



Diagnostic Manual

TriPac EVOLUTION

*Auxiliary Heating/Cooling Temperature
Management System*

TK 55739-19-OD Rev 0 (08/13)



THERMO KING

DIAGNOSTIC MANUAL

TriPac EVOLUTION

Auxiliary Heating/Cooling Temperature Management System

TK 55739-19-OD Rev 0 (08/13)

Base Controller Hardware Version D and later

Base Controller Software Revision 41 01 and later

HMI Control Panel Hardware Version A and later

HMI Control Panel Software Revision 42 01 and later

TK Monitor Software Revision 43 01 and later

Revision History

TriPac EVOLUTION Auxiliary Heating/Cooling Temperature Management System

TK 55739-19-OD Rev 0 (08/13) TriPac EVOLUTION Production Release August 2013

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HOW TO USE THIS MANUAL

Since not everyone is familiar with microprocessor based control systems, please take a few minutes to read this page. It explains the content and structure of this manual. This will make it easier for you to find the information you need.

Section 1 - Safety information

This section contains the safety information for the TriPac EVOLUTION control system. Read this material carefully before working on the unit.

Section 2 - Hardware Description

This section describes the TriPac EVOLUTION control system hardware. It identifies and locates controllers, relays, LED's, fuses and other components and provides connector maps for all connectors.

Section 3 - Software Description

This section discusses the operation of the TriPac EVOLUTION control system software and programmable features. Each menu and feature is discussed individually to illustrate how they are used.

Section 4 - Operation

This section explains how to operate the TriPac EVOLUTION control system. This information is referenced by material in Section 5 Diagnostics.

Section 5 - Diagnostics

This section explains how to diagnose units equipped with the TriPac EVOLUTION control system. It includes both Alarm Code Diagnostics and Other Symptom Diagnostics. This section will reference material in Section 4 Operation and Section 6 Service Procedures.

Section 6 - Service Procedures

This section includes Service Procedures to assist the technician when servicing units equipped with the TriPac EVOLUTION control system. These procedures are referenced by the diagnostic routines in Section 5 Diagnostics.

Section 7 - Service Information

This section offers Service Information on the basic component parts of the TriPac EVOLUTION control system. It includes hardware and software history as well as interchangeability information.

Section 8 – Schematics and Wiring Diagrams

This section includes the TriPac EVOLUTION control system electrical schematics and unit wiring diagrams.

CHANGES AND COMMENTS

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

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Section 4 – TriPac EVOLUTION Safety Information

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Section 4 – TriPac EVOLUTION Safety Information

Section 4 – TriPac EVOLUTION Safety Information

This section includes general safety precautions, specific cautions, and first aid information. Read this material carefully before working on the unit.

SAFETY DEFINITIONS

The following types of safety precautions appear in this manual:

!	<i>DANGER: Denotes the possibility of serious injury or death.</i>
!	<i>WARNING: Denotes the possibility of serious damage to equipment and/or serious injury to self.</i>
!	<i>CAUTION: Denotes the possibility of minor to severe damage to equipment and/or possible injury to self.</i>

SAFETY PRECAUTIONS

NOTE: EPA Section 609 Certification is needed to work on mobile vehicle air conditioning systems.

General Practices

!	<i>DANGER: Always turn the TriPac unit off by pressing the HMI Main Power On/Off key before refueling the truck. Failure to do so can cause fuel vapors to ignite or explode.</i>
!	<i>DANGER: Always wear goggles or safety glasses when working on TriPac. Refrigerant and battery acid can permanently damage the eyes.</i>
!	<i>DANGER: Never apply heat to a sealed refrigeration system or container. This can cause an explosion.</i>
!	<i>DANGER: Fluorocarbon refrigerants in the presence of an open flame, spark, or electrical short produce toxic gases that are severe respiratory irritants CAPABLE OF CAUSING DEATH.</i>

Section 4 – TriPac EVOLUTION Safety Information



DANGER: Keep your hands, clothing and tools clear of moving parts when the TriPac unit is running. Loose clothing can become entangled in moving parts, causing serious injury or possible death.



DANGER: Do not breathe refrigerant. Use caution when working with refrigerant or a refrigeration system in any closed or confined area with a limited air supply. Refrigerant can displace air and cause oxygen depletion. This might result in suffocation and possible death.



WARNING: Make sure the gauge manifold hoses are in good condition. Never let them come in contact with a belt, fan, pulley, or a hot surface. This will damage equipment and can cause serious injury.



WARNING: Use caution when using ladders to install or service TriPac. Always observe the manufacturer's safety labels and warnings.



CAUTION: Make sure all mounting bolts are tight and are the correct length for their application. Improper torque and incorrect bolt lengths can damage equipment.

Auto Start Hazards



CAUTION: The TriPac can start and run automatically any time the unit is turned on. Before removing covers, or working on any part of the TriPac unit, always turn TriPac off by pressing the HMI Main Power On/Off key.

Refrigerant Hazards



DANGER: Do not use a Halide torch. When a flame comes in contact with refrigerants, toxic gases are produced. These gases can cause suffocation or death.



DANGER: Store refrigerants in proper containers out of direct sunlight and away from intense heat. Heat increases pressure inside storage containers, which can cause a container to explode.



DANGER: Do not use oxygen (O₂) or compressed air for leak testing. A mixture of oxygen (O₂) and refrigerant can be combustible.

Section 4 – TriPac EVOLUTION Safety Information



WARNING: Always use butyl-lined gloves when handling refrigerants, in order to be protected from frostbite.



CAUTION: Always be careful when handling refrigerants. Refrigerants can cause frostbite. When exposed to the atmosphere in the liquid state, refrigerants evaporate rapidly, freezing anything they contact.



CAUTION: When removing refrigerant from a unit, use a recovery process that prevents or absolutely minimizes refrigerant escape into the atmosphere. Refrigerants can be harmful to the Earth's ozone layer.

Refrigeration Oil Hazards



WARNING: Avoid refrigeration oil contact with the eyes. Refrigeration oil can cause serious eye injury. Avoid prolonged or repeated contact of refrigeration oil with skin or clothing. Wash thoroughly after handling refrigeration oil to prevent irritation.



CAUTION: Do not use the wrong refrigeration oil. It will damage equipment and void the warranty.



CAUTION: Do not mix refrigeration oils. Mixing incompatible oils will damage the system.



CAUTION: Use dedicated equipment to prevent contaminating the system with the wrong type of oil or refrigerant.



CAUTION: Store refrigeration oil in an approved sealed container to avoid moisture contamination.



CAUTION: When adding oil to a system, do not expose the refrigeration oil to the air any longer than necessary. Moisture in the oil will increase evacuation times, and can contaminate the system.



CAUTION: Wipe up spills immediately. Oil can damage paints and rubber materials.

Section 4 – TriPac EVOLUTION Safety Information

ELECTRICAL HAZARDS

Low Voltage



WARNING: Control circuits are low voltage (12 volts dc). This voltage potential is not considered dangerous, but current over 30 amperes can cause severe burns if shorted or grounded.



WARNING: Do not wear jewelry, watches or rings. These items can short out, damage equipment, and cause severe burns.

Battery Removal



DANGER: When removing a battery, ALWAYS disconnect the negative battery terminal first. Then remove the positive terminal. When RECONNECTING THE BATTERY TERMINALS, CONNECT THE POSITIVE TERMINAL (+) FIRST, AND CONNECT THE NEGATIVE (-) TERMINAL LAST.

IMPORTANT: The above Danger message is critical. The frame of the TriPac is grounded to the negative battery terminal. If the negative terminal is still connected, a complete circuit exists from the positive terminal of the battery to the frame. This can cause the following:

- If a conductive tool contacts the positive side and the frame simultaneously, a spark or arcing will occur.
- If there are sufficient hydrogen gases emitted from the battery, a battery explosion might occur. This can damage equipment and cause serious injury or even death.

Welding Precautions

Take precautions before performing electric welding on any portion of the unit or vehicle to which the unit is attached. Ensure that welding currents are not allowed to flow through the electronic circuits of the TriPac unit. For additional information, see Service Procedure A26A in Section 6 of this manual.

Section 4 – TriPac EVOLUTION Safety Information

MICROPROCESSOR PRECAUTIONS

The following procedures must be followed when working on microprocessor based control systems.

- Never use testers consisting of a battery and a light bulb to test circuits on any microprocessor based equipment.
- Always turn the TriPac unit off by pressing the HMI Main Power On/Off key before connecting or disconnecting the truck batteries. Read and follow all truck instructions for removing batteries.
- Always use TriPac Service Procedure A03A to replace the Interface Board.
- Always use TriPac Service Procedure A03B to replace the HMI Controller.

FIRST AID

First Aid: Refrigerants

In the event of frostbite protect the frozen area from further injury, warm the affected area rapidly, and maintain respiration.

EYES

For contact with liquid, immediately flush eyes with large amounts of water. 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 and injury. Get prompt medical attention. Wash contaminated clothing before reuse.

Section 4 – TriPac EVOLUTION Safety Information

INHALATION

Move victim to fresh air and use CPR (Cardio Pulmonary Resuscitation) or mouth-to-mouth resuscitation, if necessary. Stay with victim until emergency medical personnel arrive.

First Aid: Refrigeration Oil

EYES

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

INGESTION

Do not induce vomiting. Immediately contact local poison control center or physician.

First Aid: Engine Coolant

EYES

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

INGESTION

Do not induce vomiting. Immediately contact local poison control center or physician.

Section 4 – TriPac EVOLUTION Safety Information

First Aid: Electrical Shock

Take IMMEDIATE action! Obtain immediate medical assistance, if available.

Remove the source of the shock immediately. Shut down the power or remove the victim from the source.

If it is not possible to shut off the power:

- Cut the wire with an insulated instrument (e.g., a wooden handled axe or cable cutters with heavy insulated handles)
- Wear electrically insulated gloves and safety glasses.
- Do not look at the wire while it is being cut. The ensuing flash can cause burns and blindness.

If the victim has to be removed from a live circuit, pull the victim off with a non-conductive material.

DO NOT TOUCH the victim! You can receive a shock from current flowing through the victim's body.

Use the victim's coat, a rope, wood, or loop your belt around the victim's leg or arm and pull the victim off.

After separating the victim from power source, check immediately for the presence of a pulse and respiration.

- If a pulse is not present, start CPR (Cardio Pulmonary Resuscitation) and call for emergency medical assistance.
- If a pulse is present, use mouth-to-mouth resuscitation. Call for emergency medical assistance.

Section 4 – TriPac EVOLUTION Safety Information

SAFETY DECALS



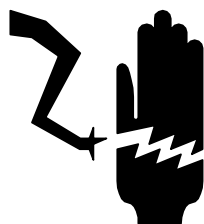
CAUTION FAN

ATTENTION VENTILATEUR

ACHTUNG VENTILATOR

ATTENZIONE VENTILATORE

CUIDADO VENTILADOR



CAUTION
HIGH VOLTAGE

ATTENTION
HAUTE TENSION

ACHTUNG
HOCHSPANNUNG

ATTENZIONE
ALTA TENSIONE

CUIDADO ALTO VOLTAJE



SWITCH UNIT TO OFF BEFORE
SERVICING

ARRETER LE GROUPE AVANT DE
PROCEDURE A L'ENTRETIEN

VOR WARTUNG EINHEIT
ABSCHALTEN

SPEGNERE L'UNIT A PRIMA DEGLI
INTERVENTI DI SERVIZIO

PARAR LA UNIDAD ANTES DE
HACERLE EL SERVICIO

Section 2 – TriPac EVOLUTION Hardware Description

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Section 2 – TriPac EVOLUTION Hardware Description

GENERAL DESCRIPTION

The Thermo King TriPac EVOLUTION Auxiliary Heating/Cooling Temperature Management System allows drivers to reduce unnecessary truck engine idling to conserve diesel fuel, reduce maintenance costs and save money. TriPac EVOLUTION provides truck cab and sleeper compartment climate control, truck battery charging and truck engine preheating. Available options include an Arctic Package for additional truck engine preheating and a Power Inverter Option to supply 120 VAC.



TriPac EVOLUTION APU



TriPac EVOLUTION HMI Control Panel

- When a truck is equipped with TriPac EVOLUTION, drivers can reduce fuel cost, rest comfortably during stops and comply with local, state and federal anti-idle laws. Reducing unnecessary truck engine idling also reduces engine wear and extends truck engine maintenance intervals. The TriPac diesel engine uses an automatic start/stop feature for additional fuel efficiency.
- The TriPac EVOLUTION APU (Auxiliary Power Unit) is mounted on the truck frame. The TriPac 7.5 HP two cylinder direct injection diesel engine is EPA Tier 4F approved. A 65 amp alternator provides power to operate the TriPac unit and charge the truck batteries.

Section 2 – TriPac EVOLUTION Hardware Description

- Cooling for the truck cab and sleeper compartment is provided by an evaporator coil and evaporator blower. These components are typically located under the bunk in the truck cab sleeper compartment. Conditioned air from the evaporator is supplied through air vents installed in the truck cab and sleeper compartment walls. A condenser coil with condenser fan is mounted on the outside rear of the truck cab. The compressor is located in the APU. TriPac EVOLUTION uses R134a refrigerant.
- Heating for the truck cab and sleeper compartment is provided by a separate diesel fuel fired air heater. Heated air is supplied by an internal fan in the heater through an air vent into the truck cab sleeper compartment. Diesel fuel for the heater is drawn from the tractor fuel tank. The evaporator blower can also be run during heating operation for additional air flow if desired. The heater is typically located under the bunk in the truck cab sleeper compartment.
- Truck battery charging is by means of the TriPac EVOLUTION alternator located in the APU. Low battery voltage sensing is used to automatically start the APU as required to maintain the truck batteries in a charged condition. Charge current sensing is used to determine when the batteries are charged and the APU will shut down, unless additional running is required for temperature control.
- An optional Arctic Package senses the coolant temperature of the truck engine at the APU. If the coolant temperature falls below 35°F (1.7°C), the TriPac engine located in the APU will start. The TriPac engine coolant is circulated through the truck engine until the temperature of the coolant returning to the APU reaches 55°F (13°C). The TriPac engine will shut down, unless additional running is required for temperature control or to charge the truck batteries.
- An optional power inverter supplies 120 VAC to power small appliances in the truck. The power inverter is connected directly to the truck batteries. The TriPac unit will start and stop as required to charge the truck batteries as long as the TriPac Main Power On/Off switch is turned on.
- An optional Diesel Particulate Filter (DPF) is available. See the TriPac DPF Diagnostic and Maintenance Manual (TK 53924) for additional information.

Section 2 – TriPac EVOLUTION Hardware Description

HMI CONTROL PANEL

The microprocessor based HMI (Human/Machine Interface) Control Panel is the primary interface between the driver and the TriPac EVOLUTION unit. It is a simple to use device that allows the driver to control and monitor unit operation. The HMI has three selector knobs and a System Condition. It also contains an integral Cab Temperature Sensor. The HMI also informs the driver of existing alarms and indicates system status. The HMI Control Panel is typically mounted in the bunk area of the truck.



HMI Control Panel (ARA2100)

The driver can control these functions using the HMI Control Panel:

- ✓ System On/Off
- ✓ Mode (Cool, Fan, Heat)
- ✓ Desired Cab Temperature (Cooler-Warmer)
- ✓ Fan Speed (OFF, Low, Medium, High)

In addition, the HMI Control Panel provides information on the following:

- ✓ System Status
- ✓ Existence of system alarms, should an alarm condition occur.

For additional information see the TriPac EVOLUTION Operators Manual (TK 55711-19-OP) and Section 4 of this Manual.

Section 2 – TriPac EVOLUTION Hardware Description

APU (AUXILIARY POWER UNIT)

The TriPac EVOLUTION Auxiliary Power Unit APU is mounted on the frame rail of the truck. The Standard TriPac EVOLUTION APU contains the following components:

- 7.5 HP direct Injection 2 Cylinder EPA Tier 4F Certified Engine
- 65 Amp Alternator (standard) or 120 Amp Dual Output Alternator (optional)
- Thermo King QM-15-XD compressor
- Electric Compressor Clutch
- Pre-cooler Coil and Fan
- Engine On/Off switch
- Preheat buzzer

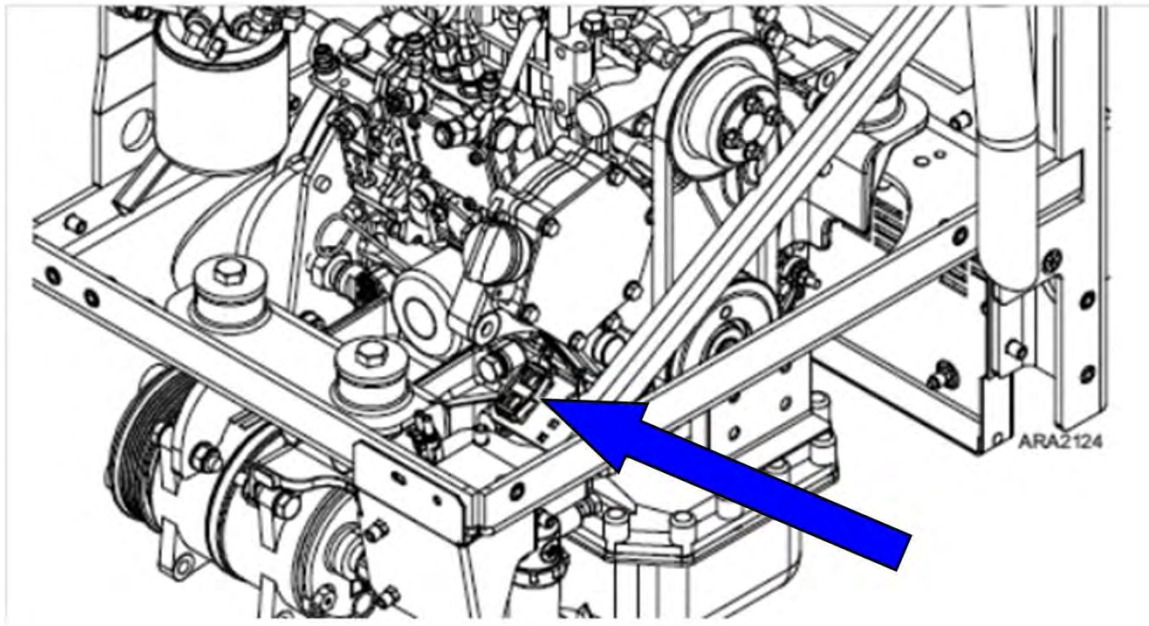


TriPac EVOLUTION APU

Section 2 – TriPac EVOLUTION Hardware Description

ENGINE ON/OFF SWITCH

The TriPac EVOLUTION APU Engine On/Off Switch is located inside the APU as shown below. The Engine On/Off Switch functions as a service switch to allow maintenance personnel to disable the APU when working on the unit.



TriPac EVOLUTION APU Engine On/Off Switch

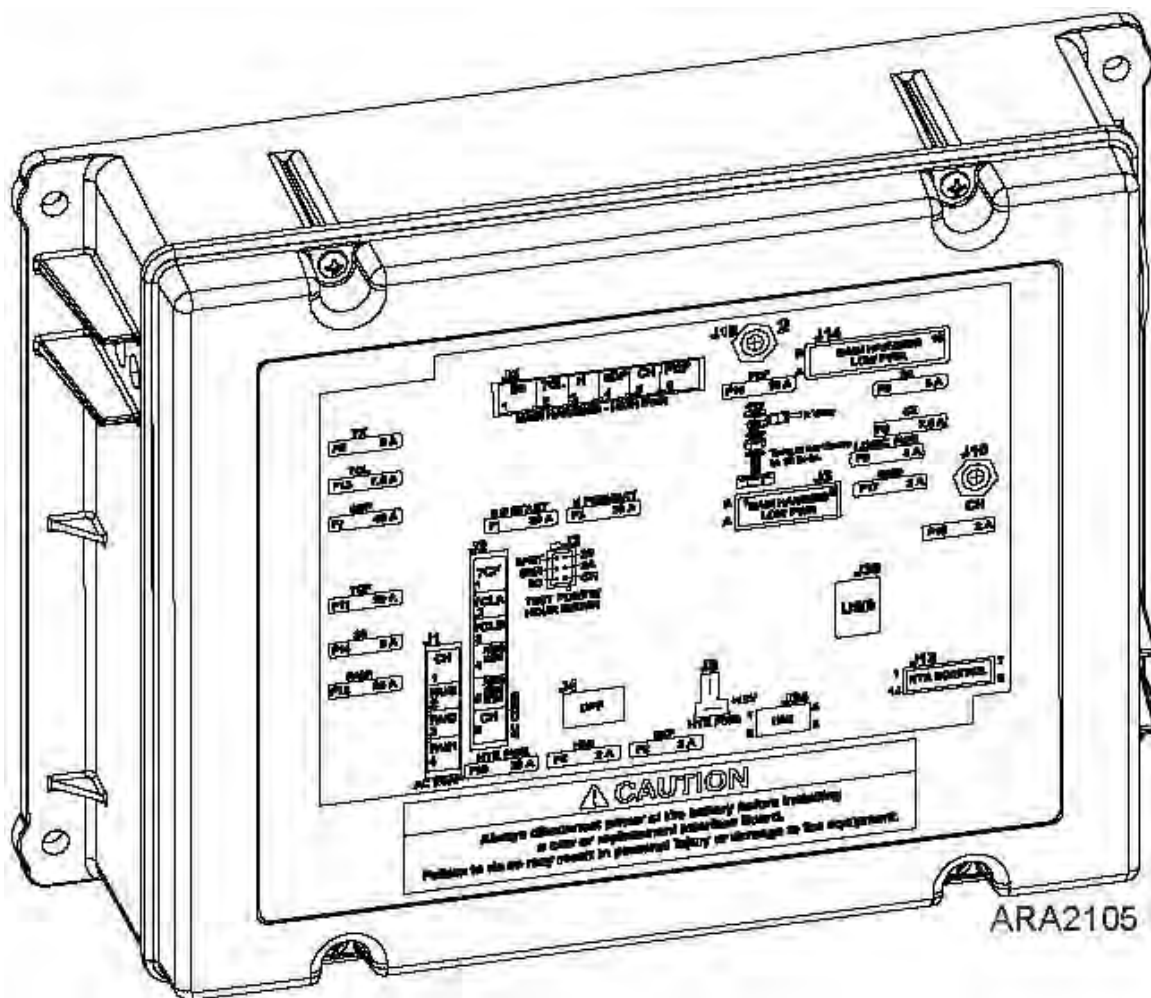
The Engine On/Off Switch must be in the On position to allow normal system operation. The Engine On/Off Switch is located inside the APU and is accessed by opening the APU access panel. When the Engine On/Off Switch is placed in the Off position the following actions occur.

- ✓ If the unit is Off and the HMI Control Panel On/Off button is pressed, an [ENG] Group Shutdown Alarm Code 35 Run Relay is set. The engine will not start.
- ✓ If the unit is On but the engine is not running, an [ENG] Group Shutdown Alarm Code 35 Run Relay is set. The engine will not start.
- ✓ If the unit is On and the engine is running, the engine will shut down and an [ENG] Group Shutdown Alarm Code 35 Run Relay is set. The engine will not start.

Section 2 – TriPac EVOLUTION Hardware Description

CONTROL BOX

The Control Box contains the Interface Board and harness connections. The Control Box cover is secured with 4 screws and provides a decal showing the location of components on the Interface Board. The Control Box is typically located under the bunk in the truck cab sleeper compartment.



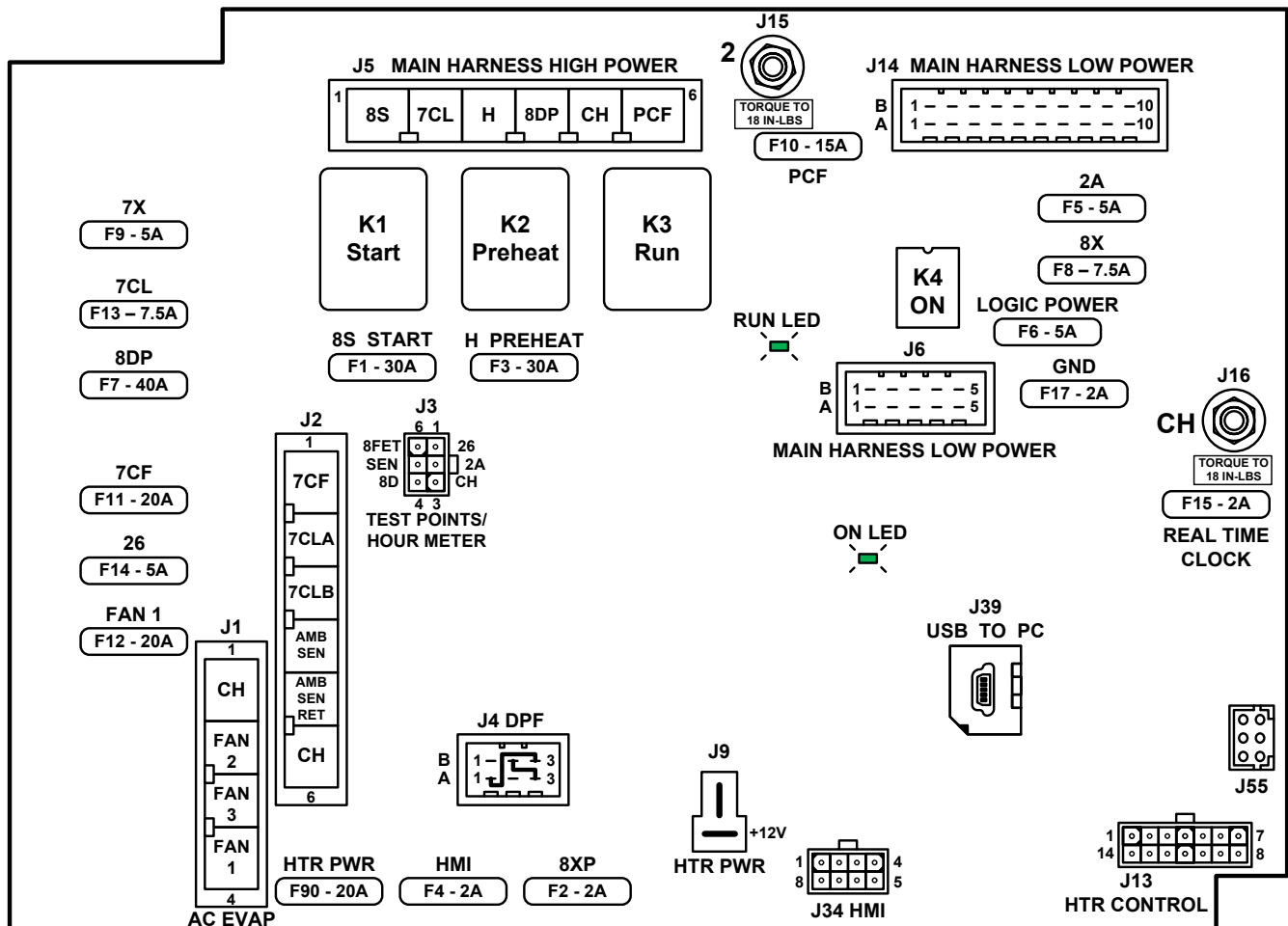
TriPac EVOLUTION Control Box

Section 2 – TriPac EVOLUTION Hardware Description

INTERFACE BOARD

The Interface Board is the heart of the TriPac EVOLUTION Control System. It consists of the Base Controller, Base Controller software, memory, inputs and outputs. The Interface Board also provides the interface between the controller inputs and outputs and the unit control components, including the HMI Control Panel. The inputs are used to supply power and system information to the Base Controller. The Base Controller and software examine the status of the inputs and turn the outputs to the fans, relays or other components on and off as required to control the operation of the unit. The Interface Board also provides over-current and short circuit protection for the control circuits. The Interface Board is mounted inside of the control box.

The only user serviceable components on the Interface Board are the fuses.



TriPac EVOLUTION Interface Board

Section 2 – TriPac EVOLUTION Hardware Description

Interface Board Hardware Versions

For complete details of TriPac EVOLUTION Interface Board hardware versions and software requirements see Section 7 of this manual.

Base Controller Software Revisions

TriPac EVOLUTION Base Controllers require Base Controller Software Revision 41 01 or later. For complete details of Base Controller software revisions and hardware requirements see Section 7 of this manual.

Interface Board Relays

The Base Controller controls the operation of the unit using control relays or FETs. The relays control power to the high amperage loads such as the glow plugs, starter and Run Relay. Each output is individually fuse protected.

IMPORTANT: Do not attempt to remove the relays from the Interface Board. They are soldered in place.

Relay	Function
K1	Starter Solenoid Relay
K2	Preheat (Glow Plug) Relay
K3	Run Relay
K4	On Relay

Interface Board FETs

Field Effect Transistors (FETs) control power to the lower amperage loads such as solenoids and fans. A FET is a circuit control devices that performs the function of a relay. Each FET output is individually fuse protected.

Section 2 – TriPac EVOLUTION Hardware Description

Interface Board LEDs

LEDs show Base Controller Status and indicate the Run Relay is energized and its contacts have transferred. Each output is individually fuse protected.

LED	Function
ON	This green LED will blink about once per second while the system is turned on by the HMI. It will blink rapidly for a few seconds when the system is first turned on.
RUN	This green LED will be on steady when the Run relay coil has been energized by the controller and the relay contacts have transferred.

Section 2 – TriPac EVOLUTION Hardware Description

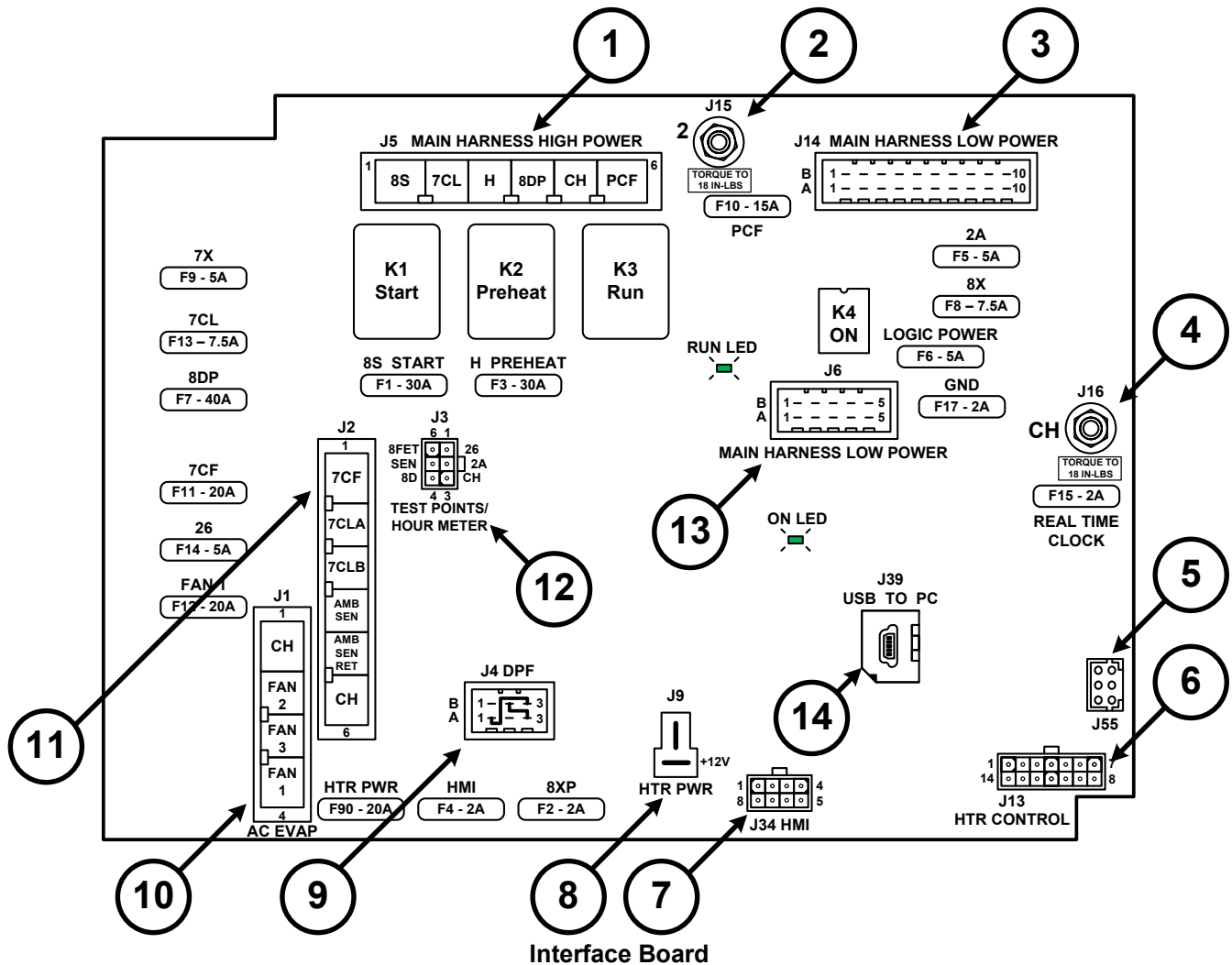
Unit Fuses

Fuse Number	Location	Amp Rating	Component Protected / Circuit – Connector
F1	Interface Board	30	Starter / 8S – J5
F2	Interface Board	2	HMI / 8XP – J34
F3	Interface Board	30	Glow plugs / H – J5
F4	Interface Board	2	HMI / 2P – J34
F5	Interface Board	5	Optional Standby Switch / 2A – J14
F6	Interface Board	5	Controller Power Supply – Interface Board
F7	Interface Board	40	Fuel Solenoid Pull / 8DP – J5
F8	Interface Board	7.5	Run / 8X – J14
F9	Interface Board	5	7X FET / 7X – J4
F10	Interface Board	15	Pre-cooler Fan / PCF – J5
F11	Interface Board	20	Condenser Fan / 7CF – J5
F12	Interface Board	20	Evaporator Fan / FAN1, 2, 3 – J1
F13	Interface Board	7.5	Compressor Clutch / 7CL – J5
F14	Interface Board	5	Heater / 26/YEL – J13
F15	Interface Board	2	Real Time Clock
F16	Power Harness	50	System Power / 2 – J15
F17	Interface Board	2	IFB Ground Plane – J16
F18	Sense Harness	3	Voltage Sense / SEN – J14
F19	Ignition Harness	1	Standby / IGN-SBY – J14
F24	DPF Harness (option)	150	DPF Main Power / RED
F25	DPF Air Box (option)	10	DPF Control Power / 2B
F26	DPF Ignition Harness (option)	1	DPF Ignition / IGN – SECM
F28	Heater Harness	5	Heater Power Sense / RED – J13
F29	Battery Box	200	Main Power Cable / RED – Starter
F30	Battery Box	3	Alternator Sense / 2A – S
F90	Interface Board	20	Heater / RED – J9

Section 2 – TriPac EVOLUTION Hardware Description

CONNECTOR LOCATION AND PIN-OUT DIAGRAMS

Interface Board Connector Locations



Section 2 – TriPac EVOLUTION Hardware Description

Interface Board Connector Usage

See the following pages for individual connector maps.

Number	Connector	Circuit
1	J5	Main High Power
2	J15	Main Power Terminal (2)
3	J14	Main Low Power
4	J16	Main Ground Terminal (CH)
5	J55	Factory Use Only
6	J13	Connections to Heater Control Harness
7	J34	HMI Control Panel Harness
8	J9	Heater Power
9	J4	DPF (option)
10	J1	Evaporator Fan
11	J2	AC Harness
12	J3	Test Points / Hour Meter (option)
13	J6	Main Low Power
14	J39	USB Data – Access to TK Monitor by connecting to PC.

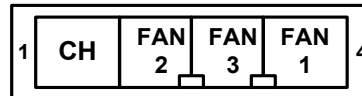
Section 2 – TriPac EVOLUTION Hardware Description

INTERFACE BOARD CONNECTOR MAPS

J1 – Evaporator Fan

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
1	CH-07B		Ground for EFM
2	FAN2		To EFM medium speed
3	FAN3		To EFM high speed
4	FAN1		To EFM low speed

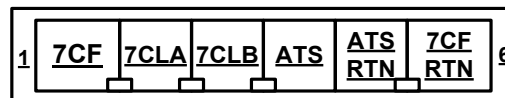
J1 – Shown from wire
side of connector



J2 – AC Harness

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
1	7CF		FET output to CFM
2	7CLA1		Sense input from HPCO
3	7CLB		Sense input from LPCO
4	ATS		Ambient Temperature Sensor positive
5	ATS_RTN		Ambient Temperature Sensor negative
6	7CF_RTN		Ground for CFM

J2 – Shown from wire
side of connector

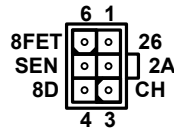


Section 2 – TriPac EVOLUTION Hardware Description

J3 – Test Points / Hour Meter Option

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
1	CH		Chassis ground
2	2A		Interface Board Power
3	26		Output Heat Enable
4	8D		Output Run Relay
5	SEN		Input Battery Voltage Sense
6	8FET		System On

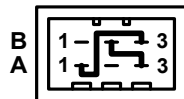
J3 – Shown from wire side of connector



J4 – DPF Option

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
A1	7X	RED	Output Start Demand
A2	8D		Run Circuit Output – DPF Option
A3	8	GRN	Input Run Circuit to Run Relay (RR)
B1	SBY		Standby Signal Input – DPF Option
B2	8FET	GRN	Output Run Circuit
B3	7A	RED	Input Start Demand

J4 – Shown from wire side of connector



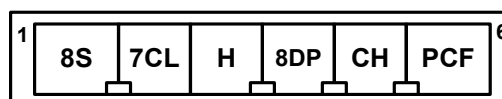
Shown with jumpers installed. Jumpers are removed if Diesel Particulate Filter (DPF) is installed.

Section 2 – TriPac EVOLUTION Hardware Description

J5 – Main High Power

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
1	8S		To engine Starter Solenoid (SS)
2	7CL		To HPCO and compressor clutch (CLU)
3	H		To Glow Plugs (GP1, GP2)
4	8DP		To Fuel Solenoid Pull-in (FSP)
5	CH-01		Interface Board Ground
6	PCF		To Pre-cooler Fan (PCF)

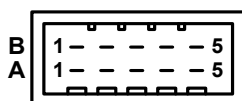
J5 – Shown from wire side of connector



J6 – Main Low Power

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
A1	WT2		To Water Temp Sensor 2 (WT2)
A2	HSEN_HI		From Hall Current Sensor (HCS)
A3	FLD 1		From alternator Field (FLD) terminal
A4	FLD 3		From LSR_HI resistor and alternator Field (FLD) terminal
A5	HSEN_PWR		To Hall Current Sensor (HCS)
B1	WT2_RTN		From Water Temp Sensor 2 (WT2)
B2	HSEN_LO		From Hall Current Sensor (HCS)
B3	FLD2		From LSR_LO resistor and alternator Field (FLD) terminal
B4	Not Used		Not Used
B5	HSEN_RTN		From Hall Current Sensor (HCS)

J6 – Shown from wire side of connector



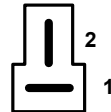
Note that pins are identified in two rows as follows:
Row A, Pins 1 to 5
Row B, Pins 1 to 5

Section 2 – TriPac EVOLUTION Hardware Description

J9 – Heater Power Harness Connector – arranged by pin number

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
1		Red	Power to Heater
2		Brown	Ground from Heater

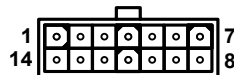
J9 – Shown from wire side of connector



J13 – Heater Control Harness Connector – arranged by pin number

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
1		Red	From Heater, voltage input to Interface Board (future expansion)
2		Yellow	To Heater, enable signal
3		Blue/Yellow	From Heater (future expansion)
4		Blue/White	From Heater, diagnostic communication (future expansion)
5		Brown/White	To Heater, setpoint signal
6		Gray/Red	To Heater, setpoint signal
7		Gray	From Heater, External Sensor (option)
8		Brown	From Heater, ground
9			Not Used
10			Not Used
11			Not Used
12			Not Used
13			Not Used
14			Not Used

J13 – Shown from wire side of connector

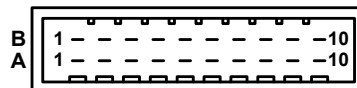


Section 2 – TriPac EVOLUTION Hardware Description

J14 – Main Low Power

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
A1	SEN		From Main Power (RED), sense battery voltage.
A2	SBY		From IGN or optional Standby Switch (SSW). Not used with DPF option.
A3	8X		System On voltage to Engine Switch (ESW) in APU.
A4	8D2		Engine run circuit to Fuel Solenoid Hold (FSH) and Electric Fuel Pump (FP).
A5	LOPS		To Oil Pressure Switch (OPS).
A6	Not Used		Not Used
A7	WT1_RTN		From Engine Coolant Temperature Sensor 1 (WT1).
A8	Not Used		Not Used
A9	COILSEN		To Evaporator Coil Temperature Sensor (CTS).
A10	FS1		From Flywheel Sensor (FWS).
B1	D+		To Alternator Excite (L) terminal.
B2	Not Used		Not Used
B3	2A		To optional Standby Switch (SSW).
B4	8X_SW		From Engine Switch (ESW) in APU.
B5	Not Used		Not Used
B6	Not Used		Not Used
B7	WT1		To Engine Coolant Temperature Sensor 1 (WT1).
B8	Not Used		Not Used
B9	COILSEN_RTN		From Evaporator Coil Temperature Sensor (CTS).
B10	FS2		From Flywheel Sensor (FWS).

J14 – Shown from wire side of connector

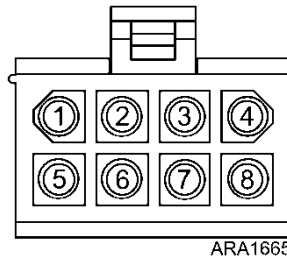


Note that pins are identified in two rows as follows:
Row A, Pins 1 to 10
Row B, Pins 1 to 10

Section 2 – TriPac EVOLUTION Hardware Description

J34 – HMI Control Panel Harness CAN Connector

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
1	CANL	Red	Communication
2	CANH	Black	Communication
3	SHLD	Clear	Communication
4	ON	White	On signal to Interface Board (grounded by HMI)
5	2P	White	Power to HMI
6	8XP	White	On feedback signal from Interface Board
7	OFF	White	Off signal to Interface Board
8	CH	White	Ground



HMI Control Panel Harness CAN Connector – shown from pin side of harness connector

Screw Terminal Power Connections

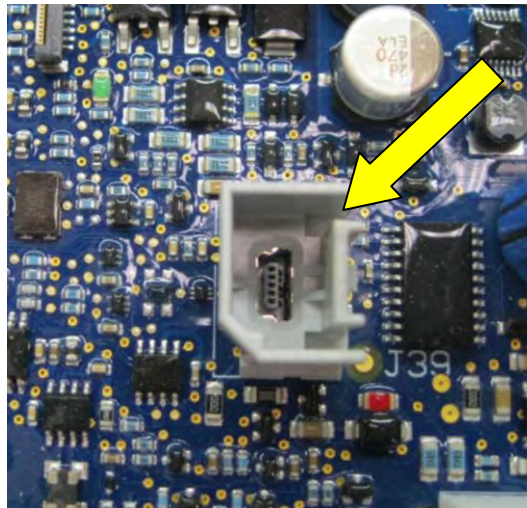
Terminal Number	Wire Number	Description
J15	2	Battery Power
J16	CH	Chassis Ground

IMPORTANT: Torque screw terminals to 18 in-lbs. Over-tightening screw terminal connections will damage the pc board.

Section 2 – TriPac EVOLUTION Hardware Description

J39 – USB Data Port Connector

This USB Mini B connector is used to access TK Monitor. Connect to PC with USB Mini B communication cable.



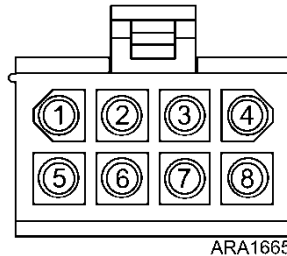
J39 – USB Mini B Data Connector – shown from board side of harness connector.

Section 2 – TriPac EVOLUTION Hardware Description

HMI CONNECTOR MAP

HMI Control Panel Harness CAN Connector – arranged by pin number

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
1	CANL	Red	To Interface board Interface Board Connector J34 Pin 1
2	CANH	Black	To Interface board Interface Board Connector J34 Pin 2
3	SHLD	Clear	To Interface board Interface Board Connector J34 Pin 3
4	ON	White	To Interface board Interface Board Connector J34 Pin 4
5	2P	White	From Interface board Interface Board Connector J34 Pin 5
6	8XP	White	From Interface board Interface Board Connector J34 Pin 6
7	OFF	White	To Interface board Interface Board Connector J34 Pin 7
8	CH	White	To Interface board Interface Board Connector J34 Pin 8



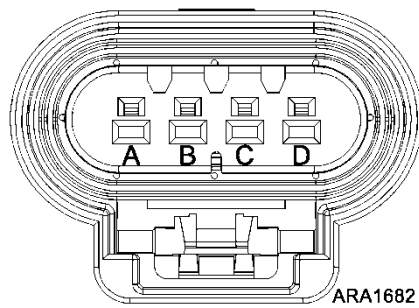
HMI Control Panel Harness CAN Connector – shown from pin side of harness connector

Section 2 – TriPac EVOLUTION Hardware Description

CURRENT SENSOR CONNECTOR MAP

Current Sensor Connector – arranged by pin number

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
1/A	HSEN_HI	Blue	To Interface Board Connector J6 Pin A2
2/B	HSEN_PWR	White	To Interface Board Connector J6 Pin A5
3/C	HSEN_RTN	Black	To Interface Board Connector J6 Pin B5
4/D	HSEN_LO	Brown	To Interface Board Connector J6 Pin B2



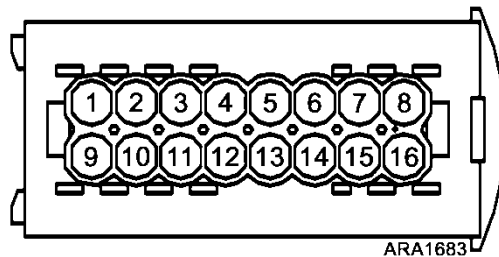
Current Sensor Connector – shown from pin side of harness connector

Section 2 – TriPac EVOLUTION Hardware Description

HEATER CONNECTOR MAP

Heater Control Harness Heater Connector – arranged by pin number

Pin Number	Circuit Code (Wire Number)	Wire Color	Description
1		Red	To Interface board Interface Board Connector J13 Pin 1, J65 Pin 1, Diagnostic Harness Connector
2			Not Used
3		Blue/Yellow	To Interface board Interface Board Connector J13 Pin 3
4		Yellow	To Interface board Interface Board Connector J13 Pin 2, Diagnostic Harness Connector
5		Green/Red	To Fuel Pump Connector Pin 1
6		Brown/White	To Interface board Interface Board Connector J13 Pin 5
7		Gray/Red	To Interface board Interface Board Connector J13 Pin 6
8		Blue/White	To Interface board Interface Board Connector J13 Pin 4, Diagnostic Harness Connector
9			Not Used
10		Brown	To Interface board Interface Board Connector J13 Pin 8, J65 Pin 2, Fuel Pump Connector Pin 2, Diagnostic Harness Connector
11			Not Used
12		Gray	To Interface board Interface Board Connector J13 Pin 7
13			Not Used
14			Not Used
15			Not Used
16			Not Used



Heater Control Harness Heater Connector – shown from pin side of harness connector

Section 2 – TriPac EVOLUTION Hardware Description

AIR CONDITIONING SYSTEM

Air Conditioning is provided by a basic four component system. It uses 1.5 pounds of R-134a refrigerant. Automotive style quick connect service ports are available near the compressor in the APU.

To prevent the evaporator coil from frosting the compressor will stop as evaporator coil temperature reaches 32°F (0°C).

The compressor utilizes PAG type oil that is not compatible with other types of refrigeration oil. This oil is extremely hygroscopic and will readily absorb moisture. Care must be taken during installation and A/C system service to prevent moisture absorption. Allowing moisture into the system will significantly increase the time required to fully evacuate and dehydrate the system.

Refer to TriPac EVOLUTION Maintenance Manual (TK 55675-19-MM) for additional details.

Section 2 – TriPac EVOLUTION Hardware Description

EVAPORATOR ASSEMBLY

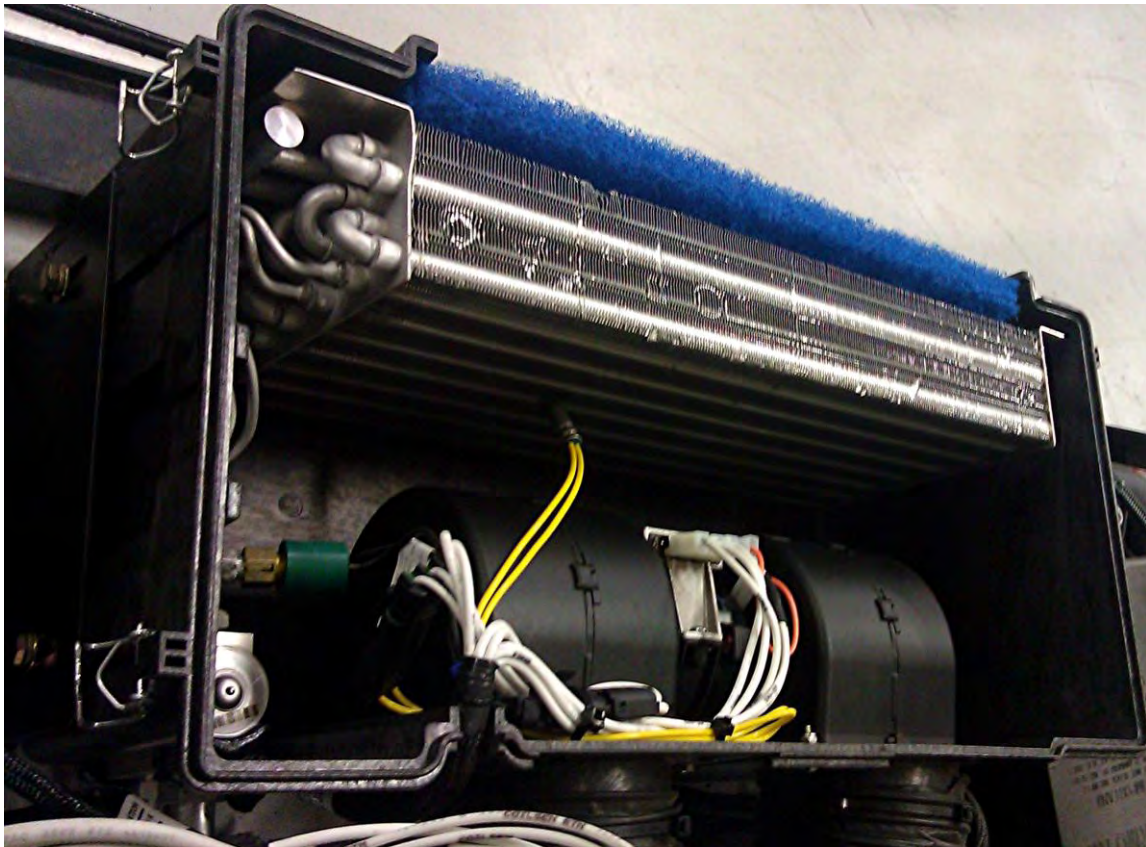
The TriPac EVOLUTION Evaporator Assembly consists of the Evaporator Coil and Evaporator Blowers. The Evaporator Assembly is typically located under the bunk in the truck cab sleeper compartment.

Evaporator Coil

The evaporator coil absorbs heat from the cab air flowing through it. The coil receives high pressure liquid refrigerant from the condenser and sends low pressure refrigerant vapor to the compressor.

Evaporator Fan

The evaporator fan circulates air from the cab, through the evaporator coil and back to the cab. It is a multi-speed fan that receives power and speed commands from the Interface Board.



TriPac EVOLUTION Evaporator Assembly

Section 2 – TriPac EVOLUTION Hardware Description

CONDENSER ASSEMBLY

The Condenser Assembly is mounted on the outside back wall of the cab. It contains the following components.

Condenser Coil

The condenser coil releases heat from the air conditioning system. This coil receives high pressure refrigerant vapor from the compressor and returns high pressure liquid to the receiver tank.

Condenser Fan

The condenser fan provides outside air circulation through the condenser coil to remove heat from the refrigerant. It is a single speed fan that receives power from the Interface Board.

Ambient Temperature Sensor (Optional)

The Ambient Temperature Sensor (ATS) provides ambient air temperature information to the Interface Board. This information is used to control APU engine load during air conditioning operation. This sensor is used with optional 120 Amp charging system.

Receiver/Drier

The receiver/drier is mounted near the condenser housing. It acts as a temporary refrigerant storage tank to accommodate changing refrigerant demands. It will also absorb a small amount of moisture from the refrigerant to help prevent system contamination.

High Pressure Cutout

A High Pressure Cutout (HPCO) switch is mounted on the receiver/drier. If the refrigerant pressure becomes abnormally high the normally closed High Pressure Cutout Switch contacts will open. This removes power from the compressor clutch and stops the compressor. An ACS Alarm Code 10 High Discharge Pressure will be set.

When refrigerant pressure returns to normal the normally closed High Pressure Cutout Switch contacts will close. If cooling is still required power is applied to the compressor clutch and starts the compressor.

See Section 5 of this manual for information on Alarm Codes and solutions.

Section 2 – TriPac EVOLUTION Hardware Description



TriPac EVOLUTION Condenser

Section 2 – TriPac EVOLUTION Hardware Description

SYSTEM SENSORS

The TriPac EVOLUTION control system uses several sensors to provide operational information to the base controller. Temperature sensors are not polarity sensitive. They may be tested with an ohm meter. See Service Procedure D01A in Section 6 of this manual.

Cab Temperature

The Cab Temperature sensor is part of the HMI Control Panel. It senses the air temperature in the bunk area of the cab. It is the controlling sensor while in Cool mode. The Cab Temperature sensor is directly connected to the HMI circuit board. It is not serviceable.

Evaporator Coil Temperature

The Evaporator Coil Temperature sensor (CTS) is primarily used to prevent frost from forming on the evaporator coil. As coil temperature reaches 32°F (0°C) the compressor will stop but evaporator fan will continue to run. Compressor will not restart until evaporator coil temperature rises above 45°F (7°C).

Water Temperature 1

Engine coolant temperature is sensed at the thermostat housing by the Water Temperature 1 sensor (WT1). The Base Controller uses this information to determine preheat time and engine protection alarms. It may also be used for Pre-cooler Fan control in Closed Loop applications.

Water Temperature 2

Engine coolant temperature is sensed as it enters the Pre-cooler Coil by the Water Temperature 2 sensor (WT2). The controller uses this information to control the Pre-cooler Fan. If the Arctic option is installed this sensor is moved to the coolant return hose from the truck engine. Information from this sensor is also used to start and stop the APU engine when the ambient temperature is low.

Ambient Temperature

The Ambient Temperature Sensor (ATS) provides ambient air temperature information to the Base Controller. This information will assist in controlling engine load during air conditioning operation. The sensor is mounted on the condenser assembly. This sensor is part of the optional 120 Amp charging system.

Section 2 – TriPac EVOLUTION Hardware Description

Low Pressure Cutout Switch

A Low Pressure Cutout (LPCO) switch is located in the Evaporator Box Assembly. If refrigerant pressure is abnormally low the normally closed switch contacts will open to remove power from the compressor clutch. This is to protect the Air Conditioning system.

When refrigerant pressure returns to normal the normally closed Low Pressure Cutout Switch contacts will close. If cooling is still required power is applied to the compressor clutch and starts the compressor.

High Pressure Cutout Switch

A High Pressure Cutout (HPCO) switch is mounted on the receiver/drier. If the refrigerant pressure becomes abnormally high the normally closed High Pressure Cutout Switch contacts will open. This removes power from the compressor clutch and stops the compressor. An ACS Alarm Code 10 High Discharge Pressure will be set.

When refrigerant pressure returns to normal the normally closed High Pressure Cutout Switch contacts will close. If cooling is still required power is applied to the compressor clutch and starts the compressor.

See Section 5 of this manual for information on Alarm Codes and solutions.

Current Sensor

A Hall Effect Current Sensor (HCS) is mounted on the side of the APU frame. The battery cable running to the OEM truck battery pack passes through this sensor. This sensor informs the Base Controller how much and in what direction current is flowing between the truck batteries and APU. If the Hall Current Sensor or sensor circuit is open TK Monitor will show a current reading of +250A.

Flywheel Sensor

A Flywheel Sensor (FW) is mounted on the engine next to the engine flywheel to monitor engine RPM. The Base Controller uses this information during automatic engine starts. It is also used to generate some alarms.

Section 2 – TriPac EVOLUTION Hardware Description

AIR HEATER

The TriPac EVOLUTION system uses an Espar diesel-fueled Air Heater to provide warm air to the truck cab. The Air Heater vent is located near floor level in the truck cab sleeper compartment. A return inlet air vent is typically located at floor level. The Air Heater is turned On and Off and the temperature setpoint is set using the HMI Control Panel. The Air Heater, wiring harness, and ducting are typically located in the storage compartment under the truck cab sleeper compartment. The Air Heater combustion air inlet ducting, exhaust ducting, and fuel inlet line are located below and outside of the truck cab sleeper compartment. A dedicated heater fuel metering pump transfers diesel fuel from the truck fuel tank to the Air Heater.



TriPac EVOLUTION Air Heater

The Interface Board will provide the Air Heater with power, setpoint information and an enable (On) signal. Air Heater operation will be controlled by the microprocessor and return air sensor on the heater control module inside the Air Heater. The Air Heater shuts down if its heat exchanger temperature exceeds an overheat limit of 240°F (115°C).

The evaporator blower is defaulted off when Heat mode is selected. However, the evaporator blower can be operated along with the Air Heater for additional air circulation.

