kPa)
Suction Bypass CPR Valve Setting - SPECTRUM Only		See “Suction Bypass CPR Valve Setup Procedure” on page 58.

Compressors

Main Compressor		10 cu. in. (163 cc), Engine Driven, Swash Plate, 6 Cylinder
Electric Standby Compressor - Model 20 and 50 Only		D211Y, Reciprocating, 3 Cylinder,
System Oil Capacity:	Model 10	12 oz (355 cc)
	Model 20	64 oz (1893 cc)
	Model 30	18 oz (532 cc)
	Model 50	70 oz (2070 cc)
	SPECTRUM Model 10	16 oz (473 cc)
	SPECTRUM Model 20	68 oz (2011 cc)
	SPECTRUM Model 50	74 oz (2188 cc)
Compressor Oil Type		Polyol Ester P/N 203-515
Defrost Method:		Hot gas
Defrost Timer:	Initiation Interval	Adjustable, 1 hour to 10 hours
	Termination Interval	Termination is not timed. Defrost is terminated by Klixon switch.

CAUTION: Failure to use correct Thermo King recommended oil will invalidate your warranty.

Belt Tension (Using Tool P/N 204-427)

	Field Reset
Engine Driven Compressor Belt	Check vehicle manufacturer specifications

AC Semi-Hermetic Compressor

Voltage/Phase/Frequency	Horsepower	Kilowatts	RPM	Full Load (Amps)	Locked Rotor Amps
230V/3PH/60Hz	2	1.5	1740	14.1	86.9
230V/1PH/60Hz	2	1.5	1740	16.0	83.2
400V/3PH/60Hz	2	1.5	1740	8.1	29.9
400V/3PH/50Hz	2	1.5	1450	6.8	24.9

Electric Standby Power Requirements

Supply Circuit Breaker	20 amp
Extension Cord Size	25 ft - 10 gauge, up to 75 ft - 8 gauge

Electric Heaters

Voltage	Power Rating Watts	Current	Resistance
208/230	2000	14.7 Amps	16.2 ohms at 230 V

Solder Applications

Refrigeration Component	
For general refrigeration tubing connections: copper to copper or copper to brass	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 15% Silver TK No. 203-364 Use: Flux Type TK No. 203-365
For refrigeration tubing connections of dissimilar metals: copper to stainless steel or brass to stainless steel	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 35% Silver TK No. 203-366 Use: Flux Type TK No. 203-365

Hot Water Component	
For hot water tubing connections: copper to copper or copper to brass	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 95% Tin and 5% antimony TK No. 204-167 Use: Flux Type TK No. 204-417
For hot water tubing connections of dissimilar metals: copper to stainless steel or brass to stainless steel	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 35% Silver TK No. 203-366 Use: Flux Type TK No. 203-365

NOTE: Some units may be equipped with an compressor pressure regulating valve (CPR). To reduce the chance of overheating the CPR valve, 95-5 solder or equivalent may be used.

Use 95-5 TK No. 204-167

Use Flux TK No. 204-417

General Description

Introduction

The Thermo King V-520 and V-520 MAX truck refrigeration systems are two or three piece units. They are designed for medium-sized trucks and vans carrying fresh produce and frozen and deep frozen goods.

The system condenser is mounted on the front of the truck box or container. The system evaporator is mounted on the cargo compartment ceiling. SPECTRUM units have two evaporators. The main compressor is powered by the vehicle engine via a belt. The unit is connected to the compressor by refrigeration hoses. Model 20 and 50 units also have an electric compressor mounted in the condenser.

Control circuits operate on 12 and 24 VDC supplied by the truck batteries for over-the-road operation. The refrigeration system is protected by a high pressure cutout and a low pressure cutout.

The operating mode is selected automatically: When the unit is connected to an electric power source, engine-driven operation is automatically blocked. If the vehicle engine is started up while the power cable is still connected to the electric power source, the unit will continue to operate in electric standby mode. It is not possible to start the engine-driven compressor until the power cable is disconnected from the unit.

There are four basic models:

- Model 10: Cool and defrost on truck engine driven compressor operation.
- Model 20: Cool and defrost on both truck engine driven compressor operation and electric standby compressor operation.
- Model 30: Cool, heat, and defrost on truck engine driven compressor operation.
- Model 50: Cool, heat, and defrost on both vehicle engine driven compressor operation and electric standby compressor operation.

AMA1003

Figure 1: V-520 Condenser Unit

Standard Features

- In-Cab Controls with Digital LCD Thermometer
- Hot Gas Defrost
- Defrost Termination Switch
- Oil Separator
- Liquid Injection
- Main Compressor, 6-Cylinder Swash Plate

Optional Features

- Electric Compressor, Model 20 and 50 Units
- Evaporator Drain Heaters (MAX Units Only)
- Electric/Hot Water Heat (Model 20 before fourth quarter of 2011 and Model 20 SPECTRUM only)
- Hot Water Heat (Model 10 before fourth quarter of 2011 and Model 10 SPECTRUM only)
- Hot Gas Heat (Model 30 and 50 Units Only)

Condenser

The condenser has a unique design that allows it to be mounted horizontally on the roof, or on the front of the truck box.

Evaporator

An evaporator is mounted on the ceiling inside the truck box.

Compressor

Refrigeration hoses or lines are used to connect the condenser, the evaporator, the main compressor and any other refrigeration components.

Model 20 and 50 units have an electric compressor mounted in the condenser section for electric standby operation. The electric standby compressor is connected in parallel with the engine-driven compressor.

Both compressors use the same refrigeration system circuit. Check valves isolate one compressor from the other during operation.

Compressor operation is controlled by the electronic control system, which energizes the compressor clutch during engine operation or starts the electric compressor on electric standby operation. The refrigeration system is protected by a high pressure transducer and a low pressure cutout switch.

When plugged into standby power, engine operation is automatically locked out. If the truck engine is turned on while the power cord is still plugged into a power receptacle, the unit will remain working in electric mode; the engine driven compressor cannot be started until the power cord is unplugged from the unit because the selection of engine operation or standby operation is automatic.

Control Circuits

The control circuits operate on 12V or 24V supplied by the truck batteries for engine operation. On standby operation, the power is rectified from an AC transformer.

Electronic Control System

The Electronic Control System is composed of an Electronic Control Module (located inside the condenser unit) and the In-Cab Control Box. This In-Cab Control Box allows the truck driver to operate the Thermo King refrigeration unit.

Refer to the Direct Smart Reefer Microprocessor Control System Diagnostic Manual TK 52573 for complete service information about the Electronic Control System and the related components.

Figure 2: In-Cab Control Box

The Electronic Control System has the following characteristics:

- Auto Start
- Soft Start
- Active Display
- Lit Keypad
- Total Hourmeter
- Vehicle Compressor Hourmeter
- Electric Standby Compressor Hourmeter
- Low Battery Voltage Alarm
- Buzzer
- Unit Control without In-Cab Control Box
- Manual or Automatic Defrost
- Maintenance Warning
- Return Air Temperature Sensor
- Setpoint Temperature Reading
- Electric Power Warning

Auto Start: Should the unit stop due to a failure in the power supply, whether during on-the-road or electric standby operation, it will start up again as soon as the power supply is re-established.

Soft Start: All operation modes remain inactive for 15 seconds after an Auto Start.

Active Display: The In-Cab Control Box display is always active and backlit except when the unit is disconnected (no power) or when the unit is connected but has been manually switched off from the In-Cab Control Box (when there is no active alarm).

Lit Keypad: The In-Cab Control Box keys are always lit except when the unit is disconnected (no power) or when the unit is connected but has been manually switched off from the In-Cab Control Box (when there is no active alarm). The On/Off key is always lit except when the unit is disconnected (no power), and thus indicates the presence of power in the unit.

Total Hourmeter: Total number of hours the unit is in operation.

Vehicle Compressor Hourmeter: Number of hours the unit has been operating on-the-road.

Electric Standby Compressor Hourmeter: Number of hours the unit has been operating in electric standby.

Low Battery Voltage Alarm: Disconnects the unit when the battery voltage falls below 10.5V in 12VDC systems or below 21V in 24VDC systems.

Buzzer: It is energized when the vehicle battery and the electric power supply are connected at the same time. It is also energized if the doors are opened while the refrigeration unit is running.

Unit Control without In-Cab Control Box: The unit can also be operated by the Electronic Control System without the In-Cab Control Box, under conditions selected by the In-Cab Control Box before it is disconnected.

Manual or Automatic Defrost: It is possible to choose between manual or automatic defrost.

Maintenance Warning: On-screen warning of the need to carry out maintenance on the unit.

Return Air Temperature Sensor: On-screen reading of the temperature in the load compartment. In multi-temperature units, the temperature in both compartments can be read on the same screen.

Setpoint Temperature Reading: On-Screen Setpoint Temperature Reading. In multi-temperature units, the setpoint temperature of both compartments can be read on the same screen.

Electric Power Warning: On-screen warning that the unit is connected to an electric power supply.

Oil Separator

An oil separator is a standard feature. The oil separator 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.

Refrigerant

- V-520 10, V-520 20, V-520 30, and V-520 50 units use R-134a refrigerant.
- V-520 MAX 10, V-520 MAX 20, V-520 RT MAX 30, V-520 RT MAX 50, V-520 SPECTRUM 10, V-520 SPECTRUM 20, and V-520 SPECTRUM 50 units use R-404A refrigerant.

Liquid Injection System

These units have a liquid injection system to limit discharge temperature of the engine driven compressor. If the discharge gas leaving the 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 drier inlet to the metering orifice. The metering orifice is attached to the suction line fitting on the engine driven compressor on earlier units, or to the suction tube assembly in the condenser in later units. 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 closes and refrigerant no longer flows through the liquid injection system.

Evaporator Drain Tube Heaters

Evaporator heaters are used in R-404A units to avoid drain tube blockage because of ice accumulation inside the evaporator. Two harnesses are located inside the drain tube. These resistive wires melt the ice while the unit is in Defrost mode.

Electric Standby Operation

When the unit is connected to an electric power source, the battery disconnect relay and the standby relay are energized and provide rectified power from the transformer to the electronic control system.

During electric standby operation, the electronic control system controls the operation of the unit by energizing and de-energizing the compressor contactor.

The electronic control system places the unit in cool, heat or defrost by energizing the compressor contactor.

The electronic control system places the unit in null by de-energizing all the compressor contactor.

Protection Features

- High Pressure Transducer - The high pressure transducer is a pressure sensitive device. It is located in the discharge line near the oil separator or the discharge check valve.

  If the discharge pressure rises above a certain pressure, the ECM opens the circuit to the compressor clutch to stop the unit.

  For units with R-134a, the ECM opens the compressor clutch circuit at 300 psig (2068 kPa) and shuts down the unit. The ECM closes when the pressure drops to 200 psig (1379 kPa).

  For units with R-404A, the ECM opens the compressor clutch circuit at 450 psig (3103 kPa) and shuts down the unit. The ECM closes the compressor clutch circuit when the pressure drops to 375 psig (2586 kPa).

- Low Pressure Cutout Switch - The Low Pressure Cutout Switch is a pressure sensitive switch located in the suction line. If the pressure falls below 5 to 11 in. Hg vacuum (-17 to -34 kPa), the switch opens the LPCO/CH circuit. This signals the ECM to open the circuit to the compressor clutch to stop unit operation.

Control Box

P.C. Board

All Printed Circuit Boards manufactured by Thermo King can be easily identified by the Part Number stamped on them.

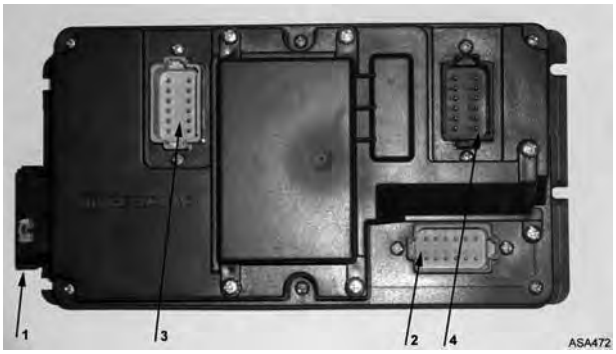
Connectors

All connector codes (C-1, C-2, etc.) are stamped on the P.C. Board. Pins on the connectors are numbered counter-clockwise.

Electronic Control Module (ECM)

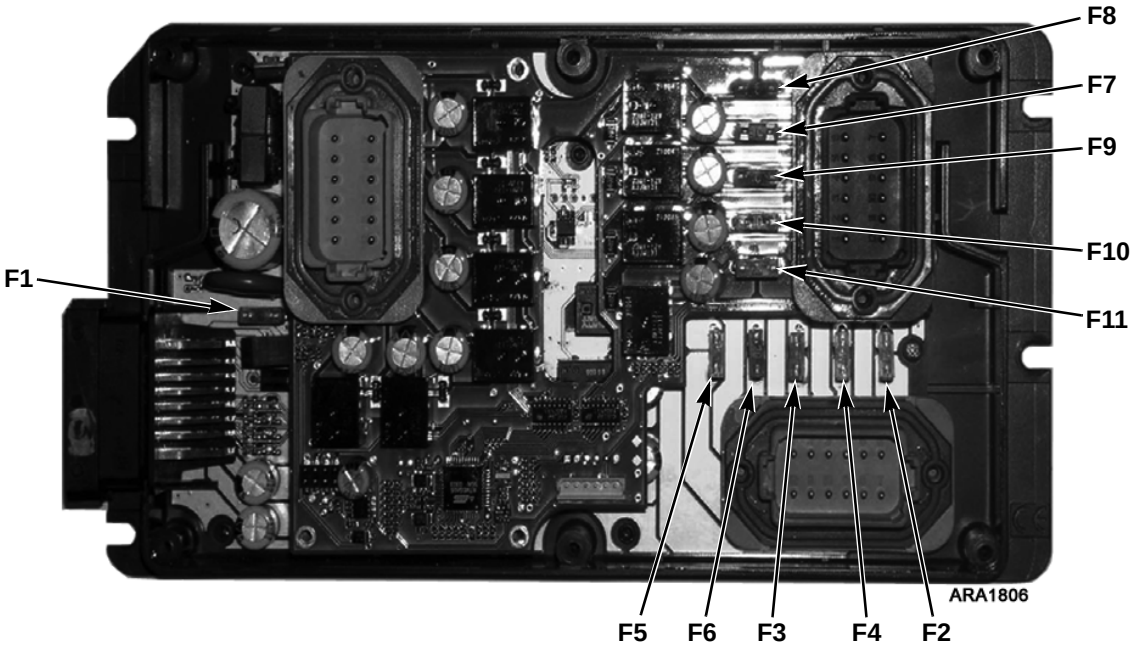
The ECM contains the system’s secondary microprocessors, I/O connectors, output relays, fuses, LEDs, cooling fan, and discrete electronic components mounted on two printed circuit boards PCB2 is mounted on top of PCB1. This configuration is known as Platform 2.

The microprocessors receives output signals from the load compartment return air sensor and electronic thermostat. These signals are sent to the microprocessor in the In-Cab Control Box. Based on setpoint temperature and other parameters, the In-Cab Control Box microprocessor determines when to adjust the temperature-control state in the load compartment to Cool, Heat, or Null mode, or to initiate a Defrost cycle.



1.	Connector 1 PCB1	3.	Connector 1 PCB2
2.	Connector 2 PCB1	4.	Connector 2 PCB2

Figure 3: ECM Platform 2 with Covers Installed



F1.	Fuse 1 (5 amps) Power Supply Circuit to PCB1	F6.	Fuse 6 (10 amps) Condenser Fan Motor (CFM1 and CFM2)
F2.	Fuse 2 (15 amps) Condenser Fan Motor (CFM1)	F7.	Fuse 7 (15 amps) Condenser Fan Motor (CFM2)
F3.	Fuse 3 (15 amps_ Evaporator Fan Motor (EFM1)	F8.	Fuse 8 (20 amps) Remote Liquid Solenoid Valve (PS2), Host Liquid Solenoid Valve (PS3), Remote Hot Gas Defrost Solenoid Valve (PS4), Suction Bypass Solenoid (PS6)
F4.	Fuse 4 (15 amps) Evaporator Fan Motor (EFM2)	F9.	Fuse 9 (15 amps) Evaporator Fan Motor (EFM3)
F5.	Fuse 5 (20 amps) Compressor Clutch 1 (CCL1), Liquid Injection Switch (LIS), Liquid Injection Valve (LIV), Host Hot Gas Defrost Solenoid (PS1), Hot Gas Heat Relay (HG), Compressor Motor Contactor (CC), 26A Circuit to Heat Option	F10.	Fuse 10 (15 amps) Evaporator Fan Motor (EFM4)
		F11.	Fuse 11 (2 amps) Defrost Drain Heaters (DH1 and DH2)

Figure 4: ECM Platform 2 with Covers Removed Showing Fuses on PCB1 and PCB2

Unit Operation

Standard Model 10 and 20 units (without heat options) operate in Cool mode or Null mode, as required, to maintain the load compartment temperature at the setpoint temperature.

Model 30 and 50 units and 10 and 20 units with heat options operate in Cool, Null or Heat, as required, to maintain the load compartment temperature at the setpoint temperature.

Defrost cycles occur manually or automatically, as required.

If power is shut off, the unit comes back in Null mode when the unit is restarted. There is a momentary delay at auto start-up for circuit protection.

NOTE: The compressor will "bump start" five times while coming out of Null when the unit is restarted after being turned off. This does not happen if the unit went into Null because it reached setpoint. In a "bump start" the compressor is turned on for about one second and then goes off for about four seconds.

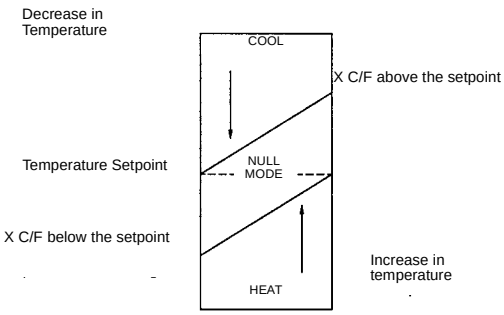


Figure 5: Thermostat Algorithm

For units with Electric Standby, there are protective delays for the electric compressor/compressor motor contactor.

Options

- The Heat options provide heating by hot water or hot gas. Some Model 20 units also have electric heaters.
- The Electric Standby options provide a second electric compressor for standby applications.
- The TC options provide temperature control for two-compartment systems.

Operation

The vehicle engine must be running and the unit must be turned on. On units with Electric Standby, connect the external power cord and the unit switches to Electric mode operation. Unit operation can be tailored, as required, using programmable settings that are shown later is this section.

Cool Mode

Standard Model 10 and 20 Units

When cooling is required (when there is a requirement to lower the evaporator return air temperature in the load compartment), the controller energizes the compressor clutch (or compressor contactor in model 20 units) and evaporator fans. The controller monitors the discharge pressure through the high pressure transducer (THPCO). The condenser fans are energized if necessary and turn on and off as determined by the controller.

The unit operates in Cool mode until the setpoint temperature is reached. The unit then enters Null mode. When the temperature rises to a pre-determined number of degrees, the unit restarts in Cool mode.

V-520 units only have a triple-cooling capacity (TCC) feature. The controller monitors the discharge pressure through the high pressure transducer (THPCO) and controls the speed of condenser fans CF1 and CF2 by opening and closing relays RY6, RY9, RY10 in the following manner:

- When the discharge pressure is less than 180 psig (1241 kPa), RY6, RY9, and RY10 are open. CF1 and CF2 receive no voltage and are in Null state.
- When the discharge pressure is between 180 psig (1241 kPa) and 300 psig (2068 kPa), RY9 closes. CF1 and CF2 become connected in series, receive low voltage, and operate at low speed

- When the discharge pressure is greater than 300 psig (2068 kPa), RY6 and RY10 close and RY9 opens. CF1 and CF2 become connected in parallel, receive high voltage, and operate at high speed.

Model 30 and 50 Units

The following components are added to the refrigeration system for Model 30 and 50 units: condenser blocking solenoid, accumulator tank, CPR (compressor pressure regulator) valve, and liquid line check valve. Cool in Model 30 and 50 units is basically the same as Cool in Model 10 and 20 units because the condenser blocking solenoid is open and the defrost solenoid is closed. See Figure 6 on page 27.

Null Mode - All Units

The unit operates in Null mode when the setpoint temperature is reached and cooling (or heating) is not required. All outputs are de-energized. If the temperature rises a pre-determined number of degrees, the unit restarts in Cool mode. If the temperature falls a pre-determined number of degrees, and a heat option is present, the unit restarts in Heat mode.

In addition, the evaporator fans (parameter EFc) operate during Null mode.

Heat Mode - Model 10 and 20 Units Only

If the Heat option is present, the unit enters Heat mode when the temperature falls a pre-determined number of degrees below the setpoint temperature. When heat is required, the outputs of the microprocessor energize the evaporator fans. (For units with Electric Standby, the Compressor Motor Contactor are energized when the standby input is high).

The unit operates in Heat mode until the setpoint temperature is reached. The unit then enters Null mode.

- If the temperature falls a pre-determined number of degrees, the unit restarts in Heat mode.
- If the temperature rises a pre-determined number of degrees, the unit restarts in Cool mode.

Purge Mode - Model 30 and 50 Units Only

When the temperature falls a pre-determined number of degrees below the setpoint temperature, the controller prepares the unit for the Heat mode by placing the unit in the Null mode for 10 seconds, and then placing the unit in the Purge mode for 45 seconds before shifting to the Heat mode. In the Purge mode the compressor clutch is energized but the evaporator fans are not. This moves the refrigerant from the condenser to the low side to increase the heating capacity. See Figure 6 below.

NOTE: The unit will not go into the Purge mode when coming out of the Null mode because it reached setpoint. The unit will only go into the Purge mode when first going into the Heat mode because the unit is powering up or when going directly from the Cool mode to the Heat mode.

NOTE: The following diagram shows a Model 30 unit. Purge mode in a Model 50 unit is similar.

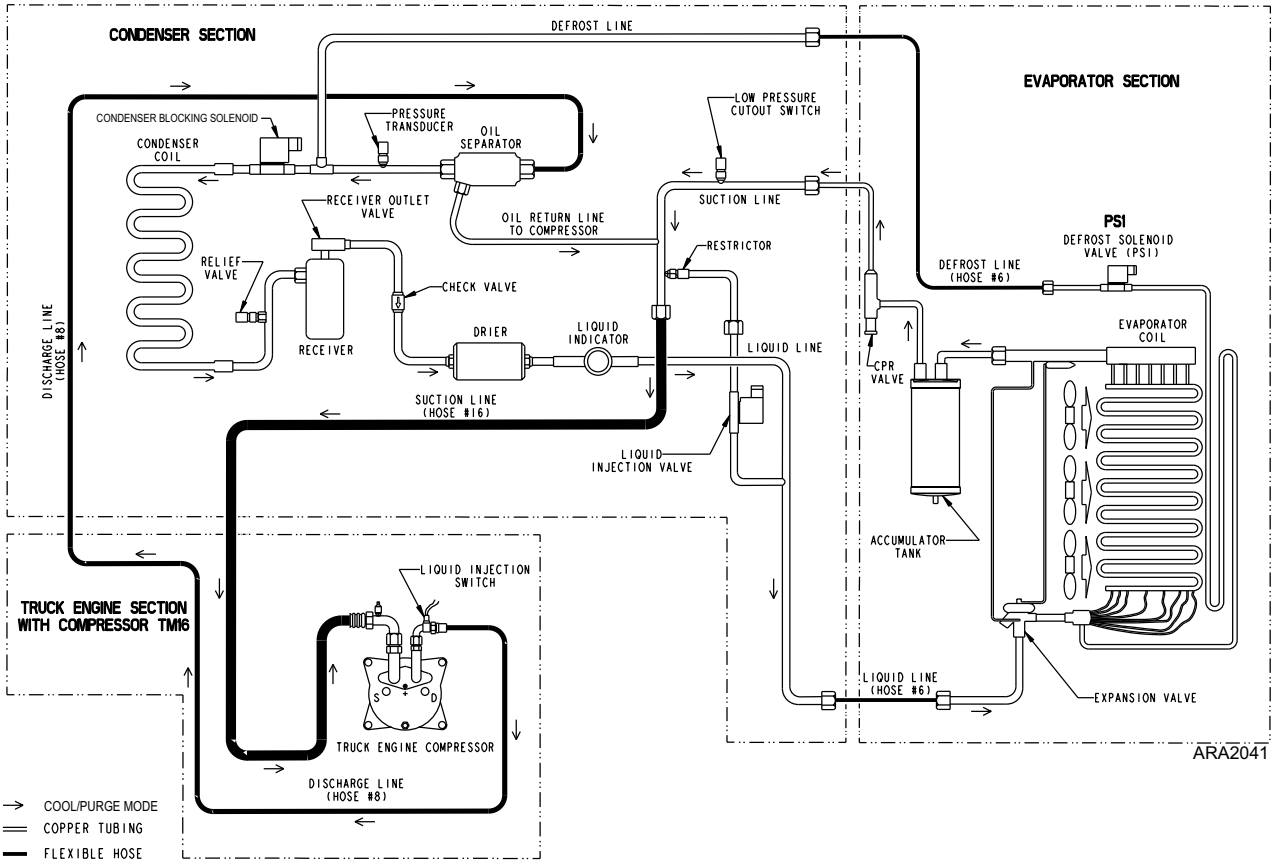


Figure 6: Model 30 Refrigerant Flow in Cool and Purge Modes

Heat Mode - Model 30 and 50 Units Only

The unit enters Heat mode when the temperature falls a pre-determined number of degrees below the setpoint temperature. Before going into the Heat mode, the controller places the unit the Null mode for 10 seconds and then the Purge mode for 45 seconds before shifting to the Heat mode.

NOTE: The unit only uses the Purge mode before the Heat mode the first time the unit goes into Heat. After that the Purge mode is not used before the Heat mode unless the unit is powering up or when going directly from the Cool mode to the Heat mode.

To shift to the Heat mode the controller energizes the compressor clutch, evaporator fans, defrost solenoid, condenser blocking solenoid, and hot gas heat relay, which energizes the liquid injection valve.

The refrigerant flow in Heat mode is similar to a conventional hot gas heat cycle in a T-Series truck unit. The condenser blocking solenoid is closed and the defrost solenoid is open so high pressure refrigerant vapor leaves the compressor and flows through the defrost line, defrost solenoid, and drain pan heater to the evaporator. There, the refrigerant heats the evaporator and returns to the compressor through the accumulator, CPR, and suction lines. The liquid injection valve is open so refrigerant in the condenser will flow through the liquid injection valve into the suction line when the pressure in the condenser is higher than the pressure in the suction line.

The unit operates in Heat mode until the setpoint temperature is reached. The unit then enters Null mode.

- If the temperature falls a pre-determined number of degrees, the unit will go into Purge mode for 45 seconds and then go into Heat mode.
- If the temperature rises a pre-determined number of degrees, the unit will go into Cool mode.

NOTE: The following diagram shows a Model 30 unit. Heat mode in a Model 50 unit is similar.

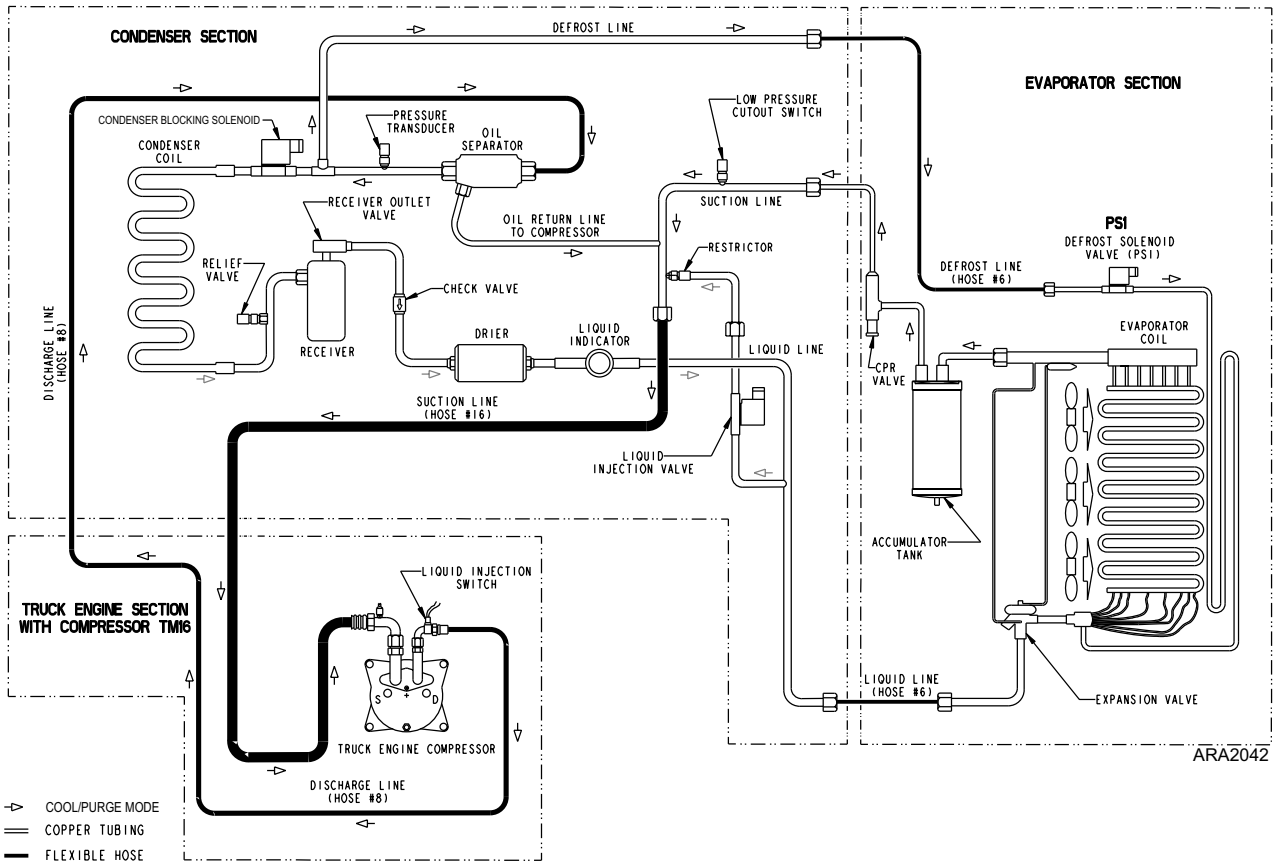


Figure 7: Model 30 Refrigerant Flow in Heat and Defrost Modes

Defrost Mode

Defrost can be initiated any time the evaporator coil temperature is below 36 F (2.2 C), causing the defrost termination switch to close. Defrost is initiated automatically by the defrost timer, or manually using the In-Cab Control Box.

Defrost will continue until the evaporator coil temperature rises 48 F (8.9 C), causing the defrost termination switch to open ending the defrost cycle. Defrost cycle can be also terminated by pressing the On/Off Key to turn the unit off, and then pressing it again to turn the unit back on.

Model 10 and 20 Units

When defrost is required, the controller energizes the defrost solenoid so most of the high pressure refrigerant vapor leaves the compressor and flows through the defrost line, defrost solenoid, and drain pan heater to the evaporator. There, the refrigerant heats the evaporator and returns to the compressor through the suction lines. Some of the refrigerant flows through the condenser and liquid lines to force any liquid refrigerant out through the drier and expansion valve to the evaporator. From which it returns to the compressor through the suction lines.

Model 30 and 50 Units

Defrost in Model 30 and 50 units is basically the same as Heat except the evaporator fans are not energized. See “Heat Mode - Model 30 and 50 Units Only” and Figure 7 on page 28.

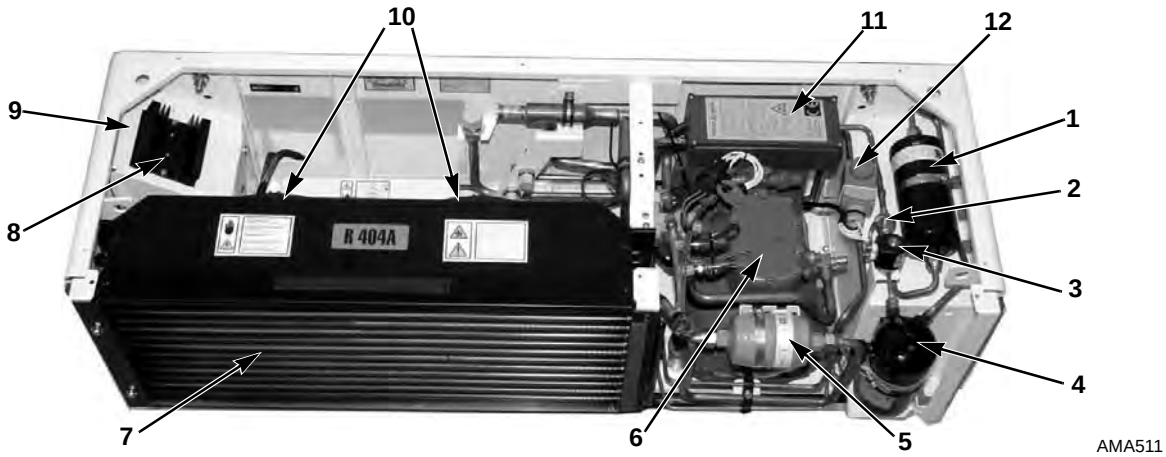
Serial Number Locations

Condenser: Nameplate located on the back inside wall of condenser frame.

Engine Driven Compressor: Nameplate located on compressor body. The engine driven compressor is located in the truck engine compartment.

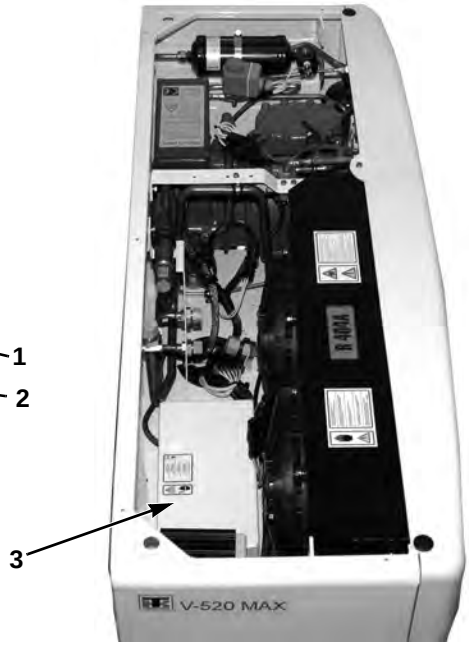
Standby Compressor: Nameplate located on compressor body. The standby compressor is located inside the condenser assembly.

Unit Components



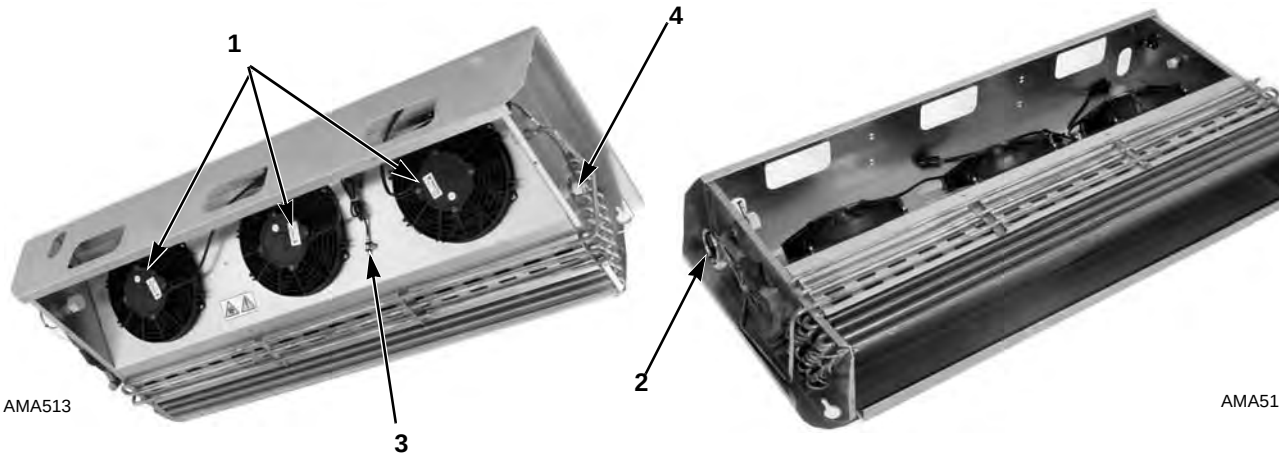
1.	Filter-Drier	5.	Oil Separator	9.	Transformer Cover
2.	Liquid Sight Glass	6.	Electric Standby Compressor	10.	Condenser Fans
3.	Liquid Injection Valve	7.	Condenser Coil	11.	AC Compressor Electric Box
4.	Receiver Tank	8.	Rectifier Heat Sink	12.	Defrost Valve

Figure 8: Unit Components (Model 20)



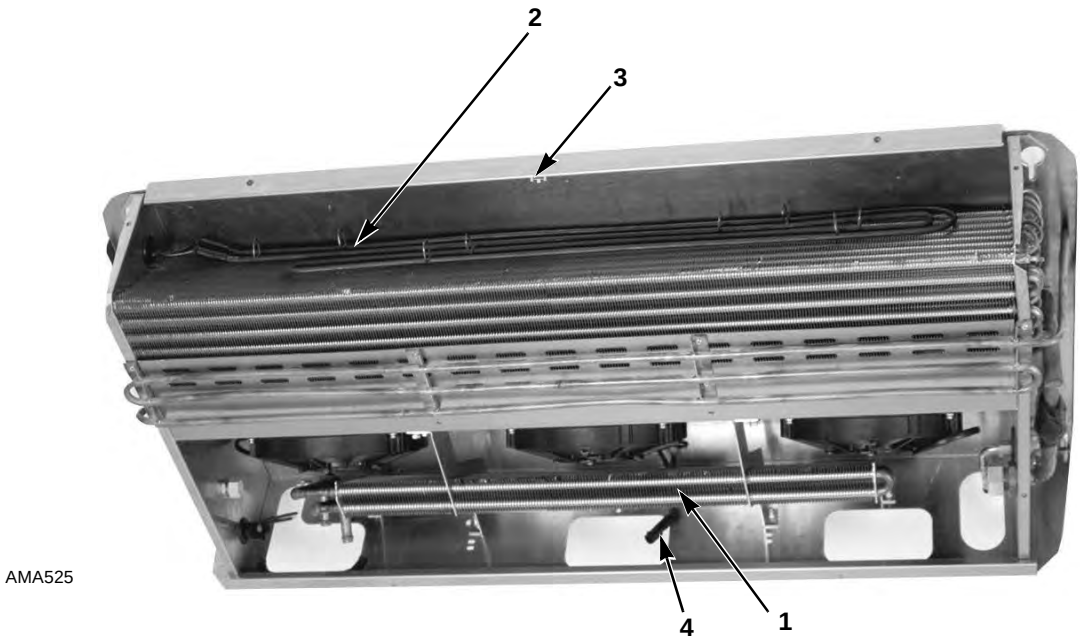
1.	Electronic Control Module (single temp shown)	3.	Capacitor Box
2.	Motor Contactor		

Figure 9: Condenser Electric and Capacitor Boxes (Model 20 and 50)



1.	Evaporator Fans	3.	Temperature Sensor
2.	Expansion Valve	4.	Defrost Switch

Figure 10: Evaporator



1.	Hot Water Heat Defrost Coil	3.	High Temperature Limit Switch
2.	Electric Heat Element	4.	Air Temperature Sensor

Figure 11: Evaporator with Hot Water and Electric Heat Options

In truck-driven units, temperature control is based on two values: The setting (Setpoint) of the electronic thermostat and the evaporator return temperature. The difference between these two temperatures will determine the mode of operation: cool, heat, or null.

Cool: When the temperature in the load compartment is higher than the setpoint, the unit runs in cool mode to reduce the evaporator return temperature.

Heat (If So Equipped): When the temperature in the load compartment is lower than the setpoint, the unit changes to heat mode to raise the evaporator return temperature.

Null: Once the Setpoint Temperature has been reached, and while the temperature remains between X F/C above or below the setpoint, there is no demand for transfer of heat or cold, and the unit runs in null mode.

Defrost: After a scheduled period of time in cool mode, between 1 and 8 hours, the unit runs in this fourth mode of operation to eliminate ice that has accumulated in the evaporator coil. Defrost can be initiated automatically or manually.

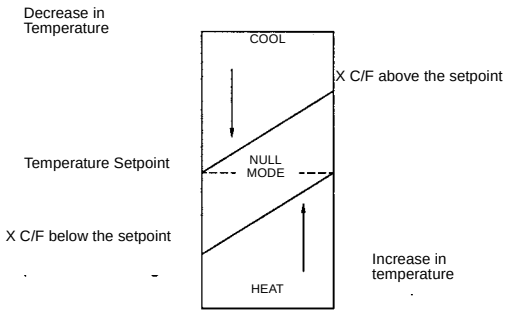


Figure 12: Thermostat Algorithm

Factory setting for X is 5 F (3 C). During unit installation, this value can be adjusted by between 2 and 9 F (1 and 5 C) in increments of 1 F/C.

Units with R-134a refrigerant: Temperatures can be controlled from -8 F to +71 F (-22 C to +22 C).

Units with R-404A refrigerant: Temperatures can be controlled from -26 F to +71 F (-32 C to +22 C).

Unit Controls

WARNING: Never operate the unit unless you completely understand the controls; otherwise serious injury may occur.

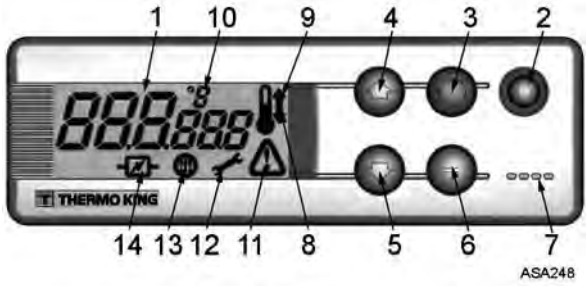


Figure 13: In-Cab Control Box Display, Keys and Symbols

1. Display	It is always active and backlit except when the unit is disconnected (no power) or when the unit is connected but has been manually switched off from the In-Cab Control Box. It normally displays the return air temperature.
2. On/Off Key	This key is used to start/stop the unit. It is always lit except when the unit is disconnected (no power), and thus acts as an indicator of the presence of power in the unit.
3. Select Key	Selects prompt screens and information screens.
4. Up Key	Is used to increase the setpoint temperature.
5. Down Key	Is used to reduce the setpoint temperature.
6. Enter Key	Is used to enter a new command such as manual defrost, etc.
7. Buzzer	It is energized when the vehicle battery and the electric power supply are connected simultaneously. It is also energized if the doors are opened while the refrigeration unit is running.
8. Cool Symbol	(Thermometer with an arrow pointing downward). The unit is cooling.
9. Heat Symbol	(Thermometer with an arrow pointing upward). The unit is heating.
10. C/ F Symbol	Indicates whether the on-screen temperature reading is in degrees Celsius (C) or degrees Fahrenheit (F).
11. Alarm Symbol	Indicates that there is an alarm in the system.

12. Maintenance Symbol	Warns of the need to carry out maintenance to the unit.
13. Defrost Symbol	Indicates the unit is in Defrost Mode.
14. Electrical Symbol	Indicates that the unit is in Electric Standby.

Starting the Unit

Engine Operation

1. Start the truck engine.
2. Press the On/Off Key located in the In-Cab Control Box. The In-Cab Control Box display will be activated.
3. Check the setpoint, and adjust if necessary.

Electric Standby Operation

1. Connect the external power supply to the electric power receptacle. Ensure that the power supply is of the correct voltage and phase for the unit.
2. Press the On/Off Key located in the In-Cab Control Box. The In-Cab Control Box display will be activated. The electric symbol will appear on the screen.
3. Check the setpoint, and adjust if necessary.

NOTE: The operating mode, whether engine-driven or electric standby, is selected automatically. When the unit is connected to an electric power source, engine-driven operation is automatically blocked. If the truck engine is started up while the power cable is still connected to the electric power source, the unit will continue to operate in electric standby mode.

Standard Display

This is the display that appears when the On/Off key is pressed and the unit started. It normally displays the return air temperature (of both load compartments in multi-temperature units) and the current operating mode with the appropriate symbol.

Should there be an alarm, the alarm symbol will also appear on screen.

Single-Temperature Units

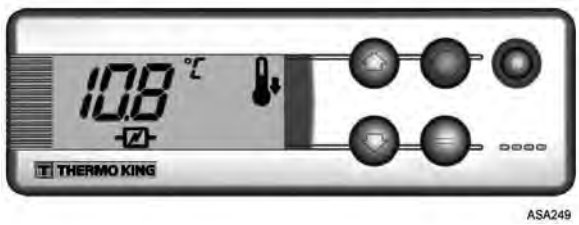


Figure 14: Single-Temperature Units

The example in the drawing shows: 10.8 C temperature, cool mode and standby operation.

Multi-Temperature Units

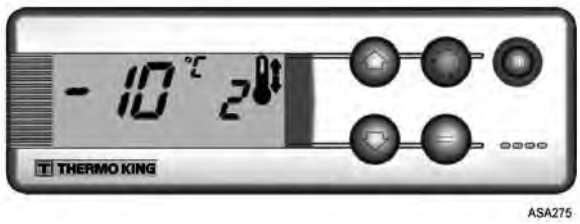


Figure 15: Multi-Temperature Unit

The example in the drawing shows: -10 C temperature and cool mode in the main compartment, and 2 C temperature and heat mode in the remote compartment. Unit running in on-the-road mode.

Entering the Setpoint Temperature

The Setpoint Temperature can be quickly and easily changed.

In Single-Temperature Units

Figure 16: Single-Temperature Units

1. Press and release the Select key twice, and the current Setpoint Temperature and the letters SP will appear on screen.

2. Press the Up or Down arrow keys to select the desired Setpoint Temperature. Each time either of these buttons is pressed and released, the Setpoint Temperature will change 1 degree.
3. Press and release the Select key, and the Standard Display will reappear on screen.

IMPORTANT: If the SELECT key is not pressed within 20 seconds to select the new Setpoint Temperature, the unit will continue to run at the original Setpoint Temperature.

In Multi-Temperature Units

1. **Main (Host) Compartment:** Press and release the Select key twice, and the current Setpoint Temperature in the main compartment and the letters SP will appear on screen.

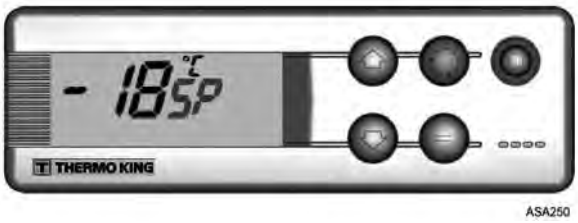


Figure 17: Main Compartment Setpoint

2. Press the Up or Down arrow keys to select the desired Setpoint Temperature. Each time either of these buttons is pressed and released, the Setpoint Temperature will change 1 degree.
3. Press and release the Select key to change to the Remote Compartment Setpoint Temperature Setting Screen.

IMPORTANT: If the SELECT key is not pressed within 20 seconds to select the new Setpoint Temperature, the unit will continue to run at the original Setpoint Temperature.

4. **Remote Compartment:** The present Setpoint Temperature in the remote compartment and the letters SP2 will appear on screen.

Figure 18: Remote Compartment Setpoint

5. Press the Up or Down arrow keys to select the desired Setpoint Temperature. Each time either of these buttons is pressed and released, the Setpoint Temperature will change 1 degree.
6. Press and release the Select key, and the Standard Display will reappear on screen.

IMPORTANT: If the SELECT key is not pressed within 20 seconds to select the new Setpoint Temperature, the unit will continue to run at the original Setpoint Temperature.

Initiating the Manual Defrost Cycle

CAUTION: Before initiating a manual defrost, ensure that the unit is not already in a defrost cycle. When the unit is in a defrost cycle the defrost symbol appears on screen.

1. Press and release the SELECT key once, and the letters dEF will appear (flashing) on screen along with the present defrost condition OFF.

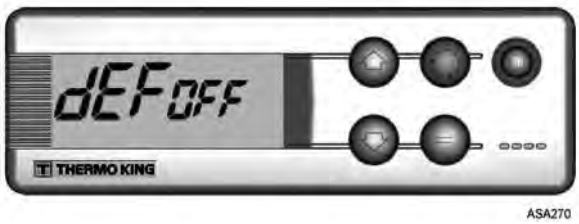


Figure 19: Defrost Condition Off

2. To activate manual defrost, press the Enter key and then the Up or Down key and the defrost condition will change to On.

Figure 20: Defrost Condition On

3. Press the Select key twice to return to the Standard Display (three times in multi-temperature units), where the Defrost symbol will appear when the defrost cycle begins (**the defrost termination switch must be closed**).

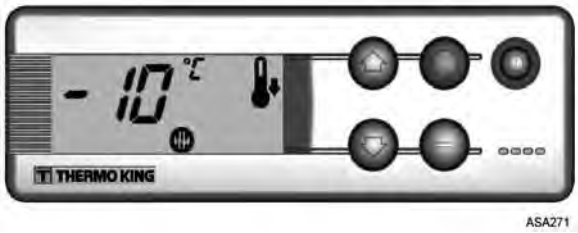


Figure 21: Defrost Symbol in Display

Alarms

When the unit is not operating properly, the microprocessor records the alarm code, alerts the operator by displaying the Alarm symbol and, depending on the type of alarm, shuts the unit down.

There are three alarm categories:

Manual Start

The alarm stops the unit, and only the ALARM symbol appears on screen.

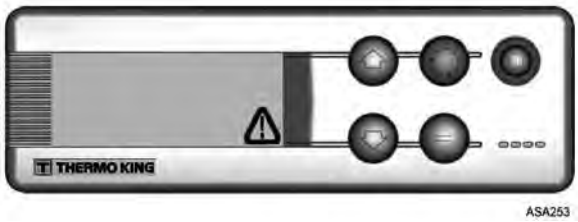


Figure 22: Manual Start

Once the alarm condition has been rectified, the On/Off key must be pressed to start up again.

Press and release the Select key to display the current alarm code on screen. If there is more than one active alarm, all the alarm codes on the unit can be viewed in sequence by pressing and releasing the Select key.

Auto Start

The alarm stops the unit, the Alarm symbol appears on screen and the unit starts up automatically once the alarm condition has been rectified.

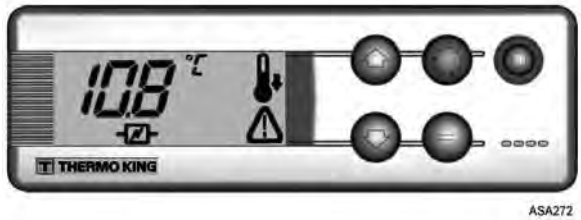


Figure 23: Auto Start

Should a **P1E** alarm occur (return air temperature read error alarm code), --- will appear on screen together with the alarm symbol, instead of the return air temperature reading.

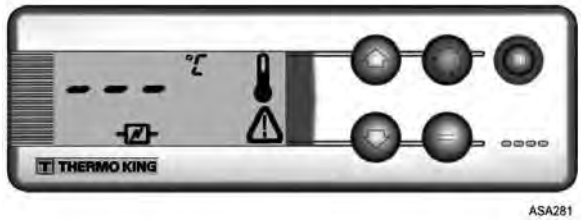


Figure 24: P1E Alarm

In multi-temperature units, should a **P2E** (return air temperature read error in the remote compartment alarm code), --- will also appear on screen together with the alarm symbol, instead of the remote compartment return air temperature reading.

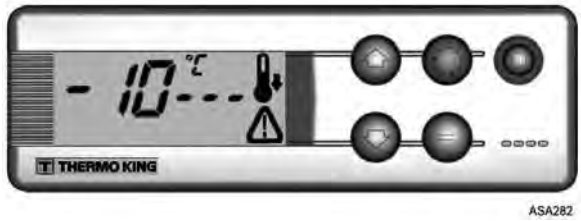


Figure 25: P2E Alarm

Press and release the Select key to display the current alarm code on screen. If there is more than one active alarm, all the alarm codes on the unit can be viewed in sequence by pressing and releasing the Select key.

Buzzers

They are energized when the vehicle battery and the electrical supply are connected simultaneously (the unit continues running in standby mode). They are also energized if the doors open, if this option is selected.

Alarm Code Descriptions

Alarm	Description
Manual Start	
OL	Electric Motor Overload. Unit protection system during electric standby operation. *If the problem persists when the unit is restarted, contact your Service Dealer.*
bAt	Low Battery Voltage. Unit and battery protection system.
Auto Start	
HP	High Pressure Alarm. Indicates that the refrigeration system will shut down in the event of excessively high pressure in the refrigerant circuit. *If the problem persists when the unit is restarted, contact your Service Dealer.*
LP	Low Pressure Alarm. Indicates that the refrigeration system will shut down in the event of excessively low pressure in the refrigerant circuit. *If the problem persists when the unit is restarted, contact your Service Dealer.*
PSE	High Pressure Sensor Failure. The high pressure sensor has become faulty or disconnected. *Contact your Service Dealer.*
tEP	Electric Motor Thermal Protection Alarm. *If the problem persists when the unit is restarted, contact your Service Dealer*
dr1, dr2	Doors Open. *This option must be activated.*
tCO (Hot)	Control Module Overheating. *If the problem persists when the unit is restarted, contact your Service Dealer.*
SOF	Software failure. *Contact your Service Dealer.*
P1E	Main or Single Cargo Box Return Air Temperature Reading Error (open circuit or short-circuit). *Contact your Service Dealer.*
P2E	Remote Cargo Box Return Air Temperature Reading Error (open circuit or short-circuit). *Contact your Service Dealer.*
C	Communications Failure. *Contact your Service Dealer.*

Clearing Alarm Codes

The alarm condition in the unit must first be corrected. After clearing the alarm condition, press and release the Select key to remove existing Alarm codes. The standard display will appear once the Alarm codes have been cleared.

Viewing Information Screens

Main Menu

From the **Standard Display** use the Select key to display:

1. Alarms (if any active)
2. Manual Defrost
3. Temperature Setpoint

Hourmeter Menu

From the Standard Display press the **Select** key for 3 seconds to open the **Hourmeter** Menu, then use the SELECT key to display:

1. **HC**: Hours remaining to maintenance notice.
2. **tH**: The total amount of time the unit has been switched on protecting the load.
3. **CC**: Engine-driven compressor operating hours.
4. **EC**: Electric standby compressor operating hours.
5. Return to Main Menu.

After Start Inspection

Thermostat: Adjust the thermostat setting to above and below the compartment temperature to check thermostat operation (see Operating Modes).

Pre-cooling: With the thermostat set at the desired temperature, run the unit for half-an-hour to one hour (or longer if possible) before loading the truck. Pre-cooling eliminates residual heat and acts as a good test of the refrigeration system.

Defrost: When the unit has finished pre-cooling the truck interior - the evaporator temperature should have dropped below 36 F (2.2 C) - initiate a defrost cycle with the In-Cab Control Box. The defrost cycle should stop automatically.

Loading Procedure

1. To minimize frost accumulation in the evaporator coil and a heat increase inside the load compartment, ensure that the unit is OFF before opening the doors. (The unit may continue to run when the truck is being loaded in a warehouse with the doors closed.)
2. Carefully check and record the load temperature when loading the truck. Note whether any products are out of temperature range.
3. Load the product in such a way that there is sufficient space for the air to circulate throughout the load. DO NOT block the evaporator inlet or outlet.
4. Product should be pre-cooled before loading. Thermo King units are designed to maintain the load at the temperature at which it is loaded. Transport refrigeration units are not designed to reduce the load temperature.

Procedure after loading

1. Ensure that all doors are closed and locked.
2. Adjust the thermostat to the desired temperature setpoint.
3. Start the unit.
4. Half an hour after loading the truck, initiate a defrost cycle with the In-Cab Control Box. If the coil temperature is below 36 F (2.2 C), the unit will defrost. The defrost cycle should stop automatically.

Weekly Pretrip Inspection

The following Weekly Pretrip Inspection should be completed before loading the truck. While the weekly inspection in not a substitute for regularly scheduled maintenance inspections, it is 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 belt tension.
3. MOUNTING BOLTS. Inspect bolts are properly tightened.
4. ELECTRICAL. Electrical connections should be securely fastened. Wires and terminals should be free of corrosion, cracks or moisture.
5. DEFROST DRAINS. Check the defrost drain hose and fittings to be sure that they are open so condensate can run out during defrosting. Check the bottom end of drain hose to be sure that is not plugged or crushed.
6. STRUCTURAL. Visually check for physical damage.
7. REFRIGERANT CHARGE. Check for proper refrigerant charge level.

Weekly Post Trip Checks

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

Maintenance Inspection Schedule

NOTE: Thermo King reserves the right to deny warranty coverage on claims due to lack of maintenance or neglect. Claims in question must be supported by maintenance records.

NOTE: See the appropriate chapter in this maintenance manual for instructions on how to correctly perform required maintenance.

Electrical

Weekly	Monthly	Semi-Annual	Annually	Check condition of or service the following:
		•	•	Check defrost initiation and termination.
		•	•	Check thermostat cycle sequence.
		•	•	Check operation of protection shutdown circuits.
			•	Check thermostat and thermometer calibration in 32 F (0 C) ice-water bath.
			•	Inspect wire harness for damaged wires or connections.

Refrigeration/Heating

Weekly	Monthly	Semi-Annual	Annually	Check condition of or service the following:
		•	•	Check refrigerant level.
			•	Replace dehydrator.
			•	Check compressor pressure regulator and suction pressure regulator settings if applicable.

Structural

Weekly	Monthly	Semi-Annual	Annually	Check condition of or service the following:
•	•	•	•	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
	•	•	•	Clean entire unit including evaporator coil and condenser coil.
		•	•	Check all unit mounting bolts, brackets, lines, hoses, etc.

Electrical Maintenance

Maintenance Inspection Schedule

Procedures	Weekly	Monthly	Semi-Annual	Annually
Check defrost initiation and termination.			•	•
Check thermostat cycle sequence.			•	•
Check operation of protection shutdown circuits.			•	•
Check thermostat and thermometer calibration in 32 F (0 C) ice-water bath.				•
Inspect wire harness for damaged wires or connections.				•
Inspect/replace DC fan motors.				•

WARNING: Take precautions to ensure the unit will not accidentally start while you are servicing the system.

Electronic Control System

Refer to the Direct Smart Reefer Microprocessor Control System Diagnostic Manual TK 52573 for complete service information about the Electronic Control System and the related components.

Defrost System

Defrost is initiated automatically by the programmable defrost timer, or manually by means of the In-Cab Control Box. If demand defrost is enabled, a demand defrost cycle occurs, based on the Defrost Initiation Timer (DIT) and the Defrost Termination Switch (DTS1 or DTS2) being closed. The evaporator coil temperature must be below 36 F (2.2 C) to allow defrost.

When defrost is required, the microprocessor output energizes the defrost solenoid to supply hot refrigerant to the evaporator coil. The Defrost Initiation Timer (DIT) has counted-down its required time-setting, and the Defrost Termination Switch (DTS1 or DTS2) is closed.

The unit remains in Defrost mode until the Defrost Termination Switch setpoint is reached (that is, when the evaporator coil temperature rises to 48.0 F (8.9 C), or until the Defrost Termination Timer (DTT) count is completed). If the evaporator coil temperature does not rise above 48.0 F (8.9 C) within the defrost duration time limit, the microprocessor terminates the defrost operation.

The startup of the evaporator fans is delayed for several seconds after Defrost mode ends to prevent water from the melting ice from being sprayed on the load.

On multi temp units defrost is performed on all evaporators at the same time.

Defrost initiation and termination settings are accessed through the Guarded Access Menu. Refer to the Direct Smart Reefer Microprocessor Control System Diagnostic Manual TK 52573 for instructions on the use of Guarded Access Menu features.

The Defrost Initiation Timer offers programming choices of 30 to 480 minutes, increments of 30 minutes. The factory setting is 240 minutes. This parameter allows maintenance personnel to set the Defrost Initiation Timer. When it times-out, it switches the unit from Cool mode to Defrost mode. The timer counts all the time that the unit is in Cool mode. The count resets when Defrost mode starts. If the timer is set at 0 (zero), this is a test position. Defrost mode starts in 15 seconds.

The Defrost Termination Timer offers programming choices of 5 to 50 minutes, in increments of 5 minutes. The factory setting is 45 minutes. This parameter allows maintenance personnel to set the Defrost Termination Timer, which begins counting from the initiation of a Defrost mode. When the timer times-out, the unit is switched from Defrost mode to Null mode. The timer resets at the end of a Defrost mode, or after

the Defrost Termination Timer has timed-out. If the timer is set at 0 (zero), this is a test position. Defrost mode stops in 15 seconds.

Liquid Injection System

This liquid injection switch is a temperature sensitive switch located on the discharge fitting of the truck engine compressor. When the discharge temperature rises above 230 ± 5 F (110 ± 3 C), the switch closes to open the liquid injection solenoid valve. When the discharge temperature falls below 200 ± 5 F (93 ± 3 C), the switch opens to close the liquid injection solenoid valve.

Testing Liquid Injection Solenoid Valve and Metering Orifice

1. Disconnect the 2-pin connector with the LIS and CLU wires in main wire harness from wires to the liquid injection switch at the compressor.
2. Install the gauge manifold set on the engine-driven compressor.
3. Set thermostat on the lowest setting.
4. Start and run the unit in Cool on the engine-driven compressor until the suction pressure stabilizes.
5. Place a jumper between LIS and CLU wires in the 2-pin connector on the main wire harness that was disconnected in step 1. This simulates that the discharge temperature is higher than 230 F (110C).
6. With the jumper wire in place the suction pressure should rise.
7. Remove the jumper. The suction pressure should return to the stabilized pressure in step 4.
8. If the suction pressure does not change, check the CLU wire for voltage, the LIS wire for continuity, the liquid injection solenoid valve, and the metering orifice. On Model 30 and 50 units also check the hot gas heat relay and the LIV wire for continuity.
9. Shut off the unit and the truck, remove the gauge manifold set, and reconnect the LIS and CLU wires to the liquid injection switch.

Condenser Fan Motors

NOTE: Non-repairable fan motor assemblies are used. If a motor malfunctions, it must be replaced.

CAUTION: Take precautions to ensure the unit will not accidently start while servicing the system.

The condenser fan motors are maintenance free. If erratic or intermittent operation is observed, the current draw of the motor should be measured while proper voltage is applied. The current draw for a condenser motor is approximately 9.2 amps at 13 volts.

If one or both of the condenser fan motors do not run at all, check fuses F2, F6, and F7 and the output to the condenser fans when they should be energized.

Condenser Fan Motor Removal and Installation

Removal

1. Turn the unit off.
2. Remove the fan motor mounting bolts (4).
3. Remove the fan motor and disconnect the motor power plug.

Installation

1. Connect the fan motor power plug.
2. Place the fan motor in the condenser. Install and tighten the fan motor mounting bolts (4).
3. Start the unit and verify correct fan motor operation.

Evaporator Fan Motors

NOTE: Non-repairable fan motor assemblies are used. If a motor malfunctions, it must be replaced.

CAUTION: Take precautions to ensure the unit will not accidently start while servicing the system.

The evaporator fan motors are maintenance free. If erratic or intermittent operation is observed, the current draw of the motor should be measured while proper voltage is applied. The current draw for a evaporator motor is approximately 6.1 to 6.2 amps at 13 volts.

If any of the evaporator fan motors do not run at all, check fuses F3, F4, F9, and F10 and the output to the evaporator fans when they should be energized.

Evaporator Fan Motor Removal and Installation

Removal

1. Turn the unit off.
2. Remove the evaporator cover.
3. Disconnect the motor power plug.
4. Remove the fan motor mounting bolts (4).
5. Remove the fan motor from the evaporator.

Installation

1. Attach the fan motor to the evaporator and tighten the fan motor mounting bolts (4).
2. Connect the fan motor power plug.
3. Install the evaporator cover.
4. Start the unit and verify correct fan motor operation.

Electric Standby Circuits

If the unit does not run in the electric standby mode use the following procedure.

Make sure the unit is connected to the proper power source.

Check the power cable receptacle for power. If power is there, check for power at the unit terminal plug.

If the contactor is pulled down and the overload relay is closed, but the standby motor fails to start, the trouble is probably in the standby motor.

If the contactor is not pulling down proceed as follows:

1. Check the AC line voltage and the transformer input fuse. If the AC line voltage is acceptable and the transformer input fuse is intact, go to step 2.
2. Measure the transformer output voltage (AC) at Connector 1 on PCB1 in the ECM. Measure the voltage between wires X1 (pin B8) and X4 (pin C8). The voltage reading should be approximately 12/24Vac (depending on the unit voltage). If not, check the transformer output fuses located in the main wire harness near the 2-pin connector that connects wires X1 and X4 in the main wire harness to wires X1 and X4 from the transformer. If the fuses are good and the X1 and X4 circuits have good continuity, the transformer is defective. If the transformer output voltage is acceptable, go to step 3.
3. Check the rectifier output voltage (DC) on the 2R wire at the power supply capacitor. If this voltage is less than approximately 12/24Vdc, and if the 2R circuits to the rectifiers and the 0V and 11.5V circuits from the rectifiers to the transformer have good continuity, the rectifier bridge is defective. If the rectifier output voltage is acceptable, go to step 4.
4. Check the voltage on 2R wire at the standby power relay. If voltage is not present, check the continuity of the 2R wire from the power supply capacitor. If the voltage on the 2R wire at the standby power relay is acceptable, go to step 5.
5. Check the voltage on both ends of the 2RB wire at the standby power relay. If voltage is not present, the 2RB wire is open. If the voltage on both ends of the 2RB wire is acceptable, go to step 6.

6. Check the voltage on the 2RB1 wire at the battery disconnect relay. If voltage is not present, check the continuity of the 2RB1 wire from the standby power relay. If the voltage on the 2RB1 wire at the battery disconnect relay is acceptable, go to step 7.
7. Check for continuity to ground on the SWD wire at the battery disconnect relay. If continuity to ground is not present, check for continuity to ground on the CHX wire at the battery disconnect relay. If the CHX wire has good continuity to ground, the battery disconnect relay is probably defective. If there is good continuity to ground on the SWD wire at the battery disconnect relay, go to step 8.
8. Check for continuity to ground on the SWS wire at the standby power relay If continuity to ground is not present, check the continuity of the SWS/SWD wire from the battery disconnect relay. If there is good continuity to ground on the SWS wire at the standby power relay, go to step 9.
9. Check the voltage on the 2B wire at the standby power relay. If voltage is not present, the standby power relay is probably defective. If the voltage on the 2B wire at the standby power relay is acceptable, go to step 10.
10. Check the voltage on the PC wire at Pin 10 in Connector 2 on PCB1 in the ECM. If voltage is not present, check the continuity of the PC circuit to junction connector 1 (jumper JC1) and the 2B2/2B circuit to the standby power relay. If the voltage on the PC wire is acceptable, go to step 11.
11. Check the voltage on the CMC wire at the compressor contactor. If voltage is not present, check the continuity of the CMC circuit to Pin B1 in Connector 1 on PCB1 in the ECM, and Fuse 5 on the ECM. If the voltage on the CMC wire is acceptable, go to step 12.
12. Check for continuity to ground on the 69 wire at the compressor contactor. If there is good continuity to ground on the 69 wire at the compressor contactor, the compressor contactor is probably defective. If continuity to ground on the 69 wire at the compressor contactor is not present, go to step 13.
13. Check the continuity of the 69 wire from the compressor contactor to the thermal motor protector. If the 69 wire from the compressor contactor to the thermal motor protector has good continuity, go to step 14.
14. Check for continuity to ground on the CH9 wire at the thermal motor protector. If there is good continuity to ground on the CH9 wire at the thermal motor protector, the thermal motor protector is probably open or defective. If continuity to ground on the CH9 wire at the thermal motor protector is not present, Check the continuity of the CH9 wire from the thermal motor protector to battery disconnect relay.

Maintenance Inspection Schedule

Procedures	Weekly	Monthly	Semi-Annual	Annually
Check refrigerant level.			•	•
Replace dehydrator.				•
Check compressor pressure regulator and suction pressure regulator settings if applicable.				•

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.

Evacuating and Charging the Refrigeration System

Procedures

IMPORTANT: Thermo King Evacuation Station P/N 204-725 and Evacuation Station Operation and Field Application Instructions (TK-40612) is required.

NOTE: The oil in the evacuation station vacuum pump should be changed after each use.

Solenoid Valve Positions

The liquid injection valve and the defrost solenoid must be in the open position during evacuation procedures. These valves must be held open manually using special magnet tools (P/N 204-1074) designed for this purpose.

NOTE: The condenser blocking solenoid is normally open so it does not need to be held open with a magnet tool.

1. Unscrew the solenoid coil retaining nut and remove the coil assembly.
2. Place a magnet tool on the solenoid valve stem.
3. Carry out the evacuation procedure.
4. After completing the evacuation procedure, remove the magnet tools and replace the solenoid coil assembly on the solenoid valve and hand tighten the coil retaining nut.

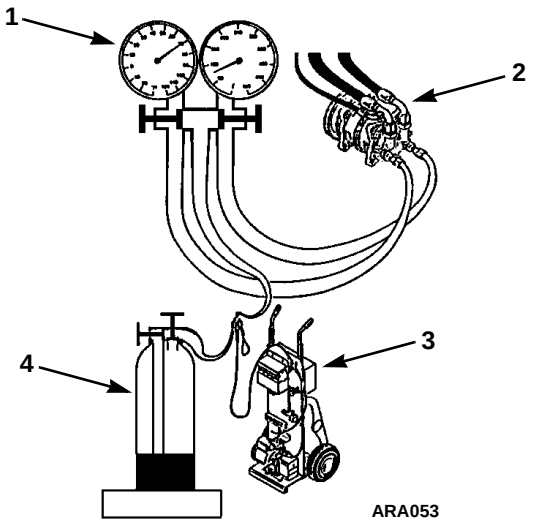
Evacuation and Charging Procedure

The liquid line sight glass helps the operator to determine the amount of charge under established operating conditions. These units can be damaged by an overcharge 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 evacuating and charging the system is as follows:

1. Connect a gauge manifold set to the suction and discharge service ports on the engine driven compressor.
2. Connect the center hose of the gauge manifold to the manifold of an evacuation station. The use of Thermo King Evacuation Station P/N 204-725 is recommended.
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.



1.	Gauge Manifold Set
2.	Engine Driven Compressor
3.	Evacuation Station
4.	Refrigerant Drum

Figure 26: Evacuating and Charging Refrigeration 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 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.Then repeat steps 5 and 6.

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 approximately 3.0 lb (1.4 kg) of refrigerant to enter the system. Then close the valve on the refrigerant drum and the high side valve on the gauge manifold.
11. Start the unit on engine operation and run the truck engine at approximately 1000 rpm.
12. Set the thermostat at 32 F (0 C), and run the unit in cool until the box temperature approaches 32 F (0 C).
13. Make sure that the unit is running in cool, the compressor is running at approximately 1000 rpm, the suction pressure is 2 to 8 psig (14 to 55 kPa), and the head pressure is at least 180 psig (1241 kPa) for R-134a systems or 275 psig (1896 kPa) for R-404A systems. If necessary, raise the head pressure by covering the condenser grille.
14. With these conditions established, open the valve on the refrigerant drum to deliver liquid.
15. Observe the suction pressure and slowly open the low side gauge manifold valve to allow liquid refrigerant to flow into the compressor suction service valve.
16. Control the liquid flow so the suction pressure increases approximately 20 psig (138 kPa).
17. Observe the liquid line sight glass. Close the valve on the refrigerant drum when the bubbles disappear from the sight glass or when the system capacity has been reached (see Specifications).
18. Close the low side valve on the gauge manifold and operate the unit for 15 minutes.
19. Model 20 and 50 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.
    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.
20. Check the liquid line sight glass for bubbles. Repeat steps 13 through 20 if bubbles are visible.
21. Stop the unit, shut off the truck engine and remove the gauge manifold set.

22. 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 a 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 can be determined by inspection of the refrigerant through the 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 gauge manifold set.
3. Run the unit in cool on engine driven compressor operation until the thermometer reads 32 F (0 C).
4. Establish head pressure of 180 psig (1241 kPa) for R-134a systems or 275 psig (1896 kPa) for R-404A systems. It may be necessary to partially cover the condenser grille on the front of the unit to create the desired head pressure.
5. Look at the liquid line sight glass. Under these conditions there should be no bubbles in the flow of refrigerant through the liquid line sight glass. Bubbles in the refrigerant indicate the unit is low on refrigerant. Refer to "Charging the Refrigeration System" for information about adding refrigerant.

Testing the Refrigerant Charge with a Loaded Box

1. Install a gauge manifold.
2. Run the unit in cool on engine driven compressor 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 liquid line sight glass. There should be no bubbles in the flow of refrigerant through the liquid line sight glass. Bubbles in the refrigerant indicate the unit is low on refrigerant. Refer to "Evacuating and Charging the Refrigeration System" on page 43 for information about adding refrigerant.

   NOTE: If no bubbles are present, there is sufficient refrigerant in the unit for that load at that particular box temperature. This test does not determine if the unit contains a full charge of 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.

Refrigeration System Checks

1. Connect a gauge manifold set to the suction and discharge service ports on the engine driven compressor.
2. Check the system pressures and the refrigerant flow in cool, heat (Model 30 and 50 units only), and defrost. The suction and discharge pressures should be within the normal ranges for a standard unit. Check the temperatures of the refrigeration lines by hand to check the refrigerant flow. See the individual test for a component if you suspect it is not functioning properly.

Cleanup Procedure for Small Truck Units

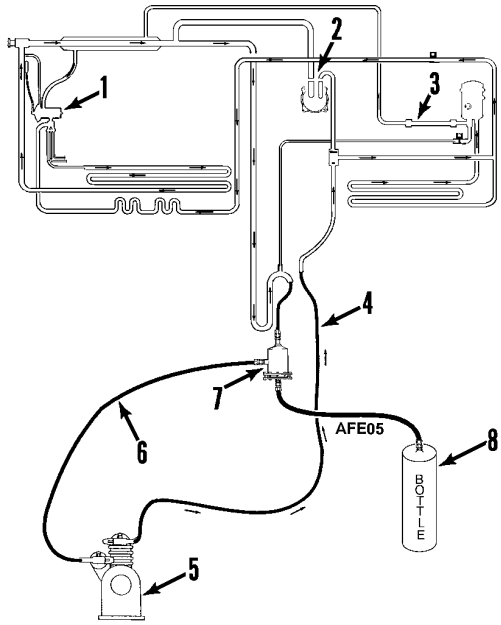
NOTE: If a Van Steenburgh reclaimer is available, do not use this procedure. Follow procedure described in Service Bulletin T&T 134.

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 the contaminated refrigerant from the system.
4. Remove the lines from the compressors (engine driven and standby).
5. Flush each compressor using the flushing compressor and an HFC refrigerant. (Always recover the refrigerant before disconnecting the flushing compressor.)



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

Figure 27: Connecting Flushing Compressor to Unit

6. Remove the check valve (or check valve seats) from system to ensure flow in all directions.
7. Remove the oil separator and install a connecting pipe.

8. Remove the internal parts from the expansion valve.
9. Remove the internal parts from the expansion valve.
10. Open the compressor pressure regulator (CPR) valve and/or suction pressure regulator (SPR) (if used) to their highest setting.
11. Install a temporary suction line filter (P/N 204-498 and P/N 66-2988) in the suction line.
12. Install a connecting pipe in place of the standby compressor.
13. Connect the flushing compressor system to the engine driven compressor discharge and suction lines (see illustration).
14. Evacuate the system and check for leaks. Continue to evacuate to remove moisture and air.
15. Install HFC refrigerant and run the flushing compressor to flush the system. Energize (open) the 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.
16. Test the recovered compressor oil for acid contamination.
17. Continue flushing until the compressor oil is clean.

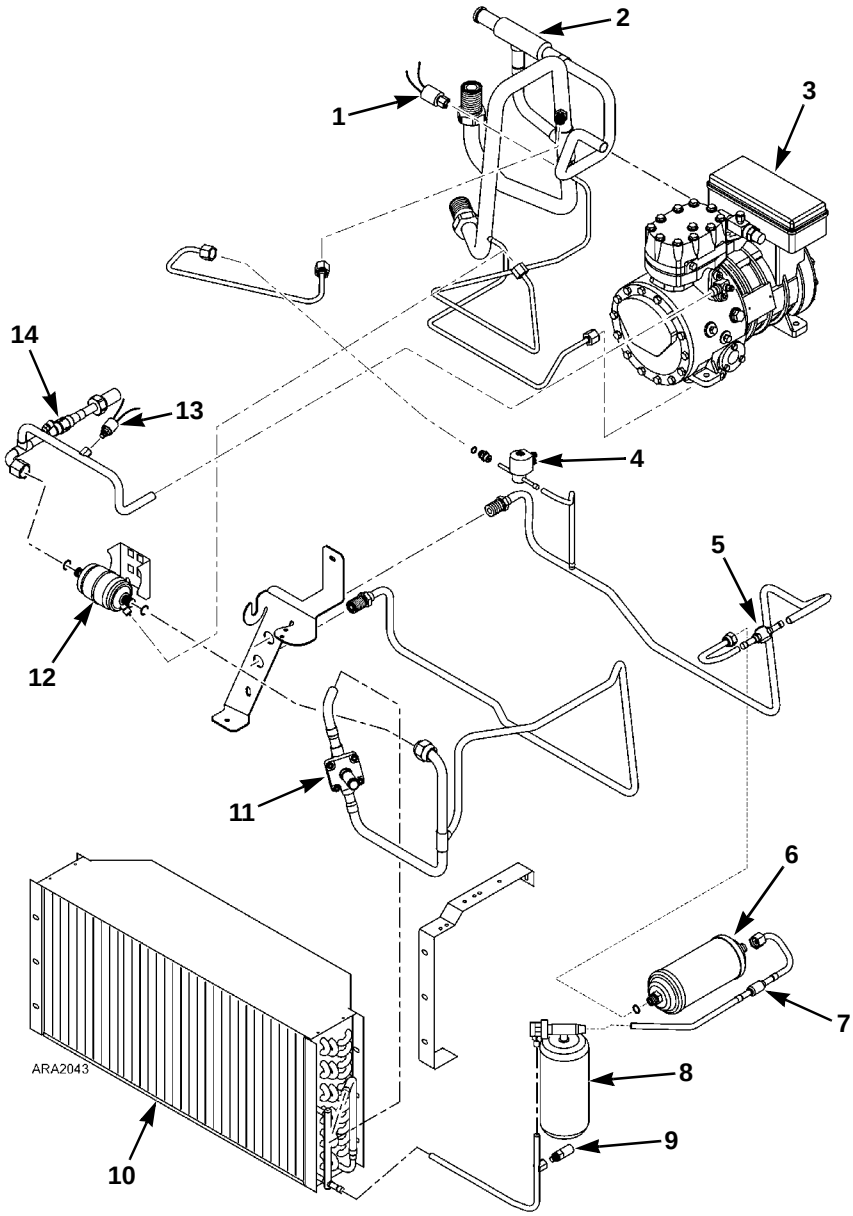
Putting the Unit Back Into Operation

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

Refrigeration Service Operations

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

WARNING: Disconnect the power supply before servicing the unit to prevent personal injury.



1.	Low Pressure Cutout Switch (LPCO)	8.	Receiver Tank
2.	Suction Pressure Regulator (Model 20 and 50 Only)	9.	High Pressure Relief Valve
3.	Electric Compressor (Model 20 and 50 Only)	10.	Condenser
4.	Liquid Injection Solenoid Valve	11.	Condenser Blocking Solenoid Valve (Model 30 and 50 Only)
5.	Liquid Line Sight Glass	12.	Oil Separator
6.	Drier	13	High Pressure Transducer
7.	Liquid Line Check Valve (Model 30 and 50 Only)	14.	Discharge Check Valve (Model 20 and 50 Only)

Figure 28: Condenser Refrigeration Components (Model 50 Shown)

Engine Driven Compressor

Removal

1. Recover the refrigerant charge from the system.
2. Loosen and remove the compressor drive belt.
3. Disconnect the clutch and liquid injection switch wires.
4. Disconnect the discharge and suction lines.
5. Keep the compressor ports and the suction and discharge lines for the compressor covered to prevent contamination of system components.
6. Remove the compressor mounting screws and remove the compressor.

Installation

NOTE: Any compressor installed in this system must contain the proper amount of compressor oil. 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. Adjust the belt tension to the vehicle manufacturer specifications.
3. Connect clutch and liquid injection switch wires, and 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.

Electric Compressor

Removal

1. Recover the refrigerant charge from the system.
2. Remove the condenser grille.
3. Disconnect the compressor wiring.
4. Disconnect the discharge and suction lines.
5. Keep the compressor ports and the suction and discharge lines for the compressor covered to prevent contamination of system components.
6. Remove the compressor mounting screws and remove the compressor.

Installation

NOTE: Any compressor installed in this system must contain the proper amount of compressor oil. 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.
2. Connect the discharge and suction lines.
3. Connect the compressor wiring.
4. Pressurize the system and test for leaks.
5. Reinstall the condenser grille.
6. Evacuate the system and recharge.

Condenser Coil

Removal

1. Recover the refrigerant charge.
2. Remove the condenser grille.
3. Remove the condenser fans.
4. Disconnect the inlet and liquid lines.
5. Remove the mounting hardware.
6. Remove the condenser coil.

Installation

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

8. Recharge the unit.

Drier

Removal

1. Recover the refrigerant charge.
2. Disconnect the ORS nuts at the ends of the drier.
3. Loosen the mounting hardware and remove the drier.

Installation

1. Coat the new O-rings with refrigerant oil (same type that is used in the system) and place the 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 ORS nuts. Hold the drier with a back-up wrench on the hex behind the ORS fitting.
4. Pressurize the system and test for leaks.
5. Evacuate and recharge the system.

High Pressure Transducer

Removal

1. Recover the refrigerant charge.
2. Remove the condenser grille if necessary.
3. Disconnect the wires and remove the transducer.

Installation

1. Install and tighten the switch and reconnect the wires.
2. Pressurize the system and test for leaks.
3. Reinstall the condenser grille (if removed).
4. Evacuate and recharge the system.

Defrost Solenoid Test

1. Install a gauge manifold set on the engine driven compressor.
2. Disconnect the 2-pin connector with the LIS and CLU wires in main wire harness from wires to the liquid injection switch at the engine driven compressor.
3. On Model 30 and 50 units disconnect the 2-pin connector with the 26 and CHM wires in main wire harness from the wires to the condenser blocking solenoid.
4. Set the thermostat on the lowest setting.
5. Start and run the unit in Cool on the engine driven compressor until the suction pressure stabilizes.
6. Check the temperatures of the refrigeration lines on both sides of the defrost solenoid by hand. A temperature difference between the two sides of the defrost solenoid indicates it is leaking.
7. Use the In-Cab Control Box to place the unit in defrost.

   NOTE: The defrost termination switch must be closed for the unit to enter defrost. Use a jumper wire to connect the 12 and CHB circuits in the main wire harness at the 2-pin connector for the defrost termination switch if the evaporator temperature is not low enough to close the defrost termination switch.
8. The suction pressure should rise. If the suction pressure does not rise, the defrost solenoid is not opening. Check the continuity of the wiring and the solenoid coil before assuming the solenoid is faulty.
9. Reconnect the wires that were disconnected and remove the gauge manifold set when finished with the test.

Liquid Injection Solenoid Test

See “Testing Liquid Injection Solenoid Valve and Metering Orifice” on page 40.

Condenser Blocking Solenoid Test (Model 30 and 50 Only)

1. Install a gauge manifold set on the engine driven compressor.
2. Set the thermostat on the lowest setting.
3. Start and run the unit in Cool on the engine driven compressor until the suction pressure stabilizes.
4. Check the temperatures of the refrigeration lines on both sides of the condenser blocking solenoid by hand. Both sides should be hot. If not, the condenser blocking solenoid might be stuck closed.
5. Set the thermostat on the highest setting to make the unit shift to Heat.
6. The suction pressure should rise and the discharge pressure should fall as the condenser blocking solenoid, defrost solenoid, and liquid injection valve open when the unit shifts to heat.
7. Let unit run in Heat until the suction and discharge pressures stabilize.
8. Check the temperatures of the refrigeration lines on both sides of the condenser blocking solenoid by hand. Both sides should be about the same temperature, but should not be hot.
    - If both sides are hot, the condenser blocking solenoid is probably not closing. Check the continuity of the wiring, the hot gas heat relay, and the solenoid coil before assuming the solenoid is faulty.
    - If the side of the condenser blocking solenoid going to the condenser is significantly colder than the side coming from the oil separator, the condenser blocking solenoid is probably leaking.
9. Remove the gauge manifold set when finished with the test.

Liquid Solenoid Test (SPECTRUM Only)

1. Install a gauge manifold set on the engine driven compressor.
2. Set the thermostat for the compartment being tested to the lowest setting so it will run in Cool. Set the thermostat for the other compartment to the highest setting so it will be in Null.
3. Start and run the unit on the engine driven compressor until the suction pressure stabilizes.
4. Check the temperatures of the refrigeration lines on both sides of the liquid solenoid by hand. Both sides should be warm. If not, the liquid solenoid might be stuck closed.
5. Set the thermostat for the compartment being tested to the highest setting to make that compartment shift to Null.
6. The suction pressure should fall because the liquid solenoid closes when the compartment shifts to Null.
7. Check the temperatures of the refrigeration lines on both sides of the liquid solenoid by hand. A temperature difference between the two sides of the liquid solenoid indicates it is leaking.
8. Remove the gauge manifold set when finished with the test.

Suction Bypass Solenoid Test (SPECTRUM Only)

1. Install a gauge manifold set on the engine driven compressor.
2. Set the thermostat for the frozen compartment to the highest setting so it will be in Null. Set the thermostat for the fresh compartment the lowest setting so it will run in Cool.
3. Start and run the unit on the engine driven compressor until the suction pressure stabilizes.
4. Set the thermostat for the frozen compartment to the lowest setting to make it shift to Cool.

5. The suction pressure should fall because the suction bypass solenoid closes when the frozen compartment shifts to Cool.
6. Check the temperatures of the refrigeration lines on both sides of the suction bypass solenoid by hand. A temperature difference between the two sides of the suction bypass solenoid indicates it is leaking.
7. Remove the gauge manifold set when finished with the test.

Solenoid Valve Replacement

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

Removal

1. Recover the refrigerant charge.
2. Remove the condenser grille if necessary to access the solenoid valve.
3. Remove the coil and disassemble the valve if unsoldering the valve.
4. Disconnect or unsolder the refrigeration lines from the valve and remove the valve from the unit. Note the direction of the flow arrow on the valve.

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

Installation

1. Clean the tubes for soldering if necessary.
2. Remove the coil and disassemble the valve if soldering.
3. Place the valve in position with the flow arrow pointing in the direction noted when removed.
4. Connect or 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 when soldering.

5. Pressurize the system and test for leaks.
6. Reinstall the condenser grille (if removed).
7. Evacuate and recharge the system.

Oil Separator

Removal

1. Recover the refrigerant charge.
2. Remove the condenser grille.
3. Disconnect the ORS nuts at the ends of the oil separator.
4. Loosen the mounting hardware and remove the oil separator.

Installation

1. Coat the new O-rings with refrigerant oil (same type that is used in the system) and place the new O-rings in the ORS fittings on the ends of the oil separator.
2. Install and tighten the inlet and outlet ORS nuts. Hold the oil separator with a backup wrench on the hex behind the ORS fitting.
3. Pressurize the system and test for leaks.
4. Reinstall the condenser grille.
5. Evacuate and recharge the system.

Liquid Injection Metering Orifice

Removal

1. Recover the refrigerant charge.
2. Disconnect the refrigeration line from the metering orifice and remove the metering orifice from the suction tube fitting.

   NOTE: This orifice may become plugged with dirt unless the refrigeration hoses are kept clean.

Installation

1. Install the metering orifice on the suction tube fitting.
2. Connect the refrigeration line to the metering orifice fitting.
3. Pressurize the system and test for leaks.
4. Evacuate and recharge the system.

Liquid Line Check Valve (Model 30 and 50 Only)

The liquid line check valve prevents refrigerant from moving into the condenser when a Model 30 or 50 unit is running in Heat of Defrost.

Liquid Line Check Valve Test

1. Install a gauge manifold set on the engine driven compressor.
2. Set the thermostat on the lowest setting.
3. Start and run the unit in Cool on the engine driven compressor until the suction pressure stabilizes.
4. Check the temperatures of the refrigeration lines on both sides of the liquid line check valve by hand. A temperature difference between the two sides of the liquid line check valve indicates it is not opening completely.
5. Set the thermostat on the highest setting to make the unit shift to Heat.
6. Let unit run in Heat until the suction and discharge pressures stabilize.
7. Check the temperatures of the refrigeration lines on both sides of the liquid line check valve by hand. A temperature difference between the two sides of the liquid line check valve indicates it is leaking.
8. Remove the gauge manifold set when finished with the test.

Liquid Line Check Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Disconnect the ORS nut at the end of the liquid line check valve tube assembly, unsolder the other end, and remove the tube assembly from the unit.

Installation

1. Coat the new O-ring with refrigerant oil (same type that is used in the system) and place the new O-ring in the ORS fitting on the end of the liquid line check valve tube assembly.
2. Place the liquid line check valve tube assembly in position and tighten the ORS nut. Hold the tubes with a backup wrench on the hex behind the ORS fitting.
3. Solder the connection on the other end of the liquid line check valve tube assembly.
4. Pressurize the system and test for leaks.
5. Evacuate and recharge the system.

Discharge Check Valve (Model 20 and 50 Only)

Model 20 and 50 units are equipped with a discharge check valve. The discharge check valve isolates the engine driven compressor from the electric standby compressor, ensuring the compressor oil and refrigerant do not migrate between compressors.

Discharge Check Valve Test

The discharge 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 discharge check valve requires two gauge manifold sets.

1. Disconnect the liquid injection solenoid valve wires.
2. With the unit off, install a gauge manifold set on each compressor.
3. Observe the gauge manifold readings of the electric 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. Set the thermostat on the lowest setting.
5. Start the truck and run the unit in Cool on the engine driven compressor.
6. Observe the gauge manifold readings of the engine driven compressor. The head pressure should increase and the suction pressure should decrease.
7. 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 to the standby compressor is leaking internally and should be replaced.

8. Turn the unit off and shut off the truck engine. Connect the unit power receptacle to an appropriate electric power source.
9. 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.
10. Set the thermostat on the lowest setting.
11. Start the unit and run it in Cool on the electric standby compressor.
12. Observe the gauge manifold readings of the electric standby compressor. The head pressure should increase and the suction pressure should decrease.
13. Observe the gauge manifold readings of the engine driven compressor. The high side pressure should remain the same as the pressure in step 9 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 and should be replaced.
14. Stop the unit.
15. Remove the gauge manifold sets and the electric standby power source. Connect the wires to the liquid injection solenoid valve.

Discharge Check Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the condenser grille.
3. Place a heat sink on the check valve.
4. Unsolder the lines and remove the check valve.

Installation

NOTE: A heat sink must be used on the in-line check valve when it is being soldered in place to prevent damage to the neoprene seal.

1. Clean the tubes for soldering.
2. Place the check valve in position. The arrow on the valve body indicates the direction of refrigerant flow through the valve.
3. Place a heat sink on the check valve.
4. Solder the inlet and outlet connections.
5. Pressurize the system and test for leaks.
6. Reinstall the condenser grille.
7. Evacuate and recharge the system.

Suction Pressure Regulator Valve (Model 20 and 50 Only)

Model 20 and 50 units are equipped with a suction pressure regulator valve. The suction pressure regulator valve is used to limit the load on the electric standby compressor.

Suction Pressure Regulator Valve Test

1. Install a gauge manifold set on the electric standby compressor. Attach an additional compound gauge to the suction service port on the engine driven compressor to monitor suction pressure at the inlet to the suction pressure regulator.
2. Connect the unit power receptacle to an appropriate electric power source.
3. If the evaporator temperature is above 31 F (-1 C), place a jumper wire between the 12 and CHB wires at the defrost termination switch to ensure the unit will run in Defrost.
4. Start the unit and run it in Defrost on the electric standby compressor until the pressure on the additional compound gauge attached to the suction service port stabilizes at a pressure above 45 psig (310 kPa).
5. Check the suction pressure on the gauge attached to the suction service port at the standby compressor. It should be 39.0 ± 4 psig (269 ± 28 kPa). If the setting is incorrect,

remove the protective cap and try to adjust the suction pressure regulator valve to the correct setting before assuming it is faulty.

6. Remove the gauge manifold set, the additional compound gauge, and the jumper wire when finished with the test.

Suction Pressure Regulator Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the mounting hardware from the suction pressure regulator valve.
3. 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. Install the mounting hardware.
4. Pressurize the system and test for leaks.
5. Evacuate and recharge the system.

Evaporator Coil

Removal

1. Recover the refrigerant charge.
2. Remove the evaporator cover.
3. Disconnect the refrigeration lines.
4. Disconnect the expansion valve from the distributor.
5. Remove the evaporator fans.
6. Remove the temperature sensor.
7. Remove the defrost termination switch.
8. Remove the mounting bolts and remove the evaporator coil.

Installation

1. Place the evaporator coil in position, and install and tighten the mounting bolts.
2. Install the defrost termination switch.
3. Install the temperature sensor.
4. Install the evaporator fans.
5. Clean the tubes for soldering.
6. Connect the expansion valve to the distributor.
7. Connect the refrigeration lines.
8. Pressurize the system and test for leaks.
9. Install the evaporator cover.
10. Evacuate and recharge the system.

Expansion Valve Assembly

Removal

1. Recover the refrigerant charge.
2. Remove the evaporator cover.
3. Remove the feeler bulb from the suction line clamps. Note the position of the feeler bulb on the suction line.
4. Disconnect the equalizer line from the expansion valve.
5. Disconnect the liquid line and the distributor from the expansion valve.
6. 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 on the side of the suction line in its former position. The feeler bulb must make good contact with the suction line or operation will be faulty. Wrap the bulb with insulating tape.

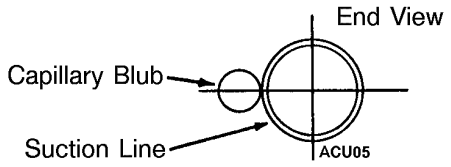


Figure 29: Location of Expansion Valve Bulb

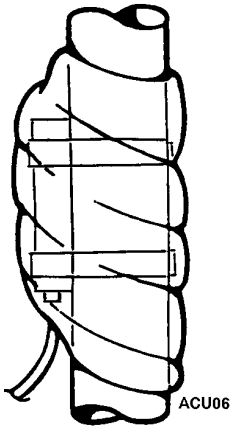


Figure 30: Completely Wrap Bulb with Tape

5. Pressurize the system and test for leaks.
6. Install the evaporator cover.
7. Evacuate and recharge the system.

Low Pressure Cutout Switch (LPCO)

The low pressure cutout switch is located on a suction tube in the condenser. If the suction pressure drops below 5 to 11 in. Hg of vacuum (-17 to -37 kPa), it opens the LPCO circuit to the controller to stop the unit.

Low Pressure Cutout Switch Test

1. Install a gauge manifold at the compressor.
2. Disconnect the 2-pin connector with the LPCO and CHJ wires in main wire harness from wires to the low pressure cutout switch.
3. Set the thermostat on the lowest setting.
4. Start and run the unit in Cool.
5. Check the continuity between the low pressure cutout switch wires. The low pressure cutout switch should be closed when the suction pressure is above 5 to 11 in. Hg of vacuum (-17 to -37 kPa). If the suction pressure falls below 5 to 11 in. Hg of vacuum (-17 to -37 kPa), the low pressure cutout switch should open.
6. Reconnect the wires that were disconnected and remove the gauge manifold set when finished with the test.