Section 2 – TriPac EVOLUTION Hardware Description

The Air Heater receives electrical power from the Interface Board via the RED wire from the J9 plug. The Air Heater ground circuit is also connected to this plug. This circuit is protected by a 20 amp fuse (F90) on the Interface Board. Information is sent to and from the Air Heater through the J13 plug on the Interface Board. The YEL wire provides a signal to enable or turn the Air Heater on. The GRY/RED and BRN/WHT wires supply setpoint information to the Air Heater. The RED wire provides a feedback signal that power is available to the Air Heater. The remaining wires are used for other communications.

The internal Air Heater microprocessor monitors the functions and operations of the Air Heater. The Air Heater microprocessor is also programmed to recognize Air Heater fault codes. The five most-recent fault codes are retained in the Air Heater's microprocessor memory. Older fault codes are deleted from memory as new alarm codes occur. Fault codes can be retrieved and read by using the EDiTH Diagnostic Tool or the Heater Diagnostic Unit.

- ✓ See Section 5 of this manual for a description of air heater fault codes.
- ✓ See Service Procedure H31A TriPac Air Heater Diagnostics using the EDiTH Diagnostic Tool in Section 6 of this manual for instructions regarding the use of the EDiTH Diagnostic Tool.
- ✓ See Service Procedure H32A TriPac Air Heater Diagnostics using the Heater Diagnostic Unit in Section 6 of this manual for instructions regarding the use of the Heater Diagnostic Unit.

Section 2 – TriPac EVOLUTION Hardware Description

OPTIONS

DC to AC Power Inverter (12 Vdc to 115 Vac)

The optional 1000 Watt Power Inverter provides 115 VAC “Hotel Power” for the driver. It changes 12 VDC from the truck batteries to 115 VAC. The Inverter will be mounted in the cab, typically under the bunk.

An 1800 Watt Power Inverter is available as an upgrade. This Driver Convenience Package will automatically include the 120 Amp Charging System. An Ambient Air Temperature Sensor is also provided with the 120 Amp alternator.

IMPORTANT: *Some appliances or electronic devices may not function properly when powered by a DC to AC power inverter.*

NOTE: The 120 amp alternator is required when using the optional 1800W DC to AC Power Inverter.

Truck Integration

The TriPac EVOLUTION unit typically does not operate when the truck engine is running. This is accomplished by placing the APU in Standby Mode when the truck engine is running. The APU can also be forced to standby mode with the optional Standby Switch.

Ignition Switch in On or Start Position

When the truck ignition switch is in the On or Start position, power is routed to the interface board SBY terminal. When this occurs, the APU unit is forced to Standby Mode and all Interface Board outputs are de-energized. The HMI Control Panel will illuminate the [STBY] indicator.

Ignition Switch in the Off or Accessory Position

When the truck’s ignition switch is in the Off or Accessory position, power is removed from the SBY terminal. The APU will enter Monitor Mode.

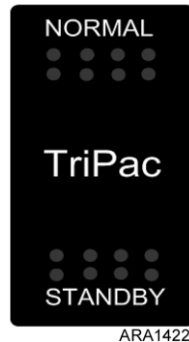
Section 2 – TriPac EVOLUTION Hardware Description

Optional Standby Switch

The optional Standby Switch is located on the truck instrument panel.

When the Standby Switch is in the Normal (On) position, the APU operates as stated previously.

When the Standby Switch is in the Standby (Off) position, power is routed to the interface board SBY terminal via the SBY wire. When this occurs, the APU is forced to Standby Mode and all Interface Board outputs are de-energized. The HMI Control Panel will illuminate the [STBY] indicator. The unit will remain in Standby Mode until the Standby Switch is placed in the Normal position. The truck ignition switch will have no effect.



Optional TriPac EVOLUTION Standby Switch

The APU will remain in Standby Mode until the Standby switch is placed in the Normal (On)

Section 2 – TriPac EVOLUTION Hardware Description

120 Amp Charging System

The TriPac EVOLUTION 120 Amp Charging System upgrade will provide the user with additional truck battery charging capacity. The option includes a Thermo King 120 amp dual output alternator and additional load control circuitry.

IMPORTANT: The 120 amp alternator cannot be used as a replacement for the standard 65 amp alternator.

NOTE: The 120 amp alternator option includes an Ambient Air Temperature Sensor.

NOTE: The 120 amp alternator is required when using the optional 1800W DC to AC Power Inverter.

Engine Hour Meter

An optional Engine Hour Meter is available. If installed, it is located inside the truck tool box area, typically visible through the access door.

Section 2 – TriPac EVOLUTION Hardware Description

Section 3 – TriPac EVOLUTION Software Description

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Section 3 – TriPac EVOLUTION Software Description

Section 3 – TriPac EVOLUTION Software Description

SOFTWARE OPERATION

The software is a very complex set of instructions used by the Base Controller on the Interface Board and HMI Control Panel to control the HVAC system, manage the APU engine and interface with the driver. The Base Controller examines the conditions of all the available inputs and compares them to the instructions contained in the software. The outputs are then energized or commands are sent as specified by the software instructions.

There is no way to determine from the schematic diagram what conditions will cause the system components to operate in a particular mode. These decisions are made by the software after examining all input conditions, programmable settings, HVAC mode selection and desired setpoint. APU operation is automatically managed to provide driver comfort and maintain truck battery charge level.

All software for the TriPac system is flash loaded using TK Monitor. Refer to Section 6, A51A Communication Using TK Monitor.

The TriPac system utilizes three separate software sets.

For software revision detail refer to Section 7 of this manual.

SOFTWARE REVISIONS

Base Controller Software

The Base Controller software will make overall system operation decisions based on current system information from sensors, components and HMI Control Panel. The Base Controller software revision is 41.xx.

HMI Control Panel Software

The HMI Control Panel software in the HMI interprets driver inputs and communicates them to the Base Controller. It also interprets information from the Base Controller and displays it to the driver. The HMI software revision is 42.xx.

TK Monitor Software

TK Monitor Software allows external communication with the system using a PC computer. It provides system service and diagnostic tools. TK Monitor software resides on the Main Controller board; it is not loaded on the PC computer. The TK Monitor software revision is 43.xx.

Section 3 – TriPac EVOLUTION Software Description

PROGRAMMABLE FEATURES

Programmable feature settings are selected using the Programmable Settings menu of TK Monitor.

1. Select the desired feature.
2. Change the setting value by clicking on the up/down arrow.
3. After all changes have been made, click the [Update Setup] button.

All changes will be saved. The system will perform a Warm Restart to implement the changes. TK Monitor will need to be restarted. Refer to Section 6, A51A Communication Using TK Monitor.

Temperature Settings

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – Fahrenheit or Celsius
Default – Fahrenheit
Description – This feature selects temperature scale to be used by the system. This setting affects temperatures displayed in both TK Monitor and data logger downloads. Select appropriate button.

Section 3 – TriPac EVOLUTION Software Description

Switch To Monitor

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – YES or NO
Default – YES
Description – This feature defines the system mode when it is first powered on or then the truck ignition is turned from on (Standby) to off while the TriPac system is turned on. Select appropriate button. [YES] will cause the TriPac system to enter Monitor Mode. The HVAC system will remain off when the truck ignition is turned off. The STBY indicator on the HMI will be on. The system will monitor truck battery voltage. If battery voltage falls below the Battery Voltage Reset Value setting the APU engine will start. The unit will shut down when current flow to the battery reaches the limit set by Charge Current Shutoff Value unless there are other active run demands such as low coolant temperature. If equipped with the Arctic option the system also monitors engine coolant temperature at Temperature Sensor WT2. If temperature falls below 35°F the APU engine will start. The unit will shut down when temperature of coolant returning from the truck engine rises to 55°F unless there are other active run demands such as high charging current. To begin climate control operation the driver must press the On/Off button, select an HVAC mode or change fan speed at the HMI. [NO] will cause the TriPac HVAC system to automatically turn back on when the truck ignition is turned off. Driver does not need to turn system on at the HMI. System will operate in the selected mode. The STBY indicator on the HMI will be off. When the system is first powered on at the HMI the selected HVAC mode will initiate. <u>This setting is not recommended.</u>

Section 3 – TriPac EVOLUTION Software Description

Charge Current Shutoff Value

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 1 – 50 amps in 0.5 amp increments
Default – 20 amps
Description – While the APU engine is running charge current is monitored. When charge current falls below this value the engine is allowed to shut down unless there are other active run demands such as air conditioning or low coolant temperature. Lower settings will provide batteries that are more fully charged but increases engine run time. Higher settings will provide batteries that are less fully charged but decreases engine run time.

Engine Off Delay Timer

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 0 – 15 minutes, 1 minute increments
Default – 8 minutes
Description – The APU engine will run for the specified time after the cab temperature has reached setpoint in Cool mode. This reduces the number of engine start cycles. This feature does not affect heat operation.

Section 3 – TriPac EVOLUTION Software Description

DL Logging Interval

Controller Rev – 41.01
HMI Rev – 42.02
TK Monitor Rev – 43.01
Choices – 1 – 15 minutes, 1 minute increments
Default – 5 minutes
Description – This feature sets the interval for timed logs recorded by the data logger. Lower numbers will provide increased detail but reduce the total period of time that can be stored in memory. Higher numbers will provide decreased detail but increase the total period of time that can be stored in memory. This setting does not affect event logging. Refer to Section 6, Service Procedure A50A Data Logger.

HMI Display Brightness

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 1 - 10
Default – 7
Description – Sets the illumination level the HMI drops to after 90 seconds of inactivity. The HMI switches to full brightness during any activity. 1 = lights off. 10 = remains at full brightness.

Section 3 – TriPac EVOLUTION Software Description

Run Time Period

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 0 disabled, 8 – 16 hours in 1 hour increments.
Default – 0 disabled
Description – This feature sets a maximum run time in a given mode for Cool, Fan or Heat. This feature prevents the TriPac APU engine from running to provide climate control on an unattended truck for an extended period of time. When the time period is exceeded the unit will switch to Monitor mode and terminate Cool, Fan or Heat mode. If the Mode is changed while the Run Time Period timer is running the elapsed time will be reset to 0 and the timer restarted.

Cooling Dead Band

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 1 – 10 degrees, 1 degree increments
Default – 3 degrees
Description – During Cool mode This feature determines the number of degrees above setpoint the Cab Temperature Sensor reading must raise before air conditioning operation is started. This feature has no effect on heat operation. Lower numbers will increase engine run time but hold cab temperature closer to setpoint. Higher numbers will reduce engine run time but the cab temperature will have wider variations.

Section 3 – TriPac EVOLUTION Software Description

Battery Voltage Restart Value

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 11.4 – 13.0 Vdc, 0.1 Volt increments
Default – 12.1 Vdc
Description – The Base Controller senses truck battery voltage at the SEN input. When this voltage falls to the Battery Voltage Restart Level, the APU engine will start to recharge the truck batteries. Higher settings will provide batteries that are more fully charged but will increase engine run time. Lower settings will provide batteries that are less fully charged but will decrease engine run time. Value should be set 0.1 volts above any truck battery voltage alarm or shutdown level.

Low Temp Limit Cool

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 50 - 90°F (10 – 32°C) in 1 degree increments
Default – 65°F (18°C)
Description – This is the minimum cab temperature that can be selected in Cool Mode by the HMI Temperature Control Knob when it is fully turned to the left stop (0%). Lower setting may result in more engine run time.

High Temp Limit Cool

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 50 - 90°F (10 – 32°C) in 1 degree increments
Default – 80°F (27°C)
Description – This is the maximum cab temperature that can be selected in Cool Mode by the HMI Temperature Control Knob when it is fully turned to the right stop (100%).

Section 3 – TriPac EVOLUTION Software Description

Low Temp Limit Heat

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 50 - 90°F (10 – 32°C) in 1 degree increments
Default – 50°F (10°C)
Description – This is the minimum cab temperature that can be selected in Heat Mode by the HMI Temperature Control Knob when it is fully turned to the left stop (0%).

High Temp Limit Heat

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 50 - 90°F (10 – 32°C) in 1 degree increments
Default – 80°F (27°C)
Description – This is the maximum cab temperature that can be selected in Heat Mode by the HMI Temperature Control Knob when it is fully turned to the right stop (100%).

Set Real Time Clock

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – Check Box
Default – Current system time of the PC computer connected.
Description – The Real Time Clock is used by the data logger as the time stamp for logged events. By selecting the check box and then selecting Save Setup the TriPac Real Time Clock will be reset to match the clock in the connected computer. The Real Time Clock will display as a 24 hour clock. There is no method to enter a different time.

Section 3 – TriPac EVOLUTION Software Description

UNIT SETUP

When a TriPac system is first put into service some information must be given to the Main Controller so it will operate correctly based on the individual installation. Unit Setup features are selected and changed using the Unit Setup menu in TK Monitor. The system will perform a Warm Restart to implement the changes. TK Monitor will need to be restarted. Refer to Section 6, Service Procedure A51A Communication Using TK Monitor for details.

NOTE: Failure to setup the unit to match the hardware configuration will cause operating issues. Failure to program unit information will make datalogger files difficult to identify.

Alternator Capacity

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – 65 Amps or 120 Amps
Default – 65 Amps
Description – This feature indicates to the Base Controller what alternator is installed in the APU. It also defines alternator load shedding parameters based on alternator size and engine load. Refer to Section 4, Engine Load Management for details.

Section 3 – TriPac EVOLUTION Software Description

Engine Cooling Option

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – Standard, Standard + Arctic, Closed Loop
Default – Standard + Arctic
Description – This feature defines the location and function of the Coolant Temperature Sensor (WT2). Standard: In the standard configuration Coolant Temperature Sensor WT2 controls Pre-Cooler Fan operation. Coolant Temperature Sensor (WT2) is mounted to a threaded block on the Pre-Cooler coil to sense the temperature of the incoming coolant from the truck engine. The TriPac engine Pre-Cooler fan will turn on above 120°F (48°C) and off below 105°F (40°C). The APU engine will not start based on coolant temperature. Standard + Arctic: The Standard + Arctic option has two functions. The Coolant Temperature Sensor (WT2) is mounted on an optional adapter in the coolant hose returning to the APU from the truck engine. 1) It is used to control the Pre-Cooler Fan as described under “Standard” above. 2) When coolant temperature falls below 35°F (2°C) the TriPac APU engine will start or continue to run. When coolant temperature has risen above 50°F (10°C) the APU engine will shut down unless there are other active run demands such as air conditioning or low battery voltage. Closed Loop: With the Closed Loop option, the TriPac APU engine cooling system is not connected to the truck engine. Information from Coolant Temperature Sensor (WT2) is ignored by the Controller. The Pre-Cooler Fan is controlled by the Engine Temperature Sensor (WT1) mounted in the engine thermostat housing. The TriPac engine Pre-Cooler fan will turn on above 160°F (71°C) and off below 140°F (60°C). The APU engine will not start based on coolant temperature.

Section 3 – TriPac EVOLUTION Software Description

Unit Serial Number

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – Ten digit number from unit serial plate.
Default – xxxxxxxxxx
Description – The TriPac unit serial number entered will be included in the data logger file. If no serial number is input, unit operation will not be affected. Dashes will be shown in the data logger output.

Unit ID

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices – User defined six character alphanumeric with no special characters. All six characters must be used.
Default – TT4DLF
Description – Typically used to identify what truck number the TriPac system is installed on. The Unit ID will be the first six characters of the automatically generated data logger download file name. This will be followed by 01.bin. This number will increment up each time the data logger is downloaded. The Unit ID will be included in the data logger file. All six characters must be used.

Section 3 – TriPac EVOLUTION Software Description

Hour Meter Reset

Controller Rev – 41.01
HMI Rev – 42.01
TK Monitor Rev – 43.01
Choices –
Default – 0000
Description – This feature allows the hourmeter to be reset as required when an Interface Board is replaced and the number of hours on the unit is known. TK Monitor text boxes will allow new hour meter setting to be entered from computer keyboard. After 100 hours this feature is locked and will no longer accept hourmeter changes.

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Section 4 – TriPac EVOLUTION Operation

HMI CONTROL PANEL

The HMI (Human Machine Interface) Control Panel is the operator's control module. The HMI is typically mounted in the bunk area of the truck cab. It has three selector knobs and a system condition display. The HMI contains an internal Cab Temperature Sensor. It communicates with the Base Controller using the Controller Area Network (CAN) communication bus.



HMI Control Panel Display

The operator can select these functions from the HMI:

- ✓ System On/Off
- ✓ Mode (Cool, Fan, Heat)
- ✓ Cab Temperature (Cooler/Blue - Warmer/Red)
- ✓ Fan Speed (Off, Low, Medium, High)

When any change of settings is made there is a two second delay before the Base Controller will recognize the new setting. This prevents momentary or accidental mode changes.

The HMI indicator LEDs will dim after 90 seconds if no selections are made. Tap the On/Off button to activate bright display for an additional 90 seconds.

Section 4 – TriPac EVOLUTION Operation

On/Off Button

The On/Off Button is behind the Mode Control on the left side of the HMI. It provides several functions depending on how long the button is pressed.

- ✓ **Turn system On:** If the system is off, press the Mode Selector knob for a minimum of 1 second to turn the system on. The mode icon will flash for 10 seconds while the Base Controller completes a boot process. Once the system has been turned on the system mode, temperature or fan speed may then be selected. If no selection is made the system will remain in Monitor Mode. See Monitor Mode later in this section.

NOTE: Pressing the Mode Selector knob for less than 1 second will not turn the TriPac system on.

- ✓ **Turn system Off:** If system is on, press the Mode Selector knob for a minimum of 2 seconds to turn the system off.
- ✓ **Display System Status:** If system is on but display has dimmed, tap the Mode Selector knob for less than 1 second to restore display to full brightness. The display will automatically dim again in about 90 seconds. Pressing the Mode Selector knob for less than 1 second is referred to as a “Bump”.

Mode Selector

Mode selection of the three operating modes is accomplished by rotating the left Mode Selector knob. A mode icon will flash then light to indicate the selection. There is a two second delay before the new mode is activated to prevent momentary or accidental mode changes. When the system is first turned on there will be a 10 second delay before the selected mode is activated. The following modes are as follows:

- ✓ Cool Mode
- ✓ Fan Only Mode
- ✓ Heat Mode

NOTE: When the system is turned on for the first time after replacing or disconnecting the Base Controller from power the mode icon will flash for approximately 60 seconds. This indicates the Base Controller is powering up.

Section 4 – TriPac EVOLUTION Operation

Temperature Selector

Temperature selection for driver comfort is accomplished by rotating the center Temperature Selector knob. It adjusts the desired cab temperature cooler (blue) or warmer (red). The default represented range is approximately 65° – 80°F (20° – 27°C) in Cool Mode and 50° – 80°F (10° – 27°C) in Heat Mode.

Fan Speed Selector

The available Evaporator Fan speed selections are Off, Low, Medium and High. Rotating the Fan Speed Selector knob clockwise will increase fan speed, counterclockwise will decrease fan speed. As fan speed increases or decreases, groups of four LEDs will progressively turn on or off. The fan will run at the chosen speed. If Air Conditioning mode is selected and Fan Speed is set OFF, the fan speed will default to LOW. When Fan Only or Heat mode are selected Fan Speed will default to OFF.

System Condition Display

Several System Condition LED indicators are located on the left side of the HMI. These provide additional unit operating information.

Standby Indicator

STBY is illuminated when the system is in Standby or Monitor mode.

Alarm Icon

If the system has an active alarm the Alarm Icon will illuminate. It will be red for Shutdown Alarms and yellow for Check Alarms. Refer to Section 5 Alarm Codes for more information.

Alarm Group Indicator

System shutdown alarms have been organized into three general groups to aid diagnosis. When a shutdown alarm is generated the red Alarm Icon and the corresponding Alarm Group name will illuminate.

- ✓ **[ENG]** are APU engine related alarms.
- ✓ **[ALT]** are alternator or charging system alarms.
- ✓ **[ACS]** are air conditioning system related alarms.

Alarm codes can be cleared by turning the system off then on again. If the condition that generated the alarm still exists, the alarm will return. Refer to Section 5 Alarm Codes for more information.

Section 4 – TriPac EVOLUTION Operation

OPERATING MODES

Cool Mode

When Cool Mode is selected using the Mode Selector knob, the HMI Control Panel uses the Cab Temperature Sensor to measure sleeper compartment temperature. If it is above the temperature selected by the Temperature Selector knob, the APU engine will begin a start sequence (if not already running). The evaporator fan is defaulted ON and will run in low or the speed selected by the Fan Speed Selector knob. The compressor clutch will engage 60 seconds after a successful engine start. The system will cool the sleeper compartment until it falls to the selected setpoint temperature. The compressor clutch will disengage but the APU engine will continue to run for several minutes based on the Engine Delay Timer setting (default 8 minutes). The evaporator fan will continue to run at the selected speed. If sleeper compartment temperature rises above setpoint by more than the Dead Band setting (default 3°F) during this time the compressor clutch will re-engage.

During normal air conditioning operation the compressor clutch may cycle on and off with no alarm but the evaporator fan will continue to run. This indicates the system is monitoring the Evaporator Coil temperature sensor to prevent frost buildup on the evaporator coil. If the Evaporator Coil temperature falls below 32°F (0°C) the compressor clutch is de-energized. When the Evaporator Coil temperature rises above 45°F (7.2°C) the compressor clutch is energized.

The APU engine will shut down when the sleeper compartment temperature reaches setpoint and no other demands exist. The Evaporator Fan will continue to run. If the sleeper compartment temperature rises above setpoint by more than the Dead Band setting (default 3°F) the APU engine will restart and compressor clutch will re-engage. Battery voltage sensing and engine coolant temperature sensing (if equipped with the Arctic Option) are enabled for the APU. Refer to Monitor Mode in this section of the manual for details.

Heat Mode

The air heater is a separate module that heats the sleeper compartment to the setpoint selected with the HMI Temperature Selector knob. Sleeper compartment temperature is sensed inside the air heater, it does not use the Cab Temperature Sensor on the HMI Control Panel. All heater functions are controlled by a separate module inside the heater. The TriPac Evaporator Fan is defaulted to OFF when Heat Mode is selected. It can be turned on to provide additional air circulation if desired. Battery voltage sensing and engine coolant temperature sensing (if equipped with the Arctic Option) are enabled for the APU. Refer to Monitor Mode in this section of the manual for details.

Section 4 – TriPac EVOLUTION Operation

Fan Mode

The TriPac Evaporator Fan can be turned on with the Fan Speed Selector knob to provide additional air circulation in the sleeper compartment and truck cab. Three fan speeds can be selected - (Low, Medium or High). LEDs around the Fan Speed Selector will indicate the selected speed. Battery voltage sensing and engine coolant temperature sensing (if equipped with the Arctic Option) are enabled for the APU. Refer to Monitor Mode in this section of the manual for details.

Standby Mode (Optional)

The optional TriPac Standby Mode allows the system to be controlled by an external switch input. This is typically the truck ignition using the optional Standby Truck Integration. The feature is used to disable the TriPac APU when the truck engine is running. When the truck ignition switch is in the run position, a voltage signal is sent to the Base Controller. The TriPac system will enter Standby Mode. The following occurs when the TriPac system is in Standby Mode:

- ✓ The STBY indicator on the HMI will illuminate.
- ✓ Air conditioning, fan or heat operation will terminate.
- ✓ The APU engine will stop.

The TriPac Base Controller remains on but will not respond to any operation requests, such as low battery voltage or low coolant temperature.

Standby Truck Integration (Optional)

An optional wire harness connects the truck ignition switch to an SBY circuit input connection on the TriPac Interface Board. The Base Controller monitors voltage on this circuit. The following conditions occur.

- ✓ **The Truck ignition switch is in the Off or Acc position.** If the TriPac system is turned on the unit operates normally.
- ✓ **The Truck ignition switch is in the Start or On position.** The TriPac unit is forced to Standby mode. The HMI Control Panel STBY indicator will illuminate.

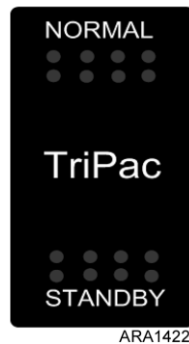
Section 4 – TriPac EVOLUTION Operation

Truck Integration Standby Switch (optional)

The optional Standby Switch is located on the truck instrument panel. It is connected to the Interface Board.

When the Standby Switch is in the Normal (On) position, the APU operates as stated previously. The system will respond to the truck ignition as with the Standby Truck Integration option.

When the Standby Switch is in the Standby (Off) position, power is routed from the 2A circuit to the Interface Board SBY circuit input connection. When this occurs, the APU is forced to Standby Mode and all Interface Board outputs are de-energized. The HMI Control Panel will display [STBY]. The unit will remain in Standby Mode until the Standby Switch is placed in the Normal position. The truck ignition switch will have no effect. This allows the operator to disable the TriPac system without accessing the HMI Control Panel in the sleeper.



Optional TriPac Evolution Standby Switch

Section 4 – TriPac EVOLUTION Operation

MONITOR MODE

Activate

By default Monitor Mode is active when the TriPac system is turned on at the HMI Control Panel but an operating mode has not been selected by the operator. Monitor Mode is also active when the truck ignition has been turned on (Standby) then turned off. The STBY indicator on the HMI Control Panel will illuminate.

Deactivate

Monitor Mode will be deactivated and system will begin HVAC operation if the operator presses the On/Off button at the HMI, changes the Mode selection, or changes the Fan Speed selection. The selected HVAC mode will activate. The STBY indicator on the HMI will turn off. The system will continue to monitor battery voltage and engine coolant temperature (if the Arctic Option is installed).

Operation

While Monitor Mode is active the APU will continue to start and stop as necessary to maintain battery voltage and engine coolant temperature (if the Arctic Option is installed). While in Monitor Mode the system will not react to changes in cab temperature. TriPac Cool, Heat and Fan modes will remain off.

Battery voltage sensing is enabled. When battery voltage falls to the level set by Battery Voltage Restart Value (default 12.1 VDC), the APU engine will start to charge the batteries. The engine will continue to run until the Charge Current Shutoff Value setting has been reached (default 20 Amps).

If the Arctic Option is installed and enabled, the truck engine coolant temperature is monitored. If the engine coolant temperature at WT2 falls below 35°F(1.6°C), the APU engine will start to warm the truck engine. It will continue to run until the returning coolant temperature rises to 55°F (12.7°C).

Monitor Mode may also be disabled. If disabled the system will return to the mode it was in when the truck ignition was turned on.

NOTE: This is not the recommended Monitor Mode setting. See Monitor Mode in Section 3 of this manual for details.

Section 4 – TriPac EVOLUTION Operation

Engine Load Management

To maintain Tier 4 engine emission levels, the engine load may be reduced under some conditions. Some TriPac units will have an optional 120 amp charging system. The 120 amp alternators used in this system have a special dual output voltage regulator that is not interchangeable with the standard 65 amp Thermo King alternator. It requires some additional external circuitry (Load Control Harness) to function. During charging system diagnosis, use TK Monitor > Service Test mode > Alternator Output Test to bypass the load management system.

Control Conditions

The Load Management system continuously monitors three conditions:

- ✓ Air conditioning clutch circuit.
- ✓ Ambient temperature.
- ✓ Cab temperature.

Control Levels

The TriPac EVOLUTION 120 amp alternator has an external Field (FLD) terminal that must be grounded to charge. The level of alternator load control is achieved by varying the resistance in this ground circuit. The Interface board has three terminals that represent different resistance levels. The Base Controller will choose the appropriate terminal for the required load management level.

TriPac Evolution Engine Load Management levels are as follows:

1. The air conditioning Compressor Clutch is disengaged. FLD1 alternator terminal is grounded to supply full alternator output.
2. The air conditioning Compressor Clutch is engaged. The Ambient Temperature is below 95°F (35°C). The FLD1 alternator terminal is grounded to supply full alternator output.
3. The air conditioning Compressor Clutch is engaged. The Ambient temperature is above 95°F (35°C). The cab temperature is below 85°F (29.4°C). The FLD2 and FLD3 alternator terminals are grounded to provide a minimum alternator output reduction.
4. The air conditioning Compressor Clutch is engaged. The Ambient temperature is above 95°F (35°C). The cab temperature is above 85°F (29.4°C). The FLD3 alternator terminal is grounded to provide a additional alternator output reduction.

Section 4 – TriPac EVOLUTION Operation

5. The air conditioning Compressor Clutch is engaged. The Ambient temperature is above 95°F (35°C). The cab temperature is above 95°F (35°C). The FLD2 alternator terminal is grounded to provide maximum alternator output reduction.

NOTE: There is a 10 second Compressor Clutch delay after engine start or Cool Mode selection.

ENGINE ON/OFF SWITCH

!

DANGER: Always turn the TriPac system OFF at the HMI Control Panel On/Off button while the truck is being refueled. Fuel vapors could ignite if they come in contact with TriPac electrical or heater components.

!

WARNING: TriPac engine can start automatically without warning if the Engine On/Off switch is in the ON position. Always place the Engine On/Off switch in the OFF position before performing service on the engine or engine accessories.

!

WARNING: Immediately stand clear when the preheat buzzer sounds. This indicates that the engine is preheating and preparing to start. If the engine is hot, preheat time will only be a few seconds.



TriPac Evolution APU Engine On/Off Switch

Section 4 – TriPac EVOLUTION Operation

The TriPac EVOLUTION APU Engine On/Off Switch is located inside the APU as shown on the previous page. The Engine On/Off Switch is accessed by opening the APU access panel. The Engine On/Off Switch functions as a service switch to allow maintenance personnel to disable the APU when working on the unit.

The Engine On/Off Switch must be in the On position to allow normal system operation. When the Engine On/Off Switch is placed in the Off position the following actions occur.

- ✓ If the unit is Off and the HMI Control Panel On/Off button is pressed, an [ENG] Group Shutdown Alarm Code 35 Run Relay is set. The engine will not start.
- ✓ If the unit is On but the engine is not running, an [ENG] Group Shutdown Alarm Code 35 Run Relay is set. The engine will not start.
- ✓ If the unit is On and the engine is running, the engine will shut down and an [ENG] Group Shutdown Alarm Code 35 Run Relay is set. The engine will not start.

ALARM CODES

Alarm Notification



The TriPac control system continually monitors operation and can generate several alarm codes. If the unit has an alarm condition the operator will be notified by an illuminated Alarm Icon on the HMI Control Panel. The icon can be Yellow or Red.

Yellow = Check Alarm. This indicates one or more of the system Check Alarms are active. This level of alarm serves as notice to take corrective action at the earliest convenience before a problem becomes severe. The system will continue to operate but some features and functions may be inhibited or disabled.

Red = Shutdown Alarm. This indicates one of the system Shutdown Alarms is active. This level of alarm serves as notice that a potentially severe system problem exists. Immediate corrective action should be taken. The system will not be operating. Along with the Red Alarm Icon, one of the shutdown alarm group names (ENG, ALT or ACS) will be illuminated. This indicates which category the alarm falls, helping to focus diagnosis and repair. See Section 5 of this manual for detailed alarm descriptions.

All recent alarm codes can be read and cleared by a technician using the Alarm screen in TK Monitor. See Section 6 Service Procedure A51A Communication Using TK Monitor.

SHUTDOWN ALARM GROUPS

The shutdown alarm group indication on the HMI helps to focus preliminary fault diagnosis toward a limited group of potential failure causes. It may be necessary for the technician to determine the actual fault code and other system information to form an accurate diagnosis. See Diagnostics and Alarm Codes in Section 5, and Service Procedure A51A Communication Using TK Monitor in Section 6.

ENG Codes

Alarms in this group are engine related. The operator/technician should look for:

- ✓ Conditions that cause unusually high APU engine coolant temperature.
- ✓ Conditions that cause unusually low APU engine oil pressure.
- ✓ Conditions that prevent the engine from starting.
- ✓ Conditions that may cause fuel starvation.

ALT Codes

Alarms in this group are charging system related. This includes the alternator, battery or system voltages. The operator/technician should look for:

- ✓ Loose or missing APU drive belt.
- ✓ Loose or corroded APU power cable connections.
- ✓ An unusually low or high voltage at the truck batteries.

ACS Codes

Alarms in this group are air conditioning system related. The operator/technician should look for:

- ✓ Conditions that cause unusually high air temperature at the condenser coil.
- ✓ Conditions that reduce or restrict air flow through the condenser coil.

Section 4 – TriPac EVOLUTION Operation

Clearing Alarm Codes

If the alarm icon is Red, note the alarm group that is illuminated on the HMI display (ENG, ALT, ACS).

1. Use the HMI Control Panel System On/Off button to turn the TriPac unit off.
2. Resolve the condition that caused the alarm.
3. Use the HMI Control Panel System On/Off button to turn the TriPac unit on.
4. Any active alarms will be cleared when the unit is turned on.

NOTE: If the alarm condition still exists the alarm will return.

Active alarms and those recently cleared by the operator can be read and cleared by a technician using the Alarm screen in TK Monitor. The most recent Alarm Code will be shown at the top of the list. This screen provides the technician with a list of alarms that have occurred. They may be cleared individually or all at once.

All alarm codes are stored in the unit data logger. Alarms cleared through TK Monitor remain in the data logger memory and may be retrieved with a data logger download. See Section 6 Service Procedure A51A Communication Using TK Monitor for details.

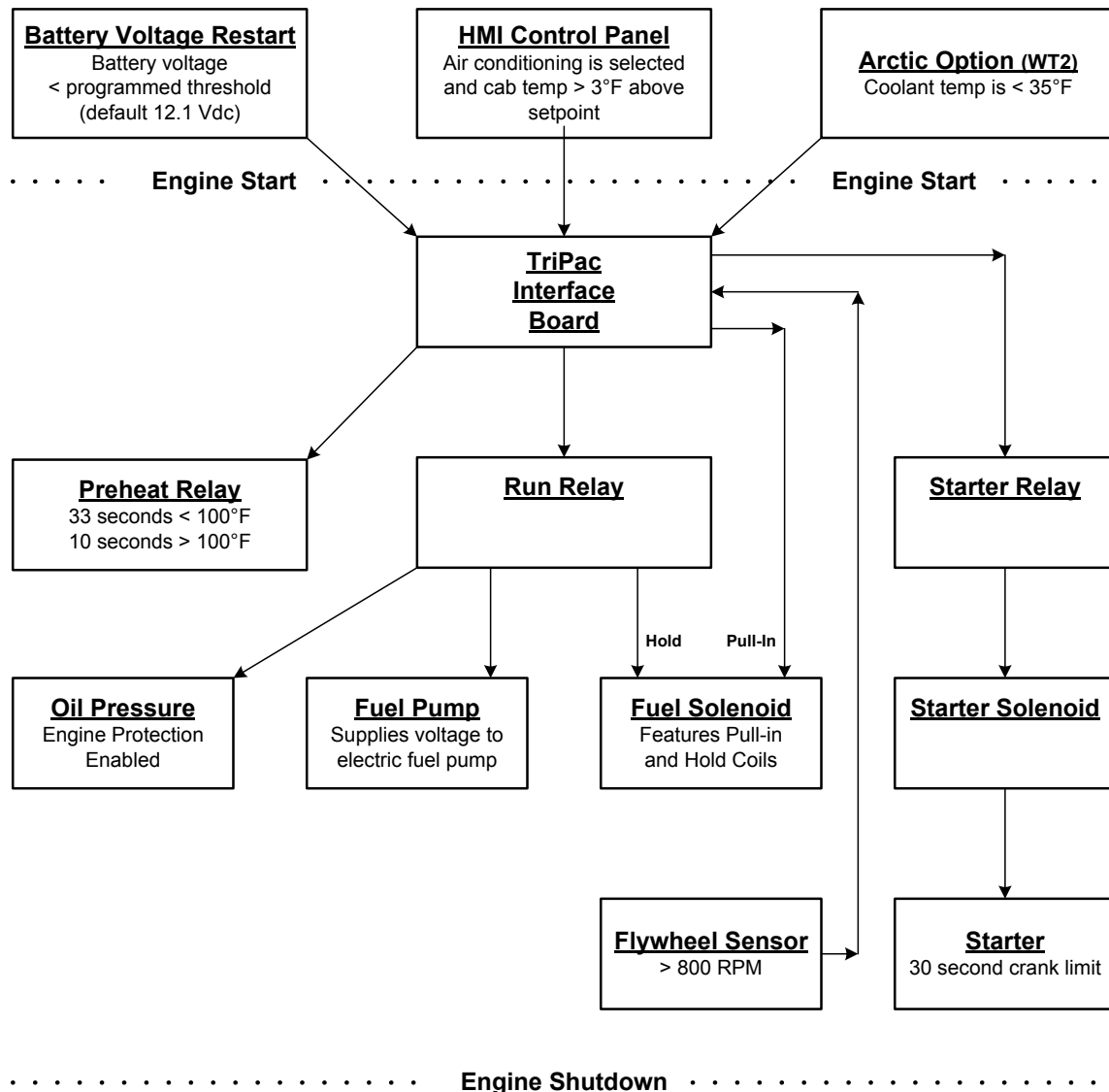
Section 4 – TriPac EVOLUTION Operation

OPERATING CONDITIONS

This flowchart illustrates the conditions that will cause the engine to start, the engine start sequence and the conditions that will allow the engine to shut down.

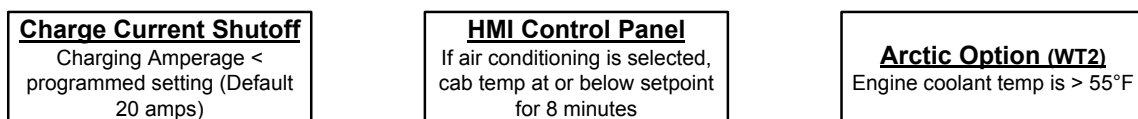
CONDITIONS THAT CAUSE AN ENGINE START

Any single condition will cause an engine start



CONDITIONS THAT ALLOW THE ENGINE TO SHUT DOWN

All conditions must be satisfied before the engine will shut down



Section 4 – TriPac EVOLUTION Operation

CIRCUIT DESCRIPTIONS

The following descriptions of TriPac EVOLUTION circuit function can aid with system diagnosis. Understanding the logic of the operating circuits and sequence of events will help with system testing. These descriptions are based on Schematic Diagram 2E32872 Rev A and Wiring Diagram 2E32871 Rev B.

POWER CIRCUITS

Battery

Truck batteries should be connected to provide 12 volt power to the unit. Source voltage is available from the truck batteries through Fuse F29 (200A) Main Power Fuse located in the truck battery box. A cable runs to the APU starter solenoid positive terminal and contacts.

Source voltage branches from the main power fuse in the truck battery box. The 2A circuit supplies power through Fuse F30 (3A) to the alternator voltage regulator sense terminal (S) located in the two wire alternator plug. This provides sense voltage that the voltage regulator uses to determine battery level and charge rate.

Source voltage is available from the starter terminal through Fuse F18 (3A) fuse to the SEN input connection on the Interface Board at J14 Pin A1. This allows the control system to read battery voltage.

Source voltage is available from the starter solenoid on the RED circuit to the APU alternator B+ terminal. The 2 circuit leaves the alternator B+ terminal and passes through Fuse F16 (50A) and on to the J15 screw terminal on the Interface Board. This provides power for the control system and components.

Section 4 – TriPac EVOLUTION Operation

Interface Board

On the Interface Board source voltage from the J15 screw terminal is available to the Starter (SR) and Preheat (PR) relay contacts through Fuses F1 Starter and F3 Glow Plugs.

Source voltage from the J15 screw terminal is available to each of the FET controlled outputs: 8X (F8), 7X (F9), 8DP (F7), PCF (F10), 7CL (F13), 7CF (F11), FAN1, FAN2, FAN3 (F12) and YEL (F14).

From the J15 screw terminal, source voltage is sent through:

- ✓ Fuse F6 Controller Power Supply to the controller circuits.
- ✓ Fuse F5 Optional Standby Switch to J14 Pin B3 as the 2A output for the Optional Standby Switch.
- ✓ Fuse F90 Heater to the RED circuit J9 Pin 1 to power the heater.

Voltage is available to the HMI on 2P Fuse F4 at J34 Pin 5 and 8XP Fuse (F2) at J34 Pin 6.

System On

The On/Off button on the HMI Control Panel is pressed for at least one second. The HMI and Base Controller turn on. Cool, Heat or Fan mode may then be selected. If no selection is made the system will operate in Monitor mode. Refer to Monitor Mode earlier in this section.

The 8X output connection J14 Pin A3 is powered by the On Relay (OR). This relay sends voltage to the Engine On/Off Switch (ESW) in the APU and returns via the 8X_SW input connection at J14 Pin B4).

This circuit passes through the board to the 8FET output connection J4 Pin B2.

Units without the DPF option have a jumper plug in J4. The 8FET connects through the green wire to the 8 input J4-A3. This circuit provides power to the Run Relay (RR) contacts.

Section 4 – TriPac EVOLUTION Operation

RUN CIRCUITS

Start Demand

An engine start demand can come from any one of three possible sources.

1. A start demand is issued if battery voltage at the SEN connection at J14 Pin A1 falls below the programmed Battery Voltage Restart Value (default 12.1 volts). An open or disconnected SEN circuit to the Interface Board will cause a start demand.
2. A start demand is issued if Air conditioning mode selected on the HMI Control Panel and the Cab Temperature Sensor is 3°F or more above setpoint.
3. A start demand is issued if the optional Arctic Option sensor (WT2) indicates that engine coolant temperature has fallen below 35°F.

Any of the above will cause the 7X output connection at J4 Pin A1 to be energized by the Base Controller. Units without the DPF option have a jumper plug in J4 sending the voltage signal through the red wire to the 7A input connection at J4 Pin B3.

NOTE: Any time there is voltage at the 7A input connection at J4 Pin B3 the APU engine will start or will continue to run. No voltage at this terminal will cause the engine to shut down or terminate a start attempt.

Engine Preheat

The Preheat Relay coil is energized by the Base Controller, closing the Preheat Relay (PR) normally open contacts. Voltage from Fuse F3 Glow Plugs is available to the H circuit connection at J5 Pin 3. The glow plugs and buzzer in the APU are energized.

Preheat time is based on engine temperature (WT1).

Below 100°F = 33 seconds.

Above 100°F = 10 seconds.

The Preheat Relay remains energized for 10 seconds after engine start.

Section 4 – TriPac EVOLUTION Operation

Engine Run

The Run relay coil is energized by the Base Controller, closing the Run Relay (RR) contacts. Voltage from the 8 circuit input connection at J4 Pin A3 energizes the 8D output connection at J14 Pin A4. The 8D circuit powers the fuel solenoid hold-in coil (FSH) and electric fuel pump (FP) in the APU. The 8DP connection at J5 Pin 4 is powered for 2 seconds to energize the fuel solenoid pull-in coil (FSP).

The D+ connection at J14 Pin B1 is energized 20 seconds after engine start to provide Excite voltage to the APU alternator.

The Base Controller monitors the WT2 water temperature sensor. If the returning coolant temperature is above 115°F (46.1°C) the Base Controller will energize the PCF output connection at J5 Pin 6, powering the Pre-cooler Fan on the APU. When the coolant returning from the truck engine falls below 95°F (35°C), the Base Controller will turn off the PCF output, stopping the fan.

The Base Controller monitors the voltage at the 8 circuit input connection at J4 Pin A3. No voltage at the 8 circuit input connection when the Run Relay coil is energized will trigger a Shutdown Alarm Code 35 in the [ENG] group.

Engine Start Sequence

The Starter relay coil is energized by the Base Controller, closing the contacts. Voltage from F1 is available to the 8S circuit connection at J5 Pin 1. The 8S circuit energizes the starter solenoid in the APU.

A flywheel sensor (FWS) monitors engine RPM. It is connected to the FS1 and FS2 connections at J14 Pin A10 and J14 Pin B10 on the Interface Board. If the engine does not crank (engine speed < 40 RPM in 3 seconds) the start attempt is terminated. When the engine starts (engine speed > 800 RPM), cranking is terminated. If the engine does not start, cranking is limited to 30 seconds. If the engine does not start on the first attempt, two additional start attempts will be made. If the engine still fails to start the Base Controller will generate a Shutdown Alarm Code 20 in the ENG group.

30 seconds after engine start the Base Controller starts to monitor the Oil Pressure Switch (LOPS circuit at J14 Pin A5).

The D+ connection at J14 Pin B1 is energized 20 seconds after engine start to provide Excite voltage to the APU alternator.

Section 4 – TriPac EVOLUTION Operation

Air Conditioning Circuits

If Cool Mode operation is selected, the HMI Control Panel temperature sensor monitors the cab temperature. If cab temperature rises more than the number of degrees set by Cooling Dead Band (default = 3°F) above setpoint, the Base Controller on the Interface Board will initiate an engine start.

The Evaporator Blower in the Evaporator Box is turned on and will run in either low speed or the speed selected by the HMI Fan Speed Selector. If High Speed is selected the FAN3 terminal sends voltage directly to the evaporator fan motor (EFM). If Medium is selected the FAN2 terminal sends voltage through the resistor block at the fan motor. If Low is selected the FAN1 terminal sends voltage through the resistor block at the fan motor.

After a 60 second delay, the 7CF connection at J2 Pin 1 sends voltage to the condenser fan motor (CFM) on the back of the cab.

After a 60 second delay, the 7CL connection at J5 Pin 2 sends voltage to the high pressure cutout switch (HPCO) located at the receiver/drier. This normally closed switch opens at 360 psig. From the High Pressure Cutout Switch the circuit changes to 7CLA. The 7CLA circuit carries power to the compressor clutch (CLU) in the APU. A branch of the 7CLA circuit provides an input signal to the 7CLA connection at J2 Pin 2 on the Interface Board. If voltage to this connection is lost while 7CL is energized Alarm Code 10 will be set.

Evaporator coil temperature is monitored with a Coil Temperature Sensor (CTS). When the Evaporator Coil temperature falls below 32°F (0°C) the 7CL circuit is de-energized, de-energizing the Compressor Clutch. When the Evaporator Coil temperature rises above 45°F (7.2°C), the 7CL circuit is energized, to restart the compressor. No alarm is generated.

A low pressure cutout switch (LPCO) reads air conditioning system pressure at the Evaporator Coil. This switch opens below 5 psig, breaking the path to ground. This causes the voltage at the 7CLB terminal (J2-3) to increase to system voltage to de-energize the Compressor Clutch. Alarm Code 93 is generated.

The 7CF and 7CL circuits are turned off when the cab temperature reaches setpoint. This stops the Condenser Fan and de-energizes the Compressor Clutch. The evaporator blower continues to run. The Run Relay remains energized and the engine continues to run for the number of minutes set by the Engine Off Delay Timer (default = 8 minutes) after setpoint is reached.

Section 4 – TriPac EVOLUTION Operation

Heat Circuits

If Heat Mode operation is selected, the cab temperature is controlled by the optional Espar air heater. The Espar heater is a self-contained system with its own microprocessor base temperature controller. The heater requires minimal connection to the TriPac control system. The APU engine does not start for a heat demand, however the engine may start to charge batteries or warm the truck engine.

Heater power is supplied from the Interface Board to the Espar heater via the RED wire at J9 Pin 1 of the Espar heater harness.

The YEL output connection at J13 Pin 2 on the Interface Board sends the ON (enable) signal to the heater through the Espar heater harness.

The HMI sends setpoint information from the Interface Board to the heater on the GRY/RED wire at J13 Pin 6 and the BRN/WHT wire at J13 Pin 5 in the Espar heater harness. This is a variable resistance signal generated by the digital potentiometer on the Interface Board. **NOTE:** This circuit is polarity sensitive and must be correctly connected.

The temperature controller inside the heater reads return air temperature with an internal sensor. **NOTE:** The Espar heater does not use the Cab Temperature Sensor in the HMI.

The heater controller sends pulsed DC voltage to the fuel metering pump (FMP) via the GRN/RED wire of the Espar heater harness. The pump is grounded by the BRN wire of the Espar heater harness.

The burner function is monitored by an internal Heater Temperature Sensor (HTS). During startup the system looks for rising heat exchanger temperature to verify ignition. During operation the system looks for abnormally high heat exchanger temperature.

Section 4 – TriPac EVOLUTION Operation

Engine Shutdown Requirements

An APU engine shutdown can only occur after all of the following conditions are met:

The charging current measured by the Current Sensor (CS) must be below the programmed Charge Current Shutoff Value (default 20 amps).

The air conditioning demand from the HMI Control Panel has been satisfied for the number of minutes specified by the Engine Off Delay Timer (default = 8 minutes).

If the Arctic Option is installed and enabled the engine coolant temperature returning to the APU must be above 55°F at Engine Temp Sensor 2 (WT2).

NOTE: The APU engine will start or continue to run any time there is voltage at the 7A input connection at J4 Pin B3 on the Interface Board. No voltage at this terminal will cause the engine to stop running or terminate a start attempt.

Section 4 – TriPac EVOLUTION Operation

STANDBY OPTIONS

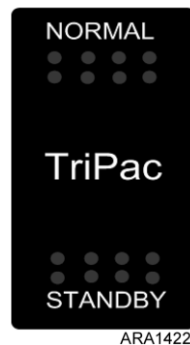
Truck Integration

An IGN wire is connected to the truck ignition switch so that it is energized in the run position only. When the ignition switch is in the Run position, voltage is sent through fuse F19 to the SBY connection at J14 Pin A2 of the Interface Board. The system will enter Standby mode and STBY will illuminate on the HMI. The APU will not start.

When the ignition switch is in the off or accessory position, voltage is removed from the IGN wire and SBY connection. The TriPac system will be active.

Standby Select Switch

The optional dash mounted Standby Select Switch allows the driver to choose standby modes.



Optional TriPac Evolution Standby Switch

Normal Position – The system functions the same as with Truck Integration. An IGN wire is connected to the truck ignition switch so that it is energized in the run position only. The IGN wire is connected to the Standby Switch (SSW). When the ignition switch is in the run position voltage is supplied to fuse F19. Voltage passes through the Standby Switch contacts to the SBY connection at J14 Pin A2 of the Interface Board. The system will enter standby mode and STBY will illuminate on the HMI. The APU will not start. When the ignition switch is in the off or accessory position, voltage is removed from the IGN wire and SBY connection. The TriPac system will be active.

Standby Position – Source voltage from the Interface Board 2A connection at J14 Pin B3 passes through the Standby Switch (SSW) contacts to the SBY connection on the Interface Board at J14 Pin A2. The system will enter standby mode and STBY will illuminate on the HMI. The APU will not start. The position of the truck ignition switch has no effect.

Section 4 – TriPac EVOLUTION Operation

Load Control Harness

The Load Control harness is connected to the alternator FLD (field) terminal near the plug connection. It is used to reduce maximum alternator output thereby reducing engine load under some conditions. The harness runs toward the TriPac control box. It splits into three circuits (FLD1, FLD2 and FLD3) before connecting to the Interface Board. One or two circuits may be active at any time. There is a 10 second delay after engine start or Cool Mode selection.

IMPORTANT: The Load Control Harness should never be connected to the F2 terminal of a 65 amp single output alternator. Alternator failure will result.

The FLD1 circuit connects directly to the Interface Board at J6 Pin A3. When active, the circuit provides a direct path to ground for the alternator field. The alternator can charge at full output.

The FLD3 circuit connects through a 2 Ohm resistor to the Interface Board at J6 Pin A4. When active, the circuit provides 2 ohms of resistance in the ground path for the alternator field. This reduces field voltage to limit alternator output and reduce engine load.

The FLD2 circuit connects through a 4 Ohm resistor to the Interface Board at J6 Pin B3. When active, the circuit provides 4 ohms of resistance in the ground path for the alternator field. This further reduces field voltage to limit alternator output and further reduce engine load.

Section 4 – TriPac EVOLUTION Operation

Section 5 – TriPac EVOLUTION Diagnostics

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Section 5 – TriPac EVOLUTION Diagnostics

Section 5 – TriPac EVOLUTION Diagnostics

TriPac DIAGNOSTICS

Section 5 is devoted to diagnostic information and procedures designed to help the technician quickly and accurately diagnose a problem and efficiently repair the problem using the correct tools, information and procedures.

It is important that the required procedures be followed exactly. Failure to do so may result in an incomplete or ineffective diagnosis and repair.

Use the following hints to help with diagnostics.

- Check the system for physical damage and signs of leaks.
- Note the condition of all LED indicators on the Base Controller and HMI Control Panel.
- Use TK Monitor to record and clear any alarm codes before performing diagnostic routines. Use the alarm code descriptions in this section to help diagnose the fault.
- Be certain all connectors on the Interface Board and HMI Control Panel are completely and securely seated.
- Be certain all battery connections are clean and tight.

TriPac SERVICE NOTES

Follow these procedures when working on TriPac units:

- Any time welding is necessary, follow the information in TriPac Service Procedure A26A.
- For optional Power Inverter diagnostic information refer to the Power Inverter Operator & Diagnostic Manual (TK 53707-1-OP).
- For optional Diesel Particulate Filter (DPF) diagnostic information refer to the Diesel Particulate Filter Maintenance and Diagnostic Manual (TK 53924-19-MM).
- Never use circuit testers consisting of a bulb light bulb and ground lead or battery and a light to test the circuits on any microprocessor-based device unless specifically stated in a diagnostic procedure. A quality digital multi-meter is required.

Section 5 – TriPac EVOLUTION Diagnostics

ELECTROSTATIC DISCHARGE

Electrostatic Discharge will occur when static electricity in your body causes a high voltage electrical charge to transfer to system components. This discharge can damage control system microprocessor circuits. Follow these electrostatic precautions to prevent system or component damage:

- Use an approved anti-static wrist strap (such as 204-622) connected to chassis ground when handling or servicing microelectronic components.
- Keep all new TriPac Interface Boards and HMI Control Panels in anti-static bags at all times. Remove from bag only when component is ready to be installed.
- Protect any defective TriPac Interface Boards and HMI Control Panels from physical damage by placing them in the shipping carton supplied with the replacement. They will be returned for failure analysis and possible re-manufacture.

TK MONITOR DIAGNOSTIC TOOL

The TriPac EVOLUTION control system provides a diagnostic tool that can be accessed using a PC computer and commonly available USB to Mini-B interconnect cable (204-2000). Use of this tool is required for most TriPac EVOLUTION system diagnostics. The TK Monitor software is contained in the TriPac EVOLUTION control system. No special software is required to be loaded on the diagnostic computer.

Selecting the Datalogger button in the Tools screen will allow downloading the information recorded in the Base Controller memory to the attached PC computer. TriPac EVOLUTION data logger files are BIN format and cannot be directly viewed. See Service Procedure A50A in Section 6 for details.

TK Monitor provides the following information and functions. For a more detailed description see Service Procedure A51A Communication Using TK Monitor in Section 6 of this manual.

Dashboard

This screen displays an overview of basic system operation information. This includes the hour meters.

Section 5 – TriPac EVOLUTION Diagnostics

System Monitoring

This screen displays a more detailed view of the real time information being received by the control system inputs. It also displays what components are currently activated by the control system outputs. This information may be valuable during system diagnosis.

Programmable Setup

TriPac EVOLUTION has a group of programmable features. This screen allows the feature settings to be viewed and changed. For details of software settings see Section 3 Software Description.

Service Test

The selections on this screen allow various operating modes to be selected. The unit will remain in that mode for 15 minutes. This allows diagnostic procedures to be performed while the system is in a known steady state. These test modes are not affected by setpoint, cab temperature or ambient temperature. For example, cool mode can be forced on even though cab temperature is below the 65 F minimum setpoint.

The Service Test screen also includes a Run-In Test that will enable cool and heat operation simultaneously. This allows the TriPac EVOLUTION engine to run loaded during break-in when ambient temperature would prevent continuous air conditioning operation.

Alarms

This screen displays system alarm numbers and names. Alarms may be cleared individually or as a group. See Alarm Codes later in this section.

Software Upgrade

Current software revision level can be viewed on this screen. There are three software sets in the TriPac EVOLUTION system:

- Base Controller
- HMI Control Panel
- TK Monitor.

Upgrading of software by flash loading is also done through this screen.

Section 5 – TriPac EVOLUTION Diagnostics

Unit Setup

During new unit installation some setup information must be provided to the Base Controller through this screen. Setup information includes the alternator type, cooling system configuration, unit serial number and unit identification number.

Tools

Access to system restarts and Data Logger download functions are provided by this screen. These functions are password protected. The password is 4444.

Section 5 – TriPac EVOLUTION Diagnostics

CHARGING SYSTEM DIAGNOSIS

Use the following information and procedures to help diagnose TriPac charging system issues.

General Conditions

Poor charging performance may not be caused by a bad alternator. The following conditions can cause improper battery charging, even with a good alternator. Refer to the Diagnostic Procedures for additional details.

- The truck batteries and all connections must be in good condition.
 - ✓ Batteries should be charged to 12.5 VDC or higher before beginning testing. Each battery should be load tested following the recommendations from the manufacturer of the tool being used.
 - ✓ Batteries should be checked for damage and correct electrolyte level. A defective battery may consume the entire alternator charging capacity or not be capable of accepting a charge.
 - ✓ All battery cable connections should be clean and tight. Poor connections will prevent charging current from reaching all the batteries.
- Loose or dirty cable connections at the TriPac alternator B+, starter or battery terminals will prevent alternator output from reaching the batteries.
- Loose or dirty connections at the 2A, D+, and CH circuits connected to the alternator will prevent it from providing correct output.
- The alternator charging output will be low if the alternator belt or pulleys are defective or the belt is not properly adjusted. The belt should not be loose, worn or cracked and the pulley must be in good condition.
- The TriPac system circuits or installed truck accessories such as a power inverter may be drawing excessive current. Check for excessive power drain before replacing an alternator.
- Overcharged batteries are usually caused by a defective voltage regulator in the truck alternator.

Alternator Identification

65 Amp Single Output Alternator

The Thermo King 65 Amp Alternator is the TriPac standard production alternator.

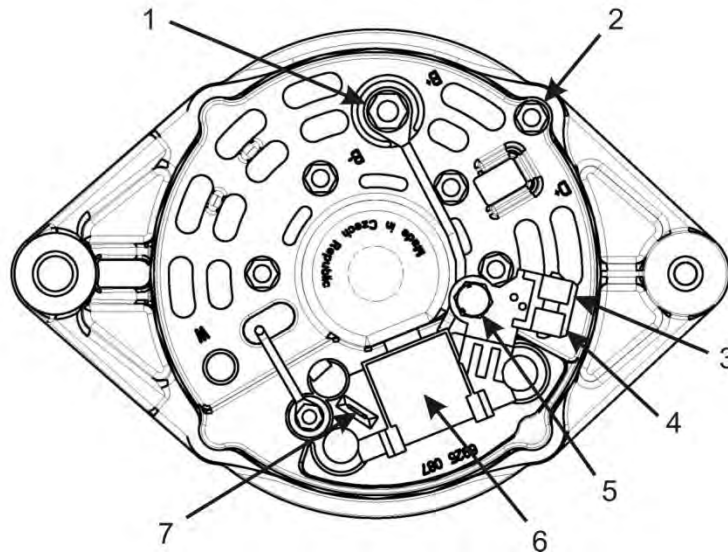
- Thermo King Alternators are painted black.
- The alternator uses an orange single output 14.5 VDC voltage regulator. This regulator is not compatible with 120 amp dual output alternators.
- The F2 terminal should never be grounded or connected to the Load Control harness. Damage to alternator will result.
- The Alternator Capacity must be set to 65 Amps using TK Monitor > Unit Setup screen.

Section 5 – TriPac EVOLUTION Diagnostics

NOTE: The 120 Amp Dual Output alternator cannot be used to replace a 65 Amp Single Output alternator.

NOTE: The alternators used on TriPac EVOLUTION units have counterclockwise (CCW) fans and 2.25" pulleys. When replacing an alternator, make sure to use the correct fan and pulley.

NOTE: Alternators with orange voltage regulators should never be used on any Thermo King Truck/Trailer application.



Thermo King 65 Amp Alternator Terminal and Component Locations

1.	B+ Terminal (Positive Output – RED and 2 wires)	5.	F2 Terminal on 65 Amp Alternator (Do Not Ground)
2.	B- Terminal (Negative Ground – CH wire)	6.	Voltage Regulator and Brush Assembly
3.	S Terminal (Regulator Sense – 2A wire)	7.	W Terminal (AC Output)
4.	L Terminal (Regulator Excite – D+ wire)		

Section 5 – TriPac EVOLUTION Diagnostics

120 Amp Dual Output Alternator

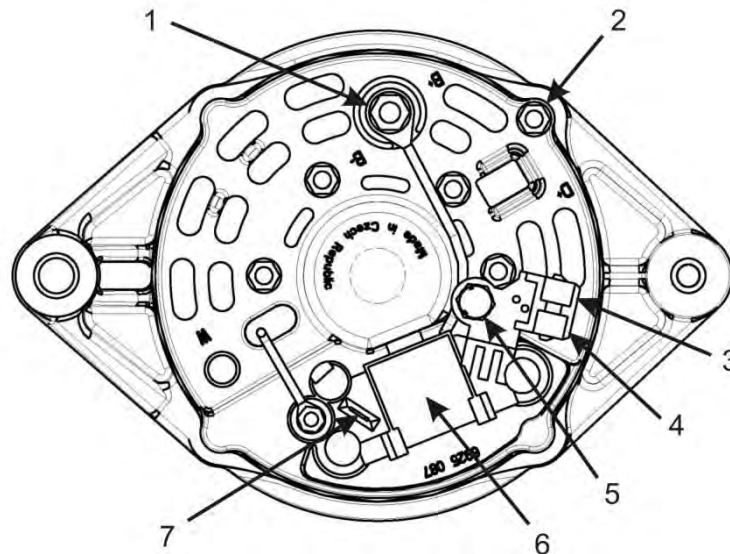
The Thermo King 120 Amp alternator is available as an optional TriPac charging system.

- Thermo King Alternators are painted black.
- The alternator uses an orange dual output 14.5 VDC voltage regulator. This regulator is not compatible with 65 amp alternators.
- The Field (FLD) terminal must be connected to the Load Control harness. The unit will not charge without this connection.
- The Alternator Capacity must be set to 120 Amps using TK Monitor > Unit Setup screen.

NOTE: The 120 Amp Dual Output alternator cannot be used to replace a 65 Amp Single Output alternator.

NOTE: The alternators used on TriPac EVOLUTION units have counterclockwise (CCW) fans and 2.25" pulleys. When replacing an alternator, make sure to use the correct fan and pulley.

NOTE: Alternators with orange voltage regulators should never be used on any Thermo King Truck/Trailer application.



Optional Thermo King 120 Amp Dual Output Alternator Terminal and Component Locations

1.	B+ Terminal (Positive Output – RED, 2 and 2A wires)	5.	FLD (Field) Terminal on 120 Amp Alternator (Must be connected to Load Control harness)
2.	B- Terminal (Negative Ground – CH wire)	6.	Voltage Regulator and Brush Assembly
3.	S Terminal (Regulator Sense – 2A wire)	7.	W Terminal (AC Output)
4.	L Terminal (Regulator Excite – D+ wire)		

Section 5 – TriPac EVOLUTION Diagnostics

ALTERNATOR DIAGNOSIS

Always use accurate test equipment such as the Fluke 179 Digital Multi-Meter and the Fluke Clamp-On Ammeter accessory when checking alternator circuit voltage and amperage. See the table below for Thermo King Service Part numbers. Be sure voltages are measured from the designated terminal to the alternator chassis ground. All voltages are DC voltages unless otherwise noted. Charge Current, Sense Voltage and System Voltage may be directly read using TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.

Meter	Service Part Number
Fluke 179 Digital Multi-Meter	204-1079
Clamp-On Ammeter for above meter	204-947

Diagnostic Procedure – Truck Batteries Low/Dead

Symptoms

- System Shutdown Alarm in the ALT alarm group is set.
- The APU does not automatically start for low battery voltage to maintain battery charge.
- The APU starts but truck batteries are still low/dead.

System Shutdown Alarm is set

1. Turn system on at the HMI.
2. The HMI Control Panel displays a RED Alarm Icon and the ALT alarm group.
 - ✓ Yes = The system has experienced an alarm condition dealing with system voltage or alternator output. Go to next step.
 - ✓ No = Continue with appropriate Diagnostic routine based on symptoms.
3. Connect unit to TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.
4. Use TK Monitor, Alarms screen to determine the specific alarm code. Follow the diagnostic procedures for that alarm. Refer to the Alarm Codes descriptions in this section.

Section 5 – TriPac EVOLUTION Diagnostics

The APU Does Not Start for Low Battery Voltage

1. Turn system on at the HMI.
2. Connect to unit with TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.
3. Go to the Programmable Setup screen. Record the Battery Voltage Restart Value (default 12.1 volts).
4. Go to System Monitoring screen. Record Sense Voltage.
5. Compare Sense Voltage to Battery Voltage Restart Value.
 - ✓ Sense Voltage is above the Restart Value. Reduce battery voltage to Restart Value by increasing power drain on batteries. Retest operation.
 - ✓ Sense Voltage is within 0.2 volts of Restart Value and APU engine started. The Base Controller is responding to voltage input. Go to Diagnostic Procedure – Under Charging.
 - ✓ Sense Voltage is below the Restart Value by less than 0.2 volts. APU engine did not start. Raise Restart Value 0.2 volts. Go to next step.
 - ✓ Sense Voltage is below the Restart Value by more than 0.2 volts. APU engine did not start. Base Controller is not responding to voltage input. Replace the Interface Board.
6. Engine started after Restart Value adjustment.
 - ✓ Yes = The Base Controller is responding to voltage input. Recheck system operation.
 - ✓ No = The Base Controller is not responding to voltage input. Replace the Interface Board.

The APU Starts but Batteries Low/Dead

Inspection

Complete the following diagnostic procedures before replacing an alternator or voltage regulator. When testing an alternator, use accurate equipment such as a Thermo King digital multi-meter and a Thermo King amp clamp or equivalent.

1. Measure and record the truck battery voltage. The truck batteries must be charged to 12.5 VDC and be in good condition and the battery cable connections must be clean and tight. **NOTE:** If the batteries are questionable, a known good jumper battery should be substituted during alternator testing.
2. Verify the drive belt and pulleys of the charging system are in good condition and are adjusted properly before testing the alternator. Worn belts, loose belts and worn pulleys will lower the output of the alternator. Make sure the alternator pulley nut is tight. It should be torqued to 50 ft-lb (68 N•m).
3. Determine if the alternator is 65 Amp Single Output or 120 Amp Dual Output.
4. Verify the Red (B+), 2A (sense), D+ (excite) and CH circuits are connected properly. All charging circuit connections must be clean and secure. **NOTE:** Optional 120 Amp Dual Output alternators also have a FLD (field) terminal that must be connected to a Load Control harness.

Section 5 – TriPac EVOLUTION Diagnostics

Testing

1. Turn the TriPac system on at the HMI Control Panel. Do not select a mode. The system should be in Monitor Mode. See Operating Modes in Section 4 Operation.
2. Connect the unit to TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.
3. Go to the Unit Setup screen. Verify the Alternator Capacity is correctly set for the installed charging system.
4. Go to the Service Test screen and select Alternator Output Test. The APU engine will start. A/C will be off.
5. Go to the System Monitoring screen.
6. Record System Voltage reading.
 - ✓ If voltage is above the battery voltage recorded in Inspection step 1 and rising toward 14.5 VDC go to the next step.
 - ✓ If voltage is below the battery voltage recorded in Inspection step 1 the alternator is not charging enough to overcome system operating load. Go to Diagnostic Procedure – Alternator Check.
7. With a meter, measure voltage at the truck battery post. Compare to System Voltage.
 - ✓ If there is less than 1 volt difference then go to next step.
 - ✓ If there is more than 1 volt difference only partial voltage is reaching the batteries. Check for high resistance in cables and connections. Locate problem and repair.
8. Note Charge Current reading in TK Monitor.
 - ✓ The Charge Current reading should start high (20 amps or more) and slowly fall as the batteries charge. Go to next step.
 - ✓ If the Charge Current reading stays high (20 amps or more) and does not fall:
 - Individually test truck batteries.
 - Connect APU to one known good battery and retest.
 - ✓ If the Charge Current reading stays low (less than 20 amps) go to the Alternator Check.
9. Cancel the Alternator Output Test on the Service Test screen. Select Fan or Heat mode at the HMI Control Panel.
10. Go to the Programmable Setup screen. Note the Charge Current Shutoff Value (Default 20 Amps).

Section 5 – TriPac EVOLUTION Diagnostics

11. Allow the APU to run. Periodically monitor Charge Current:

- ✓ If the Charge Current continues to fall and the APU stops when Charge Current Shutoff Value is reached the charging system is working properly.
- ✓ If the Charge Current continues to fall but the APU does not stop when Charge Current Shutoff Value is reached the Interface Board is defective. Replace Interface Board.
- ✓ If the Charge Current stops falling but does not reach Charge Current Shutoff Value:
 - Individually test the truck batteries.
 - Connect the APU to one known good battery and retest.

Section 5 – TriPac EVOLUTION Diagnostics

Diagnostic Procedure – Under Charging

Complete the following diagnostic procedures before replacing an alternator or voltage regulator. When testing an alternator, use accurate equipment such as a Thermo King digital multi-meter and a Thermo King amp clamp or equivalent.

Symptoms

- The APU starts but does not shut down.
- The truck must be jump started after APU stops charging.
- The APU starts, runs briefly then shuts down. This cycle repeats every few minutes.

APU Does Not Shut Down

Inspection

1. Measure and record the truck battery voltage. The truck batteries must be charged to 12.5 VDC and in good condition and the battery cable connections must be clean and tight. **NOTE:** If the batteries are questionable, a known good jumper battery should be substituted during alternator testing.
2. Verify the drive belt and pulleys of the charging system are in good condition and are adjusted properly before testing the alternator. Worn belts, loose belts and worn pulleys will lower the output of the alternator. Make sure the alternator pulley nut is tight. It should be torqued to 50 ft-lb (68 N•m).
3. Determine if the alternator is 65 Amp Single Output or 120 Amp Dual Output.
4. Verify the RED, 2A (sense), D+ (excitation) and CH circuits are connected properly. All charging circuit connections must be clean and secure. **NOTE:** Optional 120 Amp Dual Output alternators also have a FLD (field) terminal that must be connected to a Load Control harness.

Testing

1. Turn the TriPac system on at the HMI Control Panel. Select Low Fan or Heat Mode. See Operating Modes in Section 4 Operation.
2. Connect the unit to TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.
3. Go to the Programmable Setup screen. Record the Battery Voltage Restart Value (default 12.1 volts).
4. Go to the Programmable Setup screen. Record the Charge Current Shutoff Value (default 20 amps).
5. Go to the System Monitoring screen. Record the Sense Voltage.
6. Compare the Sense Voltage to Battery Voltage Restart Value.
 - ✓ If the Sense Voltage is above the Restart Value reduce the battery voltage to Reset Value by increasing power drain on the truck batteries.
 - ✓ When the Sense Voltage is below the Restart Value the APU engine should start.

Section 5 – TriPac EVOLUTION Diagnostics

7. After the engine starts, go to the System Monitoring screen and monitor Charge Current.
 - ✓ The Charge Current reading should start high (20 amps or more) and slowly fall as the batteries charge. When the Charge Current Shutoff Value is reached the Engine then shuts down. This is normal operation.
 - ✓ The Charge Current reading should start high (20 amps or more) and slowly fall as the batteries charge. If the charge current does not achieve Charge Current Shutoff Value:
 - If the Charge Current reading stays low (less than 20 amps) go to the Alternator Check.
 - The current draw by external truck systems such as lights, power inverters, etc is high. Turn off external loads then retest.

APU Runs Until Charge Current Shutoff Value Is Reached But Truck Must Be Jump Started

1. Turn the TriPac system on at the HMI Control Panel. Select Low Fan or Heat Mode. See Operating Modes in Section 4 Operation.
2. Connect the unit to TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.
3. Go to the Programmable Setup screen.
4. Record the Battery Voltage Restart Value (default 12.1 volts).
5. Record the Charge Current Shutoff Value (default 20 amps).
6. Go to the System Monitoring screen. Record the Sense Voltage.
7. Compare the Sense Voltage to Battery Voltage Restart Value.
 - ✓ If the Sense Voltage is above the Restart Value reduce the battery voltage to Reset Value by increasing power drain on the truck batteries.
 - ✓ When the Sense Voltage falls below the Restart Value the APU engine should start.
8. After the engine starts, go to the System Monitoring screen and monitor Charge Current.
 - ✓ The Charge Current reading should start high (20 amps or more) and slowly fall as the batteries charge. When the Charge Current Shutoff Value is reached the Engine then shuts down. This is normal operation. Go to next step.
 - ✓ If the Charge Current reading stays low (less than 20 amps) go to the Alternator Check.
9. With a meter, monitor battery voltage during truck engine start attempt.
 - ✓ If the voltage drops 2 or more volts then one or more truck batteries are defective and will not hold a charge. Load test all batteries.
 - ✓ If the voltage does not drop 2 or more volts then check all battery and starter connections.

Section 5 – TriPac EVOLUTION Diagnostics

APU Engine Short Cycles

1. Turn the TriPac system on at the HMI Control Panel. Select Low Fan or Heat Mode. See Operating Modes in Section 4 Operation.
2. Connect the unit to TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.
3. Go to the Programmable Setup screen.
4. Record the Battery Voltage Restart Value (default 12.1 volts).
5. Record the Charge Current Shutoff Value (default 20 amps).
6. Go to the System Monitoring screen. Record the Sense Voltage.
7. Compare the Sense Voltage to Battery Voltage Restart Value.
 - ✓ If the Sense Voltage is above the Restart Value reduce the battery voltage to Restart Value by increasing power drain on the truck batteries.
 - ✓ When the Sense Voltage falls below the Restart Value the APU engine should start.
8. After the engine starts, go to the System Monitoring screen and monitor Charge Current.
 - ✓ If the Charge Current stays below Charge Current Shutoff Value and the APU shuts down after a short run time, then the Sense Voltage falls rapidly causing a restart. Go to the Alternator Check Diagnostic Procedure below.
 - ✓ If the Charge Current begins high (above 20 amps) then rapidly decreases to Charge Current Shutoff Value and the APU then shuts down, then the Sense Voltage falls rapidly causing a restart. One or more truck batteries are defective and will not hold a charge. Load test all batteries

Section 5 – TriPac EVOLUTION Diagnostics

Diagnostic Procedure – Alternator Check

Symptoms

- The alternator does not charge the batteries.
- Alarm Code 25 is set.

Inspection

1. Determine if the HMI Control Panel displays a RED Alarm Icon and the ALT alarm group. If present, this indicates the system has experienced an alarm condition dealing with system voltage or alternator output. Use TK Monitor to determine the specific alarm code. Follow the diagnostic procedures for that alarm. Refer to the Alarm Codes descriptions in this section. If there are no alarms continue with Diagnostic Procedure.
2. Measure and record the truck battery voltage. The truck batteries must be charged to 12.5 VDC and in good condition and the battery cable connections must be clean and tight. **NOTE:** If the batteries are questionable, a known good jumper battery should be substituted during alternator testing.
3. Verify that the drive belt and pulleys of the charging system are in good condition and are adjusted properly before testing the alternator. Worn belts, loose belts and worn pulleys will lower the output of the alternator. Make sure the alternator pulley nut is tight. It should be torqued to 50 ft-lb (68 N•m).
4. Determine if the alternator is 65 Amp Single Output or 120 Amp Dual Output.
5. Verify the RED, 2A (sense), D+ (excitation) and CH circuits are connected properly. All charging circuit connections must be clean and secure. **NOTE:** Optional 120 Amp Dual Output alternators also have a FLD (field) terminal that must be connected to a Load Control harness.

Testing – Not Running

NOTE: Do not perform these tests with a battery charger connected to the battery.

NOTE: Unless otherwise stated all voltage readings should be taken from the terminals indicated on the alternator and chassis ground.

1. Verify the unit is turned off at the HMI Control Panel. LEDs should all be off.
2. Check and record the voltage at the truck batteries with both the TriPac unit and the truck turned off.
3. Check and record the voltage at the B+ terminal on the alternator. Battery voltage recorded in step 2 must be present. If not, check the RED circuit for an open. Repair and retest.

Section 5 – TriPac EVOLUTION Diagnostics

4. Disconnect the alternator harness plug from the voltage regulator by carefully pushing on the spring clip to release the plug lock.
5. Check the voltage at the sense circuit (2A) plug terminal.
 - ✓ If the battery voltage is the same as recorded at step 2 go to next step.
 - ✓ If no voltage is present check the sense circuit (2A) to the fuse holder in the truck battery box for an open circuit. Repair and retest.
6. Turn the unit on at the HMI Control Panel. LED display should be on (lighted). Create an engine start demand. The Run Relay should be energized (fuel pump on).
7. Check the voltage at the excitation circuit (D+) plug terminal. It may be helpful to use a remote HMI Control Panel or a helper so test readings can be taken before the engine cranks.
 - ✓ If voltage at the (D+) plug terminal is 10 VDC or more go to next step.
 - ✓ If voltage at the (D+) plug terminal is 0 VDC check the voltage at the D+ connection on the Interface Board.
 - If battery voltage is available at the D+ Interface Board connection there is an open in the D+ circuit to alternator. Repair and retest.
 - If the voltage is 0 at the D+ board connection the D+ circuit may be shorted to chassis ground. Remove the J14 plug from the Interface Board and retest the voltage at D+ board terminal. If the D+ voltage rises to 10 VDC or more the D+ circuit is grounded. If the voltage remains low the Interface Board is defective.
8. Turn the unit off at the HMI and reconnect the alternator harness plug.

Testing – Running

1. Connect a digital multi-meter set to read DC Volts between the B+ terminal at the alternator and chassis ground.
2. Attach a clamp-on ammeter around the RED wire between the alternator and the starter. This will read alternator output to the truck batteries. **NOTE:** The Current Sensor reading in TK Monitor will provide the same information.
3. Turn the unit on and allow it to start. **NOTE:** Units with the 120 amp alternator should use Service Test mode Alternator Output Test to assure the alternator is allowed to charge at maximum output.
4. Decrease the charging system load by selecting Fan Mode Low Speed at the HMI Control Panel. Turn off all auxiliary loads in the truck.

Section 5 – TriPac EVOLUTION Diagnostics

5. Check and record the current flow in the RED wire using either the clamp on ammeter or TK Monitor > System Monitoring > Charge Current.
 - ✓ A positive reading indicates the alternator is charging and current is flowing to the batteries. On unit startup, the current flow should momentarily increase above 16 amps to compensate for the heavy battery current drawn during preheat and cranking. The current should fall as the batteries charge. Go to next step.
 - ✓ A zero or negative reading indicates the alternator is not charging or is not charging enough to support TriPac system demand. The alternator is defective if there are no problems in the wiring. Recheck the wiring before assuming the alternator is defective.
6. Check and record the low load alternator output voltage at the B+ terminal using either the clamp on ammeter or TK Monitor > System Monitoring > Charge Current.
7. Increase the charging system load as much as possible by turning on the truck head lights and other auxiliary loads.
8. Check and record the high load alternator output voltage at the B+ terminal using either the clamp on ammeter or TK Monitor > System Monitoring > Charge Current.
9. Compare the low load voltage, recorded in Step 6 to the high load voltage recorded in Step 8.
 - ✓ If the output voltage decreases less than 0.5 VDC or increases up to 1.0 VDC go to next step.
 - ✓ If the output voltage decreases more than 0.5 VDC the alternator is defective if there are no problems in the wiring. Recheck the wiring before replacing the alternator.
10. Compare to the running voltage at the B+ terminal recorded in Step 8 to the voltage recorded during **Testing – Not Running** Step 3.
 - ✓ If the running voltage is higher alternator is charging and increasing system voltage. The voltage should increase until it reaches the voltage regulator setting of about 14.5 VDC. Go to next step.
 - ✓ If the running voltage is the same or lower the alternator is defective if there are no problems in the wiring. Recheck the wiring before replacing the alternator.
11. Check the voltage at the positive battery post. Compare to the voltage reading at the B+ terminal recorded in step 8.
 - ✓ If there is less than 1.0 volt difference the cable and connections are good. No problem found.
 - ✓ If there is more than 1.0 volt difference the cable and connections are complete but have high resistance. This prevents full charging current from reaching batteries. Check for loose or corroded connections, repair and retest.

Section 5 – TriPac EVOLUTION Diagnostics

120 Amp Alternator Load Control Circuit

Some TriPac units will have an optional 120 amp charging system. Current 120 amp alternators have a special dual output voltage regulator that is not interchangeable with the standard 65 amp alternator. The 120 Amp alternator requires some additional external circuitry to function. During charging system diagnosis use TK Monitor > Service Test mode > Alternator Output Test to bypass the load control system.

Load Control Harness

The Load Control harness is connected to the 120 amp alternator FLD (field) terminal near the plug connection. It is used to reduce maximum alternator output and engine load under some conditions. The harness runs toward the TriPac control box. It splits into three circuits (FLD1, FLD2 and FLD3) before connecting to the Interface Board. One or two circuits may be active at any time. There is a 10 second delay after engine start or Cool Mode selection.

NOTE: The Load Control Harness should never be connected to the F2 terminal of a 65 amp single output alternator. Alternator failure will result.

Full Output The FLD1 circuit connects directly to the Interface Board at J6 Pin A3. When active, the circuit provides a direct path to ground for the alternator field. The alternator can charge at full output.

Medium Output The FLD3 circuit connects through a 2 Ohm resistor to the Interface Board at J6 Pin A4. When active, the circuit provides 2 ohms of resistance in the ground path for the alternator field. This reduces field voltage to limit alternator output and reduce engine load.

Low Output The FLD2 circuit connects through a 4 Ohm resistor to the Interface Board at J6 Pin B3. When active, the circuit provides 4 ohms of resistance in the ground path for the alternator field. This further reduces field voltage to limit alternator output and further reduce engine load.

Section 5 – TriPac EVOLUTION Diagnostics

Diagnostics

The dual output alternator will generally use the same diagnostic method as a single output alternator with the following additions.

NOTE: TK Monitor > Service Test Mode > Alternator Output Test may be used to temporarily disable the Load Control system for diagnostic testing of the 120 amp charging system. See Service Procedure A51A Communication Using TK Monitor in Section 6.

Alternator does not charge:

- The Load Control harness is disconnected from the FLD terminal on the alternator. Reconnect and retest.
- The Load Control harness circuit is open between alternator and Interface Board. Repair and retest.
- The Load Control terminals at Interface Board are inactive. Replace defective Interface Board.

Alternator always charges at full output:

- The Load Control harness circuit between the alternator FLD terminal and Interface Board J6 Pin A3 is shorted to ground before the resistors.
- The Interface Board is defective.

Alternator always charges at reduced output:

- The FLD2 or FLD3 circuit is shorted to ground between the resistor and the Interface Board connection at J6 Pin B3 or J6 Pin A4).
- The Interface Board is defective.

Additional Alternator Tests

Alternator Diode Quick Check

This check confirms proper rectifier diode function. Defective rectifier diodes will reduce alternator charging capacity.

1. Connect a digital multi-meter set to read AC Volts between the B+ terminal at the alternator and chassis ground.
2. Turn the unit on and allow it to start.
3. Check and record the alternator output voltage at the B+ terminal. There should be no more than 1.0 VAC present. A reading of more than 1.0 VAC indicates damaged alternator diodes.
4. Turn the unit off.
5. Replace alternator if diodes are damaged.

Section 5 – TriPac EVOLUTION Diagnostics

Field Current Test – 65 Amp Alternators Only

Use this test to determine if the alternator can be repaired. Perform this test with the unit turned off.

NOTE: This test must not be performed on the 120 amp dual output Thermo King alternator used with optional 120 Amp Alternator Package. There are no available connections on the alternator that will provide a valid test result. The FLD terminal does not replace the F2 terminal found on the 65 amp alternator.

1. Verify the unit is off.
2. Attach a clamp-on ammeter to the 2A wire near the B+ terminal on the alternator.
3. Energize the field:
 - ✓ On the 65 amp Thermo King alternator, connect a jumper wire between the F2 terminal and the B+ terminal. Do not connect the F2 terminal to ground or the alternator will be damaged.
4. Note the ammeter reading. The ammeter reading indicates the field current, which should be 2.0 to 5.0 amps at 12 volts.
 - ✓ No field current or a low field current indicates an open circuit or excessive resistance in the field circuit. Remove the voltage regulator and brush assembly and inspect the slip rings. If the slip rings are acceptable, install a new voltage regulator and brush assembly and repeat the test. If the brushes are not the problem, replace the alternator.
 - ✓ High field current indicates a short in the field circuit. Replace the rotor or the alternator.

Alternator Load Test

Thermo King no longer recommends a full field test for determining the alternator current output. Full fielding an alternator can cause increases in alternator output voltage that may damage internal alternator or unit components. This damage may not be readily apparent.

To test the alternator under load, Thermo King recommends the use of a clamp-on ammeter to monitor output current, both on initial startup and under full unit load conditions. For example, the APU should be turned on and operating in the A/C Mode.

ALARM CODE DIAGNOSTICS

Alarm Notification



The TriPac EVOLUTION control system continually monitors operation and can generate several alarm codes. If the unit has an alarm condition the operator is notified by an illuminated Alarm Icon on the HMI Control Panel. The icon can be Red or Yellow.

Red = Shutdown Alarm. This indicates one of the system Shutdown Alarms is active. This level of alarm serves as notice that a potentially severe system problem exists. Immediate corrective action should be taken. The unit will be shut down. Along with the Red Alarm Icon, one of the Shutdown Alarm group names (ENG, ALT, ACS) will illuminate. This helps to focus diagnosis and repair.

Yellow = Check Alarm. This indicates one or more of the system Check Alarms are active. This level of alarm serves as notice to take corrective action at the earliest convenience before a problem becomes severe. The system will continue to operate but some features and functions may be inhibited or disabled.

Log Alarm. This category of alarm does not illuminate the Alarm Icon on the HMI. The unit will continue to operate with a log alarm.

All recent alarm codes can be read and cleared by a technician using the Alarm screen in TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.

NOTE: Alarms are a symptom of a problem. They should not be considered as a complete diagnosis of the problem. A logical step-by-step diagnostic process should be used to identify the actual cause.

Section 5 – TriPac EVOLUTION Diagnostics

Clearing Alarms

If the alarm icon is Red note the alarm group that is illuminated on the HMI Control Panel (ENG, ALT, ACS). Use the HMI Control Panel On/Off button to turn the TriPac unit off. Resolve the condition that caused the alarm. Use the HMI Control Panel System On/Off button to turn the TriPac unit on. Any active alarms will be cleared.

NOTE: If the alarm condition still exists the alarm will return.

Active alarms and those recently cleared by the operator can be read and cleared by a technician using the Alarm screen in TK Monitor. This screen provides the technician with a list of alarms that have occurred. They may be cleared individually or as the full list. All alarm codes are stored in the unit data logger. Alarms cleared through TK Monitor remain in the data logger memory and may be retrieved with a data logger download. See Service Procedure A51A Communication Using TK Monitor in Section 6.

Log Alarms

Log Alarms are displayed in TK Monitor and recorded by the Data Logger. The HMI Control Panel Alarm Icon does not illuminate. This level of alarm serves as notice of an abnormal system event. The event condition may have self-corrected. The system will continue to operate with a Log Alarm.

Check Alarms

Check Alarms are indicated by a steady yellow HMI alarm icon. The appropriate alarm group icon will also illuminate. This level of alarm serves as notice to take corrective action at the earliest convenience before a problem becomes severe. The system will continue to operate but some features and functions may be inhibited or disabled. The alarm code is displayed in TK Monitor and logged in the data logger.

Shutdown Alarms

Shutdown Alarms are indicated by a steady red HMI alarm icon. The unit will be shut down. The appropriate alarm group icon will also illuminate. This level of alarm serves as notice to take immediate corrective action. The unit has detected a potentially severe problem and shut down. The unit will not restart until the alarm is manually cleared. The alarm code is displayed in TK Monitor and logged in the data logger.

Section 5 – TriPac EVOLUTION Diagnostics

Shutdown Alarm Groups

The Shutdown Alarm group indication on the HMI Control Panel helps to focus preliminary fault diagnosis toward a limited group of potential failure causes. It may be necessary for the technician to determine the actual fault code and other system information to form an accurate diagnosis.



ENG

Alarms in this group are engine related. The operator/technician should look for:

- Conditions that cause unusually high APU engine coolant temperature.
- Conditions that cause unusually low APU engine oil pressure.
- Conditions that prevent the engine from starting.
- Conditions that may cause fuel starvation.

ALT

Alarms in this group are alternator, battery or system voltage related. The operator/technician should look for:

- Loose or missing APU drive belt.
- Loose or corroded APU power cable connections.
- Unusually low or high voltage at the truck batteries.

ACS

Alarms in this group are air conditioning system related. The operator/technician should look for:

- Conditions that cause unusually high air temperature at the condenser coil.
- Conditions that reduce or restrict air flow through the condenser coil.

Section 5 – TriPac EVOLUTION Diagnostics

ALARM CODES

02 Check Evaporator Coil Sensor

Alarm Type	Check Alarm

TriPac EVOLUTION

Component Description and Location

This sensor is a thermistor style sensor that can be tested with an ohmmeter. It is not polarity sensitive. The sensor is located in the Evaporator Box.

Circuit Description

The evaporator coil temperature sensor circuit is a two wire circuit connected to the Interface Board at COILSEN (J14 Pin A9) and COILSEN_RTN (J14 Pin B9).

Considerations

This sensor information is used by the system to help prevent ice buildup on the evaporator coil. The sensor should be positioned to minimize the potential for moisture entry where the wires enter the sensor shell. Mount sensors with the barrel up and the wires down wherever possible.

How Alarm is Set

If the sensor reading is outside the allowable limit of -38°F to 170°F (-39°C to 77°C) and does not return within 10 seconds then Alarm Code 02 Check Evaporator Coil Sensor is set as a Check Alarm. All decisions made with this sensor are disabled. The compressor and evaporator fan will continue to operate as requested. This alarm has no effect on heat mode.

How Alarm is Cleared

The alarm will automatically clear if the sensor reading returns to the normal range. This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. A high temperature reading indicates a shorted sensor or harness.
2. A low temperature reading indicates an open or high resistance in sensor or harness.
3. Check the resistance of the CTS circuit between COILSEN at J14 Pin A9 and COILSEN_RTN at J14 Pin B9.

See Service Procedure D01A Unit Temperature Sensor Test in Section 6.

Section 5 – TriPac EVOLUTION Diagnostics

05 Check Ambient Temperature Sensor (Optional)

Alarm Type	Check Alarm	TriPac EVOLUTION

Component Description and Location

This sensor is a thermistor style sensor that can be tested with an ohmmeter. It is not polarity sensitive. The sensor is located on the Condenser Housing. The Ambient Temperature Sensor is part of the optional 120 amp Charging System.

Circuit Description

The Ambient Temperature Sensor (ATS) circuit is a two wire circuit. The ATS (J2 Pin 4) and ATS_RTN (J2 Pin 5) wires connect to the Interface Board. The sensor wires are routed to the Condenser Coil Housing.

Considerations

This sensor information is used by the system to determine appropriate alternator load shedding operation. Sensors should be positioned to minimize the potential for moisture entry where the wires enter the sensor shell. Mount sensors with the barrel up and the wires down wherever possible.

How Alarm is Set

If the sensor reading is outside of the allowable limit of -38°F to 170°F (-39°C to 77°C) and does not return within 10 seconds then Alarm Code 05 Check Ambient Temperature Sensor is set as a Check Alarm. Disable all decisions made with this sensor while alarm is active.

How Alarm is Cleared

The alarm will automatically clear if the sensor reading returns to the normal range. This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. A high temperature reading indicates a shorted sensor or harness.
 2. A low temperature reading indicates an open or high resistance in sensor or harness.
 3. Check the resistance of the CTS circuit between ATS (J2 Pin 4) and ATS_RTN (J2 Pin 5).
- See Service Procedure D01A Unit Temperature Sensor Test in Section 6.

Section 5 – TriPac EVOLUTION Diagnostics

06 Check Engine Water Temperature Sensor (WT1)

Alarm Type	Check Alarm	TriPac EVOLUTION

Associated Alarm Codes Alarm Code 18 High Engine Coolant Temperature

Component Description and Location

This sensor is a thermister style sensor that can be tested with an ohmmeter. It is not polarity sensitive. The sensor is located in the APU engine thermostat housing.

Circuit Description

The Engine Water Temperature Sensor (WT1) circuit is a two wire circuit. The WT1 (J14 Pin B7) and WT1_RTN (J14 Pin A7) wires connect to the Interface Board. The sensor wires are routed in the Main Harness to the APU.

Considerations

Sensors should be positioned to minimize the potential for moisture entry where the wires enter the sensor shell. Form a drip loop in the harness near the sensor.

How Alarm is Set

If the sensor reading is outside of the allowable limit of -58°F to 300°F (-50°C to 149°C) and does not return within 10 seconds then Alarm Code 06 Engine Water Temperature Sensor (WT1) is set as a Check Alarm. Disable all decisions made with this sensor while alarm is active. Engine operation will continue as required.

How Alarm is Cleared

The alarm will automatically clear if the sensor reading returns to the normal range. This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. A high temperature reading indicates a shorted sensor or harness.
2. A low temperature reading indicates an open or high resistance in sensor or harness.
3. Check the resistance of the WTS circuit between WT1 (J14 Pin B7) and WT1_RTN (J14 Pin A7). See Service Procedure D01A Unit Temperature Sensor Test in Section 6.

Section 5 – TriPac EVOLUTION Diagnostics

10 High Discharge Pressure

Alarm Type	Check or Shutdown Alarm (ACS group)	TriPac EVOLUTION

Component Description and Location

The high pressure cutout switch (HPCO) is located on the receiver/dryer.

Circuit Description

The high pressure cutout circuit is a two wire circuit. The 7CL (J5 Pin 2) wire connects the Interface Board to one side of the high pressure cutout switch (HPCO). A branch of the 7CLA wire connects the Interface Board (J2 Pin 2) to the other side of the high pressure cutout switch. Another branch of 7CLA provides power from HPCO to the compressor clutch. When HPCO opens the voltage signal is lost on 7CLA to the interface board. The clutch disengages and the compressor stops. The switch wires are routed to the receiver/drier on the back of the cab.

How Alarm is Set

HPCO Switch: Opens at 360 psig (2482 kPa) Closes at 240 psig (1655 kPa)

Check: If the HPCO switch opens Alarm Code 10 High Discharge Pressure is set as a Check Alarm. The air conditioning compressor will stop. The Base Controller removes power from 7CL (J5-2). The Evaporator Fan will continue to run in the selected speed. Compressor operation will be delayed for 180 seconds, and then the switch position is checked. If the switch is closed, the system will restart. If the switch is still open, a new 180 second delay will begin.

Shutdown: A 60 minute probation timer is started on the first occurrence of high pressure. If the HPCO switch opens a third time before the 60 minute probation timer expires the alarm will become a Shutdown Alarm.

How Alarm is Cleared

This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. Check the refrigeration system for high discharge pressure and correct as required.
2. Check the High Pressure Cutout Switch for proper operation (closed under normal conditions). Check the switch for excessive resistance. The nominal switch resistance is less than 1 ohm.
3. Check the High Pressure Cutout Switch circuit, as shown by Service Procedure D01A.

Section 5 – TriPac EVOLUTION Diagnostics

17 Engine Failed to Crank

Alarm Type	Log or Shutdown (ENG group)	TriPac EVOLUTION

Component Description and Location

Engine starting system.

Circuit Description

Truck battery voltage must be available at the main starter terminal. Start signal is sent to the starter solenoid on the 8S circuit from the Interface Board. The Flywheel sensor measures engine RPM.

How Alarm is Set

If the engine fails to reach 40 RPM within 3 seconds or rises above and then falls below 40 RPM during the engine crank sequence then Alarm Code 17 Engine Failed to Crank is set as a Log Alarm. Two attempts are made to crank, and then Alarm Code 17 Engine Failed to Crank is set as a Shutdown Alarm. If the engine cranks successfully on the second attempt the Log Alarm will clear. There is a 10 second interval between crank attempts.

How Alarm is Cleared

The Log Alarm will automatically clear if the engine successfully cranks. This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. Check the battery, battery cables and starter.
2. Check the operation of the starter circuit by forcing an engine start. The engine should crank and start.
3. Check the 8S circuit for a pushed pin, loose pin crimp or broken wire.
4. Check the 8S wire with an ohmmeter for continuity per Service Procedure H04A.
5. Check for a seized starter or engine.

Section 5 – TriPac EVOLUTION Diagnostics

18 High Engine Coolant Temperature

Alarm Type	Shutdown (ENG group)	TriPac EVOLUTION

Associated Alarm Codes Alarm Code 06 Check Engine Water Temperature Sensor

Component Description and Location

Coolant Temperature Sensor (WT1) is located in the engine thermostat housing.

Circuit Description

The Engine Water Temperature Sensor (WT1) circuit is a two wire circuit. The WT1 (J14 Pin B7) and WT1_RTN (J14 Pin A7) wires connect to the Interface Board. The sensor wires are routed in the Main Harness to the APU.

How Alarm is Set

The Coolant Temperature Sensor (WT1) detects engine coolant temperature is above 220°F (104°C) for more than 10 seconds.

How Alarm is Cleared

This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. Check the engine water temperature using TK Monitor. If the temperature is above 220°F (104°C) check the engine cooling system to determine the cause of overheating.
2. Standard cooling system: Verify isolation valves are open and the coolant hoses to the truck are not kinked or crushed.
3. Closed Loop cooling system: Check the engine coolant level. Bleed air from the cooling system if necessary.
CAUTION: Do not open the cap on the expansion tank when the coolant is hot!
4. Check the water pump drive belt.
5. Check the Pre-cooler Coil for airflow and coolant flow restrictions.
6. Verify the Pre-cooler Fan is running.
7. Check the Water Temperature Sensor as shown in Alarm Code 06 Check Coolant Temperature Sensor.

Section 5 – TriPac EVOLUTION Diagnostics

19 Low Engine Oil Pressure

Alarm Type	Shutdown (ENG group)	TriPac EVOLUTION

Associated Alarm Codes Alarm Code 31 Check Oil Pressure Switch

Component Description and Location

The Low Oil Pressure Switch is located on the engine block near the oil filter.

Circuit Description

The Low Oil Pressure Switch circuit goes to ground through the switch. The LOPS (J14 Pin A5) wire connects the Interface Board to the normally closed OPS. The switch body is connected to chassis ground. The switch wire is routed in the Main Harness.

When oil pressure rises above 15 psi the switch is open. The Low Oil Pressure Switch circuit is not grounded and voltage rises to system voltage. When oil pressure falls below 15 psi the switch is closed. The Low Oil Pressure Switch circuit is grounded and voltage drops to near 0 volts.

How Alarm is Set

The engine must have been running for more than 30 seconds. If the Low Oil Pressure Switch (LOPS) is closed for 30 seconds indicating low oil pressure, then Alarm Code 19 Low Engine Oil Pressure is set as a Shutdown Alarm.

How Alarm is Cleared

This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. Check APU engine oil level. Adjust as required.
2. Verify engine oil pressure is 18 psi or greater.
3. Check for Alarm Code 31 Check Oil Pressure Switch. This alarm indicates the switch or switch circuit is defective.
4. Check the Low Oil Pressure Switch circuit for intermittent short to chassis ground.

Section 5 – TriPac EVOLUTION Diagnostics

20 Engine Failed to Start

Alarm Type	Log or Shutdown (ENG group)	TriPac EVOLUTION

Associated Alarm Codes Alarm Code 17 Engine Failed to Crank

Component Description and Location

Engine starting system and/or engine fuel delivery system.

Circuit Description

Truck battery voltage must be available at the main starter terminal. Start signal is sent to the starter solenoid on the 8S circuit from the Interface Board. The Flywheel sensor measures engine RPM.

How Alarm is Set

During cranking engine RPM exceeded 40 RPM but did not exceed 800 RPM within 30 seconds. There is a 10 second interval between start attempts.

Log Alarm is set for the first two unsuccessful start attempts.

Shutdown Alarm is set after the third consecutive unsuccessful start attempt.

How Alarm is Cleared

If Alarm Code 20 Engine Failed to Start is set as a log alarm and the engine successfully starts the alarm is cleared. This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. Check the truck fuel level.
2. Verify that the battery and starter cable connections are clean and tight.
3. Check the fuel solenoid, fuel pump, and fuel system electrically, mechanically and for fuel flow restrictions or blockages.
4. Inspect and clean the screen in the fuel pre-filter.
5. Check for cause of slow start or no start of the engine, such as low battery voltage.
6. In cold ambient temperatures check for fuel gelling.
7. Check for restricted air cleaner or air intake system.

Section 5 – TriPac EVOLUTION Diagnostics

25 Alternator Check

Alarm Type	Shutdown (ALT Group)	TriPac EVOLUTION

Associated Alarm Codes	Alarm Code 61 Low Battery Voltage

Component Description and Location

The battery voltage is sensed at the SEN (J14 Pin A1) connection on the Interface Board.

The charge current is sensed by the Current Sensor (CS). This sensor is mounted where the battery cable enters the APU.

NOTE: A Current Sensor that is open or disconnected will read greater than +200 amps.

Circuit Description

The sensed battery voltage is low enough to cause the alternator to be charging. The current sensor determines the alternator is not sending current to the truck batteries. TriPac shuts down to prevent discharged truck batteries.

Considerations

The alarm shall be disabled when Load Control is active.

How Alarm is Set

1. If the engine is running, oil pressure is good, charging amps are less than -1.0 amps (discharging) and system volts are less than 13.2 volts for 3 minutes then Alarm Code 25 Alternator Check is set as a Shutdown Alarm.
2. If the engine is running, oil pressure is good and battery volts are greater than 16.0 volts for 3 minutes then Alarm Code 25 Alternator Check is set as a Shutdown Alarm.

How Alarm is Cleared

This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

Refer to Alternator Diagnosis earlier in this section.

Section 5 – TriPac EVOLUTION Diagnostics

31 Check Oil Pressure Switch

Alarm Type	Check	TriPac EVOLUTION

Associated Alarm Codes Alarm Code 19 Low Engine Oil Pressure

Component Description and Location

The Low Oil Pressure Switch is located on the engine block near the oil filter.

Circuit Description

The Low Oil Pressure Switch circuit goes to ground through the switch. The LOPS (J14 Pin A5) wire connects the Interface Board to the normally closed OPS. The switch body is connected to chassis ground. The switch wire is routed in the Main Harness.

When oil pressure rises above 15 psi the switch is open. The Low Oil Pressure Switch circuit is not grounded and voltage rises to system voltage. When oil pressure falls below 15 psi the switch is closed. The Low Oil Pressure Switch circuit is grounded and voltage drops to near 0 volts.

Considerations

If the switch passes on the first start attempt it is not checked again during second and third start attempts.

How Alarm is Set

The Base Controller checks the oil pressure switch (OPS) position at the end of the preheat cycle prior to engine cranking. The oil pressure should be low and the switch should be closed with LOPS circuit voltage near 0 volts. If the switch is open the LOPS circuit voltage will be near battery voltage and Alarm Code 31 Check Oil Pressure Switch is set as a Check Alarm.

How Alarm is Cleared

This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. Check engine oil level. Adjust as required.
2. With an external oil pressure gauge check engine oil pressure during cranking.
 - ✓ If oil pressure is less than 15 psi locate and repair the cause.
 - ✓ If oil pressure is greater than 15 psi replace the Oil Pressure Switch (OPS).

Section 5 – TriPac EVOLUTION Diagnostics

35 Check Run Relay

Alarm Type	Shutdown (ENG group)	TriPac EVOLUTION

Component Description and Location

The Run Relay (RR) is located on the Interface Board. It controls engine run components.

Circuit Description

Voltage on the 8 circuit passes from J4 Pin A3 to the Run relay contacts. When the engine is in run mode these contacts are closed. Voltage on the 8D circuit passes to J14 Pin A4.

How Alarm is Set

When the control system is in an engine run mode it expects to read voltage in the 8D circuit after the Run Relay contacts. Alarm Code 35 Check Run Relay will be set 5 seconds after the Run Relay coil is energized if this voltage is not present.

How Alarm is Cleared

This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

If voltage to the Run Relay contacts is lost or the contacts do not close Alarm Code 35 Check Run Relay will be set.

1. Verify the APU engine switch (ESW) is on (closed).
2. Verify voltage is available on 8X at J14 Pin B4.
3. Check connections in the option plug (J4). Verify it is not loose, unplugged or missing. This includes the DPF option harness.
4. Verify optional DPF dash switch is in the on (center) position.
5. Determine if the optional DPF system has an alarm. Fault Relay (FR) is open.
6. Run Relay contacts did not close. Replace Interface Board.

Section 5 – TriPac EVOLUTION Diagnostics

49 Check Cab Temperature Sensor

Alarm Type	Check Alarm	TriPac EVOLUTION

Associated Alarm Codes None

Component Description and Location

This sensor is a thermister style sensor. The sensor is located in the HMI housing. It is connected to the HMI circuit board and is not serviceable.

Circuit Description

The cab temperature sensor circuit is a two wire circuit connected to the HMI circuit board.

Considerations

This sensor information is used by the system to determine the temperature in the truck cab bunk area during air conditioning operation. Temperature information from the sensor is reported by the HMI Control Panel to the Base Controller via the CAN bus.

How Alarm is Set

If the sensor reading is outside of the allowable limit of -50°F to 150°F (-45°C to 65°C) and does not return within 30 seconds then Alarm Code 49 Check Cab Temperature Sensor is set as a Check Alarm. Alarm Code 49 Check Cab Temperature Sensor will self clear if the sensor returns to the normal range.

Air conditioning mode is disabled. The evaporator fan will continue to operate as requested. Has no effect on heat mode.

How Alarm is Cleared

The alarm will automatically clear if the sensor reading returns to the normal range. This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. A high temperature reading indicates a shorted sensor or harness.
2. A low temperature reading indicates an open or high resistance in sensor or harness.
3. If the sensor continues to read out of range replace the HMI.

Section 5 – TriPac EVOLUTION Diagnostics

50 Reset Clock

Alarm Type	Log Alarm	TriPac EVOLUTION

Associated Alarm Codes	None

Component Description and Location

The Base Controller Real Time Clock (RTC) maintains the internal time used by the data logger. Real Time Clock power is supplied from the truck battery. The Interface Board may be removed from truck power and the an internal clock capacitor will keep the RTC operating for up to 200 hours.

Circuit Description

The TriPac Base Controller has an internal clock module that provides time and date for data logging purposes. This clock has an indication when the power has been lost and the time should be reset.

Considerations

Loss of the Real Time Clock (RTC) does not affect system operation. Data logger information will not have an accurate time stamp.

How Alarm is Set

The RTC integrated circuit has an internal signal to indicate that power source for the RTC has been depleted. The Base Controller detects this upon power-up and will set Alarm Code 50 Reset Clock to indicate the time should be reset by TK Monitor.

How Alarm is Cleared

TK Monitor will clear this alarm code automatically when the time is reset. See Service Procedure A51A Communication Using TK Monitor in Section 6.

Diagnostic Procedure

None

Section 5 – TriPac EVOLUTION Diagnostics

54 Test Mode Timeout

Alarm Type	Shutdown Alarm	TriPac EVOLUTION

How Alarm is Set

If the unit has been in the same Service Test Mode function for 15 minutes then Alarm Code 54 Test Mode Timeout is set as a Shutdown Alarm. This alarm is not set if the Service Test is terminated early.

NOTE: The “Run In Test” mode has a 10 hour time out.

How Alarm is Cleared

Exit the Service Test Mode. This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6.

Diagnostic Procedure

Clear the alarm and re-enter the test mode as necessary to complete the diagnosis or repair.

Section 5 – TriPac EVOLUTION Diagnostics

61 Low or High Battery Voltage

Alarm Type	Log/Shutdown Alarm (ALT group)	TriPac EVOLUTION

Associated Alarm Codes 25 Alternator Check

Circuit Description

Battery voltage is sensed at the SEN (J14 Pin A1) connection on the Interface Board.

Considerations

No other alarms will be set after Alarm Code 61 Low or High Battery Voltage is set.

How Alarm is Set

Log: Alarm Code 61 shall be set as a Log Alarm during the engine start sequence if:

- ✓ Battery voltage is less than 9.5 VDC during engine crank.
- ✓ Battery voltage is less than 9.5 VDC during engine preheat.

Shutdown: Alarm Code 61 shall be set as a Shutdown Alarm if:

- ✓ The battery voltage falls below 11.2 VDC for greater than 3 minutes with engine running.
- ✓ The battery voltage falls below 9.5 VDC during a second or third engine preheat.
- ✓ The battery voltage rises above 16 VDC for greater than 3 minutes with engine running.

How Alarm is Cleared

This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. Verify voltage at truck batteries during preheat and cranking.
2. If the voltage falls below alarm limit = Check truck battery condition. See Charging System Diagnosis.
3. If the voltage stays above alarm limit = Check for high resistance at main power cable connections.
4. Battery voltage over 16 VDC is generally caused by the truck alternator.

Section 5 – TriPac EVOLUTION Diagnostics

63 Engine Stopped

Alarm Type	Shutdown (ENG group)	TriPac EVOLUTION

Circuit Description

Run relay and 8D circuit were energized by the Base Controller at the time of engine shutdown.

Considerations

There is no system control reason for the engine to have stopped. Some other factor has shut the engine down.

How Alarm is Set

Alarm code 63 is set if engine speed is less than 100 RPM after the engine has undergone a successful start, so long as the run relay is energized and the engine is running. This indicates the engine has shut down after running without the unit control circuits directing it to do so. There may be no other Shutdown Alarms set.

How Alarm is Cleared

This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

The engine may have lost fuel supply. Check for:

- ✓ Plugged fuel pre-filter
- ✓ Plugged fuel primary filter
- ✓ Lost power to fuel pump or defective fuel pump
- ✓ Lost power to fuel solenoid or defective solenoid
- ✓ Fuel system air leak
- ✓ Fuel supply low

The engine may be mechanically locked up.

Section 5 – TriPac EVOLUTION Diagnostics

93 Check Low Pressure Cutout

Alarm Type	Log/Check Alarm	TriPac EVOLUTION

Component Description and Location

A Low Pressure Cutout (LPCO) switch is installed on the evaporator outlet tube. It measures air conditioning system low side (suction) pressure.

Circuit Description

The low pressure cutout circuit is a two wire circuit. The 7CLB circuit runs from the Interface Board (J2 Pin 3) to one side of the LPCO. The other side is connected to ground by the CH-08 circuit to the Interface Board (J2 Pin 6). When suction pressure is normal the LPCO is closed. The 7CLB circuit is grounded, supplying a near 0 VDC signal to the Base Controller. If suction pressure falls the switch will open, breaking the path to ground supplying a 12+ VDC signal to the Base Controller.

Considerations

This circuit protects the compressor from low refrigerant charge. It also prevents compressor operation when cab temperature is very low. Does not affect Fan or Heat modes.

How Alarm is Set

LPCO Switch: Open = 5 psig (34 kPa) Close = 20 psig (138 kPa)

Log: If the Base Controller senses the Low Pressure Cutout Switch is open the 7CL (J5 Pin 2) output circuit will be turned off and the compressor clutch will disengage. The Evaporator Fan will continue to run. The Base Controller will delay 60 seconds before checking the position of the Low Pressure Cutout Switch. If the Low Pressure Cutout Switch is closed the compressor will restart. If the Low Pressure Cutout Switch is still open a new 60 second delay will begin.

Check: When Alarm Code 93 Check Low Pressure Cutout has been logged three times within 60 minutes this alarm is set as a Check Alarm. The Yellow alarm icon will illuminate. Further air conditioning function is disabled.

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Section 5 – TriPac EVOLUTION Diagnostics

93 Check Low Pressure Cutout

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How Alarm is Cleared

This alarm can be cleared manually from the HMI. Turn the system Off then On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Section 6, A51A, Communication Using TK Monitor.

Resolve the condition that caused the alarm. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

Check the following:

- Check for low air conditioning system pressures.
- Verify correct refrigerant level.
- Note very low ambient and/or cab temperature.

Section 5 – TriPac EVOLUTION Diagnostics

155 Lost CAN Communication

Alarm Type	Check	TriPac EVOLUTION

Associated Alarm Codes None

Circuit Description

CAN communication signals are on the CANL, CANH and SHLD circuits in the HMI Control Panel harness that connects to the Interface Board J34 connector.

Considerations

System will continue to operate based on the last communicated settings.

How Alarm is Set

If CAN data or heartbeat signal from HMI Control Panel to the Interface Board is lost for more than two seconds Alarm Code 155 Lost CAN Communication is set as a Check Alarm. The alarm will automatically clear upon successful re-establishment of CAN communication.

How Alarm is Cleared

This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. Verify the HMI Control Panel harness is securely connected at the HMI and the J34 connector on the Interface Board.
2. Verify the HMI harness is not damaged.
3. Connect a known good HMI. Replace as required.
4. Replace the Interface Board.

Section 5 – TriPac EVOLUTION Diagnostics

254 Check Inlet Water Temperature Sensor (WT2)

Alarm Type	Check Alarm	TriPac EVOLUTION

Associated Alarm Codes Alarm Code 18 High Engine Coolant Temperature

Component Description and Location

This sensor is a thermistor style sensor that can be tested with an ohmmeter. It is not polarity sensitive. The sensor is located on the Pre-cooler coil of standard units or an adapter tube in the coolant inlet hose with Arctic option (if installed). This sensor provides information to control the Pre-cooler Fan and Arctic option.

Circuit Description

The Inlet Water Temperature Sensor (WT2) circuit is a two wire circuit. The WT2 (J6 Pin A1) and WT2_RTN (J6 Pin B1) wires connect to the Interface Board. The sensor wires are routed in the Main Harness to the APU.

Considerations

Closed loop cooling option will disable Alarm Code 254 Check Inlet Water Temperature Sensor. Sensors should be positioned to minimize the potential for moisture entry where the wires enter the sensor shell. Mount sensors with the barrel up and the wires down wherever possible.

How Alarm is Set

If the sensor reading is outside of the allowable limit of -58°F to 300°F (-50°C to 149°C) and does not return within 10 seconds then Alarm Code 254 Check Inlet Water Temperature Sensor (WT2) is set as a Check Alarm. Disable pre-cooler fan and Arctic option while alarm is active. Engine operation will continue as required.

How Alarm is Cleared

The alarm will automatically clear if the sensor reading returns to the normal range. This alarm can be cleared manually from the HMI Control Panel by turning the system Off then back On. All alarms can be viewed and cleared using the TK Monitor Alarm screen. See Service Procedure A51A Communication Using TK Monitor in Section 6. Failure to resolve the alarm condition will cause the alarm to reoccur.

Diagnostic Procedure

1. A high temperature reading indicates a shorted sensor or harness.
2. A low temperature reading indicates an open or high resistance in sensor or harness.
3. Check resistance of the WT2 circuit between WT2 (J6 Pin A1) and WT2_RTN (J6 Pin B1). See Service Procedure D01A Unit Temperature Sensor Test in Section 6.

LED INDICATORS

Interface Board

On LED

A green On LED will turn on and flash about once per second when the Base Controller recognizes the system is turned on at the HMI Control Panel. If the system experiences a non-standard shutdown, such as a loss of power, the green LED will fast blink for a few seconds. The fast blink rate indicates the system is rebooting.

Run LED

A second green LED will be on steady when the Run relay has been energized by the Base Controller and the relay contacts have closed.

HMI CONTROL PANEL DIAGNOSIS

HMI Control Panel dark and will not turn on.

This indicates a loss of power or ground to the HMI Control Panel. Refer to the connector maps in Section 2.

- ✓ Power = 2P at (HMI Pin 5) and Interface Board (J34 Pin 5).
- ✓ Ground = CH at (HMI Pin 8) and Interface Board (J34 Pin 8).
- ✓ Open F4 fuse on Interface Board.
- ✓ No voltage on 2 circuit to Interface Board J15 stud terminal.
- ✓ Defective HMI Control Panel.