Low Pressure Cutout Switch Replacement

Removal

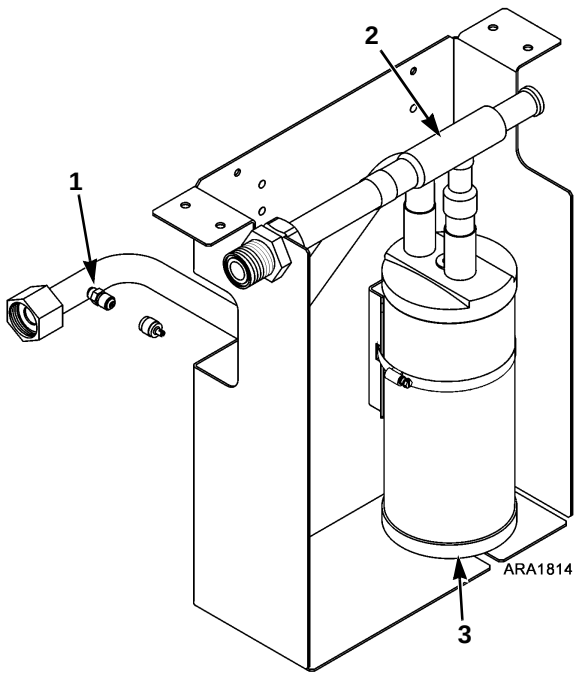
1. Recover the refrigerant charge.
2. Remove the condenser grille if necessary.
3. Disconnect the wires and remove the switch.

Installation

1. Install and tighten the switch and reconnect the wires.
2. Pressurize the system and test for leaks.
3. Reinstall the condenser grille (if removed).
4. Evacuate and recharge the system.

Compressor Pressure Regulator Valve (Model 30 and 50 Only)

The compressor pressure regulator valve is located in the accumulator module, which is mounted on the back of the evaporator.



1.	Evaporator Suction Service Port
2.	Compressor Pressure Regulator Valve
3.	Accumulator Tank

Figure 31: Accumulator Module (Model 30 and 50 Only)

Compressor Pressure Regulator Valve Test

1. Install a gauge manifold set on the engine driven compressor. Attach an additional compound gauge to the evaporator suction service port to monitor suction pressure in the evaporator.
2. Set the thermostat on the highest setting.
3. Start and run the unit in Heat on the engine driven compressor until the pressure on the additional compound gauge attached to the evaporator suction service port stabilizes at a pressure above 60 psig (414 kPa).
4. Check the suction pressure on the gauge attached to the suction service port at the compressor. It should be 50.0 ± 5 psig (345 ± 34 kPa). If the setting is incorrect, remove the protective cap and try to adjust the compressor pressure regulator valve to the correct setting before assuming it is faulty.
5. Remove the gauge manifold set and the additional compound gauge when finished with the test.

Compressor Pressure Regulator Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the mounting hardware from the compressor pressure regulator valve.
3. Unsolder the compressor pressure regulator valve from the accumulator.

Installation

1. Clean the tubes for soldering.
2. Place the valve in position and solder the connection.
3. Install the mounting hardware.
4. Pressurize the system and test for leaks.
5. Evacuate and recharge the system.

Suction Bypass CPR Valve (SPECTRUM Only)

SPECTRUM Advanced Control System

In multi-temperature refrigeration systems the frozen evaporator has lower suction pressure than the fresh evaporator because temperature is relative to pressure. If both evaporators are calling for cool at the same time, the fresh evaporator takes the major portion of the capacity because it has a higher pressure to feed into the common suction line. With multiple door openings and the fresh compartment taking most of the capacity, the frozen department can loose control of the temperature and rise above the desired setpoint.

The advanced control system balances the suction pressure between the fresh and frozen evaporators to allow both evaporators to have equal capacity to control the two zones. This system gives priority to the frozen section. It also keeps refrigerant from migrating into the frozen evaporator when it is not running.

Advanced Control System Components and Operation

- The advanced control system module contains a suction bypass solenoid (normally open), a suction bypass CPR (compressor pressure regulator) valve, and a check valve. The suction bypass solenoid is a bypass around the suction bypass CPR valve. When the suction bypass solenoid is not energized, it allows full flow of suction gas to the compressor from the fresh compartment.
- The suction bypass solenoid in connected to the same electrical control circuit as the liquid solenoid in the frozen evaporator. When this circuit is energized (frozen compartment calling for Cool), the suction bypass solenoid closes and causes the fresh evaporator suction gas to go through the suction bypass CPR valve. This matches the capacity between the two compartments
- The check valve keeps refrigerant from backing into the frozen evaporator when the frozen compartment is in Null and the fresh compartment is in the Cool.

Suction Bypass CPR Valve Setup Procedure

The following procedure is used to set the suction bypass CPR valve when the unit is installed. It can also be used to check the suction bypass CPR valve setting.

1. Install a gauge manifold set on the engine driven compressor.
2. Shut off the fresh compartment by raising its setpoint to the highest setting.
3. Start the unit on the engine driven compressor at 1800 to 2000 RPM.
4. Bring the frozen compartment to 5 to 7 F (3 to 4 C) above setpoint. Record the suction pressure and then shut the unit off.
5. Remove the suction bypass solenoid coil and install a magnet (P/N 204-1074) to close valve.
6. Raise the frozen compartment setpoint to the highest level and lower the fresh compartment setpoint to 35 F (2 C) and start the unit.
7. With the unit running, set the suction pressure to the recorded value from step 4 by adjusting the suction bypass CPR valve. Once the suction pressure has been set, turn the unit off.
8. Remove magnet and reinstall the coil on the suction bypass solenoid.
9. Remove the gauge manifold set.
10. Start the unit with both compartments set to desired setpoints and let the unit pull down.

    NOTE: The frozen will pull down faster on first start up than the fresh compartment.

Suction Bypass CPR Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the mounting hardware from the suction bypass CPR valve.
3. Unsolder the suction bypass CPR valve.

Installation

1. Clean the tubes for soldering.
2. Place the valve in position and solder the connection.
3. Install the mounting hardware.
4. Pressurize the system and test for leaks.
5. Evacuate and recharge the system.
6. Perform the “Suction Bypass CPR Valve Setup Procedure” on page 58.

Replacing Refrigerant Hoses (Speedy Clip System)

Disassembly

1. Recover the refrigerant charge.
2. Loosen the hose fittings using two spanner wrenches.
3. Remove the hose and the hose connectors.

Assembly

1. Cut the hose to the desired length. Use the recommended hose-cutting tool. Do not use saws, knives or similar tools.

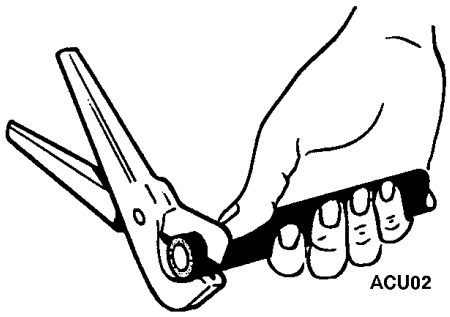


Figure 32: Cutting Hose

2. Fit two clips of appropriate diameter over the hose. Use only one clip for hose #4.

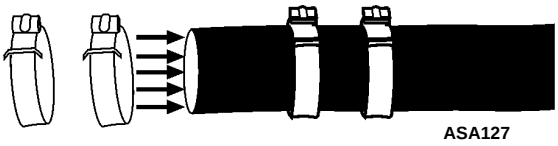


Figure 33: Fitting Clips

3. Lubricate the cylinder of the fitting to be inserted into the hose using refrigerant oil.

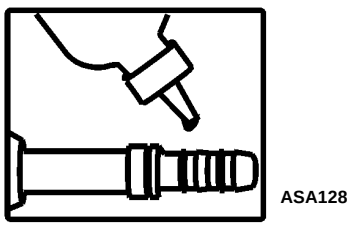


Figure 34: Lubricating Cylinder of Fitting

4. Manually insert the fitting into the hose. The hose should touch the projecting part of the fitting without rising over it. Clean off the excess oil.

Figure 35: Manually Inserting Fitting

5. Place the clamp for the clips into the fitting slot. The clamp is properly positioned when it can rotate in the slot.

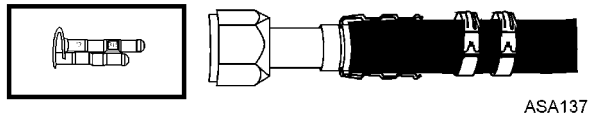


Figure 36: Positioning Clamp

6. Fit the clips in the clamp arm seat.

Figure 37: Fitting Clips

7. Tighten both clips using recommended pliers. Check that the clips are properly positioned and tightened.

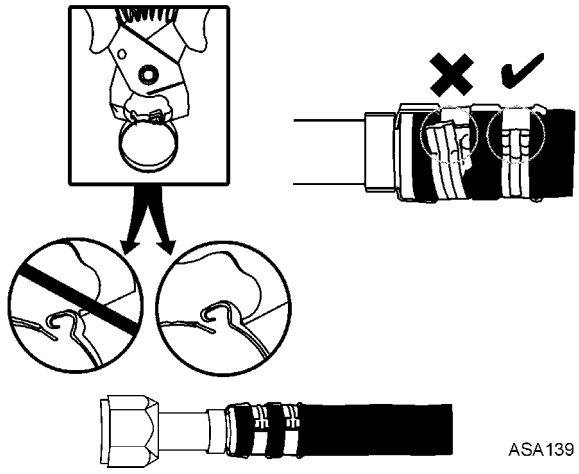


Figure 38: Tightening Both Clips

8. Install the hose and use two spanner wrenches to tighten the hose fittings.
9. Pressurize the system and test for leaks.
10. Evacuate and recharge the system.

Compressor Maintenance

Refrigerant Handling Instructions

Refrigerant Handling Safety

DANGER: Explosion Hazard! Never throw or strike refrigerant bottles and never handle the packing carton roughly. Do not use refrigerant bottles that are damaged or dented. Store refrigerant bottles out of reach of children.

DANGER: Explosion Hazard! Never directly heat refrigerant bottles or put them in hot water heated above 104 F (40 C) because the bottle might explode and cause personal injury. When it is necessary to heat refrigerant bottles for charging in cold weather, use warm water at a temperature below 104 F (40 C).

DANGER: Explosion Hazard! Never put refrigerant bottles on the engine or the radiator when charging Excessive heat increases pressure to a dangerous level that might cause the bottle to explode.

DANGER: Explosion Hazard! Never store refrigerant bottles in direct sunlight, near flame, or where the temperature exceeds 104 F (40 C). Always store refrigerant bottles in a cool dry place.

CAUTION: Do not put the charge valve in warm water.

Refrigerant Recovery

Some refrigeration system refrigerant compounds are chlorofluorocarbons, and therefore may be damaging to the earth's ozone layer. Consequently, the release of refrigerant into the atmosphere must be avoided. Whenever refrigerant is to be removed from the refrigeration system, a refrigerant recovery unit must be used to recover the refrigerant. This refrigerant can then be recycled and reused, which is both environmentally safe and economical.

NOTE: Consult the operators manual for your recovery unit for the proper hookup and operating procedures.

Figure 39: Typical Recovery Unit

Compressor Function Test

Preliminary Checks

1. Check the suction and discharge pressures to make sure they are in an acceptable range.
2. Check to make sure the unit is cooling.
3. Check the compressor for signs of overheating such as discolored stickers on the compressor body.
4. Check to make sure the compressor clutch has 12 volt power when energized.

5. Check to make sure the compressor clutch has a good ground. Paint on the mounting brackets can impede a good ground connection.
6. Let the unit sit for 1/2 hour after charging to let the charge go through the system.
7. Check to make sure all the fans running with the correct rotation.
8. Check to make sure all the check valves holding.
9. Check to make sure all the coils are clean.

IMPORTANT: Three point evacuation is a must on units with standby option.

The following six steps are used to identify if a compressor has actually failed and should be removed. If the compressor fails to meet any one of these 6 steps it should be replaced with a new compressor/clutch or clutch. (Note: Failing a step does not assign warranty responsibility.)

1. Compressor Rotation Test

Internal compressor failures can be quickly identified by performing a shaft rotation test. Normal rotation of the compressor shaft should be smooth without catching or binding. Binding or hang felt during the shaft rotation test have an internal part failure. This compressor should be removed and replaced with a new unit.

Figure 40: Compressor Rotation Test

2. Voltage Test

Confirm that the clutch is receiving at a minimum 11.5 V or 23 V for 12 V and 24 V systems respectively. If voltage is not being received at the clutch run a diagnostic on the vehicle electrical system. (Note: Perform test with power applied to coil to fully load the circuit.)

Figure 41: Voltage Test

NOTE: Also make sure that the compressor body has good continuity to ground to ensure the clutch is energized when it receives voltage. Later units have a ground wire attached to the compressor to ensure good continuity to ground.

Units installed before the compressor ground wire was included in the installation kit should have a compressor ground wire (P/N 42-1599) installed if they exhibit intermittent clutch operation.

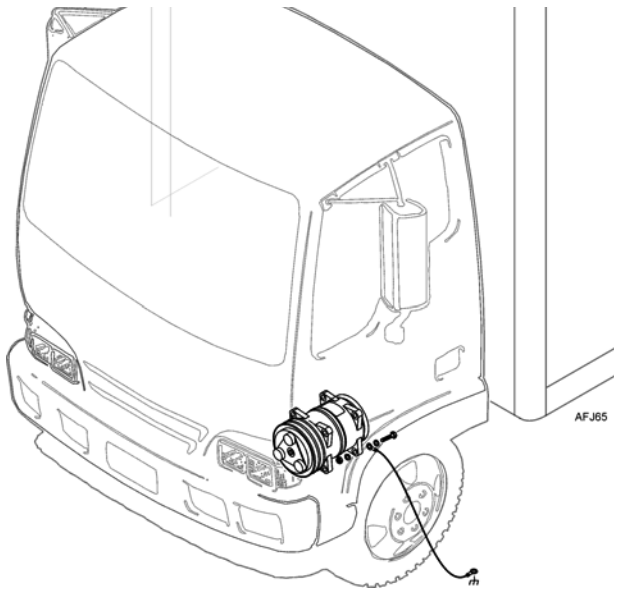


Figure 42: Typical Compressor Ground Wire Installation

3. Pulley or Rotor Spin Check

With clutch disengaged the pulley should spin freely with no wobbling or roughness.

Figure 43: Pulley or Rotor Spin Check

4. Air Gap Check

Air gaps exceeding 0.051 in. (1.3 mm) can prevent engagement. This condition is seen at the end of normal clutch life as the friction surfaces wear away, like brake pads.

Figure 44: Air Gap Check

5. Coil Resistance Check

Field coils with internal shorts can be tested by measuring resistance across the field coil. Resistance should fall within these values.

- 12 Volt coil resistance read between 2.8 and 4.4 ohms at room temperature
- 24 Volt coil resistance read between 14 and 18.2 ohms at room temperature

Figure 45: Coil Resistance Check

6. Pressure or Pumping Test

Compressors circulate refrigerant through the system by creating a pressure differential, high and low pressures. If the compressor can be forced to produce a high pressure in excess of 350 psig (2413 kPa) it is a good compressor.

IMPORTANT: This test must be performed with a full system charge! Confirm the system is fully charged before proceeding.

1. Cover the condenser with sheet of card board. The purpose is to limit heat rejection from the system and build compressor discharge pressure.
2. Start engine and engage clutch.
3. Compressors operating within specification should be capable of reaching 350 psig (2413 kPa).

   IMPORTANT: This test should only be run for a short time period. Shut the system down immediately once 350 psig (2413 kPa) is achieved.

Figure 46: Pressure or Pumping Test

Recommended Pressures and Temperatures

Discharge

- Short term 430 psig max.
- Long term continuous less than 300 psig
- Max continuous temperature 280 F

Suction

- Short term 6 psig minimum
- Long term 14 psig minimum

Temperature

- Non operational: above -40 F and below 250 F
- Operating mode between 32 F and 200 F

Recommended Pressure Charts

The following charts show the typical recommended system pressures for R-134a and R-404A.

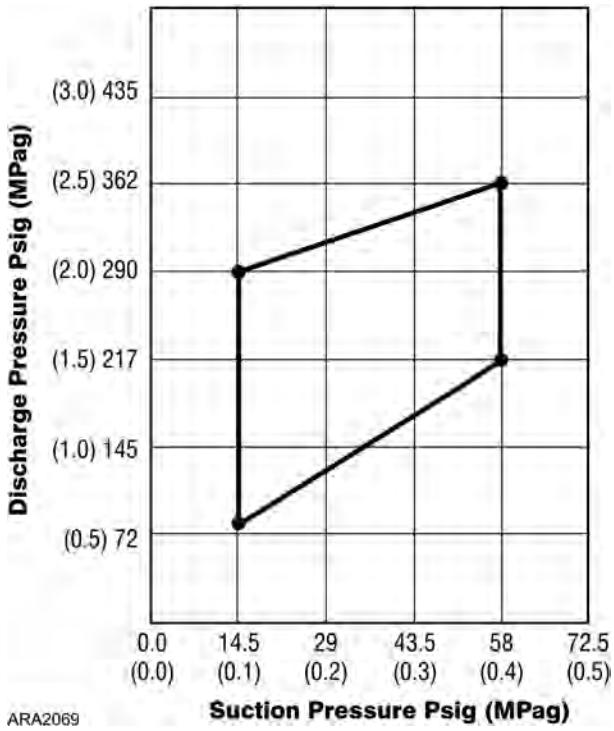


Figure 46: Recommended Pressures for R-134a

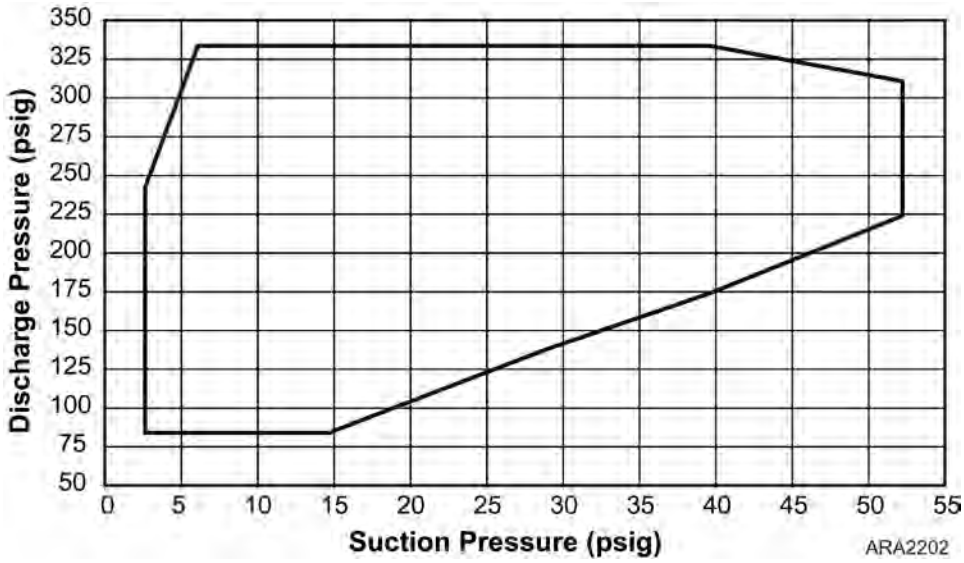


Figure 47: Recommended Pressures for R-404A

Compressor Oil Balance

Compressor lubrication occurs as the oil which circulates with the refrigerant passes through the compressor crankcase during operation. The compressor achieves optimal durability and cooling performance when oil circulates through the system at a ratio of approximately 15% oil to refrigerant. Excess oil can act as an insulator limiting heat transfer in the evaporator and condenser, while too little oil can negatively affect durability.

Oil Checking Is Not Required Under Normal Conditions

The mobile refrigeration system is a closed loop system, hence it is not necessary to check or change oil in systems functioning normally and not in need of repair. The system isolates the oil and refrigerant from moisture and contaminants, while normal operating temperatures will be well below a point that will cause oil degradation.

When Oil Addition or Balancing is Required

- Compressor or component replacement
- Loss of refrigerant and oil mixture
- Adding oil to the system is required when refrigerant loss occurs due to leakage at any system component. Since oil is held in suspension with the refrigerant, oil will be lost with the escaping refrigerant gas. Oil will need to be inspected for contamination during repairs to determine if flushing is required.

Oil Addition When Replacing System Components

Refrigeration systems are designed to have a given oil charge, so during component replacement the goal should be to maintain the initial factory oil charge. It is understood that system oil balance resulting from service activities is not an exact process, however using these guidelines should roughly maintain the OEM system oil charge.

Operating conditions at the time of system shut down will determine where and how much oil settles in any given component in the refrigeration system. Therefore the exact amount of oil removed during refrigerant loss or component replacement can only be estimated in a shop environment.

Compressor Replacement Oil Balance

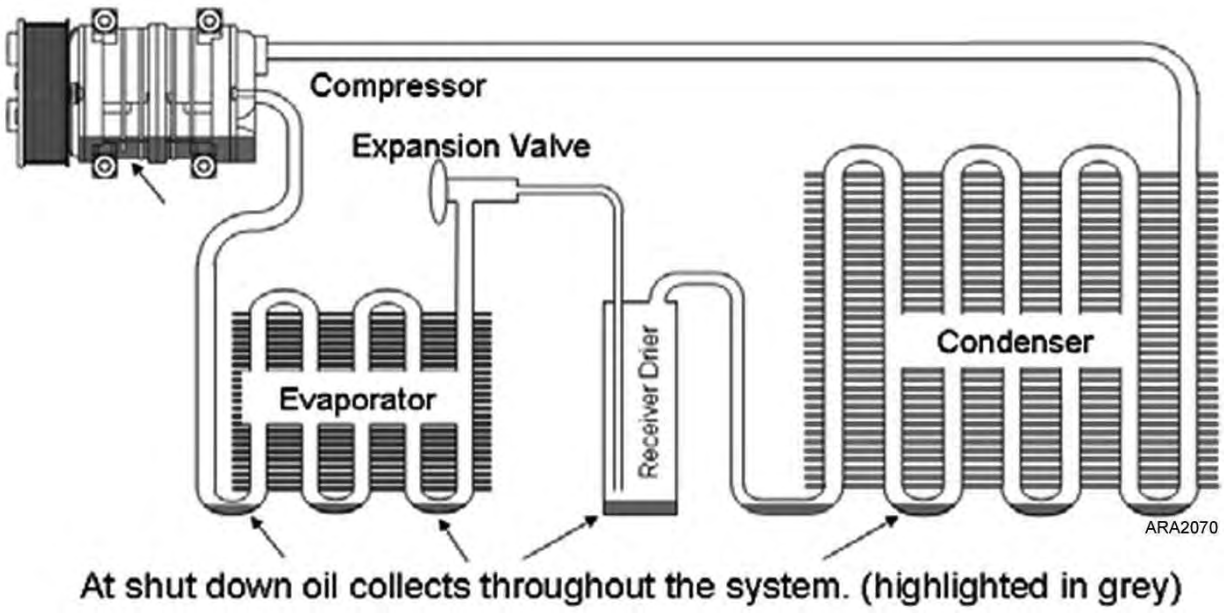


Figure 48: Oil Collection Points

New units are built with a set amount of oil in the refrigeration system. When replacing a compressor the original factory oil amount should be maintained. During normal operation oil and refrigerant circulate through the system, at shutdown as much as 75% of the oil can stored in system components.

The goal of oil balance is to identify how much oil is lost when replacing components during service activities. Then this lost amount should be the amount included when replacing components or repairing the system. Here are some examples:

Example #1 Compressor Change Only

Drain the oil from the compressor drain plug and all other ports. If possible, turn the clutch (rotating the internal compressor parts) by hand and drain the oil again. Repeat until all oil is removed from the compressor. Measure the amount oil drained from the compressor. This is the amount that should be in the new compressor. If 4 ounces are drained from the failed compressor then 4 ounces should be the amount in the new compressor.

IMPORTANT: If less than 3 ounces of oil is drained from the compressor, at least 3 ounces should be in the new compressor. Do not start and run a compressor with less than 3 ounces of oil in it.

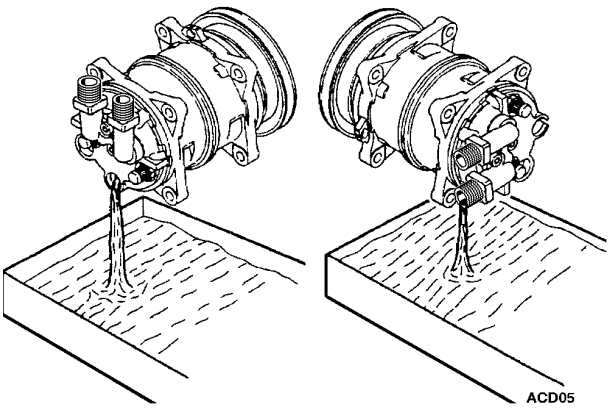


Figure 49: Drain and Measure Oil

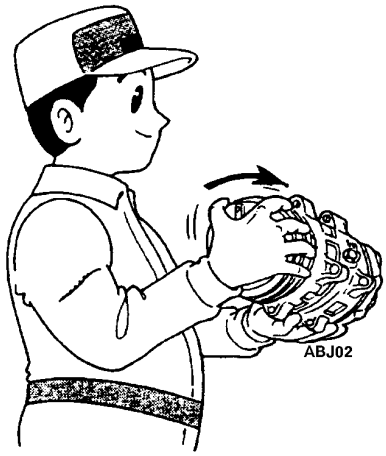


Figure 50: Turn Clutch If Possible

Example #2 Replacing Compressor and Drier Change on Multi Temp System

Since oil cannot be drained from system components these amounts must be estimated using the chart below (page 66). Oil Drained Failed Compressor + Estimated Drier Oil = Oil In Replacement Compressor 3 oz (from failed compressor) + 1.0 oz (estimate from chart) = 4 oz (total oil to add to system)

NOTE: So if the new compressor is delivered with 6 oz. remove 2 oz.

Example #3 Replacing Compressor, Drier and Suction Hose on Single Temperature System

Oil Drained From Failed Compressor	4 oz
Estimated Oil From Removed Drier (chart below)	1 oz
Estimated Oil From Removed Suction Hose (chart below)	4 oz
Total Amount to be added	**9 oz**

In example # 3, if the new compressor is supplied with 6 oz then 3 oz should be added to reach a total of 9 oz. Let's say the new compressor is supplied with 0 oz or no oil, then the amount to add would be 9 oz.

Component	Typical Oil Amount Multi-Temp System	Typical Oil Amount Single Temperature System
Compressor	3 oz (89 cc) Minimum	3 oz (89 cc) Minimum
Suction Line to Front Evaporator	2 oz (59 cc)	4 oz (118 cc)
Suction Line to Rear Evaporator	2 oz (59 cc)	N/A
Receiver Drier	1 oz (30 cc)	1 oz (30 cc)
Accumulator	4 oz (118 cc)	3 oz (89 cc)
Evaporator	3 oz (89 cc) Each	4 oz (118 cc)
Condenser	3 oz (89 cc)	4 oz (118 cc)
Other Hoses and Hard Lines	3 oz (89 cc)	3 oz (89 cc)
Major System Leak	3 oz (88 cc)	3 oz (89 cc)
Minor System Leak	1 oz (30 cc)	1 oz (30 cc)

Compressor Oil Type

Compressor oil P/N 203-515 is required in all direct drive (vehicle powered) units.

Charging the Refrigeration System

IMPORTANT: When charging the refrigeration system on initial installation and anytime that the system is completely evacuated make sure of the following recommendations.

- **The refrigeration system must be evacuated to the recommended micron value (VACCUM) of 500 microns. After the system reaches 500 microns, evacuate the system for an additional hour. Then 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.**
- **An initial charge of liquid refrigerant must be added through the discharge hose at the roadside compressor while the unit is off. The average amount of charge that the unit will take is around 3/4 to 7/8 of the total recommended charge. This amount varies due to the ambient condition that would affect the pressure inside the refrigerant supply bottle. This allows the unit to have an initial refrigerant charge in the system and protects the compressor from excessive liquid intake.**
- **After the initial charge has been added the system must be topped off by metering liquid refrigerant slowly through the suction side of the compressor while the unit is running. Make sure that the high side valve on the gauge manifold is closed to block the passage of refrigerant to or from the discharge side of the system. Control the liquid flow so the suction pressure increases by approximately 20 psig (138 kPa).**
- **Refer to the Refrigeration Maintenance chapter of this manual for specific information about the unit.**

Initial Installation Pressure Regulator Setting

During initial installation and when the pressure regulator is replaced, the pressure regulator must be adjusted in order to make sure that the unit roadside and standby refrigeration capacity is correct. Please follow the procedures in the Refrigeration Service Operations chapter of this manual to properly adjust these valves.

Torque Requirements

Fastener	Ft-Lb	N•m	Kgf-cm
Armature Retaining Nut	13.0 ± 2.0	17.7 ± 2.9	180 ± 30
Oil Fill Plug	14.5 ± 3.6	19.6 ± 4.4	200 ± 50
Hose Fitting 1”- 14	26.7 ± 2.9	36.3 ± 3.9	370 ± 40
Hose Fitting 3/4” Tube-O	17.3 ± 2.5	23.5 ± 3.4	240 ± 35
Hose Fitting 7/8” Tube-O	23.9 ± 2.9	32.4 ± 3.9	330 ± 40
Hose Fitting 1- 1/16” Tube-O	30 ± 3	40.0 ± 4.0	414 ± 41
Pad Bolt M10	28.9 ± 2.9	39.2 ± 3.9	440 ± 40
Pad Bolt M8	26.3 ± 2.9	34.0 ± 3.9	350 ± 40
Pressure Release Valve (PRV)	7.1 ± 1.4	9.8 ± 2.0	100 ± 20

Mounting

Rotation

TK 7 and TK 5 series compressors can be rotated 90° either direction from an upright position.

NOTE: Oil plug is at 12:00 o-clock when compressor is upright.

Figure 51: 90 Degree Rotation

TK 08, TK 13, TK 15, TK 16, and TK 21 series compressors can be rotated 45° either direction from an upright position.

NOTE: Oil plug is at 7:00 O-clock when compressor is upright.

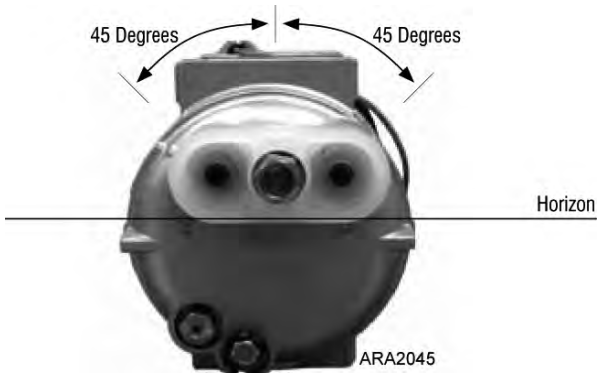


Figure 52: 45 Degree Rotation

Ear Deflection

Total combined ear deflection or bending must not exceed 0.016 in. (0.4 mm). Engine brackets which allow mounting ears to exceed 0.016 in. (0.4 mm) deflection can cause cracked or broken ears. Deflection of the ear can also result in refrigerant leakage.

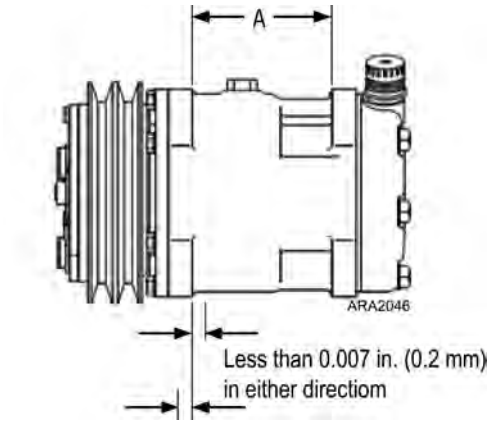
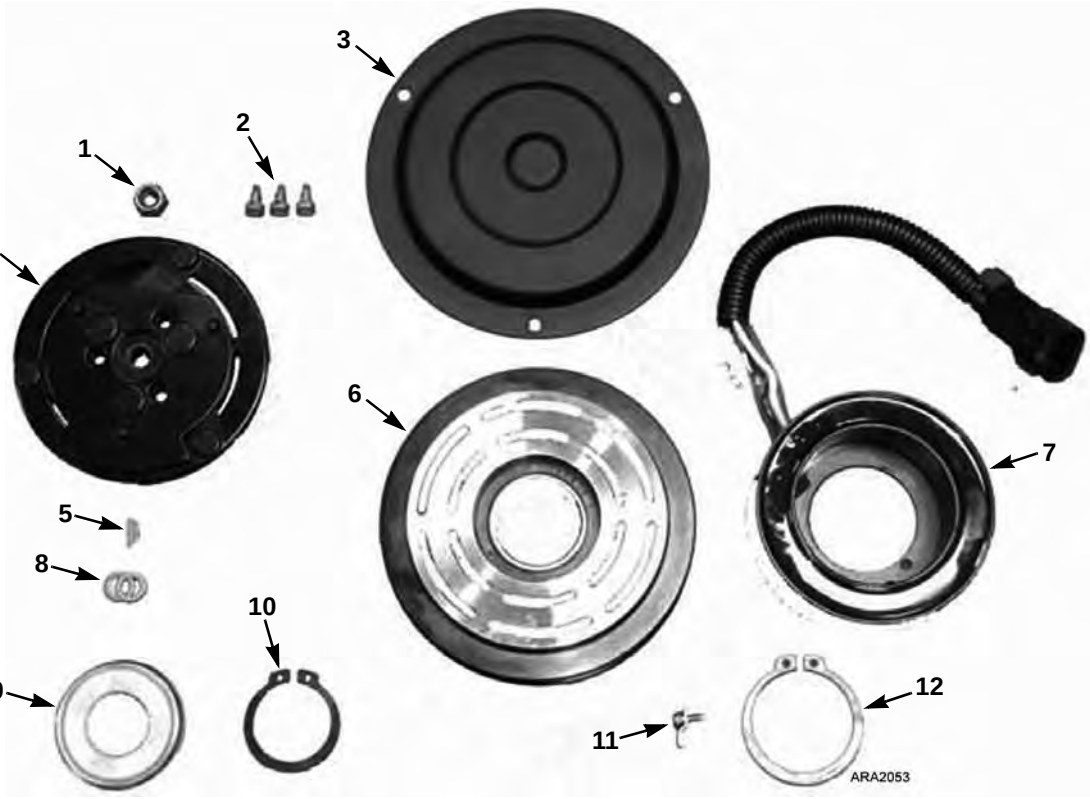


Figure 53: Ear Deflection

Clutch Removal and Replacement



1.	Shaft Nut	5.	Shaft Key	9.	Bearing Dust Cover (Optional)
2.	Dust Cover Screws (Optional)	6.	Pulley	10.	Snap Ring
3.	Dust Cover (Option)	7.	Field Coil	11.	Lead Wire Clamp
4.	Armature Plate	8.	Armature Shims	12	Coil Snap Ring

Figure 54: Clutch Components – Wobble Type Compressor

Clutch Removal

Armature Nut Removal – Wobble Compressor

1. If armature dust cover is present, remove the 3 or 6 bolts holding it in place and remove cover.
2. Insert pins of armature plate spanner into threaded holes of armature assembly.
3. Hold armature assembly stationary while removing retaining nut with 3/4 in., 19 mm, or 14 mm socket wrench.

Figure 55: Armature Nut Removal – Wobble Compressor

Armature Nut Removal – Swash Compressor

1. Use a screw driver to support rubber dampers and prevent armature rotation.
2. Hold armature assembly stationary while removing retaining nut with 3/4in., 19 mm or 14 mm socket wrench.

Figure 56: Armature Nut Removal – Swash Compressor

Armature Removal – Wobble Type

Remove armature plate assembly using a puller. Thread 3 bolts into the threaded holes in the armature assembly. Turn center screw clockwise until armature assembly comes loose.

Figure 57: Armature Removal – Wobble Type

Armature Removal – Swash Type

Remove armature plate assembly by screwing a 10 mm bolt into the armature plate. Tightening the bolt will move the armature off of the shaft.

Figure 58: Armature-Removal – Swash Type

Remove Clutch Accessories

Bearing Dust Cover (if applicable)

Shaft Key (if applicable)

Shims

Figure 59: Remove Clutch Accessories

Clutch Pulley Removal

1. Remove pulley snap ring.
2. Insert the lip of the jaws into the snap ring groove.
3. Place rotor pulley shaft protector (Puller set) over the exposed shaft.
4. Align thumb screws to puller jaws and finger tighten.
5. Turn puller center bolt clockwise using a socket wrench until rotor pulley is free.

Figure 60: Clutch Pulley Removal

Field Coil Removal

1. Loosen lead wire clamp screw until wire(s) can be slipped out from under clamp.

Figure 61: Loosen Lead Wire Clamp Screw

2. Remove field coil snap ring.
3. Remove the field coil assembly.

Figure 62: Remove Snap Ring

Clutch Replacement

Field Coil Installation

1. Place field coil over nose of compressor. Insert the projection on underside of field coil ring into the hole in front housing face to set alignment.
2. Secure field coil with snap ring.

Figure 63: Install Snap Ring

Pulley Installation

1. Set pulley bearing perpendicular over compressor nose.
2. Place the pulley/bearing installer into the bearing bore. Ensure that the edge rests only on the inner race of the bearing, not on the seal, pulley or outer bearing race.

3. Place the installer against the pulley/bearing and drive over the compressor nose with a hammer or arbor press until bearing is seated against front housing.

Figure 64: Pulley Installation

4. Reinstall pulley retaining snap ring with snap ring pliers. If a bevel is present on the snap ring, it should face up (away from the body of the compressor).

Figure 65: Install Snap Ring

Armature Plate Installation

1. Install clutch shims.
2. Shim selection determines clutch air gap. When installing a clutch on a used compressor, try the original shims first. When installing a clutch on a compressor that has not had a clutch installed before, first try 0.04, 0.02, and 0.004 in. (1.0, 0.5, 0.1 mm) shims.

Figure 66: Armature Plate Installation

Keyed Shaft – Wobble Compressor

1. Install shaft key with pliers.
2. Align keyway in armature assembly to shaft key. Using driver and a hammer or arbor press, drive the armature assembly down over the shaft until it bottoms on the shims.

Figure 67: Install Shaft Key

Spline Shaft – Swash Compressor

1. Insert armature nut into hub and hold in place with fore finger.

Figure 68: Insert Armature Nut Into Hub

2. Place armature on top of shaft centering armature nut into compressor shaft.

Figure 69: Place Armature on Top of Shaft

Tighten Armature Retaining Nut

1. Replace TK 5H and TK 7H retaining nut and torque to specification. 1/2-20: 20-25 ft-lb (27-34 N•m, 270-350 kg-cm) M8: 11-15 ft-lb (15-21 N•m).
2. Replace TK 08 through TK 21 retaining nut and torque to specification. M6: 8.7-10 ft-lb (12 to 14 N•m).

Figure 70: Tighten Armature Nut – Wobble Compressor

Figure 71: Tighten Armature Nut – Swash Compressor

Air Gap Set

1. Check air gap with feeler gauge. Specification is 0.016 - 0.031 in. (0.4 - 0.8 mm). If gap is not even around the clutch, gently tap down at the high spots.
2. If the overall gap is out of spec., remove the armature assembly and change the shims as necessary.
3. Replace armature dust cover (if used) and torque 3 or 6 bolts to specification below.

   1/4-20 bolts (SD-5): 2-4 ft-lb (2-5 N•m, 25-50 Kgf-cm)

   M5 bolts (SD-7): 5-8 ft-lb (7-11 N•m, 70-110 kgf-cm)

Figure 72: Check Air Gap

Pressure Release Valve (PRV) Replacement

Some compressors are fitted with a PRV designed to open when discharge pressures exceed 540 psig. The PRV provides a controlled release at a specified location instead of bursting any number of components located on the system high pressure side.

If a PRV has vented the following step should be taken.

1. Locate and repair cause of excessive high pressure.
2. Replace PRV with new PRV.

Direct Drive Compressor Selection Guide

Selecting the correct compressor is vital to providing your customer with the most capacity and highest quality product.

Step 1

Identify what unit model has been selected for the vehicle.

Consult the Thermo King Unit Selection Guide to ensure correct choice of unit.

Choose initial compressor from “Standard Recommended Compressor” column.

Unit Model	Standard Recommended Compressor
V-200 (MAX)	TK 13
V-300 (MAX)	TK 15
V-520 (MAX)	TK 16
V-520 RT (MAX)	TK 16

Standard Recommended Compressor (circle one): TK13 TK15 TK16

Step 2

Consult the Compressor Mounting Kit Instructions to determine whether a Tab Mount or Direct Mount is necessary.

Figure 73: Tab Mount Assembly

Figure 74: Direct Mount Assembly

Mounting Kit (circle one): Tab Mount Direct Mount

Step 3

Identify the Clutch Pulley Assembly that will be used with the unit.

Figure 75: Double A Groove
Clutch Pulley Diameter:
5.31 in. (135 mm)

Figure 76: Poly V Groove
Clutch Pulley Diameter:
4.69 in. (119 mm)

Figure 77: Variable Groove
Clutch Pulley Diameter:
6.26 in. (159 mm)

Clutch Pulley Assembly (circle one): Double A (5.31") Poly V (4.69") Variable (6.26")

Step 4

Complete the following equation to calculate the Sustained Compressor Speed (RPM):

$$\frac{\text{Drive Pulley Diameter}}{\text{Clutch Pulley Diameter}} \times \text{Engine RPM} = \text{Compressor RPM}$$

Drive Pulley Diameter: Determined by the vehicle engine

Clutch Pulley Diameter: Determined in above chart

Engine RPM: Engine speed at sustained highway speeds, not peak RPM

Compressor Speed should not exceed 3,000 RPM.

If the Compressor Speed does not exceed 3,000 RPM, continue to Step 5.

If the Compressor Speed does exceed 3,000 RPM, choose the compressor from the chart below:

Unit Model	Alternate Recommended Compressor
V-200 (MAX)	TK 08
V-300 (MAX)	TK 13
V-520 (MAX)	TK 15
V-520 RT (MAX)	TK 15

Sustained Compressor Speed (circle one): Less than 3,000 RPM More than 3,000 RPM

If more than 3,000 RPM...

Alternate Recommended Compressor (circle one): TK 08 TK 13 TK 15

Step 5

Check compressor dimensions from the V-Series Compressor Chart below; verify the fit of the compressor in the vehicle.

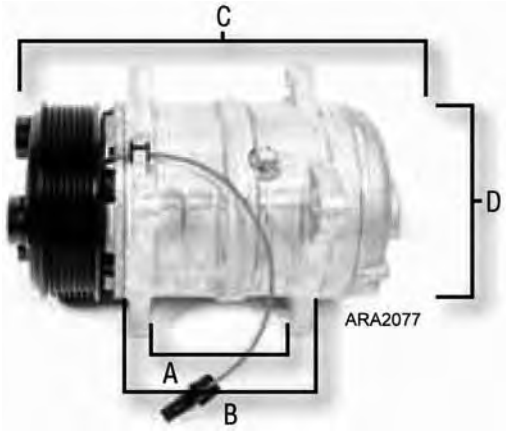


Figure 78: Tab Mount Assembly

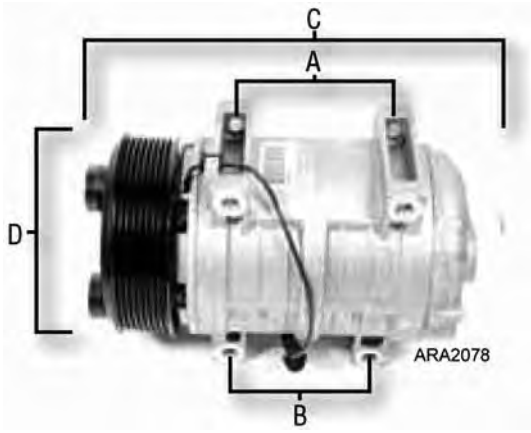


Figure 79: Direct Mount Assembly

Step 6

Find the compressor product number by using the chart that corresponds with your selected Mount Kit and your compressor, as determined above.

DOUBLE A GROOVE

Model	Dimensions	Manufacturing Product Number	Aftermarket Product Number
TK 13 Tab Mount Displacement: 8.0 cid (131 cc)	A: 3.28 in. (83.3 mm) B: 4.41 in. (112 mm) C: 9.06 in. (230.2 mm) D: 4.72 in. (120 mm)	702827	102-1016
TK 15 Tab Mount Displacement: 9.0 cid (146.7 cc)	A: 3.28 in. (83.3 mm) B: 4.41 in. (112 mm) C: 9.25 in. (235 mm) D: 4.72 in. (120 mm)	702826	102-1014
TK 16 Tab Mount Displacement: 10.0 cid (162.9 cc)	A: 3.28 in. (83.3 mm) B: 4.41 in. (112 mm) C: 9.63 in. (244.7 mm) D: 4.72 in. (120 mm)	702825	102-1012
TK 16 Direct Mount Displacement: 10.0 cid (162.9 cc)	A: 3.62 in. (92.0 mm) B: 3.43 in. (87 mm) C: 9.65 in. (245 mm) D: 5.31 in. (135 mm)	702927	102-1024

POLY V GROOVE

Model	Dimensions	Manufacturing Product Number	Aftermarket Product Number
TK 13 Tab Mount Displacement: 8.0 cid (131 cc)	A: 3.28 in. (83.3 mm) B: 4.41 in. (112 mm) C: 9.14 in. (232.2 mm) D: 4.72 in. (120 mm)	702828	102-1017
TK 15 Tab Mount Displacement: 9.0 cid (146.7 cc)	A: 3.28 in. (83.3 mm) B: 4.41 in. (112 mm) C: 9.33 in. (237 mm) D: 4.72 in. (120 mm)	702829	102-1018
TK 16 Tab Mount Displacement: 10.0 cid (162.9 cc)	A: 3.28 in. (83.3 mm) B: 4.41 in. (112 mm) C: 9.71 in. (246.7 mm) D: 4.84 in. (123 mm)	702823	102-1011
TK 16 Direct Mount Displacement: 10.0 cid (162.9 cc)	A: 3.62 in. (92.0 mm) B: 3.43 in. (87 mm) C: 9.65 in. (245 mm) D: 4.69 in. (119 mm)	702824	102-1022

VARIABLE GROOVE

Model	Dimensions	Manufacturing Product Number	Aftermarket Product Number
TK 15 Tab Mount Displacement: 9.0 cid (146.7 cc)	A: 3.28 in. (83.3 mm) B: 4.41 in. (112 mm) C: 9.25 in. (235 mm) D: 4.72 in. (120 mm)	702832	102-1020
TK 16 Tab Mount Displacement: 10.0 cid (162.9 cc)	A: 3.28 in. (83.3 mm) B: 4.41 in. (112 mm) C: 9.65 in. (245.1 mm) D: 6.26 in. (159 mm)	1A/1B: 702830	1A/1B: 102-1019

Compressor Product Number: _____

NOTE: A road test is recommended in order to verify an acceptable rate of system pressures. Ambient pressures, temperatures and load conditions will affect system pressures.

Belt Tensions

Engine Driven 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 vehicle manufacturer specifications. 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.

Structural Maintenance

Maintenance Inspection Schedule

Procedures	Weekly	Monthly	Semi-Annual	Annually
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.		•	•	•
Clean entire unit including evaporator coil and condenser coil.		•	•	•
Check all unit mounting bolts, brackets, lines, hoses, etc.			•	•

WARNING: Take precautions to ensure the unit will not accidentally start while you are servicing the system.

Evaporator Coil

Clean the coils during scheduled maintenance inspections. Remove any debris (e.g., leaves or plastic wrap) that reduces the air flow. Clean dirty coils with compressed air or a pressure washer. Be careful not to bend the fins when cleaning a coil. If possible, blow the air or water through the coil in the direction opposite the normal air flow. Repair bent fins and any other noticeable damage.

CAUTION: The air pressure should not be high enough to damage coil fins.

Condenser Coil

Clean the coils during scheduled maintenance inspections. Remove any debris (e.g., leaves or plastic wrap) that reduces the air flow. Clean dirty coils with compressed air or a pressure washer. Be careful not to bend the fins when cleaning a coil. If possible, blow the air or water through the coil in the direction opposite the normal air flow. Repair bent fins and any other noticeable damage.

Unit Mounting Bolts

Periodically check and torque the unit mounting bolts.

AMA523

Figure 80: Evaporator

AMA1003

Figure 81: Condenser

Over-the-Road Mechanical Diagnosis

If desired box temperature cannot be obtained during engine driven compressor operation, any of the following may be indicated:

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.

Dirt On Coils: Dirt on the condenser or evaporator coil acts as an insulator reducing the capacity of the unit.

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

Shortage Of Refrigerant: Shortage of refrigerant reduces capacity of the unit. Find and remedy the cause of the shortage and recharge the system. DO NOT operate the unit if it is low on refrigerant.

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 serviceman.

Excessive Oil: Too much compressor oil in the system may result in lower than normal suction pressure as well as lowered capacity.

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

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.

Air In 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. Reclaim the refrigerant, evacuate the system to 500 microns and recharge with the proper amount of refrigerant.

Temperature Of The Liquid Line: During normal operation, the liquid line will be slightly warmer than surrounding air. An extremely hot line indicates either shortage of refrigerant or 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.

Dirty Or Wet Filter-Drier: If the outlet line of the filter-drier is colder than the inlet line, the filter-drier is either saturated with moisture or is dirty and must be replaced.

Dirt In The Expansion Valve Screen: Reclaim the refrigerant charge, remove the screen and clean. Moisture is in the system will collect at the expansion valve and freeze. This is indicated by abnormally low suction pressure. Replace the drier, dry the system and recharge.

Ice On The Evaporator Coil: Note operation under Defrost Cycle.

Air Flow: Do not load product directly in front of the air return or discharge. Insure that the fan is correctly positioned in the orifice to achieve maximum air flow.

Compressor Life: The following will shorten the life of the compressor:

- Operating a contaminated system
- No oil trap
- Clogged oil separator (JetLube™)
- Clogged liquid injection orifice (JetCool™)
- Defective liquid injection switch (JetCool™)
- Insufficient oil charge
- Wrong or mixed oil
- Lack of compressor lubrication on installation and startup
- Excessive compressor speed (maximum speed 3,000 rpm)

Electric Standby Mechanical Diagnosis

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 by operating manually. Replace relay if defective
	Fuses blown	Replace fuses
	Open circuit in motor winding	Check stator leads
	High pressure cutout open	Eliminate cause of excessive pressure
	ECM faulty	Repair or replace
	Compressor faulty	Replace compressor
	Shortage of refrigerant	Recharge
	Low pressure cutout open	Recharge leak test
	Overload relay open	Locate overload, reset
Unit short cycles	Shortage of refrigerant (low pressure cutout)	Repair leak and recharge
	Restricted expansion valve	Clean expansion valve
	Refrigerant overcharge (high pressure cutout)	Remove excess charge
	Cycling on high pressure cutout	Check air flow and fan
	Dirty condenser coil	Clean coil
	Defrost timer set too low for application.	Adjust timer to higher interval.

Condition	Possible Cause	Remedy
Unit operates long or continuously	Shortage of refrigerant	Repair leak and recharge
	Discharge valve leaking	Replace leak
	ECM faulty	Repair or replace
	Dirty condenser	Clean condenser
	Air in system	Evacuate and recharge system
	Compressor inefficient	Replace compressor
	Plugged expansion valve	Clean expansion valve
	Iced or plugged coil	Defrost or clean coil
	Defective truck body insulation	Correct or replace
	Too many door openings	Keep doors closed, install plastic curtains
	Load too warm	Precool hot product
	Excessive superheat at expansion valve	Adjust superheat
	Door seals worn	Repair/replace
Box temperature too high	Refrigerant shortage	Repair leak and recharge
	Thermostat setpoint too high	Reset thermostat
	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 superheat
Head pressure too high	Refrigerant overcharge	Remove excess
	Air in system	Evacuate and recharge system
	Dirty condenser	Clean
	Restricted condenser	Clean condenser
	Condenser fan not running	Check fan motor
	Condenser fan rotation	Check fan motor polarity

Condition	Possible Cause	Remedy
Head pressure too low	Refrigerant shortage	Repair leak and recharge
	Compressor suction or discharge valve inefficient	Replace valve
Noisy unit	Insufficient compressor oil	Add oil to proper level
	Mounting bolts loose	Tighten
	Refrigerant flooding back	Adjust oil level or refrigerant charge. Check expansion valve for proper superheat
Compressor loses oil	Shortage of refrigerant	Repair leak and recharge
	Plugged expansion valve or strainer	Clean expansion valve
	Wrong oil viscosity	Use proper oil
	Short cycling	Refer to unit “short cycling”
	Superheat too high	Adjust expansion valve
Frosted or sweating suction line	Expansion valve set too low, admitting excess refrigerant	Adjust expansion valve
Hot liquid line	Shortage of refrigerant	Repair leak and recharge
	Condenser fan not running	Check fan motor
	Dirty condenser coil	Clean condenser
Frosted liquid line	Restricted dehydrator or strainer	Replace restricted part
Condenser coil is cool when unit is in cool operation	Refrigerant undercharge	Repair leak and recharge
	Compressor inefficient	Replace compressor
Unit in vacuum. Frost 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
	Sensor bulb lost charge	Replace expansion valve

Electric Standby Service Checks

1.Compressor does not run.	a.Check for power at source. b.Check for power at plug. c.Check for power at compressor contactor. d.Check for power at overload terminals (contactor closed). e.Check for power at motor terminals.
2.Power at compressor terminals but motor does not run.	a.Replace compressor.
3.Compressor hums but does not run.	a.Check for locked rotor. b.Check for worn bearings. Replace if necessary. c.Check for locked compressor and repair. d.Check power source for single phasing (on three phase units). e.Check capacitors (on single phase units). f.Check start relay.
4.Check transformer.	a.Check for power output.
5.Check rectifier.	a.Check for rectifier output.

Refrigeration Diagnosis Chart

Unit Not Heating	Rapid cycling	Unit cools in defrost cycle	High head pressure	Low head pressure	No head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in vacuum	Sight glass / empty	Suction line frosting back	Noisy compressor	Unit not refrigerating	Unit not defrosting	SYMPTOM / POSSIBLE CAUSES
			•									•			Overcharge of refrigerant
				•	•		•		•	•			•	•	Shortage of refrigerant
				•	•				•	•	•	•	•	•	No refrigerant
			•												Air through condenser too hot (ambient)
			•												Air flow through condenser restricted (dirty)
				•			•								Air through condenser too cold (ambient)
			•									•	•		Air in refrigerant system
			•												Condenser fan blades bent or broken
	•														Air short cycling around evaporator coil
							•		•	•	•				Air through evaporator restricted
							•		•	•	•	•	•		Evaporator needs defrosting
					•								•		Broken engine driven compressor belt
				•											Compressor discharge valves leaking
							•					•	•		Too much compressor oil in system
												•			Loose engine driven compressor pulley
												•			Compressor bearing loose or burned out
				•		•						•	•		Broken valve plate in compressor
							•		•			•	•		Expansion valve power element lost its charge
						•						•	•		Expansion valve feeler bulb improperly mounted
						•					•		•		Expansion valve feeler bulb making poor contact
						•				•	•		•		Expansion valve open too much
							•						•		Expansion valve closed too much
						•					•		•		Expansion valve needle eroded or leaking
				•			•		•				•		Expansion valve partially closed by ice, dirt or wax
•		•													Defrost solenoid stuck closed
•															Condenser blocking solenoid not closing
•															Water valves not open
•															Water pump not working.
•															Truck engine not running
						•					•	•	•		Liquid refrigerant entering compressor
							•		•				•		Restricted line on the low side
			•						•						Restricted line on the high side
							•		•				•		Restricted dehydrator
	•			•											Reverse fan rotation
		•				•							•	•	Faulty pilot solenoid
		•												•	Loose or broken electrical connections
						•	•	•	•						Gauge out of calibration
			•												Condenser fan motor not operating
•							•		•		•	•	•		Evaporator fan motor not operating

Index

Wiring, Schematic, and Refrigeration Diagrams Index

V-520 10/30, V-520 MAX 10/30 Wiring Diagram, page 1 of 2

RELEASED 26/Mar/2014

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
795110	A	RELEASED	25-Mar-14	M. TURNQUIST

VEHICLE POWER
VEHICLE & ENGINE COMPARTMENT

BTI
CH
POS
F21 40A
SI-VEH IGN SWITCH
F22 10A
CH-01
CH-02
2-01
2-02
BAT
ACC

S2-LIQ INJ TEMP SWITCH
LIS
CLU
CLU-01
MP1-VEH COMP CLUTCH
CLUI

VEHICLE CAB

TO A1-IN CAB CONTROLLER
CHO
TXD
RXD
9V
SHLD

K1-BATTERY POWER RELAY
87 2A 2A1 2A2
30 2-03 2-01 2-02
86 02 ACC 03
85 CH2
K1

JP2
2A1
EF3-01
CF2-01
PC2
EXR2-01
EF4-01
EF3-01
CF2-01
EXR2-01

JP1
EF1-01
EF2-01
CF1-01
PC
2A2

CF2-02

CONDENSER SECTION

UNUSED CONNECTOR
26A
CHN
LPCO
CHJ
S3-LPCO
CF1-01
CF1-02
CF1
M1-COND FAN MOTOR 1
P1
P2
CF2-03
CF2
M2-COND FAN MOTOR 2
CHK
CHT
5V
HP
TO A3-HIGH PRESSURE TRANSDUCER
LI-LIV
LIS
CHL
JP3
CHJ
CHK
CHL
CHN
CH3
CH2
CH-01
CH-02
CH3
CH4
CH5
CHP
CHI
CH-03
GND STUD
SEE NOTE 1

EVAP SECTION

M5-EVAP FAN MOTOR 3
EF3
CHE
L2-HOT GAS DEFROST SOLENOID
26
CHM
S4-DEFROST SWITCH
I2
CHB
M3-EVAP FAN MOTOR 1
EF1
CHC
M4-EVAP FAN MOTOR 2
EF2
CHD
RT1-TEMP SENSOR
PNK
BLK
HR1-DRAIN TUBE HEATER
27
CHF
HR2-DRAIN TUBE HEATER
27-01
27A
CHG
S5-DOOR SWITCH
DSWI
CHH
JP1
CH5
CHF
CHG
CHE
JP4
CHB
CHC
CHD
CHM
CHH
CH4

PCB1
MP1-C1
26A LPCO DSWI PNK NC CHI BAT 03 NC NC NC BLK NC RXD TXD NC I2 NC TOROID CHT HP 5V CHO SHLD 9V NC
A1 A2 A3 A4 A5 A6 A7 A8 B1 B2 B3 B4 B5 B6 B7 B8 C1 C2 C3 C4 C5 C6 C7 C8

MP1-C2
EF1-01 EF1 EF2-01 EF2 CF1-02 CHP NC 26 CLU-01 PC P2 P1
1 2 3 4 5 6 7 8 9 10 11 12

PCB2
MP2-C1
NC NC NC NC NC NC NC NC NC NC NC NC
1 2 3 4 5 6 7 8 9 10 11 12

MP2-C2
NC NC EF3-01 EF3 CF2-01 CF2-02 NC NC NC NC 27-01 EXR2-01
1 2 3 4 5 6 7 8 9 10 11 12

NOTE 1: GROUND STUD LOCATION AT THE BOTTOM OF THE CONDENSER FRAME

1 DOOR SWITCH OPTION
2 MAX UNITS ONLY

DSR CONTROL BOX/CONDENSER SECTION

V520 NM/MAX 10 - 12V/24V

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

DRAWN	M. TURNQUIST	25-Mar-14
CHECKED	D. MURPHY	25-Mar-14
APPROVED	M. TURNQUIST	25-Mar-14
ENG APPVL	-	-

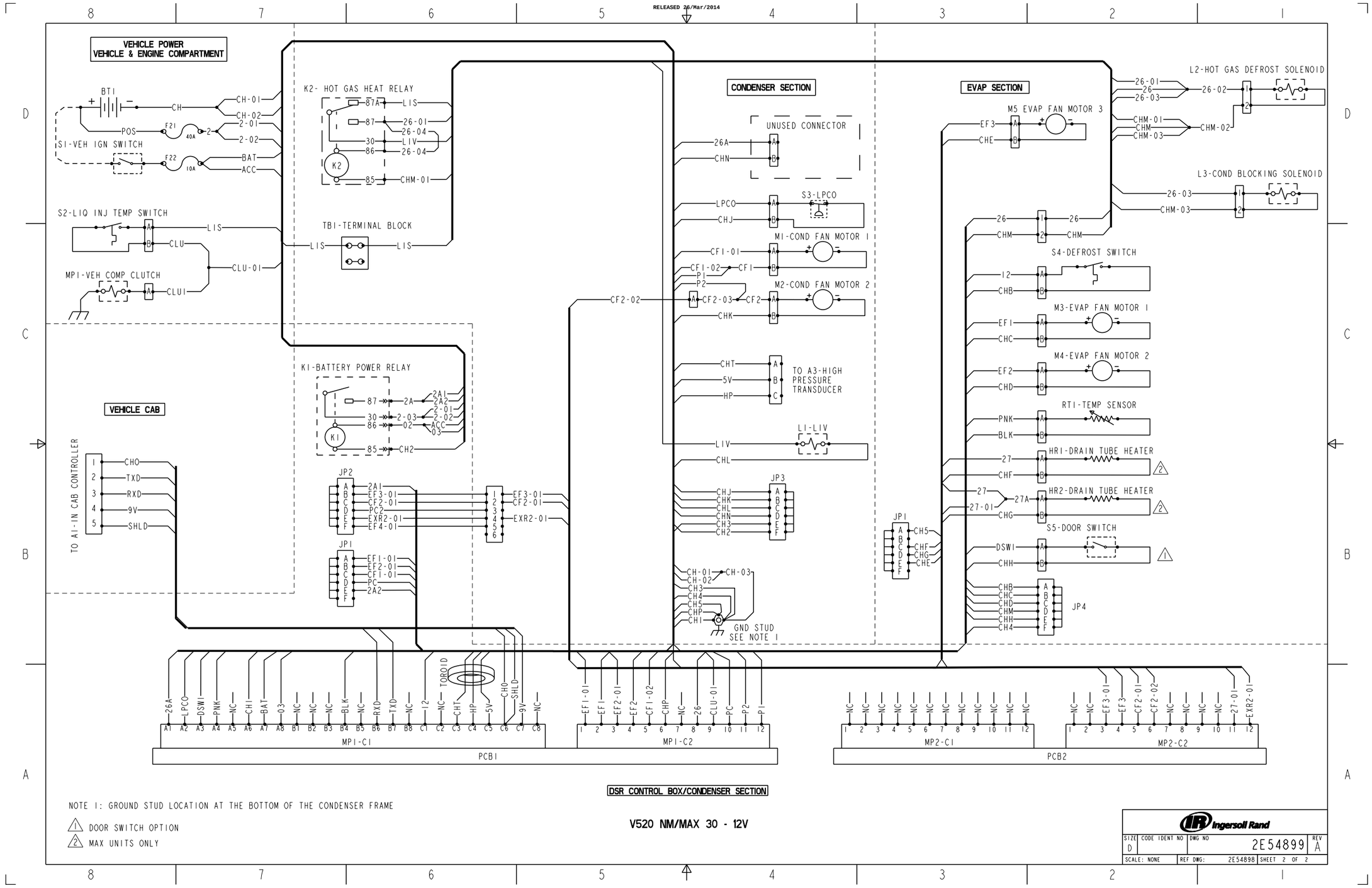
Ingersoll Rand. Thermo King

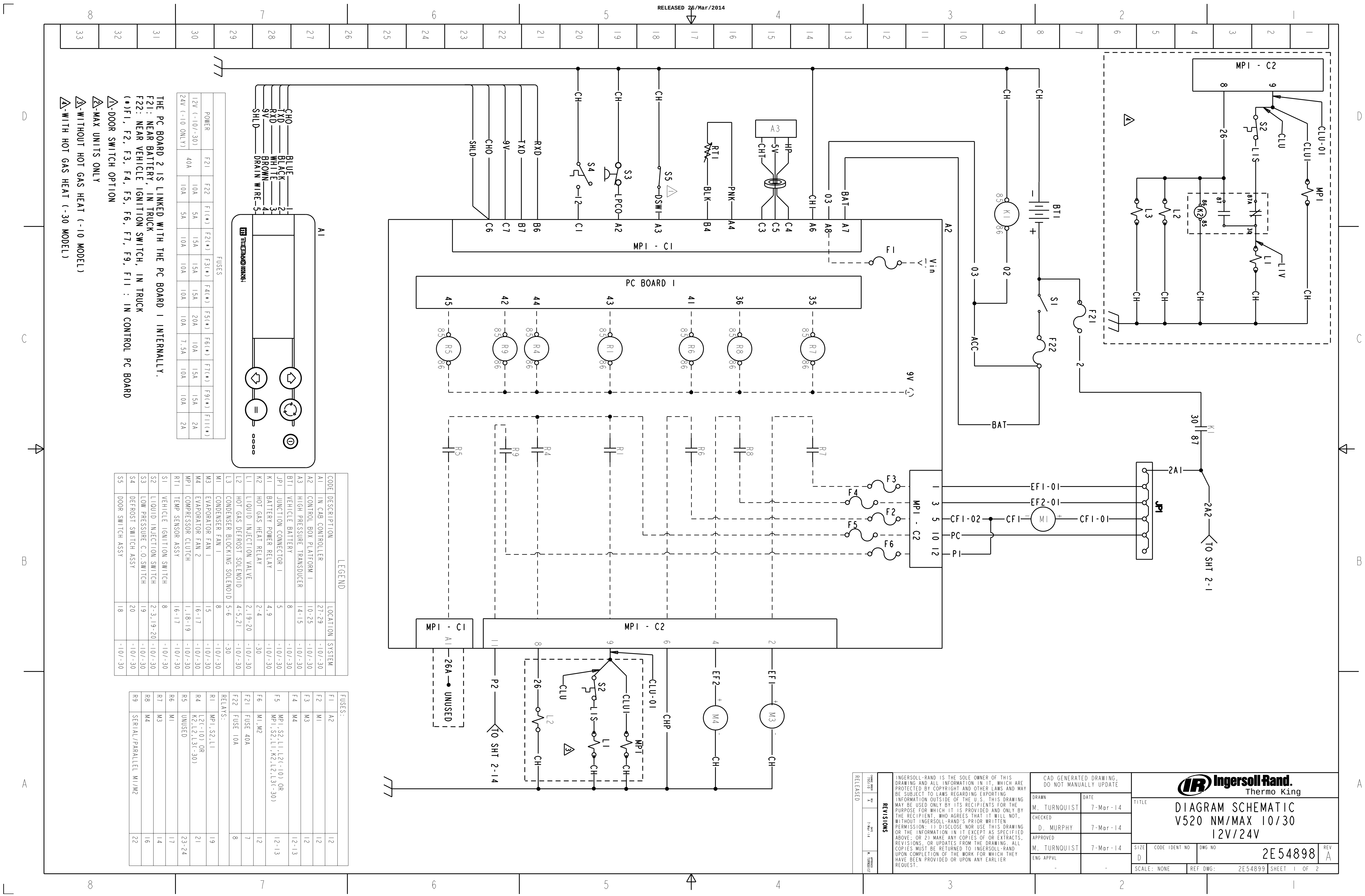
TITLE: DIAGRAM WIRING V520 NM/MAX 10/30 12V/24V

SIZE D | CODE IDENT NO | DWG NO 2E54899 | REV A

SCALE: NONE | REF DWG: 2E54898 | SHEET 1 OF 2

V-520 10/30, V-520 MAX 10/30 Wiring Diagram, page 2 of 2




RELEASED 28/Mar/2014
CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE
Ingersoll Rand
Thermo King
DIAGRAM SCHEMATIC
V520 NM/MAX 10/30
12V/24V
DRAWN M. TURNQUIST 7-Mar-14
CHECKED D. MURPHY 7-Mar-14
APPROVED M. TURNQUIST 7-Mar-14
2E54898
SCALE: NONE
REF DWG: 2E54899
SHEET 1 OF 2

V-520 10/30, V-520 MAX 10/30 Schematic Diagram, page 2 of 2

RELEASED 26/Mar/2014

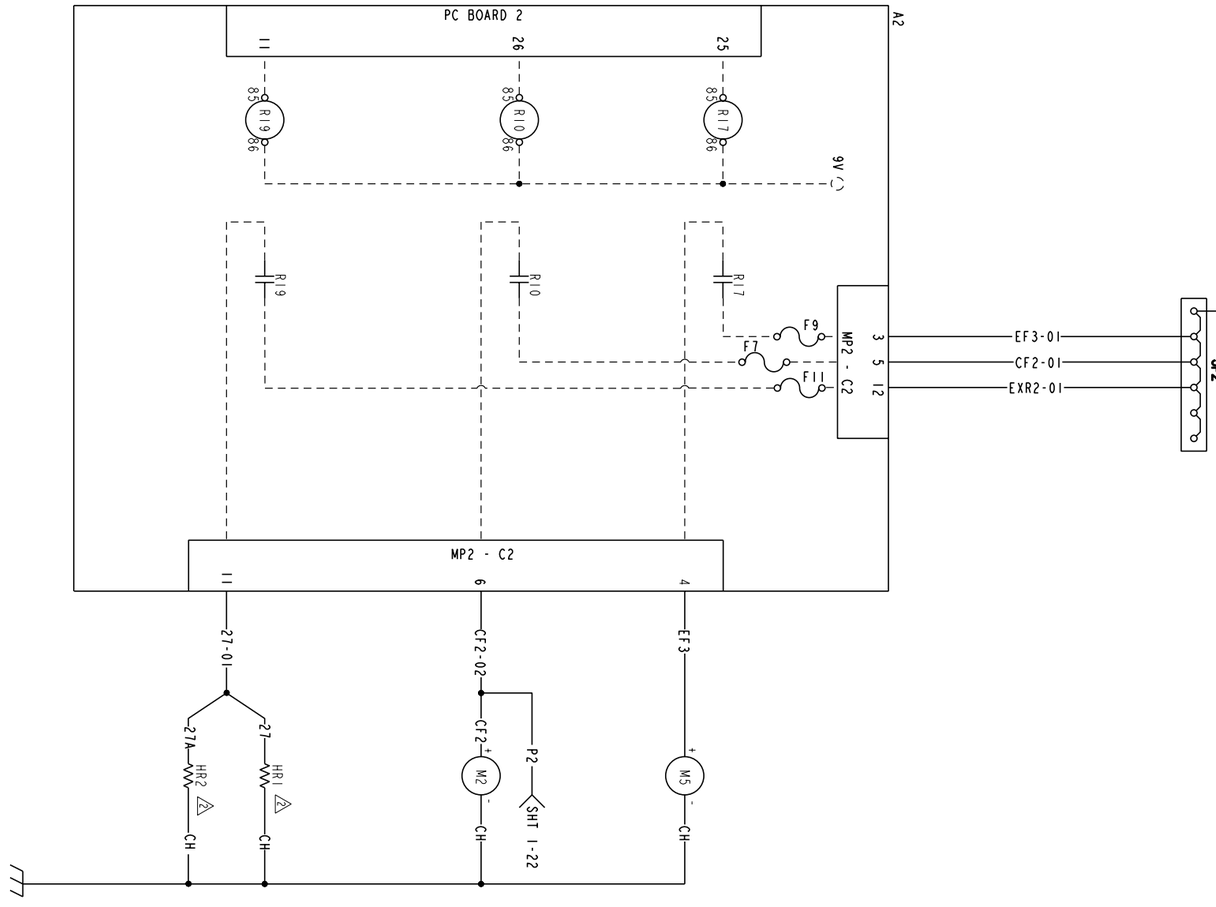
THE PC BOARD 2 IS LINKED WITH THE PC BOARD 1 INTERNALLY.
F21: NEAR BATTERY, IN TRUCK
F22: NEAR VEHICLE IGNITION SWITCH, IN TRUCK
(*)F1, F2, F3, F4, F5, F6, F7, F9, F11 : IN CONTROL PC BOARD

⚠1-DOOR SWITCH OPTION
⚠2-MAX UNITS ONLY
⚠3-WITHOUT HOT GAS HEAT (-10 MODEL)
⚠4-WITH HOT GAS HEAT (-30 MODEL)

FUSES											
POWER	F21	F22	F1(*)	F2(*)	F3(*)	F4(*)	F5(*)	F6(*)	F7(*)	F9(*)	F11(*)
12V (-10/-30)	40A	10A	5A	15A	15A	15A	20A	10A	15A	15A	2A
24V (-10 ONLY)		10A	5A	10A	10A	10A	10A	7.5A	10A	10A	2A

LEGEND			
CODE	DESCRIPTION	LOCATION	SYSTEM
A2	CONTROL BOX PLATFORM 2	8-21	-10/-30
HR1	DRAIN HEATER 1	18	-10/-30(MAX)
HR2	DRAIN HEATER 2	19-20	-10/-30(MAX)
JP2	JUNCTION CONNECTOR 2	3	-10/-30
M2	CONDENSER FAN 2	14-15	-10/-30
M5	EVAPORATOR FAN 3	11-12	-10/-30

FUSES:		
F7	M2	10
F9	M5	9-10
F11	HR1,HR2	9-10
RELAYS:		
R10	M2	14
R17	M5	10-11
R19	HR1, HR2	18-19



Ingersoll-Rand. Thermo King

SIZE	CODE IDENT NO	DWG NO	REV
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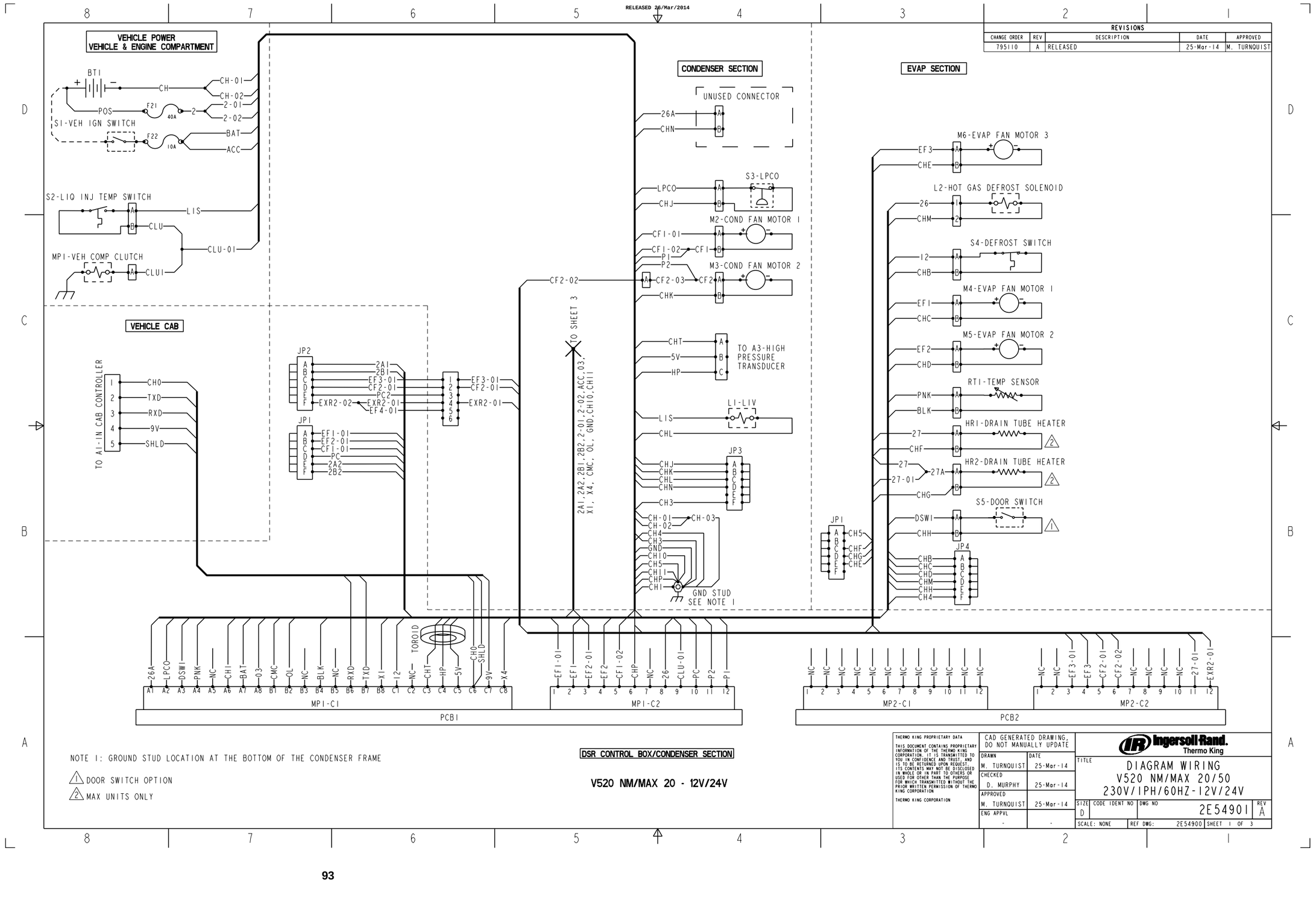
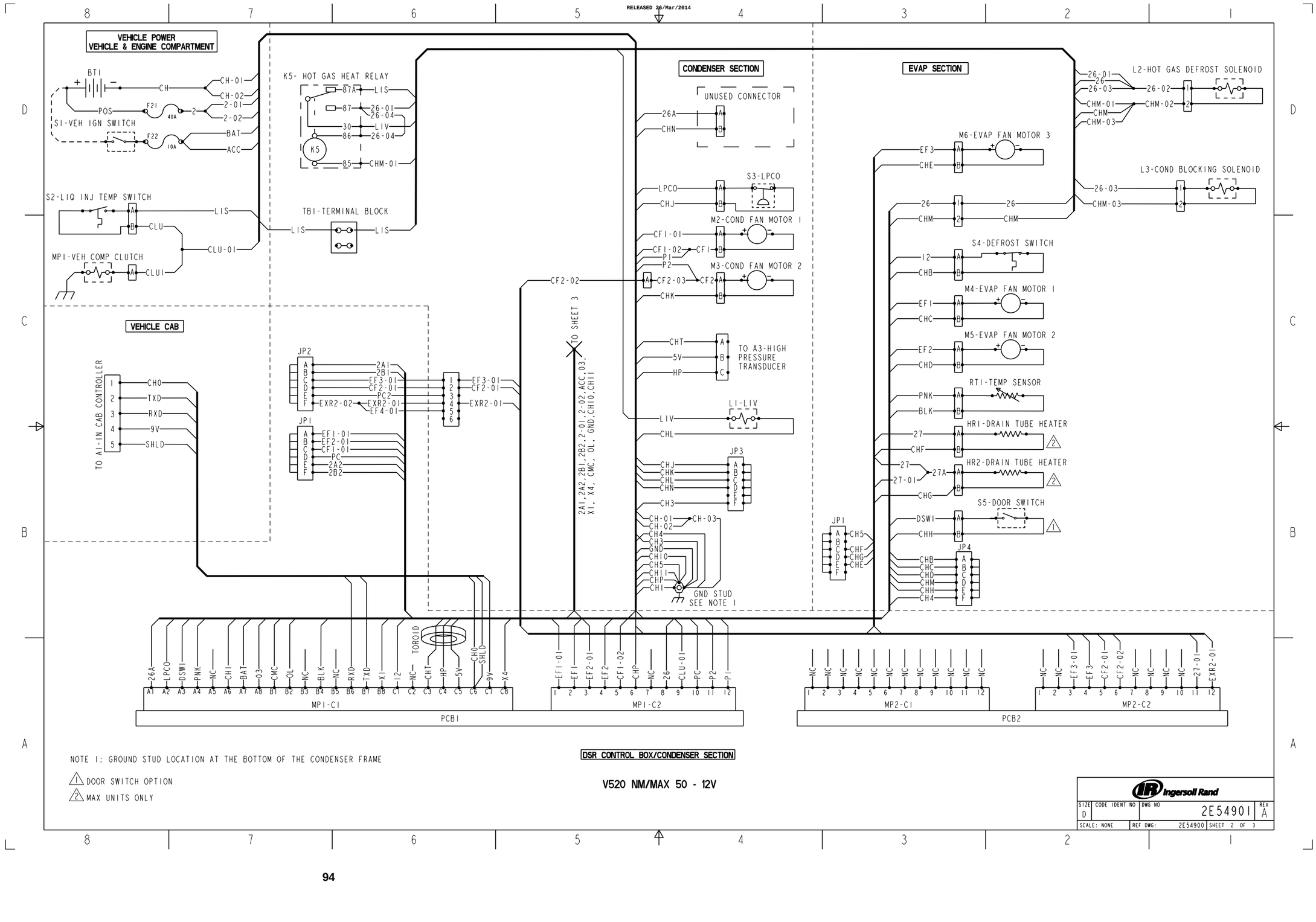
SCALE: NONE	REF DWG: 2E54899	SHEET 2 OF 2	

V-520 20/50 1PH, V-520 MAX 20/50 1PH Wiring Diagram, page 1 of 3



V-520 20/50 1PH, V-520 MAX 20/50 1PH Wiring Diagram, page 2 of 3



NOTE 1: GROUND STUD LOCATION AT THE BOTTOM OF THE CONDENSER FRAME

1 DOOR SWITCH OPTION

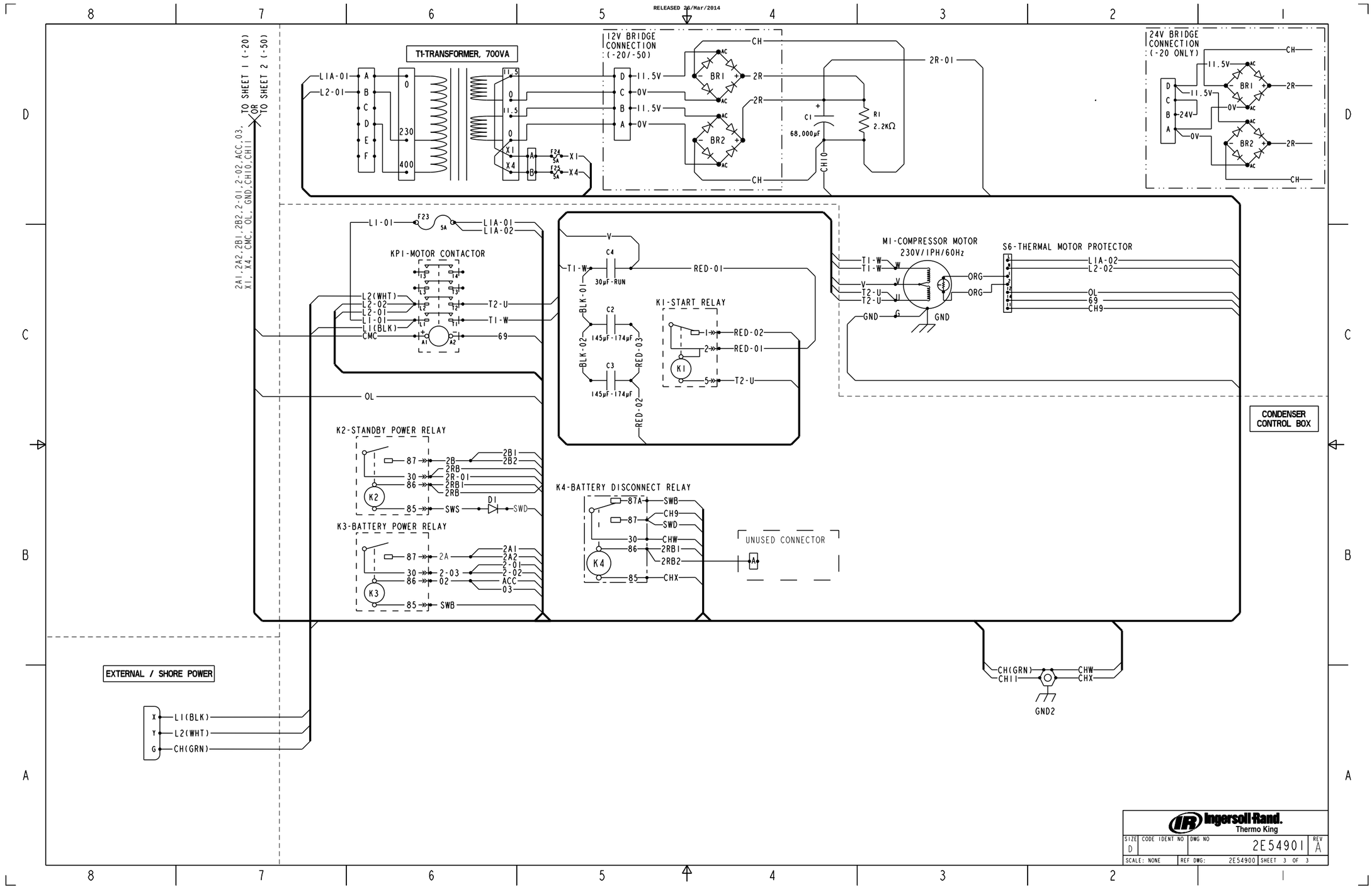
2 MAX UNITS ONLY

DSR CONTROL BOX/CONDENSER SECTION

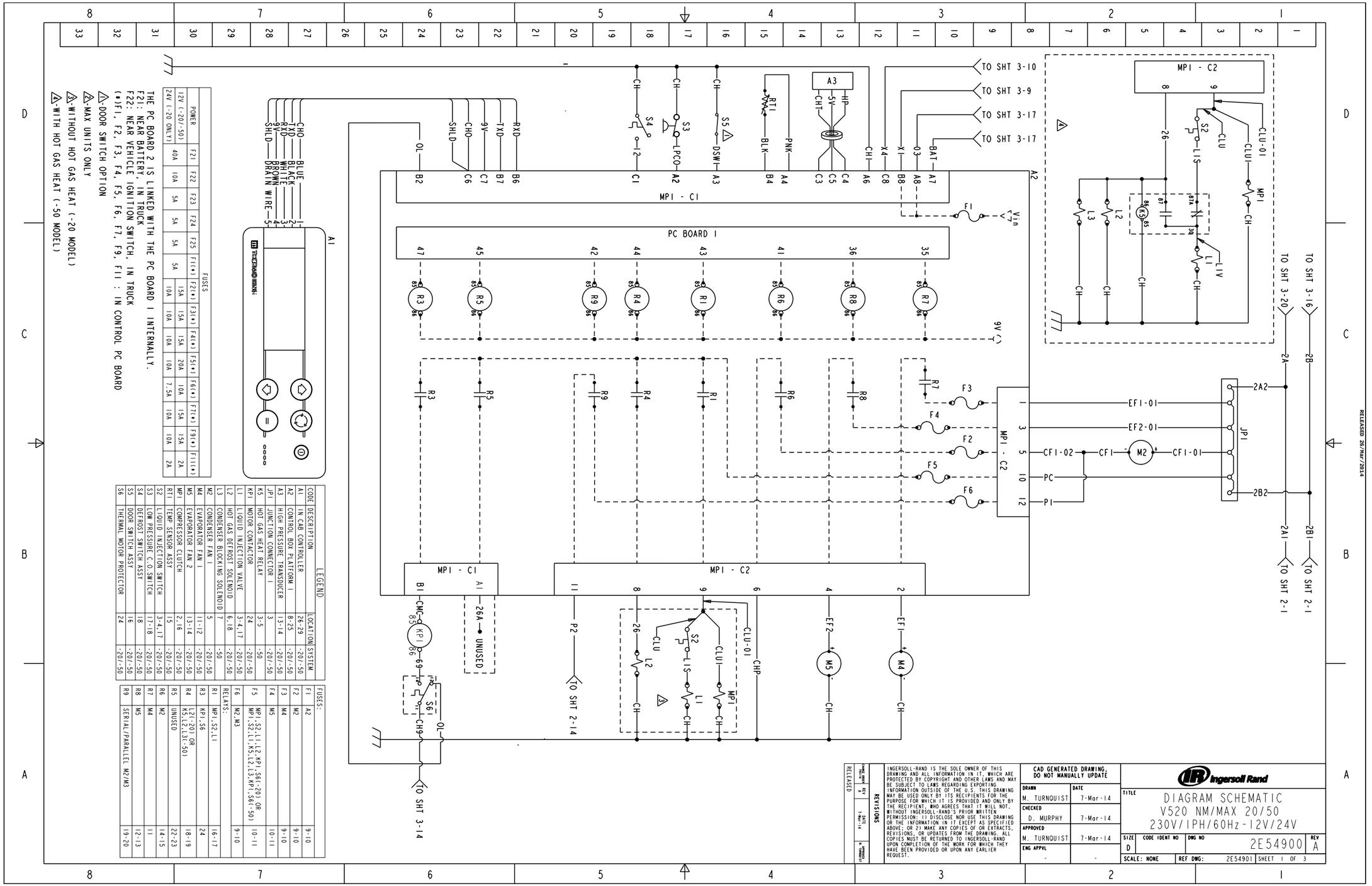
V520 NM/MAX 50 - 12V

Ingersoll Rand			
SIZE D	CODE IDENT NO	DWG NO 2E54901	REV A
SCALE: NONE	REF DWG: 2E54900	SHEET 2 OF 3	

V-520 20/50 1PH, V-520 MAX 20/50 1PH Wiring Diagram, page 3 of 3



V-520 20/50 1PH, V-520 MAX 20/50 1PH Schematic Diagram, page 1 of 3



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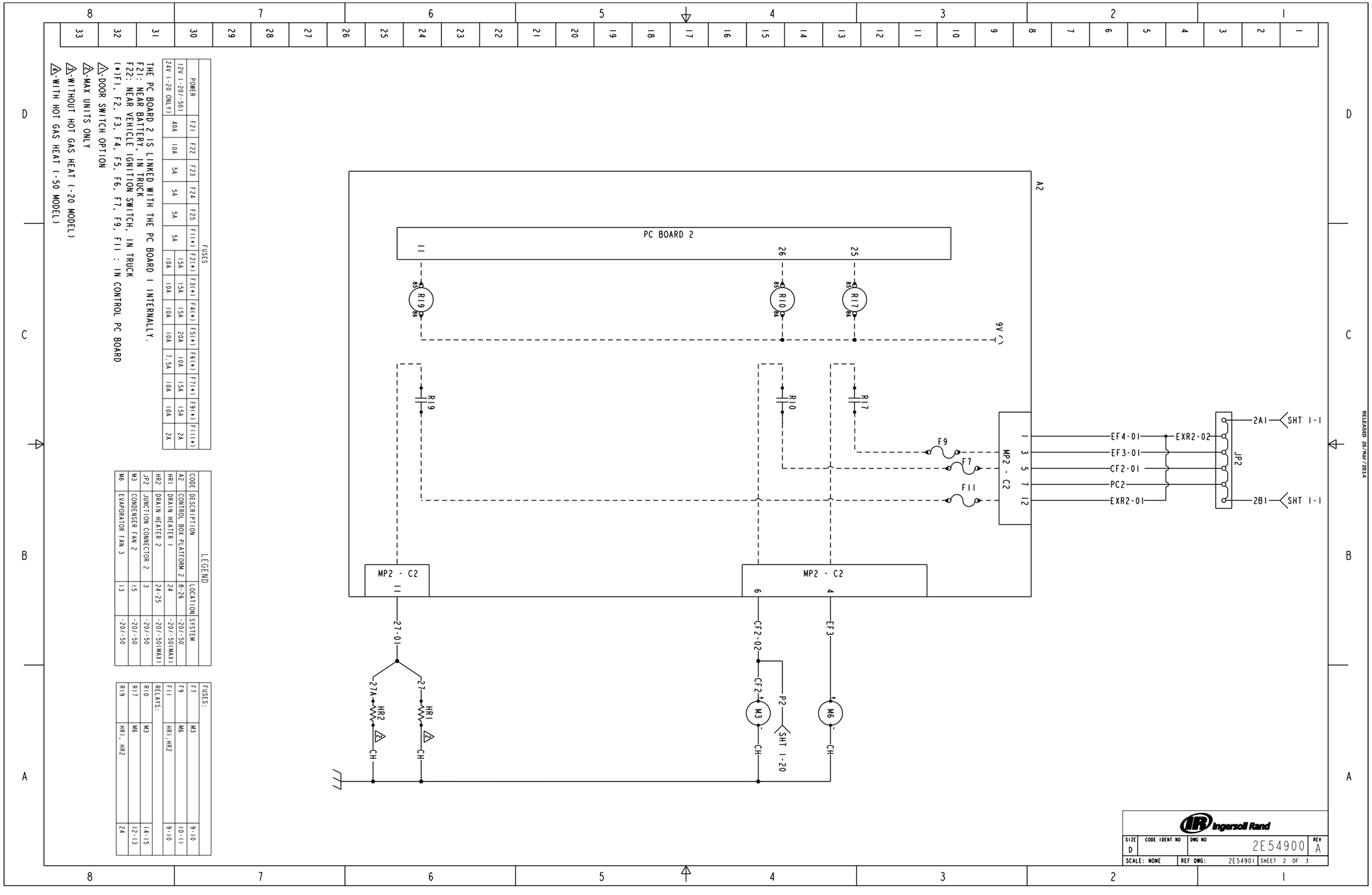
⚠-DOOR SWITCH OPTION
⚠-MAX UNITS ONLY
⚠-WITHOUT HOT GAS HEAT (-20 MODEL)
⚠-WITH HOT GAS HEAT (-50 MODEL)

POWER	FUSES										
12V (-20/-50)	F21	F22	F23	F24	F25	F11(*)	F21(*)	F3(*)	F4(*)	F5(*)	F6(*)	F7(*)	F9(*)	F11(*)
24V (-20 ONLY)	40A	10A	5A	5A	5A	5A	10A	15A	15A	15A	20A	10A	7.5A	10A	15A	15A	2A

LEGEND			
CODE	DESCRIPTION	LOCATION	SYSTEM
A1	IN CAB CONTROLLER	26-29	-20/-50
A2	CONTROL BOX PLATFORM 1	8-25	-20/-50
A3	HIGH PRESSURE TRANSDUCER	13-14	-20/-50
JP1	JUNCTION CONNECTOR 1	3	-20/-50
K5	HOT GAS HEAT RELAY	3-5	-50
KP1	MOTOR CONTACTOR	24	-20/-50
L1	LIQUID INJECTION VALVE	3-4,17	-20/-50
L2	HOT GAS DEFROST SOLENOID	6,18	-20/-50
L3	CONDENSER BLOCKING SOLENOID	7	-50
M2	CONDENSER FAN 1	5	-20/-50
M4	EVAPORATOR FAN 1	11-12	-20/-50
M5	EVAPORATOR FAN 2	13-14	-20/-50
MP1	COMPRESSOR CLUTCH	2,16	-20/-50
RT1	TEMP SENSOR ASSY	15	-20/-50
S2	LIQUID INJECTION SWITCH	3-4,17	-20/-50
S3	LOW PRESSURE C.O.SWITCH	17-18	-20/-50
S4	DEFROST SWITCH ASSY	18	-20/-50
S5	DOOR SWITCH ASSY	16	-20/-50
S6	THERMAL MOTOR PROTECTOR	24	-20/-50

FUSES:		
F1	A2	9-10
F2	M2	9-10
F3	M4	9-10
F4	M5	10-11
F5	MP1,S2,L1,L2,KP1,S6(-20),OR MP1,S2,L1,K5,L2,L3(KP1,S6(-50)	10-11
F6	M2,M3	9-10
RELAYS:		
R1	MP1,S2,L1	16-17
R3	KP1,S6	24
R4	L2(-20) OR K5,L2,L3(-50)	18-19
R5	UNUSED	22-23
R6	M2	14-15
R7	M4	11
R8	M5	12-13
R9	SERIAL/PARRALEL M2/M3	19-20



FUSES												
POWER	F21	F22	F23	F24	F25	F1(•)	F2(•)	F3(•)	F4(•)	F5(•)	F6(•)	F7(•)	F9(•)	F11(•)
12V (-20/-50)	40A	10A	5A	5A	5A	5A	10A	15A	15A	15A	20A	10A	15A	15A	2A
24V (-20 ONLY)								10A	10A	10A	10A	7.5A	10A	10A	2A