HMI Control Panel Mode Icon Flashing.

If any of the HMI Control Panel Mode Indicators (Cool, Fan, Heat) are flashing it indicates that the HMI Control Panel is powered up but not communicating. The 2P and CH circuits are powered and complete from the Interface Board to the HMI Control Panel.

If the Interface Board ON LED does not flash and a HMI Control Panel Mode Icon is flashing:

- ✓ The On signal was not received by the Interface Board. The ON signal is 9.3 VDC and should drop to near 0 VDC when the On button is pressed. The ON wire is at (HMI Pin 4) and Interface Board (J34 Pin 4).

Section 5 – TriPac EVOLUTION Diagnostics

If the Interface Board ON LED is flashing once per second and a HMI Control Panel Mode Icon is flashing:

- ✓ The On signal has been received by the Interface Board from the HMI Control Panel.
- ✓ A CAN communication fault exists. Refer to Alarm Code 155, Lost CAN Communication, earlier in this section. Check the HMI harness connectors for secure connection. Check the HMI Harness for continuity. See Service Procedure H06A Checking Harness Continuity in Section 6.
- ✓ The HMI Control Panel may be defective.
- ✓ The Interface Board may be defective.

Section 5 – TriPac EVOLUTION Diagnostics

HMI Circuits

The HMI harness is connected to the Interface Board at J34. Refer to connector maps in Section 2.

- **ON:** This circuit from the HMI Control Panel (HMI Pin 4) to the Interface Board (J34 Pin 4) is used to enable the HVAC system. This is 9.3 VDC circuit. When the HMI On/Off button is pressed the ON circuit at the HMI Control Panel is grounded and pulled low signaling the Base Controller to activate HVAC or Display Mode.
- **OFF:** This circuit from the HMI Control Panel (HMI Pin 7) to the Interface Board (J34 Pin 7) is designed to shut down the system when activated. When the HMI On/Off button is pressed for three seconds the OFF circuit is pulled low indicating signaling the Base Controller to deactivate the HVAC modes and turn off.
- **2P:** This circuit from the HMI Control Panel (HMI Pin 5) to the Interface Board (J34 Pin 5) is the direct connection to the Interface Board power circuit. It is powered whenever voltage is available to the #2 screw terminal (J15) on the Interface Board. This is the voltage source for all HMI Control Panel functions and indicators.
- **8XP:** This circuit from the HMI Control Panel (HMI Pin 6) to the Interface Board (J34 Pin 6) is the feedback signal from the Interface Board ON relay contacts.
- **CH:** This circuit from the HMI Control Panel (HMI Pin 8) to the Interface Board (J34 Pin 8) is chassis ground for all HMI Control Panel circuits.

HMI CAN Bus Connections

Communications between the HMI Control Panel and the Base Controller on the Interface Board are carried via this CAN Bus. The CAN Bus sends and receives mode, fan speed, feedback, battery monitor information and alarm status.

- **CANL:** This circuit from the HMI Control Panel (HMI Pin 1) to the Interface Board (J34 Pin 1) is the CAN Bus CANL wire.
- **CANH:** This circuit from the HMI Control Panel (HMI Pin 2) to the Interface Board (J34 Pin 2) is the CAN Bus CANH wire.
- **SHLD:** This circuit from the HMI Control Panel (HMI Pin 3) to the Interface Board (J34 Pin 3) is the CAN Bus shield.

Section 5 – TriPac EVOLUTION Diagnostics

TEMPERATURE SENSORS

The system uses several temperature sensors to monitor and control the engine and air conditioning function. If these systems are not functioning as expected it is possible that one or more of the temperature sensors are not providing correct information to the Base Controller. A failed temperature sensor or circuit will generate an alarm. The sensor readings and alarms can be viewed with TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.

The system sensors are thermistor type that change resistance as the temperature changes. Resistance values can be measured using a high quality ohmmeter. The resistance value may be compared to a table to directly determine the represented temperature.

NOTE: The Cab Temperature Sensor is integral with the HMI Control Panel and cannot be individually tested. Readings are sent to the Base Controller via the CAN Bus. If the Cab Temperature Sensor is defective the HMI Control Panel must be replaced.

NOTE: Ambient Air Temperature and Evaporator Coil Temperature sensors are not used to control Heat Mode. A failed sensor will generate an alarm code but will not affect heater operation.

TK Monitor Sensor Values

When sensor readings are checked using TK Monitor the information shown below is available:

- ✓ An open sensor or circuit will display 1811°F.
- ✓ A shorted sensor or circuit will display dashes.
- ✓ Normal sensor resistance values can be found using the table in Service Procedure D01A Unit Temperature Sensor Test in Section 6.

Test Procedure

Use TK Monitor > Dash Board or TK Monitor > System Monitoring to view temperature readings. Use TK Monitor > Alarm to record and clear alarm codes.

- ✓ See Service Procedure A51A Communication Using TK Monitor in Section 6.
- ✓ See Service Procedure D01A Unit Temperature Sensor Test in Section 6.

Section 5 – TriPac EVOLUTION Diagnostics

AIR HEATER DIAGNOSTICS

Heater Connections

The air heater receives electrical power from the Interface Board via the RED wire from the J9 Interface Board connector. The BRN heater ground circuit is also connected to this plug. This heater power circuit is protected by the Interface Board 20A Fuse F90.

Information goes to and from the heater through the Interface Board J13 connector.

- ✓ The YEL wire (J13 Pin 2) provides a signal to turn the air heater on. The YEL wire is protected by the Interface Board 5A Fuse F14.
- ✓ The GRY/RED wire (J13 Pin 6) and BRN/WHT wire (J13 Pin 5) supply setpoint information to the heater.
- ✓ The RED wire (J13 Pin 1) provides a feedback signal that power is available to the heater. The RED wire is protected by the Heater Harness 5A Fuse F28.
- ✓ The remaining wires are for communication.

The microprocessor in the air heater monitors the functions and operations of the air heater. The air heater's microprocessor is also programmed to recognize air heater fault codes. The five most-recent fault codes are retained in the air heater's microprocessor memory. Older fault codes are deleted from memory as new alarm codes occur. Fault codes can be retrieved and read using the EDiTH Diagnostic Tool or Heater Diagnostic Unit.

Heater Does Not Ignite

Symptom	Corrective Action
Blower motor does not run.	1. Verify Heat mode is selected at HMI. 2. Check RED wire for power to heater control unit. 3. Check YEL wire for on signal to heater control unit. 4. Check system for alarms.
Blower motor runs approximately 20 seconds and shuts off.	Ensure that voltage at the control unit remains above 10 VDC during startup with the glow plug circuit energized.
Blower motor runs and fuel metering pump starts and then shuts down after two start attempts.	1. Check fuel lines and fuel filter. 2. Check fuel level. 3. Check for combustion air or exhaust tube blockage.
Blower motor runs, but fuel metering pump does not.	1. Check for electrical pulses at the fuel metering pump. 2. Check for gelled fuel. 3. Check for blocked fuel line.

Section 5 – TriPac EVOLUTION Diagnostics

Air Heater Ignition and Random Shutdown Problems

Symptom	Corrective Action
Heat shuts down at random.	1. Check metering pump fuel quantity using Service Procedure H30A. 2. Check for possible overheat condition. 3. Check YEL wire for intermittent control unit input voltage.
Heater smokes and carbons up.	1. Check for blocked exhaust pipe. 2. Check for blocked combustion air intake. 3. Check for exhaust entering combustion air intake pipe. 4. Check for short cycling – rapid on/off operation. 5. Check fuel system. 6. Check metering pump fuel quantity using Service Procedure H30A. 7. Check motor RPM.

Section 5 – TriPac EVOLUTION Diagnostics

Diagnosing TriPac Heater Units for Excessive White Smoke and/or Heater Alarm Code

52 – Safety Time Exceeded

IMPORTANT: If the heater is used regularly at high altitudes (above 5000 feet) a High Altitude Kit (P/N 80-0115) should be installed. Failure to use a high altitude kit at higher elevations may result in excessive white smoke, Alarm Code 52 and/or carbon buildup.

Symptom	Cause	Corrective Action
Excessive white smoke on startup and/or Heater Alarm Code 52 – Safety Time Exceeded	Dirty or poor quality fuel.	Be sure the diesel fuel used is clean and of good quality. The fuel must be appropriate for the climate in the region where the unit is used. Fuel that is more than 5% biodiesel should not be used.
	Excessive fuel in the burner combustion chamber.	Start and run the heater to determine if the white smoke clears. If it does the heater may be experiencing difficulty starting. Troubleshoot as required to determine the reason for difficult starts.
	Restricted intake or exhaust tubes.	Check the intake and exhaust tubes for any restrictions. Reduced air flow due to tube restrictions can result in an incorrect air to fuel ratio.
	Restricted fuel delivery system.	Check the fuel delivery system to be sure there are no damaged or restricted fuel lines or connections. Be sure the fuel pump is installed at least 15° to 35° from horizontal with the pump outlet port higher than the pump inlet port.
	Dirty or Plugged Glow Pin Screen.	Check the Glow Pin Screen for dirt or carbon and replace if necessary. Do not attempt to clean the Glow Pin Screen. Also check the small ventilation hole on the side of the chamber where the glow pin screen is mounted to make sure it is clear. Clean the glow pin screen chamber before installing the replacement screen. The glow pin screen should be replaced at least once a year. Check more often if dictated by local conditions.

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Symptom	Cause	Corrective Action
Excessive white smoke on startup and/or Heater Alarm Code 52 – Safety Time Exceeded	Dirty, Old or Damaged Glow Pin	Check the glow pin for damage to the ceramic tip and carbon build up on the tip. Check the glow pin wires. The glow pin should be inspected at least once a year while changing the glow pin screen. Check more often if dictated by local conditions.
	Incorrect fuel quantity supplied to burner/combustion chamber.	Perform a Fuel Quantity Test using Service Procedure H30A to be sure the correct volume of fuel is supplied to the burner/combustion chamber.
	Defective flame sensor.	Check the flame sensor resistance values Using Service Procedure D05A.

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Diagnosing TriPac Heater Units with a Dirty or Carboned Glow Pin, Glow Pin Screen or Burner/Combustion Chamber

Correcting a symptom (such as replacing a dirty or carboned burner) may result in a temporary fix but will seldom result in a permanent solution. The heater must be diagnosed to determine and correct the root cause of the carbon buildup and dirt problems. The Diagnostic Procedure below will help the technician determine and correct the root cause.

IMPORTANT: If the heater is used regularly at high altitudes (above 5000 feet) a High Altitude Kit (P/N 40-1027) should be installed. Failure to use a high altitude kit at higher elevations may result in excessive white smoke, Alarm Code 52 and/or carbon buildup.

IMPORTANT: Do not attempt to clean the glow pin screen.

IMPORTANT: Mechanically clean the burner/combustion chamber using a soft metal brush. Do not sand blast the burning chamber. A combustion chamber with severe carbon buildup should be replaced.

NOTE: The glow pin and glow pin screen should be inspected at least annually or as local conditions dictate. When Ultra Low Sulfur Diesel (ULSD) fuel is used the glow pin and glow pin screen may need to be inspected more often.

NOTE: If the glow pin and glow pin screen show excessive dirt or carbon buildup the burner/combustion chamber may also need to be checked for excessive carbon buildup.

NOTE: The exhaust outlet of the heater and the glow pin screen chamber may also provide an indication of excessive carbon buildup in the burner / combustion chamber.

NOTE: A burner/combustion chamber with slight carbon buildup should correct itself once the root cause of the problem is corrected and the heater is operating efficiently.

NOTE: When removing the burner/combustion chamber, the thermal insulator between the burner/combustion chamber and the heater body will likely be cracked into several pieces. This is normal and does not contribute to carbon buildup in the burner/combustion chamber. However, the thermal insulator must be replaced when the burner/combustion chamber and the heat exchanger are disassembled. For additional information see Thermo King Service Bulletin TT462 TriPac Air Heater Cracked Thermal Insulator.

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Symptom	Cause	Corrective Action
Excessive dirt or carbon buildup on the Glow Pin, Glow Pin Screen or the Burner/Combustion Chamber. This may result in excessive white smoke during operation.	Dirty or poor quality fuel.	Be sure the diesel fuel used is clean and of good quality. The fuel must be appropriate for the climate in the region where the unit is used. Fuel that is more than 5% biodiesel should not be used.
	If the heater is always running in high or low operating modes excessive carbon buildup may result.	If the heater is equipped with a Hella Control Unit, use the EDiTH Diagnostic Tool to examine the hours of operation in high and low mode. For additional information see Service Procedure H31A Air Heater Diagnostics using the EDiTH Diagnostic Tool.
	Restricted intake or exhaust tubes.	Check the intake and exhaust tubes for any restrictions. Reduced air flow due to tube restrictions can result in an incorrect air to fuel ratio.
	Restricted fuel delivery system.	Check the fuel delivery system to be sure there are no damaged or restricted fuel lines or connections. Be sure the fuel pump is installed at least 15° to 35° from horizontal with the pump outlet port higher than the pump inlet port.
	Incorrect fuel quantity supplied to burner/combustion chamber.	Perform a Fuel Quantity Test using Service Procedure H30A to be sure the correct volume of fuel is supplied to the burner/combustion chamber.

ESPAR AIR HEATER FAULT CODES

Fault Code: 0	<i>No Fault</i>
Fault Type	<i>Not a Fault</i>
Requirements	<i>Applies to all TriPac D2 and D4 Airtronic Heaters.</i>
Related Fault Codes	
How Fault Code is Set <i>When switching on the heater and the Fault Code 0 is shown as the AF or Actual Fault there is no Fault occurring with the heater at that time. When the F1 to F5 Memory Locations show 0 there are no stored fault codes in the memory of the ECU.</i> <i>The ability to retrieve the Fault Code 0 indicates that the Fault Code Retrieval System works.</i>	
How Fault Code is Cleared <i>Fault Code 0 indicates there is no fault so it cannot be cleared.</i> <i>To permanently delete any the fault codes that may be in the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Reported problem not related to the heater.	Verify that the reported problem is with the heater and not with another TriPac or vehicle system.
No Active Fault. <i>When the AF is 0 there is no Active Fault. A fault that happened previously will be stored in the memory and may be the reason a problem was reported.</i>	- Check for any previous Fault Codes in the ECU memory locations F1 to F5 and troubleshoot the heater according to the most recent fault code which is F1. - Check to make sure the heaters power supply is good. Sudden losses in power may not allow the heater to detect or record a fault code to the ECU Memory. Refer to Fault Code 11 for instructions on checking the power supply. - The only Fault Code that is not stored in the ECU Memory after it occurs is the F-9. This Fault Code can only be detected when it occurs. Refer to Fault Code 9 for further details.
Problem is Temperature Control Related. <i>The reported problem may be that the truck sleeper temperature is too hot or too cold. If the temperature set- point is out of tolerance or the control temperature sensor cannot detect the sleeper temperature accurately the heater may not regulate to the desired set-point. Unless the temperature set-point or control sensor is too far out of range a Fault Code will not be set.</i>	- Test the temperature set-point as outlined in F-62 to make sure it is accurate. - Test the Internal Temperature Sensor as outlined in F-96 to make sure it is accurate. - If the optional External Temperature Sensor is installed then test it as outlined in F-60 and F-61. - Make sure the Control Sensor, either the internal one or the optional external one is able to detect the sleeper temperature properly. You may need to modify the installation by installing a return air duct or relocate the location of the external temperature sensor if there is one. - Using EDiTH Diagnostics is the best way to check the set-point the ECU is receiving as well as the temperature the control sensor is detecting.

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Fault Code: 4	<i>Short circuit in electronic control unit fresh air output</i>
Fault Type	<i>Warning</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	
How Fault Code is Set <i>After switching on the heater the ECU has detected a short circuit between the wire going to Pin 16 of the Heater Harness connector and power or while the heater is in the Low Regulation Mode it has detected a short circuit to ground.</i> <i>When using EDiTH Diagnostics the Vehicle Blower Measured Value will be highlighted in Green when the heater is in Low Regulation Mode, this is normal since the fresh air output is only turned on in Low Regulation Mode.</i> <i>The fresh air output is not normally used in North America or when the heater is installed with a TriPac. The fresh air output could be used to activate a relay which in turn would activate an auxiliary fan or vehicle blower if this option were used.</i>	
How Fault Code is Cleared <i>The fault does not show up as an Actual Fault or AF so it does not need to be cleared in order for the heater to function.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Wire Connected to Pin 16 on the Harness Connector. <i>If this wire has a short circuit to or is connected to power or ground it will cause the fault.</i>	• If there is a wire connected to the Pin 16 of the Harness Connector check it for a short circuit to ground or power. • Find out why the wire is connected since it may be an error since this option is not used on the TriPac. Remove it if no reason for wire is found.
Short Circuit in ECU Harness or Connectors. <i>Damage to the ECU harness wires can cause them to short circuit.</i>	• Check the harness between the ECU and the Heater Connector for damage since this could cause a short circuit between the black/grey wire going to Pin 16 on the Heater Connector and power or ground in the ECU Harness. If it is not possible to repair the harness then the whole ECU will have to be replaced. • Check if there is any damage to the Heater Harness Connectors or terminals and repair or replace.
Short Circuit inside ECU. <i>It is not possible to check for this short circuit if it is inside the ECU.</i>	• After confirming there is nothing connected to Pin 16 of the Harness Connector and there is no short circuit in the ECU wires or connector, delete the fault codes and try running the heater again. • If the Fault Code 4 is set again then the short circuit is inside the ECU and it should be replaced. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 5	<i>Short circuit in electronic control unit car alarm output</i>
Fault Type	<i>Warning</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	
How Fault Code is Set <i>After switching on the heater the ECU has detected a short circuit between the wire going to Pin 15 of the Heater Harness connector and ground.</i> <i>When using EDiTH Diagnostics the Anti-theft alarm Measured Value will be highlighted in Green to indicate it is active, this is normal. If the short circuit exists the Measured Value will no longer be highlighted in Green.</i> <i>The car alarm output is not normally used in North America or when the heater is installed with a TriPac. The car alarm output could be used as a signal to deactivate a car alarm while the heater is running if the option was used. The ECU produces a signal voltage on Pin 16 of the Heater Harness Connector when the heater is on and no voltage when the heater is off.</i>	
How Fault Code is Cleared <i>The fault does not show up as an Actual Fault or AF so it does not need to be cleared in order for the heater to function.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Wire Connected to Pin 15 on the Harness Connector. <i>If this wire has a short circuit to or is connected to ground it will cause the fault.</i>	• If there is a wire connected to the Pin 15 of the Harness Connector check it for a short circuit to ground. • Find out why the wire is connected since it may be an error since this option is not used on the TriPac. Remove it if no reason for wire is found.
Short Circuit in ECU Harness or Connectors. <i>Damage to the ECU harness wires can cause them to short circuit.</i>	• Check the harness between the ECU and the Heater Connector for damage since this could cause a short circuit between the Pink wire going to Pin 15 on the Heater Connector and ground in the ECU Harness. If it is not possible to repair the harness then the whole ECU will have to be replaced. • Check if there is any damage to the Heater Harness Connectors or terminals and repair or replace.
Short Circuit inside ECU. <i>It is not possible to check for this short circuit if it is inside the ECU.</i>	• After confirming there is nothing connected to Pin 15 of the Harness Connector and there is no short circuit in the ECU wires or connector, delete the fault codes and try running the heater again. • If the Fault Code 5 is set again then the short circuit is inside the ECU and it should be replaced. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 6	<i>Inexplicable atmospheric altitude information</i>
Fault Type	<i>Warning</i>
Requirements	<i>Only High Altitude Compatible D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>High Altitude Sensor specific Fault Codes F-0, F-11, F12, F-13</i>
How Fault Code is Set <i>The Electronic Control Unit has not received any understandable information from the optional High Altitude Sensor.</i> <i>The optional High Altitude Sensor has a separate Fault Code Memory and Fault Code List. The High Altitude Sensor Fault Code List is available in the EDiTH Diagnostics Program Version S3V7-F and higher. Refer to Service Procedure H31A for instructions to download and install the latest version. When the EDiTH Program is opened, go to the Help tab and select Help Topics from the drop down, then under the Contents Tab select the + sign next to the EDiTH folder to open it. Within the EDiTH Folder there is a Folder named Air Pressure Sensor, select the Air Pressure Sensor Folder to open it and view the Fault Code List.</i> <i>Refer to Service Bulletin TT499 to identify high altitude sensor compatible Electronic Control Units.</i>	
How Fault Code is Cleared <i>The fault does not show up as an Actual Fault or AF so it does not need to be cleared in order for the heater to function.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Fault with High Altitude Sensor.	- Retrieve the Fault Codes from the High Altitude Sensor memory using the EDiTH Diagnostic Tool. A high altitude sensor adaptor (Espar Part Number 22 1000 33 3100) is required. - Correct the fault according to the instructions for the specific Fault Code retrieved from the High Altitude Sensor Memory. - Refer to Air Heater Diagnostics using the EDiTH Diagnostic Tool, Section 6, H31A.

Air pressure sensor fault code display

Fault code display	Fault description	Comments • Remedial action
0	No faults	—
11	Communication loss	Interruption of the diagnostics cable between the control box (heater) and the air pressure sensor • Check wiring and plug-in connections
12	No altitude adjustment	Control box (heater) does not support altitude operation with the air pressure sensor • Use a control box (heater) which supports altitude adjustment
13	Air pressure sensor fault	The air pressure sensor is defective • Replace the air pressure sensor

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Fault Code: 9	<i>ADR Shutdown</i>
Fault Type	<i>Warning with shut down</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	
How Fault Code is Set <i>The ADR function is not normally used in North America or with TriPacs unless it was specially modified. ADR is a European agreement on the international transport of dangerous on the road which the heater, installation and operation must comply with on vehicles that transport dangerous goods.</i> <i>If power is detected upon start up at the Pin 14 of the Heater Connector the heater will not start and will indicate an F-9. If the power to Pin 14 or short to power is detected after the heater is running it will immediately generate the F9 and then shut down with only a 40 Second Cool Down.</i> <i>If a power signal is detected at Pin 13 upon switching on the heater it will still start. If however this power signal is lost after having been applied the heater will generate the F-9 and then shut down with only a 40 second Cool Down.</i> <i>This does not necessarily indicate a true failure but is a warning that indicates the heater cannot start or was shut down by a signal. These signals are used to shut down the heater in certain applications where ADR regulations require it.</i> <i>The F-9 is not stored in the Memory of the ECU. It will only be detected if either a Diagnostic Retrieval Tool or EDiTH Diagnostics is connected when it occurs. When using EDiTH it is possible to view the signal inputs and operating status in more detail. Generator D+ highlighted indicates Pin 13 has power, Auxiliary Drive highlighted indicates Pin 14 has power.</i> <i>Refer to the Airtronic / Airtronic M – ADR Circuit Diagrams in the Airtronic / Airtronic M Troubleshooting and Repair Instructions published by Eberspaecher for more information. Document Number 25 2115 95 19 01 dated 04 2009.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the shut down may cause it to re-occur.</i> <i>The fault does not show up as an Actual Fault or AF and is not recorded in the Fault Code Memory so it does not need to be deleted from the Heater's Electronic Control Unit Memory.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Short Circuit in ECU Harness or Connectors. <i>Damage to the ECU harness wires can cause them to short circuit which could replicate the signal which would set this fault.</i>	• Check the harness between the ECU and the Heater Connector for damage since this could cause the Blue wire going to Pin 13 or the Blue/Black wire going to Pin 14 on the Heater Connector to short circuit to and power in the ECU Harness. If it is not possible to repair the harness then the whole ECU will have to be replaced. • Check if there is any damage to the Heater Harness Connectors or terminals and repair or replace.

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How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Pin 13 at the Harness Connector has a wire inserted and that signal changed from Positive to Off or was grounded. <i>The Pin 13 may be used as a mechanism to automatically shut the heater down quickly in areas such as a fuel transfer station where the Engine of a vehicle must also be shut off due to safety concerns.</i>	• If there is a wire inserted in Pin 13 of the Harness connector, remove it and test run the heater to find out if the signal that caused the F-9 was from this wire. • If there is a wire inserted at Pin 13 check what the wire is connected to. It may be connected to a Generator or Alternator on an Engine so that the heater receives a positive voltage signal to Pin 13 when the Engine is on. This would allow the Engine to start while the heater is on and the heater to start while the Engine is on but it will shut the heater off when the Engine is turned off after it was running. • If the wire going to Pin 13 is connected there for legitimate reasons do not remove it. The system may have been modified so the heater can only run at certain times due to safety concerns and this should not be deactivated if it was installed.
Pin 14 at the Harness Connector has a wire inserted and the signal was powered with a positive power signal. <i>The Pin 14 is used as a mechanism for shutting off the heater quickly when a positive voltage signal is provided at Pin 14.</i>	• If there is a wire inserted in Pin 14 of the Harness connector, remove it and test run the heater to find out if the signal that caused the F-9 was from this wire. • If there is a wire inserted at Pin 14 check what the wire is connected to. It may be connected to something that generates a positive voltage sign when it is turned on. This may be an emergency shut off switch or a fuel transfer pump on a Fuel Tanker Truck which should not have a heater running near it when the transfer pump is activated. • If the wire going to Pin 14 is connected there for legitimate reasons do not remove it. The system may have been modified so the heater cannot start and will shut off when the device it is connected to is activated. This could be for safety or emergency reasons and this should not be deactivated if it was installed.

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Fault Code: 10	<i>Overvoltage shut down</i>
Fault Type	<i>Warning with shut down.</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	
How Fault Code is Set <i>After switching on the heater the ECU has detected a voltage higher than 16 Volts DC between Pin 1 and Pin 10 of the Heater Harness connector for a minimum of 20 seconds. Maximum voltage applied to heater must be less than 16 Volts DC.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDITH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Overvoltage supplied to Heater.	• Disconnect the Heater Harness connector and check the voltage between Pin 1 (Power +) and Pin 10 (Ground -) at the Harness Connector. • TriPac APU system: Check while Engine/Alternator is running. If the Voltage is higher than 16 Volts then check the TriPac APU charging system including voltage regulators. • TriPac system: Check System Voltage at the fuse block inside the TriPac battery box while the HVAC system is set to heat. If the voltage is higher than 16 Volts then batteries are over charged. Check the Tractor charging system and voltage regulators.

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Fault Code: 11	<i>Under voltage shut down</i>
Fault Type	<i>Warning with shut down</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-91, F-98, F- 99</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected a voltage lower than 10.5 V between Pin 1 and Pin 10 of the Heater Harness connector for at least 20 seconds without interruption. Minimum voltage applied to heater has to be more than 10.5 V.</i> <i>During Start Up while the Glow Pin is on the lower voltage limit is 9.5 Volts to compensate for the high current the Glow Pin draws.</i> <i>It is possible to get a low voltage code if the Blower Motor is jammed when the heater is first turned on. If the Blower Motor is jammed the heater will attempt to turn it and draw a lot of power which can cause a voltage drop.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Low Battery Voltage <i>Make sure that the TriPac APU Engine/Alternator and tractor Engine/Alternator are turned off when checking for low voltage.</i>	• Disconnect the Heater Harness connector and check the voltage between Pin 1 (Power +) and Pin 10 (Ground -) on the Harness connector. This voltage must be more than 10.5 Volts. • If the voltage is below 10.5 Volts then check system voltage at the #2 terminal of the TriPac controller. If the system voltage is less than 10.5 Volts then test the batteries. Charge or replace the batteries as required. • If the voltage at the Harness Connector is less than at the TriPac Interface Board/controller then check all the connections and fuses from the Interface Board/controller to the Harness Connector for damage, corrosion or poor connection and repair or replace them.

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How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Voltage drop occurs between the Battery and the Heater ECU when under load. <i>When a load is applied to the power supply the voltage may drop if there is a poor connection or the battery is weak. The Airtronic uses up to 100 Watts when starting or about 8.3 Amps at 12 Volts.</i>	• If the Voltage at the Harness Connector and TriPac Interface Board/controller are the same and above 10.5 Volts then check the Power Supply between Pin 1 (Power +) and Pin 10 (Ground -) at the Harness Connector under a 10 amp load to see if the voltage drops below 9.5 Volts. • If the voltage drops below 9.5 Volts then measure the voltage at the system batteries. If the voltage does not drop at the system batteries then there is voltage drop in the circuit caused by high resistance between the batteries and the Harness Connector. Refer to Voltage Drop Test, Section 6, H24A. If battery voltage drops then test the batteries. Charge or replace the batteries as required. • If there is no Voltage drop up to the Harness Connector then check the ECU Harness and the Heater and Harness Connector and Terminals for damage or corrosion since that could cause a voltage drop. Make sure the Heater Harness Terminals are locked in and cannot be pushed back when the connector is closed. Repair if possible. If the ECU Harness is damaged and cannot be repaired the ECU must be replaced. • Perform a Function Test with the EDiTH Diagnostic Tool to check for a Voltage Drop in the complete Power Supply circuit while the Glow Pin is on when starting the heater. This is the only way to check the entire power supply circuit right up the ECU and to confirm the ECU is measuring the voltage properly. Refer to Air Heater Diagnostics using the EDiTH Diagnostic Tool, Section 6, H31A.

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Fault Code: 12	<i>Overheating at the Overheating Sensor</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-13, F14, F15</i>
How Fault Code is Set <i>Temperature at the overheating sensor is too high. The heater will generate the Fault Code 12 and Shut Down. The overheat sensor measures the Air Temperature just above the heater exchanger. The normal overheat limit at the overheating sensor is 120°C (248°F) for the D2 Airtronic and 150°C (302°F) for the D4 Airtronic. In the latest Model ECU the overheat limit can temporarily increase to avoid unnecessary overheats. Please refer to Thermo King Service Bulletin TT499 for details on the latest ECU. The increased overheat limits and the measured sensor values can be viewed by using EDiTH Diagnostics.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur. To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Restriction in Ducting. <i>When the air flow is restricted the air temperature above the heat exchanger can rise too high and can cause an overheat at the Overheat Sensor.</i> <i>When trying to recreate an overheat make sure that the layout and conditions of the sleeper are not altered too much from normal since changes in layout can affect the airflow.</i> <i>A restriction to air flow may be unknowingly removed and then the cause cannot be found.</i>	• Check the air inlet and outlet for blockage and make sure the ducting is not crushed. Remove any blockage and test run heater. • When the heater does not have a return air duct then make sure the under bunk area is not too tightly sealed when the bed is down. Install a return air duct or cut ventilation holes to make sure the heater has enough return air. • When the area under the bed is too tightly sealed and the heater does not get enough return air the overheating may be intermittent and it will not happen if the heater is tested with the bed raised. • When test running the heater to see if it will overheat you must make sure the bunk is down and the set-point is high and all the doors and windows are closed. • The overheat might only happen when the sleeper has reached a high temperature and then the heater cycles down. This is due to the fact that when the heater is cycling down and the air flow is decreasing the Overheat Sensor temperature temporarily rises. If the Overheat Sensor was already running at a temperature close to the limit then it may overheat as it cycles down.

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How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Air Flow restriction due to exceeding the ducting rating guide. <i>If the ducting rating guide is exceeded the heater could overheat even though there is no apparent blockage.</i>	• Add up the ratings for all the components of the ducting system to see if it goes over the heaters ducting limit. Refer to the Ducting Rating Guide in the Espar Product Catalogue for ducting ratings and component values. • Modify the ducting system so that it does not exceed the permissible ducting rating for the heater and test run the heater again to make sure it does not overheat.
Overheat Sensor out of tolerance. <i>If the Overheat Sensor is out of tolerance it may be reading a temperature that is higher than actual and trigger a false overheat.</i>	• Check the resistance value of the Overheat Sensor as outlined in Service Procedure D05A. • Use EDiTH Diagnostics to verify that the Overheat Sensor temperature is accurate. Refer to Service Procedure H31A. • When reading the Overheat Sensor temperature with EDiTH it is possible to see if the sensor is accurate by performing a Function Test when the heater is completely cooled off and there is no residual heat left since the sensor will then read the approximate room temperature.
Fuel Quantity is out of specification. <i>If the heater is running too lean it could overheat.</i>	• Perform Fuel Quantity Test as outlined in Service Procedure H30A.

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Fault Code: 13	<i>Overheating at the Flame Sensor</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-12, F14, F15</i>
How Fault Code is Set <i>Temperature at the flame sensor is too high. The heater will generate the Fault Code 13 and Shut Down. The Flame Sensor measures the surface temperature of the heat exchanger. The overheat limit at the flame sensor is 280°C (536°F) for the D2 Airtronic and 290°C (554°F) for the D4 Airtronic.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDITH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Restriction in Ducting. <i>When the air flow is restricted the temperature of the heat exchanger can rise too high and cause an overheat at the Flame Sensor.</i> <i>When trying to recreate an overheat make sure that the layout and conditions of the sleeper are not altered too much from normal since changes in layout can affect the airflow.</i> <i>A restriction to air flow may be unknowingly removed and then the cause cannot be found.</i>	• Check the air inlet and outlet for blockage and make sure the ducting is not crushed. Remove any blockage and test run heater. • When the heater does not have a return air duct then make sure the under bunk area is not too tightly sealed when the bed is down. Install a return air duct or cut ventilation holes to make sure the heater has enough return air. • When the area under the bed is too tightly sealed and the heater does not get enough return air the overheating may be intermittent and it will not happen if the heater is tested with the bed raised. • When test running the heater to see if it will overheat you must make sure the bunk is down and the set-point is high and all the doors and windows are closed. • The overheat might only happen when the sleeper has reached a high temperature and then the heater cycles down. This is due to the fact that when the heater is cycling down and the air flow is decreasing the Flame Sensor temperature temporarily rises. If the Flame Sensor was already running at a temperature close to the limit then it may overheat as it cycles down.

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How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Air Flow restriction due to exceeding the ducting rating guide. <i>If the ducting rating guide is exceeded the heater could overheat even though there is no apparent blockage.</i>	• Add up the ratings for all the components of the ducting system to see if it goes over the heaters ducting limit. Refer to the Ducting Rating Guide in the Espar Product Catalogue for ducting ratings and component values. • Modify the ducting system so that it does not exceed the permissible ducting rating for the heater and test run the heater again to make sure it does not overheat.
Flame Sensor out of tolerance or plugged in wrong. <i>If the Flame Sensor is out of tolerance it may be reading a temperature that is higher than actual and trigger a false overheat.</i> <i>If the Flame Sensor wires are reversed the Overheat Sensor has lost its proper ground and the ECU cannot read it properly anymore and the ECU will read that the Flame Sensor is hotter than it actually is which could trigger a Fault Code 13.</i>	• Check the green Flame Sensor Connector to make sure the green wire from the combination sensor is plugged into Terminal 1 in the green connector and that the brown wire is plugged into Terminal 2 in the green connector. The terminal numbers are on the connectors and inside the ECU socket. • Check to make sure the green flame sensor connector was not forced into the ECU the wrong way. The connector is keyed but if forced enough it can go in the wrong way. • Also make sure that the connector is plugged into the middle socket on the ECU between the Glow Pin and the Overheat Sensor. • Check the resistance value of the Flame Sensor as outlined in Service Procedure D05A. • Use EDiTH Diagnostics to verify that the Flame Sensor temperature is accurate. • When reading the Flame Sensor temperature with EDiTH it is possible to see if the sensor is accurate by performing a Function Test when the heater is completely cooled off and there is no residual heat left since the sensor will then read the approximate room temperature.
Overheat Sensor out of tolerance.	• Check the resistance value of the Overheat Sensor as outlined in Service Procedure D05A. • Use EDiTH Diagnostics to verify that the Overheat Sensor temperature is accurate. • When reading the Overheat Sensor temperature with EDiTH it is possible to see if the sensor is accurate by performing a Function Test when the heater is completely cooled off and there is no residual heat left since the sensor will then read the approximate room temperature.
Fuel Quantity is out of specification. <i>If the heater is running too lean it could overheat.</i>	• Perform Fuel Quantity Test as outlined in Service Procedure H30A.

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Fault Code: 14	<i>Delta T between Flame Sensor and Overheating Sensor too large</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-12, F13, F15</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected that the temperature difference between the flame sensor and overheating sensor is too large.</i> <i>This may indicate there is a problem with one of the sensors. This is another back up to make sure the heater could not overheat at either sensor and not detect it because a sensor did not work properly.</i> <i>If the temperature difference between the two sensors is more than 200°C (360°F) for the D2 Airtronic or 190°C (342°F) for the D4 Airtronic and either the Flame or Overheat Sensor is over 100°C (212°F) on a D2 Airtronic and over 20°C (68°F) on a D4 Airtronic the Fault Code 14 will be set.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Flame Sensor out of tolerance or plugged in wrong. <i>If the Flame Sensor is out of tolerance it may be reading a temperature that is lower or higher than actual.</i> <i>If the Flame Sensor wires are reversed the Overheat Sensor has lost its proper ground and the ECU cannot read it properly anymore and the ECU will read that the Flame Sensor is hotter than it actually is which could trigger a Fault Code 14.</i>	• Check the green Flame Sensor Connector to make sure the green wire from the combination sensor is plugged into Terminal 1 in the green connector and that the brown wire is plugged into Terminal 2 in the green connector. The terminal numbers are on the connectors and inside the ECU socket. • Check to make sure the green flame sensor connector was not forced into the ECU the wrong way. The connector is keyed but if forced enough it can go in the wrong way. • Also make sure that the connector is plugged into the middle socket on the ECU between the Glow Pin and the Overheat Sensor. • Check the resistance value of the Flame Sensor as outlined in Service Procedure D05A. • Use EDiTH Diagnostics to verify that the Flame Sensor temperature is accurate. • When reading the Flame Sensor temperature with EDiTH it is possible to see if the sensor is accurate by performing a Function Test when the heater is completely cooled off and there is no residual heat left since the sensor will then read the approximate room temperature.

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How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Overheat Sensor out of tolerance. <i>If the Overheat Sensor is out of tolerance it may be reading a temperature that is lower or higher than actual.</i>	• Check the resistance value of the Overheat Sensor as outlined in Service Procedure D05A. • Use EDiTH Diagnostics to verify that the Overheat Sensor temperature is accurate. • When reading the Overheat Sensor temperature with EDiTH it is possible to see if the sensor is accurate by performing a Function Test when the heater is completely cooled off and there is no residual heat left since the sensor will then read the approximate room temperature.
Restriction in Ducting. <i>When the air flow is restricted the air temperature above the heat exchanger can rise too high and can cause an overheat at the Flame Sensor.</i> <i>When trying to recreate an overheat make sure that the layout and conditions of the sleeper are not altered too much from normal since changes in layout can affect the airflow.</i> <i>A restriction to air flow may be unknowingly removed and then the cause cannot be found.</i>	• Check the air inlet and outlet for blockage and make sure the ducting is not crushed. Remove any blockage and test run heater. • When the heater does not have a return air duct then make sure the under bunk area is not too tightly sealed when the bed is down. Install a return air duct or cut ventilation holes to make sure the heater has enough return air. • When the area under the bed is too tightly sealed and the heater does not get enough return air the overheating may be intermittent and it will not happen if the heater is tested with the bed raised. • When test running the heater to see if it will overheat you must make sure the bunk is down and the set-point is high and all the doors and windows are closed. • The overheat might only happen when the sleeper has reached a high temperature and then the heater cycles down. This is due to the fact that when the heater is cycling down and the air flow is decreasing the Flame Sensor and Overheat Sensor temperatures temporarily rise. If the Flame Sensor was already running at a temperature close to the limit then it may overheat as it cycles down.
Air Flow restriction due to exceeding the ducting rating guide. <i>If the ducting rating guide is exceeded the heater could overheat even though there is no apparent blockage.</i>	• Add up the ratings for all the components of the ducting system to see if it goes over the heaters ducting limit. Refer to the Ducting Rating Guide in the Espar Product Catalogue for ducting ratings and component values. • Modify the ducting system so that it does not exceed the permissible ducting rating for the heater and test run the heater again to make sure it does not overheat.
Fuel Quantity is out of specification. <i>If the heater is running too lean it could overheat.</i>	• Perform Fuel Quantity Test as outlined in Service Procedure H30A.

Section 5 – TriPac EVOLUTION Diagnostics

Fault Code: 15	<i>Electronic Control Unit locked</i>
Fault Type	<i>Operating Lockout</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-12, F-13, F-14, F-17, F-74</i>
How Fault Code is Set <i>This fault code can be set in one of two ways.</i> <i>The first possible reason the Fault Code 15 may be set is if the heater has overheated too many times in a row. This could include all the overheat Fault Codes 12, 13 and 14.</i> <i>For the older style Wehrle ECUs the maximum number of overheats allowed consecutively is 10 and for the new style Hella ECUs it is 255.</i> <i>Please refer to the Service Bulletin TT 461-1 to identify the difference between the older Wehrle and newer Hella ECUs.</i> <i>The second possible reason the Fault Code 15 may be set is if the Heater was switched back on after the Fault Code 17 was set.</i>	
How Fault Code is Cleared <i>It is not possible to clear this fault code by turning the heater on and then back on again or by disconnecting the power.</i> <i>The Operating Lockout can only be cleared by permanently deleting the fault code from the Heater's Electronic Control Unit memory by using the EDiTH Diagnostic Tool or the Heater Diagnostic Unit. Refer to Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Too many consecutive overheats.	- Check if there are any overheat fault codes including F-12, F-13 and F-14 in the ECU memory prior to the F-15. - If there are other Fault Codes then diagnose and correct the root cause of the overheat by referring to the most recent overheat fault code first.
Failed Flame or Overheat Sensor.	If there is a Fault Code 17 in the ECU memory then check the Overheat and Flame Sensor resistance using Service Procedure D05A.
Failed ECU	- If there is a Fault Code 17 in the ECU memory and the Overheat and Flame Sensor resistance values are in tolerance then replace the ECU. Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 17	<i>Overheating</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters.</i>
Related Fault Codes	<i>F-15, F-74</i>
How Fault Code is Set <i>This fault code is set because the hardware threshold value (180° C or 356°F) of the overheating sensor has been exceeded because the ECU Failed to detect the Fault Code 12 (Overheating at the Overheating Sensor) or Fault Code 13 (Overheating at the Flame Sensor). If the heater is switched on again after the Fault Code 17 was set it will set the Fault Code 15.</i>	
How Fault Code is Cleared <i>It is not possible to clear this fault code by turning the heater on and then back on again or by disconnecting the power. The Operating Lockout can only be cleared by permanently deleting the fault code from the Heater's Electronic Control Unit memory by using the EDiTH Diagnostic Tool or the Heater Diagnostic Unit. Refer to Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed Flame or Overheat Sensor.	• If there is a Fault Code 17 in the ECU memory then check the Overheat and Flame Sensor resistance using TriPac Service Procedure D05A.
Failed ECU	• If there is a Fault Code 17 in the ECU memory and the Overheat and Flame Sensor resistance values are in tolerance then replace the ECU. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 18	<i>Starting energy of the glow pin is too low</i>
Fault Type	<i>Error</i>
Requirements	<i>Only High Altitude Compatible D2 and D4 Airtronic ECUs.</i>
Related Fault Codes	<i>F-19, F-52, F-57</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected a low starting energy at the glow pin. The current draw of the glow pin is checked in preheat mode before the start of the fuel supply. If the glow pin current is found to be insufficient the ECU will increase the preheat time of the glow pin by 20 seconds. If the glow pin current is still found insufficient after the extended preheat the start sequence will be repeated. If the glow pin current is still insufficient the fault code 18 will be set. This will help prevent fuel delivery / flooding if there is little chance of ignition due to a weak glow pin. Refer to Service Bulletin TT499 to identify a high altitude compatible Electronic Control Unit.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur. To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Glow Pin Resistance too High.	- Check the resistance value of the Glow Pin at the black 2 pin connector when the glow pin is at a room temperature of 20°C or (68°F). - The resistance must be between 0.42Ω and 0.7 Ω at 20°C or (68°F). If the resistance value is out of range, replace the glow pin
Damaged Glow Pin Harness or connections.	- Check the glow pin harness for damage such as being pinched or missing insulation and for fraying at the glow pin connection points. Replace Glow Pin if damaged. - Check the black 2 pin connector and terminals on the Glow Pin for damage. Make sure the terminals are locked in the connector and cannot be pushed back. Replace the Glow Pin if damaged. - Check the terminals in the ECU where the Glow Pin plugs in to see if they are bent or corroded. Clean or straighten if possible.
Low Power Supply Voltage.	Check the Voltage as outlined in Fault Code 11.
Failed ECU.	- Replace the Glow Pin and test run the heater to see if the Fault Code happens again. If it does then replace the ECU and test run the heater with the old Glow Pin to make sure it works. Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 19	<i>Ignition Energy too Low</i>
Fault Type	<i>Error</i>
Requirements	<i>All Hella Type D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-18, F-52, F-57</i>
How Fault Code is Set <i>If the heater fails to ignite the flame during the start phase the ECU will check the Glow Pin Power Consumption. If the Power Consumption is too low, the heater will set a Fault Code 19.</i> <i>If the Glow Pin Power Consumption is at a sufficient level then the Heater will Generate a Fault Code 52 instead. The Fault Code 19 indicates that the most likely reason the heater could not start was the Glow Pin.</i> Note: <i>On some early Hella type ECUs when the Fault Code 19 was set that it was due to incorrect software and not a failed Glow Pin. The Week and Year of production are shown in a small box on the Silver ECU Part Label. The Week is at the top of the box and the year at the bottom. When 24 is in the top of the box and 05 is in the bottom of the box it indicates Week 24 Year 2005. Any Hella ECU up to Week 24 2005 which sets a Fault Code 19 the ECU must be replaced and not the Glow Pin. When the Hella ECU has a week after 24 and year after 2005 the Glow Pin is the problem.</i> <i>Refer to TriPac Service Procedure H31A to identify a Hella and Wehrle ECU.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Glow Pin Resistance too High.	- Check the resistance value of the Glow Pin at the black 2 pin connector when the glow pin is at a room temperature of 20°C or (68°F). - The resistance must be between 0.42Ω and 0.7 Ω at 20°C or (68°F). If the resistance value is out of range, replace the glow pin
Damaged Glow Pin Harness or connections.	- Check the glow pin harness for damage such as being pinched or missing insulation and for fraying at the glow pin connection points. Replace Glow Pin if damaged. - Check the black 2 pin connector and terminals on the Glow Pin for damage. Make sure the terminals are locked in the connector and cannot be pushed back. Replace the Glow Pin if damaged. - Check the terminals in the ECU where the Glow Pin plugs in to see if they are bent or corroded. Clean or straighten if possible.
Failed ECU. <i>Refer to Note in the How Fault Code is Set section above to see if you have an older ECU where it is known to be faulty when it gets this Fault Code.</i>	- Replace the Glow Pin and test run the heater to see if the Fault Code happens again. If it does then replace the ECU and test run the heater with the old Glow Pin to make sure it works. Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 20	<i>Glow Pin Interruption</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-18, F-19, F-21, F-22</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected that the Glow Pin circuit is open or that the resistance in the circuit is too high.</i> <i>On Heaters with the older Wehrle Style ECUs the Fault Code 20 will be generated if the Glow Pin output has a short circuit to Power (+). With a New Style Hella this would generate a Fault Code 22. Refer to Service Bulletin 461-1 to identify the difference between an older Wehrle ECU and the new Hella ECU.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDITH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Glow Pin circuit is open.	- Check to make sure the Glow Pin is plugged all the way into the ECU. - Check the Glow Pin for Continuity at the black 2 Pin connector and replace the Glow Pin if it is open.
Glow Pin Resistance too High.	- Check the resistance value of the Glow Pin at the black 2 pin connector when the glow pin is at a room temperature of 20°C or (68°F). - The resistance must be between 0.42Ω and 0.7 Ω at 20°C or (68°F). If the resistance value is out of range, replace the glow pin
Damaged Glow Pin Harness or connections.	- Check the glow pin harness for damage such as being pinched or missing insulation and for fraying at the glow pin connection points. Replace Glow Pin if damaged. - Check the black 2 pin connector and terminals on the Glow Pin for damage. Make sure the terminals are locked in the connector and cannot be pushed back. Replace the Glow Pin if damaged. - Check the terminals in the ECU where the Glow Pin plugs in to see if they are bent or corroded. Clean or straighten if possible.
Glow Pin output has a short circuit to Power. <i>Only on Heaters with older Wehrle Type ECUs. Refer to TriPac Service Procedure H31A to identify Wehrle ECU.</i>	- When the Heater has a Wehrle ECU it is possible that this fault code can be caused by a short circuit between the FMP Output which is the white wire on the Glow Pin and a power source. - Refer to the How Fault Code is Set section above. - Refer to Fault Code 22 for instruction on diagnosis and repair if the heater has a Wehrle ECU.
Failed ECU.	- Complete all previous checks to make sure the problem is not external of the ECU. - Also complete all steps in F-22 if it is a Wehrle ECU. - Replace the Glow Pin and test run the heater to see if the Fault Code happens again. If it does then replace the ECU and test run the heater with the old Glow Pin to make sure it works. Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 21	<i>Glow Pin Overload or Short Circuit to Ground</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-18, F-19, F-20, F-22</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected a short circuit between the Glow Pin output and ground or the Glow Pin resistance is too low.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Glow Pin output has short circuit to ground.	• Check the glow pin harness for damage such as being pinched or missing insulation and for fraying at the glow pin connection points. This could cause a short circuit between the white Glow Pin output and a ground. • Check the black 2 pin connector and terminals on the Glow Pin for damage. Make sure the terminals are locked in the connector and cannot be pushed back. Replace the Glow Pin if damaged. • Check the terminals in the ECU where the Glow Pin plugs in to see if they are bent or corroded. Clean or straighten if possible.
Glow Pin Resistance too Low.	• Check the resistance value of the Glow Pin at the black 2 pin connector when the glow pin is at a room temperature of 20°C or (68°F). • The resistance must be between 0.42Ω and 0.7 Ω at 20°C or (68°F). If the resistance value is out of range, replace the glow pin
Failed ECU.	• Replace the Glow Pin and test run the heater to see if the Fault Code happens again. If it does then replace the ECU and test run the heater with the old Glow Pin to make sure it works. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 22	<i>Glow Pin Output Short Circuit to Power (+)</i>
Fault Type	<i>Error</i>
Requirements	<i>All Hella Type D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-18, F-19, F-20, F-21</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected a short circuit between the Glow Pin output and Power (+). When the heater has an older Wehrle style ECU the Fault Code 20 will be generated if the Glow Pin output lead has a short to Power (+). Refer to TriPac Service Procedure H31A to indentify the Wehrle and Hella ECUs.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur. To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDITH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Glow Pin output has short circuit to power.	• Check the glow pin harness for damage such as being pinched or missing insulation and for fraying at the glow pin connection points. This could cause a short circuit between the white Glow Pin output and a Power source. • Make sure the Glow Pin Harness is routed correctly so it cannot short circuit to Power.
Failed ECU.	• Replace the Glow Pin and test run the heater to see if the Fault Code happens again. If it does then replace the ECU and test run the heater with the old Glow Pin to make sure it works. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 31	<i>Blower Motor Open Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-32, F-33, F-34</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected that the Blower Motor circuit is open or that the resistance in the circuit is too high.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Blower Motor circuit is open.	• Check the blower motor cable harness for correct routing and damage. • If acceptable disconnect the cable harness from the control unit and check the harness for continuity.
Failed ECU.	• If test results above are acceptable replace the ECU. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 32	<i>Blower Motor Short Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-31, F-33, F-34</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected that the Blower Motor circuit has a short circuit.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Blower Motor circuit has a short circuit.	Check the blower motor wiring for a short circuit.
Failed ECU or Blower Motor.	- Check the functions of the blower motor. Disconnect the connector from the control unit. Apply DC voltage as shown below and measure the motor current flow after 40 seconds. Caution! The power source used must be capable of delivering at least 20 Amps minimum. For 12 volt applications, check functions with maximum 10 ± 0.1 VDC. For 24 volt applications, check functions with maximum 18 ± 0.1 VDC for the D2 Airtronic and 18.5 ± 0.1 VDC for the D4 Airtronic. Caution! If the above voltage values are exceeded the component will be destroyed. - If the current is less than 6.5 amps the blower motor is acceptable, replace the ECU. - If the current is more than 6.5 amps, replace the blower motor. Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 33	<i>Blower Motor Does Not Turn</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-31, F-32, F-34</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected that the blower motor speed has varied from specification by more than 10% for longer than 30 seconds. This can be checked using a non-contact RPM counter. Refer to the heater manual for correct RPM values for each control stage.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDITH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Blower Motor circuit has a short or open circuit.	Check the blower motor wiring for a short circuit, open circuit, or damage.
Restrictions prevent free running of the motor Blower.	If the motor speed is too low: Check for restrictions that prevent free running of the motor such as a warped case caused by something pressing on the heater housing or an over-tightened intake duct clamp. If interference is found, correct and function test the heater.
Damaged or missing magnetic insert on blower wheel.	If the motor speed is too high: Check for a damaged or missing magnetic insert on blower wheel. Replace the blower motor if the magnetic insert is missing or damaged.
Failed Blower Motor or ECU.	- Manually Test Motor Speed: First make sure the motor is free spinning and the fan is not rubbing against housing. Apply 10 ± 0.1 VDC to the motor. Measure motor speed in rpms with a non-contact rpm counter. Motor speed should be 5000 rpms $\pm$ 1250 rpms for the D2 Airtronic and 4400 rpms $\pm$ 1100 rpms for the D4Airtronic. Caution! The power source used must be capable of delivering at least 20 Amps minimum. For 12 volt applications, check functions with maximum 10 ± 0.1 VDC. For 24 volt applications, check functions with maximum 18 ± 0.1 VDC for the D2 Airtronic and 18.5 ± 0.1 VDC for the D4 Airtronic. Caution! If the above voltage values are exceeded the component will be destroyed. - If the motor speed is incorrect then replace the blower motor. - If motor speed is correct then replace the control unit. Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 34	<i>Blower Motor Output Short Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-31, F-32, F-33</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected that the Blower Motor output circuit has a short circuit.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Blower Motor output circuit has a short circuit.	• Check the blower motor harness for correct routing and damage. • If acceptable disconnect the cable harness from the ECU and check the harness for continuity.
Failed ECU.	• If test results above are acceptable replace the ECU. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 47	<i>Fuel Metering Pump Overload or Short Circuit to Ground</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-48, F-49</i>
How Fault Code is Set <i>A short circuit to ground has been detected in the Fuel Metering Pump or between the green / red cable at Pin 5 at the Heater Harness Connector and ground.</i> <i>The short circuit will not be detected by the ECU until the Fuel Metering Pump is supposed to start. Normally the Fuel Metering Pump will start about a minute after the heater is turned on unless the heater is performing a pre-cool or it was just turned off and is still performing a shut down phase.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDITH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Short Circuit in the Fuel Metering Pump.	• Disconnect the connector at the Fuel Metering Pump and turn the heater on again. • If the Fault Code 48 is shown then the short circuit is in the fuel metering pump and it must be replaced. • If the Fault Code 47 is displayed when the fuel metering pump is disconnected then the short is not in the metering pump.
Short Circuit in the Fuel Metering Pump Harness. <i>Since this harness is exposed it is could be damaged more easily and have a short circuit.</i>	• Disconnect the Heater Harness Connector at the heater and check the green / red wire from Pin 5 at the Harness Connector up to the fuel metering pump for a short circuit to ground at Pin 10 on the Harness connector. • Check green / red wire between Pin 5 at the Harness Connector and Fuel Metering Pump for short to chassis ground. • Repair the short circuit to ground.
Short Circuit in ECU Harness between Heater Connector and ECU.	• Check the ECU Harness for damage which may have caused a short circuit between the green red cable at Pin 5 and the Ground at Pin 10 or chassis ground. • If the ECU harness is damaged and cannot be repaired the ECU must be replaced.
Short Circuit in ECU.	• Complete all previous steps to make sure the short circuit is not external of the ECU. • Test run the heater with new ECU to make sure the F47 does not appear again. Make sure to run it until the fuel metering pump starts since the fault is not detected until the pump starts. • If the F47 does not appear again after testing until the Fuel Metering Pump is running the short circuit was in the ECU and it must be replaced. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 48	<i>Fuel Metering Pump Interruption</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters.</i>
Related Fault Codes	<i>F-47, F-49</i>
How Fault Code is Set <i>An interruption has been detected in either the Fuel Metering Pump or between the green / red cable at Pin 5 at the Heater Harness Connector and ground at Pin 10 on the Heater Harness Connector.</i> <i>This fault could be due to an open circuit or too high of a resistance in the fuel metering pump circuit.</i> <i>This fault will normally be detected when the heater is first turned on and then the heater will not try to start and set the Fault Code 48.</i> <i>With a heater with an older style Wehrle ECU this fault can also be caused by a short circuit between the Fuel Metering Pump output at Pin 5 on the Heater Harness Connector and Power (+). Refer TriPac Service Procedure H31A to identify Wehrle ECU.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Open Circuit or too high of a resistance in the Fuel Metering Pump. <i>The FMP Connector is exposed and therefore can be damaged or corroded which can cause an open circuit or high resistance due to poor contact. Make sure the weather seals at the FMP are installed properly to protect against moisture.</i>	• Make sure the FMP Connector is securely plugged into the FMP and locked on with the metal clip for that connector. If loose, then repair and reconnect and then run the heater again. • Remove the connector from the Fuel Metering Pump and measure the resistance value of the Fuel Metering Pump. The resistance should be $9.5\Omega \pm 0.50\Omega$. Make sure the Terminals in the FMP are clean and not corroded. • Check the FMP Connector and Terminals to see if they are loose, damaged or corroded. Make sure the terminals are locked in place so they do not get pushed back when connected. Replace the Terminals and weather seals if the connector is corroded or damaged.
Open Circuit or too high of a resistance in the Fuel Metering Pump Harness.	• Reconnect the FMP before this check. • Disconnect the Heater Harness Connector at the heater and measure the resistance value of the FMP Circuit between the Pin 5 and Pin 10 at the Harness Connector. The resistance should be the same as it was at the Fuel Metering Pump in the previous check or there is an open circuit in the FMP harness and it must be repaired. • Make sure the Terminals at Pin 5 and Pin 10 on the Harness Connector are locked in and cannot be pushed back when the connector is locked closed.