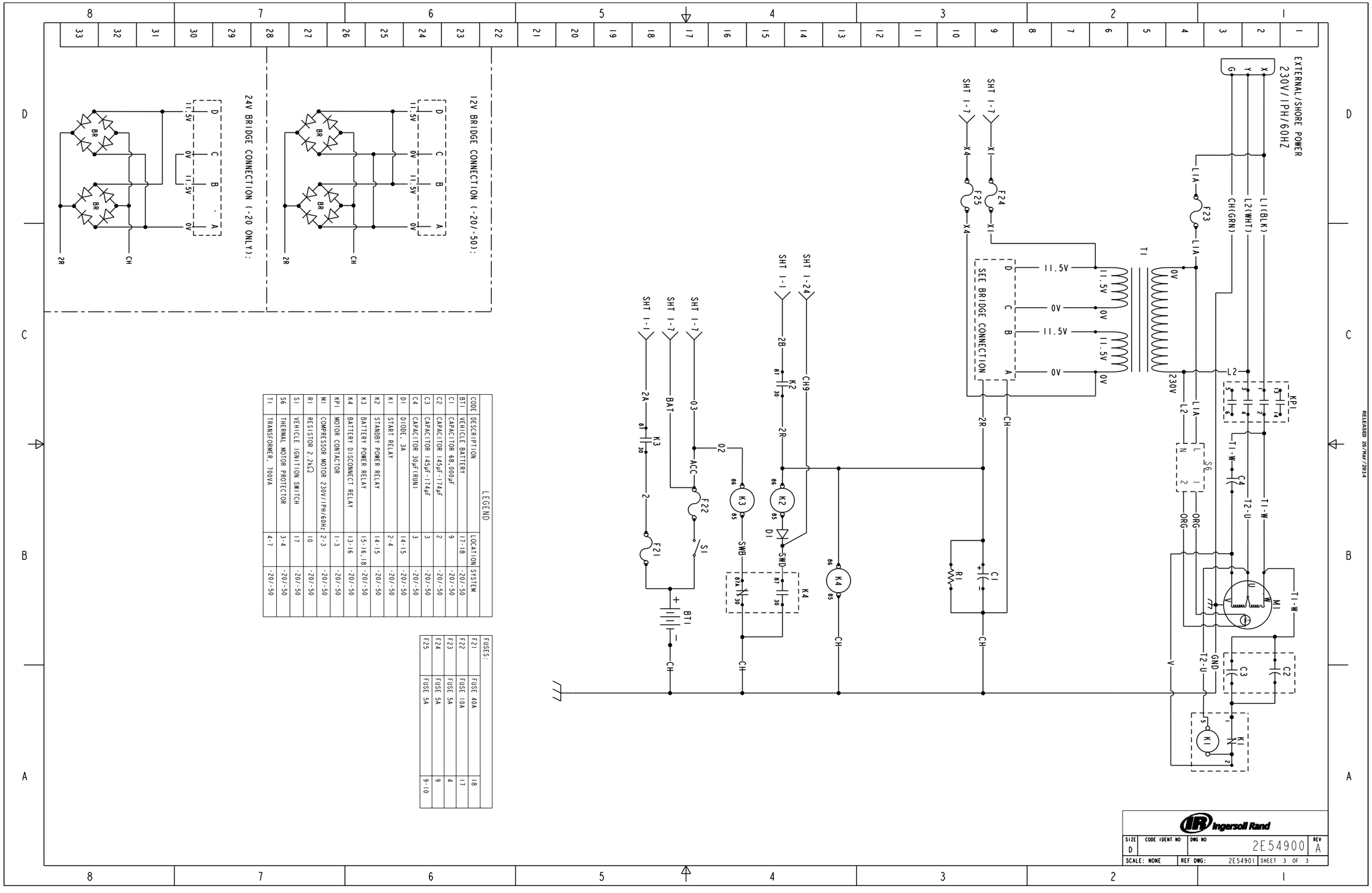
THE PC BOARD 2 IS LINKED WITH THE PC BOARD 1 INTERNALLY.
F21: NEAR BATTERY, IN TRUCK
F22: NEAR VEHICLE IGNITION SWITCH, IN TRUCK
(•)F1, F2, F3, F4, F5, F6, F7, F9, F11 : IN CONTROL PC BOARD

⚠1 -DOOR SWITCH OPTION
⚠2 -MAX UNITS ONLY
⚠3 -WITHOUT HOT GAS HEAT (-20 MODEL)
⚠4 -WITH HOT GAS HEAT (-50 MODEL)

LEGEND			
CODE	DESCRIPTION	LOCATION	SYSTEM
A2	CONTROL BOX PLATFORM 2	8-26	-20/-50
HR1	DRAIN HEATER 1	24	-20/-50(MAX)
HR2	DRAIN HEATER 2	24-25	-20/-50(MAX)
JP2	JUNCTION CONNECTOR 2	3	-20/-50
M3	CONDENSER FAN 2	15	-20/-50
M6	EVAPORATOR FAN 3	13	-20/-50

FUSES:		
F7	M3	9-10
F9	M6	10-11
F11	HR1,HR2	9-10
RELAYS:		
R10	M3	14-15
R17	M6	12-13
R19	HR1, HR2	24

V-520 20/50 1PH, V-520 MAX 20/50 1PH Schematic Diagram, page 3 of 3



CODE	DESCRIPTION	LOCATION SYSTEM
BT1	VEHICLE BATTERY	17-18 -20/-50
C1	CAPACITOR 68,000µF	9 -20/-50
C2	CAPACITOR 145µF-174µF	2 -20/-50
C3	CAPACITOR 145µF-174µF	3 -20/-50
C4	CAPACITOR 30µF(RUN)	3 -20/-50
D1	DIODE, 3A	14-15 -20/-50
K1	START RELAY	2-4 -20/-50
K2	STANDBY POWER RELAY	14-15 -20/-50
K3	BATTERY POWER RELAY	15-16,18 -20/-50
K4	BATTERY DISCONNECT RELAY	13-16 -20/-50
KP1	MOTOR CONTACTOR	1-3 -20/-50
M1	COMPRESSOR MOTOR 230V/1PH/60Hz	2-3 -20/-50
R1	RESISTOR 2.2kΩ	10 -20/-50
S1	VEHICLE IGNITION SWITCH	17 -20/-50
S6	THERMAL MOTOR PROTECTOR	3-4 -20/-50
T1	TRANSFORMER, 700VA	4-7 -20/-50

FUSES:		
F21	FUSE 40A	18
F22	FUSE 10A	17
F23	FUSE 5A	4
F24	FUSE 5A	9
F25	FUSE 5A	9-10

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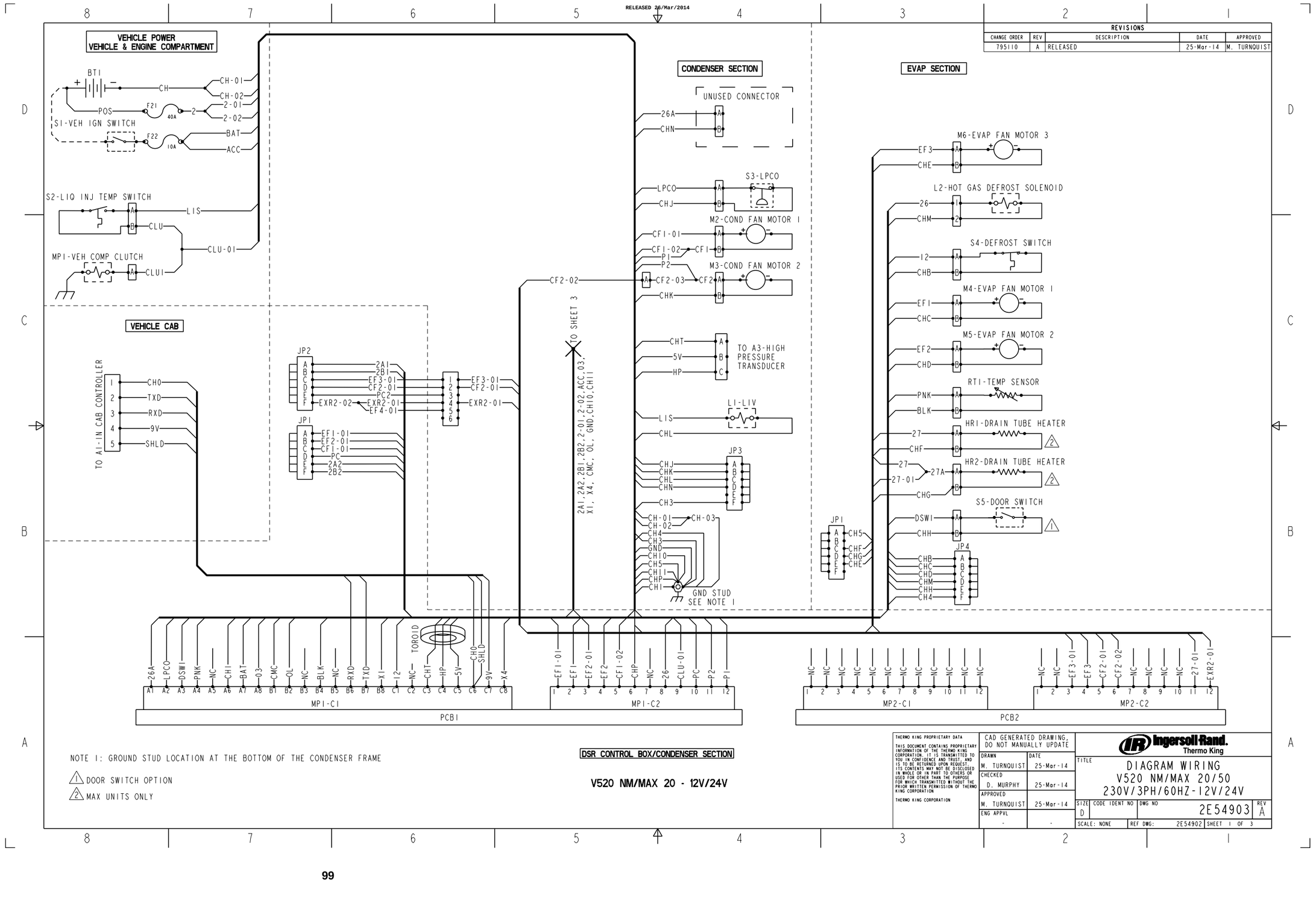
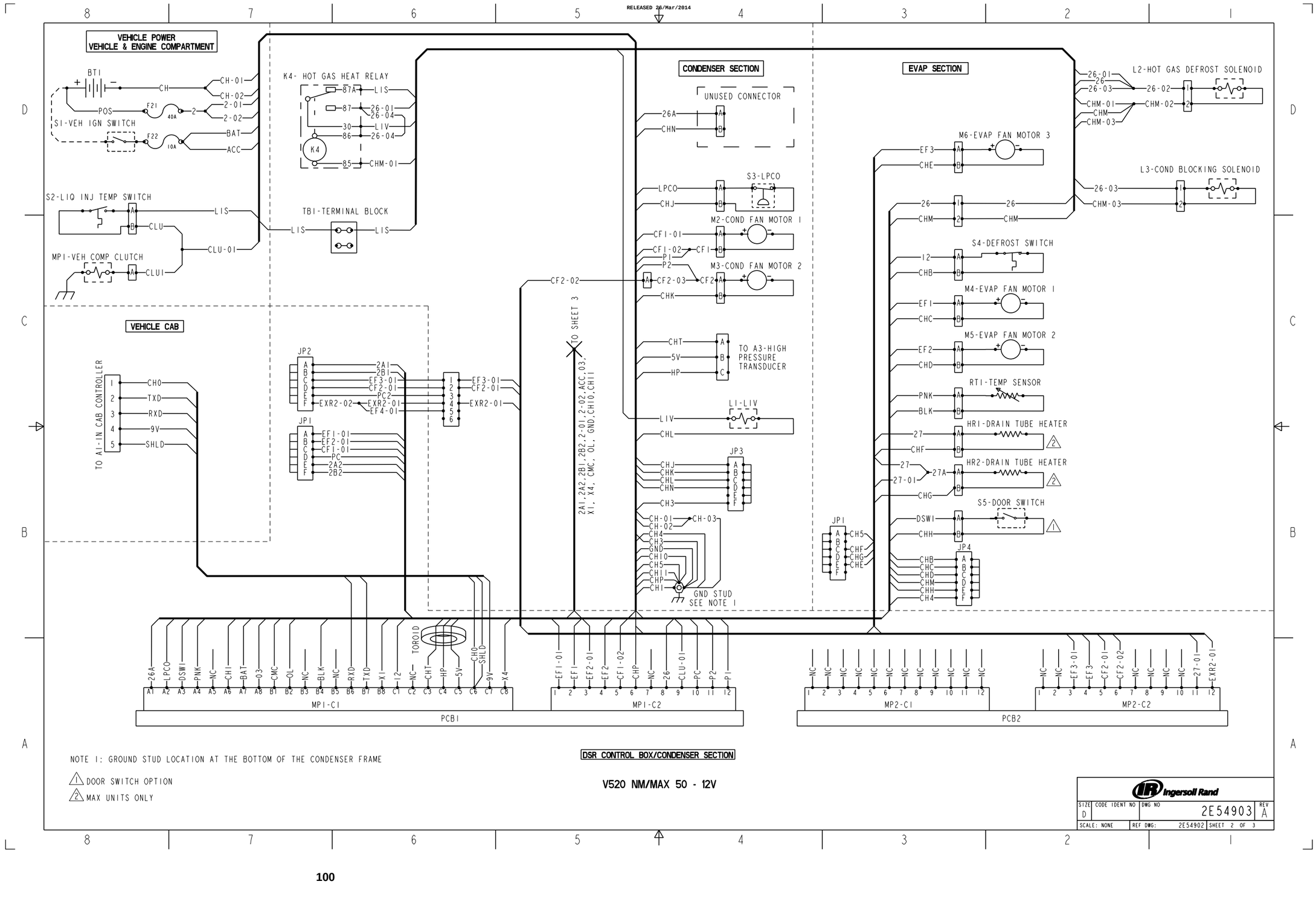
SIZE	CODE IDENT NO	DWG NO	REV
D		2E54900	A
SCALE: NONE	REF DWG: 2E54901	SHEET 3 OF 3	

RELEASED 28/Mar/2014

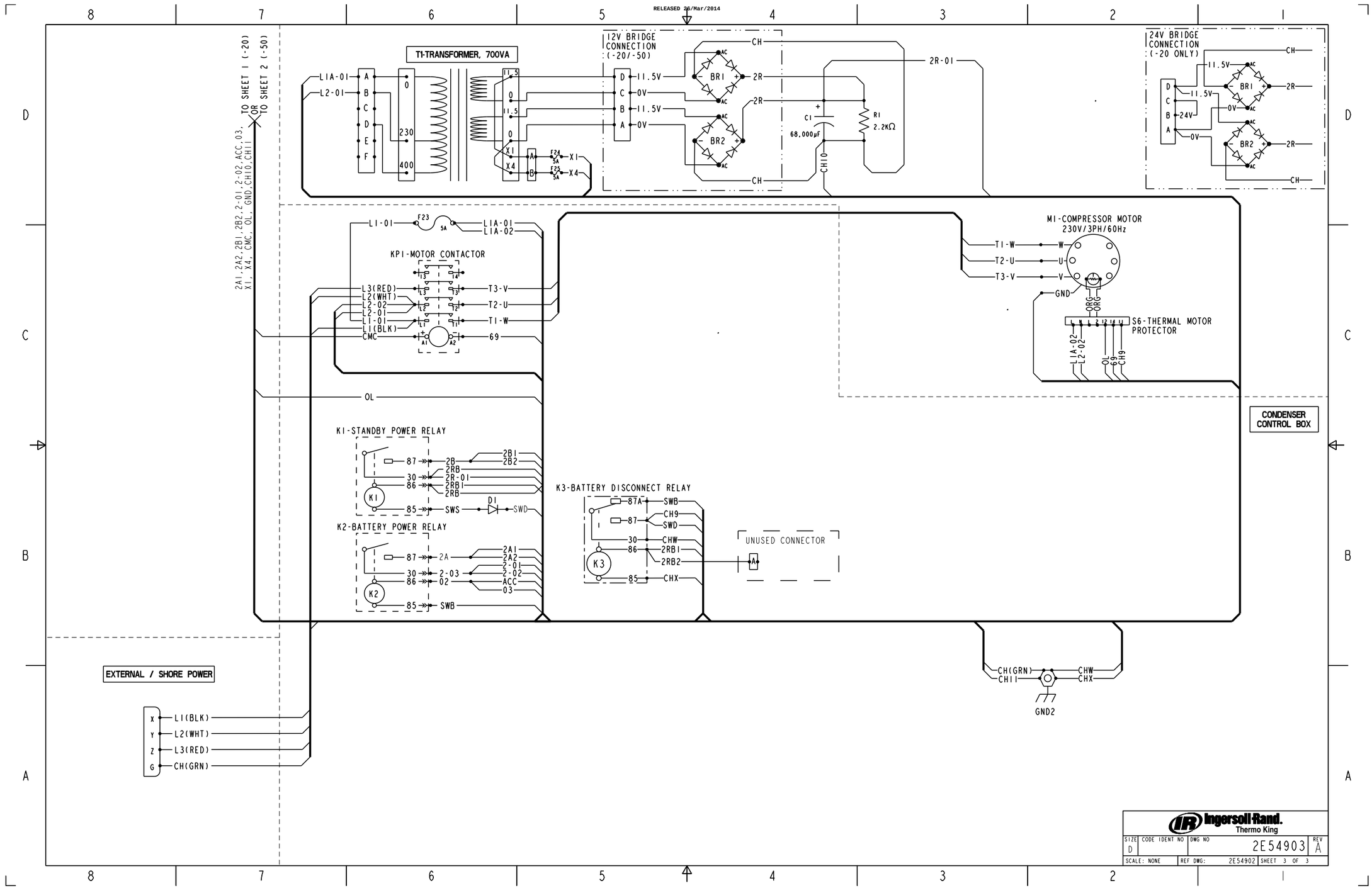
V-520 20/50 3PH, V-520 MAX 20/50 3PH Wiring Diagram, page 1 of 3



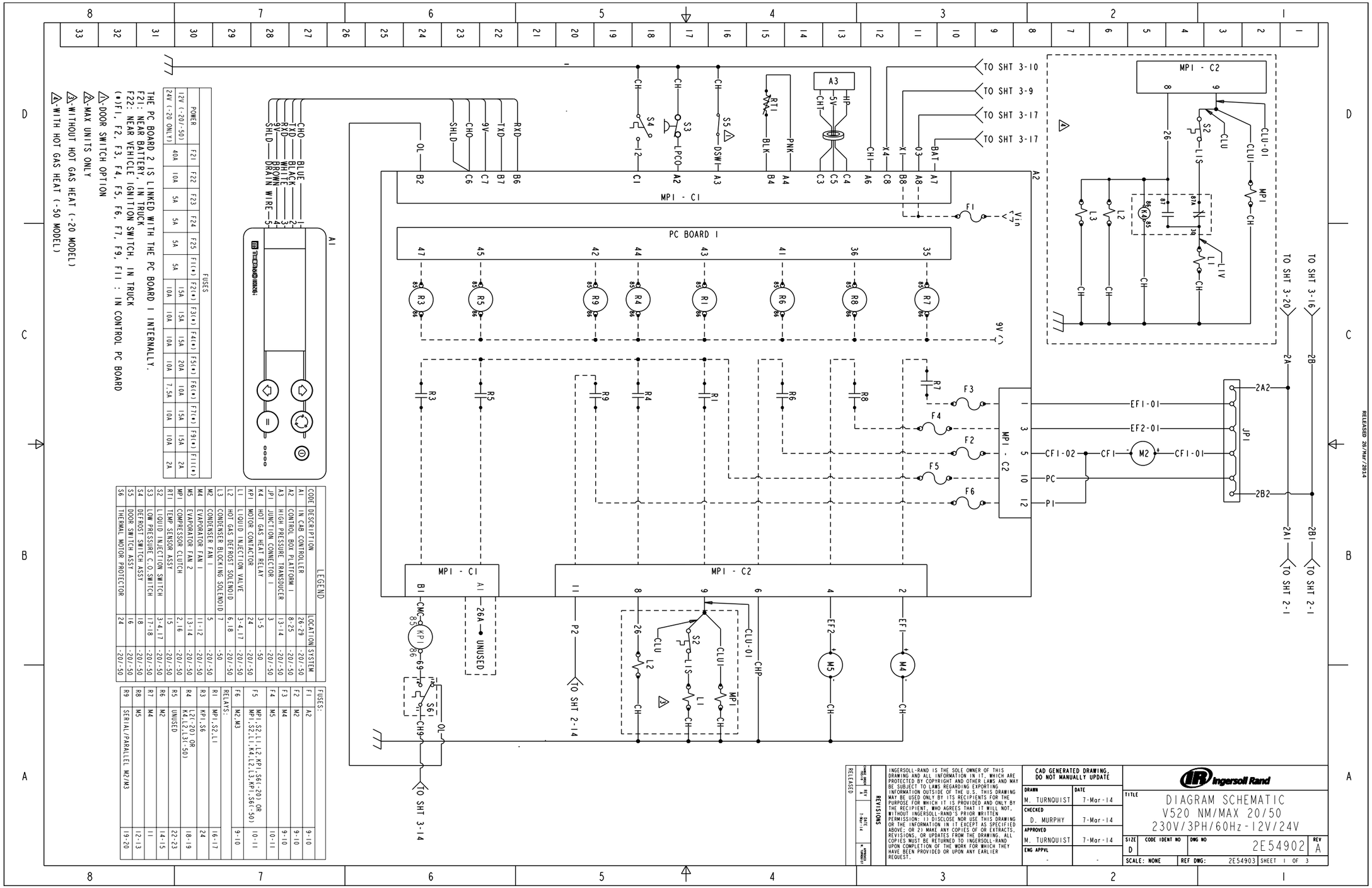
V-520 20/50 3PH, V-520 MAX 20/50 3PH Wiring Diagram, page 2 of 3



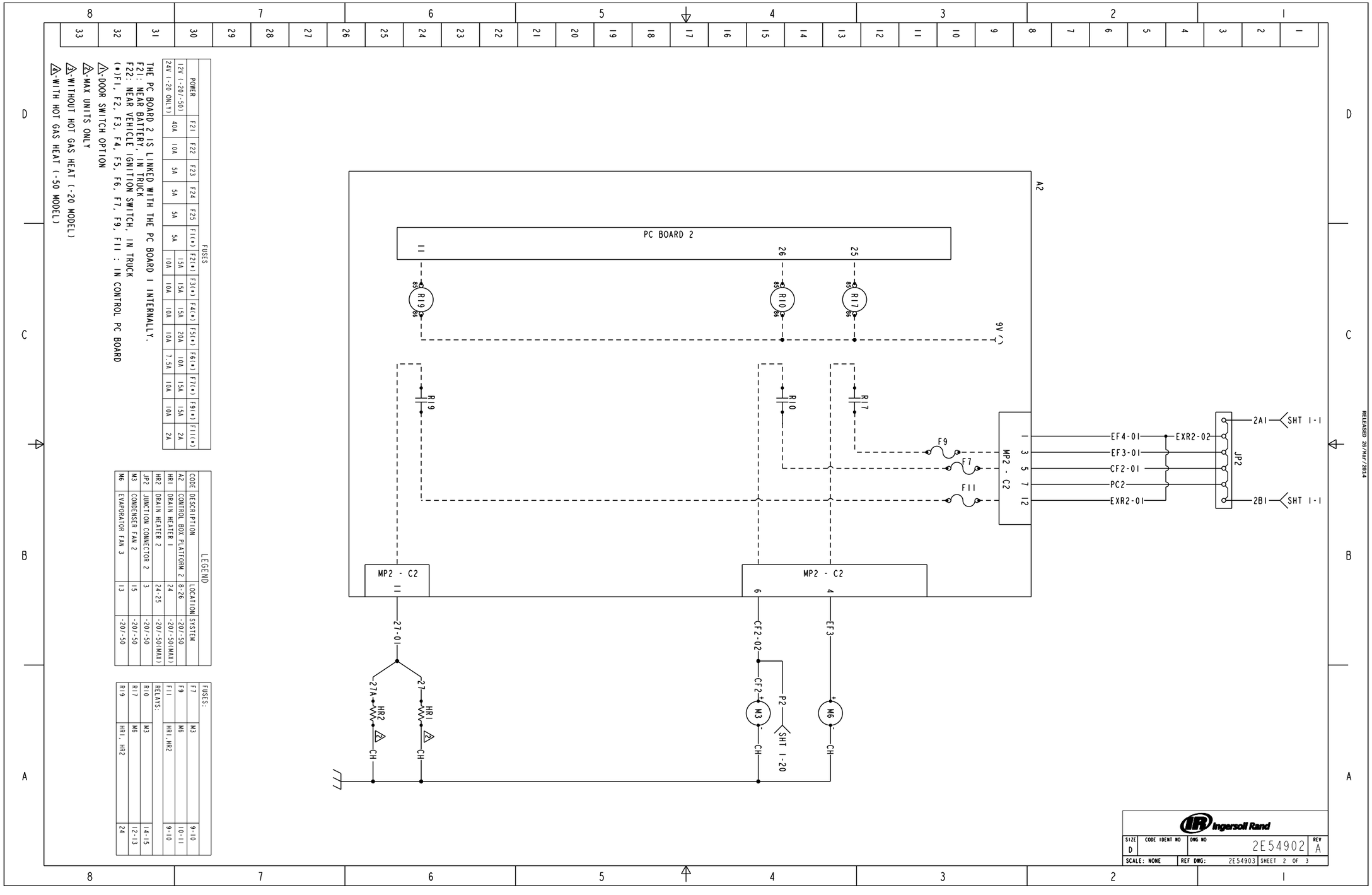
V-520 20/50 3PH, V-520 MAX 20/50 3PH Wiring Diagram, page 3 of 3



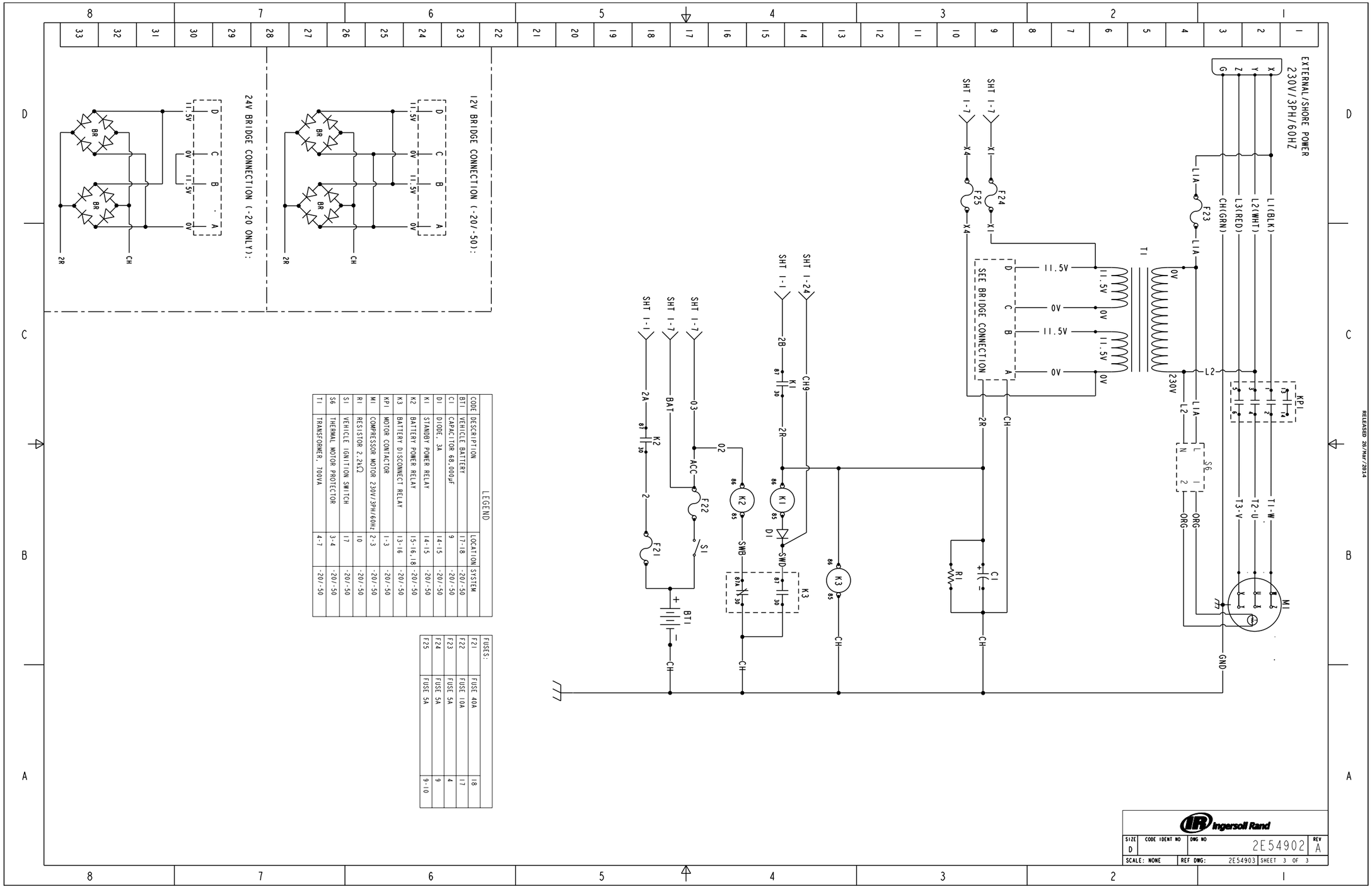
V-520 20/50 3PH, V-520 MAX 20/50 3PH Schematic Diagram, page 1 of 3



V-520 20/50 3PH, V-520 MAX 20/50 3PH Schematic Diagram, page 2 of 3



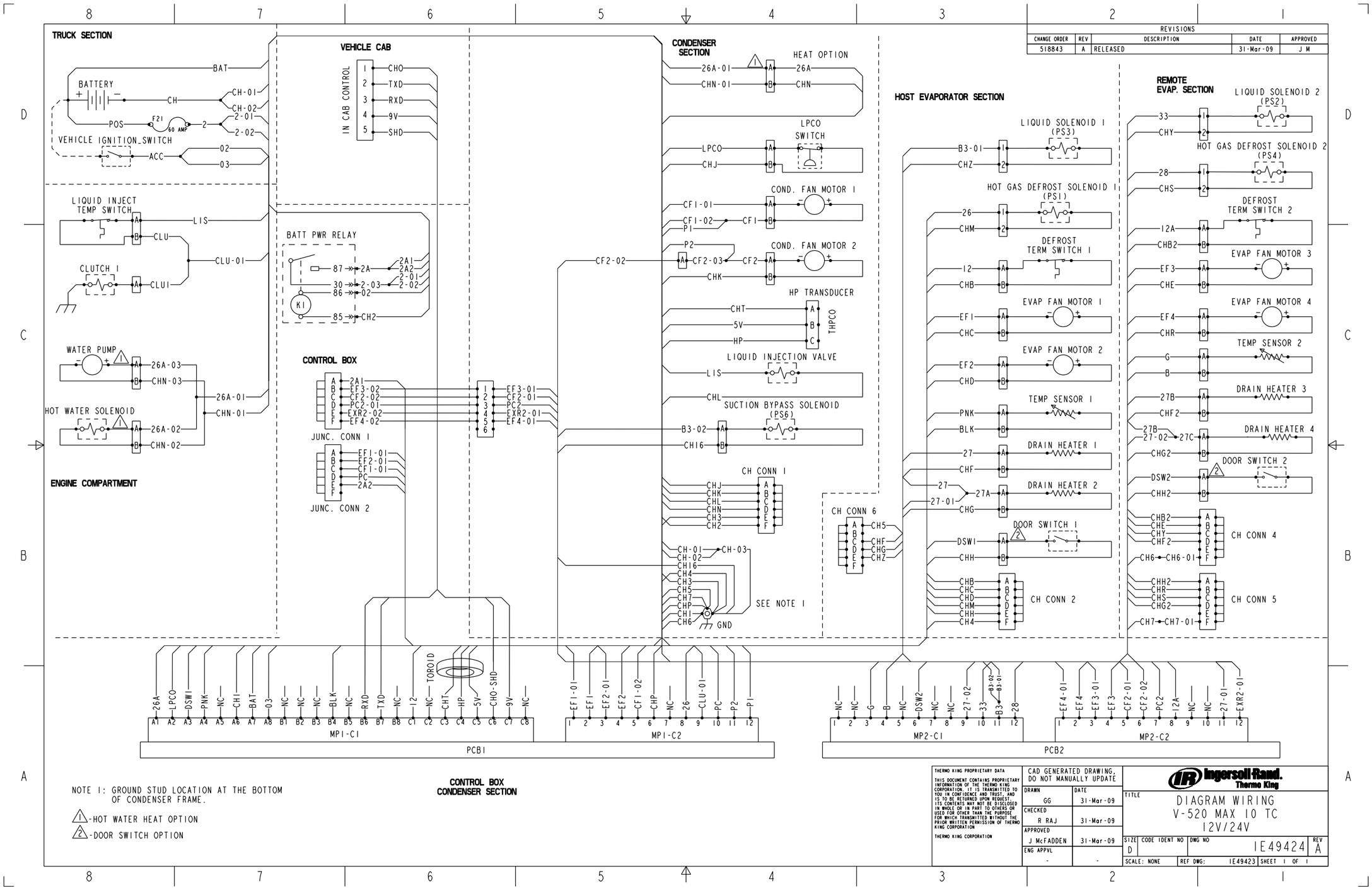
V-520 20/50 3PH, V-520 MAX 20/50 3PH Schematic Diagram, page 3 of 3



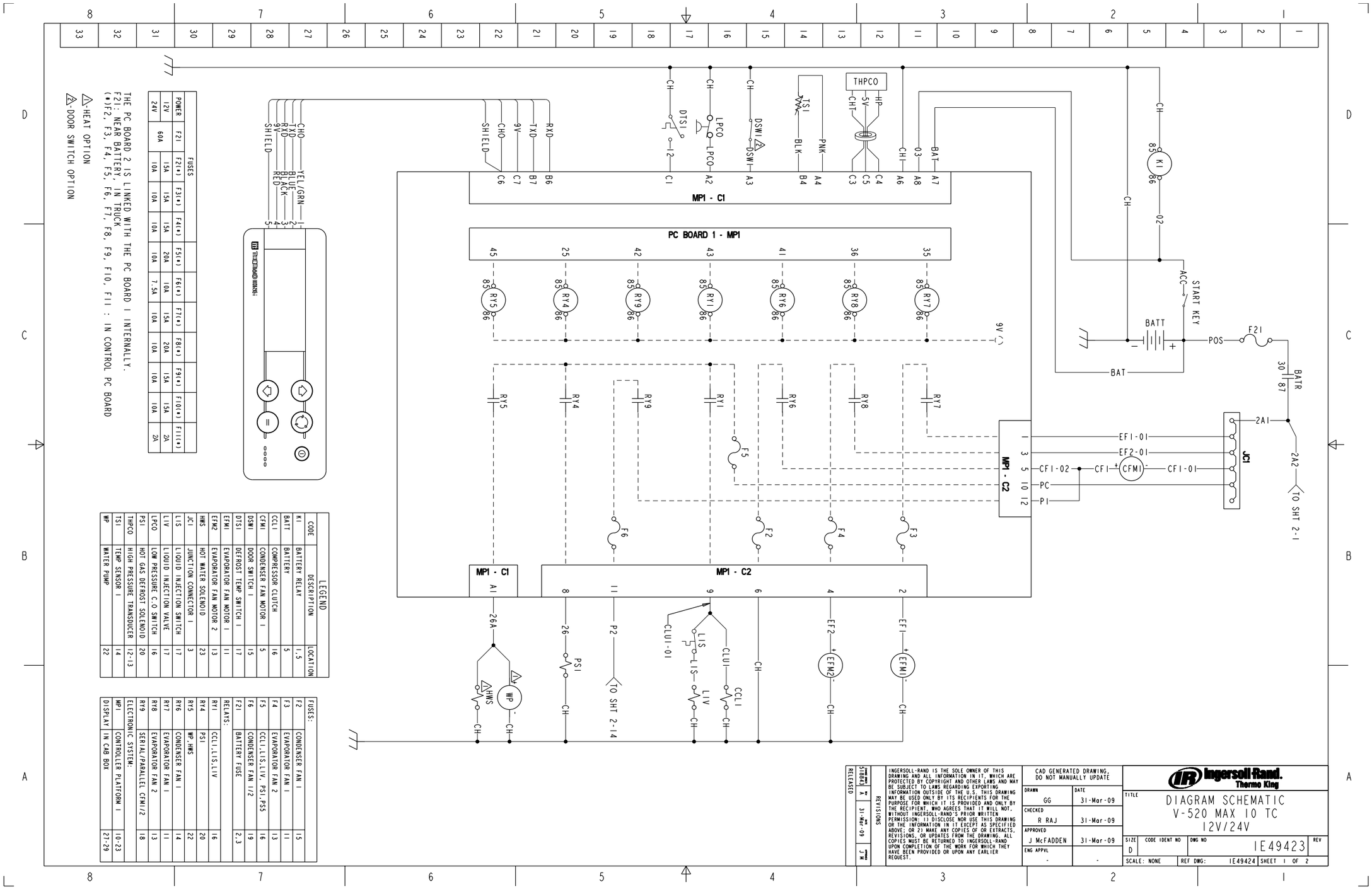
CODE	DESCRIPTION	LOCATION	SYSTEM
BT1	VEHICLE BATTERY	17-18	-20/-50
C1	CAPACITOR 68,000µF	9	-20/-50
D1	DIODE, 3A	14-15	-20/-50
K1	STANDBY POWER RELAY	14-15	-20/-50
K2	BATTERY POWER RELAY	15-16,18	-20/-50
K3	BATTERY DISCONNECT RELAY	13-16	-20/-50
KP1	MOTOR CONTACTOR	1-3	-20/-50
M1	COMPRESSOR MOTOR 230V/3PH/60Hz	2-3	-20/-50
R1	RESISTOR 2.2kΩ	10	-20/-50
S1	VEHICLE IGNITION SWITCH	17	-20/-50
S6	THERMAL MOTOR PROTECTOR	3-4	-20/-50
T1	TRANSFORMER, 700VA	4-7	-20/-50

FUSES:		
F21	FUSE 40A	18
F22	FUSE 10A	17
F23	FUSE 5A	4
F24	FUSE 5A	9
F25	FUSE 5A	9-10

V-520 MAX 10 SPECTRUM Wiring Diagram



V-520 MAX 10 SPECTRUM Schematic Diagram, page 1 of 2



FUSES											
POWER	F21	F2(•)	F3(•)	F4(•)	F5(•)	F6(•)	F7(•)	F8(•)	F9(•)	F10(•)	F11(•)
12V	60A	15A	15A	15A	20A	10A	15A	20A	15A	15A	2A
24V		10A	10A	10A	10A	7.5A	10A	10A	10A	10A	2A

THE PC BOARD 2 IS LINKED WITH THE PC BOARD 1 INTERNALLY.
F21: NEAR BATTERY, IN TRUCK
(•)F2, F3, F4, F5, F6, F7, F8, F9, F10, F11 : IN CONTROL PC BOARD

⚠1-HEAT OPTION
⚠2-DOOR SWITCH OPTION

LEGEND		
CODE	DESCRIPTION	LOCATION
K1	BATTERY RELAY	1,5
BATT	BATTERY	5
CCL1	COMPRESSOR CLUTCH	16
CFM1	CONDENSER FAN MOTOR 1	5
DSW1	DOOR SWITCH 1	15
DTS1	DEFROST TEMP SWITCH 1	17
EFM1	EVAPORATOR FAN MOTOR 1	11
EFM2	EVAPORATOR FAN MOTOR 2	13
HWS	HOT WATER SOLENOID	23
JC1	JUNCTION CONNECTOR 1	3
LIS	LIQUID INJECTION SWITCH	17
LIV	LIQUID INJECTION VALVE	17
LPCO	LOW PRESSURE C.O SWITCH	16
PS1	HOT GAS DEFROST SOLENOID	20
THPCO	HIGH PRESSURE TRANSDUCER	12-13
TS1	TEMP SENSOR 1	14
WP	WATER PUMP	22

FUSES:		
F2	CONDENSER FAN 1	15
F3	EVAPORATOR FAN 1	11
F4	EVAPORATOR FAN 2	13
F5	CCL1,LIS,LIV, PS1,PS5	16
F6	CONDENSER FAN 1/2	19
F21	BATTERY FUSE	2,3
RELAYS:		
RY1	CCL1,LIS,LIV	16
RY4	PS1	20
RY5	WP HWS	22
RY6	CONDENSER FAN 1	14
RY7	EVAPORATOR FAN 1	11
RY8	EVAPORATOR FAN 2	13
RY9	SERIAL/PARALLEL CFM1/2	18
ELECTRONIC SYSTEM:		
MP1	CONTROLLER PLATFORM 1	10-23
DISPLAY	IN CAB BOX	27-29

REVISIONS		
RELEASED	A	31-Mar-09
		J.M.

CAD GENERATED DRAWING.
DO NOT MANUALLY UPDATE

DRAWN	GG	31-Mar-09
CHECKED	R RAJ	31-Mar-09
APPROVED	J McFADDEN	31-Mar-09
ENG APPVL	-	-

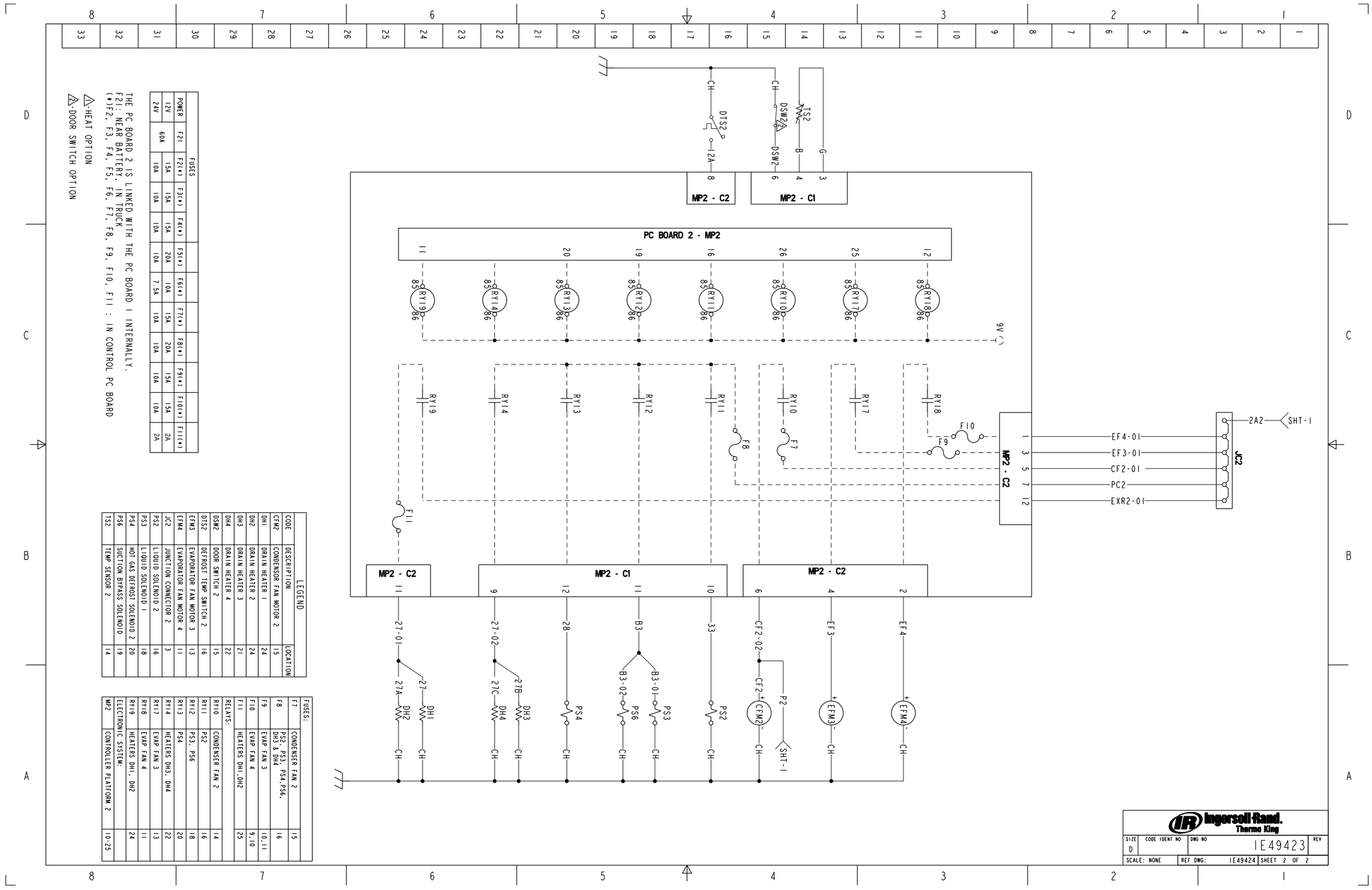
Ingersoll-Rand. Thermo King

TITLE
DIAGRAM SCHEMATIC
V-520 MAX 10 TC
12V/24V

SIZE	CODE IDENT NO	DWG NO	REV
D		IE49423	

SCALE: NONE | REF DWG: IE49424 | SHEET 1 OF 2

V-520 MAX 10 SPECTRUM Schematic Diagram, page 2 of 2



FUSES											
POWER	F21	F21(*)	F3(*)	F4(*)	F5(*)		F6(*)	F7(*)	F8(*)	F9(*)	F10(*)	F11(*)	
12V													
24V	60A	15A	15A	15A	20A		10A	15A	20A	15A	15A	2A	
		10A	10A	10A	10A		7.5A	10A	10A	10A	10A		

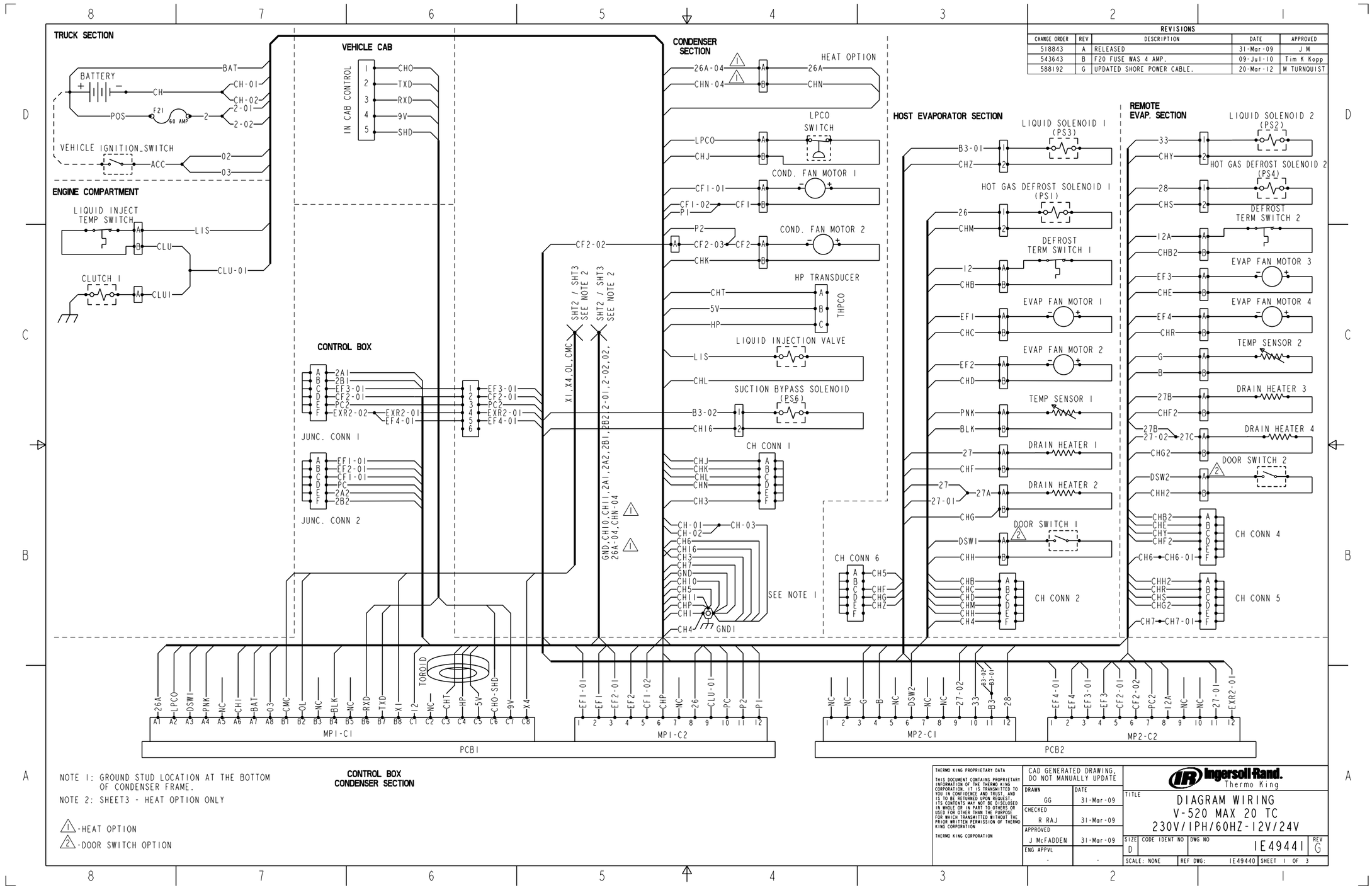
THE PC BOARD 2 IS LINKED WITH THE PC BOARD 1 INTERNALLY.
F21: NEAR BATTERY, IN TRUCK
(*)F2, F3, F4, F5, F6, F7, F8, F9, F10, F11 : IN CONTROL PC BOARD

△-HEAT OPTION
△-DOOR SWITCH OPTION

LEGEND		
CODE	DESCRIPTION	LOCATION
CFM2	CONDENSOR FAN MOTOR 2	15
DH1	DRAIN HEATER 1	24
DH2	DRAIN HEATER 2	24
DH3	DRAIN HEATER 3	21
DH4	DRAIN HEATER 4	22
DSW2	DOOR SWITCH 2	15
DTS2	DEFROST TEMP SWITCH 2	16
EFM3	EVAPORATOR FAN MOTOR 3	13
EFM4	EVAPORATOR FAN MOTOR 4	11
JC2	JUNCTION CONNECTOR 2	3
PS2	LIQUID SOLENOID 2	16
PS3	LIQUID SOLENOID 1	18
PS4	HOT GAS DEFROST SOLENOID 2	20
PS6	SUCTION BYPASS SOLENOID	19
TS2	TEMP SENSOR 2	14

FUSES:		
F7	CONDENSER FAN 2	15
F8	PS2, PS3, PS4,PS6, DH3 & DH4	16
F9	EVAP FAN 3	10,11
F10	EVAP FAN 4	9,10
F11	HEATERS DH1,DH2	25
RELAYS:		
RY10	CONDENSER FAN 2	14
RY11	PS2	16
RY12	PS3, PS6	18
RY13	PS4	20
RY14	HEATERS DH3, DH4	22
RY17	EVAP FAN 3	13
RY18	EVAP FAN 4	11
RY19	HEATERS DH1, DH2	24
ELECTRONIC SYSTEM:		
MP2	CONTROLLER PLATFORM 2	10-25

V-520 MAX 20 SPECTRUM 1PH Wiring Diagram, page 1 of 3



REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
518843	A	RELEASED	31-Mar-09	J M
543643	B	F20 FUSE WAS 4 AMP.	09-Jul-10	Tim K Kopp
588192	G	UPDATED SHORE POWER CABLE.	20-Mar-12	M TURNQUIST

NOTE 1: GROUND STUD LOCATION AT THE BOTTOM OF CONDENSER FRAME.

NOTE 2: SHEET3 - HEAT OPTION ONLY

1 -HEAT OPTION

2 -DOOR SWITCH OPTION

CONTROL BOX CONDENSER SECTION

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

DRAWN	GG	31-Mar-09
CHECKED	R RAJ	31-Mar-09
APPROVED	J McFADDEN	31-Mar-09
ENG APPVL	-	-

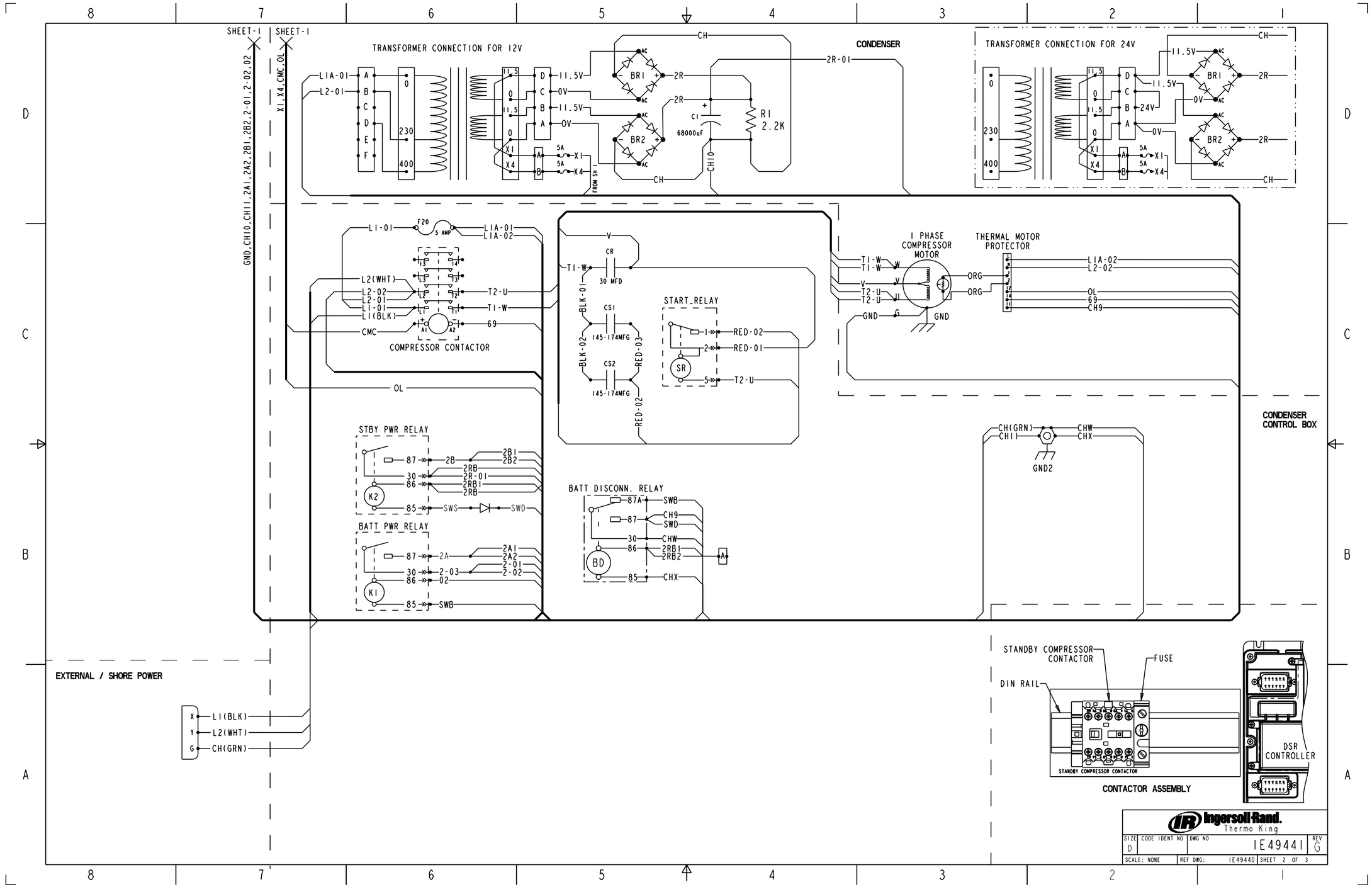
Ingersoll Rand. Thermo King

TITLE: DIAGRAM WIRING V-520 MAX 20 TC 230V/1PH/60HZ-12V/24V

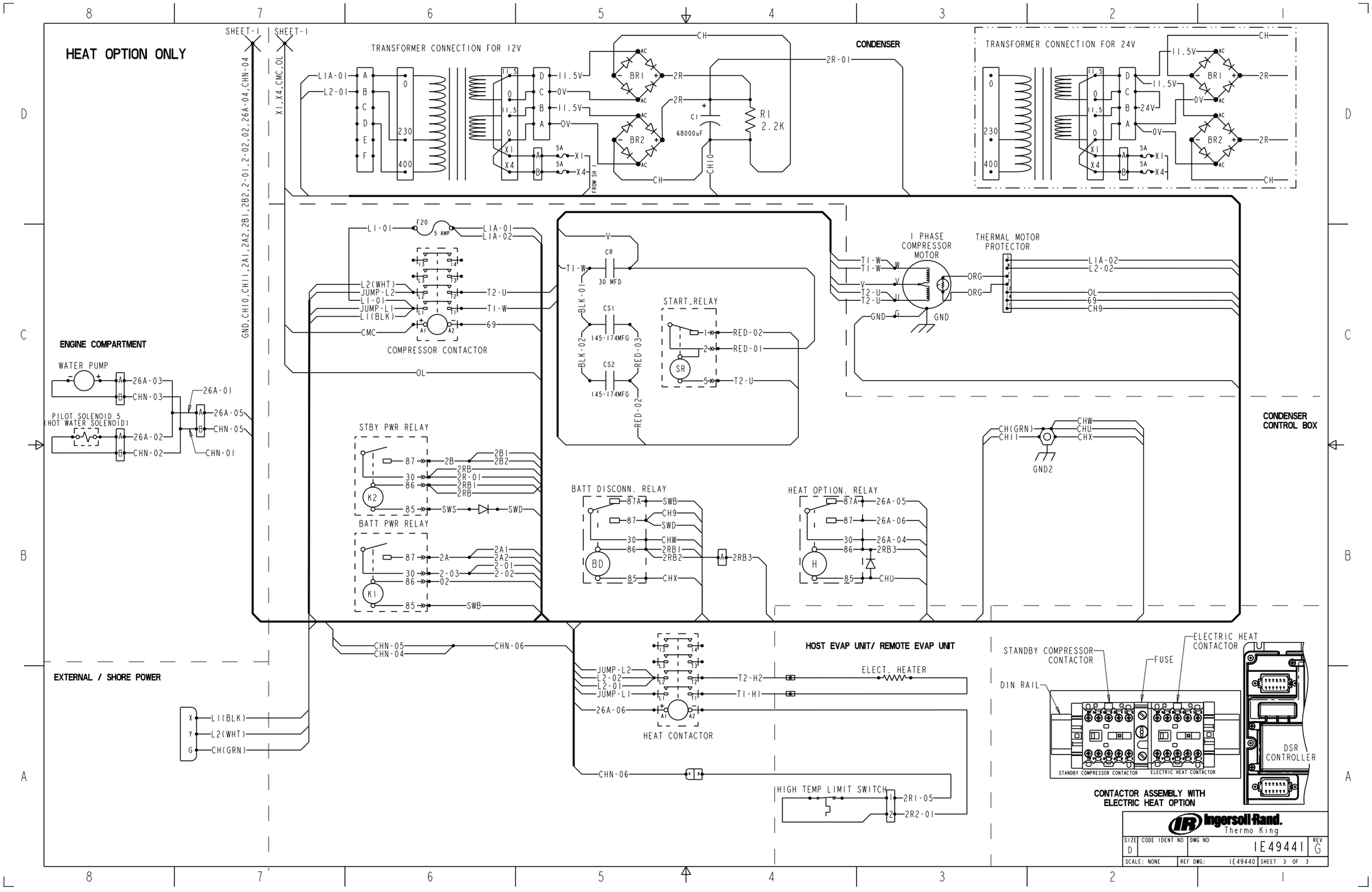
SIZE	CODE IDENT NO	DWG NO	REV
D		IE49441	G

SCALE: NONE | REF DWG: IE49440 | SHEET 1 OF 3

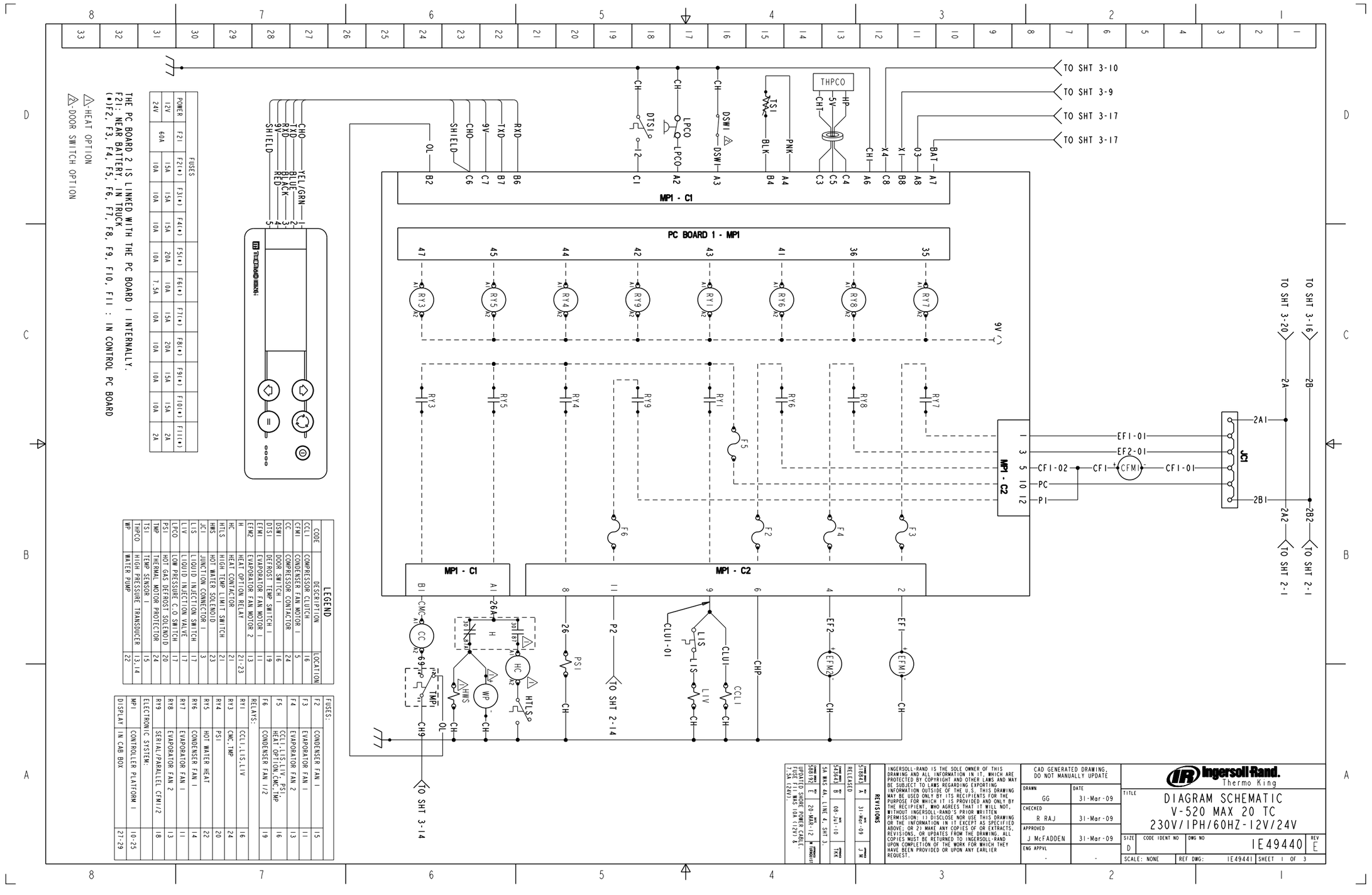
V-520 MAX 20 SPECTRUM 1PH Wiring Diagram, page 2 of 3



V-520 MAX 20 SPECTRUM 1PH Wiring Diagram, page 3 of 3



V-520 MAX 20 SPECTRUM 1PH Schematic Diagram, page 1 of 3



THE PC BOARD 2 IS LINKED WITH THE PC BOARD 1 INTERNALLY.
F21: NEAR BATTERY, IN TRUCK
(•)F2, F3, F4, F5, F6, F7, F8, F9, F10, F11 : IN CONTROL PC BOARD

△-HEAT OPTION
△-DOOR SWITCH OPTION

FUSES											
POWER	F21	F2(•)	F3(•)	F4(•)	F5(•)	F6(•)	F7(•)	F8(•)	F9(•)	F10(•)	F11(•)
12V 24V	60A	15A 10A	15A 10A	15A 10A	20A 10A	10A 7.5A	15A 10A	20A 10A	15A 10A	15A 10A	2A 2A

LEGEND		
CODE	DESCRIPTION	LOCATION
CCLI	COMPRESSOR CLUTCH	16
CFMI	CONDENSER FAN MOTOR 1	5
CC	COMPRESSOR CONTACTOR	24
DSWI	DOOR SWITCH 1	16
DTSI	DEFROST TEMP SWITCH 1	19
EFMI	EVAPORATOR FAN MOTOR 1	11
EFM2	EVAPORATOR FAN MOTOR 2	13
H	HEAT OPTION RELAY	21-23
HC	HEAT CONTACTOR	21
HTLS	HIGH TEMP LIMIT SWITCH	21
HWS	HOT WATER SOLENOID	23
JC1	JUNCTION CONNECTOR 1	3
LIS	LIQUID INJECTION SWITCH	17
LIV	LIQUID INJECTION VALVE	17
LPCO	LOW PRESSURE C.O SWITCH	17
PSI	HOT GAS DEFROST SOLENOID	20
TMP	THERMAL MOTOR PROTECTOR	24
TSI	TEMP SENSOR 1	15
THPCO	HIGH PRESSURE TRANSDUCER	13,14
WP	WATER PUMP	22

FUSES:		
F2	CONDENSER FAN 1	15
F3	EVAPORATOR FAN 1	11
F4	EVAPORATOR FAN 2	13
F5	CCLI,LIS,LIV, PSI, HEAT OPTION,CMC,TMP	16
F6	CONDENSER FAN 1/2	19
RELAYS:		
RY1	CCLI,LIS,LIV	16
RY3	CMC,TMP	24
RY4	PSI	20
RY5	HOT WATER HEAT	22
RY6	CONDENSER FAN 1	14
RY7	EVAPORATOR FAN 1	11
RY8	EVAPORATOR FAN 2	13
RY9	SERIAL/PARALLEL CFMI/2	18
MP1	ELECTRONIC SYSTEM: CONTROLLER PLATFORM 1	10-25
DISPLAY	IN CAB BOX	27-29

REVISIONS			
5788(2)	N	31-Mar-09	J.M.
RELEASED			
5436(3)	B	08-Jul-10	TKN
5A WAS 4A, LINE 4, SHT 3			
5881(2)	E	20-MAR-12	
UPDATED SHORE POWER CABLE. FUSE F1 WAS 10A (12V) & 5A (24V).			

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

DRAWN: GG	DATE: 31-Mar-09
CHECKED: R RAJ	31-Mar-09
APPROVED: J McFADDEN	31-Mar-09
ENG APPVL: -	-

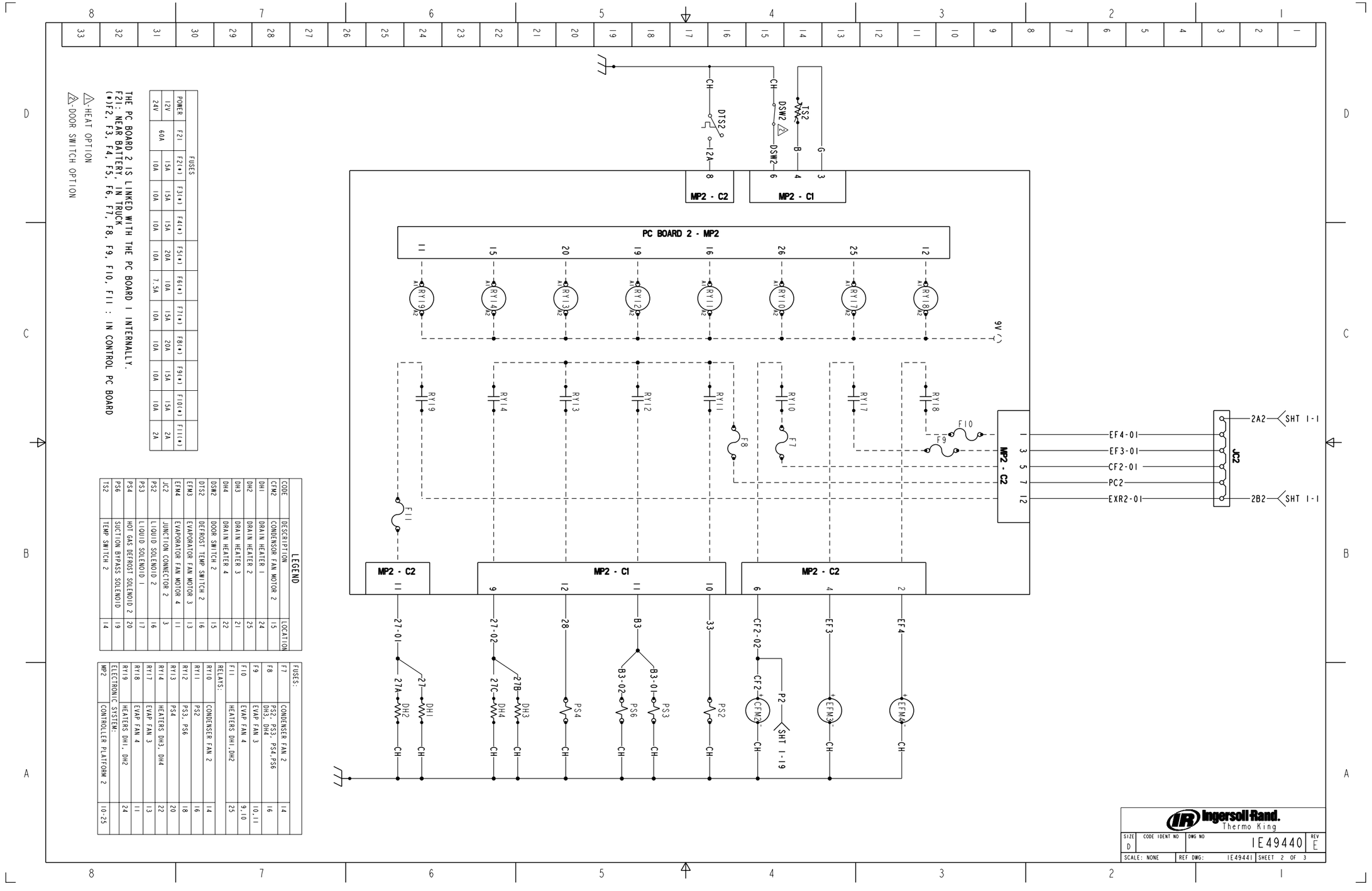
Ingersoll Rand. Thermo King

TITLE: DIAGRAM SCHEMATIC V-520 MAX 20 TC 230V/1PH/60HZ-12V/24V

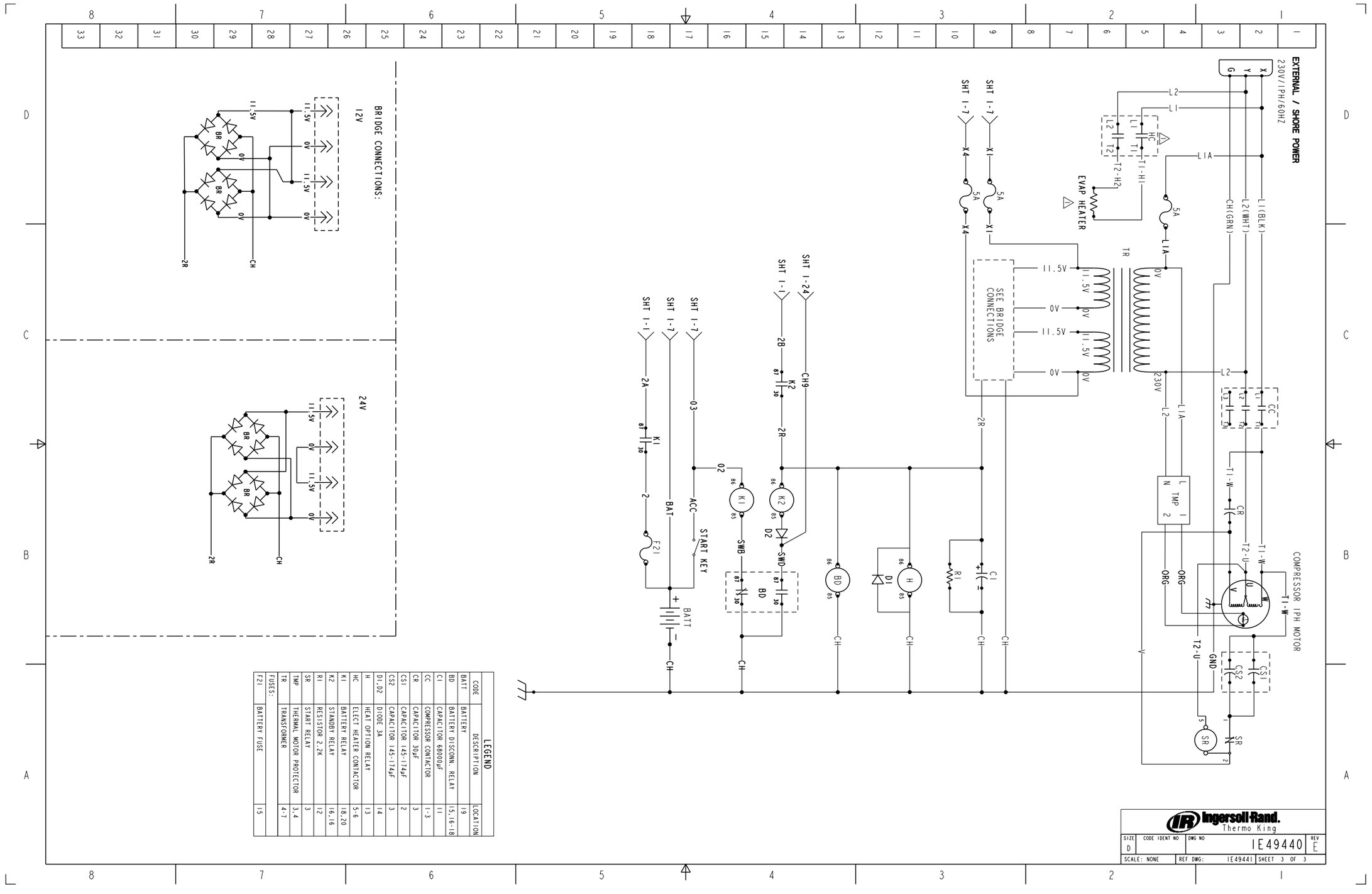
SIZE	CODE IDENT NO	DWG NO	REV
D		IE49440	E

SCALE: NONE | REF DWG: IE49441 | SHEET 1 OF 3

V-520 MAX 20 SPECTRUM 1PH Schematic Diagram, page 2 of 3



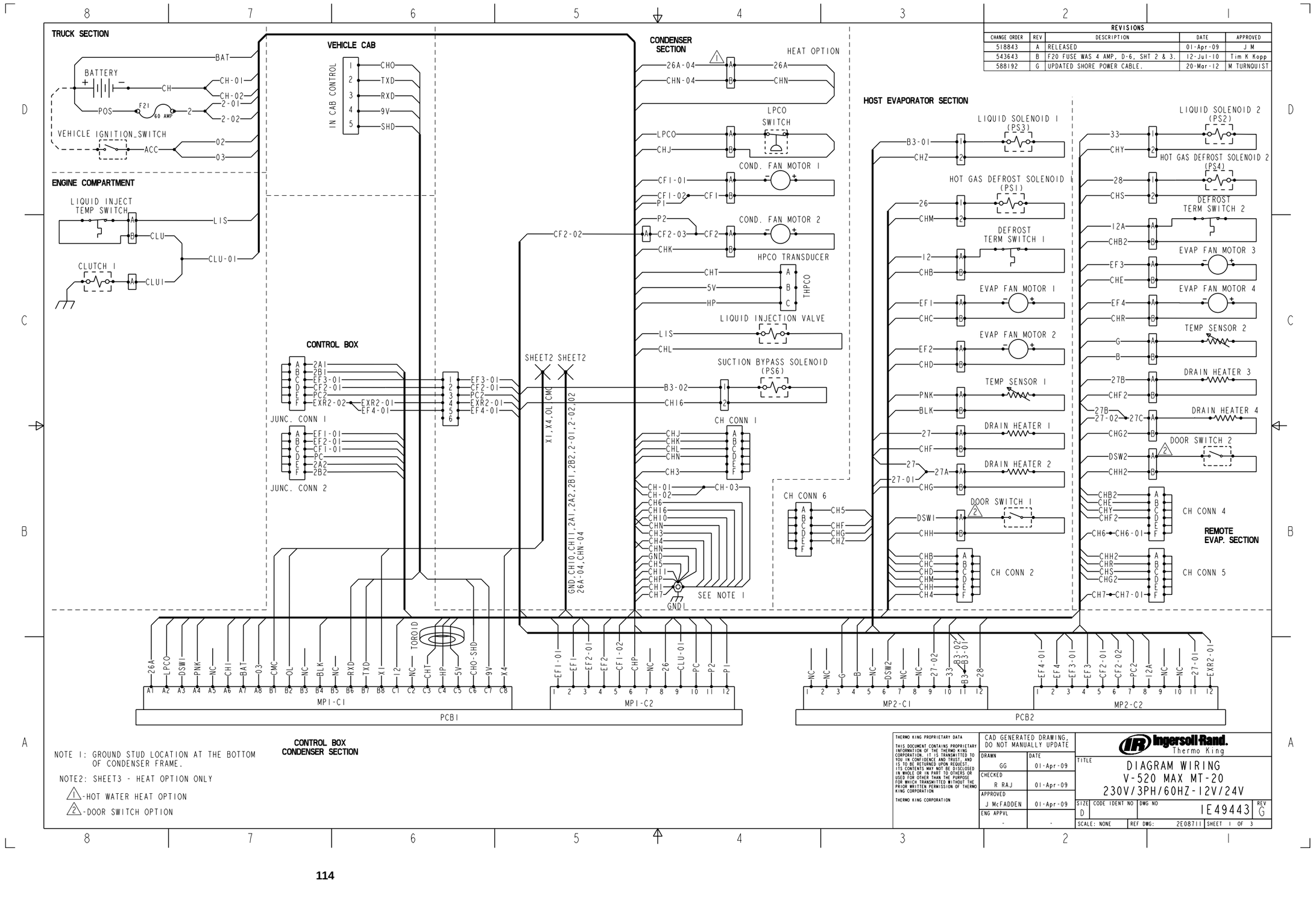
V-520 MAX 20 SPECTRUM 1PH Schematic Diagram, page 3 of 3



LEGEND

CODE	DESCRIPTION	LOCATION
BATT	BATTERY	19
BD	BATTERY DISCONN. RELAY	15,16-18
C1	CAPACITOR 68000µF	11
CC	COMPRESSOR CONTACTOR	1-3
CR	CAPACITOR 30µF	3
CS1	CAPACITOR 145-174µF	2
CS2	CAPACITOR 145-174µF	3
D1,D2	DIODE 3A	14
H	HEAT OPTION RELAY	13
HC	ELECT HEATER CONTACTOR	5-6
K1	BATTERY RELAY	18,20
K2	STANDBY RELAY	16,16
R1	RESISTOR 2.2K	12
SR	START RELAY	3
TMP	THERMAL MOTOR PROTECTOR	3,4
TR	TRANSFORMER	4-7
FUSES:		
F21	BATTERY FUSE	15

V-520 MAX 20 SPECTRUM 3PH Wiring Diagram, page 1 of 3



REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
518843	A	RELEASED	01-Apr-09	J M
543643	B	F20 FUSE WAS 4 AMP, D-6, SHT 2 & 3.	12-Jul-10	Tim K Kopp
588192	G	UPDATED SHORE POWER CABLE.	20-Mar-12	M TURNQUIST

NOTE 1: GROUND STUD LOCATION AT THE BOTTOM OF CONDENSER FRAME.

NOTE2: SHEET3 - HEAT OPTION ONLY

1 -HOT WATER HEAT OPTION

2 -DOOR SWITCH OPTION

CONTROL BOX CONDENSER SECTION

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

	DRAWN	DATE
	GG	01-Apr-09
CHECKED	R RAJ	01-Apr-09
APPROVED	J McFADDEN	01-Apr-09
ENG APPVL	-	-

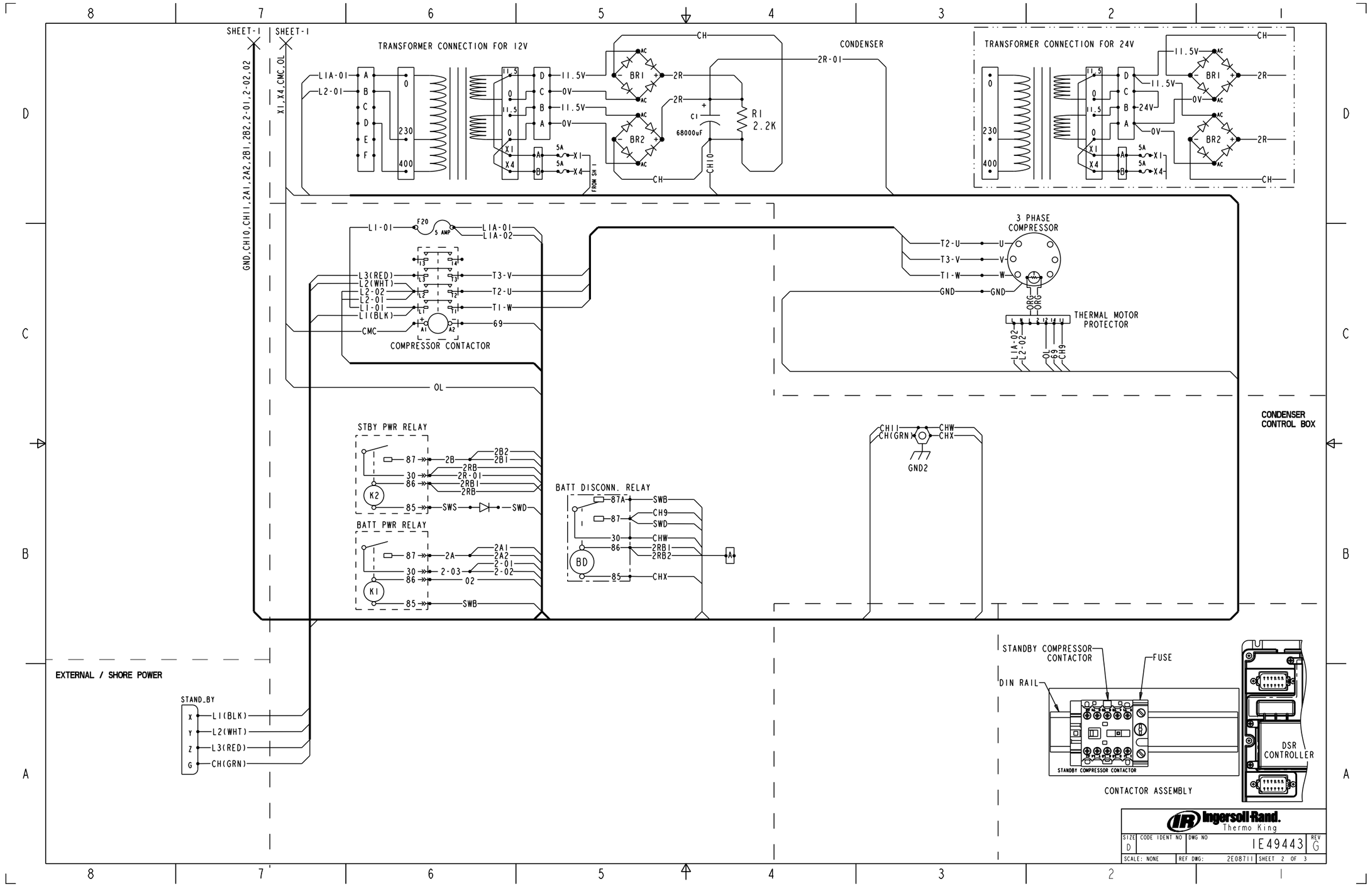
Ingersoll-Rand. Thermo King

TITLE: DIAGRAM WIRING V-520 MAX MT-20 230V/3PH/60HZ-12V/24V

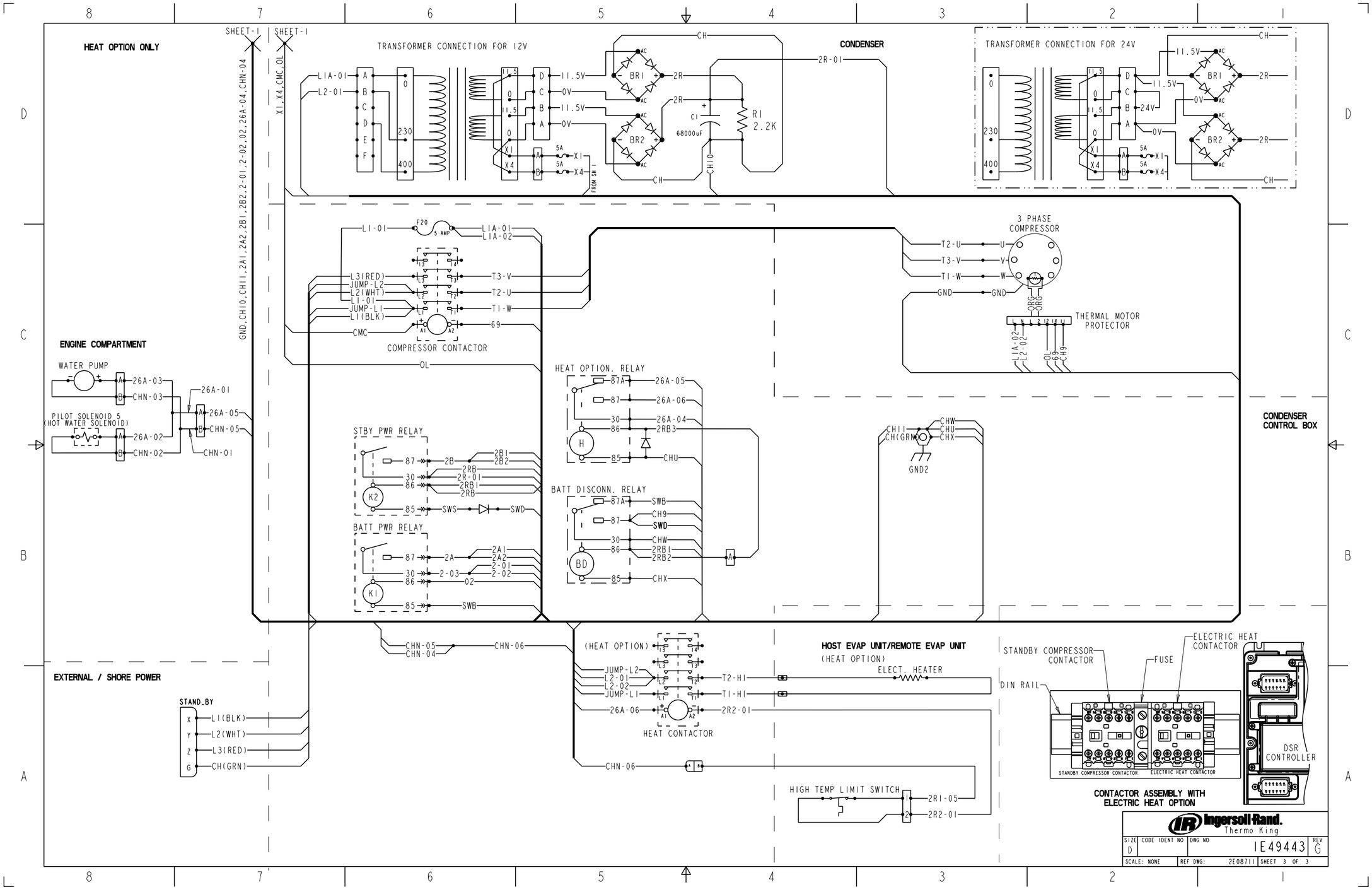
SIZE	CODE IDENT NO	DWG NO	REV
D		IE49443	G

SCALE: NONE | REF DWG: 2E0871I | SHEET 1 OF 3

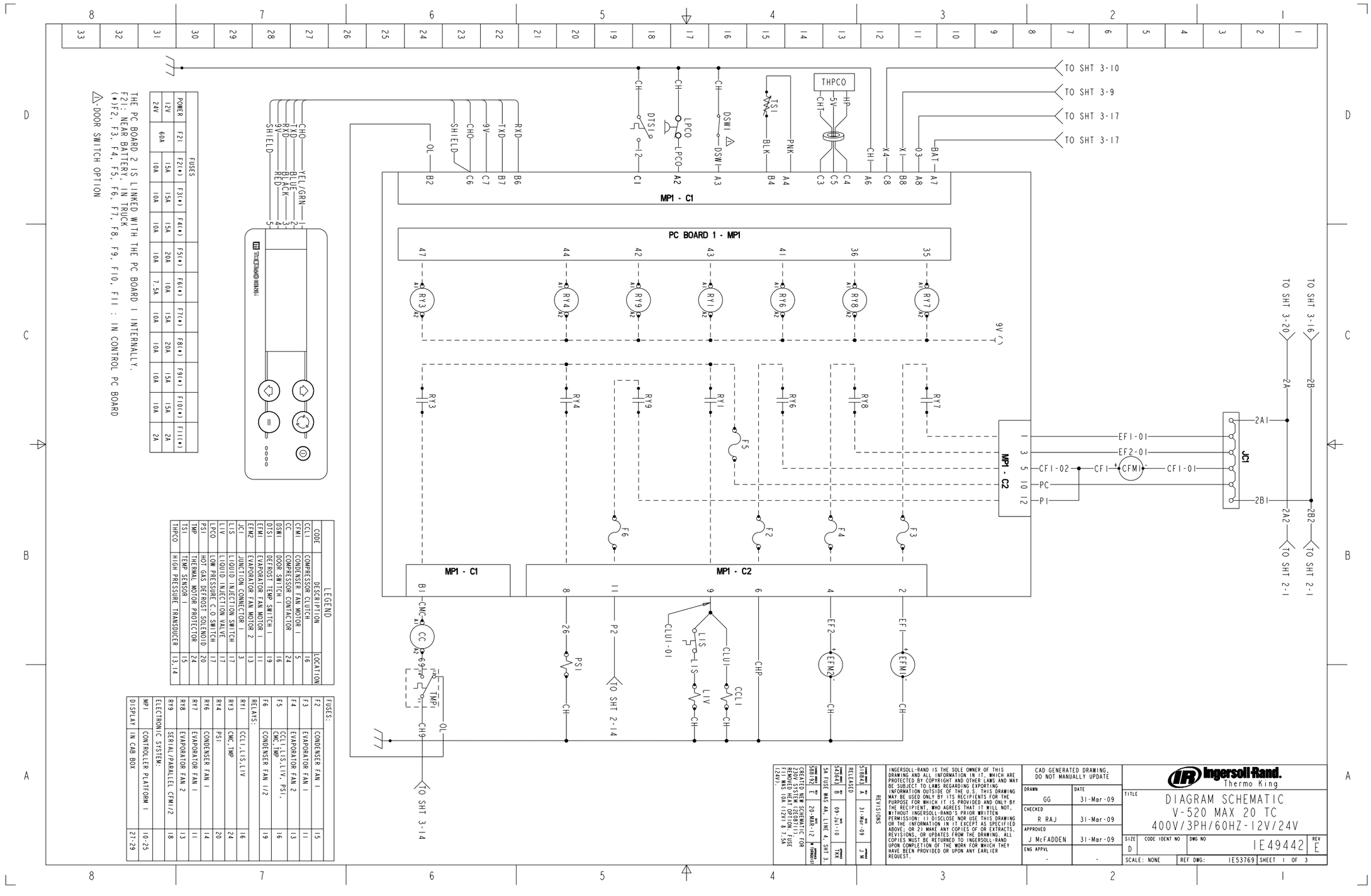
V-520 MAX 20 SPECTRUM 3PH Wiring Diagram, page 2 of 3



V-520 MAX 20 SPECTRUM 3PH Wiring Diagram, page 3 of 3



V-520 MAX 20 SPECTRUM 3PH Schematic Diagram, page 1 of 3



FUSES											
POWER	F2(*)	F3(*)	F4(*)	F5(*)	F6(*)	F7(*)	F8(*)	F9(*)	F10(*)	F11(*)	
12V	15A	15A	15A	20A	10A	15A	20A	15A	15A	2A	
24V	10A	10A	10A	10A	7.5A	10A	10A	10A	10A	2A	
F21	F21(*)	F31(*)	F41(*)	F51(*)	F61(*)	F71(*)	F81(*)	F91(*)	F101(*)	F111(*)	
60A	15A	15A	15A	20A	10A	15A	20A	15A	15A	2A	
	10A	10A	10A	10A	7.5A	10A	10A	10A	10A	2A	

THE PC BOARD 2 IS LINKED WITH THE PC BOARD 1 INTERNALLY.
F21: NEAR BATTERY, IN TRUCK
(*)F2, F3, F4, F5, F6, F7, F8, F9, F10, F11 : IN CONTROL PC BOARD

△-DOOR SWITCH OPTION

LEGEND		
CODE	DESCRIPTION	LOCATION
CCL1	COMPRESSOR CLUTCH	16
CFM1	CONDENSER FAN MOTOR 1	5
CC	COMPRESSOR CONTACTOR	24
DSW1	DOOR SWITCH 1	16
DTS1	DEFROST TEMP SWITCH 1	19
EFM1	EVAPORATOR FAN MOTOR 1	11
EFM2	EVAPORATOR FAN MOTOR 2	13
JC1	JUNCTION CONNECTOR 1	3
LIS	LIQUID INJECTION SWITCH	17
LIV	LIQUID INJECTION VALVE	17
LPCO	LOW PRESSURE C.O SWITCH	17
PS1	HOT GAS DEFROST SOLENOID	20
TMP	THERMAL MOTOR PROTECTOR	24
TS1	TEMP SENSOR 1	15
THPCO	HIGH PRESSURE TRANSDUCER	13,14

FUSES:		
F2	CONDENSER FAN 1	15
F3	EVAPORATOR FAN 1	11
F4	EVAPORATOR FAN 2	13
F5	CCL1,LIS,LIV, PS1, CMC,TMP	16
F6	CONDENSER FAN 1/2	19
RELAYS:		
RY1	CCL1,LIS,LIV	16
RY3	CMC,TMP	24
RY4	PS1	20
RY6	CONDENSER FAN 1	14
RY7	EVAPORATOR FAN 1	11
RY8	EVAPORATOR FAN 2	13
RY9	SERIAL/PARALLEL CFM1/2	18
ELECTRONIC SYSTEM:		
MP1	CONTROLLER PLATFORM 1	10-25
DISPLAY	IN CAB BOX	27-29

REVISIONS			
RELEASED	N	31-Mar-09	JTW
5A FUSE WAS 4A, LINE 4, SHT 3	B	09-Jul-10	TKN
CREATED NEW SCHEMATIC FOR 400V SYSTEM (2080111). REVISED FUSE F11 WAS 10A (12V) & 7.5A (24V).	E	20-MAR-12	MONGKOL