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How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Open Circuit in ECU Harness between Heater Connector and ECU.	• Check the Heater Harness Connector for damage and corrosion and make sure the Pin 5 and Pin 10 as well as the other pins are locked in and cannot be pushed back when the Heater Harness Connector is locked closed. • Check the ECU Harness for damage which may have caused an open circuit in the green / red wire between the Heater Connector and the ECU. • If the ECU harness is damaged and cannot be repaired the ECU must be replaced.
FMP output has a short circuit to Power. <i>Only on Heaters with older Wehrle Type ECUs. Refer to TriPac Service Procedure H31A to identify Wehrle. ECU.</i>	• When the Heater has a Wehrle ECU it is possible that this fault code can be caused by a short circuit between the FMP Output which is the green / red wire from Pin 5 at the Harness connector and a power source. • Refer to the How Fault Code is Set section above. • Refer to Fault Code 49 for instruction on diagnosis and repair if the Heater has a Wehrle ECU.
Failed ECU.	• Complete all previous steps to make sure the open circuit is not external of the ECU. • Also complete all steps in F-49 if it is a Wehrle ECU. • Test run the heater with new ECU to make sure the F-48 does not appear again. Make sure to run it until the Fuel Metering Pump starts since the F-49 or F-47 may not be detected until the pump starts. • If no Fault Code appears again after testing until the Fuel Metering Pump is running the open circuit was in the ECU and it must be replaced. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 49	<i>Fuel Metering Pump Output Short Circuit to Power (+)</i>
Fault Type	<i>Error</i>
Requirements	<i>All Hella Type D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-47, F-48</i>
How Fault Code is Set <i>After switching on the heater the ECU has detected a short circuit to Power (+) in the glow pin output lead. The Fuel Metering Pump output is Green with a Red Stripe and comes from the ECU to the Pin 5 on the Heater Harness connector and then goes to the fuel metering pump. Refer to TriPac Service Procedure H31A to indentify the Hella ECU.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur. To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Fuel Metering Pump output short circuit to Power in the Fuel Pump Harness.	• Check the Fuel Metering Pump harness for any signs of damage and that it is routed properly from the heater to the FMP. • Make sure that the FMP Harness is not shorted to any power source.
Fuel Metering Pump output short circuit to Power in the ECU Harness.	• Check the ECU Harness for damage which may have caused a short circuit from the green / red wire at Pin 5 to power at Pin 1 at the Heater Connector. • If the ECU harness is damaged and cannot be repaired the ECU must be replaced.
Failed ECU.	• Complete all previous steps to make sure the short circuit is not external of the ECU. • Test run the heater with new ECU to make sure the F-49 does not appear again. Make sure to run it until the Fuel Metering Pump starts since the F-49 may not be detected until the pump starts. • If the Fault Code 49 does not appear again after testing until the Fuel Metering Pump is running the short circuit was in the ECU and it must be replaced. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 50	<i>Electronic Control Unit Locked</i>
Fault Type	<i>Operating Lockout</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-52</i>
How Fault Code is Set <i>This fault code is set if the heater had too many consecutive failed start attempts. For the older style Wehrle ECUs the maximum number of failed start attempts allowed consecutively is 10 and for the new style Hella ECUs it is 255. Refer to the TriPac Service Procedure H31A to identify the difference between the older Wehrle and newer Hella ECUs.</i>	
How Fault Code is Cleared <i>It is not possible to clear this fault code by turning the heater on and then back on again or by disconnecting the power. The Operating Lockout can only be cleared by permanently deleting the fault code from the Heater's Electronic Control Unit memory by using the EDiTH Diagnostic Tool or the Heater Diagnostic Unit. Refer to Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Too many failed start attempts.	• Unlock the ECU by permanently deleting the fault codes and try starting the heater. • If the heater does not start, troubleshoot and repair according to the most recent fault code.

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Fault Code: 51	<i>Flame detected when switching on</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-13, F-64, F-65</i>
How Fault Code is Set <i>If, after being switched on the flame sensor indicates a temperature above 70°C (158°F) on a D2 Airtronic and 60°C (140°F) on a D4 Airtronic the heater will run the blower motor to cool the heat exchanger down. If the flame sensor temperature reading does not fall below 70°C (158°F) on a D2 Airtronic and 60°C (140°F) on a D4 Airtronic after about 15 minutes the heater will set a Fault Code 51 and shut down.</i> <i>It is normal for the heater to pre-cool the heat exchanger when it is turned on if it is too hot which may be the case if the heater was turned on shortly after it was running. After the heater exchanger cools down the heater will perform it normal start up. This could be a reason why the heater start up is delayed in some cases.</i> <i>This fault is most likely due to a failed or damaged flame sensor or wires or a poor connection.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Flame Sensor Resistance too High <i>A poor or damaged connection could cause an increase in the Flame Sensor circuit resistance. A higher resistance of the flame sensor would indicate the temperature is higher and the heater would try to cool it down before starting.</i>	• Check to make sure the Flame Sensor is plugged all the way into the ECU. • Check the flame sensor harness, connector and terminals for any damage or corrosion. Make sure the terminals are locked in the connector and cannot be pushed back. • Check the resistance value of the flame sensor as outlined in Service Procedure D05A. If the resistance is over approximately 1274 Ω when on a D2 (1232 Ω on a D4) when the sensor is at room temperature it is the reason for the fault code and must be replaced. • When possible use EDiTH Diagnostics to view the Temperature that the Flame Sensor is reading when the heater is started to see if it stays above 70°C (158°F) on a D2 Airtronic and 60°C (140°F) on a D4 Airtronic even when it has cooled down.
Failed ECU	• Test the heater with a new Flame Sensor to see if the Fault Code happens again. If it does then reinstall the old sensor. It can take over 15 minutes to set this fault since the heater attempts to cool off for about 15 minutes before the Fault Code is set. • Replace the ECU and run it with the old Flame Sensor to confirm the fault does not happen again. Make sure when test running the heater that the Fuel Metering Pump Starts and the Flame Starts and that the heater is not just doing another pre-cool since it may appear the heater is working when the fan is running. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 52	<i>Safety Time Exceeded</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-18, F-19, F-50, F-57</i>
How Fault Code is Set <i>No flame was detected during the heater start up phase.</i> <i>The heater is allowed two start attempts to ignite while delivering fuel. The Airtronic D2 has two 90 second start attempts. The Airtronic D4s first start attempt is 105 or 110 seconds while the second is about 70 seconds. If no flame is detected during the first start attempt the heater will automatically do a second start attempt after a short preheat. If a flame is not detected in the second start attempt, the heater will shut off the Fuel Metering Pump and set a Fault Code 52. The glow pin will continue to be on for a short period and the blower motor will also stay on for about 4 minutes to cool the heater off.</i> <i>The heater detects a flame with the flame sensor that is mounted on top of the heat exchanger. During the start up attempt the flame sensor must detect a 4 °C (7.2°F) rise in the temperature of the heat exchanger within 10 seconds to recognize that a flame has started.</i> <i>For the D4 Airtronic the first start attempt times are dependent on which type of ECU it has. For the Wehrle ECU the first start attempt is about 110 Seconds and for the Hella ECU the first start attempt is about 105 seconds. Refer to TriPac Service Procedure H31A to identify the Hella and Wehrle ECUs.</i> <i>On Heaters with a Hella Electronic Control Unit a Fault Code 19 could be set instead of a Fault Code 52 when the heater does not detect a flame during the start phase. Refer to TriPac Service Procedure H31A to identify the Hella and Wehrle ECUs.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Restricted combustion air intake or exhaust. <i>If the combustion air intake or the exhaust is restricted in any way, the heater may not get enough combustion air to start or sustain the flame.</i>	• Check the combustion air intake hose and the exhaust pipe to see if they are crushed, damaged or restricted. • Check to make sure the air intake and exhaust are installed correctly according to the TriPac Installation Manual. • The Exhaust and the Air Intake should not be shorter than 12 inches each or longer than 6.5 Feet each. • Avoid excessive bends in the air intake or exhaust since they can cause restriction. A general guideline is to not have more than 180° to 270° worth of bends in either the exhaust or air intake pipes.

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How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Fuel supply problem. <i>If there is not enough fuel or too much fuel the heater may not start or be able to sustain the flame since it does not have the right amount of fuel for proper ignition and combustion. The Fuel Quantity Test is the most effective way to test the entire fuel system from the tip of the pickup pipe to the heater inlet pipe.</i>	• Check the fuel delivery system to be sure there are no loose, damaged or restricted fuel lines or connections. • Check the fuel system installation to make sure it is installed correctly according to the TriPac Installation Manual. • Perform a Fuel Quantity Test. Refer to TriPac Service Procedure H30A.
Problem with the glow pin, which is the ignition source. <i>If the glow pin is dirty or not working properly, it may not be able to ignite the flame.</i>	• Check the glow pin tip to see if it is dirty or deformed. If it cannot be wiped clean with a soft cloth it must be replaced. • Check the Glow Pin as outline in Fault Codes 20 and 21. Replace if necessary.
Problem with the combustion air supply or fuel supply inside the heater. <i>If the glow pin ventilation hole is restricted or blocked the heater may not be able to ignite the flame because the small amount of air going through the hole is critical for ignition and helps atomize the fuel for proper combustion. If the glow pin screen is dirty or plugged it will not be able to atomize the fuel well which is equivalent to a fuel restriction.</i>	• Check the glow pin ventilation hole to make sure it is completely open and not restricted. • Check to see if the glow pin screen has build-up on it or looks dirty. If it is dirty or has build up remove and replace it. • Make sure to clean the glow pin screen chamber before installing new glow pin screen. Use a small brush to loosen any build up in the Glow Pin chamber and a vacuum to remove any loose particles. Do not blow loose particles into the Burner Chamber with compressed air. • Make sure to that the glow pin screen insertion tool bottoms out when inserting the glow pin screen so that the ventilation hole is completely clear.

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How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed or incorrectly installed flame Sensor. <i>If the Flame Sensor has failed or is not mounted properly it may not detect the heater exchanger temperature properly and therefore it may detect the flame went out even if it did not or it may detect a flame started even if it did not. EDiTH Diagnostics is the most effective way to check the flame sensor for function and accuracy.</i>	• Check to make sure the flame sensor is not damaged and is correctly and securely clamped into the indent on top of the heat exchanger with the smooth silver side completely touching the heat exchanger. • Check to make sure the flame sensor wires are securely connected to the sensor and are routed properly and not damaged. • Check the green connector to make sure that the terminals are locked into the connector and cannot be pushed back. • Check the flame sensor resistance values. Refer to TriPac Service Procedure D05A. • Use EDiTH Diagnostics to perform a Function Test and view the measured temperature of the Flame Sensor. If the heater has not been running the flame sensor will read the approximate room temperature when the Function Test is first started. To see if the sensor is reading properly when the heater is warm then you will have to remove the flame sensor and perform a Function Test with it in the ambient air. If the flame sensor is not reading accurately it must be replaced. Refer to TriPac Service Procedure H31A.
Carbon Build Up in the Burner. <i>In some cases when there has been a partial restriction in the Combustion Air Supply or a problem with the Fuel Supply over a period of time, there could be carbon build up in the burner that needs to be cleaned. In many cases if the error was not present for too long or it was not too severe, the heater will burn off the carbon after the problem is corrected.</i>	• Look inside the Glow Pin Chamber to see if you can see a blockage or restriction in the bottom. • Take off the exhaust and look into the exhaust port on the heater to see if there is soot build up. • If you are able to get the heater started after making a correction or repair then first try to start it a couple of times and run it in high to see if it will burn off the carbon. • If it will not start well or does not run smoothly or without smoke then refer to Espar Technical Bulletin 282 to see how to clean a burner.
Elevation is too high. <i>If the heater is being run at 5000 Feet above sea level or higher it may not be starting because the air to fuel ratio could be too low.</i>	• Find out if the elevation at your location is close to or higher than 5000 feet and if the truck is used at elevations above 5000 feet more than on a rare occasion. • If the heater will be used at elevations above 5000 feet then install either a High Altitude Sensor on later model heaters or install a secondary high altitude fuel pump and selector switch on older model heaters. Refer to TK Service Bulletin TT500 for details.

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Fault Code: 53	<i>Flame Cutout in Power Mode</i>
Fault Code: 54	<i>Flame Cutout in High Mode</i>
Fault Code: 55	<i>Flame Cutout in Medium Mode</i>
Fault Code: 56	<i>Flame Cutout in Low Mode</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters.</i>
Related Fault Codes	<i>F-52, F-57</i>
How Fault Code is Set <i>After the heater has reached regulation mode and is in one of the controlled heat output levels the ECU has detected the flame has gone out and after restarting successfully has gone out again within 15 minutes. The ECU detects the flame cutout by evaluating the dropping temperature trend of the Flame Sensor which reads the surface temperature of the heat exchanger.</i> <i>Which of the four Flame Cutout Fault Codes is set depends on which heat output level the heater was in when the flame cutout occurred the second time in 15 minutes. It is not based on the heat output level the heater was in when the first flame cutout occurred which is followed by the automatic restart.</i> <i>After a flame-out the heater will only perform one automatic start attempt and not two start attempts as it may on an initial start up. In this restart attempt the flame must ignite within 90 seconds after the start of the fuel pump for a D2 Airtronic and about 70 seconds for a D4 Airtronic. In this restart the heater will first go into the Medium Mode before controlled regulation starts and not into Power Mode as it does on an initial start.</i> <i>If the automatic restart attempt after a flame-out is not successful the heater will not set one of the Flame Cutout in Regulation Fault Codes but instead another Fault Code such as F-52 or F-57 which indicates why the heater was not able to start.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDITH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Restricted combustion air intake or exhaust. <i>If the combustion air intake or the exhaust is restricted in any way, the heater may not get enough combustion air to start or sustain the flame.</i>	• Check the combustion air intake hose and the exhaust pipe to see if they are crushed, damaged or restricted. • Check to make sure the air intake and exhaust are installed correctly according to the TriPac Installation Manual. • The Exhaust and the Air Intake should not be shorter than 12 inches each or longer than 6.5 Feet each. • Avoid excessive bends in the air intake or exhaust since they can cause restriction. A general guideline is to not have more than 180° to 270° worth of bends in either the exhaust or air intake pipes.

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How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Fuel supply problem. <i>If there is not enough fuel or too much fuel the heater may not start or be able to sustain the flame since it does not have the right amount of fuel for proper ignition and combustion. The Fuel Quantity Test is the most effective way to test the entire fuel system from the tip of the pickup pipe to the heater inlet pipe.</i>	• Check the fuel delivery system to be sure there are no loose, damaged or restricted fuel lines or connections. • Check the fuel system installation to make sure it is installed correctly according to the TriPac Installation Manual. • Perform a Fuel Quantity Test. Refer to TriPac Service Procedure H30A.
Problem with the combustion air supply or fuel supply inside the heater. <i>If the glow pin ventilation hole is restricted or blocked the heater may not be able to keep the flame going because the small amount of air going through the hole is critical for ignition and helps atomize the fuel for proper combustion. If the glow pin screen is dirty or plugged it will not be able to atomize the fuel well which is equivalent to a fuel restriction.</i>	• Check the glow pin ventilation hole to make sure it is completely open and not restricted. • Check to see if the glow pin screen has build-up on it or looks dirty. If it is dirty or has build up remove and replace the glow pin screen. • Make sure to clean the glow pin screen chamber before installing new glow pin screen. Use a small brush and a vacuum to loosen and remove any build up in the Glow Pin chamber. Do not blow loose particles into the Burner Chamber with compressed air. • Make sure that the glow pin screen insertion tool bottoms out when inserting the new glow pin screen so that the ventilation hole is not blocked.

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Section 5 – TriPac EVOLUTION Diagnostics

How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed or incorrectly installed flame Sensor. <i>If the Flame Sensor has failed or is not mounted properly it may not detect the heater exchanger temperature properly and therefore it may detect the flame went out even if it did not or it may detect a flame started even if it did not. EDiTH Diagnostics is the most effective way to check the flame sensor for function and accuracy.</i>	• Check to make sure the flame sensor is not damaged and is correctly and securely clamped into the indent on top of the heat exchanger with the smooth silver side completely touching the heat exchanger. • Check to make sure the flame sensor wires are securely connected to the sensor and are routed properly and not damaged. • Check the green connector to make sure that the terminals are locked into the connector and cannot be pushed back. • Check the flame sensor resistance values. Refer to TriPac Service Procedure D05A. • Use EDiTH Diagnostics to perform a Function Test and view the measured temperature of the Flame Sensor. If the heater has not been running the flame sensor will read the approximate room temperature when the Function Test is first started. To see if the sensor is reading properly when the heater is warm then you will have to remove the flame sensor and perform a Function Test with it in the ambient air. If the flame sensor is not reading accurately it must be replaced. Refer to TriPac Service Procedure H31A.
Failed ECU <i>If the ECU is not measuring the flame sensor properly it may not recognize when the flame is on or off.</i>	• Before replacing the ECU, try to run the heater with a new Flame Sensor and view the temperature it is reading with EDiTH. • If after replacing the Flame Sensor, the ECU still does not measure the Flame Sensor correctly according to EDiTH then replace the ECU and reinstall the old Flame Sensor. Confirm the new ECU reads the proper temperature with the old Flame Sensor.

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Fault Code: 57	<i>Flame Cutout in Start Phase</i>
Fault Type	<i>Error</i>
Requirements	<i>Only High Altitude Compatible D2 and D4 Airtronic ECUs.</i>
Related Fault Codes	<i>F-18, F-19, F-52, F-53, F-54, F-55, F-56</i>
How Fault Code is Set <i>A flame was detected during the start phase but then went out some time before reaching the regulation mode. The heater is allowed two start attempts to ignite while delivering fuel. The Airtronic D2 has two 90 second start attempts. The Airtronic D4s first start attempt is 105 or 110 seconds while the second is about 70 seconds. If a flame is detected during one or both of these start attempts and then goes out and is not started again before the end of the second start attempt and then stays on until it reaches regulation mode the Heater will shut off the Fuel Metering Pump and set a Fault Code 57. The glow pin will continue to be on for a short period and the blower motor will also stay on for about 4 minutes to cool the heater off. The heater detects a flame with the flame sensor that is mounted on top of the heat exchanger. During the start up attempt the flame sensor must detect a 4 °C (7 °F) rise in the temperature of the heat exchanger within 10 seconds to recognize that a flame has started. The ECU detects the flame cutout by evaluating the dropping temperature trend of the Flame Sensor. For the D4 Airtronic the first start attempt times are dependent on which type of ECU it has. For the Wehrle ECU the first start attempt is about 110 Seconds and for the Hella ECU the first start attempt is about 105 seconds. Refer to TriPac Service Procedure H31A to identify the Hella and Wehrle ECUs. Refer to Service Bulletin TT499 to identify a high altitude compatible Electronic Control Unit.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur. To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Restricted combustion air intake or exhaust. <i>If the combustion air intake or the exhaust is restricted in any way, the heater may not get enough combustion air to start or sustain the flame.</i>	● Check the combustion air intake hose and the exhaust pipe to see if they are crushed, damaged or restricted. ● Check to make sure the air intake and exhaust are installed correctly according to the TriPac Installation Manual. ● The Exhaust and the Air Intake should not be shorter than 12 inches each or longer than 6.5 Feet each. ● Avoid excessive bends in the air intake or exhaust since they can cause restriction. A general guideline is to not have more than 180° to 270° worth of bends in either the exhaust or air intake pipes.

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How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Fuel supply problem. <i>If there is not enough fuel or too much fuel the heater may not start or be able to sustain the flame since it does not have the right amount of fuel for proper ignition and combustion. The Fuel Quantity Test is the most effective way to test the entire fuel system from the tip of the pickup pipe to the heater inlet pipe.</i>	• Check the fuel delivery system to be sure there are no loose, damaged or restricted fuel lines or connections. • Check the fuel system installation to make sure it is installed correctly according to the TriPac Installation Manual. • Perform a Fuel Quantity Test. Refer to TriPac Service Procedure H30A.
Problem with the glow pin, which is the ignition source. <i>If the glow pin is dirty or not working properly, it may not be able to establish a stable flame even though it was able to ignite it initially.</i>	• Check the glow pin tip to see if it is dirty or deformed. If it cannot be wiped clean with a soft cloth it must be replaced. • Check the Glow Pin as outline in Fault Codes 20 and 21. Replace if necessary.
Problem with the combustion air supply or fuel supply inside the heater. <i>If the glow pin ventilation hole is restricted or blocked the heater may not be able to ignite the flame because the small amount of air going through the hole is critical for ignition and helps atomize the fuel for proper combustion. If the glow pin screen is dirty or plugged it will not be able to atomize the fuel well which is equivalent to a fuel restriction.</i>	• Check the glow pin ventilation hole to make sure it is completely open and not restricted. • Check to see if the glow pin screen has build-up on it or looks dirty. If it is dirty or has build up remove and replace it. • Make sure to clean the glow pin screen chamber before installing new glow pin screen. Use a small brush to loosen any build up in the Glow Pin chamber and a vacuum to remove any loose particles. Do not blow loose particles into the Burner Chamber with compressed air. • Make sure to that the glow pin screen insertion tool bottoms out when inserting the glow pin screen so that the ventilation hole is completely clear.

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Section 5 – TriPac EVOLUTION Diagnostics

How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed or incorrectly installed flame Sensor. <i>If the Flame Sensor has failed or is not mounted properly it may not detect the heater exchanger temperature properly and therefore it may detect the flame went out even if it did not or it may detect a flame started even if it did not. EDiTH Diagnostics is the most effective way to check the flame sensor for function and accuracy.</i>	• Check to make sure the flame sensor is not damaged and is correctly and securely clamped into the indent on top of the heat exchanger with the smooth silver side completely touching the heat exchanger. • Check to make sure the flame sensor wires are securely connected to the sensor and are routed properly and not damaged. • Check the green connector to make sure that the terminals are locked into the connector and cannot be pushed back. • Check the flame sensor resistance values. Refer to TriPac Service Procedure D05A. • Use EDiTH Diagnostics to perform a Function Test and view the measured temperature of the Flame Sensor. If the heater has not been running the flame sensor will read the approximate room temperature when the Function Test is first started. To see if the sensor is reading properly when the heater is warm then you will have to remove the flame sensor and perform a Function Test with it in the ambient air. If the flame sensor is not reading accurately it must be replaced. Refer to Service Procedure H31A.
Carbon Build Up in the Burner. <i>In some cases when there has been a partial restriction in the Combustion Air Supply or a problem with the Fuel Supply over a period of time, there could be carbon build up in the burner that needs to be cleaned. In many cases if the error was not present for too long or it was not too severe, the heater will burn off the carbon after the problem is corrected.</i>	• Look inside the Glow Pin Chamber to see if you can see a blockage or restriction in the bottom. • Take off the exhaust and look into the exhaust port on the heater to see if there is soot build up. • If you are able to get the heater started after making a correction or repair then first try to start it a couple of times and run it in high to see if it will burn off the carbon. • If it will not start well or does not run smoothly or without smoke then refer to Espar Technical Bulletin 282 to see how to clean a burner.
Elevation is too high. <i>If the heater is being run at 5000 Feet above sea level or higher it may not be starting because the air to fuel ratio could be too low.</i>	• Find out if the elevation at your location is close to or higher than 5000 feet and if the truck is used at elevations above 5000 feet more than on a rare occasion. • If the heater will be used at elevations above 5000 feet then install either a High Altitude Sensor on later model heaters or install a secondary high altitude fuel pump and selector switch on older model heaters. Refer to TK Service Bulletin TT500 for Details.

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Fault Code: 60	<i>External Temperature Sensor Open Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-61</i>
How Fault Code is Set <i>The external temperature sensor is detecting an out of range temperature.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
External Temperature Sensor circuit is open.	• Disconnect the Heater Harness connection (main harness) and measure the resistance value at the Harness connector Pins 6 & 12. Refer to TriPac Service Procedure D06A. • If there is an open circuit, the resistance value between the pins will be more than 7175 Ω. • Disconnect the sensor from the harness and test the sensor. If the resistance is the same as the previous test, replace the sensor. If the resistance value is normal locate and repair open in the harness.
Failed ECU.	• If the resistance value is acceptable replace the ECU. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 61	<i>External Temperature Sensor Short Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-60</i>
How Fault Code is Set <i>The external temperature sensor is detecting an out of range temperature.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
External Temperature Sensor circuit is shorted.	• Disconnect the Heater Harness connection (main harness) and measure the resistance value at the Harness connector Pins 6 & 12. Refer to TriPac Service Procedure D06A. • If there is a short circuit, the resistance value between the pins will be less than 486 Ω. • Measure the resistance value between Pin 12 and chassis ground. Any reading indicates the harness is shorted to ground. Locate and repair short. • Disconnect the sensor from the harness and test the sensor. If the resistance is low, replace the sensor. If the resistance value is normal locate and repair short in the harness.
Failed ECU.	• If the resistance value is acceptable and Alarm Code 061 continues to occur then replace the ECU. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 62	<i>Setpoint Control Open Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-63</i>
How Fault Code is Set <i>The digital temperature control potentiometer values are out of range high for the TriPac digital temperature control potentiometer (thermostat). Heater will ignite then run in high speed.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Setpoint Control circuit is open, failed ECU, or failed Interface/Controller Board. <i>The TriPac temperature setpoint is supplied to the heater by a digitally simulated potentiometer. This digital potentiometer is located on the TriPac Interface Board. The digital potentiometer is connected to the heater via the Heater Harness connector. The Grey/Red wire from the heater is connected to terminal J13-6 on the TriPac Interface Board. The Brown/White wire from the heater is connected to the J13-5 terminal on the TriPac Interface Board.</i>	• Disconnect the Heater Harness connector. • Turn the TriPac system on and set for heat. • Check the resistance between Pins 6 and 7 at the Harness connector. The normal value is from 1740 Ω to 2180 $\Omega \pm 80 \Omega$. Typical TriPac values for setpoint settings with heat mode selected are as follows: 50° F (10° C) Setpoint 1775 $\Omega \pm 80 \Omega$ 77° F (25° C) Setpoint 2000 $\Omega \pm 80 \Omega$ 90° F (32° C) Setpoint 2175 $\Omega \pm 80 \Omega$ The resistance value for an open circuit between Pins 6 and 7 is more than 7175 Ω. • If the values are correct replace the ECU. • If the values are not correct then disconnect the GRY/RED wire from terminal L1 and the BRN/WHT wire from the W1 terminal on the TriPac Interface Board, or unplug connector J54 on the TriPac Interface Board. Measure the values at the board for the setpoints shown above. • If the values are correct at the Interface/Controller Board but incorrect at the heater then check the wiring harness from the heater to the Interface/Controller Board. • If the values are incorrect at the Interface/Controller Board then replace the Interface/Controller Board. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 63	<i>Setpoint Control Short Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-62</i>
How Fault Code is Set <i>The digital temperature control potentiometer values are out of range low for the TriPac digital temperature control potentiometer (thermostat).</i> <i>This Alarm Code is only active in Heat Mode. If the short circuit has already occurred and the heater is switched on then Ventilation Mode will be active.</i> NOTE: If a short circuit already exists before the heater is turned on, the heater will run in vent mode but no alarm will occur. EDiTH will report Parking Ventilation mode.	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Setpoint Control circuit has a short circuit, or failed Interface/Controller Board. Verify wires are not reversed at the Interface Board. <i>The TriPac temperature setpoint is supplied to the heater by a digitally simulated potentiometer. This digital potentiometer is located on the TriPac Interface Board. The digital potentiometer is connected to the heater via the Heater Harness connector. The Grey/Red wire from the heater is connected to terminal J13-6 on the TriPac Interface Board. The Brown/White wire from the heater is connected to the J13-5 terminal on the TriPac Interface Board.</i>	• Disconnect the Heater Harness connector. • Turn the TriPac system on and set for heat. • Check the resistance between Pins 6 and 7 at the Harness connector. The normal value is from 1740 Ω to 2180 $\Omega \pm 80 \Omega$. Typical values for setpoint settings with heat mode selected are as follows: 50° F (10° C) Setpoint 1775 $\Omega \pm 80 \Omega$ 77° F (25° C) Setpoint 2000 $\Omega \pm 80 \Omega$ 90° F (32° C) Setpoint 2175 $\Omega \pm 80 \Omega$ • The resistance value for a short circuit between Pins 6 and 7 is less than 486 Ω. • If the values are not correct then disconnect the GRY/RED wire from terminal L1 and the BRN/WHT wire from terminal W1 on the TriPac Interface Board, or unplug connector J54 on the TriPac Interface Board Pins 5 and 6. Measure the values at the board for the setpoints shown above. • If the resistance values are incorrect at the Interface/Controller Board with the wires disconnected then replace the Interface/Controller Board. • If the resistance values are correct check the resistance between Pins 6 and 7 at the Harness connector. • If the value is anything other than OL the short circuit is between the GRY/RED or BRN/WHT wires in the wiring harness from the heater to the Interface/Controller Board. Locate short and repair the harness as necessary. • Measure the resistance value between Pin 6 and chassis ground then Pin 7 and chassis ground. Any reading other than OL indicates the harness is shorted to ground. Locate short and repair the harness as necessary. • If the short circuit cannot be found then replace the wiring harness from the heater to the Interface/Controller Board.
Failed ECU.	• If the resistance values are correct replace the ECU. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 64	<i>Flame Sensor Open Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-65</i>
How Fault Code is Set <i>The Flame Sensor is sensing an out of range value.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Flame Sensor circuit is open.	• Disconnect the green connector from the ECU. Check the Flame Sensor resistance using Service Procedure D05A.
Failed ECU.	• If the Flame Sensor is acceptable then replace the ECU. The resistance value for interruption is more than 7175 Ω. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 65	<i>Flame Sensor Short Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-64</i>
How Fault Code is Set <i>The Flame Sensor is sensing an out of range value.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Flame Sensor circuit has a short circuit.	• Disconnect the green connector from the ECU and run the heater. If Alarm Code 064 is displayed then replace the combination flame/overheat sensor.
Failed ECU.	• If Alarm Code 065 is still displayed then replace the ECU. The resistance value for a short circuit is less than 486 Ω. For Flame Sensor resistance values see Service Procedure D05A. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 71	<i>Overheat Sensor Open Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-72</i>
How Fault Code is Set <i>The Overheat Sensor value is out of range.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Overheat Sensor circuit is open.	• Disconnect the green and blue connectors from the ECU. Measure the resistance value from the blue connector Pin 1- (blue wire) to the green connector Pin 2 (brown/white wire). For Overheat Sensor resistance values see Service ProcedureD05A.
Failed ECU.	• If the resistance value is acceptable then replace the ECU. The resistance value for interruption is more than 223 k Ω. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 72	<i>Overheat Sensor Short Circuit</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-71</i>
How Fault Code is Set <i>The Overheat Sensor value is out of range.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Overheat Sensor circuit has a short circuit.	• Disconnect the blue connector from the ECU and run the heater. If Alarm Code 071 is displayed then replace the combination Flame/Overheat Sensor.
Failed ECU.	• If Alarm Code 072 is still displayed then replace the ECU. The resistance value for a short circuit is less than 183 Ω. For Overheat Sensor resistance values see Service Procedure D05A. • Do not clear or erase the Fault Code in the old ECU if it is being returned under Warranty.

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Fault Code: 74	<i>Control Unit Defective</i>
Fault Type	<i>Error</i>
Requirements	<i>All D2 and D4 Airtronic Heaters</i>
Related Fault Codes	
How Fault Code is Set <i>The overheat threshold value is not detected by the ECU.</i>	
How Fault Code is Cleared <i>The fault code does not need to be cleared since the ECU needs to be replaced.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed ECU	• Replace the ECU and Function Test the heater. • Do not clear or erase the fault code in the old ECU if it is being returned under Warranty.

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Fault Code: 90	<i>Control Unit Defective</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	
How Fault Code is Set <i>The Electronic Control Unit (ECU) inside the heater has failed and is defective.</i>	
How Fault Code is Cleared <i>The fault code does not need to be cleared since the ECU needs to be replaced.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed ECU	• Replace the ECU and Function Test the heater. • Do not clear or erase the fault code in the old ECU if it is being returned under Warranty.

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Fault Code: 91	<i>External Interference Voltage</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	<i>F-10, F-11, F-98, F-99</i>
How Fault Code is Set <i>An error has occurred in the ECU due to an interference voltage from either the TriPac or tractor electrical system.</i> <i>This Fault Code can be caused by a battery charger being connected to the electrical system.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Battery Charger Connected to Truck Batteries.	- Remove the Battery Charger. - Clear the Fault Code from the ECU Memory and Function Test the Heater without the Battery Charger connected to confirm the fault does not happen again and was due to the Battery Charger.
Voltage interference from vehicle electrical system.	- Check the truck and TriPac charging systems and repair any problems. - Test the Heater Power Supply as outline in Fault Codes 10 and 11.

Fault Code: 92	<i>Control Unit Defective</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	
How Fault Code is Set <i>The Electronic Control Unit (ECU) inside the heater has failed and is defective.</i>	
How Fault Code is Cleared <i>The fault code does not need to be cleared since the ECU needs to be replaced.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed ECU	- Replace the ECU and Function Test the heater. Do not clear or erase the fault code in the old ECU if it is being returned under Warranty.

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Fault Code: 93	<i>Control Unit Defective</i>
Fault Type	<i>Error</i>
Requirements	<i>All Hella Type D2 and D4 Airtronic ECUs</i>
Related Fault Codes	
How Fault Code is Set <i>The Electronic Control Unit (ECU) inside the heater has failed and is defective. Refer to TriPac Service Procedure H31A to indentify the Hella ECU.</i>	
How Fault Code is Cleared <i>The fault code does not need to be cleared since the ECU needs to be replaced.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed ECU	• Replace the ECU and Function Test the heater. • Do not clear or erase the fault code in the old ECU if it is being returned under Warranty.

Fault Code: 94	<i>Control Unit Defective</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	
How Fault Code is Set <i>The Electronic Control Unit (ECU) inside the heater has failed and is defective.</i>	
How Fault Code is Cleared <i>The fault code does not need to be cleared since the ECU needs to be replaced.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed ECU	• Replace the ECU and Function Test the heater. • Do not clear or erase the fault code in the old ECU if it is being returned under Warranty.

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Fault Code: 95	<i>Control Unit Defective</i>
Fault Type	<i>Error</i>
Requirements	<i>All Hella Type D2 and D4 Airtronic ECUs</i>
Related Fault Codes	
How Fault Code is Set <i>The Electronic Control Unit (ECU) inside the heater has failed and is defective. Refer to TriPac Service Procedure H31A to indentify the Hella ECU.</i>	
How Fault Code is Cleared <i>The fault code does not need to be cleared since the ECU needs to be replaced.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed ECU	• Replace the ECU and Function Test the heater. • Do not clear or erase the fault code in the old ECU if it is being returned under Warranty.

Section 5 – TriPac EVOLUTION Diagnostics

Fault Code: 96	<i>Internal Temperature Sensor Defective.</i>
Fault Type	<i>Warning</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	
How Fault Code is Set <i>The internal temperature sensor on the Electronic Control Unit has failed. The internal temperature sensor is located on the outside of the ECU in the path of the return air and is used to read the return air temperature to the heater in order to regulate the heater output so that it heats to the temperature setpoint. On the Hella ECUs it has Blue Wires leading to it and on the Wehrle ECU is it just a black sensor with small black shield protruding out the same side of the ECU that the Blower Motor plugs into. If the internal temperature sensor has failed and there is no optional external temperature sensor installed the heater will still function in an emergency mode so not to leave someone stranded without heat. When the internal temperature sensor has failed the heater is not able to measure the sleeper temperature so it cannot regulate the heater. In this case the heater will run only in High heat output which could lead to a sleeper temperature rising higher than the temperature set point. By default the ECU will control to the internal temperature sensor unless an optional, normally not used external temperature sensor is connected.</i>	
How Fault Code is Cleared <i>The fault does not show up as an Actual Fault or AF so it does not need to be cleared in order for the heater to function. To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Damage to the Internal Temperature Sensor on the ECU.	• Check the temperature sensor on the ECU to see if it is damaged or if the wires leading to it are damaged. The damage could be from pulling on the wires or if the ECU was dropped or crushed somehow. • If the sensor or the wires are damaged an External Temperature Sensor will have to be installed or the ECU replaced. • Failure of the Sensor due to external physical damage is not covered by Warranty. If the Heater is out of Warranty or the sensor was physically damaged it would likely be more cost effective to install an external temperature sensor than to replace the whole ECU.
Internal Temperature Sensor is too far out of Tolerance.	• It is not possible to do a resistance check on the Internal Temperature Sensor or to replace it. • If the Fault Code 96 is in the ECU Memory the Internal Temperature Sensor has failed and it does not need to be proven, only a decision on the best way to correct it must be made. • If the Heater is under Warranty and the Sensor did not fail due to physical damage, the whole ECU should be replaced under Warranty. • Do not clear or erase the fault code in the old ECU if it is being returned under Warranty.

Section 5 – TriPac EVOLUTION Diagnostics

Fault Code: 97	<i>Control Unit Defective</i>
Fault Type	<i>Error</i>
Requirements	<i>All TriPac D2 and D4 Airtronic Heaters</i>
Related Fault Codes	
How Fault Code is Set <i>The Electronic Control Unit (ECU) inside the heater has failed and is defective.</i>	
How Fault Code is Cleared <i>The fault code does not need to be cleared since the ECU needs to be replaced.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Failed ECU	• Replace the ECU and Function Test the heater. • Do not clear or erase the fault code in the old ECU if it is being returned under Warranty.

Section 5 – TriPac EVOLUTION Diagnostics

Fault Code: 98	<i>Control Unit Defective or Low Voltage Supply under load</i>
Fault Type	<i>Error</i>
Requirements	<i>All Hella Type D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-11, F- 91, F-99</i>
How Fault Code is Set <i>The voltage supply to the heater dropped excessively low during start up or the Electronic Control Unit is defective.</i> <i>Refer to TriPac Service Procedure H31A to indentify the Hella ECU.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Low Voltage Supply or Voltage drop occurs during start up.	• Check all power supply connections and lines at both ground and power for a loose, damaged or corroded connections and make necessary repairs. • Since this voltage drop may be intermittent it may only occur when the truck is vibrating so the bad connection may be hard to find and the power supply must be checked very thoroughly. • Check the Voltage Supply according to the instructions in Fault Code 11.
Failed ECU	• After confirming the Power Supply is good by making all the checks in Fault Code 11, clear the Fault Codes from the ECU and Perform a Function Test to repeat the Fault Code 98. • If the Fault Code is repeated then replace the ECU and Function Test the Heater. • Do not clear or erase the fault code in the old ECU if it is being returned under Warranty.

Section 5 – TriPac EVOLUTION Diagnostics

Fault Code: 99	<i>Too many resets in sequence or Transistor Error in ECU</i>
Fault Type	<i>Error</i>
Requirements	<i>All Hella Type D2 and D4 Airtronic ECUs</i>
Related Fault Codes	<i>F-11, F-91, F-98</i>
How Fault Code is Set <i>The voltage supply to the heater dropped excessively low to less than 5 – 6 Volts for a short period of time repeatedly or the Electronic Control Unit Transistor has failed.</i> <i>Refer to TriPac Service Procedure H31A to indentify the Hella ECU.</i>	
How Fault Code is Cleared <i>The fault can be cleared by turning the heater off and then back on again. Failure to resolve the condition that caused the fault may cause it to re-occur.</i> <i>To permanently delete the fault code from the Heater's Electronic Control Unit memory the EDiTH Diagnostic Tool or the Heater Diagnostic Unit can be used. Refer to TriPac Service Procedures H31A and H32A.</i>	
How to Diagnose and Repair	
Possible Causes	What to inspect or test and how to correct.
Intermittent and repeated Voltage Drop in Heater Power Supply. <i>An intermittent and repeated voltage drop is likely due to a loose connection or fuse.</i>	• Check all power supply connections and lines at both ground and power for a loose, damaged or corroded connections and make necessary repairs. • Since this voltage drop is intermittent it may only occur when the truck is vibrating so the bad connection may be hard to find and the power supply must be checked very thoroughly. • Check the Voltage Supply according to the instructions in Fault Code 11.
Failed ECU	• After confirming the Power Supply is good by making all the checks in Fault Code 11, clear the Fault Codes from the ECU and Perform a Function Test to repeat the Fault Code 99. • If the Fault Code is repeated then replace the ECU and Function Test the Heater. • Do not clear or erase the fault code in the old ECU if it is being returned under Warranty.

12 Vdc TO 115 Vac 1000 WATT POWER INVERTER (OPTIONAL)

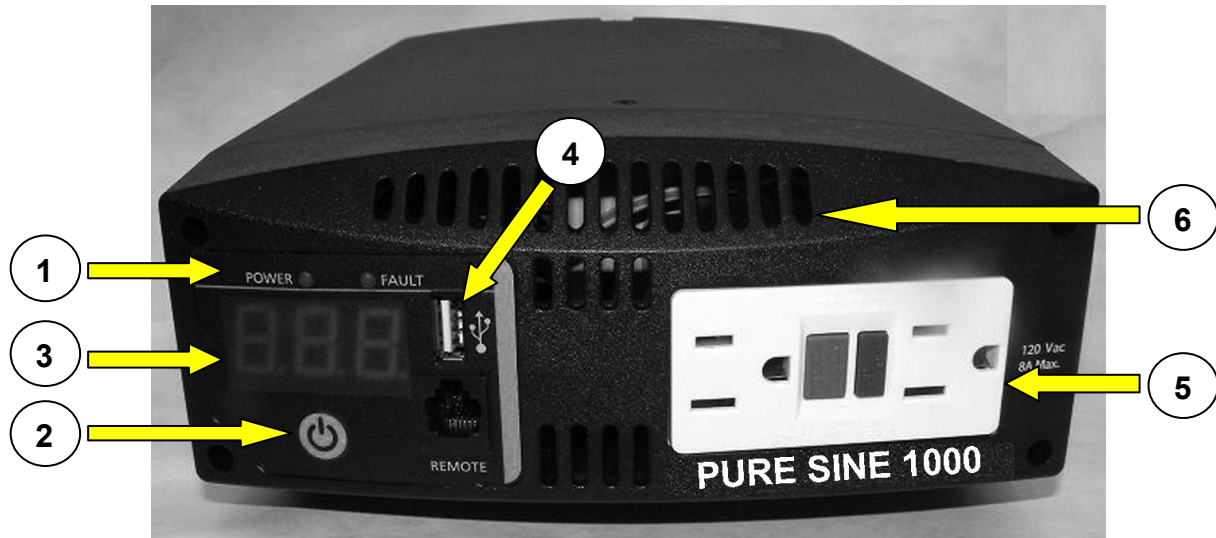
The optional Thermo King 1000 watt Pure Sine Power Inverter is available as an option on TriPac EVOLUTION units. It is compatible with the standard 65 amp charging system.

The power inverter will automatically detect an AC load and turn on to change 12 VDC from the truck batteries into 115 VAC power. The inverter has Continuous Output of 900 watts with Surge Power of 2000 watts. The Inverter is designed to handle a variety of applications including TVs, DVD players, coffee makers and small power tools. Thermo King recommends that 800 watt or smaller microwave ovens be used. The high surge capability lets it handle some peak start loads including large TVs, refrigerators and freezers. These loads should be operated one at a time.

The Power Inverter is connected to and draws power directly from the truck batteries. It is not connected to or controlled by the TriPac system. If enabled, the charging system of the TriPac APU will charge the truck batteries as required.

NOTE: If the TriPac system is not enabled the inverter could drain the truck batteries below the level required to start the truck.

Section 5 – TriPac EVOLUTION Diagnostics



1	Status LEDs Green LED indicates the unit receiving power and is on. IF a shutdown occurs due to an error condition this LED will remain on. A Red LED indicates an error or alarm condition.	4	USB Port This USB port can be used to power and charge USB enabled devices.
2	On/Off Key The On/Off Key turns the inverter on and off.	5	GFCI Receptacle The AC two outlets are protected by a standard Ground Fault Circuit Interrupter (GFCI) with test and reset buttons.
3	Display The digital display shows input voltage (in volts), output power (in kilowatts) and error code information.	6	Ventilation Holes Allows internal heat to escape.

For additional information refer to TK 54627-19-OP Pure Sine Inverter Operator Manual.

Section 5 – TriPac EVOLUTION Diagnostics

12 Vdc to 115 Vac 1800 watt power inverter (optional)

The optional Thermo King 1800 watt Power Inverter is available on TriPac EVOLUTION units. It is part of the Driver Convenience Option that includes the optional 120 amp charging system. The 1800 watt power inverter is not available separately.

The power inverter will automatically detect an AC load. It will turn on to change 12 VDC from the truck batteries into 115 VAC power. The inverter has Continuous Output of 1800 watts with Surge Power of 3600 watts. The Inverter is designed to handle a variety of applications including TVs, DVD players, coffee makers and small power tools. The high surge capability lets it handle some peak start loads including large TVs, refrigerators and freezers. These loads should be operated one at a time.

CAUTION: *Some connected AC equipment might be damaged and/or not work properly with the modified sine wave power output.*

The Power Inverter is connected to and draws power directly from the truck batteries. It is not connected to or controlled by the TriPac system. If enabled, the charging system of the TriPac APU will charge the truck batteries as required.

NOTE: If the TriPac system is not enabled the inverter could drain the truck batteries below the level required to start the truck.

For additional information refer to TK 53707-1-OP Operator and Diagnostic Manual.



Section 5 – TriPac EVOLUTION Diagnostics

POWER INVERTER DIAGNOSTICS

Both Thermo King Power Inverters operate fundamentally the same. The following diagnostic information can be applied to both units. It is important to use good diagnostic process when dealing with Thermo King Power Inverter complaints. Record test information as you work through the Diagnosis Flow Charts. This will help achieve quick and accurate diagnostic results

- ✓ Before returning a Thermo King 1800 watt Power Inverter under warranty, check the Reverse Polarity Fuse. Locate the Reverse Polarity Fuse inspection port (Back panel below negative DC terminal). The Power Inverter DC input is polarity sensitive. DC power connections to the inverter must be positive to positive and negative to negative. A reverse polarity connection (positive to negative) will permanently damage internal Inverter circuits and blow the Reverse Polarity Fuse. The Reverse Polarity Fuse is only an indicator of this condition. This fuse is not serviceable. **IMPORTANT: Inverters that fail due to Reverse Polarity are not covered under warranty.**
- ✓ Disconnect all sources of supply power, both AC and DC, before servicing the Power Inverter. Turning the Power Inverter off using the control panel does not disconnect input power and will not remove the risk of electrical shock or burns.
- ✓ **WARNING: ELECTRICAL SHOCK AND BURN HAZARD.** Do not disassemble the Thermo King Power Inverter. The unit does not contain any user-serviceable components. Attempting to service the unit yourself could result in an electrical shock or burn and will void the warranty.
- ✓ Inverter AC Output voltage readings must be taken using a true RMS voltmeter such as Fluke Model 87 or 112. Other meters may not accurately read the modified sine wave output from the inverter. If other inexpensive meters are used the reading will be lower than actual in the 96 to 104 Vac range.
- ✓ During operation, if the Ground Fault Circuit Interrupter (GFCI) trips AC output power will be interrupted. The control panel will remain on. Input Voltage (V) will continue to show battery voltage but Input Current (A) and Output Power (kW) will both read "0". Reset the GFCI. Check the AC load.

Section 5 – TriPac EVOLUTION Diagnostics

Power Inverter Status LED

There is a three color status LED on the power inverter control panel as shown below. The LED color indicates if the power inverter is running from external AC power or batteries and if a fault condition exists. The power inverter control panel only operates when DC power is connected to the inverter.

Green LED: If the LED glows green the power inverter is turned on and is connected to and using external AC standby power to operate the connected loads.

Yellow LED: If the LED glows yellow the power inverter is turned on and is using the tractor batteries to operate the connected loads. If the Inverter is beeping a Warning Fault Condition exists. See the Inverter Fault Code Diagnosis later in this section.

Red LED: If the LED glows red the power inverter is turned on and a Shutdown Fault condition exists. The power inverter output is shut down. See Inverter Fault Code Diagnosis later in this section.



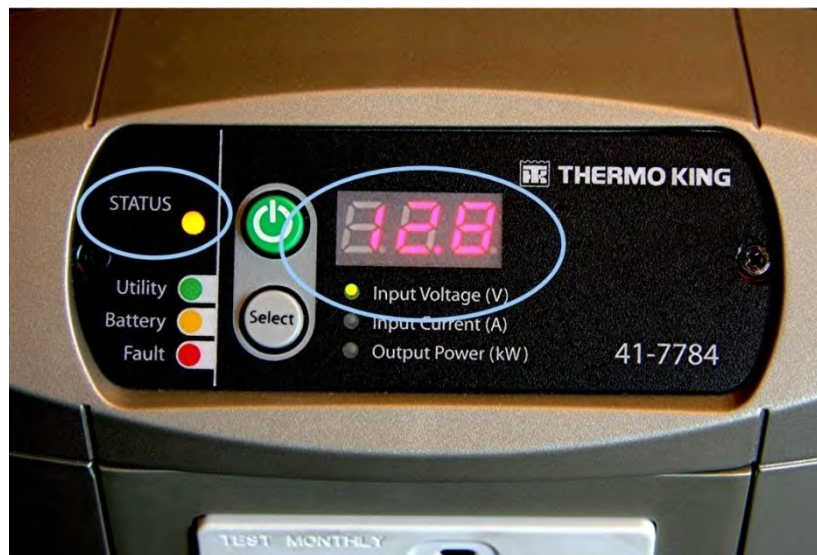
Section 5 – TriPac EVOLUTION Diagnostics

Checking Power Inverter Input Voltage, Input Current and Output Power.

When the power inverter is connected to a source of DC power, the display on the power inverter control panel can be used to display the input voltage, input current and output power. With the power inverter turned on, press the Select key to scroll through:

- ✓ Input Voltage (V): DC voltage from the truck batteries (in volts).
- ✓ Input Current (A): DC current flowing to the inverter from the truck batteries (in amps).
- ✓ Output Power (kW): AC power output of the inverter (in kilowatts).

In the photograph below the yellow status LED indicates the Power Inverter is turned on and is operating from DC power supplied by the tractor batteries. The display is showing an input voltage from the tractor batteries of 12.8 Vdc.



If the power inverter is operating on AC standby power and the inverter control panel is turned on the control panel display will indicate tractor battery voltage, not AC input voltage.

IMPORTANT: If AC voltage and current measurements are taken using a hand-held multi-meter, be sure a high quality true RMS multi-meter such as a Fluke 87 or 112 is used. Inexpensive multi-meters may not be capable of accurately reading the modified sine wave output supplied by the power inverter when running on battery power.

WARNING: Dangerous electrical voltage and current levels are present any time the power inverter is connected to a source of battery DC power or external AC input power. To reduce the risk of electrical shock, disconnect both AC and DC power from the power inverter before working on the power inverter or attached circuits. Turning the power inverter off will not reduce this risk.

Section 5 – TriPac EVOLUTION Diagnostics

POWER INVERTER TROUBLESHOOTING REFERENCE TABLE

This table describes general Power Inverter problem conditions and corrective actions. Refer to the Inverter Diagnosis Flow Charts for more detailed diagnosis.

WARNING: ELECTRICAL SHOCK AND BURN HAZARD. Do not disassemble the Thermo King Power Inverter. The unit does not contain any user-serviceable components. Attempting to service the unit yourself could result in an electrical shock or burn.

Symptom	Possible Cause	Corrective Action
AC load does not work. Front Panel Display is dark.	Inverter is off. Inverter Circuit Breaker is popped. No DC input to Inverter. Inverter has failed.	Press Front Panel On/Off key to turn Inverter on. Reset Inverter Circuit Breaker Check DC input cables are correctly connected to the truck batteries. Check for blown Inverter Power Fuse. Possible reverse polarity connection. See note below.
AC load does not work. Front Panel Display is on with yellow Status LED. Not beeping.	GFCI outlet has tripped. AC load is defective.	Disconnect all AC loads. Reset GFCI. Reconnect loads one at a time to determine what tripped the GFCI. Connect different AC load and recheck.
Inverter is beeping with yellow Status LED.	Fault Code Warning	Record Fault Code shown on Front Panel Display. Refer to Inverter Fault Code Diagnosis.
No AC output voltage. Inverter is beeping with red Status LED.	Fault Code Shutdown	Record Fault Code shown on Front Panel Display. Refer to Inverter Fault Code Diagnosis.
Microwave oven will not operate but other AC loads do. Fault Code E05 may generate.	High starting current exceeds operating limit.	Some microwave ovens will not work with the Thermo King Power Inverter. Try a different brand or model of microwave oven.

NOTE: The Power Inverter DC input is polarity sensitive. DC power connections to the inverter must be positive to positive and negative to negative. A reverse polarity connection (positive to negative) will permanently damage internal Inverter circuits and blow the Reverse Polarity Fuse. The Reverse Polarity Fuse is only an indicator of this condition. This fuse is not serviceable.

IMPORTANT: Inverters that fail due to Reverse Polarity connections are not covered under warranty.

POWER INVERTER FAULT CODE DIAGNOSIS

If a Power Inverter fault condition occurs the fault code will appear in the control panel display. It may alternate with other information. Review the following table for the eight fault codes that can appear in the three-digit LED display of the Front Panel. An audible beeper will accompany fault conditions. The Status LED may turn Red.

Types of Fault Codes

There are two types of Fault Codes that may occur.

- ✓ **Warning Codes** (Yellow Status LED): Inverter continues to operate. Warning beep once every two seconds. Informs operator an abnormal condition has been sensed. The condition should be addressed to prevent a more serious condition.
- ✓ **Shutdown Codes** (Red Status LED): Inverter has stopped operating. Warning beep once each second. Informs operator a serious abnormal condition has been sensed.

Clearing Fault Codes

To clear fault codes press the On/Off Key to turn Inverter off. Press the On/Off Key to turn Inverter on. Note if Fault Code reoccurs. Some fault codes will automatically clear if the fault condition returns to normal.

Section 5 – TriPac EVOLUTION Diagnostics

FAULT CODES

Refer to the Inverter Diagnosis Flow Chart for a more detailed diagnosis.

Fault Code	Status LED	Description	Diagnosis
No code	Yellow	No warning beep.	Normal operation.
E01 (alternate with Input Voltage)	Yellow	<u>Under-voltage Warning</u> DC input voltage has fallen below 11 Vdc.	1. Measure voltage at truck batteries. If low, recharge batteries. 2. Select Input Voltage on the Inverter Front Panel. If reading is 1 or more volts less than measured at the batteries there is high resistance in cables. 3. Check for loose or dirty cable connections at batteries and Inverter. Clean and tighten as required. 4. Reduce Inverter load.
E02 (alternate with Input Voltage)	Red	<u>Under-voltage Shutdown</u> DC input voltage has fallen below 10.5 Vdc.	1. Measure voltage at truck batteries. If low, recharge batteries. 2. Select Input Voltage on the Inverter Front Panel. If reading is 1 or more volts less than measured at the batteries there is high resistance in cables. 3. Check for loose or dirty cable connections at batteries and Inverter. Clean and tighten as required. 4. Reduce Inverter load.
E03 (alternate with Input Voltage)	Red	<u>Over-voltage Shutdown</u> DC input voltage has risen above 15.5 Vdc.	1. Check truck batteries are connected to provide 12 Vdc to Inverter. 2. Check truck or TriPac alternator is not over charging. Note: Voltage in excess of 16 Vdc may damage the Power Inverter. Damage caused by excessive input voltage is not covered under warranty.
E04	Yellow	<u>Overload Warning</u> Inverter current flow is nearing operating limit.	1. Reduce Inverter load. Recheck. 2. Select Input Voltage on the Inverter Front Panel. Verify DC input voltage is greater than 12 Vdc.

Section 5 – TriPac EVOLUTION Diagnostics

Fault Code	Status LED	Description	Diagnosis
E05 (alternate with OL)	Red	<u>Overload Shutdown</u> Inverter current flow has exceeded operating limit.	1. Reduce Inverter load. Recheck. 2. Select Input Voltage on the Inverter Front Panel. Verify DC input voltage is greater than 12 Vdc. 3. Short circuit in load. Turn Inverter off. Disconnect loads. Turn Inverter on. If fault code does not reoccur, check for defective load. 4. Short circuit in GFCI. Fault code reoccurs. Turn Inverter off. Disconnect GFCI from Inverter AC output wires. Turn Inverter on. If fault does not reoccur replace GFCI. 5. Inverter has suffered internal failure. Fault Code will not clear. May be caused by reversed polarity of DC power connections. See NOTE below. 6. Input voltage momentarily dropped below 10 Vdc. May occur during truck engine starting. Load does not need to be connected.
E06	---	Not Used	Not used
E07 (alternate with OtA)	Yellow	<u>Over-temperature Warning</u> Internal Inverter temperature is nearing operating limit.	1. Turn Inverter off and allow unit to cool. 2. Verify unobstructed ventilation. Nothing in contact with Inverter housing. Not mounted in an enclosed space. 3. Reduce cab temperature. 4. Reduce continuous Inverter load

Section 5 – TriPac EVOLUTION Diagnostics

Fault Code	Status LED	Description	Diagnosis
E08 (alternate with OT)	Red	<u>Over-temperature Shutdown</u> Internal Inverter temperature has exceeded operating limit.	1. Turn Inverter off and allow unit to cool. 2. Verify unobstructed ventilation. Nothing in contact with Inverter housing. Ventilation openings not obstructed. Not mounted in an enclosed space. 3. Reduce cab temperature. 4. Reduce continuous Inverter load
E010	Red	<u>Short Circuit or Output Circuit Overheat</u> Inverter current flow has exceeded operating limit.	1. Reduce Inverter load. Recheck. 2. Select Input Voltage on the Inverter Front Panel. Verify DC input voltage is greater than 12 Vdc. 3. Short circuit in load. Turn Inverter off. Disconnect loads. Turn Inverter on. If fault code does not reoccur, check for defective load. 4. Short circuit in GFCI. Fault code reoccurs. Turn Inverter off. Disconnect GFCI from Inverter AC output wires. Turn Inverter on. If fault does not reoccur replace GFCI. 5. Inverter has suffered internal failure. Fault Code will not clear. May be caused by reversed polarity of DC power connections. 6. Input voltage momentarily dropped below 10 Vdc. May occur during truck engine starting. Load does not need to be connected.

NOTE: The Power Inverter DC input is polarity sensitive. DC power connections to the inverter must be positive to positive and negative to negative. A reverse polarity connection (positive to negative) will permanently damage internal Inverter circuits and blow the Reverse Polarity Fuse. The Reverse Polarity Fuse is only an indicator of this condition. This fuse is not serviceable.

IMPORTANT: Inverters that fail due to Reverse Polarity are not covered under warranty.

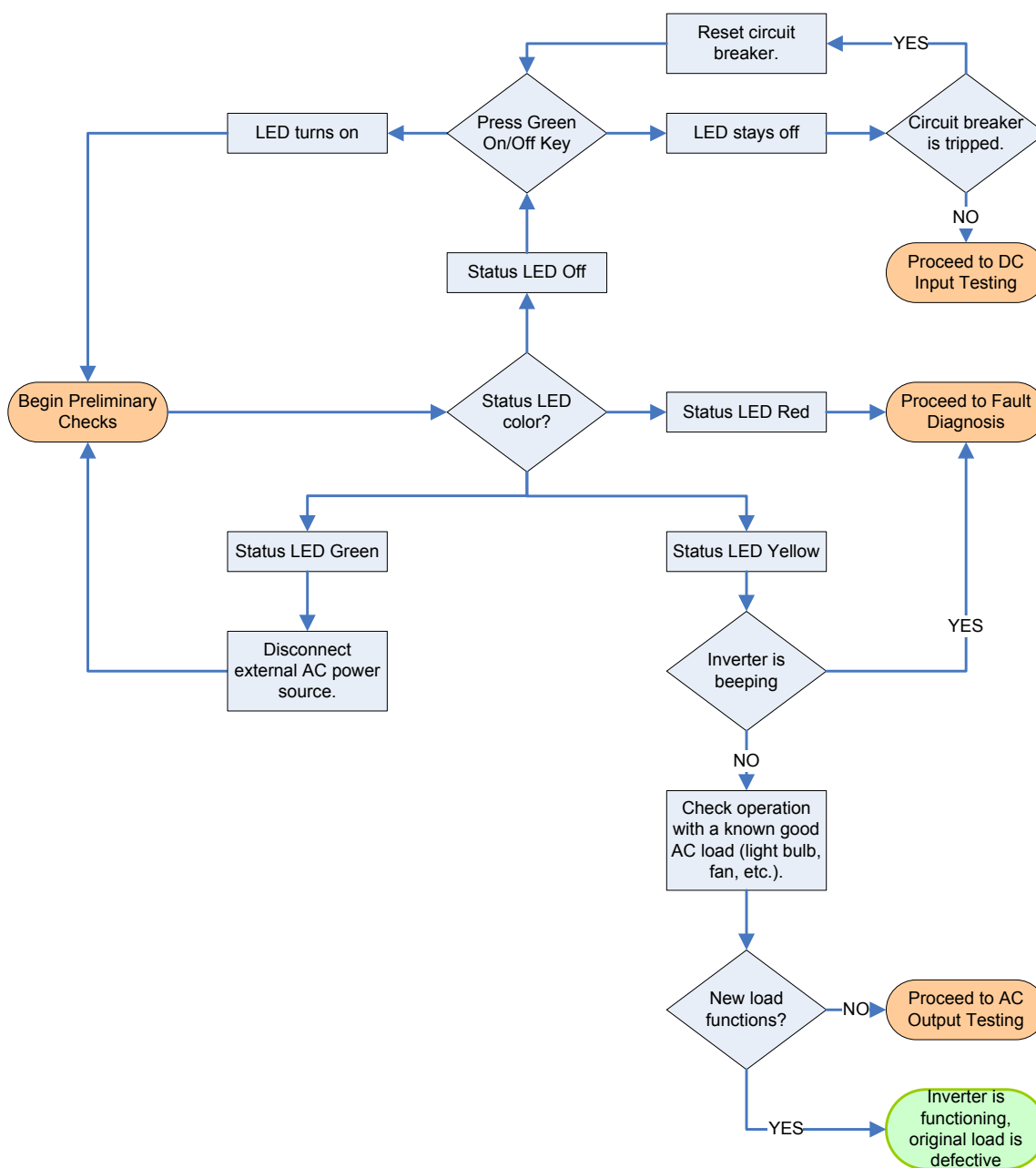
WARNING: ELECTRICAL SHOCK AND BURN HAZARD. Do not disassemble the Thermo King Power Inverter. The unit does not contain any user-serviceable components. Attempting to service the unit yourself could result in an electrical shock or burn.

DIAGNOSTIC FLOW CHART – PRELIMINARY CHECKS

Inverter Diagnosis Flow Chart Preliminary Checks

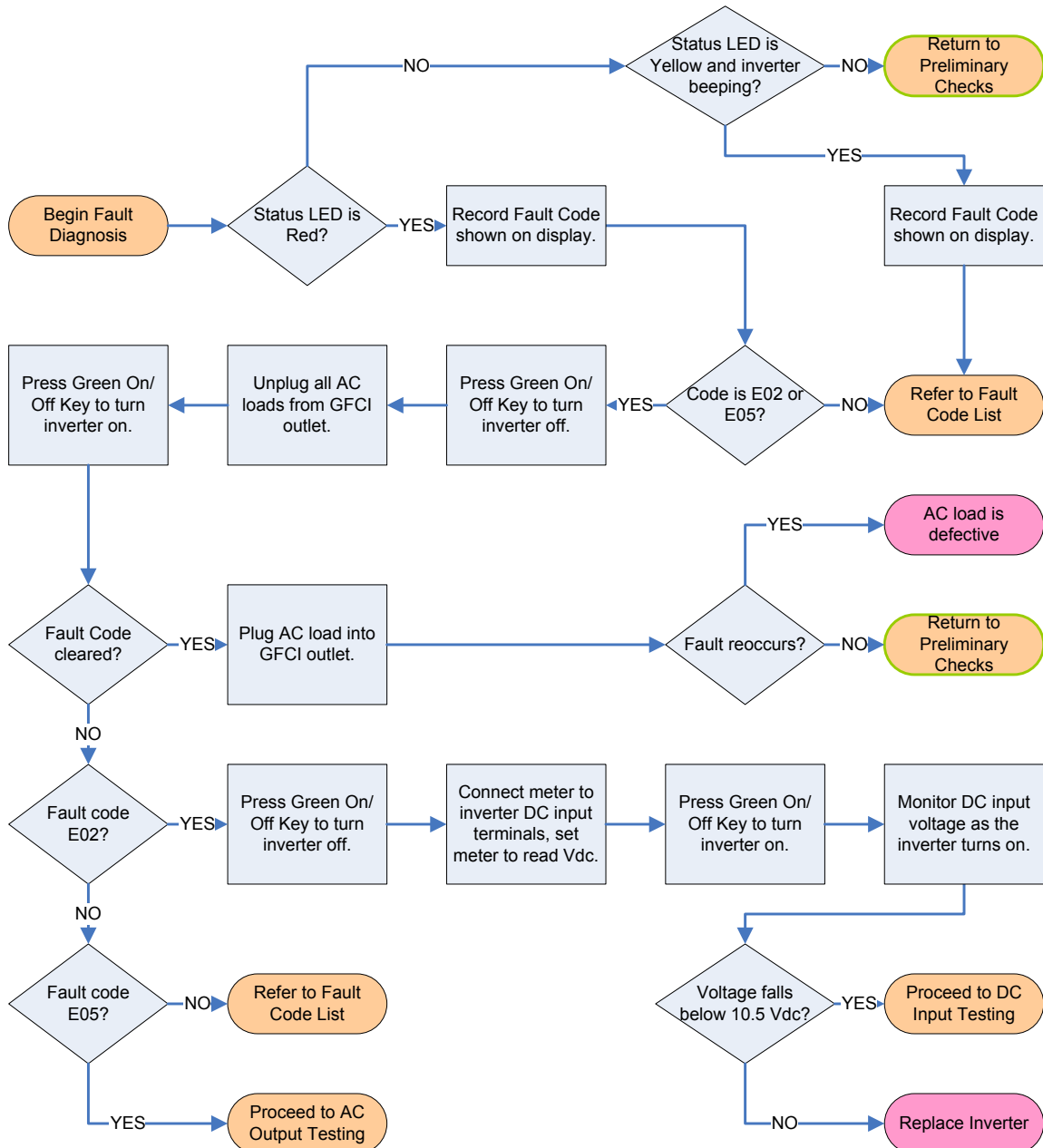
Driver complaint is that device plugged into inverter will not operate.

Begin diagnosis with Preliminary Checks. Follow the flow chart as you gather information about the inverter system. Use the “Inverter Test Result Form” to record your inspection results.



DIAGNOSTIC FLOW CHART – FAULT DIAGNOSTICS

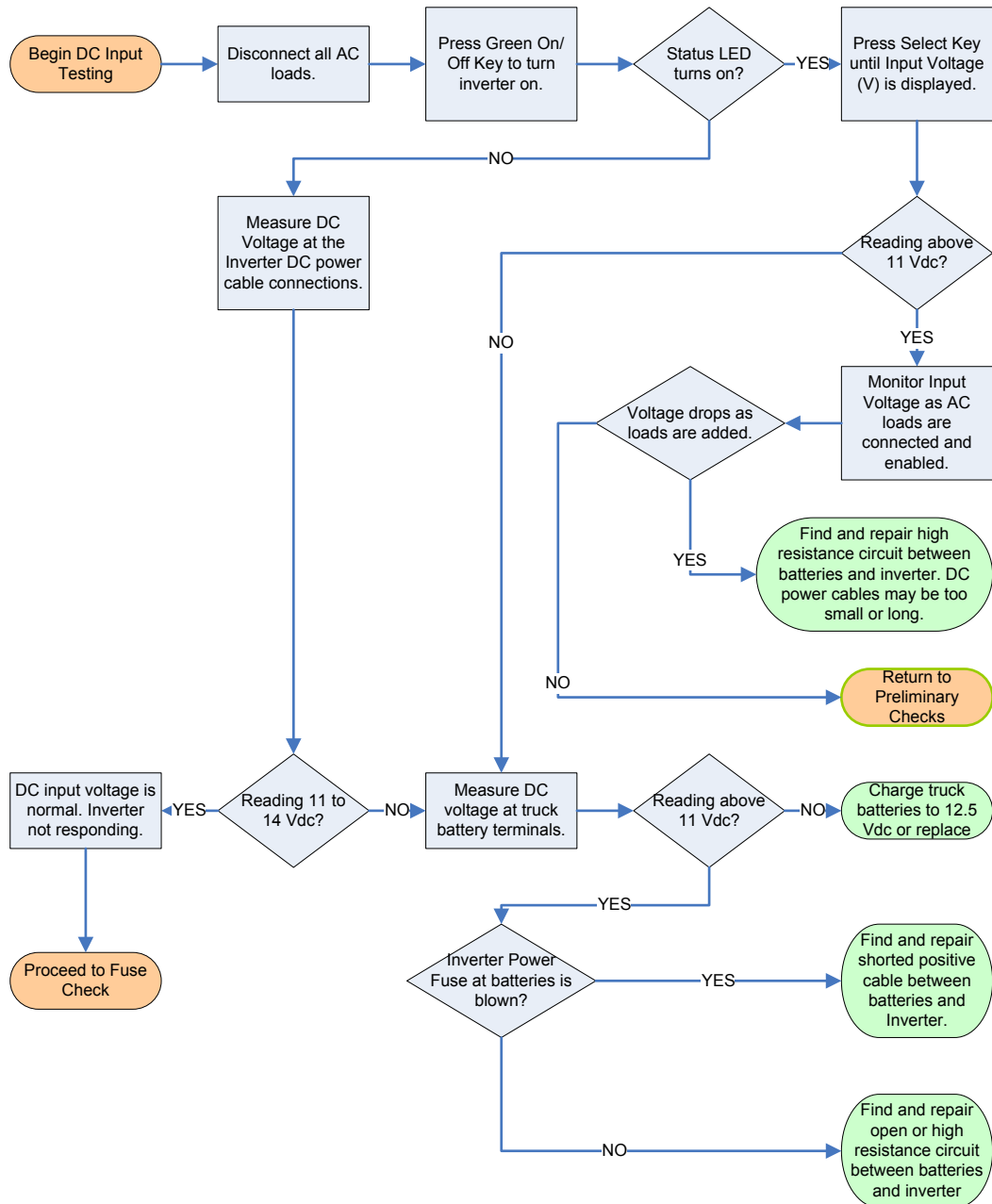
Inverter Diagnosis Flow Chart
Fault Diagnosis



Section 5 – TriPac EVOLUTION Diagnostics

DIAGNOSTIC FLOW CHART – DC INPUT TESTS

Inverter Diagnosis Flow Chart
DC Input Testing



NOTE: If DC Input Voltage drops as new AC loads are connected or enabled the DC Power Cables may be undersized for the cable length.

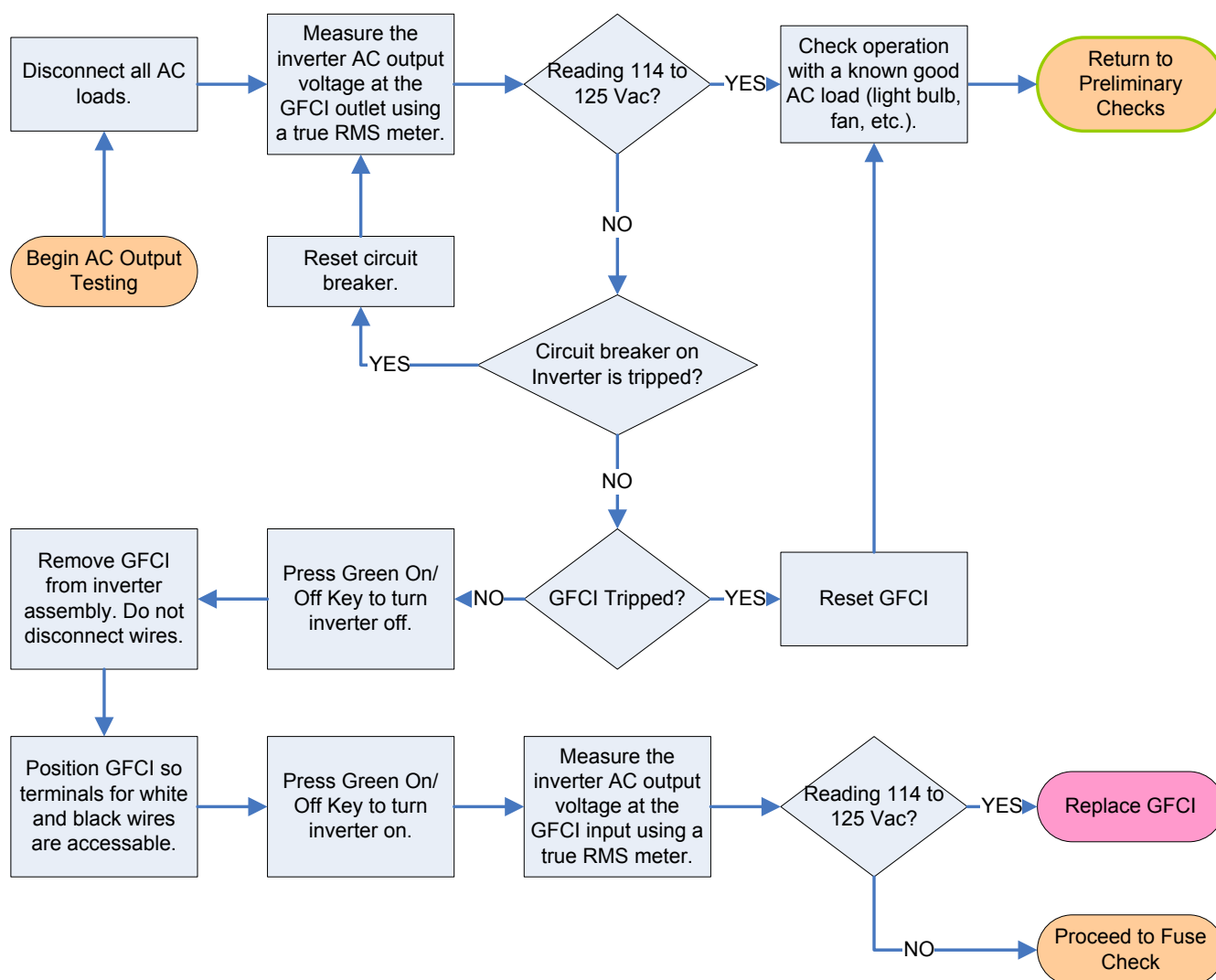
Section 5 – TriPac EVOLUTION Diagnostics

DIAGNOSTIC FLOW CHART – AC OUTPUT TESTS

Inverter Diagnosis Flow Chart AC Output Testing

WARNING: ELECTRICAL SHOCK AND BURN HAZARD. Do not disassemble the Thermo King Power Inverter. The unit does not contain any user-serviceable components. Attempting to service the unit yourself could result in an electrical shock or burn.

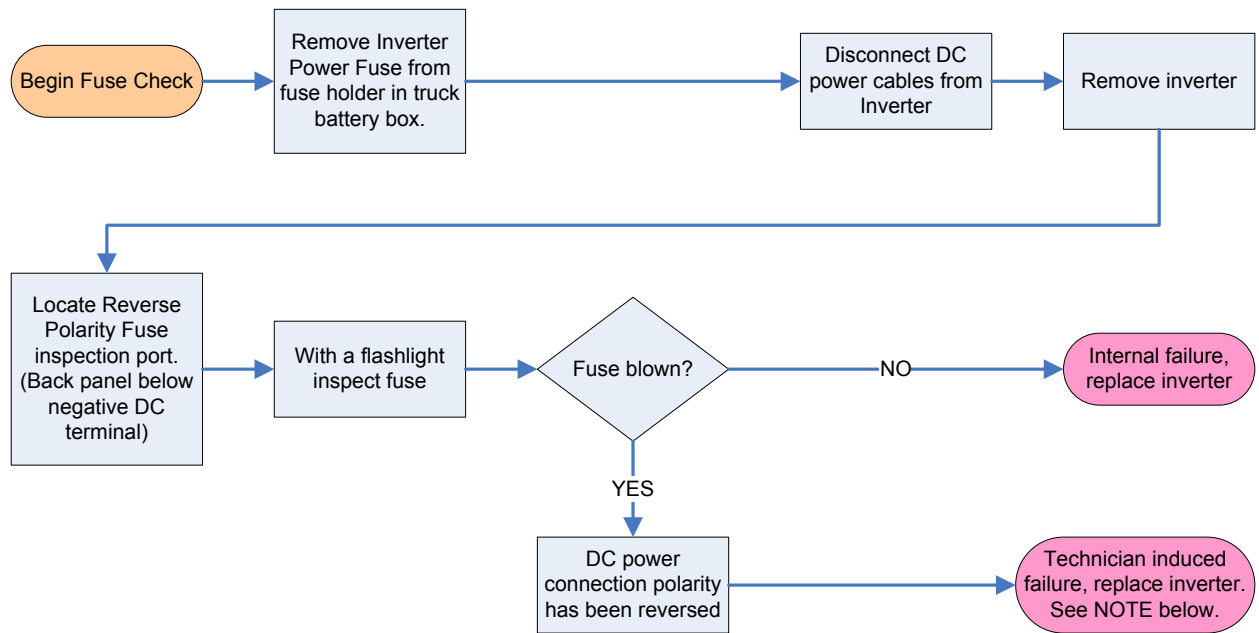
NOTE: Inverter AC Output voltage readings must be taken using a true RMS voltmeter such as Fluke Model 87 or 112. Other meters may not accurately read the modified sine wave output from the inverter. Reading will be lower than actual in the 96 to 104 Vac range.



DIAGNOSTIC FLOW CHART – FUSE CHECK

Inverter Diagnosis Flow Chart Fuse Check

WARNING: ELECTRICAL SHOCK AND BURN HAZARD. Do not disassemble the Thermo King Power Inverter. The unit does not contain any user-serviceable components. Attempting to service the unit yourself could result in an electrical shock or burn.



NOTE: The Power Inverter DC input is polarity sensitive. DC power connections to the inverter must be positive to positive and negative to negative. A reverse polarity connection (positive to negative) will permanently damage internal Inverter circuits and blow the Reverse Polarity Fuse. The Reverse Polarity Fuse is only an indicator of this condition. This fuse is not serviceable.

IMPORTANT: Inverters that fail due to Reverse Polarity are not covered under warranty.

Section 5 – TriPac EVOLUTION Diagnostics

Section 6 – TriPac EVOLUTION Service Procedures

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A05A	Clock Set (<i>See Service Procedure A51A Communication Using TK Monitor</i>)
A06A	Checking Software Revision (<i>See Service Procedure A51A Communication Using TK Monitor</i>)
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A51A	Communication Using TK Monitor
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Section 6 – TriPac EVOLUTION Service Procedures

Section 6 – TriPac EVOLUTION Service Procedure A03A

TriPac Interface Board Removal and Replacement

Where Used

All TriPac units

Purpose

This procedure is used when replacing the Interface Board.

Procedure

Remove the Interface Board from the Control Box			
Step	Action	Results	Comments
1	Turn the unit off at the HMI Control Panel.		
2	Remove the 50 amp System Power Fuse (F16) located in the APU.	This disconnects the battery voltage supply to the Interface Board #2 screw terminal and 2P circuit to the HMI.	Power is removed from the Interface Board and the HMI Control Panel.
3	Open the storage compartment in the truck cab sleeper compartment and locate the TriPac Control Box.		
4	Remove the screws that attach the Control Box to the bunk compartment.		
5	Position the Control Box for easy access.		
6	Remove the screws that attach the cover to the Control Box.		

Section 6 – TriPac EVOLUTION Service Procedure A03A

7	Remove all of the wiring harness wires from the Interface Board terminal boards.		
8	Disconnect the 2 Wire and CH Wire from the power terminals Interface Board.		Note the hardware stack when removing the wires. The hardware should be replaced in exactly the same order.
9	Remove the screws that attach the Interface Board to the bottom of the Control Box.		
10	Lift and remove the Interface Board from the Control Box.		

Replace the Interface Board in the Control Box			
Step	Action	Results	Comments
1	Position the replacement Interface Board in the Control Box.		
2	Install the screws that secure the Interface Board to the bottom of the Control Box.		
3	Connect all of the wiring harness wires to the Interface Board terminal boards.		
4	Connect the 2 Wire and CH Wire from the power terminals Interface Board. Torque the terminal screws to 18 in-lbs.		Connect the wires using the hardware in exactly the same order as it was removed. Failure to do so may result in a loose connection.

Section 6 – TriPac EVOLUTION Service Procedure A03A

Step	Action	Results	Comments
5	Position the cover on the Control Box. Insert the screws and tighten them.		
6	Position the Control Box inside the storage compartment. Insert the screws that attach the Control Box to the bunk compartment and tighten.		
7	Start and run the unit to confirm operation.		

Section 6 – TriPac EVOLUTION Service Procedure A03A

Section 6 – TriPac EVOLUTION Service Procedure A03B

Replacing the HMI Control Panel

Where Used

All TriPac Evolution Units

Purpose

This procedure is used to remove and replace the TriPac Evolution HMI Control Panel.

Procedure

HMI Control Panel Removal			
Step	Action	Result	Comments
1	Turn the unit off at the HMI Control Panel.	All icons and indicators should be off.	
3	Remove the 50 amp System Power Fuse (F16) located in the APU.	This disconnects the battery voltage supply to the Interface Board #2 screw terminal and 2P circuit to the HMI.	Power is removed from the Interface Board and the HMI Control Panel.
4	Place a screw driver tip in the slot in one of the locking tab releases on the bottom of the HMI Control Panel as shown on the next page. Pull forward on the HMI Control Panel while applying downward pressure on the locking tab.	The locking pin should release that end of the HMI from the mounting base. Repeat with the other locking tab.	The selector knobs do not need to be removed.
5	Repeat Step 4 with the other locking tab.	The HMI will swing out and up from the bottom.	
6	Unplug the harness connector from the HMI Control Panel.		

Section 6 – TriPac EVOLUTION Service Procedure A03B



HMI Control Panel Installation			
Step	Action	Result	Comments
1	Plug the harness into the new HMI Control Panel.		
2	Place the top of the HMI Control Panel onto the mounting base.		
3	Press the bottom of the HMI Control Panel onto the mounting base until the latches click.		
4	Install the 50 Amp System Power Fuse (F16) located in the APU.	This reconnects battery voltage supply to the Interface Board #2 screw terminal and the 2P circuit to the HMI Control Panel.	Power is supplied to the Interface Board and the HMI Control.
5	Turn the unit on with the HMI Control Panel.		
6	Verify HMI Control Panel operation to determine that the original problem has been fixed.		

Section 6 – TriPac EVOLUTION Service Procedure A26A

Welding on Systems Equipped with Microprocessors

Where Used

All TriPac Units

Purpose

To prevent damage to the Interface Board and HMI Control Panel during welding operations

Materials Required

- None

Operation

Electric welding generates high amperage currents that can damage electrical and electronic components. In order to minimize the possibility of damage the following procedures should be followed.

Before Welding

Step	Action	Result	Comments
1	Turn the unit off.		
2	Remove the TriPac battery cables from the truck batteries.		
3	Connect the welder ground cable as close as possible to the area where the welding is to be performed. Move the welder ground cable as required.		

Section 6 – TriPac EVOLUTION Service Procedure A26A

After Welding

Step	Action	Result	Comments
1	Reconnect the battery cables.		
2	Turn the unit on using the HMI Control Panel.		
3	Start and run the unit to verify operation.		

Section 6 – TriPac EVOLUTION Service Procedure A28A

Setting Unit Running Time Hourmeters

Where Used

TriPac Evolution Units

Purpose

This procedure should be followed to set the fixed running time hourmeters Total Engine, Total Cool and Total Heat after replacing an Interface Board with a new replacement Interface Board. If all hourmeters have less than 100 hours accumulated, time can be added to them as shown in this procedure. If any hourmeter exceeds 100 hours, the hourmeters can no longer be changed.

Materials Required

- PC computer with Internet Explorer 8 or higher.
- USB to Mini B interconnect cable.

IMPORTANT: Time can only be added if all hourmeters have less than 100 hours accumulated. If any hourmeter time exceeds 100 hours, the hourmeter time can no longer be changed.

IMPORTANT: If time in excess of 100 hours has been entered the hourmeters can no longer be changed. Exercise care when changing these hourmeter settings. Be sure the correct number of hours have been selected for each hourmeter.

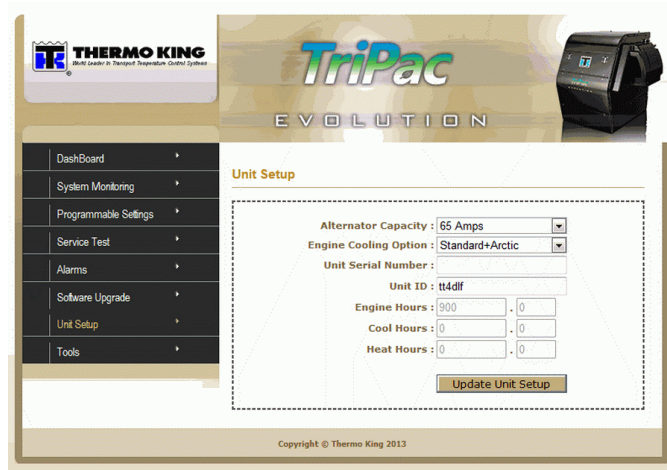
IMPORTANT: Do not click the Update Unit Setup button until all hourmeters have been set as required. Once the Unit Setup has been completed this menu is locked out and the hourmeters can no longer be changed. Leaving the Unit Setup screen does not save changes to any settings.

Setting Hourmeters

Step	Action	Result	Comments
1	Record the hourmeter readings from the existing Interface Board.	Use TK Monitor Dashboard	See Service Procedure A51A Communication Using TK Monitor.
2	Replace the Interface Board.		

Section 6 – TriPac EVOLUTION Service Procedure A28A

Step	Action	Result	Comments
3	Connect to TK Monitor.		See Service Procedure A51A Communication Using TK Monitor.
4	In the menu on the left side of the TK Monitor screen select Unit Setup.	Unit Setup screen should open.	Refer to Section 3 Software Description to determine correct settings.



PC Monitor Unit Setup

5	Change the readings of Total Engine, Total Cool and Total Heat to the values recorded from the original Interface Board.	Enter numbers into text boxes with computer keyboard.	NOTE: If any meter has exceeded 100 hours, all the readings are permanently locked and cannot be changed.
6	Select Update Unit Setup	A prompt will display stating "The Web page you are using is trying to close the window. Do you want to close the window?" Select Yes. The TK Monitor window disappears.	The internet Explorer window should close. NOTE: By selecting Update Unit Setup, hourmeters will be permanently locked and cannot be changed.
7	Disconnect from TK Monitor.		See Service Procedure A51A Communication Using TK Monitor.

Section 6 – TriPac EVOLUTION Service Procedure A50A

TriPac Evolution Data Logger

Where Used

All TriPac Evolution Units

Purpose

This procedure contains information on the TriPac Evolution Data Logger.

TriPac Evolution Data Logger

The TriPac Evolution Data Logger is a function of TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.

The TriPac Evolution Base Controller on the Interface Board contains a data logger. This data logger logs the system operating conditions every five minutes (default setting of DL Logging Interval) and will typically contain about 30 days of information. This information may be downloaded and saved using TK Monitor.

The timed log interval may be set from 1 minute to 15 minutes. Shorter intervals will provide more detailed information but use more memory, reducing the days of information. Longer intervals provide less detailed information but use less memory, increasing the days of information. Timed log interval does not affect event logging. The default setting is 5 minutes.

The data is downloaded and saved as a *.BIN file. TK Monitor does not currently have the ability to display this data.

At this time, data logger downloads can be viewed by Minneapolis Service and Engineering. These downloads are being used by Thermo King to better understand customer use and system operation. Downloads for a specific unit under repair may be requested by Minneapolis Service and Engineering.

Downloads can be attached to an email and sent to the Minneapolis Service Department for evaluation. Please contact David Palm at 866-776-2708 before sending downloads.

Section 6 – TriPac EVOLUTION Service Procedure A50A

Communication Using TK Monitor

Where Used

All TriPac EVOLUTION Units

Purpose

External communication with the Controller is available through the TK Monitor interface. It will use the USB plug (J39) on the Interface Board and a USB cable with a Mini B connector (P/N 204-2000). Communication will require the use of an IBM compatible PC service computer with Microsoft Internet Explorer 8.0 or higher. TK Monitor communication software is in the Controller on the Interface Board and will export information to the service computer. No additional software must be installed on the service computer to retrieve and view this information. TK Monitor will provide a system interface to flash load system upgrades, program system features, view real time system information, operate Service Test Mode and allow alarm clearing capabilities.

For detailed information about accessing the TK Monitor features refer to the instructions later in this procedure.

Materials Required

- PC computer with Internet Explorer 8 or higher.
- USB to Mini B interconnect cable. (204-2000)

Section 6 – TriPac EVOLUTION Service Procedure A51A

Menus

The following menu choices on the left side of each TK Monitor screen allow direct access to desired system features:

Dashboard

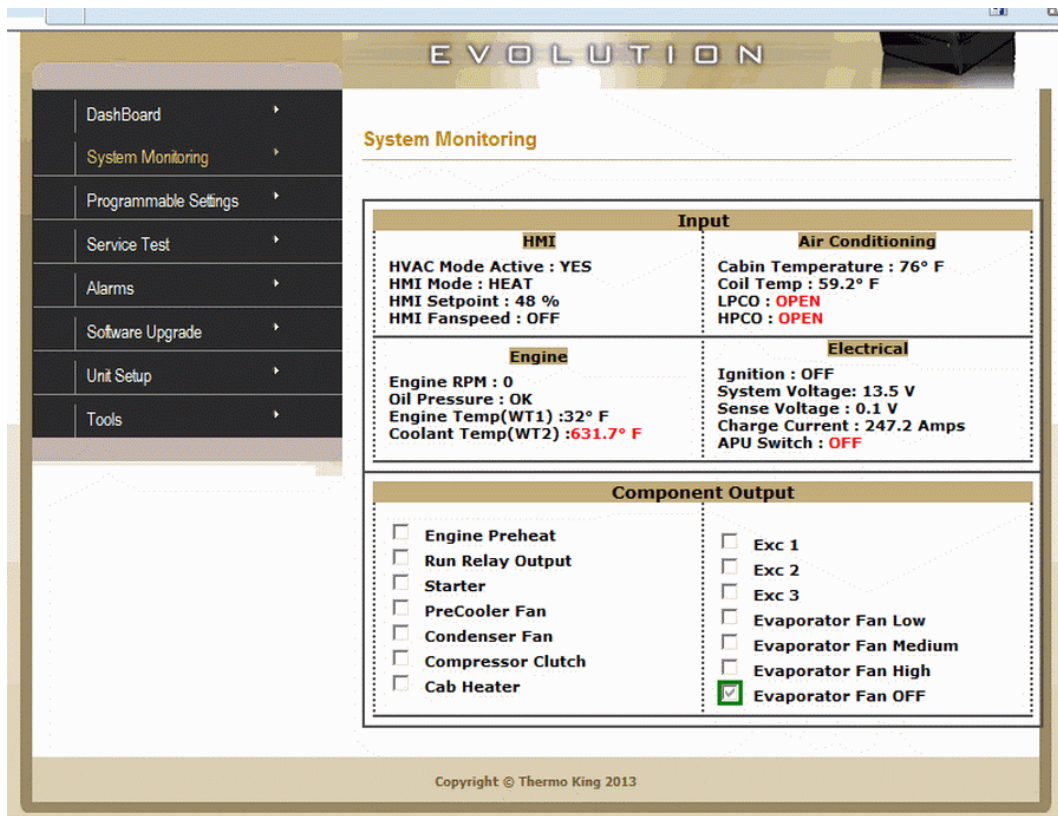
When TK Monitor is started the Dash Board screen will always appear first. This screen provides the technician quick access to basic operating information such as APU engine status, A/C or Heat operation, system electrical status, hour meters, and alarm status.



Section 6 – TriPac EVOLUTION Service Procedure A51A

System Monitoring

The TriPac EVOLUTION System Monitoring screen provides the technician with detailed real time system information to evaluate the operation of different areas of unit. This expanded system information can be helpful when diagnosing system issues. System Monitoring used in combination with Service Test can provide diagnostic information based on known operating conditions.



System Monitoring information is divided into two main sections. Red numbers indicate values that are changing.

Input

HMI = Indicates the current settings of the HMI Control Panel.

Engine = Indicates current engine RPM, oil pressure switch status and engine coolant temperatures.

Air Conditioning = Indicates system temperatures and pressure switch status.

Electrical = Indicates volt and amp readings for the system along with the position of some control switches.

Component Output

An X in the box indicates a component output has been energized by the control system.

Section 6 – TriPac EVOLUTION Service Procedure A51A

Programmable Settings

This screen provides a central location to view or change the value for all of the programmable features. Refer to Section 3, Software Description for information about the available programmable features. Select a feature. Click on the arrows to scroll up or down to the desired setting. New settings for multiple features may be selected. All changes will be saved when the Update Setup button is clicked.

The system will automatically perform a Warm Restart so the new settings can take effect. TK Monitor will lose communication and must be restarted.

Programmable Settings

Temperature Settings : ☒ FAHRENHEIT ☐ CELSIUS
Switch To Monitor : ☒ YES ☐ NO

Charge Current Shutoff Value : 20 Amps
Engine Off Delay Timer : 8 Mins
DL Logging Interval : 5 Mins
HMI Display Brightness : 7
Run Time Period : 0
Cooling Dead Band : 3 F
Battery Voltage Restart Value : 12.1 Volts
Low Temp Limit Cool : 65 F
High Temp Limit Cool : 81 F
Low Temp Limit Heat : 50 F
High Temp Limit Heat : 81 F

Real Time Clock: Friday 19 April 2013 07:36:10
☐ Set System Clock
Update Setup

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Section 6 – TriPac EVOLUTION Service Procedure A51A

Service Test Mode

The Service Test Mode screen in TK Monitor allows the technician to force the system into a specific operating mode for up to 15 minutes. This ability can be helpful when diagnosing system issues. Available tests are; Cool Mode, Heat Mode, Fan Only Mode, Alternator Output and Run In. The current test must be canceled before selecting a new one. If a Service Test is initiated while the system is running the current operation will terminate and the selected mode will begin.



Once selected, a test will be active for 15 minutes. “Running Service Test” will display in the upper right of the screen while a test is active. Once a test is selected the “Run Test” button will change to “Cancel Test”. When changing to a new test the current test must first be canceled. If the test is not canceled before the timer has expired, an alarm code 54 shutdown will generate. If any shutdown alarm occurs during the test the unit will record the alarm, exit Service Test Mode and shut down. When the alarm is cleared the unit will return to operation with the settings stored prior to entering Service Test Mode. Following is a description of the available modes.

Section 6 – TriPac EVOLUTION Service Procedure A51A

While operating in a Service Test Mode the Dashboard, System Monitoring and Alarm screens are available. This will allow the technician to gather real time diagnostic information. Shutdown alarms are still actively protecting the system.

NOTE: Operator should wait for system response before selecting new setting or changing to a new screen.

Cool Mode Test:

The APU engine will start or continue to run. The compressor, evaporator fan and condenser fan are turned on. The evaporator fan will run at the driver selected speed (default minimum low speed). Fan speed may be changed at the HMI while in the test. Setpoint and cab temperature are not monitored. The compressor may start and stop during the test based on the Low Pressure Cutout (LPCO) or evaporator coil temperature below 32 F. The functions of heat mode are disabled. When the optional 120 amp alternator is installed and 120 Amps option selected during Unit Setup, load management is required as in regular cool mode. See Section 4, Engine Load Management.

Heat Mode Test:

The interface board heat output circuit (YEL, J13-2) is turned on. The HMI setpoint setting is set to maximum (90 F [32 C]). If cab temperature is higher than the maximum the heater will not start. The other functions of Fan and Cool modes are disabled. The APU engine will not run. When Heat Mode Test is terminated the heater will enter a cool down mode.

Fan Only Mode Test:

Evaporator, condenser and pre-cooler fans are on. Evaporator fan speed can be changed at the HMI. The other functions of Heat and Cool modes are disabled. The APU engine will not run.

Section 6 – TriPac EVOLUTION Service Procedure A51A

Alternator Output Test:

The APU engine will start or continue to run. Air conditioning compressor operation is disabled. Engine Load Management system is temporarily disabled. This allows the optional 120 amp alternator to charge at full output even in high ambient conditions.

Run In Test:

Use after new unit installation to perform the required 10 hour engine run in. This test allows the air conditioning system to continue operating to load the engine when ambient and/or cab temperature is low. This is done by allowing the heater to run while air conditioning.

The test mode will initiate a 10 hour timer. The engine will start or continue to run. The air conditioning system will be activated. Setpoint will be set to 60 F. Evaporator Coil and Cab Temperature sensors along with pressure switches are functional. Compressor may cycle based on setpoint, cab temperature, coil temperature and system pressure. Heat system will also be activated. Setpoint will be set to 80 F. It is intended to keep cab temperature high enough for the air conditioning system to operate. Engine Load Management will be active if the 120 Amps option was selected during Unit Setup.

TK Monitor may be turned off and computer disconnected while Run In Test is running. At the end of the 10 hour run in period the system will shut down with an alarm in the [ENG] group. It will be a code 54, Test Mode Timeout. Turning system off at the HMI will clear the alarm. Best practice would be to reconnect TK Monitor. Verify there are no additional alarms and that the hour meter reads 10 hours. The code 54 should be cleared.

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Alarm

The Alarm screen allows the technician to view alarm history and clear alarms. Alarms that are cleared from the HMI will remain on the list as inactive and can be cleared along with the active alarms through the Alarm screen. The screen will indicate the level of each alarm. It will also allow alarms to be cleared individually or as a complete list. Cleared alarms remain in data logger memory. Alarm history may be viewed in a download.

Alarm Code	Alarm Type	Alarm Title	Action
254	CHECK	WT2 (Auxiliary) Inlet Water Temperature	Clear
61	SHUTDOWN	Low or High Battery Voltage	Clear

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Section 6 – TriPac EVOLUTION Service Procedure A51A

Software Upgrade

The currently installed software revisions for controller, HMI and TK Monitor will be listed. Software upgrades can be flash loaded for the Controller or HMI. Software for TK Monitor can also be upgraded through this screen. For detailed information about specific system software features refer to Section 3, Software Description. Also review the Service Bulletin published at the time of software release.

THERMO KING
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TriPac

EVOLUTION



- DashBoard
- System Monitoring
- Programmable Settings
- Service Test
- Alarms
- Software Upgrade**
- Unit Setup
- Tools

Software Upgrade

Select The File For Upgrade:

Current Version

Controller :	41.01
Human Machine Interface (HMI) :	42.01
TK Monitor :	43.01

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Section 6 – TriPac EVOLUTION Service Procedure A51A

Unit Setup

This screen provides access to unit configuration and identification settings. These settings will typically be made when the unit is installed. Failure to setup the unit to match the hardware configuration will cause operating issues. Failure to program unit information will make datalogger files difficult to identify. Refer to Section 3, Software Description for information about all available configuration settings.

THERMO KING
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TriPac
EVOLUTION

Unit Setup

Alternator Capacity : 65 Amps

Engine Cooling Option : Standard+Arctic

Unit Serial Number :

Unit ID : tt4dlf

Engine Hours : 900

Cool Hours : 0

Heat Hours : 0

Update Unit Setup

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Section 6 – TriPac EVOLUTION Service Procedure A51A

Tools

This is a technician access Tools screen. It provides access to advanced system service functions. Click on Tools. A box will appear that says “Enter Security PIN”. Click in the box and type 4444, click OK.

NOTE: During normal system monitoring and diagnosis it is not necessary to enter this screen.



Datalogger

Selecting the Datalogger button will allow downloading the information recorded in the controller memory to the attached PC computer. TriPac EVOLUTION data logger files are BIN format and cannot be directly viewed. See Service Procedure A50A TriPac EVOLUTION Data Logger in this section.

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Restarts

Warm Restart: Performing a Warm Restart will reboot the controller on the Interface Board. This is a “soft” restart that is equivalent to power cycling the Interface board (turning system off at the HMI or removing power from #2 terminal). Hour meters, data logger and programmable settings are retained. A Warm Restart may be required after installing a software update.

Cold Restart: Performing a Cold Restart will reboot the controller on the Interface Board and reset all software parameters to their default setting. Data logger information will be lost. Programmable settings will return to default value. Hour meters are retained. Before performing a Cold Restart the programmable feature settings should be recorded and data logger downloaded if possible.

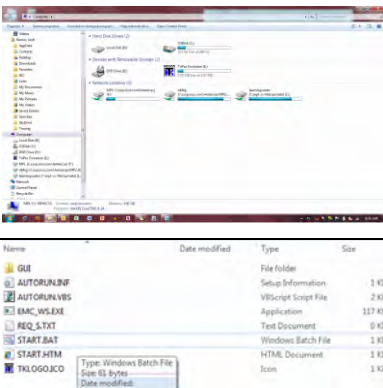
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Operation Instructions

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Section 6 – TriPac EVOLUTION Service Procedure A51A

Connect To TK Monitor

Step	Action	Result	Comments
1	Remove cover from the Control Box		
2	Connect the TK Monitor Adapter Harness (P/N 204-2000) to the J39 plug on the Interface board.		May use USB cable with Mini B connector. Do not connect to PC computer at this time.
3	Turn system on at HMI.	Wait for selected mode icon to stop flashing.	
4	Verify the green LED indicator on the Interface board is flashing.	Should be flashing about once per second.	On power up LED will flash rapidly for a few seconds then rate should return to normal.
5	Start the PC computer.		Wait for the computer to complete the startup process.
6	Connect the TK Monitor Adapter Harness to a USB port on the computer.	The computer will recognize the TriPac EVOLUTION system as a new external data drive. Similar to a USB Flash Drive	Usually drive letter "E" with a TK logo named TriPac EVOLUTION.
7	Use "My Computer" or "Windows Explorer" to locate and double click the new data drive.		START.BAT should be the first of the two start files.

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Step	Action	Result	Comments
8	In the new drive locate and double click the START.BAT file.	An Internet Explorer window should open and display the TK Monitor Dashboard screen. 	NOTE: The computer does not need to be connected to the Internet.

Disconnect From TK Monitor

Step	Action	Result	Comments
1	If operating in Service Test Mode select Cancel Test in the Service Test screen.	Returns TriPac EVOLUTION system to normal operation.	
2	Exit TK Monitor by closing the Internet Explorer window.	Terminates communication with the TriPac EVOLUTION system.	
3	Disconnect the Adapter Harness from the computer.	TK Monitor data drive will terminate.	
4	Disconnect the Adapter Harness from the Interface board.		
5	Shutdown the PC computer.		
6	Replace the Control Box cover.		
7	Verify proper unit operation.		

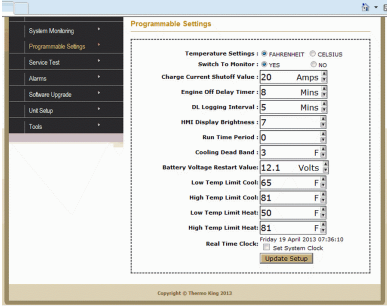
Section 6 – TriPac EVOLUTION Service Procedure A51A

View and Clear Alarms

Step	Action	Result	Comments
1	Connect to TK Monitor.		
2	In the menu on the left side of the TK Monitor screen select Alarms.	Alarm screen should open. It will display the Alarm Code, Type and Title of the listed alarms. 	If there are no alarms the screen will show “No Active Alarms”. The grid will not display.
3	Record the listed alarms.	Red = Active, Shutdown Yellow = Active, Check or Log Gray = Inactive, cleared at HMI	Refer to Alarm Code Diagnosis, Section 5.
4	Clear individual alarms by selecting a Clear button in the Action column.	The alarm will be removed from the list.	
5	Clear all alarms by selecting the Clear All button.		
6	Alarms have been cleared.	Select a new function from the left menu or refer to Disconnect From TK Monitor.	All alarms are recorded by the data logger as they occur.

Section 6 – TriPac EVOLUTION Service Procedure A51A

Record or Setup Programmable Features

Step	Action	Result	Comments
1	Connect to TK Monitor.		
2	In the menu on the left side of the TK Monitor screen select Programmable Settings.	Programmable Settings screen should open. 	Programmable Feature setup should be done as part of new unit installation. It will setup the software settings to match customer requirements and set Real Time Clock.
3	Note the programmable feature settings.	If correct: select a new function from the left menu or refer to Disconnect From TK Monitor. If incorrect: proceed to next step.	Refer to Section 3, Software Description, Programmable Features.
4	To change setting: Select the desired setting.	Press up/down arrow to scroll through options.	Do not select Update Setup until all desired changes have been selected.
5	Note Real Time Clock.	If correct: proceed to next step. If incorrect: Select the check box next to Set System Clock.	The Real Time Clock will be reset to match the connected computer. There is no ability to set a different time.
6	Select Update Setup	A prompt will display stating “The Web page you are using is trying to close the window. Do you want to close the window?”. Select Yes. The TK Monitor window disappears.	The internet Explorer window should close.
7	Disconnect the Adapter Harness from the computer.		Refer to Disconnect From TK Monitor steps 4 – 7.

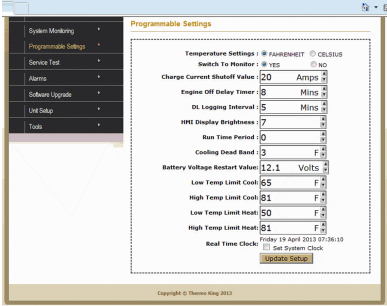
Section 6 – TriPac EVOLUTION Service Procedure A51A

Unit Setup

Step	Action	Result	Comments
1	Connect to TK Monitor.		
2	In the menu on the left side of the TK Monitor screen select Unit Setup.	Unit Setup screen should open. 	Unit setup should be done as part of new unit installation. It will setup the software to match the system hardware.
3	Note the programmable feature settings.	If correct: select a new function from the left menu or refer to Disconnect From TK Monitor. If incorrect: proceed to next step.	Refer to Section 3, Software Description, Unit Setup.
4	Change setting for Alternator Capacity and Engine cooling Option.	Select the desired setting. Press up/down arrow to scroll through options.	Do not select Update Unit Setup until all desired changes have been selected.
5	Enter unit identification information.	Click on Unit Serial Number box, type in serial number. Click on Unit ID box, type in truck number.	Serial number from unit serial plate. Unit ID any six digit number, typically truck number.
6	Select Update Unit Setup	A prompt will display stating "The Web page you are using is trying to close the window. Do you want to close the window?". Select Yes. The TK Monitor window disappears.	The internet Explorer window should close.
7	Disconnect the Adapter Harness from the computer.		Refer to Disconnect From TK Monitor steps 4 – 7.

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Set Real Time Clock

Step	Action	Result	Comments
1	Connect to TK Monitor.		
2	In the menu on the left side of the TK Monitor screen select Programmable Settings.	Programmable Settings screen should open. 	
3	Note Real Time Clock.	If correct: select a new function from the left menu or refer to Disconnect From TK Monitor. If incorrect: proceed to next step.	
4	Select the check box next to Set Real Time Clock.	The Real Time Clock will be reset to match the connected computer.	There is no ability to set a different time.
5	Select Update Setup	A prompt will display stating "The Web page you are using is trying to close the window. Do you want to close the window?". Select Yes. The TK Monitor window disappears.	The Internet Explorer window should close.
6	Disconnect the Adapter Harness from the computer.		Refer to Disconnect From TK Monitor steps 4 – 7.

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Check Software Revision

Step	Action	Result	Comments
1	Connect to TK Monitor.		
2	In the menu on the left side of the TK Monitor screen select Software Upgrade.	Software Upgrade screen should open. 	“Loading Current Version” will momentarily appear while current version information is retrieved.
3	Under Current Version, note the installed component software revisions.	If correct: select a new function from the left menu or refer to Disconnect From TK Monitor. If incorrect: proceed to Upgrade System Software.	Refer to Section 3, Software Description. Controller = 41.xx HMI = 42.xx TK Monitor = 43.xx

Section 6 – TriPac EVOLUTION Service Procedure A51A

Upgrade System Software

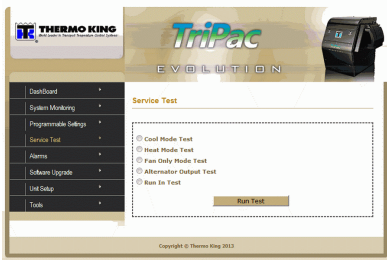
Step	Action	Result	Comments
1	Download software upgrade file from Thermo King Info Central.	Save software upgrade file to the PC computer. Unzip and save expanded files to a known location.	Recommendation: Create a file folder dedicated to TriPac EVOLUTION software upgrade files.
2	Connect to TK Monitor.		
3	In the menu on the left side of the TK Monitor screen select Software Upgrade.	Software Upgrade screen will open. 	
4	Verify current software revisions to determine if a software upgrade is required.		Refer to Service Bulletin for the planned software upgrade.
5	Beside “Select The File For Upgrade” select the Browse button.	A file search dialog box will open. Locate the software upgrade file saved in step 1.	Note: Only the software for one component; Controller, HMI or TK Monitor can be flash loaded at one time. Should start with TK Monitor unless instructed otherwise.
6	Open the selected software upgrade file.		
7	A “Percentage Complete” message will appear on the Software Upgrade screen.	Indicates progress of the flashloading process.	Flash load of each component should take 20 to 45 seconds. Green LED may flash rapidly.

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Step	Action	Result	Comments
8	A “Flashload Complete” window will appear. The Controller will automatically perform a Warm Restart.	A prompt will display stating “The Web page you are using is trying to close the window. Do you want to close the window?”. Select Yes. The TK Monitor window disappears.	Note: When HMI software is updated, the controller will turn off. You will have to turn the system on by pressing the HMI power button.
9	Restart TK Monitor to verify updated revision.	Software revision numbers should have changed to the expected level.	Refer to Service Bulletin for the planned software upgrade. Note: A Cold Restart of the Controller may be required.
10	Close TK Monitor or continue with other tasks.		Refer to Disconnect From TK Monitor.

Section 6 – TriPac EVOLUTION Service Procedure A51A

Operate Service Test Mode

Step	Action	Result	Comments
Enter Service Test Mode			
1	Connect to TK Monitor.		
2	In the menu on the left side of the TK Monitor screen select Service Test.	Service Test screen will open. 	
3	From the list select the desired test.		For details of test functions refer to Service Test Mode earlier in this section.
4	Select the Run Test button.	The system should operate in the selected test mode. “Running Service Test” will appear in the upper right of the screen.	System will operate in selected mode for 15 minutes. Alarm code 54 shutdown will then generate.
View System Information During Service Test			
1	Enter Service Test Mode		
2	In the menu on the left side of the TK Monitor screen select System Monitoring.	The screen will open. “Running Service Test” will appear in the upper right of the screen. System will continue to operate in the selected test mode.	All sections of System Monitoring are available and displaying current information.
3	In the menu on the left side of the TK Monitor screen select Service Test.	Returns to the Service Test when done reviewing information.	

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Step	Action	Result	Comments
Change Test or Exit Service Test Mode			
1	In the menu on the left side of the TK Monitor screen select Service Test.	Returns to the Service Test when done reviewing information.	
2	Select the Cancel Test button	The currently running test is terminated.	System will return to normal operation.
3	To exit Service Test screen: In the menu on the left side of the TK Monitor screen select a new function.		Exiting the Service Test screen will not terminate a running test. Refer to step 2.
4	To change to a new test: From the list select the desired new test.		A running test must be terminated before a new test can be started. Refer to step 2.
5	Select the Run Test button.	The system should operate in the selected test mode. "Running Service Test" will appear in the upper right of the screen.	System will operate in selected mode for 15 minutes. Alarm code 54 shutdown will then generate.

Section 6 – TriPac EVOLUTION Service Procedure A51A

Controller Cold Restart

Step	Action	Result	Comments
1	Connect to TK Monitor.		
2	In the menu on the left side of the TK Monitor screen select Tools.	A box will appear that says "Enter Security PIN". Click in the box and type 4444, click OK.	
3	The Tools screen will appear. Select Restarts		CAUTION: A Cold Restart is not a normal service procedure. It should only be performed when directed by Minneapolis Service or a published service bulletin.
4	From the list select Cold Restart		A Cold Restart will reboot the Controller and reset all software parameters to their default setting. Data logger information will be lost.
5	Select the Update button.	A prompt will display stating "The Web page you are using is trying to close the window. Do you want to close the window?" Select Yes. The TK Monitor window disappears.	The Internet Explorer window should close.
6	Disconnect the Adapter Harness from the computer.		Refer to Disconnect From TK Monitor steps 3 – 7.

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Download Data Logger

Step	Action	Result	Comments
1	Connect to TK Monitor.		
2	In the menu on the left side of the TK Monitor screen select Tools.	A box will appear that says “Enter Security PIN”. Click in the box and type 4444, click OK.	
3	The Tools screen will appear. Select Datalogger.		
4	Select “Download Datalogger”		
5	System will generate a datalog file.		The file will be a *.BIN file. TK Monitor cannot display these files at this time.
6	A “File Download” box will display. Select Save. Choose a file name and save location.	Rename file with a short descriptive name with no spaces. File extension must remain .bin. Save to a location that you can find again. 	Recommendation: Create a file folder dedicated to TriPac EVOLUTION data logger files. Default file name is DATALOG.bin.
7	Close the TK Monitor window.		Refer to Connect To TK Monitor steps 7 and 8.
9	Re-launch TK Monitor or disconnect computer.		Refer to Disconnect From TK Monitor steps 3 – 7.

Section 6 – TriPac EVOLUTION Service Procedure D01A

Unit Temperature Sensor Test

Where Used

All TriPac EVOLUTION Units

Purpose

To confirm the proper operation of the unit temperature sensors and circuits

Materials Required

Fluke Digital Multi-meter or equivalent

Operation

The system sensors are thermistor type that change resistance as the temperature changes. They are not polarity sensitive. Resistance values can be measured using a high quality ohmmeter. Value may be compared to a table to directly determine the represented temperature. The following tables represent normal sensor resistance value vs. temperature. Verify you are using the correct table for the sensor you are testing.

ATS & CTS

°F	°C	Ohms
-20	-29	166,356
-10	-23	115,757
0	-18	86,501
10	-12	61,737
20	-7	47,070
30	-1	34,374
32	0	32,650
40	4	26,688
50	10	19,904
60	16	15,002
70	21	11,994
80	27	9,166
90	32	7,402
100	38	5,775
113	45	4368

WT1 & WT2

°F	°C	Ohms
0	-18	680
20	-7	775
32	0	820
50	10	900
70	21	975
77	25	1000
90	32	1055
122	50	1225
167	75	1450
212	100	1670
230	110	1775

Section 6 – TriPac EVOLUTION Service Procedure D01A

Ambient Temperature Sensor (ATS)

This sensor monitors the outside air temperature. The sensor is located on the condenser coil housing and is connected directly to the Interface Board connector J2. The Ambient Air Temperature Sensor is connected to the Interface Board via the ATS & ATS_RTN wires.