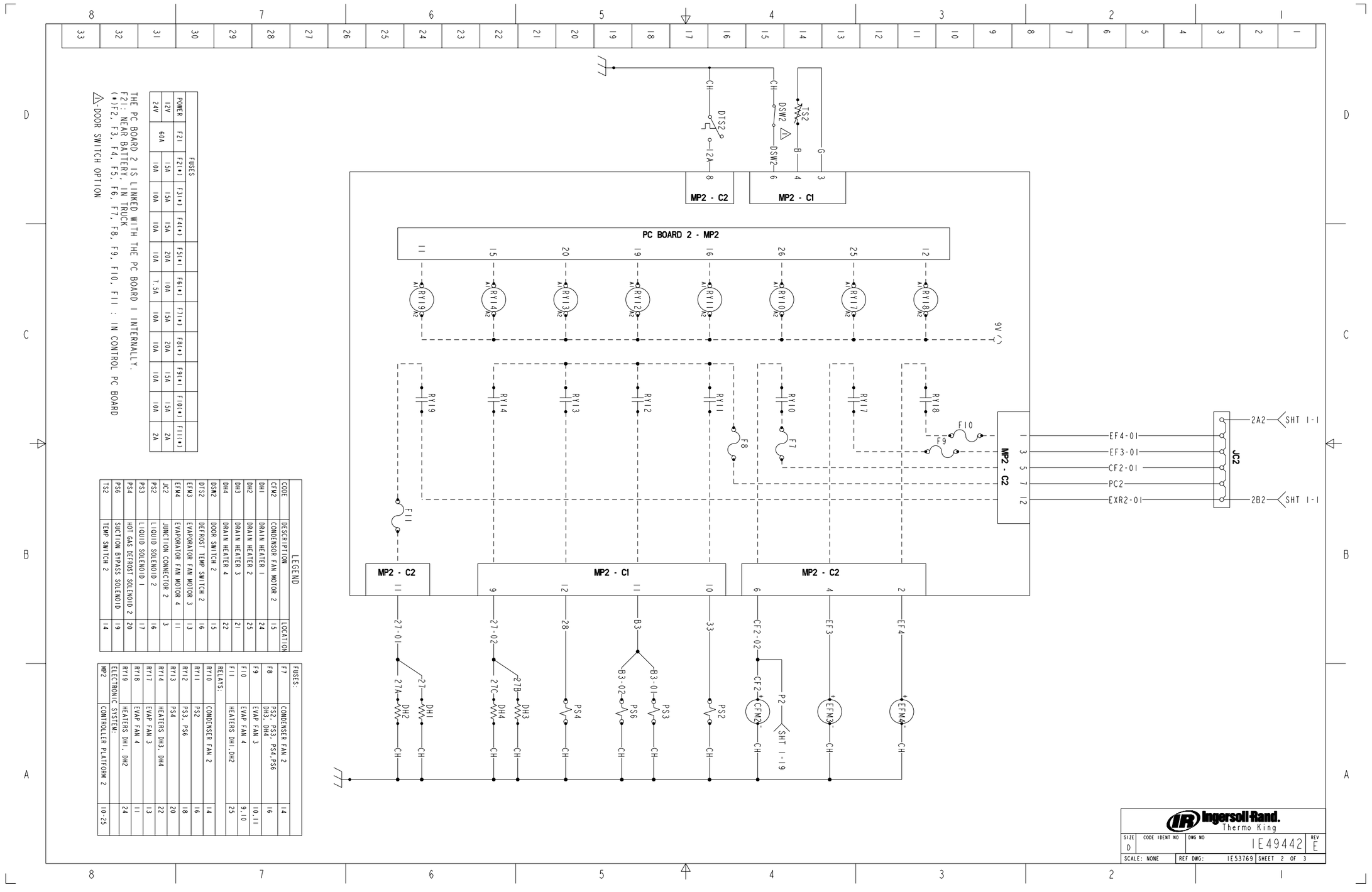
CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE		
DRAWN	GG	31-Mar-09
CHECKED	R RAJ	31-Mar-09
APPROVED	J McFADDEN	31-Mar-09
ENG APPVL	-	-

Ingersoll-Rand. Thermo King

TITLE: DIAGRAM SCHEMATIC V-520 MAX 20 TC 400V/3PH/60HZ-12V/24V

SIZE	CODE IDENT NO	DWG NO	REV
D		IE49442	E
SCALE: NONE	REF DWG: IE53769	SHEET 1 OF 3	

V-520 MAX 20 SPECTRUM 3PH Schematic Diagram, page 2 of 3



FUSES											
POWER	F21	F21(*)	F3(*)	F4(*)	F5(*)	F6(*)	F7(*)	F8(*)	F9(*)	F10(*)	F11(*)
12V	60A	15A	15A	10A	20A	10A	15A	20A	15A	15A	2A
24V		10A	10A	10A	10A	7.5A	10A	10A	10A	10A	2A

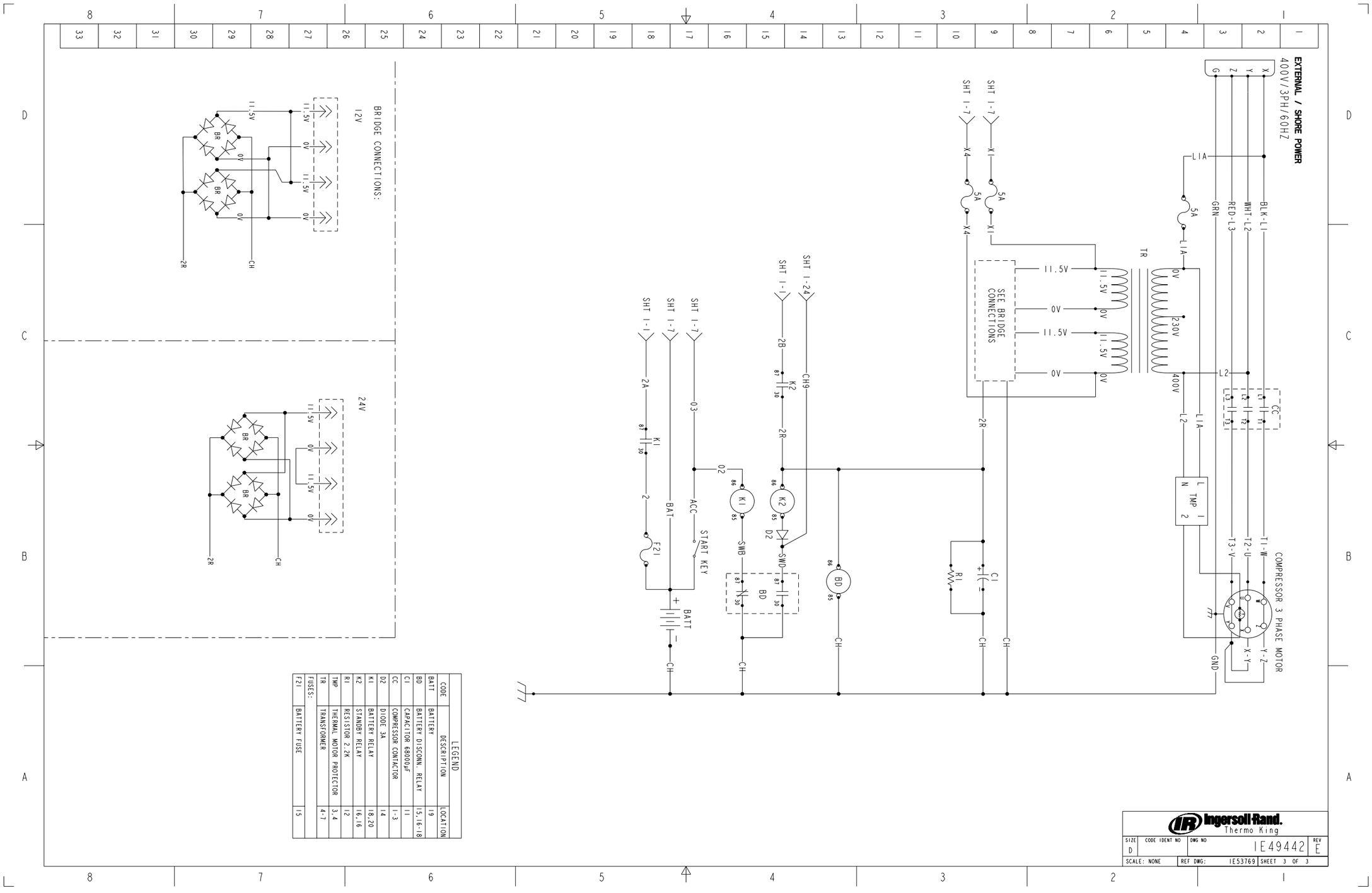
THE PC BOARD 2 IS LINKED WITH THE PC BOARD 1 INTERNALLY.
F21: NEAR BATTERY, IN TRUCK
(*)F2, F3, F4, F5, F6, F7, F8, F9, F10, F11 : IN CONTROL PC BOARD

△-DOOR SWITCH OPTION

LEGEND		
CODE	DESCRIPTION	LOCATION
CFM2	CONDENSOR FAN MOTOR 2	I5
DH1	DRAIN HEATER 1	24
DH2	DRAIN HEATER 2	25
DH3	DRAIN HEATER 3	21
DH4	DRAIN HEATER 4	22
DSW2	DOOR SWITCH 2	I5
DTS2	DEFROST TEMP SWITCH 2	I6
EFM3	EVAPORATOR FAN MOTOR 3	I3
EFM4	EVAPORATOR FAN MOTOR 4	I1
JC2	JUNCTION CONNECTOR 2	3
PS2	LIQUID SOLENOID 2	I6
PS3	LIQUID SOLENOID 1	I7
PS4	HOT GAS DEFROST SOLENOID 2	20
PS6	SUCTION BYPASS SOLENOID	I9
TS2	TEMP SWITCH 2	I4

FUSES:		
F7	CONDENSER FAN 2	I4
F8	PS2, PS3, PS4,PS6 DH3, DH4	I6
F9	EVAP FAN 3	10, I1
F10	EVAP FAN 4	9,10
F11	HEATERS DH1,DH2	25
RELAYS:		
RY10	CONDENSER FAN 2	I4
RY11	PS2	I6
RY12	PS3, PS6	I8
RY13	PS4	20
RY14	HEATERS DH3, DH4	22
RY17	EVAP FAN 3	I3
RY18	EVAP FAN 4	I1
RY19	HEATERS DH1, DH2	24
ELECTRONIC SYSTEM:		
MP2	CONTROLLER PLATFORM 2	10-25

V-520 MAX 20 SPECTRUM 3PH Schematic Diagram, page 3 of 3

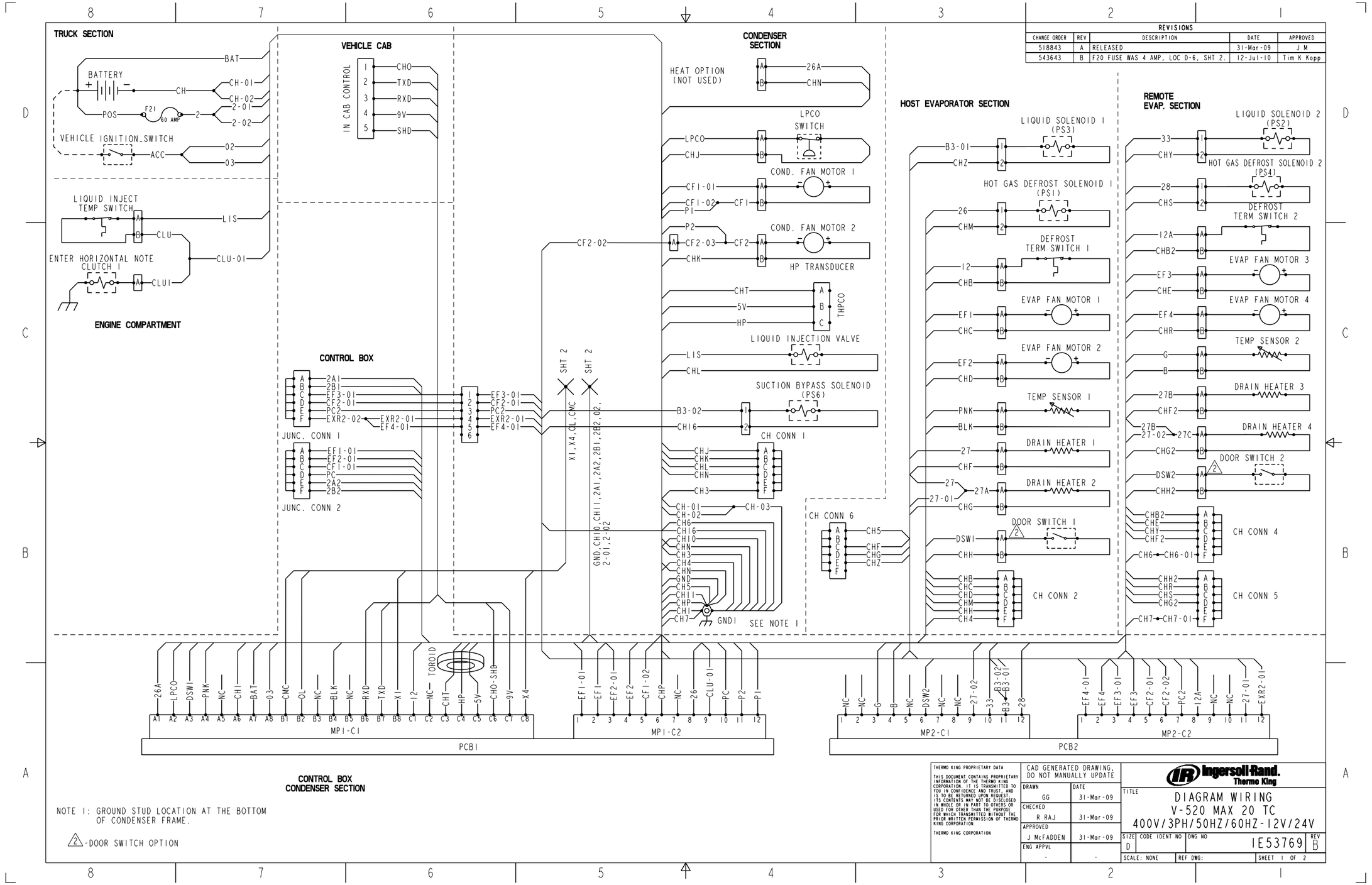


LEGEND		
CODE	DESCRIPTION	LOCATION
BATT	BATTERY	19
BD	BATTERY DISCONN. RELAY	15,16-18
C1	CAPACITOR 68000µF	11
CC	COMPRESSOR CONTACTOR	1-3
D2	DIODE 3A	14
K1	BATTERY RELAY	18,20
K2	STANDBY RELAY	16,16
R1	RESISTOR 2.2K	12
TMP	THERMAL MOTOR PROTECTOR	3,4
TR	TRANSFORMER	4-7
FUSES:		
F21	BATTERY FUSE	15

Ingersoll-Rand. Thermo King

SIZE	CODE IDENT NO	DWG NO	REV
D		IE49442	E
SCALE: NONE	REF DWG: IE53769	SHEET 3 OF 3	

V-520 MAX 20 SPECTRUM 3PH, 50/60 Hz Wiring Diagram, page 1 of 2



CONTROL BOX
CONDENSER SECTION

NOTE 1: GROUND STUD LOCATION AT THE BOTTOM OF CONDENSER FRAME.

2 -DOOR SWITCH OPTION

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
518843	A	RELEASED	31-Mar-09	J M
543643	B	F20 FUSE WAS 4 AMP, LOC D-6, SHT 2.	12-Jul-10	Tim K Kopp

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

DRAWN	GG	31-Mar-09
CHECKED	R RAJ	31-Mar-09
APPROVED	J McFADDEN	31-Mar-09
ENG APPVL	-	-

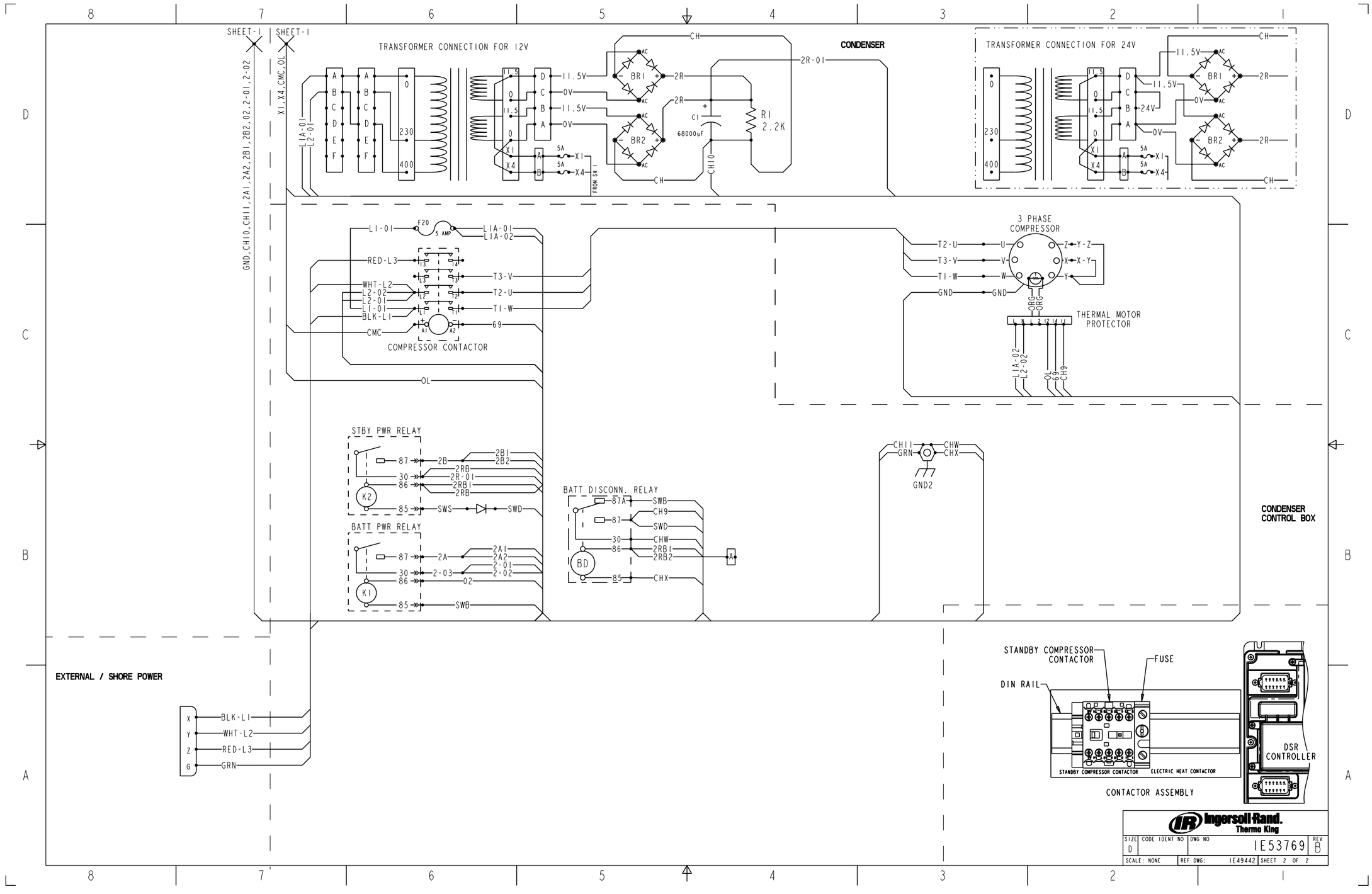
Ingersoll-Rand. Thermo King

TITLE: DIAGRAM WIRING
V-520 MAX 20 TC
400V/3PH/50HZ/60HZ-12V/24V

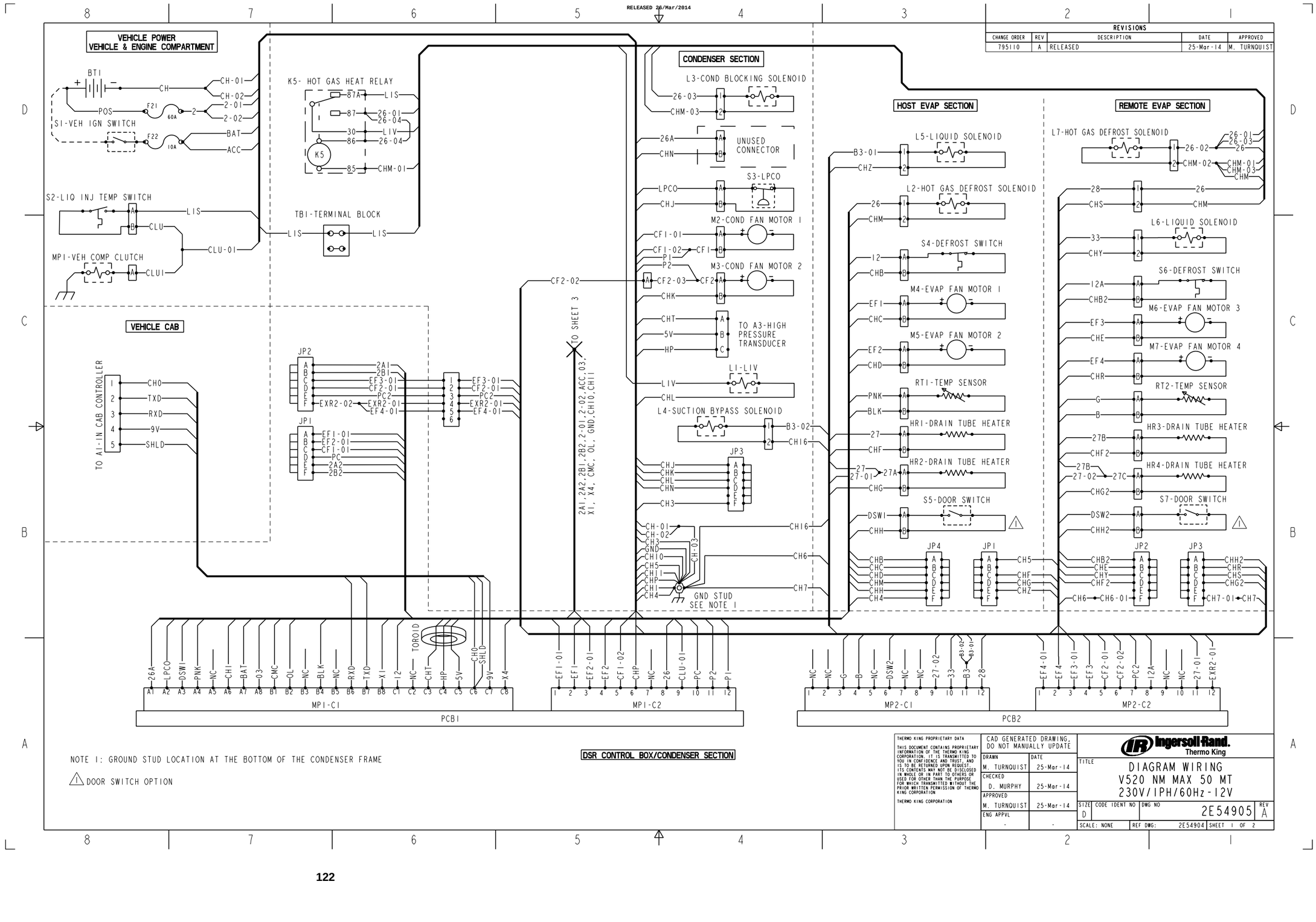
SIZE	CODE IDENT NO	DWG NO	REV
D		IE53769	B

SCALE: NONE | REF DWG: | SHEET 1 OF 2

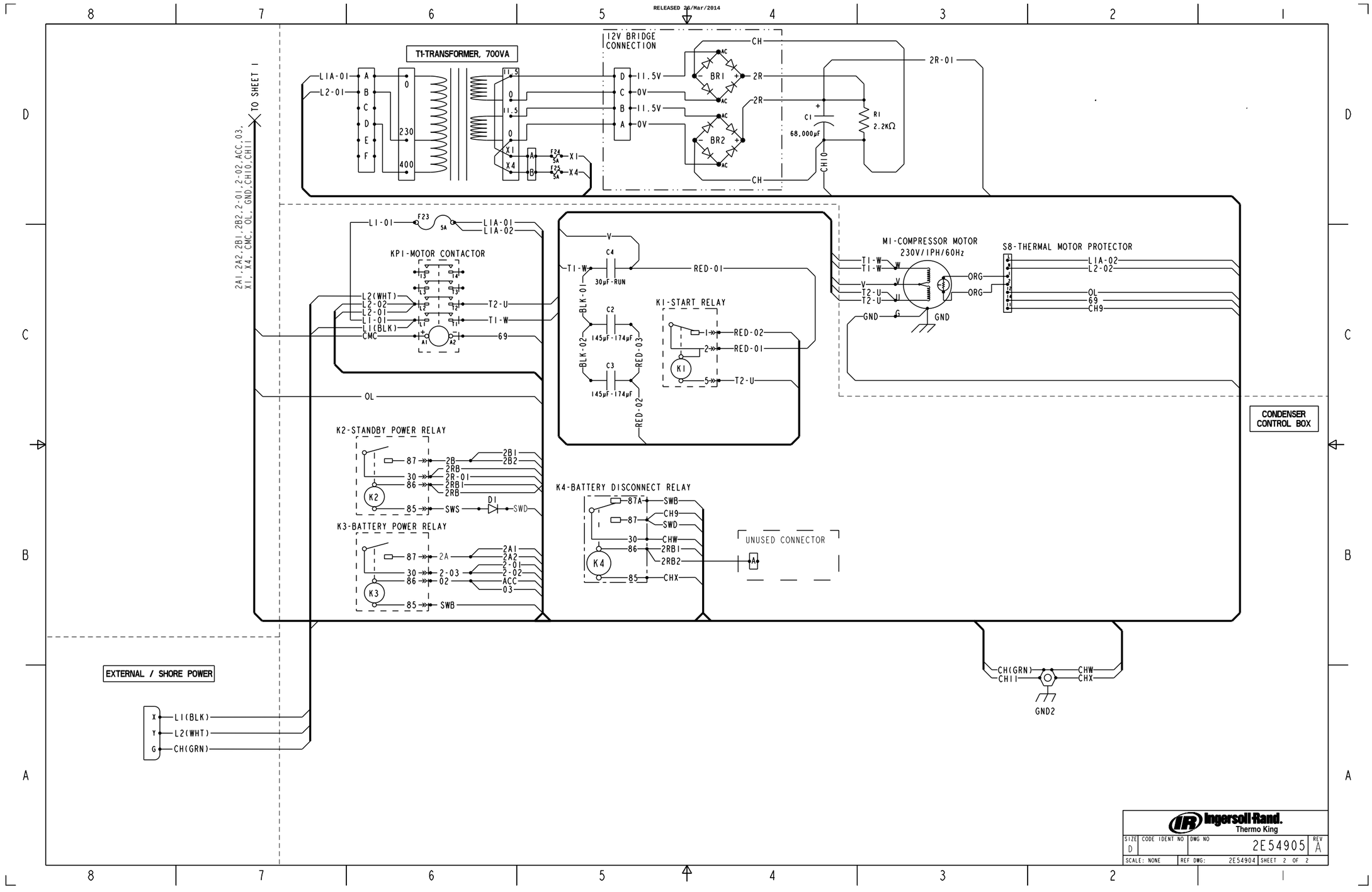
V-520 MAX 20 SPECTRUM 3PH, 50/60 Hz Wiring Diagram, page 2 of 2



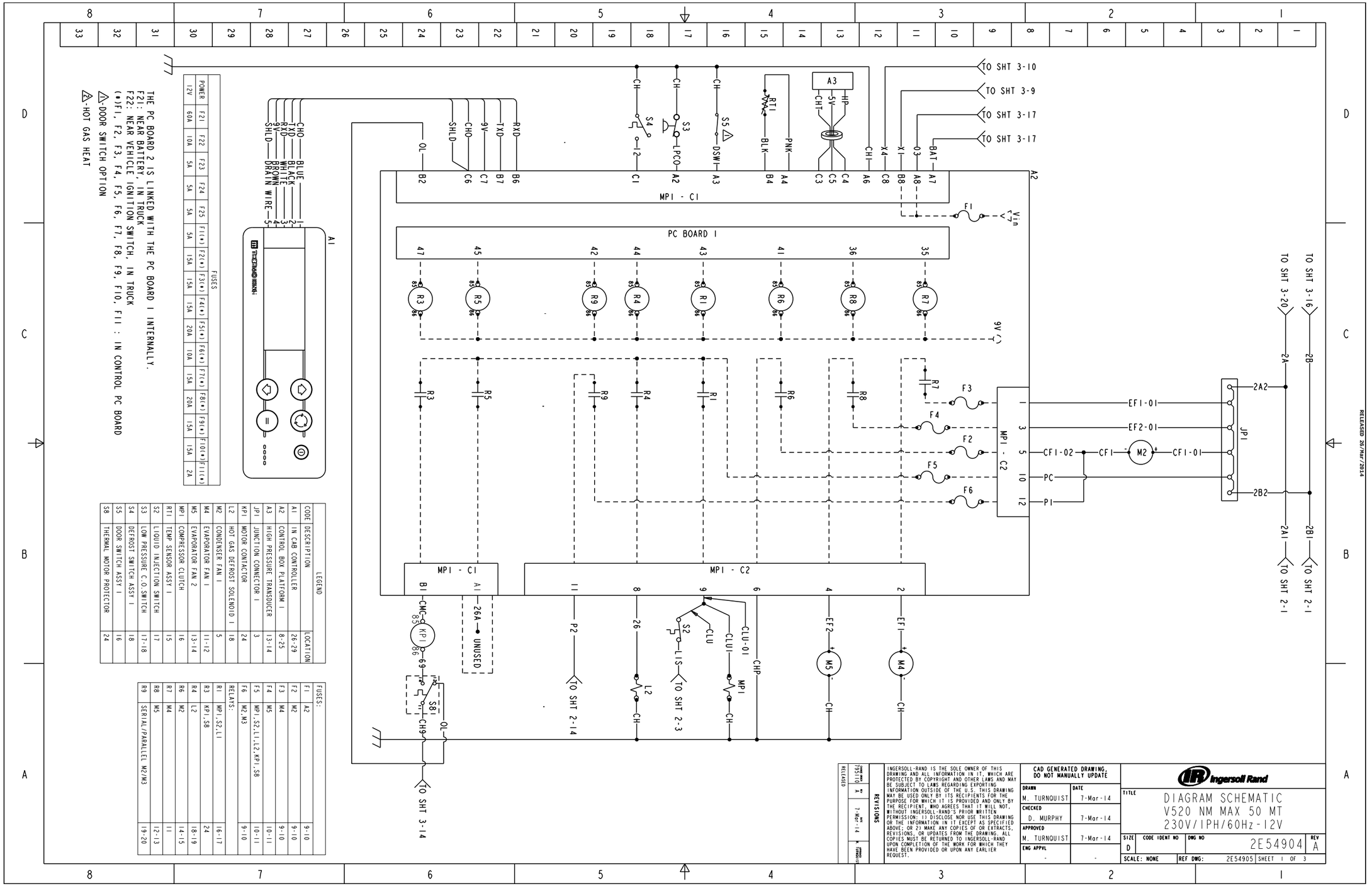
V-520 MAX 50 SPECTRUM 1PH Wiring Diagram, page 1 of 2



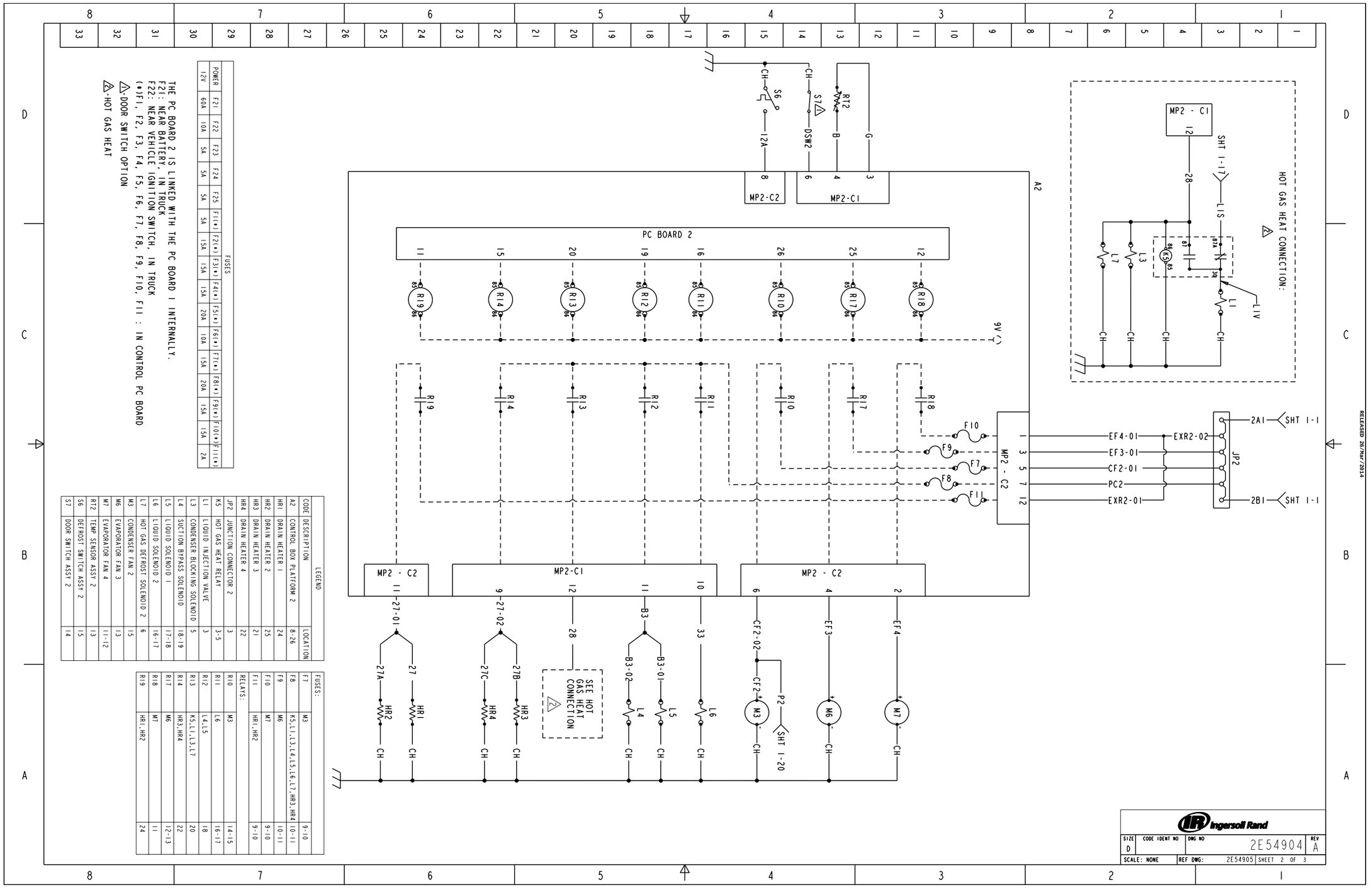
V-520 MAX 50 SPECTRUM 1PH Wiring Diagram, page 2 of 2



V-520 MAX 50 SPECTRUM 1PH Schematic Diagram, page 1 of 3



V-520 MAX 50 SPECTRUM 1PH Schematic Diagram, page 2 of 3



THE PC BOARD 2 IS LINKED WITH THE PC BOARD 1 INTERNALLY.
F21: NEAR BATTERY, IN TRUCK
F22: NEAR VEHICLE IGNITION SWITCH, IN TRUCK
(●)F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11 : IN CONTROL PC BOARD

△1-DOOR SWITCH OPTION

△2-HOT GAS HEAT

FUSES

POWER	F21	F22	F23	F24	F25	F1(●)	F2(●)	F3(●)	F4(●)	F5(●)	F6(●)	F7(●)	F8(●)	F9(●)	F10(●)	F11(●)
12V	60A	10A	5A	5A	5A	5A	15A	15A	15A	20A	10A	15A	20A	15A	15A	2A

LEGEND

CODE	DESCRIPTION	LOCATION
A2	CONTROL BOX PLATFORM 2	8-26
HR1	DRAIN HEATER 1	24
HR2	DRAIN HEATER 2	25
HR3	DRAIN HEATER 3	21
HR4	DRAIN HEATER 4	22
JP2	JUNCTION CONNECTOR 2	3
K5	HOT GAS HEAT RELAY	3-5
L1	LIQUID INJECTION VALVE	3
L3	CONDENSER BLOCKING SOLENOID	5
L4	SUCTION BYPASS SOLENOID	18-19
L5	LIQUID SOLENOID 1	17-18
L6	LIQUID SOLENOID 2	16-17
L7	HOT GAS DEFROST SOLENOID 2	6
M3	CONDENSER FAN 2	15
M6	EVAPORATOR FAN 3	13
M7	EVAPORATOR FAN 4	11-12
RT2	TEMP. SENSOR ASSY 2	13
S6	DEFROST SWITCH ASSY 2	15
S7	DOOR SWITCH ASSY 2	14

FUSES:

F7	M3	9-10
F8	K5,L1,L3,L4,L5,L6,L7,HR3,HR4	10-11
F9	M6	10-11
F10	M7	9-10
F11	HR1,HR2	9-10

RELAYS:

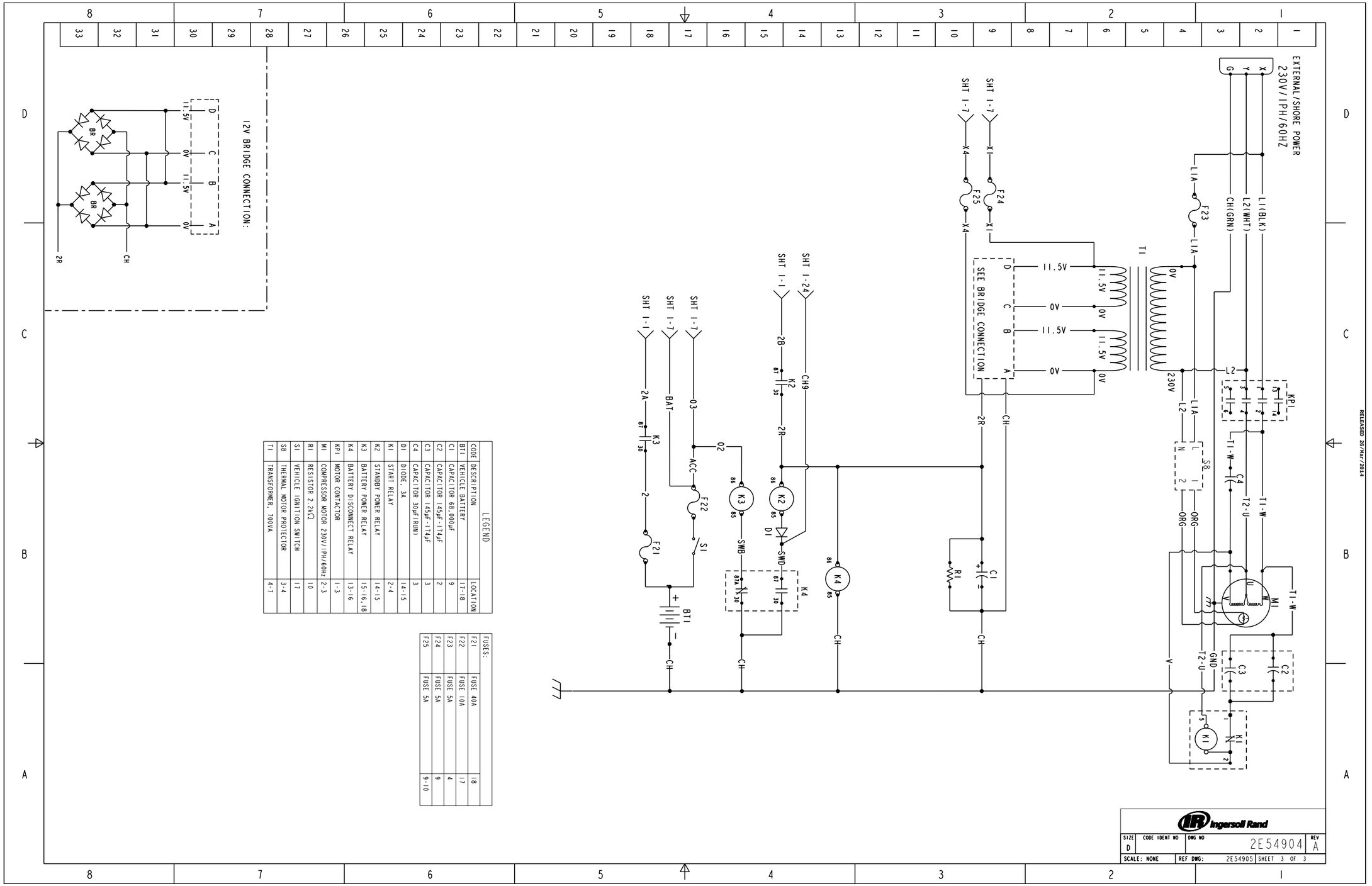
R10	M3	14-15
R11	L6	16-17
R12	L4,L5	18
R13	K5,L1,L3,L7	20
R14	HR3,HR4	22
R17	M6	12-13
R18	M7	11
R19	HR1,HR2	24

RELEASED 28/MAY/2014

Ingersoll Rand

SIZE	CODE IDENT NO	DWG NO	REV
D		2E54904	A
SCALE: NONE	REF DWG: 2E54905	SHEET 2 OF 3	

V-520 MAX 50 SPECTRUM 1PH Schematic Diagram, page 3 of 3

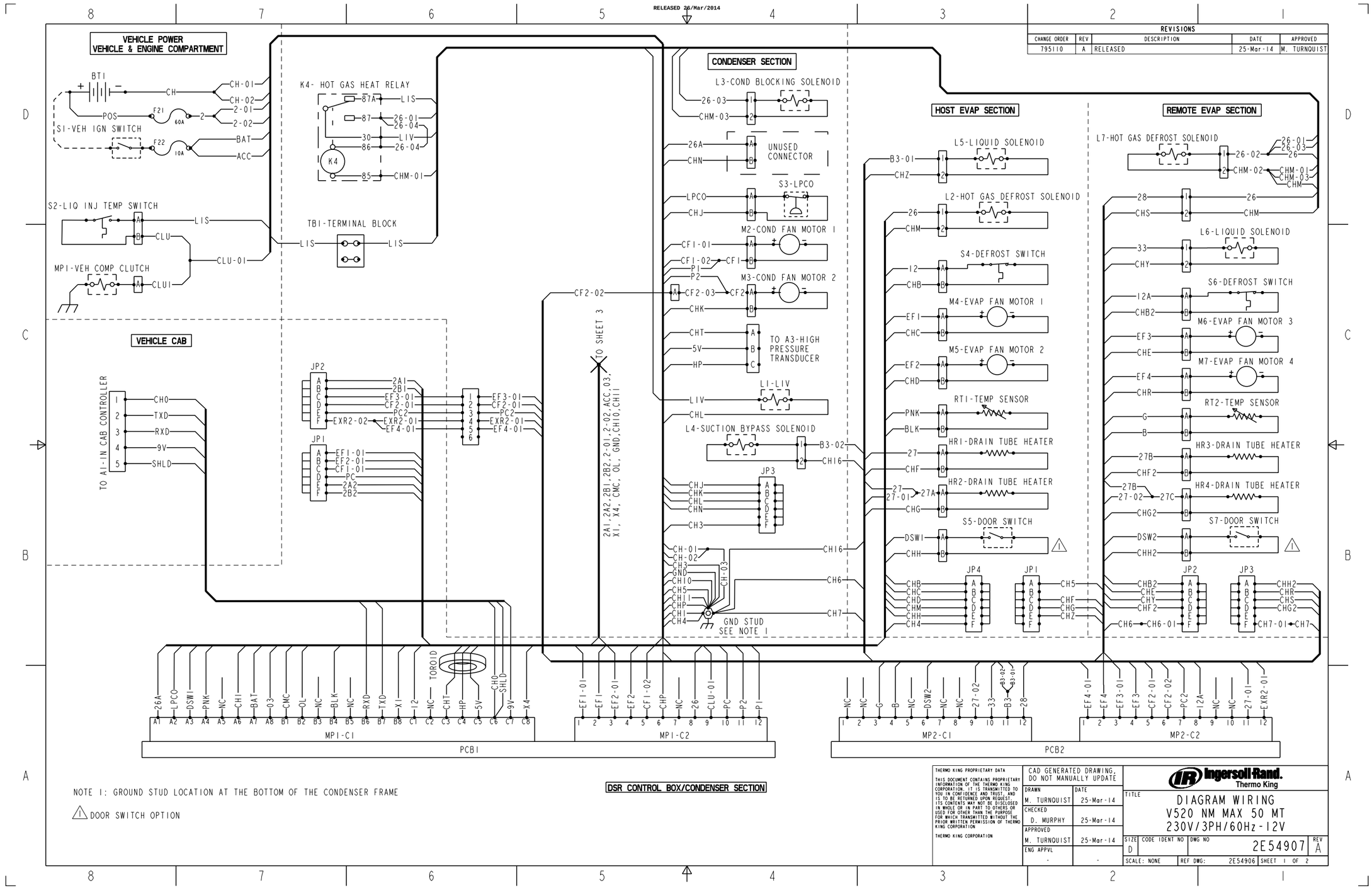


LEGEND		
CODE	DESCRIPTION	LOCATION
BT1	VEHICLE BATTERY	I7-I8
C1	CAPACITOR 68,000µF	9
C2	CAPACITOR 145µF-174µF	2
C3	CAPACITOR 145µF-174µF	3
C4	CAPACITOR 30µF(RUN)	3
D1	DIODE, 3A	I4-I5
K1	START RELAY	2-4
K2	STANDBY POWER RELAY	I4-I5
K3	BATTERY POWER RELAY	I5-I6,I8
K4	BATTERY DISCONNECT RELAY	I3-I6
KP1	MOTOR CONTACTOR	I-3
M1	COMPRESSOR MOTOR 230V/1PH/60Hz	2-3
R1	RESISTOR 2.2kΩ	I0
S1	VEHICLE IGNITION SWITCH	I7
S8	THERMAL MOTOR PROTECTOR	3-4
T1	TRANSFORMER, 700VA	4-7

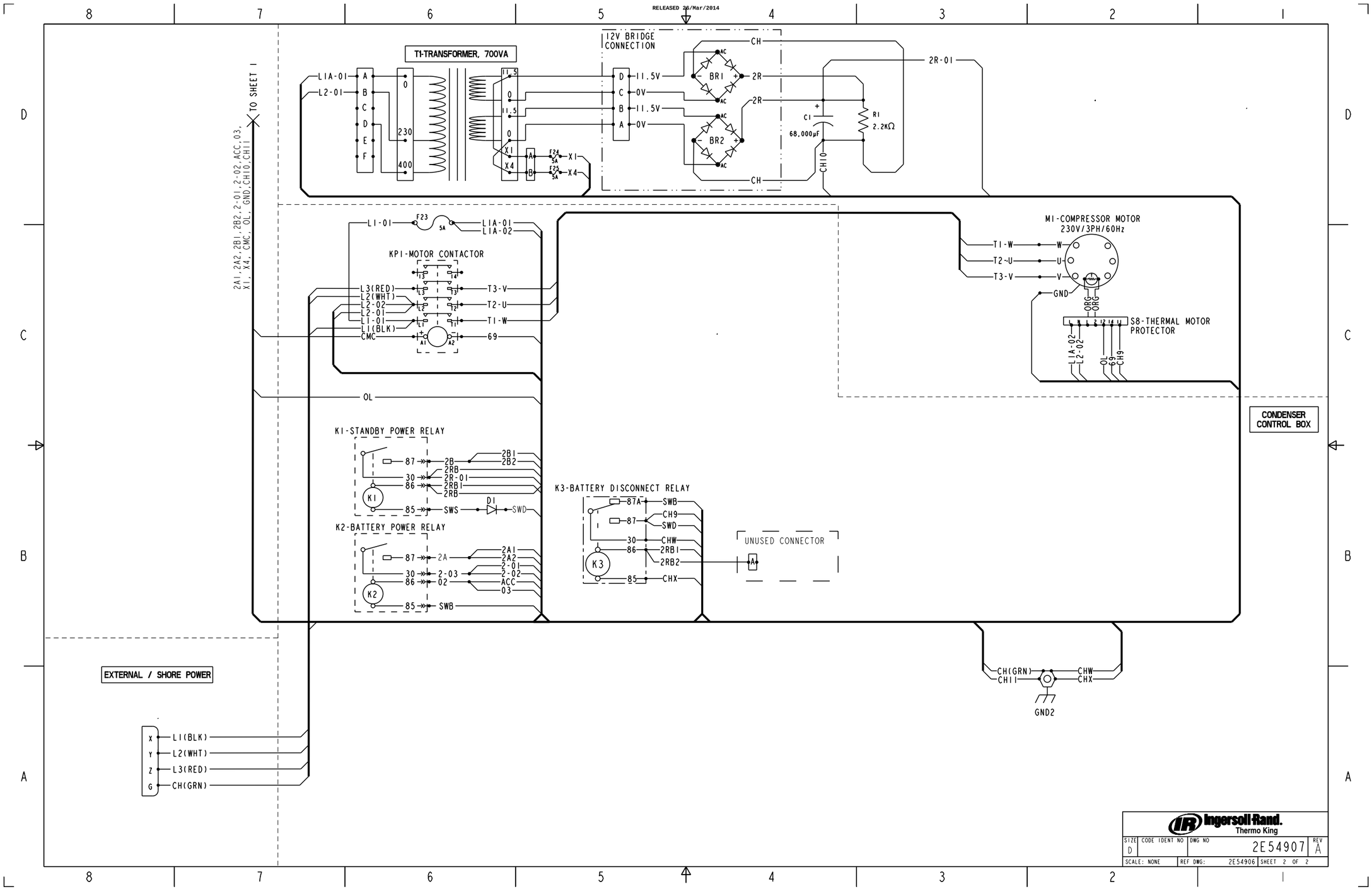
FUSES:		
F21	FUSE 40A	I8
F22	FUSE 10A	I7
F23	FUSE 5A	4
F24	FUSE 5A	9
F25	FUSE 5A	9-I0