Evaporator Coil Temperature Sensor (CTS)

This sensor monitors the temperature of the evaporator coil. The sensor is located in the Evaporator coil and is connected to the Interface Board connector J14. The Evaporator Coil Temperature Sensor is connected to the Interface Board via the COILSEN & COILSEN_RTN wires.

Engine Coolant Temperature Sensors (WT1 & WT2)

These sensors monitor engine coolant temperature. WT1 is in the engine thermostat housing. It is connected to the Interface Board connector J14 via the WT1 & WT1_RTN wires. WT2 is in the coolant returning from the truck engine. It is connected to the Interface Board connector J6 via the WT2 & WT2_RTN wires.

Sensor Failure

An ATS or CTS failure is defined by an out of range sensor reading that is greater than 170°F (77°C) or less than -38°F (-39°C). A WT1 or WT2 failure is defined by an out of range sensor reading that is greater than 300°F (149°C) or less than -58°F (-50°C). This is typically caused by an open or shorted sensor or sensor circuit. If this occurs the alarm code for that sensor will be set. Use TK Monitor to check the sensor reading and clear the alarm.

A sensor that is reading high will have abnormally high resistance in the circuit. An open or disconnected sensor circuit will read 1811°F in TK Monitor.

A sensor that is reading low will have abnormally low resistance in the circuit. It may be shorted. A shorted or bypassed sensor circuit will read dashes in TK Monitor.

Section 6 – TriPac EVOLUTION Service Procedure D01A

Diagnostic Procedure

Step	Action	Result	Comments
1	Locate the plug connector on the Interface Board for the sensor. Disconnect the sensor to be tested from the Interface Board.		
2	Using a high quality meter check the resistance of the sensor harness and sensor.	The resistance should match the table.	This verifies a complete sensor circuit and checks the accuracy of the sensor.
3	If circuit resistance is normal, check continuity from each wire to chassis ground.	The meter should read OL.	This verifies that the circuit is not shorted to chassis ground.
4	If circuit resistance is not normal, disconnect the sensor. bypass the sensor by connecting the harness wires together and retest.	Resistance is less than 10 ohms = Replace the sensor. Resistance is greater than 10 ohms or reads OL = Harness has high resistance connections or is open. Test and repair the harness as required. See Service Procedure H04A for additional information.	This isolates a defective harness from a defective sensor.
5	If the sensor harness and sensor resistance is normal place a voltmeter on the positive and negative terminals of the sensor plug on the Interface Board.	If output voltage is 5 VDC retest the harness. If output voltage is 0 VDC the Interface Board is defective.	This verifies the Interface Board sensor circuit has power and ground. Refer to Plug Pinout and Location Diagrams in Section 2 Hardware Description.

Section 6 – TriPac EVOLUTION Service Procedure D01A

Section 6 – TriPac EVOLUTION Service Procedure D05A

Checking the Air Heater Overheat Sensor and Flame Sensor

Where Used

All TriPac Air Heaters

Purpose

To confirm the proper operation of the TriPac Air Heater Overheat Sensor and Flame Sensor

Materials Required

Fluke Digital Multi-meter or equivalent

TriPac Air Heater Over-heat Sensor and Flame Sensor

These sensors change resistance as the temperature changes. The tables at the back of this procedure show the minimum and maximum resistance (in Ω) at specific temperatures (in degrees F and C) for the Overheat Sensor and Flame Sensor. The resistance can be measured directly using a high quality multi-meter.

Sensor Assembly Both sensors are part of a common assembly located at the rear of the heater body behind the glow pin. To access the sensors, open the heater housing and remove the control unit. The sensor leads are routed to connectors on the control unit. To replace the sensors, release the wire sensor clamp and remove the sensors.

Sensor Connectors There are three wires terminated in two connectors at the control unit. The green and brown wires terminate at a green connector shell and are connected to the flame sensor. The brown wire is common to both sensors. The single blue wire terminates at a blue connector shell.

Diagnostic Procedure

Step	Action	Result	Comments
1	Remove the heater cover and remove the control unit.		
2	Disconnect the sensor to be tested from the control unit.		

Section 6 – TriPac EVOLUTION Service Procedure D05A

3	Using a high quality meter, check the sensor resistance. To measure the <u>Overheat Sensor</u> measure between the brown wire and the blue wire. To measure the <u>Flame Sensor</u> measure between the brown wire and the green wire.	The sensor resistance is dependant on the sensor temperature as shown by the two tables at the back of this procedure. The measured sensor resistance should approximate the value shown for that sensor temperature (within 5-10%).	Be sure to consult the correct table for resistance values.
4	If the resistance measured in the previous step is correct the control unit may be defective. If the resistance measured is not correct replace the sensor.		
5	When reattaching the sensor connectors to the control unit, the green connector is attached to the center port on the control unit. The blue connector is attached to the other small port. The glow pin is attached to the large port.		

Section 6 – TriPac EVOLUTION Service Procedure D05A

Sensor Resistance Values vs. Temperature, Overheat Sensor

Temp °F	Temp °C	Minimum Resistance in Ω	Maximum Resistance in Ω
-40	-40	1597.00 k Ω	1913.00 k Ω
-4	-20	458.80 k Ω	533.40 k Ω
32	0	154.70 k Ω	175.50 k Ω
68	20	59.30 k Ω	65.84 k Ω
104	40	25.02 k Ω	28.04 k Ω
140	60	11.56 k Ω	13.16 k Ω
176	80	5.782 k Ω	6.678 k Ω
212	100	3.095 k Ω	3.623 k Ω
248	120	1.757 k Ω	2.081 k Ω
284	140	1.050 k Ω	1.256 k Ω
320	160	655 Ω	792 Ω
356	180	425 Ω	518 Ω
392	200	285 Ω	351 Ω

Sensor Resistance Values vs. Temperature, Flame Sensor

Temp °F	Temp °C	Resistance (Ω) Minimum	Resistance (Ω) Maximum
-40	-40	825.90 Ω	859.60 Ω
-4	-20	903.20 Ω	940.00 Ω
32	0	980.00 Ω	1020.00 Ω
68	20	1056.40 Ω	1099.50 Ω
104	40	1132.30 Ω	1178.50 Ω
140	60	1207.80 Ω	1257.10 Ω
176	80	1282.80 Ω	1335.10 Ω
212	100	1357.40 Ω	1412.80 Ω
248	120	1431.50 Ω	1489.90 Ω
284	140	1505.10 Ω	1566.60 Ω
320	160	1578.30 Ω	1642.80 Ω
392	200	1723.40 Ω	1793.70 Ω
464	240	1866.60 Ω	1942.80 Ω
536	280	2008.10 Ω	2090.00 Ω
608	320	2147.70 Ω	2235.40 Ω
680	360	2285.50 Ω	2378.80 Ω
752	400	2421.50 Ω	2520.30 Ω

Section 6 – TriPac EVOLUTION Service Procedure D05A

Section 6 – TriPac EVOLUTION Service Procedure D06A

Checking the Air Heater External Temperature Sensor

Where Used

All TriPac Air Heaters

Purpose

To confirm the proper operation of the TriPac Air Heater External Temperature Sensor

Materials Required

Fluke Digital Multi-meter or equivalent

TriPac Air Heater External Temperature Sensor Resistance Values vs Temperature

The TriPac Air Heater External Temperature Sensor changes resistance as the temperature changes. The table shown below contains data for the minimum and maximum resistance (in Ω) at specific temperatures (in degrees F and C) for the External Temperature Sensor. The resistance can be measured directly using a high quality multi-meter.

Diagnostic Procedure

Step	Action	Result	Comments
1	Disconnect the Heater Harness Connector. In the harness connector locate pin 12 (GRY) and pin 6 (BRN/WHT).		This is the large harness connector located near the heater.
2	Using a high quality digital multimeter, check and record the sensor circuit resistance from the harness connector pin 12 to pin 6.		
3	With an independent thermometer determine the actual temperature at the sensor.		The sensor resistance is dependent on the sensor temperature.

Section 6 – TriPac EVOLUTION Service Procedure D06A

Step	Action	Result	Comments
4	Compare resistance reading from step 2 to table on following page.	If the sensor circuit resistance does not match the values shown in the table within $\pm 10\%$ the sensor circuit is defective. Proceed to next step. If the sensor circuit resistance does match the values shown in the table within $\pm 10\%$ proceed to step 7.	The measured sensor resistance should approximate the value shown for the temperature reading from the previous step.
5	Disconnect the BLK and RED sensor wires from the harness.		
6	Using a high quality digital multi-meter, check the sensor resistance between the BLK and RED wires and compare reading to the table.	If the sensor resistance does not match the values shown in the table within $\pm 10\%$ the sensor is defective. Replace the sensor. If the sensor resistance does match the values shown in the table within $\pm 10\%$ locate and repair the fault in the harness wires.	
7	Using a high quality digital multi-meter, check the sensor circuit resistance from harness connector pin 12 to chassis ground.	Any reading other than OL indicates the sensor circuit is shorted to ground. Locate and repair the fault. Meter reading "OL" indicates sensor circuit is not shorted to ground.	Sensor is possibly shorted to ground. Disconnect sensor and retest.

Section 6 – TriPac EVOLUTION Service Procedure D06A

SENSOR TEMPERATURE vs RESISTANCE IN OHMS

TEMPERATURE		RESISTANCE IN OHMS		
°C	°F	MIN.	TYP.	MAX.
-55	-67	952	980	1009
-50	-58	1000	1030	1059
-40	-40	1105	1135	1165
-30	-22	1218	1247	1277
-20	-4	1338	1367	1396
-10	14	1467	1495	1523
0	32	1603	1630	1656
10	50	1748	1772	1797
20	68	1901	1922	1944
25	77	1980	2000	2020
30	86	2057	2080	2102
40	104	2217	2245	2272
50	122	2383	2417	2451
60	140	2557	2597	2637
70	158	2737	2785	2832
80	176	2924	2980	3035
90	194	3118	3182	3246
100	212	3318	3392	3466
110	230	3523	3607	3691
120	248	3722	3817	3912
125	257	3815	3915	4016
130	266	3901	4008	4114
140	284	4049	4166	4283
150	302	4153	4280	4407

Section 6 – TriPac EVOLUTION Service Procedure D06A

Section 6 – TriPac EVOLUTION Service Procedure F09A

Flywheel Sensor Test and Adjustment

Where Used

All TriPac units.

Purpose

This procedure is used to test and adjust the Flywheel Sensor.

Materials Required

Fluke Digital Multi-meter or equivalent

Operation

The Flywheel Sensor rarely fails, but might require adjustments for proper operation.

Procedure

Step	Action	Results	Comments
1	Press the Main Power On/Off key to turn the unit off.		
2	Turn the Engine On/Off switch to off.		The Engine On/Off switch is located in the upper right corner of the APU.
3	Remove the FS1 and FS2 wires from the sensor.		
4	Check the sensor resistance using a Fluke digital multimeter.	The sensor resistance should be 250 to 300 ohms with the wires removed. If it is not then the sensor should be replaced.	

Section 6 – TriPac EVOLUTION Service Procedure F09A

Step	Action	Results	Comments
5	Loosen the lock nut, turn the sensor in until it contacts the ring gear on the flywheel, then back it out 1/4 turn and tighten the lock nut.		
6	Reattach the FS1 and FS2 wires to the sensor.		Polarity is not important.
7	If a problem still exists, check circuit continuity from the flywheel sensor to the Interface Board using Service Procedure H04A.		

Checking Harness Continuity

Where Used

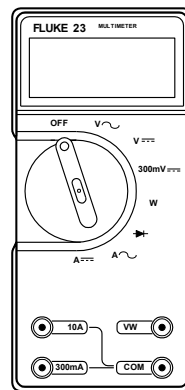
All TriPac units.

Purpose

To illustrate the correct procedures for checking harness continuity on equipment utilizing solid state devices.

Materials Required

Fluke Digital Multi-meter or equivalent



IMPORTANT

- ***Do not use battery and light combinations to check continuity.*** Using such devices might present excessive voltage or current to solid state devices. In most cases the device will be damaged or destroyed.
- ***Use a high quality digital multimeter such as that illustrated or an analog meter with high input impedance.*** Older analog (needle type meter movement) meters and some inexpensive "mechanic tool box" meters present a large load to the circuit being tested. This can significantly alter the meter reading, especially when measuring small voltages or currents.
- ***Never test a circuit to see if it is energized by tapping the circuit wire to ground and watching for a spark.*** This will damage solid state components or blow a fuse or circuit.

Section 6 – TriPac EVOLUTION Service Procedure H04A

Step	Action	Results	Comments
	General Procedures		
1	Locate the suspect circuit on the appropriate electrical schematic diagram.		
2	Isolate both ends of the circuit using the following methods, as required. • Disconnect the appropriate connector at the Interface Board. • Disconnect the device connector at the device. • Remove the wire from the device terminal.		Harness connections can be determined by consulting the electrical schematics and harness diagrams. CAUTION: Failure to isolate both ends might cause misleading results.
3	Using jumpers as required, connect each end of the circuit to a high quality multimeter.	The multimeter must show a very low resistance (less than 1.0 ohm), indicating circuit continuity. If not, the circuit is open or has excessive resistance. Troubleshoot the circuit to determine the cause, using the electrical schematic diagrams.	Be certain the ohmmeter battery is good and the meter zeros with the leads held together.
4	After determining that the circuit passes a continuity test, remove one lead and connect it to chassis ground to check for a short to ground.	The meter should indicate an open circuit. If continuity is indicated, the circuit is shorted to ground. Troubleshoot the circuit to determine the cause of the short using the electrical schematic diagrams.	

Smart FET Test Procedure

Where Used

All TriPac units

Purpose

This procedure is used to confirm the proper operation of the Smart FETs on the Interface Board.

Materials

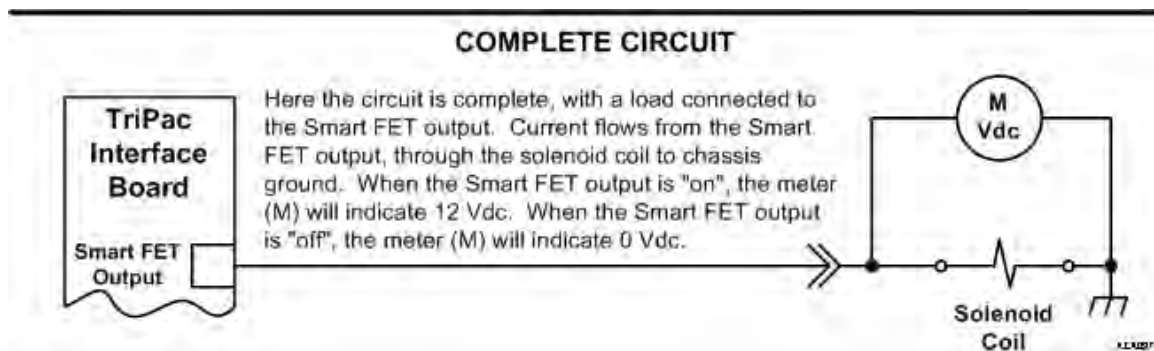
- Fluke digital Multimeter or equivalent
- Test leads with alligator clips
- 1000 Ohm Resistor, 1/2 watt or larger

Procedure

A Smart FET (Field Effect Transistor) is a solid state device used to apply and remove power to various circuit devices such as solenoids. If the device draws too much current when energized, the Smart FET will turn off to prevent damage to the connected device and related circuitry. When the problem is resolved the Smart FET will resume normal operation. Smart FET outputs typically do not use a fuse to protect the output device.

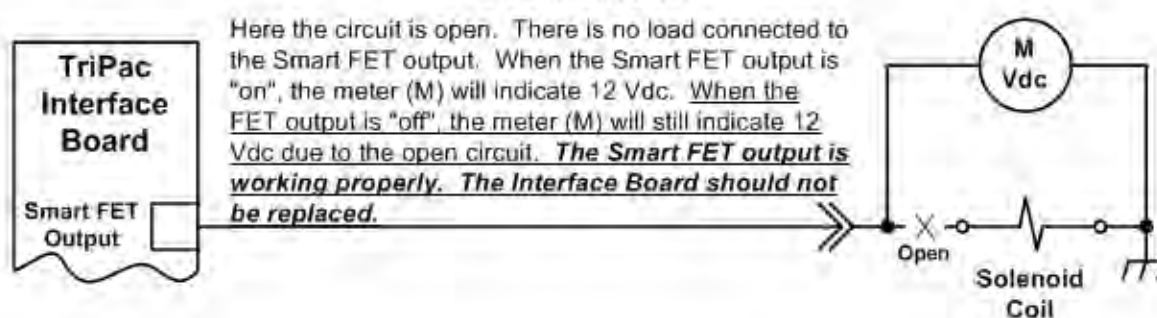
Care must be taken to insure that a load is present in order to properly check the operation of Smart FET outputs. If there is no load connected to the output, the output will read +12 Vdc even though the output is actually turned off. The Smart FET output is functioning properly. The +12 Vdc reading is caused by the lack of a load on the Smart FET output. The Interface Board should not be replaced.

To ensure accurate readings when checking Smart FET outputs, connect a 1000 ohm resistor from the positive meter lead to chassis ground. This provides a load to the Smart FET output, even if the actual load is disconnected or open. The meter will read +12 Vdc when the output is turned on and 0 Vdc when the output is turned off.

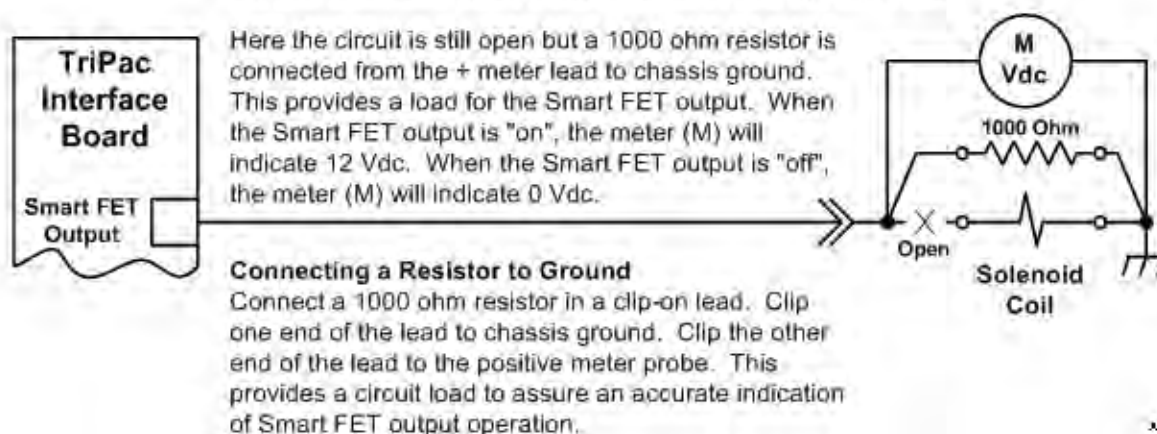


Section 6 – TriPac EVOLUTION Service Procedure H14A

OPEN CIRCUIT



OPEN CIRCUIT with LOAD RESISTOR on METER



Diagnosing a Smart FET circuit

When testing a Smart FET circuit the following steps are suggested.

- Disconnect the circuit load at the Interface Board. Check the load resistance with an ohmmeter to determine if the circuit is shorted, open or shorted to ground. Correct as required.
- Reconnect the circuit load.
- Determine what conditions will turn the Smart FET **on** and duplicate those conditions.
- Check the output with a good quality multimeter set to read DC volts. 12 Vdc should be present.
- Determine what conditions will turn the Smart FET **off** and duplicate those conditions.
- Check the output with a good quality multimeter set to read DC volts. 0 Vdc should be present. If any question exists, confirm the readings using a 1000 ohm resistor from the positive meter probe to chassis ground as shown above.

Voltage Drop Test

Where Used

All TriPac Units

Purpose

This test is used when diagnosing a circuit that is suspected of having high resistance. High resistance in a circuit may cause a device to be slow or weak by reducing the voltage and amperage available to the device experiencing the problem. High circuit resistance may also prevent batteries from supplying sufficient current or properly charging.

The Voltage Drop Test is used to locate resistance in a circuit without disassembling connections. Dirty, corroded or loose terminals or cable connections add unwanted resistance to the circuit. The Voltage Drop Test can be used to test a single connection point such as a single wire or cable terminal, plug connection or switch contact. It can also be used to check an entire circuit for high resistance. The Voltage Drop Test can also be used to locate high resistance in ground circuits.

Test Applications

- Battery connections
- Battery cables
- Control circuits
- Resisted ground
- Control points (switch contacts, relay contacts, fuses)
- Long circuits (voltage at A – voltage at B = voltage drop)

Test Conditions

To measure Voltage Drop the circuit must have current flowing. Make sure the circuit being tested is:

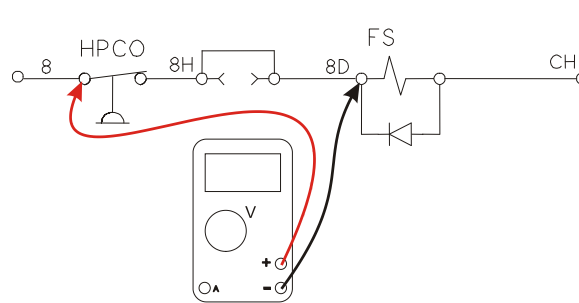
- **Complete:** A circuit that is disconnected or open has no current flowing and will not show voltage drop.
- **Powered:** A circuit that is not on or does not have voltage available will not show voltage drop.
- **Loaded:** The circuit being tested must have an operating load. This may be a solenoid coil, relay coil, motor, resistor or other electrical load. The load must be on and trying to work during the test.

Section 6 – TriPac EVOLUTION Service Procedure H24A

Test Procedure #1

Used when testing a single electrical connection, component or circuit with ends that can be reached with the leads attached to the multimeter. This is the preferred procedure because the reading can be taken in one step.

- Power the circuit. (For this test to work, the circuit must be complete, powered and trying to do work.)
- Set the meter for Vdc.
- Connect your meter leads in parallel with the circuit or component being tested, as shown in the example.
- Connect the red lead to the power side of the circuit or component being checked
- Connect the black lead to the ground side of the circuit or component being checked.
- Read the meter.



Test Procedure #2

Used when testing long circuits that cannot be reached by the leads attached to the multimeter.

- Power the circuit. (For this test to work, the circuit must be complete, powered and trying to do work.)
- Set the meter for Vdc.
- Make an Available Voltage reading at the end of the circuit segment being tested that is nearest to the power source. Record reading "A".
- Make an Available Voltage reading at the end of the circuit segment being tested that is nearest to ground. Record reading "B".
- Subtract reading B from reading A. The difference is the Voltage Drop between the test points.

Section 6 – TriPac EVOLUTION Service Procedure H24A

Results

- In a normal circuit a single wire connection, switch contact, relay contact or circuit segment should drop less than 0.5 Vdc.
- In a normal circuit the entire circuit from battery to operating load should drop less than 10% of source voltage. This should be the same for the ground side from the load back to the battery.
- Voltage Drop through the operating load in a circuit should be very close to source voltage. The operating load could be devices like an electric motor, resistor, solenoid or relay coil.

The Volt Drop Test can also be used to locate high resistance in the ground circuit.

REMINDER: Only the device or load that is trying to do work *should* have volt drop near source voltage.

TIP: To perform the Volt Drop Test the circuit must be complete, powered and trying to work.

Section 6 – TriPac EVOLUTION Service Procedure H24A

Available Voltage Test

Where Used

All TriPac Units

Purpose

This test is used to see how much voltage is available at specific points in a circuit. Available voltage is probably the most common electrical diagnostic test. It is a quick, easy test to perform that provides helpful data to determine the next steps in a diagnostic process.

Typical Uses

The primary purpose of this test is to find open faults in circuits.

Choose this test first whenever a device is not working at all.

This test may be part of a Voltage Drop test when hunting for unwanted resistance in a circuit.

Choosing a Test Point

Use a schematic diagram to determine how the circuit works and choose the best test point. Possible test points are:

- At the component if it is a single problem
- At the common point if there are multiple problems
- The easiest to reach location that gives the best information
- Experience will guide you to likely test points.

Section 6 – TriPac EVOLUTION Service Procedure H25A

Power Circuit Test

Procedure

Connect your volt meter between a good chassis ground and the test point you have chosen.

This example shows a fuel solenoid circuit.

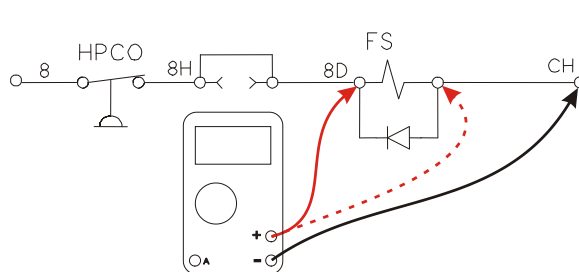
- Energize the circuit you are testing.
- Set your meter to read Vdc.
- Connect the black lead from your meter to a good chassis ground.
- Connect the red lead from your meter to the power side of the device. In this example your red meter lead would be positioned the same as the solid red arrow shown below.
- Read the available voltage on the meter.

Result

Battery voltage = complete power circuit

0 Vdc = open power circuit

Any reading above 0 Vdc but less than battery voltage = high resistance in the power circuit.



Section 6 – TriPac EVOLUTION Service Procedure H25A

Ground Circuit Test

The ground circuit can also be checked. If the component does not have a good ground, it will not work properly.

Procedure

First, verify that there is voltage reaching the component as described earlier. If there is adequate voltage on the power side, then:

- Place the red meter lead on the ground terminal of the component. Your red lead would be positioned the same as the dotted red arrow in the example.
- Connect the black lead from your meter to a good chassis ground.
- Read the voltage on the meter.

Result

0 Vdc = open component

Battery voltage = open ground

Any reading above 0 Vdc but less than battery voltage = high resistance in the ground circuit.

REMINDER: In a normal circuit the component will use up all the volts. If volts are left over, there is an additional unwanted resistance in the ground that is using the remaining volts.

Section 6 – TriPac EVOLUTION Service Procedure H25A

Section 6 – TriPac EVOLUTION Service Procedure H30A

Performing a TriPac Air Heater Fuel Quantity Test

Where Used

All TriPac Air Heaters

Purpose

To confirm the proper operation of the TriPac Air Heater Fuel Pump. The fuel quantity should be tested if the heater has difficulty starting or maintaining a flame. Check the following before measuring fuel quantity.

Materials Required

- Measuring Glass – TK 89-593

Fuel Quantity Test

The fuel quantity should be tested if the heater has difficulty starting or maintaining a flame. Check the following before measuring fuel quantity.

Diagnostic Procedure

Step	Action	Result	Comments
	<i>IMPORTANT: The fuel quantity is not affected by voltage variances.</i>		
1	Check the filter in the fuel pump.		The filter must be clean and in good condition.
2	Check that the fuel lines are correctly routed, are securely tightened and do not leak.		See the Installation Manual TK 53120 for details.
3	Verify that the fuel complies with the data in the technical description.		
4	Detach the fuel line from the air heater and insert it into the measuring glass.		Measuring Glass Service Part # 89-593
5	Switch the air heater on for approximately 60 seconds to allow the fuel system to bleed out any air.		

Section 6 – TriPac EVOLUTION Service Procedure H30A

Step	Action	Result	Comments
6	Switch the air heater off and drain the fuel from the measuring glass.		
7	Insert the fuel line back into the measuring glass. Hold the measuring glass level with the heater glow pin while fuel is being delivered in the next step.		
8	Switch the air heater back on.	Fuel will begin to pump about 60 seconds after the heater is turned on. The pump will stop automatically after delivering fuel for 90 seconds. Allow the fuel to pump until the pump turns off automatically.	
9	When the pump stops, turn the heater off.		
Test Evaluation and Corrective Actions			
10	Read the quantity of fuel in the measuring glass in milliliters (ml).	Fuel quantity should be as follows: D2 Heaters = 3.7 ml to 4.3 ml D4 Heaters = 5.4 ml to 6.3 ml	
11	If the fuel quantity is outside the range specified for the heater, check the fuel system for restrictions and correct as necessary.		Possible fuel system restrictions may include: • Dirty fuel pump inlet screen. • Poorly cut fuel lines – using a side cutter instead of a tubing cutter or razor blade. • Fuel lines not fully inserted in fittings.
12	If the fuel quantity is still outside the range specified replace the fuel pump.		

TriPac Air Heater Diagnostics using the EDiTH Diagnostic Tool

Where Used

All TriPac units

Purpose

This procedure is used to diagnose the TriPac Air Heater using the EDiTH Diagnostic Tool. When properly connected to a TriPac heater the EDiTH Diagnostic Tool and software offers the following benefits:

- The technician can display and clear heater alarm codes.
- The technician can display the heater run time.
- The technician can turn individual heater components on and off to aid in diagnostics.
- The technician can monitor and record real time heater operating conditions to aid in diagnostics.

The TriPac EDiTH Diagnostic Tool consists of a Basic ISO Adapter and the required cables. A USB Serial Adaptor can be used if the PC computer is not equipped with a serial port, but is not supplied with the EDiTH Diagnostic Tool. The EDiTH software must be installed on a PC computer.

NOTE: An EDiTH General Data printout showing all alarm codes must accompany any ECU submitted for warranty. Refer to Warranty Bulletin WB406 for details.

Availability:

Hardware: The EDiTH Diagnostic Tool is available as Service Part Number 84-1158. The tool is supplied with two cables as shown on page 3. The grey serial cable is used to connect the EDiTH Diagnostic Tool to the PC computer. The black coiled cable is used to connect the EDiTH Diagnostic Tool to the test pigtail on the TriPac heater cable.

An adapter cable as shown on page 3 is required to complete the connection to the heater. The EDiTH Diagnostic Tool Adapter is available as Service Part Number 89-0322. The TriPac heater harness is equipped with a test pigtail to allow the Diagnostic Tool to be connected to the heater. The adapter is used to connect the black Diagnostic Tool cable to the pigtail on the TriPac heater harness.

Section 6 – TriPac EVOLUTION Service Procedure H31A

Software: The TriPac EDiTH Diagnostic Tool software is available on TSA InfoCentral. Go to:

[HTTP://WWW.THERMOKING.COM](http://www.thermoking.com). Choose iService login, then select TSA Info Central - Software & Downloads - TriPac - EDiTH Software - [EDiTH_S3V11_Setup_EN.zip](#). (The most recent version software will be listed here and should be used)

EDiTH Diagnostic Tool and Software

Important EDiTH Diagnostic Tool Notes:

- All temperatures are displayed in Celsius only. The software does not allow temperatures to be displayed in Fahrenheit. Temperature conversion charts are shown where appropriate.
- If an earlier version of EDiTH software is installed, it must uninstalled and removed before installing a newer version.
- If used, the USB adapter must be connected before starting the computer. If the USB adapter is removed while EDiTH is active, it may cause unstable system behaviour.
- Always install and remove the Diagnostic Tool in the specified order.
- A defective Diagnostic Tool circuit connection can result in an alarm code.

EDiTH Diagnostic Tool Hardware System Requirements:

- Computer Hardware = Pentium 133 or better with minimum 100 MByte hard drive space, 32 MByte RAM and an available serial port. A USB Serial Adaptor can be used in place of a serial port.
- Operating Systems = Windows 98, NT, 2000, Me, XP, Vista and 7.

EDiTH Diagnostic Tool Software Installation:

- Download and save the latest EDiTH software zip file from the Thermo King TSA InfoCentral web site.
- Unzip the downloaded file.
- If the installation does not start automatically, double click on the "Setup.Exe" file to start the installation.
- Follow the setup instructions to complete the installation. AN EDiTH Diagnostic Tool Icon will be placed on the desktop.

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EDiTH Diagnostic Tool:

The EDiTH Diagnostic Tool is available as Service Part Number 84-1158. The tool is supplied with two cables as shown below. The grey serial cable is used to connect the EDiTH Diagnostic Tool to the PC computer. The black coiled cable is used to connect the EDiTH Diagnostic Tool to the test pigtail on the on the TriPac heater cable.



EDiTH Diagnostic Tool – Service Part Number 84-1158

EDiTH Diagnostic Tool Adapter:

The TriPac heater harness is equipped with a test pigtail to allow the Diagnostic Tool to be connected to the heater. An adapter cable is required to complete the connection to the heater. The EDiTH Diagnostic Tool Adapter is available as Service Part Number 89-0322. The adapter is used to connect the black Diagnostic Tool cable to the pigtail on the TriPac heater harness.



EDiTH Diagnostic Tool Adapter – Service Part Number 89-0322

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USB 2.0 Serial Adapter:

If the PC computer to be used does not have a serial port, a USB 2.0 Serial Adapter is required. A USB 2.0 Serial Adapter can be obtained at a local computer store. Be sure to purchase a USB 2.0 Serial Adapter. A software driver will be supplied with the adapter. Install the software driver as instructed by the USB 2.0 Serial Adapter documentation.



USB 2.0 Adaptor

EDiTH Diagnostic Tool Connections using a Serial Cable:

Always connect the Diagnostic Tool in the order shown here. See the illustration below for details.

- Locate the heater diagnostic pigtail. It is located in the TriPac heater harness near the heater. Note the 6 digit heater model number. Also note if the cable from the heater is covered with smooth plastic or is wrapped with fabric tape. This information is necessary to select the heater test.
- Connect the Adaptor Cable to the heater diagnostic pigtail connector.
- Connect the other end of the black coiled cable to the EDiTH Diagnostic Tool.
- Connect the EDiTH Diagnostic Tool to the serial port on the PC computer using a serial cable.



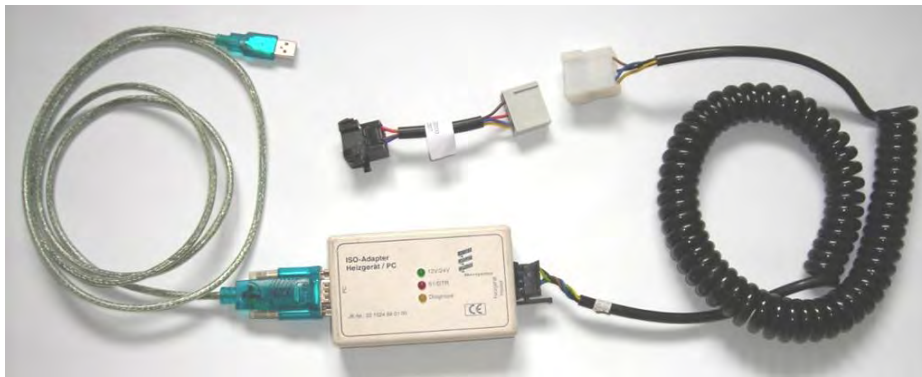
**EDiTH Diagnostic Tool Adapter
Serial Cable Application**

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EDiTH Diagnostic Tool Connections using a USB 2.0 Serial Adaptor Cable:

Always connect the Diagnostic Tool in the order shown here. See the illustration below for details.

- Locate the heater diagnostic pigtail. It is located in the TriPac heater harness near the heater. Note the 6 digit heater model number. Also note if the cable from the heater is covered with smooth plastic or is wrapped with fabric tape. This information is necessary to select the heater test.
- Connect the Adaptor Cable to the heater diagnostic pigtail connector.
- Connect the other end of the black coiled cable to the EDiTH Diagnostic Tool.
- Connect the EDiTH Diagnostic Tool to a USB 2.0 port on the PC computer using a USB 2.0 Serial Adapter.



**EDiTH Diagnostic Tool Adapter
USB 2.0 Serial Adapter Cable Application**

Starting the EDiTH Software:

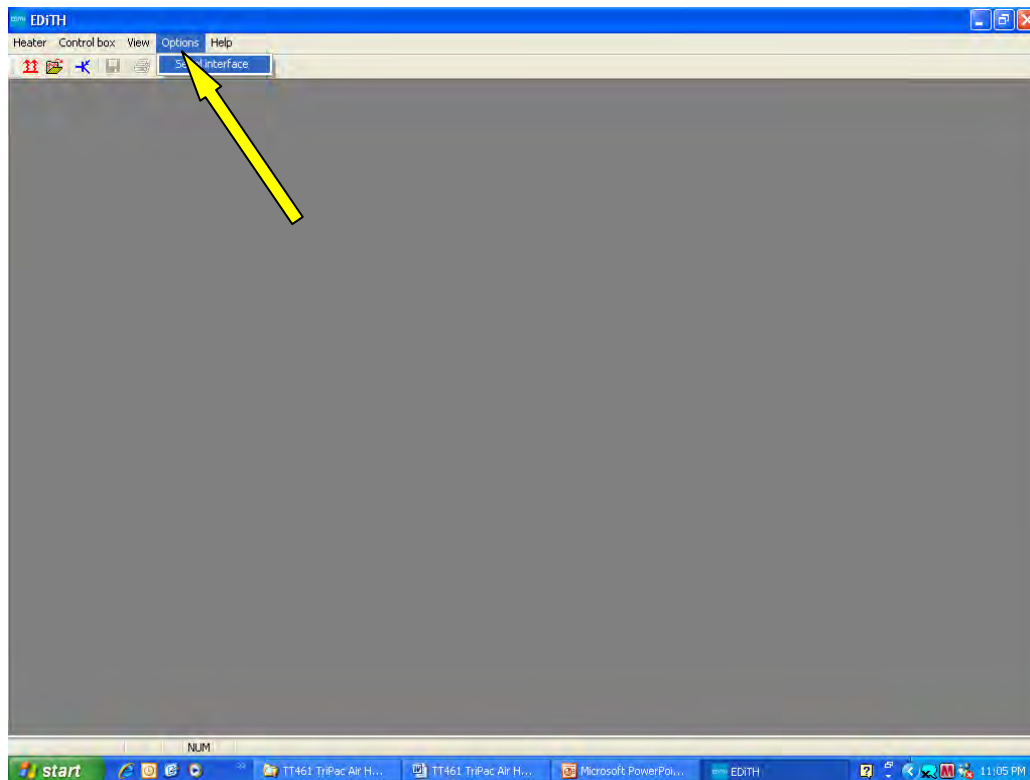
- Double click the EDiTH icon on the desktop.
- The EDiTH software will start and the EDiTH Main Menu will appear.

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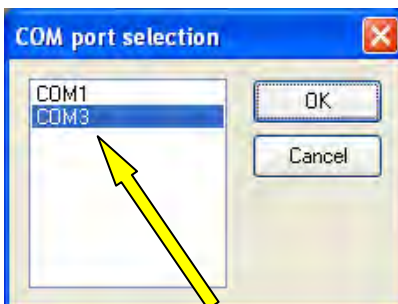
Selecting the COM Port:

The correct COM port must be selected. If the EDiTH Diagnostic Tool fails to operate the reason is likely that the wrong COM port has been set. To change the COM port used by the EDiTH Diagnostic Tool, proceed as follows.

- From the EDiTH Main Menu select the “Options” drop down menu at the top of the display. Choose “Serial Interface” from the drop down menu as shown below



- A COM Port Selection menu will appear. Choose the appropriate COM port as shown below. Once the COM port for the computer is selected it will remain selected and should not need to be changed.



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Determining the Heater Model Number and Type:

The heater tests are selected using the 6 digit heater model number. Some models also require the heater control type.

- The 6 digit model number is located on the heater serial number plate. Typical heater model numbers are 25 2440, 25 2441, 25 2069 and 25 2113.

In addition, these heaters use one of two different control units. The heater control unit type can be determined by checking the cable coming from the heater enclosure.

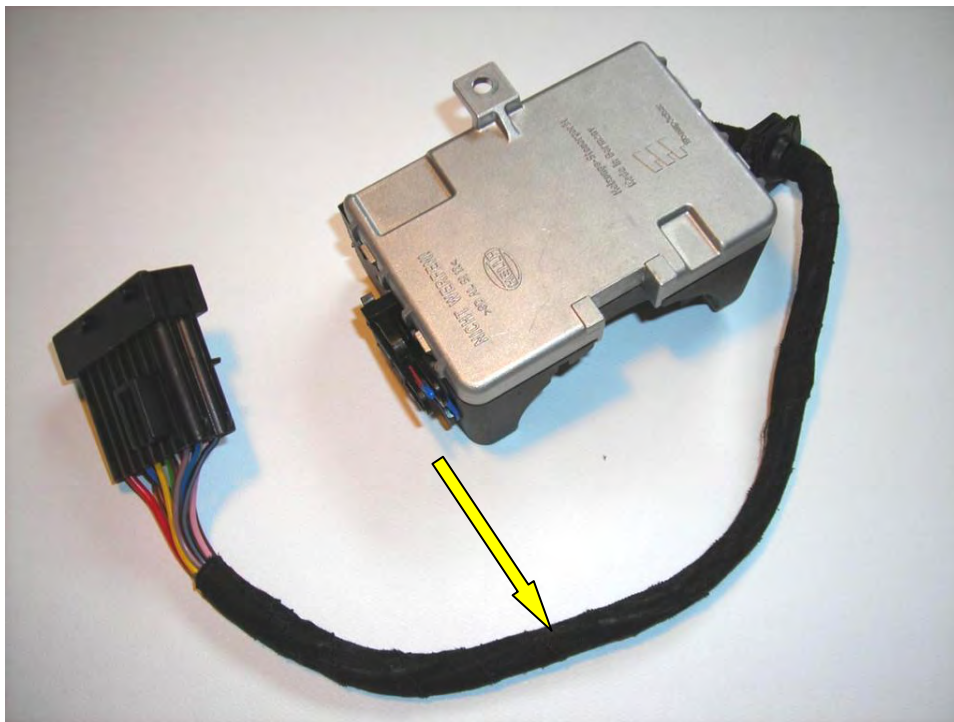
- Earlier heaters used a Wehrle heater control unit. The Wehrle heater control unit can be identified by the smooth black plastic covering on the cable coming from the heater. Note that not all tests are available with the earlier Wehrle heater control units.



**Early Wehrle Heater Control Unit
with smooth black plastic covering on the cable**

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- Later heaters (after Feb. 2006) use a Hella heater control unit. The Hella heater control unit can be identified by the black cloth wrapping on the cable coming from the heater.

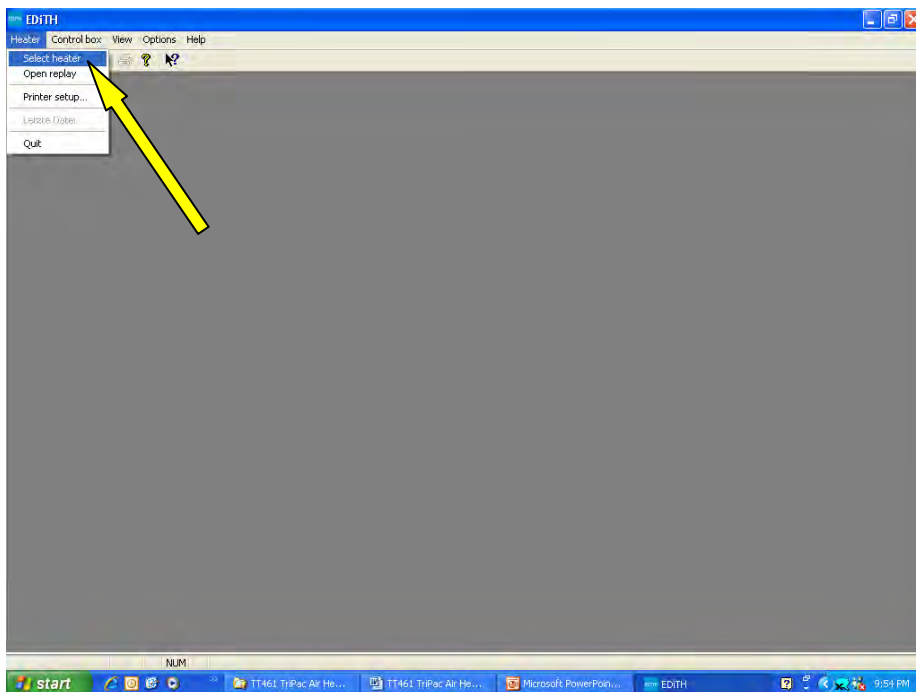


**Later Hella Heater Control Unit
with black cloth wrapping on the cable**

Section 6 – TriPac EVOLUTION Service Procedure H31A

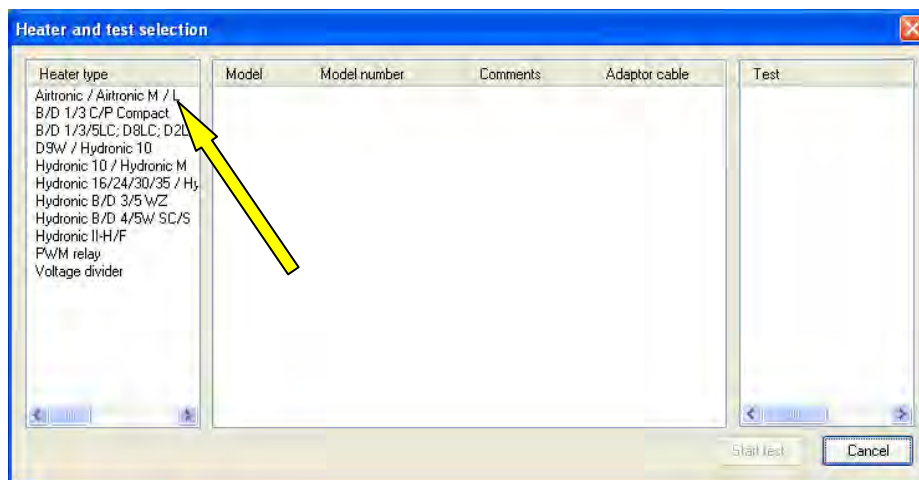
Selecting a Heater to Test:

- From the EDiTH Main Menu select the “Heater” drop down menu at the top of the display. Choose “Select Heater” from the drop down menu as shown below.



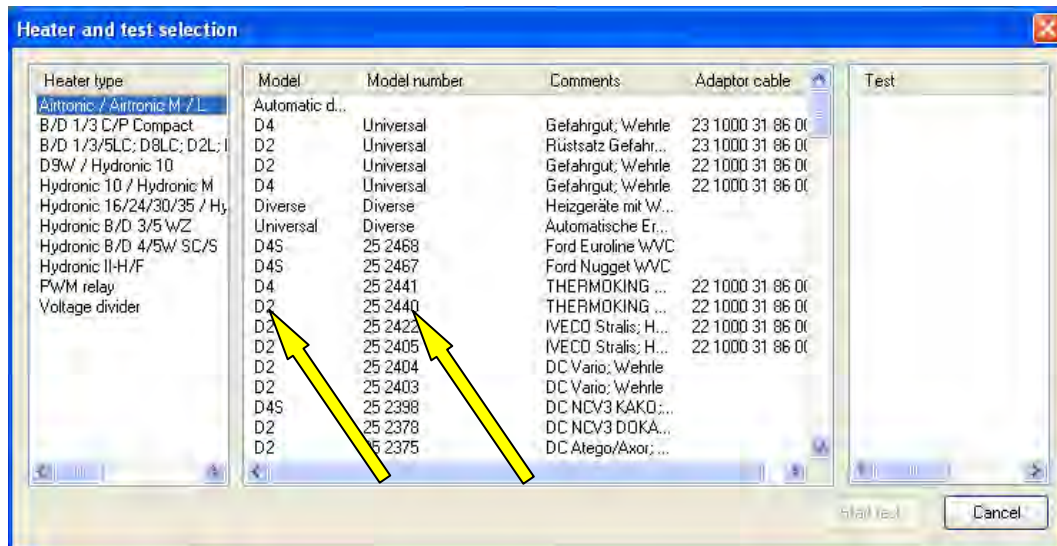
The heater to be tested is selected using the left and center columns of the menu display as shown below.

- A Heater and Test Selection menu will appear. Choose “Airtronic / Airtronic M / L” as shown below.



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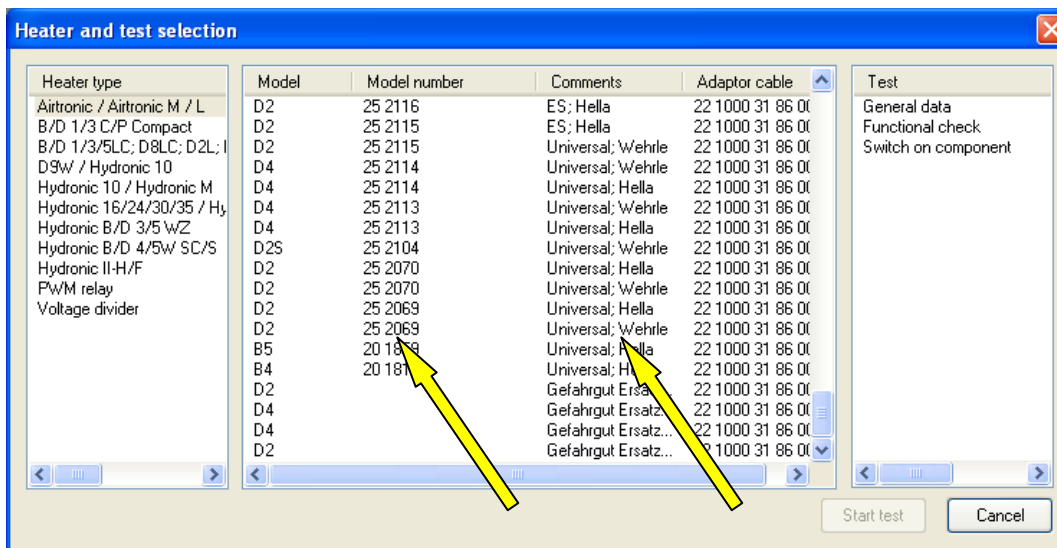
- A list of heaters will appear in the center of the display. Select the correct heater model number as shown below.



- Some universal model numbers show two versions of heater control units – Wehrle and Hella – such as the model 25 2069 heater shown below. Be sure to select the correct version.

Wehrle Heater Control Units - Smooth black plastic covering on the cable coming from the heater.

Hella Heater Control Units - Black cloth wrapping on the cable coming from the heater,



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Selecting a Heater Test:

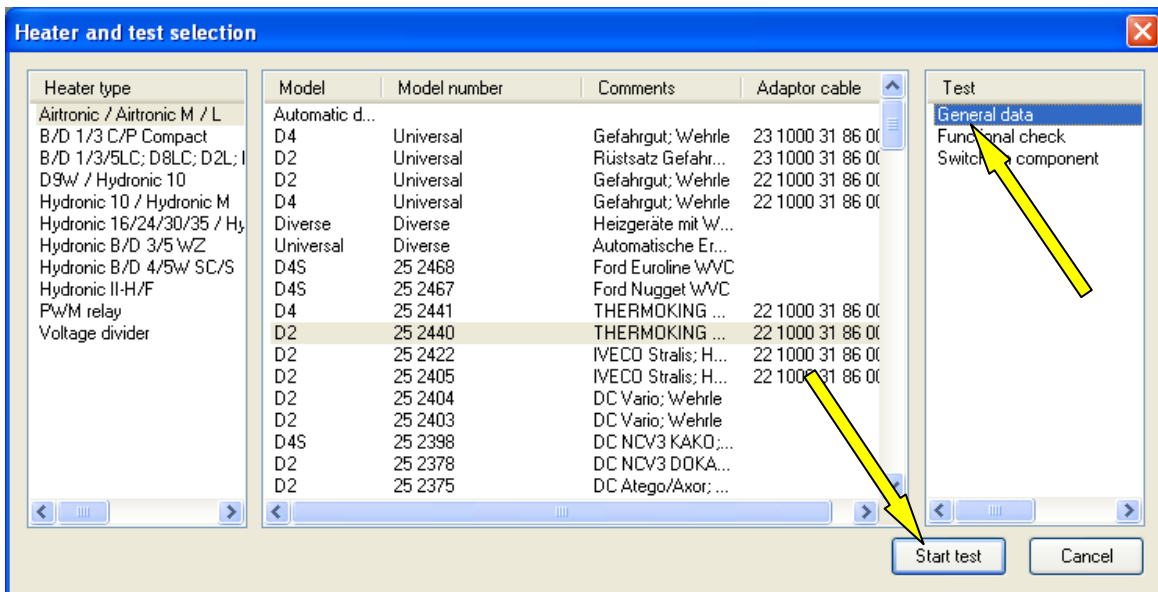
The desired test is selected using the right column of the menu display as shown below.

- A list of Tests will appear on the right side of the display. Select the desired test, and then select Start Test as shown below. The following tests are available.

General Data – This test will display general data of the selected heater including hardware and software versions, hours of operation and other general details as shown below. The Error Codes in the heater memory can also be displayed.

Functional Check – This test will allow the heater to be test run. The operating details will be displayed.

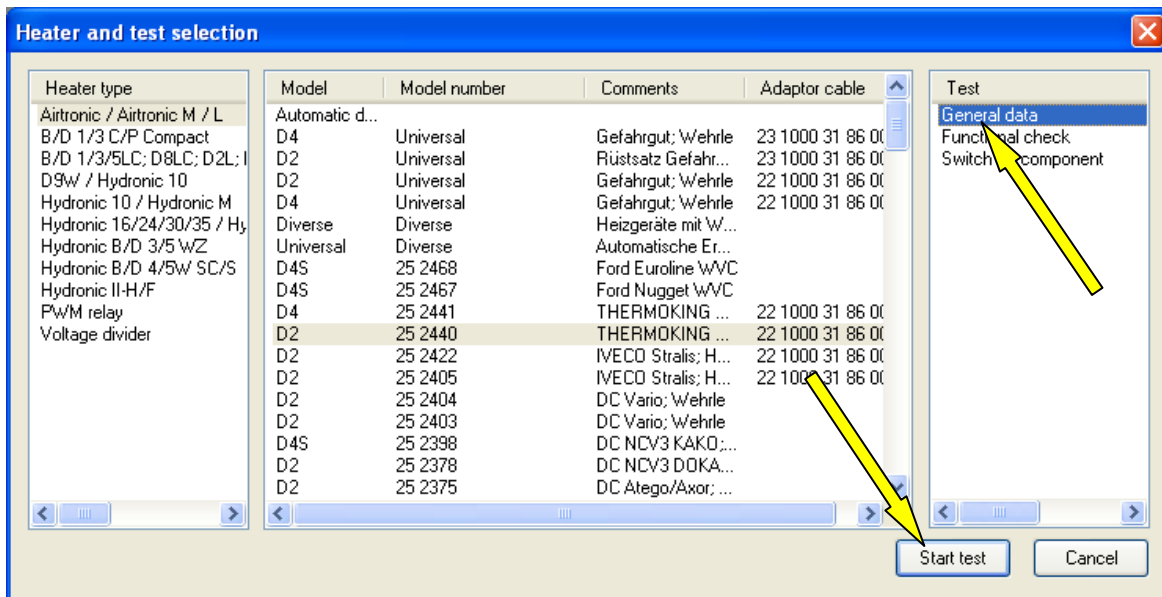
Switch on Component – This test will allow the individual components to be turned on and off. This test is only available with new style Hella Control Units.



Section 6 – TriPac EVOLUTION Service Procedure H31A

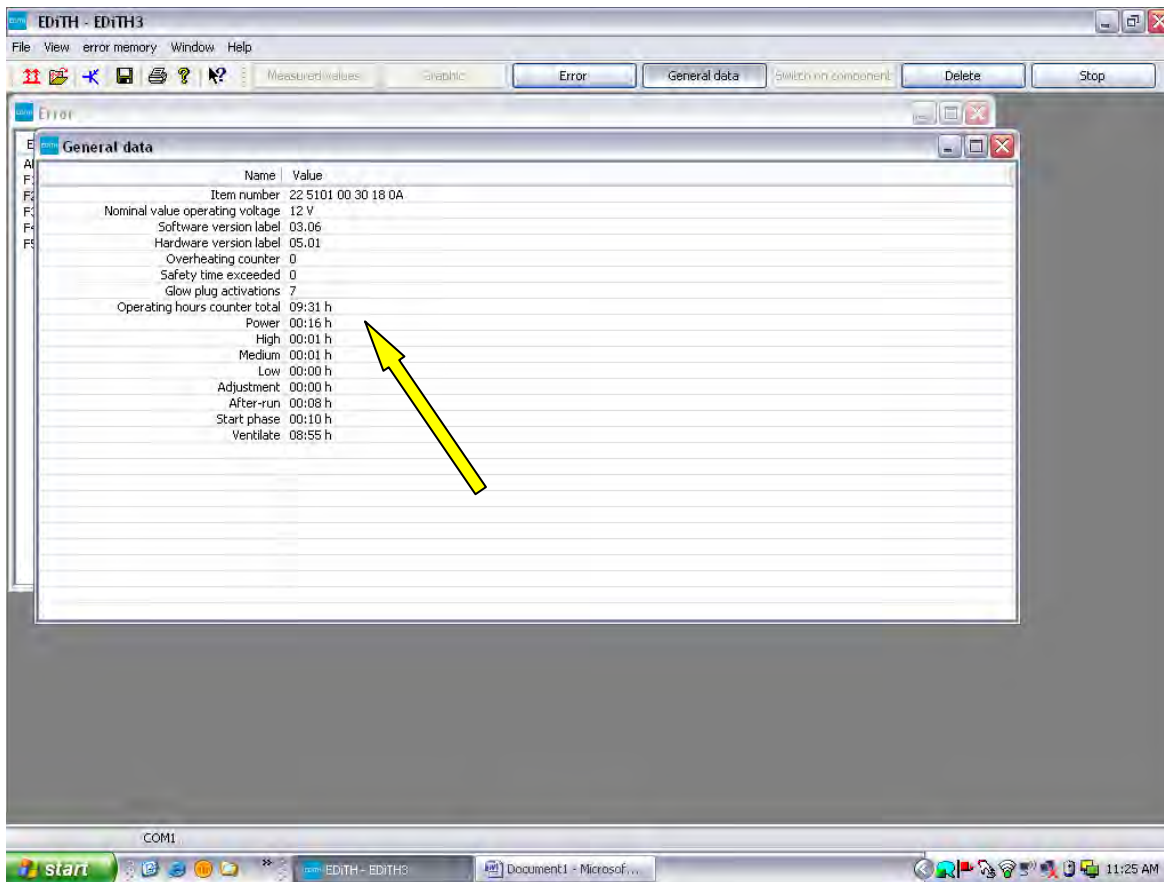
General Data Test

The General Data Test will display general data of the selected heater including hardware and software versions, hours of operation and other general details as shown below. The Error Codes in the heater memory can also be displayed. Select the General Data Test, and then select Start Test as shown below.