Ingersoll Rand			
SIZE D	CODE IDENT NO	DWG NO 2E54904	REV A
SCALE: NONE	REF DWG: 2E54905	SHEET 3 OF 3	

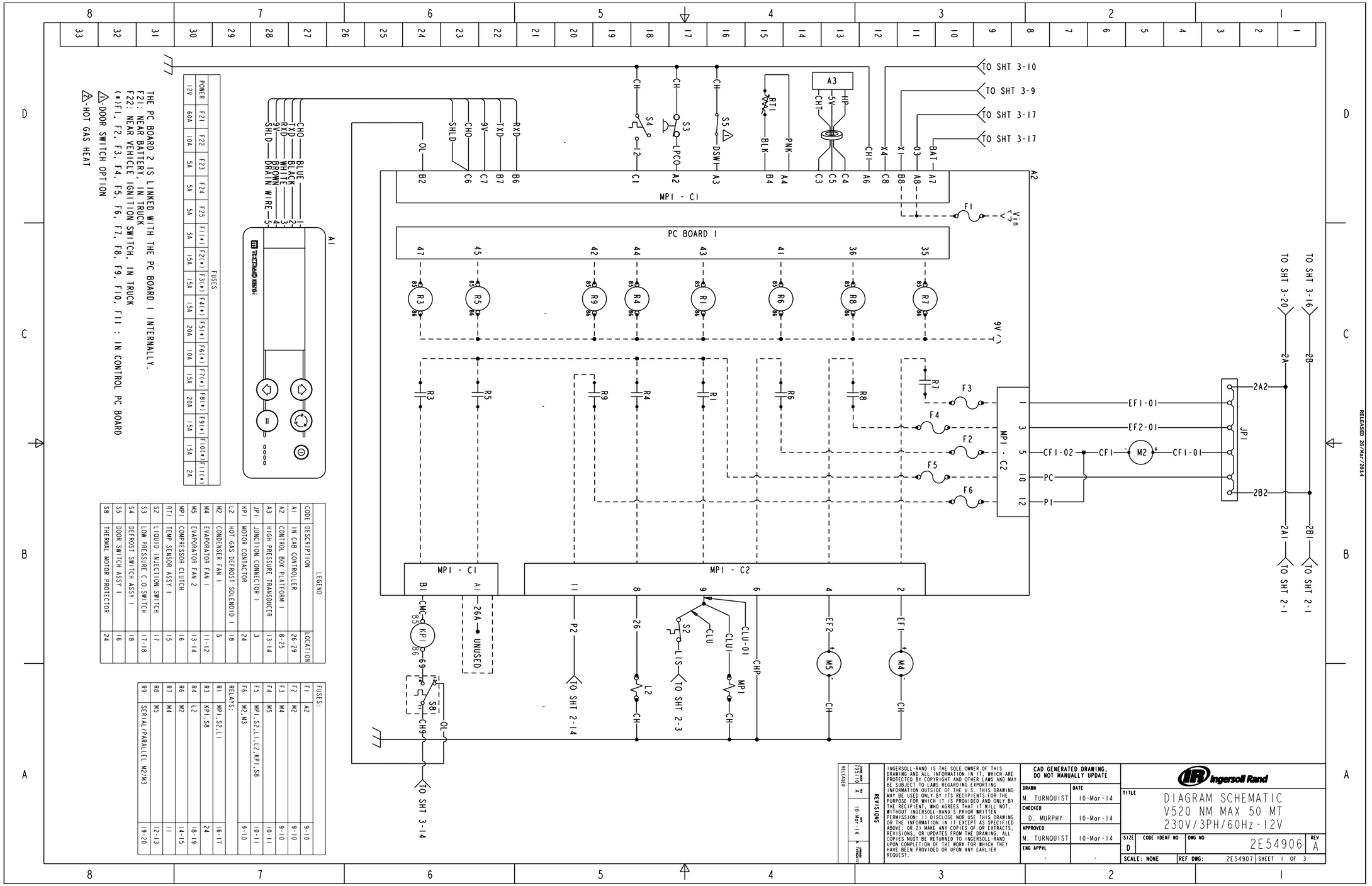
V-520 MAX 50 SPECTRUM 3PH Wiring Diagram, page 1 of 2



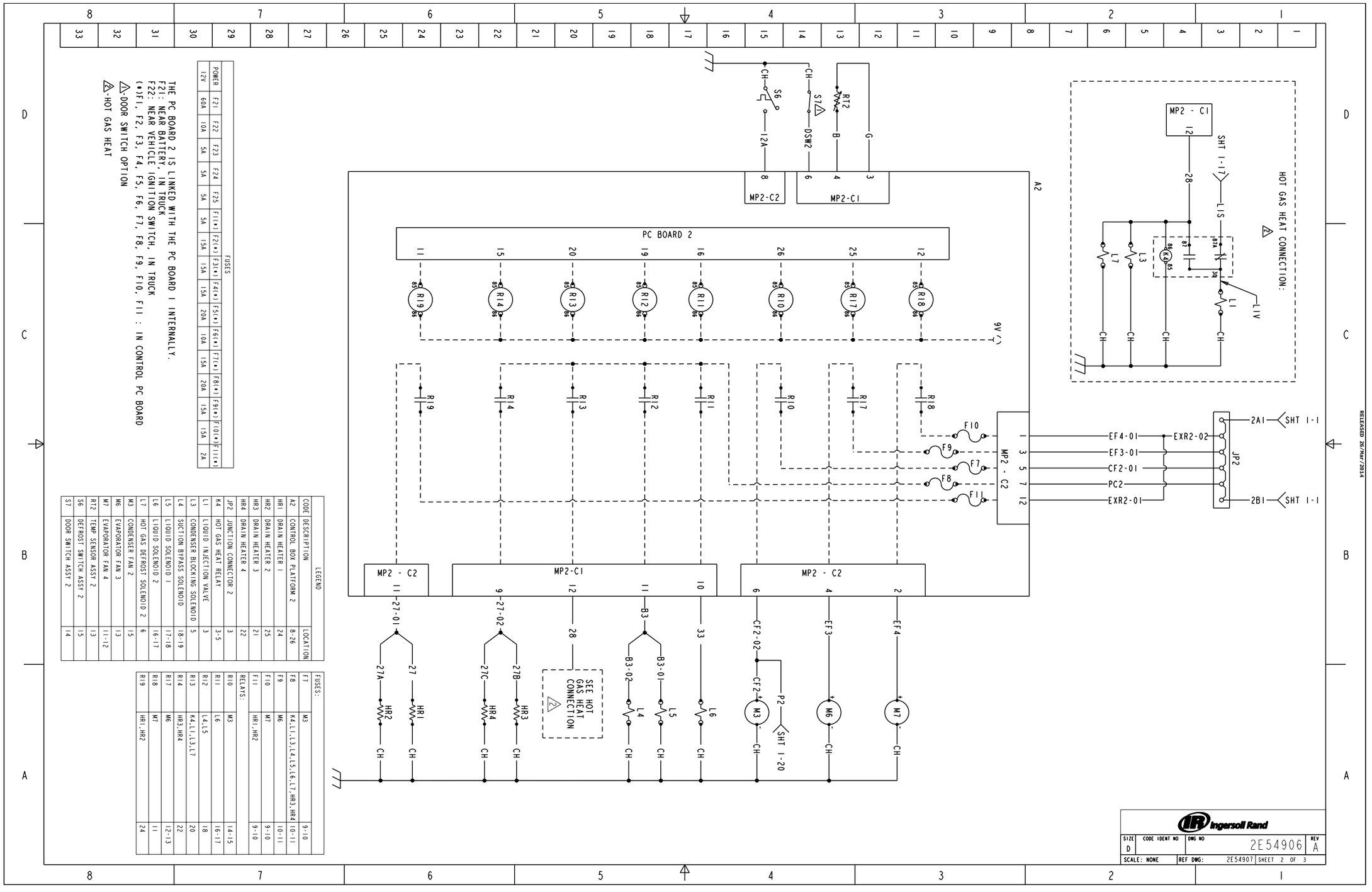
V-520 MAX 50 SPECTRUM 3PH Wiring Diagram, page 2 of 2



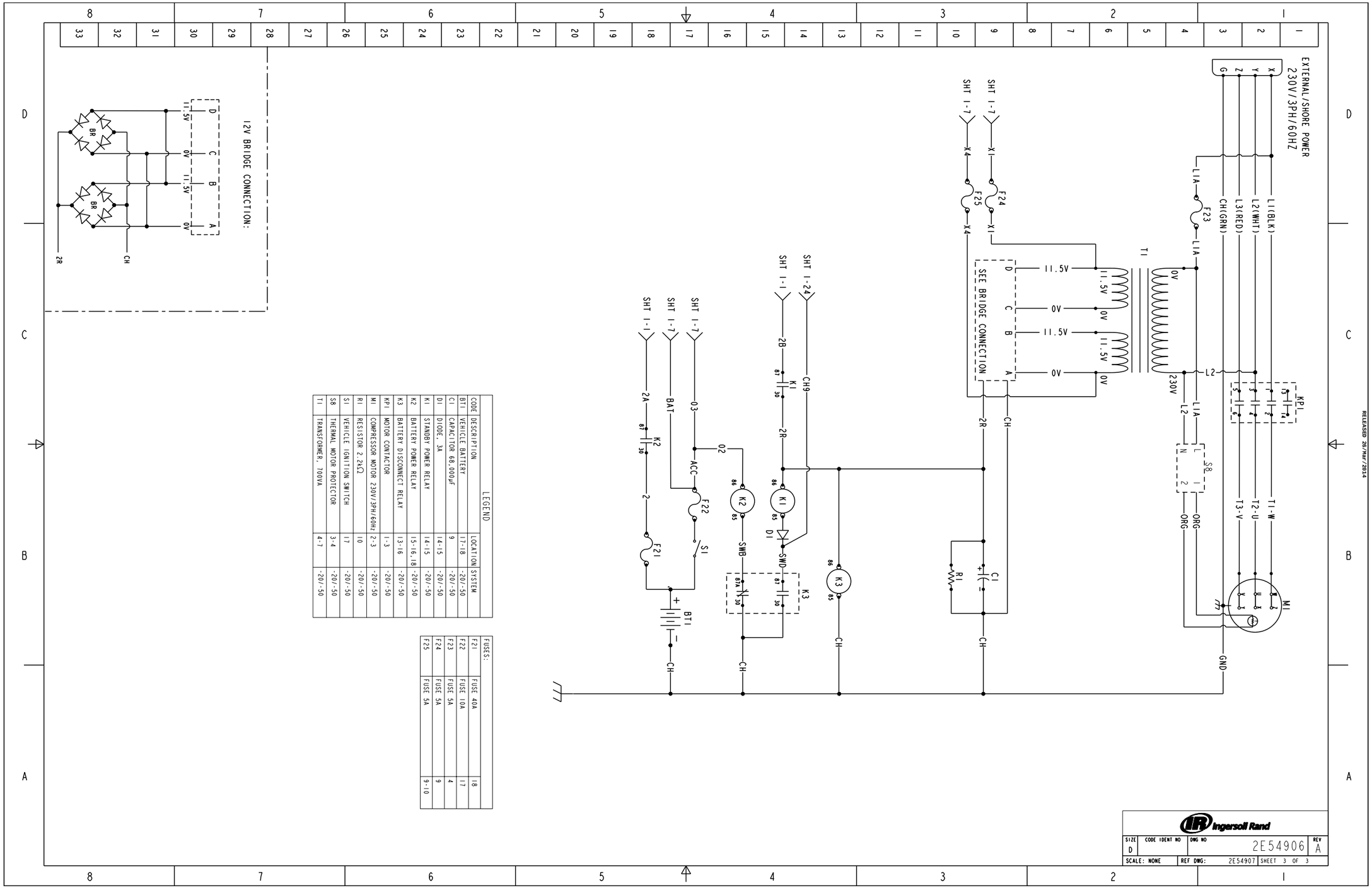
V-520 MAX 50 SPECTRUM 3PH Schematic Diagram, page 1 of 3



V-520 MAX 50 SPECTRUM 3PH Schematic Diagram, page 2 of 3



V-520 MAX 50 SPECTRUM 3PH Schematic Diagram, page 3 of 3



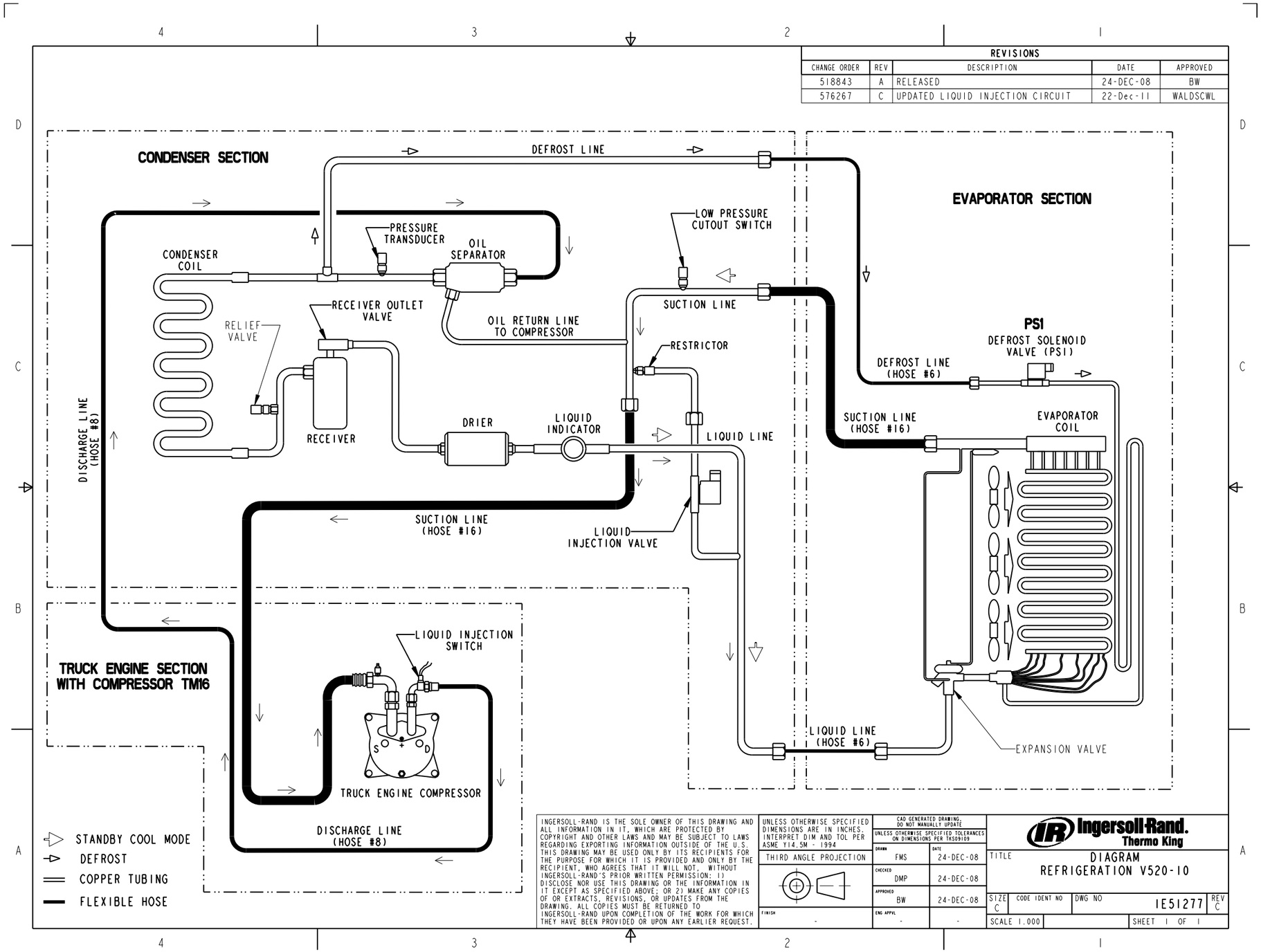
CODE	DESCRIPTION	LOCATION	SYSTEM
BT1	VEHICLE BATTERY	17-18	-20/-50
C1	CAPACITOR 68,000µF	9	-20/-50
D1	DIODE, 3A	14-15	-20/-50
K1	STANDBY POWER RELAY	14-15	-20/-50
K2	BATTERY POWER RELAY	15-16,18	-20/-50
K3	BATTERY DISCONNECT RELAY	13-16	-20/-50
KP1	MOTOR CONTACTOR	1-3	-20/-50
M1	COMPRESSOR MOTOR 230V/3PH/60Hz	2-3	-20/-50
R1	RESISTOR 2.2kΩ	10	-20/-50
S1	VEHICLE IGNITION SWITCH	17	-20/-50
S8	THERMAL MOTOR PROTECTOR	3-4	-20/-50
T1	TRANSFORMER, 700VA	4-7	-20/-50

F21	FUSE 40A
F22	FUSE 10A
F23	FUSE 5A
F24	FUSE 5A
F25	FUSE 5A

	18
	17
	4
	9
	9-10

V-520 10 Refrigeration Diagram

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
518843	A	RELEASED	24-DEC-08	BW
576267	C	UPDATED LIQUID INJECTION CIRCUIT	22-Dec-11	WALDSCWL



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIM AND TOL PER ASME Y14.5M - 1994

THIRD ANGLE PROJECTION

FINISH -

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS PER TK50910

DRAWN	FMS	24-DEC-08
CHECKED	DMP	24-DEC-08
APPROVED	BW	24-DEC-08
ENG APPVL	-	-

Ingersoll-Rand. Thermo King

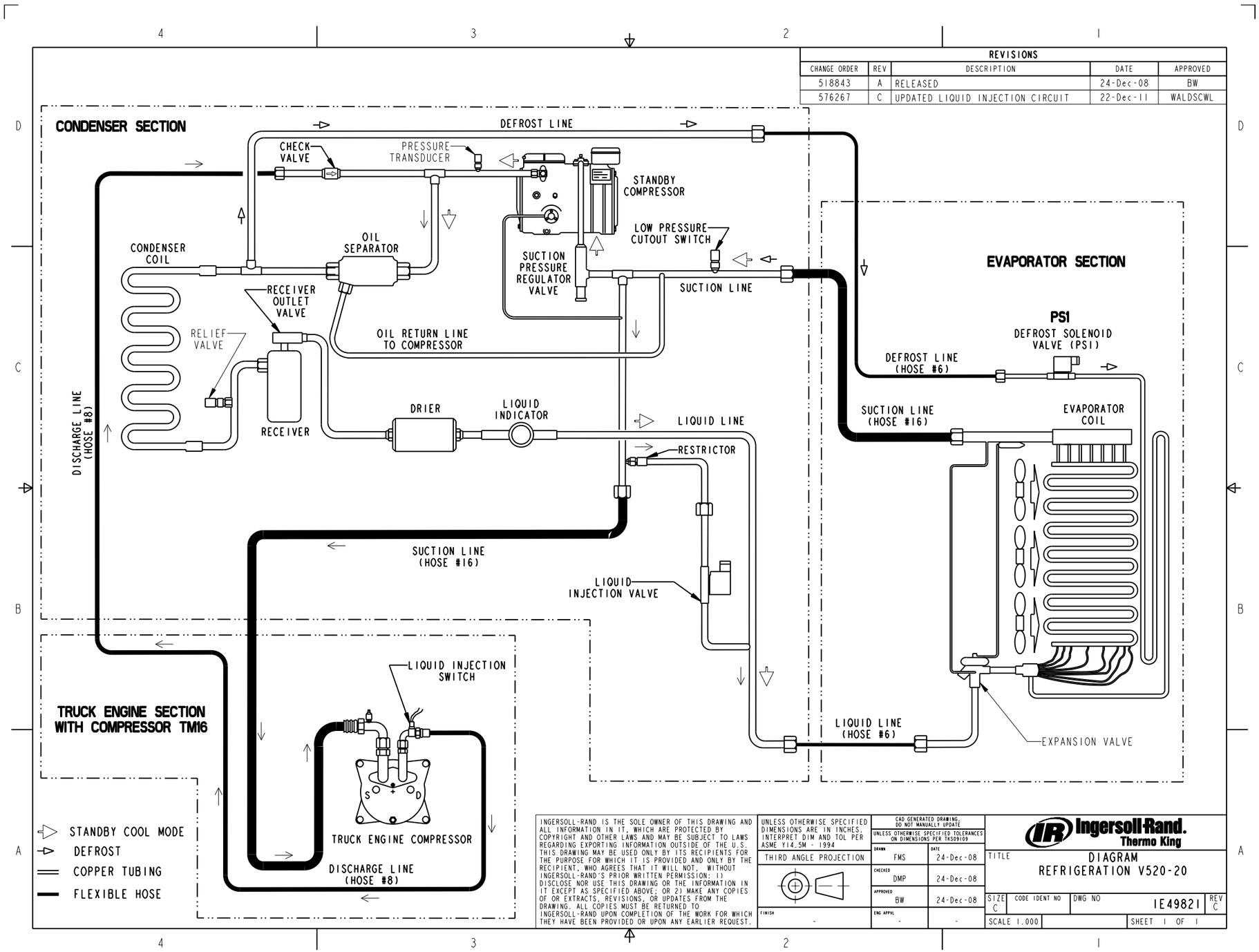
TITLE DIAGRAM REFRIGERATION V520-10

SIZE	CODE IDENT NO	DWG NO	REV
C		IE51277	C

SCALE 1.000 SHEET 1 OF 1

V-520 20 Refrigeration Diagram

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
518843	A	RELEASED	24-Dec-08	BW
576267	C	UPDATED LIQUID INJECTION CIRCUIT	22-Dec-11	WALDSCWL



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIM AND TOL PER ASME Y14.5M - 1994

THIRD ANGLE PROJECTION

FINISH -

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS PER TKS09109

		DATE
DRAWN	FMS	24-Dec-08
CHECKED	DMP	24-Dec-08
APPROVED	BW	24-Dec-08
ENG APPVL	-	-

Ingersoll-Rand. Thermo King

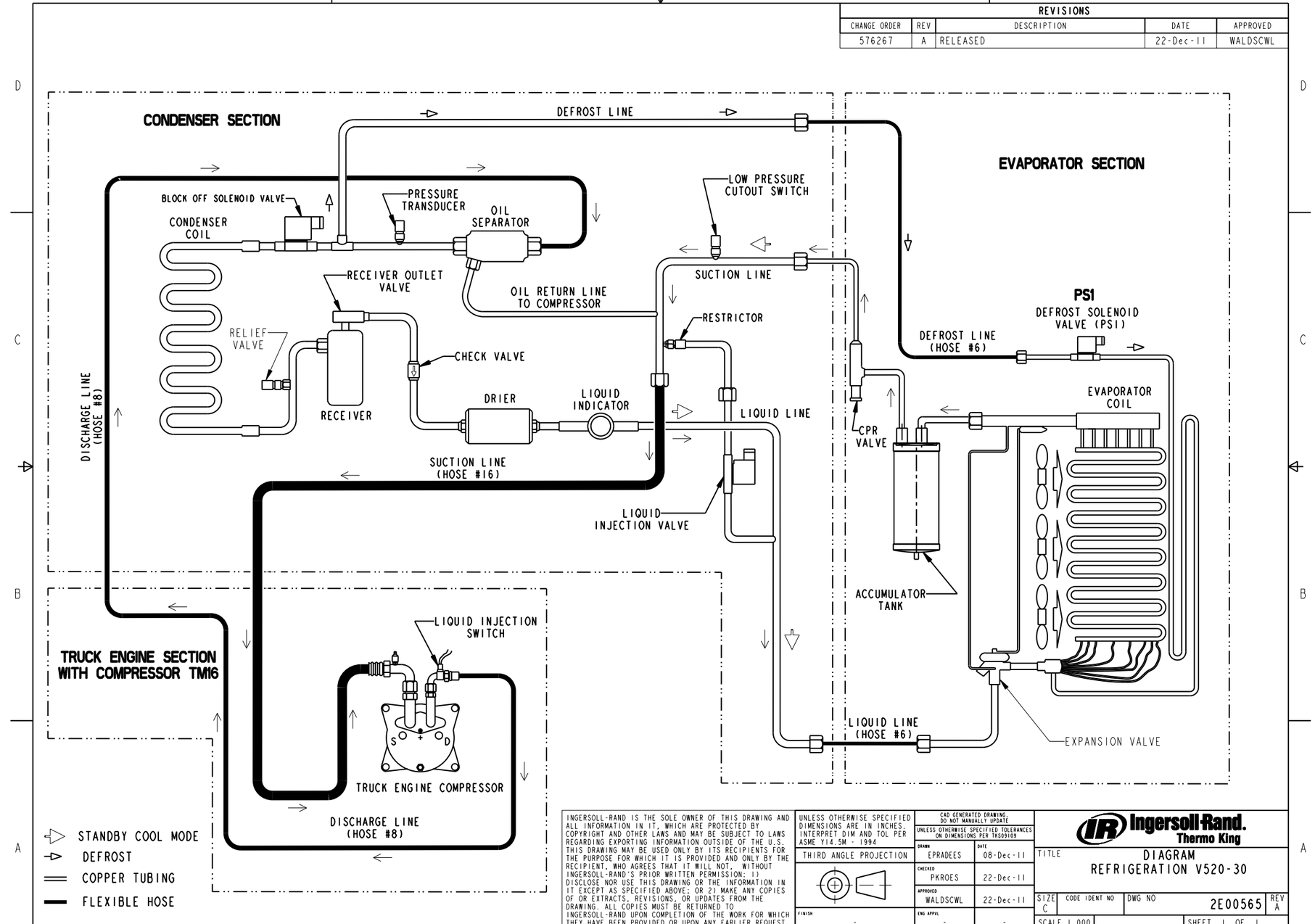
TITLE DIAGRAM REFRIGERATION V520-20

SIZE	CODE IDENT NO	DWG NO	REV
C		IE49821	C

SCALE 1.000 SHEET 1 OF 1

V-520 30 Refrigeration Diagram

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
576267	A	RELEASED	22-Dec-11	WALDSCWL



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIM AND TOL PER ASME Y14.5M - 1994

THIRD ANGLE PROJECTION

FINISH -

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS PER TKS09109

DRAWN	EPRADEES	08-Dec-11
CHECKED	PKROES	22-Dec-11
APPROVED	WALDSCWL	22-Dec-11
ENG APPVL	-	-

Ingersoll Rand. Thermo King

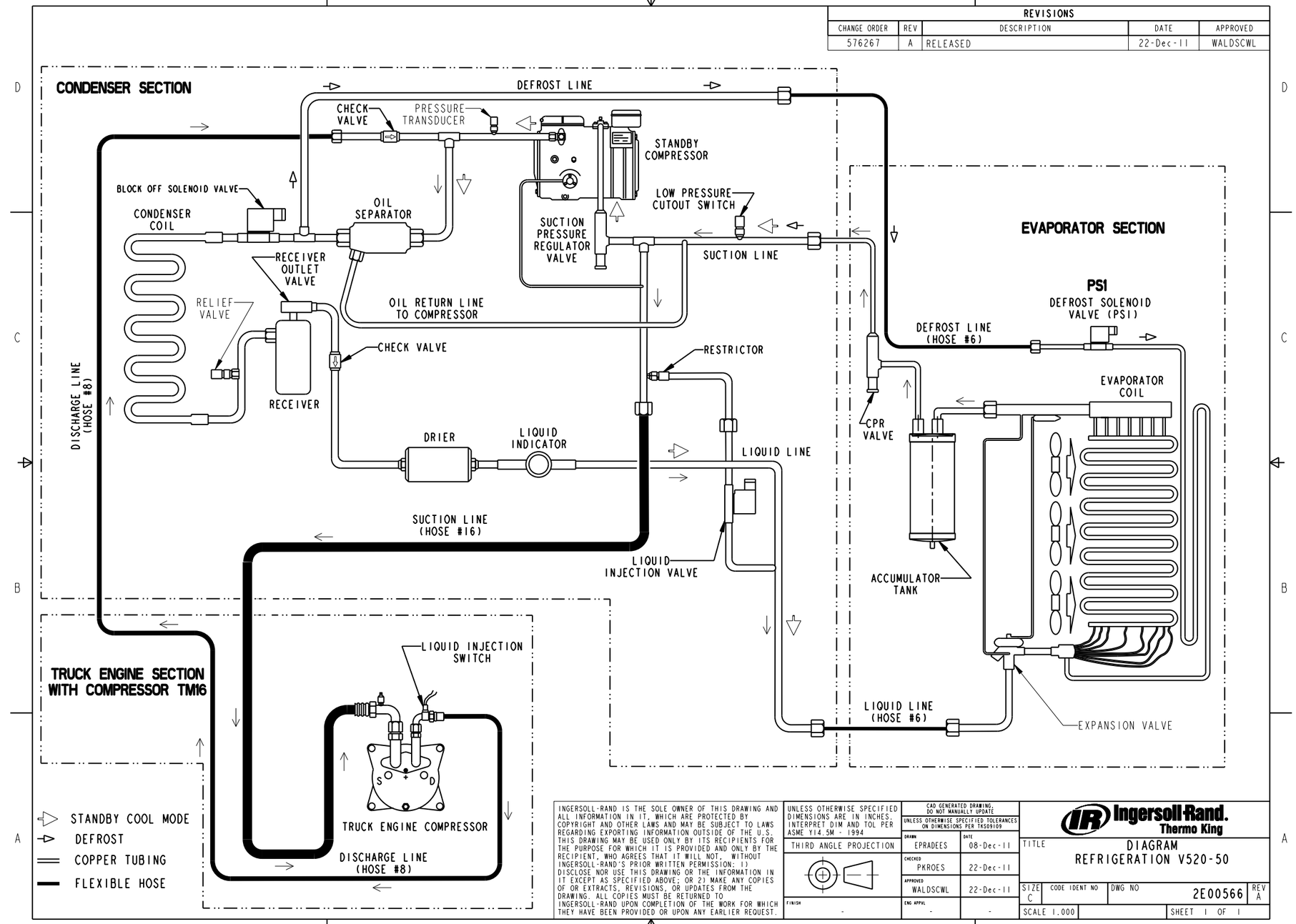
TITLE DIAGRAM REFRIGERATION V520-30

SIZE	CODE IDENT NO	DWG NO	REV
C		2E00565	A

SCALE 1.000 SHEET 1 OF 1

V-520 50 Refrigeration Diagram

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
576267	A	RELEASED	22-Dec-11	WALDSCWL



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIM AND TOL PER ASME Y14.5M - 1994

THIRD ANGLE PROJECTION

FINISH -

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS PER TR509109

DRAWN	EPRADEES	08-Dec-11
CHECKED	PKROES	22-Dec-11
APPROVED	WALDSCWL	22-Dec-11
ENG APPVL	-	-

Ingersoll-Rand. Thermo King

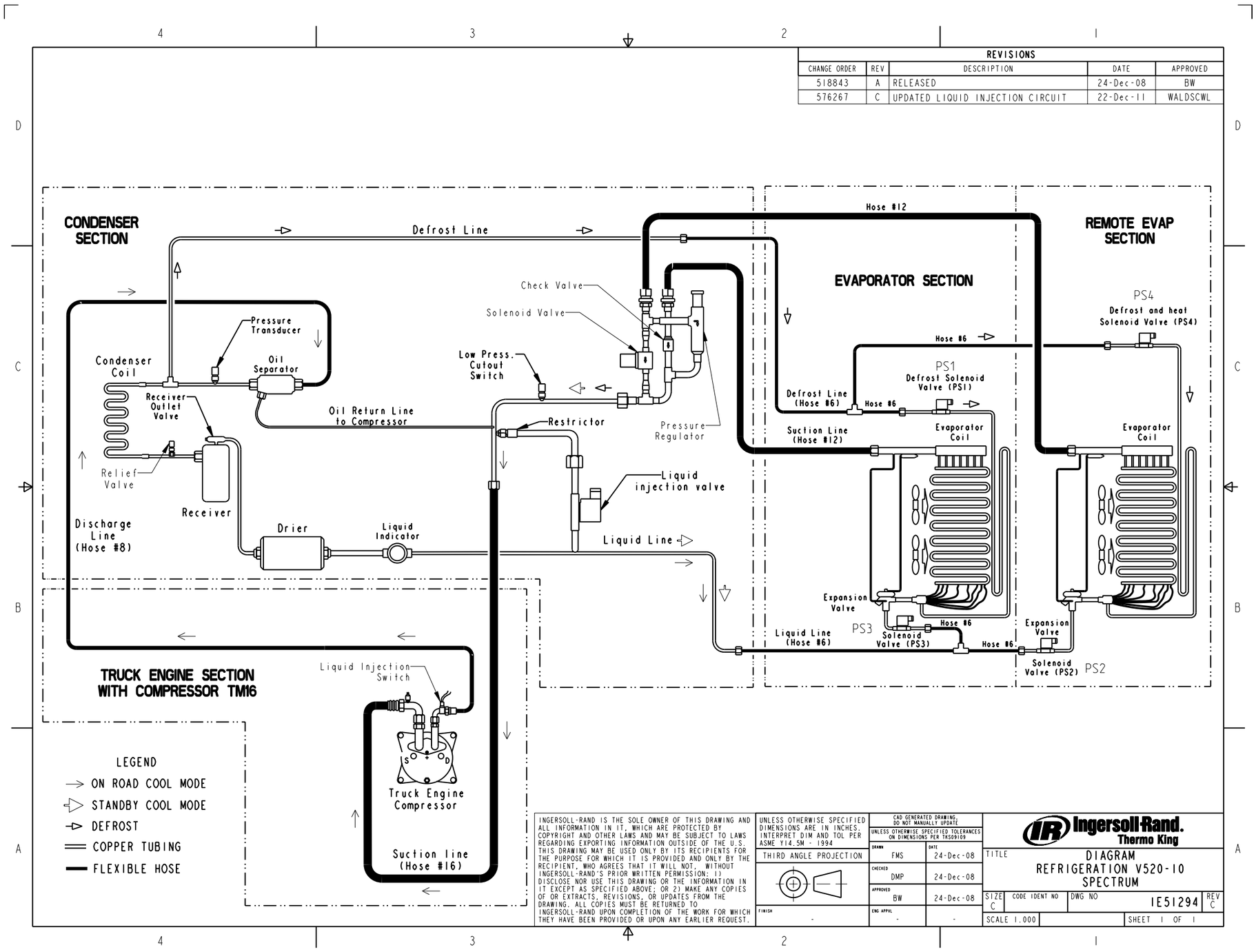
TITLE DIAGRAM REFRIGERATION V520-50

SIZE	CODE IDENT NO	DWG NO	REV
C		2E00566	A

SCALE 1.000 SHEET 1 OF 1

V-520 10 SPECTRUM Refrigeration Diagram

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
518843	A	RELEASED	24-Dec-08	BW
576267	C	UPDATED LIQUID INJECTION CIRCUIT	22-Dec-11	WALDSCWL



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIM AND TOL PER ASME Y14.5M - 1994

THIRD ANGLE PROJECTION

FINISH -

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS PER TK50910

DRAWN	FMS	24-Dec-08
CHECKED	DMP	24-Dec-08
APPROVED	BW	24-Dec-08
ENG APPVL	-	-

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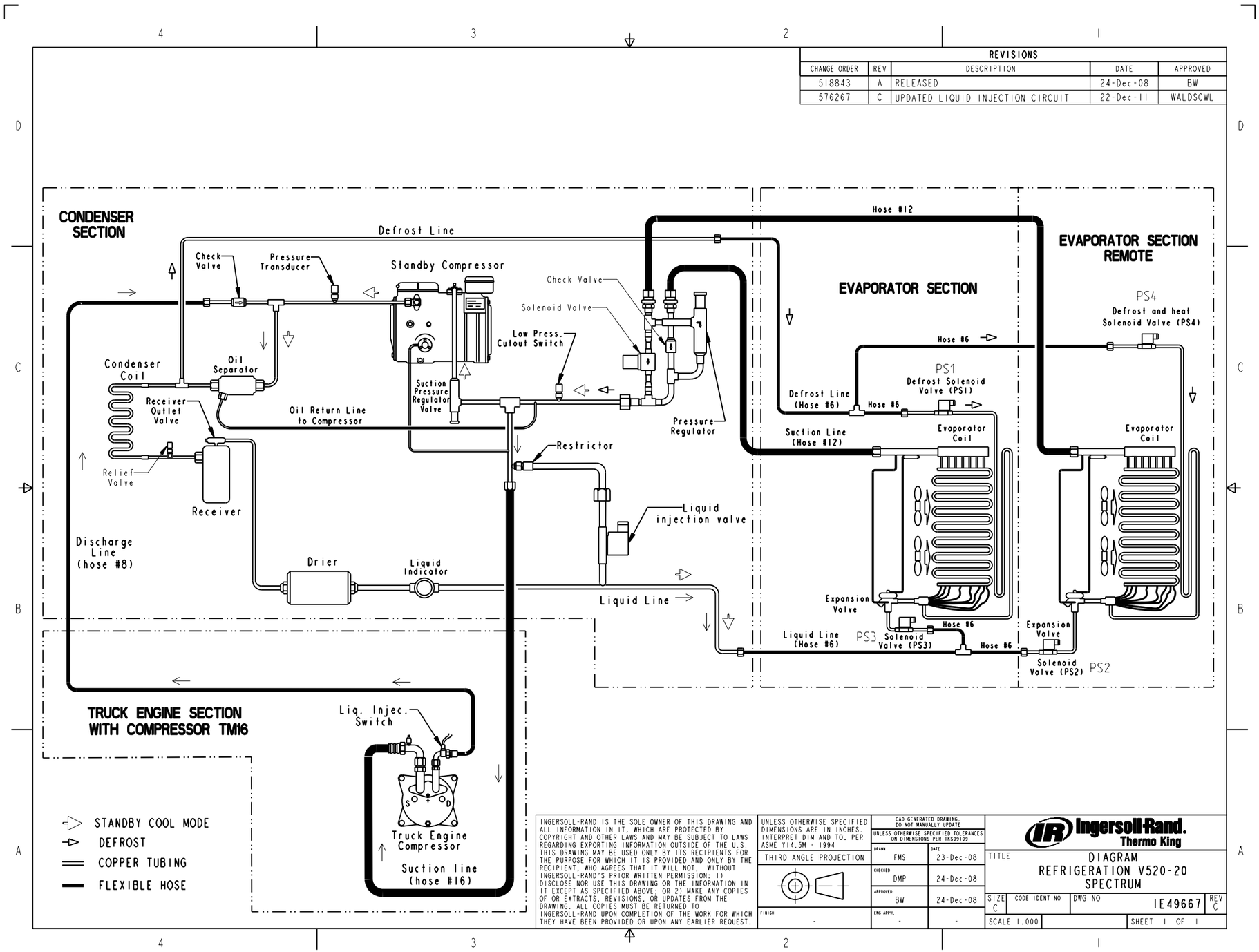
TITLE: DIAGRAM REFRIGERATION V520-10 SPECTRUM

SIZE	CODE IDENT NO	DWG NO	REV
C		IE51294	C

SCALE 1.000 SHEET 1 OF 1

V-520 20 SPECTRUM Refrigeration Diagram

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
518843	A	RELEASED	24-Dec-08	BW
576267	C	UPDATED LIQUID INJECTION CIRCUIT	22-Dec-11	WALDSCWL



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIM AND TOL PER ASME Y14.5M - 1994

THIRD ANGLE PROJECTION

FINISH -

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS PER TK509109

DRAWN	FMS	23-Dec-08
CHECKED	DMP	24-Dec-08
APPROVED	BW	24-Dec-08
ENG APPVL	-	-

Ingersoll-Rand. Thermo King

TITLE: DIAGRAM REFRIGERATION V520-20 SPECTRUM

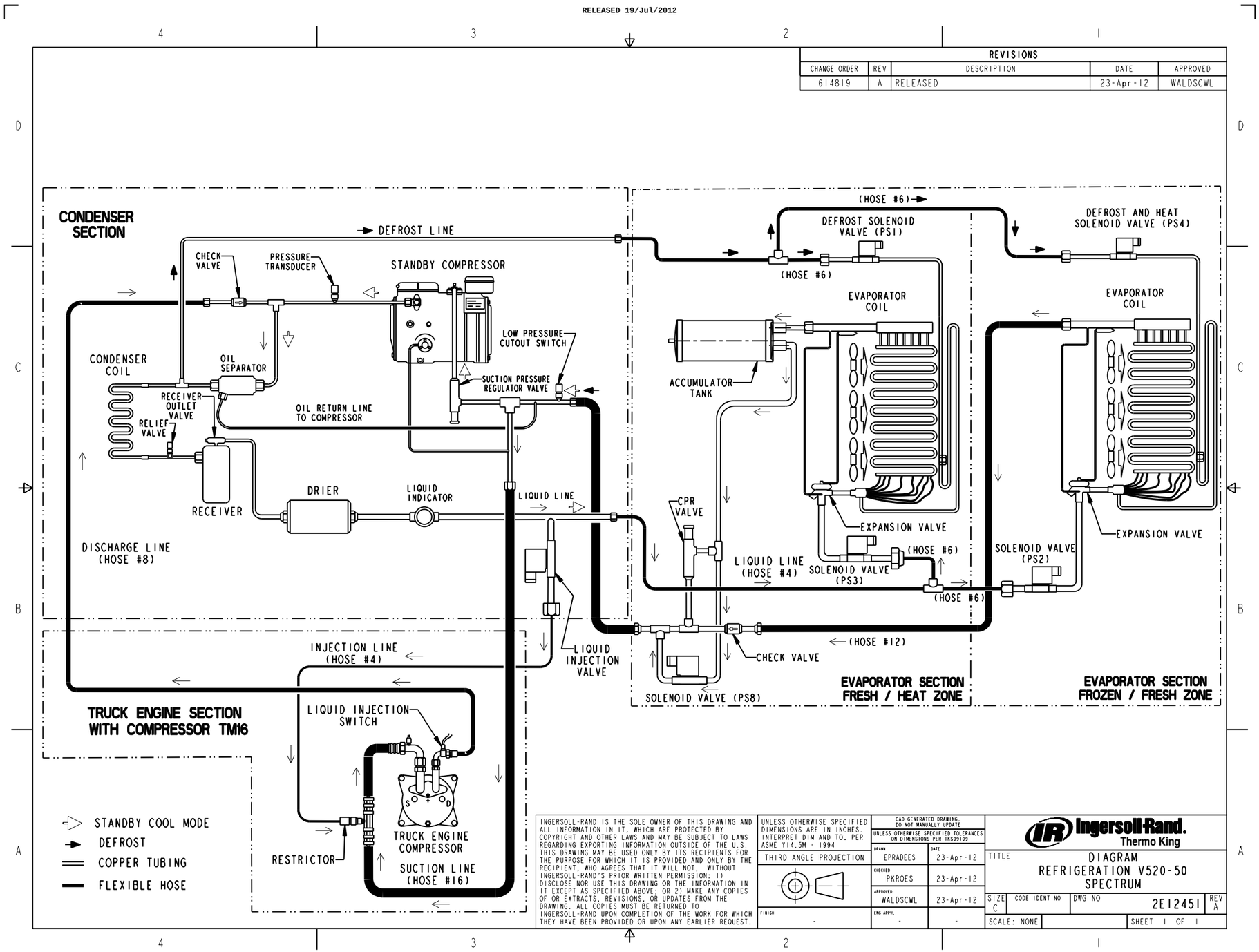
SIZE	CODE IDENT NO	DWG NO	REV
C		IE49667	C

SCALE 1.000 SHEET 1 OF 1

V-520 50 SPECTRUM Refrigeration Diagram

RELEASED 19/Jul/2012

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
614819	A	RELEASED	23-Apr-12	WALDSCWL



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIM AND TOL PER ASME Y14.5M - 1994

THIRD ANGLE PROJECTION

FINISH -

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS PER TKS09109

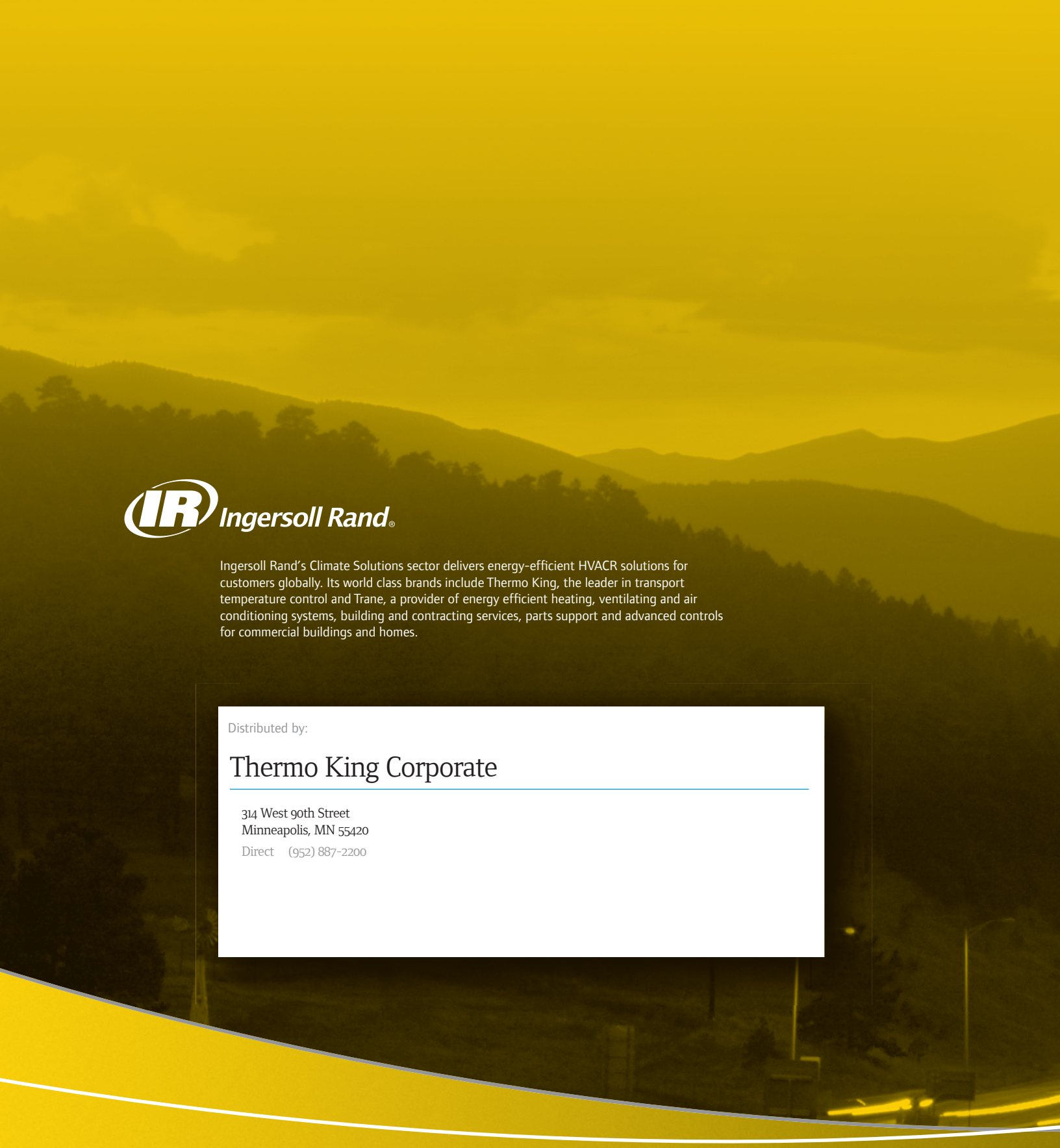
DRAWN	EPRADEES	23-Apr-12
CHECKED	PKROES	23-Apr-12
APPROVED	WALDSCWL	23-Apr-12
ENG APPVL	-	-

Ingersoll-Rand. Thermo King

TITLE: DIAGRAM REFRIGERATION V520-50 SPECTRUM

SIZE C | CODE IDENT NO | DWG NO 2E12451 | REV A

SCALE: NONE | SHEET 1 OF 1



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