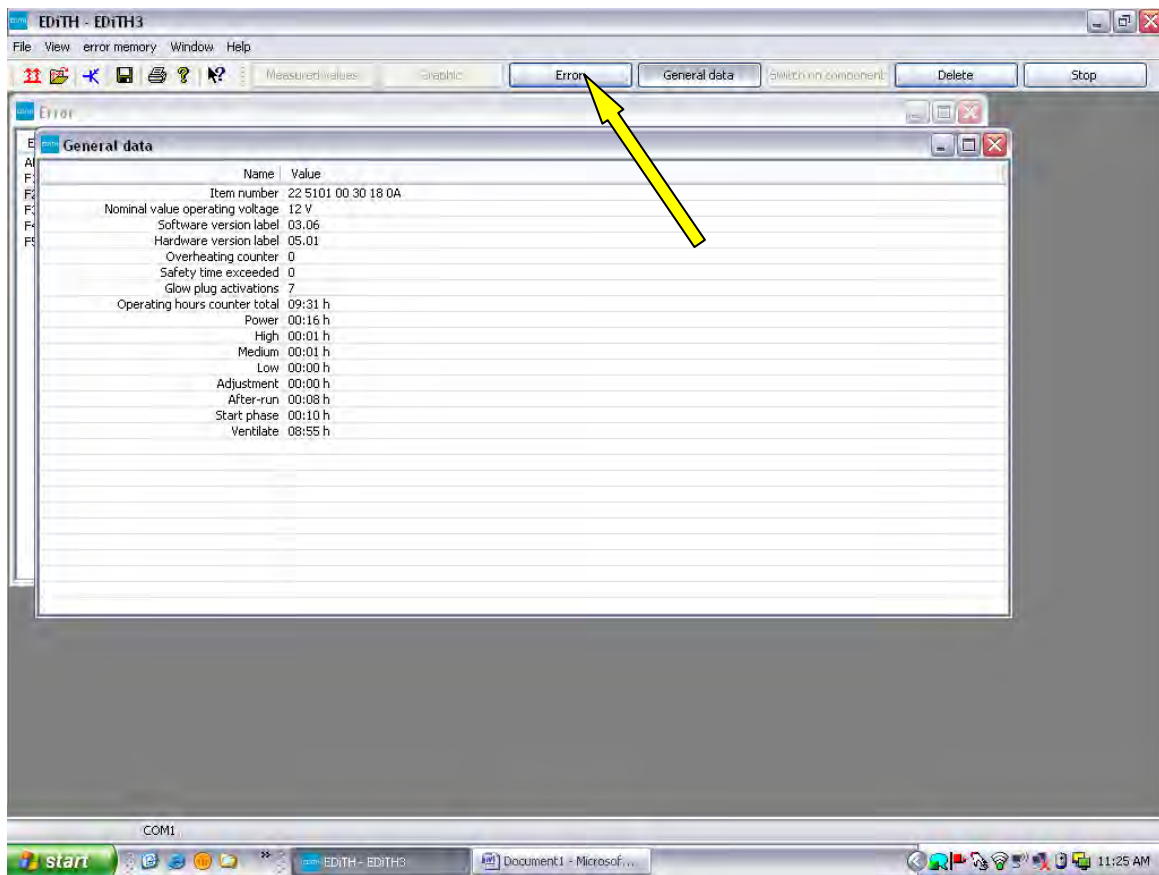
Section 6 – TriPac EVOLUTION Service Procedure H31A

The first General Data Test display that appears is the General Data menu for the selected heater. The data will be displayed as shown below.



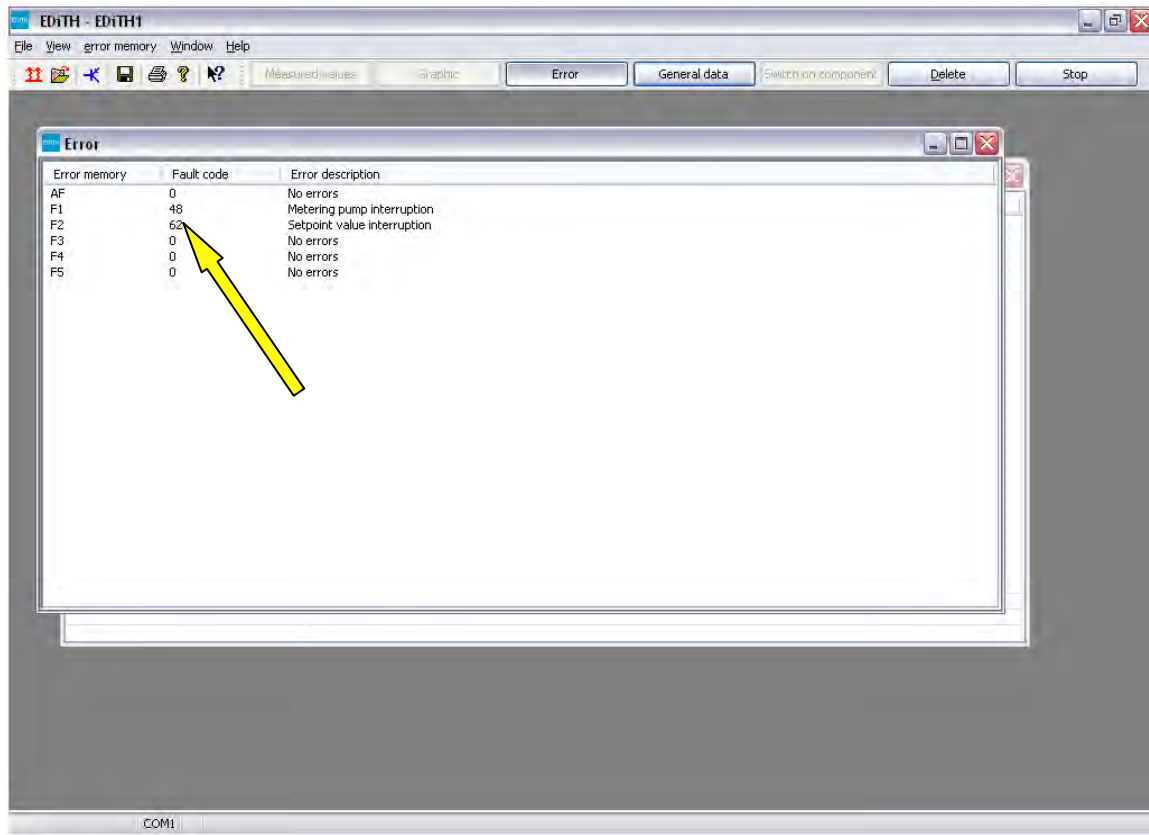
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To display the Alarm Codes (Error Codes) held in the heater memory click the Error button as shown below.



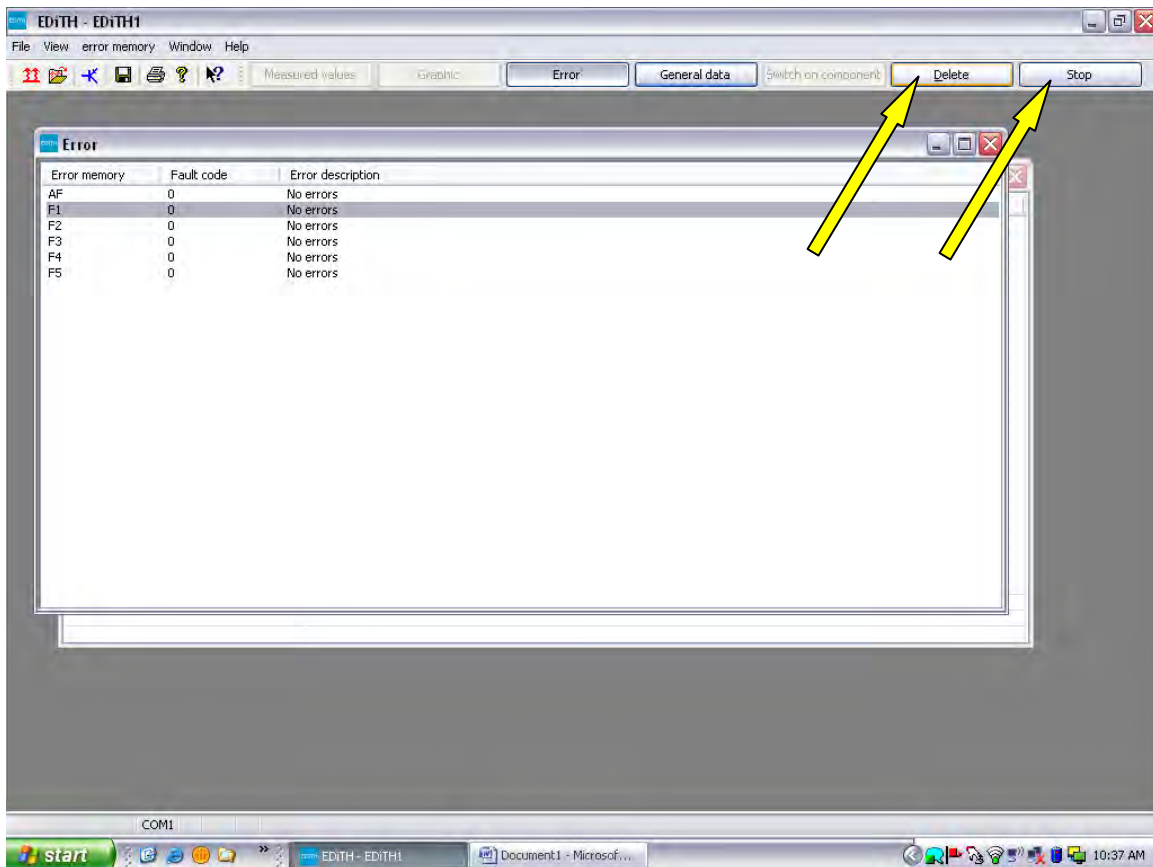
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Any Alarm Codes (Error Codes) held in the heater memory will be displayed. Record any alarm codes for future use.



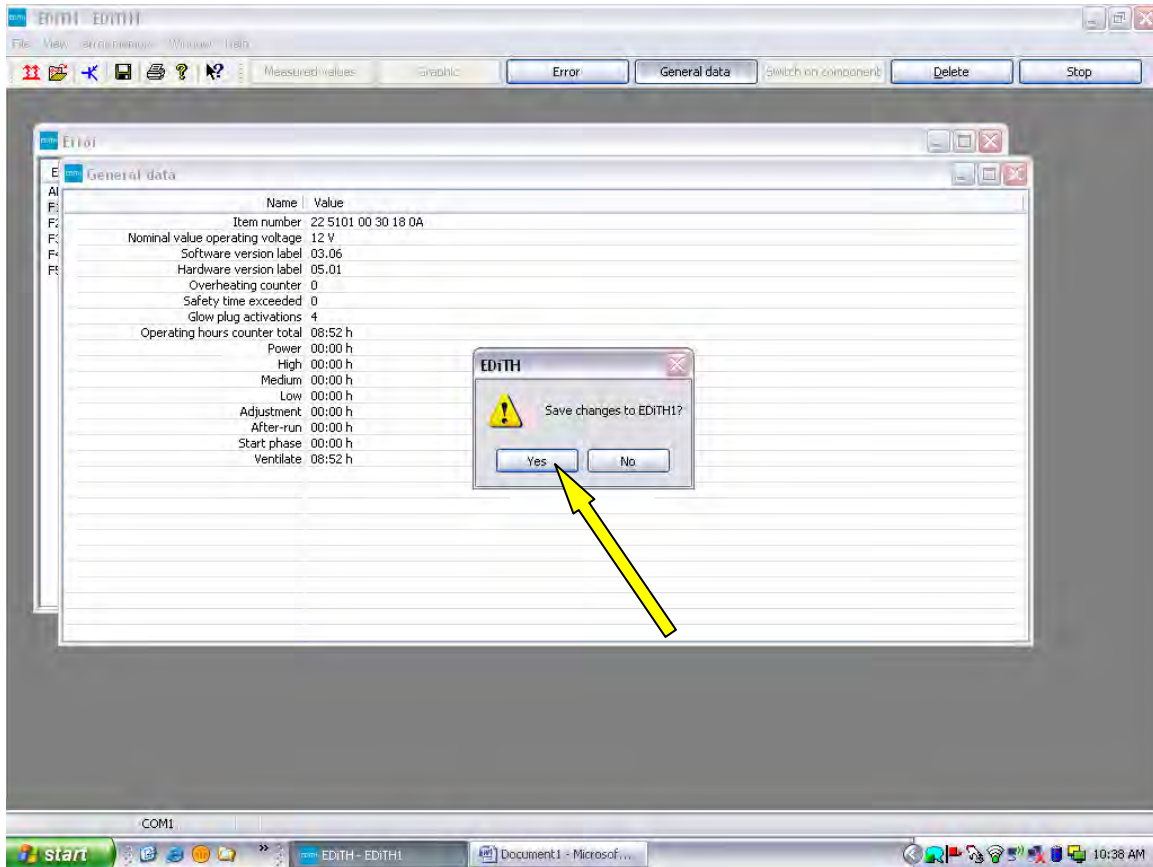
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Choosing Delete will clear the Alarm Codes (Error Codes). Choosing Stop will exit the General Data Test but allow the Alarm Codes and other data to be saved for future reference.



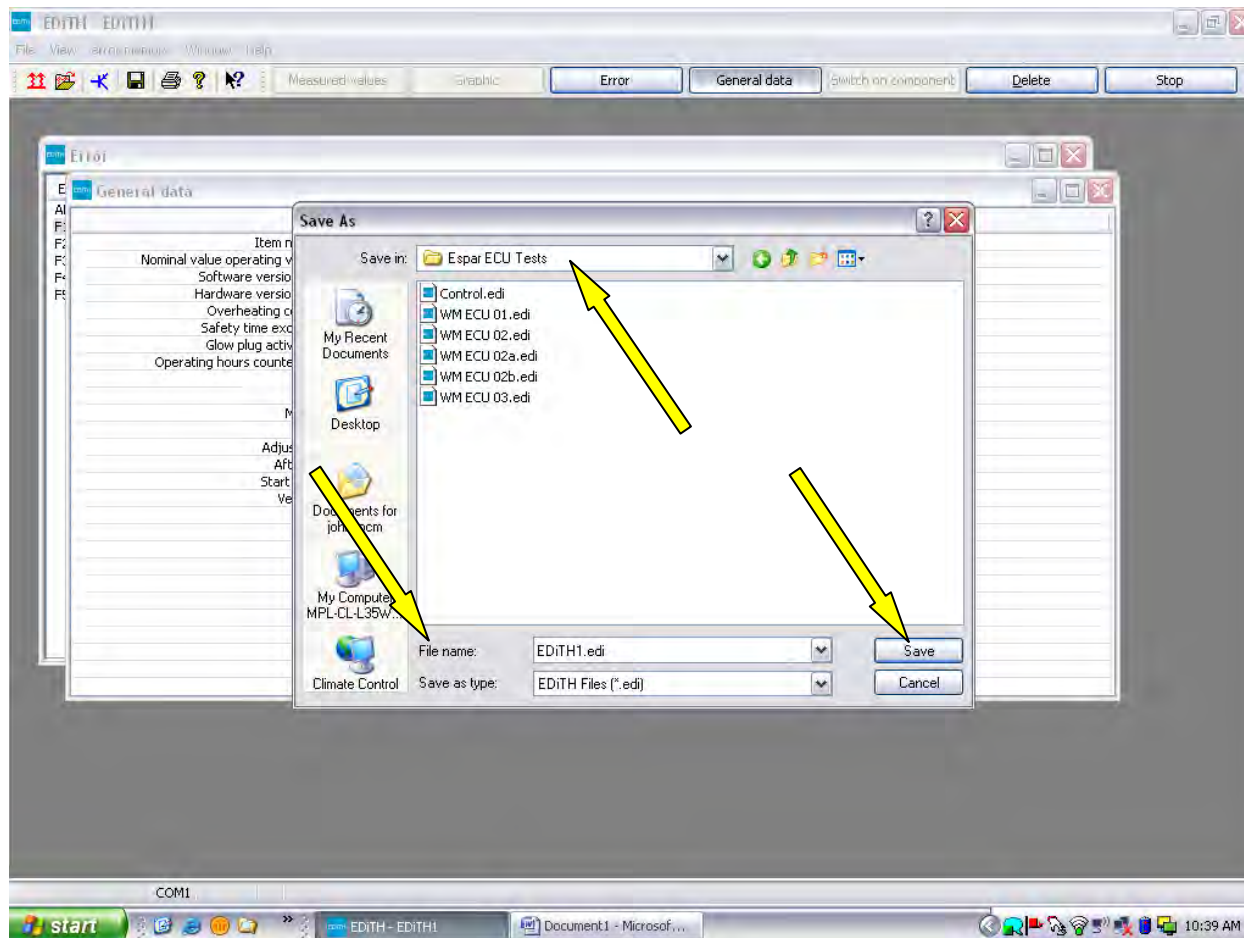
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If Stop is selected, a Save Changes prompt will appear as shown below. To exit the General Data Test without saving the data select No. To exit the General Data test and save the data select Yes.



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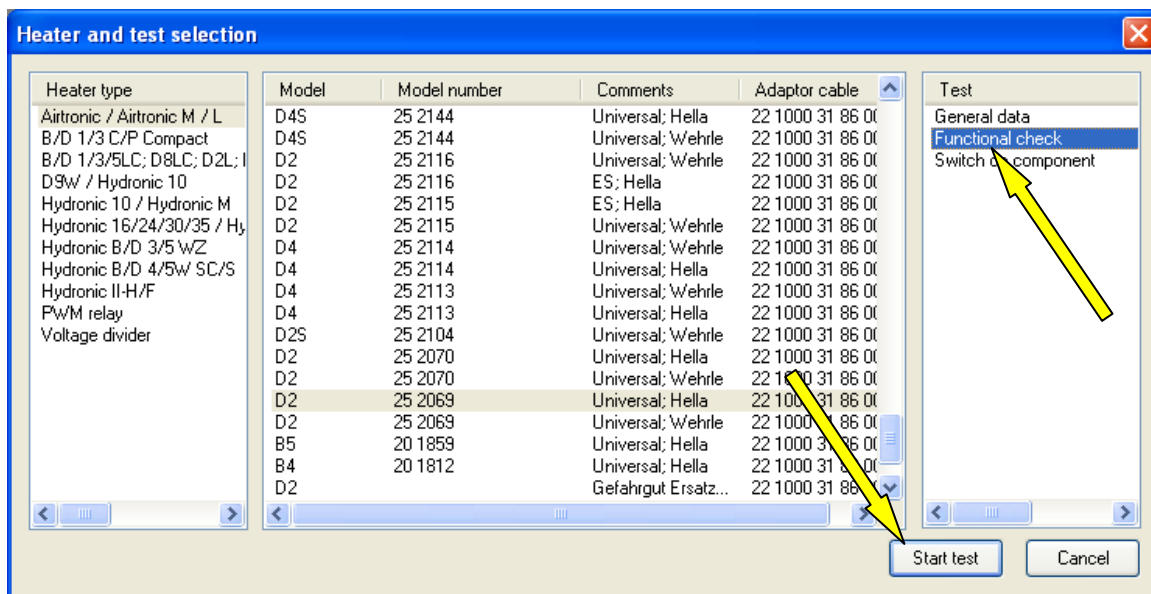
If Yes is selected, a Save As prompt will appear as shown below. Choose the desired Save In location on the PC computers local hard drive and enter the File Name. When the desired location and file name have been selected click Save to exit the General Data Test and save the data to the selected location.



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Functional Check Test

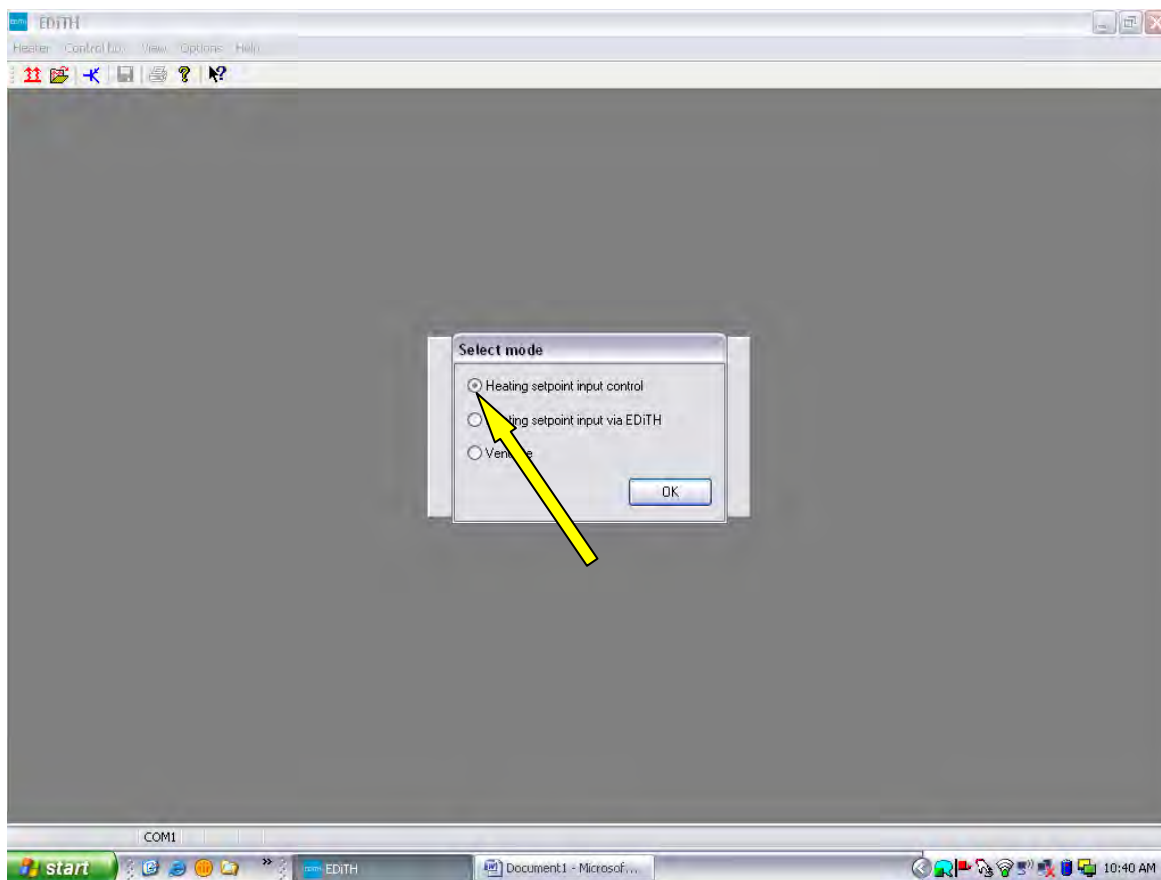
This test allows the heater to be operated to verify proper operation. Select the Functional Check test, and then select Start Test as shown below.



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The first Functional Check test display that appears allows the desired operating mode to be selected. Choose the desired operating mode and click OK.

- Heating Setpoint Input Control – the heater will control to the setpoint determined by the TriPac controls.
- Heating Setpoint Input Via EDiTH – the heater will control to the setpoint selected by the EDiTH software.
- Ventilate – the heater will operate in ventilation mode with the fan running but no heat operation.



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The next Functional Check test display that appears shows the measured values for the heater under test as shown below.

IMPORTANT: All temperatures are displayed in Celsius only. The software does not allow temperatures to be displayed in Fahrenheit. See the conversion table on the next page.

The screenshot displays the 'EDITH - [Measured values]' software window. The interface is divided into several sections for monitoring and controlling the heater system.

Components:

- Glow plug: 0 %
- Burner motor speed: 4800 1/min
- Metering pump: 3.7 Hz
- Vehicle blower
- Anti-theft alarm

Sensor values:

- Flame sensor [°C]: 202.85 °C
- Flame detected
- Overheating sensor [°C]: 66.85 °C
- Temperature setpoint value: 31 °C
- Internal temperature sensor: 26.55 °C
- External temperature sensor: -273.15 °C

Status of the inputs:

- Parking heating / D+
- Parking ventilation
- Generator D+
- Auxiliary drive

Control stage:

- Heating output [%]: 100 %
- Power
- High
- Medium
- Low
- Control off

Operating status:

- ADR/ TRS cutout
- Parking ventilation
- Cold blower
- After run when off
- After run during controlled off
- TRS after run
- After run before repeat start
- Fault after run
- Heater fault

Start mode:

- Controlled start
- Controlled start repeat start
- Initial start
- Initial start, repeat start

Safety time [s]: 0 s

Other:

- Battery voltage [V]: 11.8 V
- JE item number: 22 5101 00 30 18 0A

The bottom of the window shows a Windows taskbar with the 'start' button, several open applications (including 'EDITH - [Measured va...', 'Document1 - Microsof...', and 'Charlie Anderson [st...'), and the system clock showing 10:49 AM on 09 August 2013.

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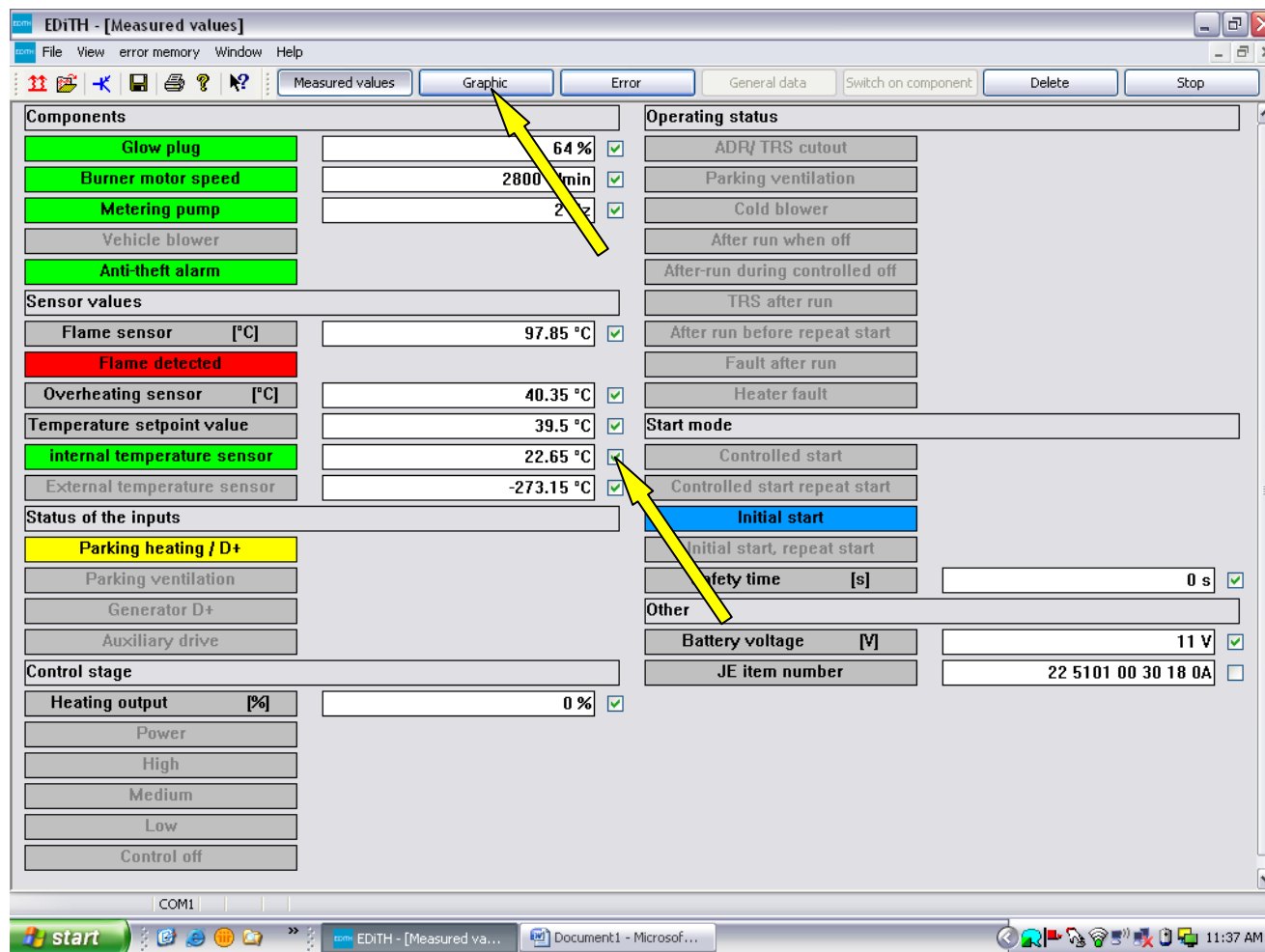
Temp Sensor Conversions	
Temp °F	Temp °C
-40	-40
-4	-20
32	0
68	20
104	40
140	60
176	80
212	100
248	120
284	140
320	160
392	200
464	240
536	280
608	320
680	360
752	400

Setpoint Conversions	
Temp °F	Temp °C
50	10
54	12
57	14
61	16
64	18
68	20
72	22
75	24
79	26
82	28
86	30
90	32

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To Graph Heater Values - Note that some of the values have a check box next to them as shown by the lower arrow below. Clicking on the check box will select that value. Only values that have been selected will be graphed.

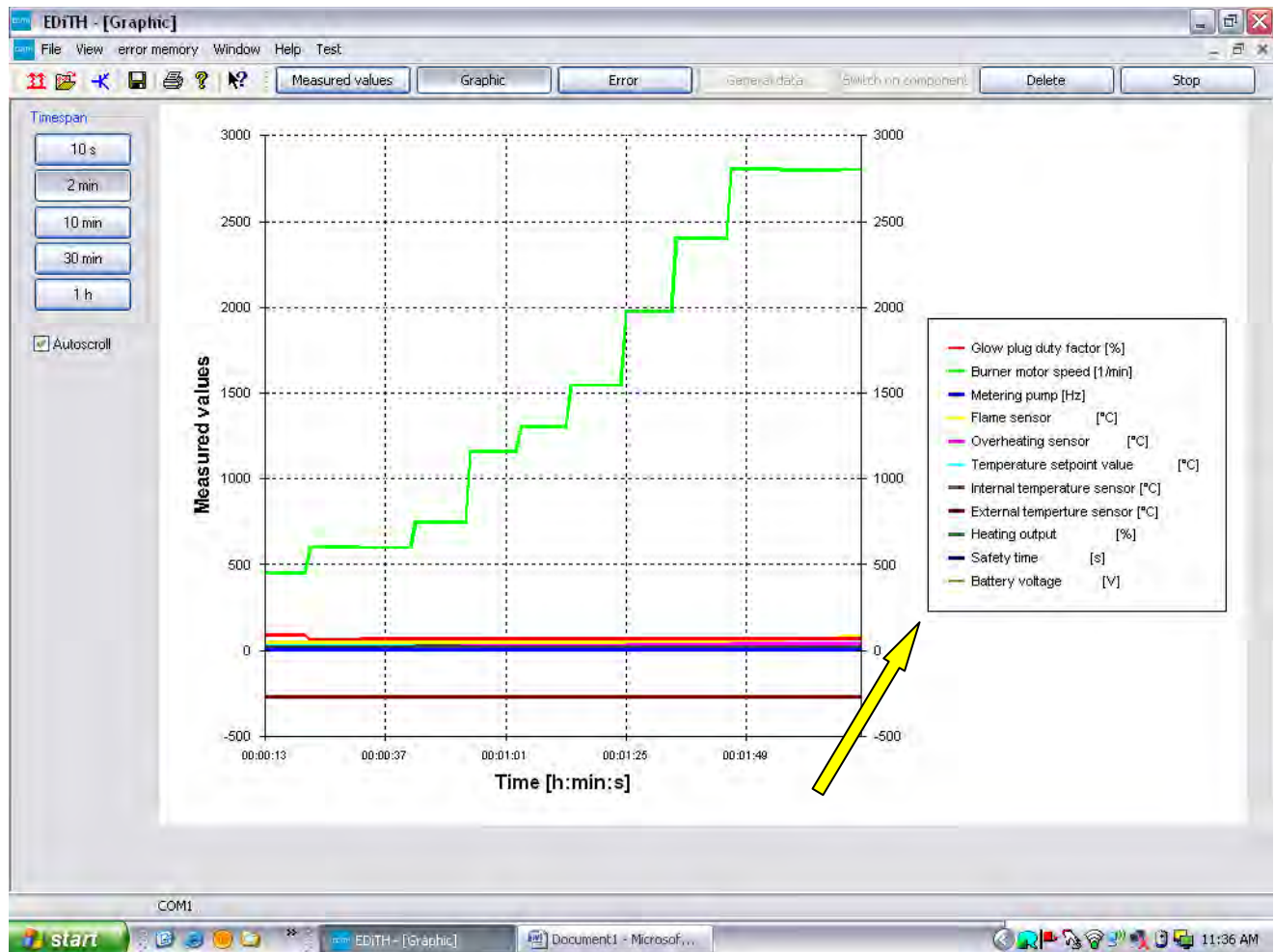
To view the graph, click the Graphic button as shown by the upper arrow below. The selected values will be presented in graphic form as shown on the next page.



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The selected values will be presented in graphic form.

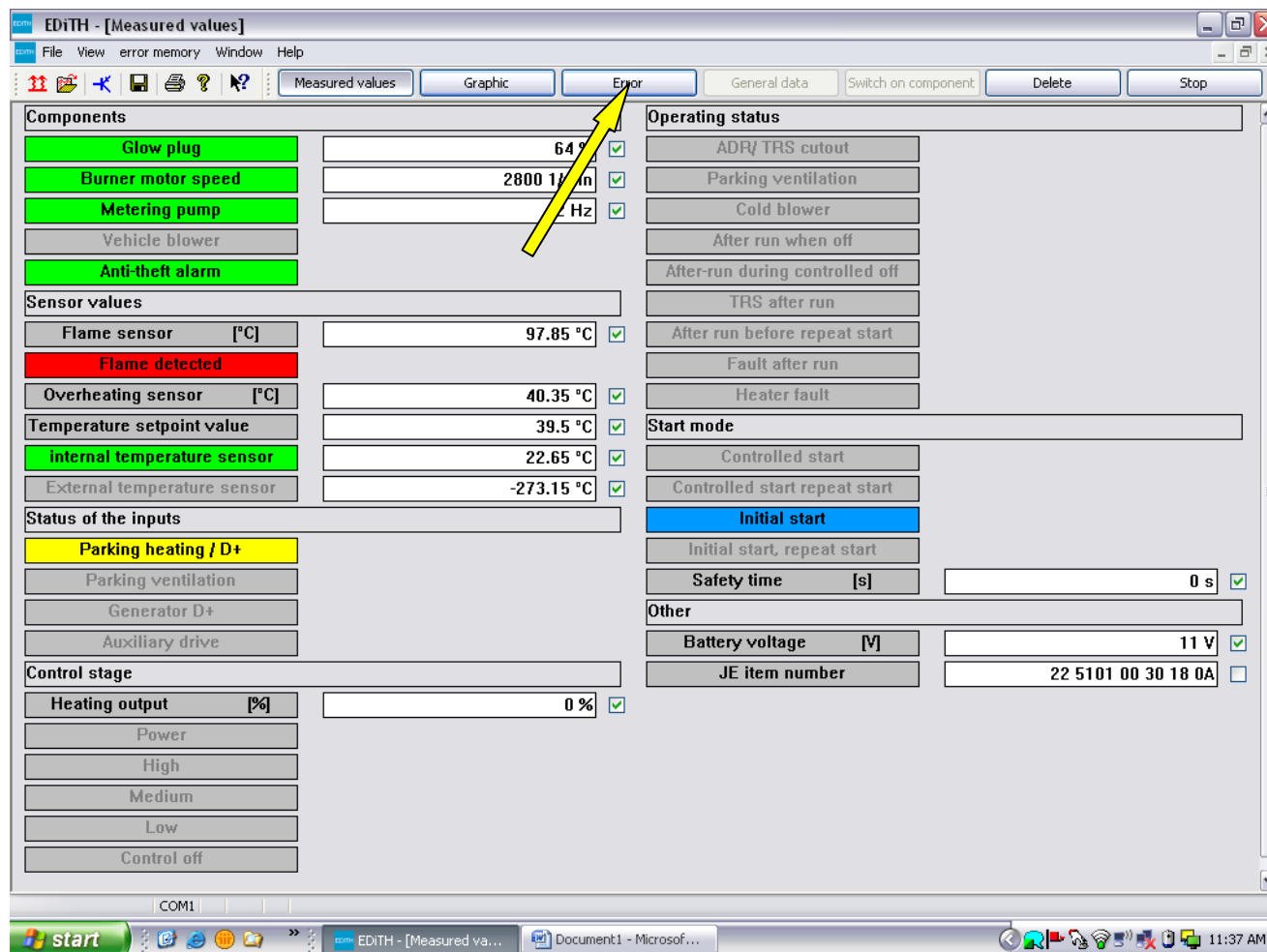
Each value is identified by color. The definitions of each color are shown in the table to the right of the graphed values.



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Any stored error codes can also be displayed from the Functional Check test. To display the Error Codes held in the heater memory click the Error button as shown below. Any error codes will be displayed as shown under General Test above.

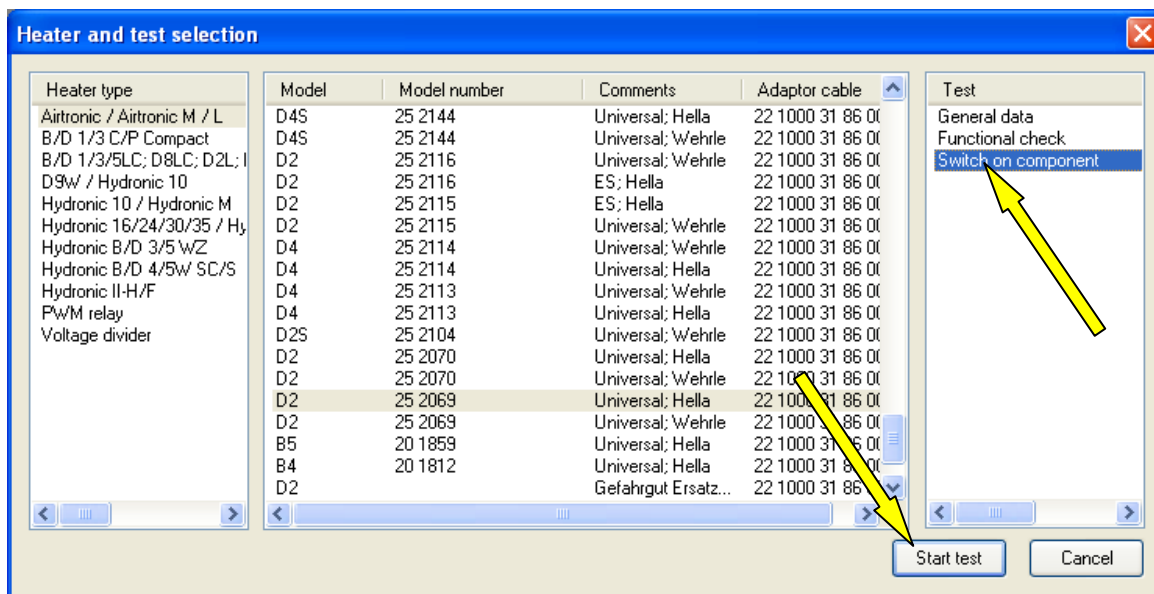
To exit the Functional Check test click Stop.



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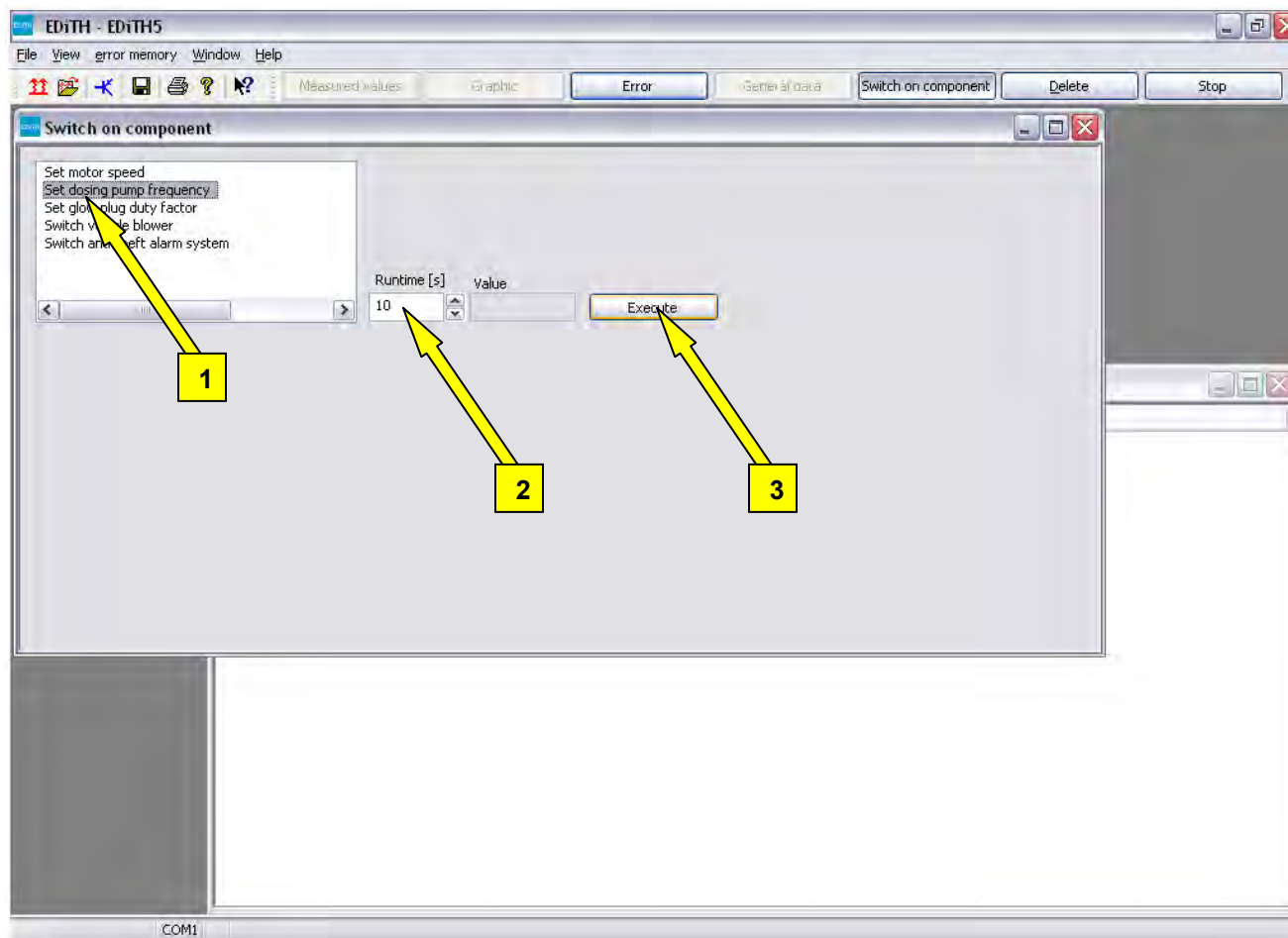
Switch On Component Test

This test allows various heater components to be switched on and off to verify proper operation. Select the Switch On Component test, and then select Start Test as shown below.



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The Switch On Component test menu will appear. First, select the desired component as shown by arrow # 1 below. Then select the amount of time the device is to be energized (if applicable) as shown by arrow # 2. Finally, select Execute to switch the component on as shown by arrow # 3.

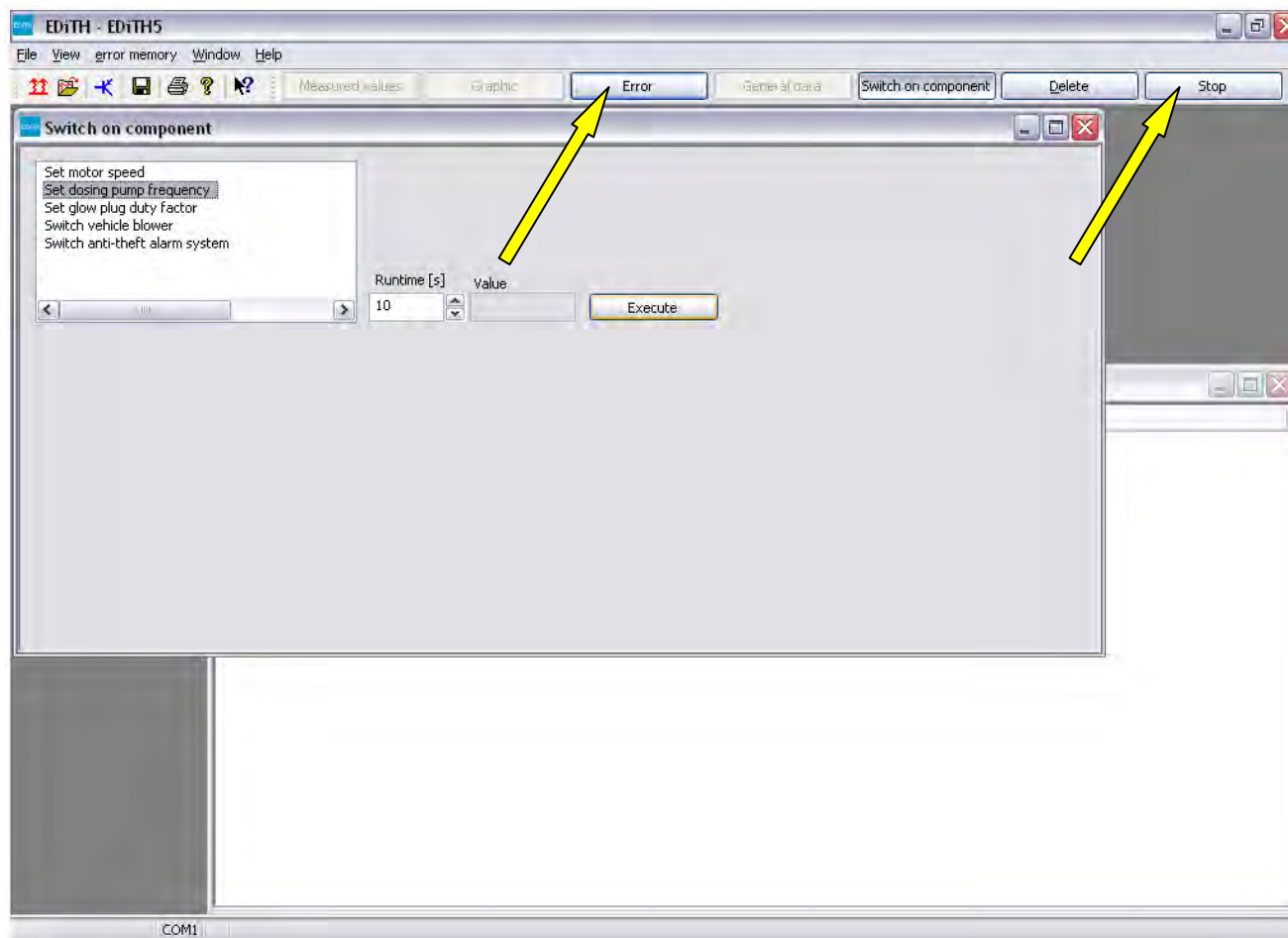


IMPORTANT: Do not run the dosing pump (heater fuel pump) for more than 10 seconds or excess fuel may be pumped into the heater and effect operation.

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Any stored Alarm Codes (Error Codes) can also be displayed from the Switch On Component test. To display the Alarm Codes (Error Codes) held in the heater memory click the Error button as shown below. Any alarm codes will be displayed as shown under General test above.

To exit the Switch On Component test click Stop.



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Stopping the EDiTH Software:

- Click the red “X” at the upper right of the larger EDiTH display.

Additional Information:

- For additional information on using the EDiTH Diagnostic Tool and Software see the EDiTH Help Menu.
- For complete Espar/Airtronic Air Heater alarm code descriptions including causes and suggested diagnostics see Section 5 of this manual.

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Heater Diagnostics using the Eberspächer Diagnostic Unit

Where Used

All TriPac units

Purpose

The Eberspächer Heater Diagnostic Unit is solely used to read out, display and delete faults stored in the heater's electronic control box. The electronic control box can store up to 5 faults (exception: auxiliary heater D 3 W Z). The current fault is displayed as " AF" and a 2-digit number and is always written in memory location F1. The stored faults "F1" to "F5" can be queried.

See the following instructions for complete details.

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OPERATING INSTRUCTIONS

DIAGNOSTIC UNIT



J. Eberspächer GmbH & Co. KG
 Eberspächerstraße 24
 73730 Esslingen
 Phone +49 (0)711 939-00
 Fax +49 (0)711 939-0643
 info@eberspaecher.com
 www.eberspaecher.com

EN

DIAGNOSTIC UNIT

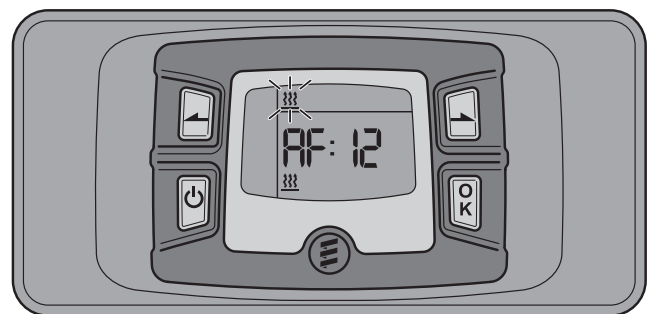
Order No. 22 1545 89 00 00

The diagnostic unit is solely used to read out, display and delete faults stored in the heater's electronic control box.

The electronic control box can store up to 5 faults (exception: auxiliary heater D 3 W Z).

The current fault is displayed as "AF" and a 2-digit number and is always written in memory location F1.

The stored faults "F1" to "F5" can be queried.



-  backwards control button
-  forwards control button
-  activation button
-  confirmation button

USABILITY OF THE DIAGNOSTIC UNIT

The diagnostic unit can be used together with the corresponding adapter cable for the following heaters:

Air heaters	Adapter cable Order No.
Airtronic / Airtronic M / Airtronic L	22 1000 31 86 00
B / D 1 L Cc, B / D 3 L Cc, B / D 3 L Pc	22 1000 30 69 00
B / D 1 L C, B / D 3 L C, B / D 3 L P, B / D 5 L C	22 1000 30 20 00
(It is only possible to connect the adapter cable and the diagnostic unit to heaters with a black, 8-pin connector housing, attached to the "Operation" lead harness)	
Water heaters	
Hydronic	22 1000 31 63 00
Hydronic II / Hydronic II C	22 1000 33 78 00
D 9 W / Hydronic 10	22 1000 31 83 00
Hydronic 10, control box with integrated connector	22 1000 32 52 00
Hydronic M II	22 1000 33 44 00
Hydronic 16 / 24 / 30 / 35	22 1000 31 66 00

CONNECT DIAGNOSTIC UNIT

Air heaters

- Disconnect the plug-in connection in the "Heater / Cable harness" cable loom.
- Connect the adapter cable to the "Heater" cable loom and to the cable harness.
- Connect the 6-pin push-on sleeve housing of the adapter cable with the 6-pin tab connector housing of the diagnostic unit.

PLEASE NOTE!

- Before starting the diagnosis, the controller of all air heaters operated with a control unit or a mini-controller must be set to max. heat output.

Water heaters

Hydronic

- Disconnect the plug-in connection in the "Heater / Cable harness" cable loom.
- Connect the adapter cable to the "Heater" cable loom and to the cable harness.
- Select heater type "Parking heater" or "Auxiliary heater" at the changeover switch.
- Connect the 6-pin push-on sleeve housing of the adapter cable with the 6-pin tab connector housing of the diagnostic unit. Start the vehicle engine also if an auxiliary heater is installed.

HYDRONIC II / HYDRONIC II C

- Disconnect the "Diagnosis" plug-in connection in the "Heater" cable loom.
- Connect the 3-pin connector housing of the adapter cable to the "Diagnosis" plug-in connection.
- Connect the 6-pin push-on sleeve housing of the adapter cable with the 6-pin tab connector housing of the diagnostic unit.

D 9 W / Hydronic 10

- Disconnect the plug-in connection in the "Operation" cable loom.
- Connect the adapter cable to the "Operation" cable loom.
- Connect the 6-pin push-on sleeve housing of the adapter cable with the 6-pin tab connector housing of the diagnostic unit.

Hydronic M / Hydronic M II

- Remove the "Heater" cable loom from the heater (control box).
- Connect the adapter cable to the heater and the cable loom.
- Connect the 6-pin push-on sleeve housing of the adapter cable with the 6-pin tab connector housing of the diagnostic unit.

Water heaters

Hydronic L / Hydronic L II

- Disconnect both plug-in connections in the "Heater / Cable harness" cable loom.
- Connect both plug-in connections to the adapter cable and the cable loom.
- Connect the 6-pin push-on sleeve housing of the adapter cable with the 6-pin tab connector housing of the diagnostic unit.

PLEASE NOTE!

- Always follow the given order of steps.
- The test duration is limited to max. 120 minutes.
- The bl/ws diagnostic cable must be connected in order to perform the diagnosis. To this end, note and follow the circuit diagram in the technical description of the heater.
- Ensure adequate battery voltage (min. 10.5 V / min. 21 V).
- Not only the defective component, but also a defective current path results in a fault being displayed.
- The fault code, fault description, cause / remedial action are described in the heater's troubleshooting.

PERFORM THE DIAGNOSIS

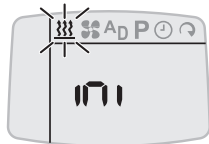
Automatic detection

Five seconds after the diagnostic unit has been connected to the heater using the adapter cable, the automatic detection starts to determine the type of heater to which the diagnostic unit is connected.

PLEASE NOTE!

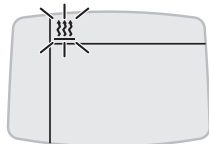
- If the automatic detection was successful, if necessary, the heater is briefly started and then switches off again.

Display until the automatic detection is completed.



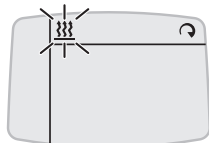
Display

- if a water heater has been detected
- if air heaters 1L, 3L, 5L or Airtronic, Airtronic M, Airtronic L air heaters (control box cable loom fixed, moulded) were detected.



Display,

- if the Airtronic, Airtronic M, Airtronic L air heaters (control box cable loom wound with cable tape) were detected.



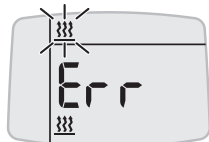
Confirm flashing symbol with

possible displays:

- if no errors/faults exist
further action → display fault memory, delete fault memory.



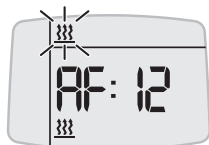
- if errors/faults exist
further actions → display current fault and fault memory, delete fault memory.



Display current fault in fault memory

Simultaneously press and

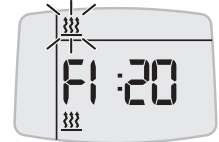
Display: e.g. AF : 12



Display fault memory F1 – F5

press or

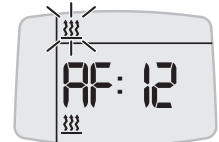
Display: e.g. F1 : 20



Display current fault in the fault memory again

Simultaneously press and

Display: e.g. AF : 12

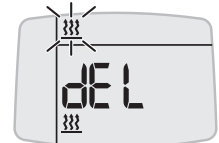


Delete the fault memory and as a result, at the same time cancel the control box lock

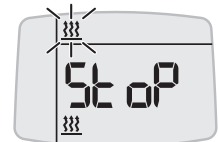
Current fault or fault F1 – F5

confirm with .

Confirm display dEL again with .



The fault memory is deleted and the control box is unlocked.



QUIT DIAGNOSIS

Switch off heater

Press , the heater is switched off.

PERFORM THE DIAGNOSIS AGAIN

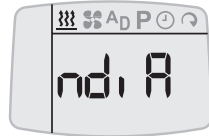
Press , the display is activated.

For further procedure, see left-hand column.

UNABLE TO PERFORM THE DIAGNOSIS

Automatic detection was unsuccessful

Display if the automatic detection was not successfully completed.



Possible causes:

- bl/ws diagnostic cable not connected
- bl/ws diagnostic cable is defective
→ check for continuity, short circuit and damage.
- Heater was not detected.

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Section 7 – TriPac EVOLUTION Information

TRIPAC EVOLUTION SOFTWARE FEATURES & INTERCHANGE

To identify the software version used with your TriPac EVOLUTION system review the Software Upgrade screen in TK Monitor. See Service Procedure A51A Communication Using TK Monitor in Section 6.

IMPORTANT: Always check the software revision of a replacement component to be sure it is the current revision.

HMI Control Panel Software

Software Revision	Features	Interchange with:
42 01	Production release	n/a

Base Controller Software

Software Revision	Features	Interchange with:
41 01	Production release	n/a

Section 7 – TriPac EVOLUTION Information

TRIPAC EVOLUTION HARDWARE FEATURES & INTERCHANGE

Interface Board

Description	Features	TK Part #	Interchange with:
Rev D Interface Board With 41 01 Software	Production release	45-2537	n/a

HMI Control Panel

Description	Features	TK Part #	Interchange with:
Rev A HMI Control Panel with 42 01 Software	Production release – Original HMI Control Panel	45-2539	n/a

TRIPAC EVOLUTION TK MONITOR SOFTWARE REVISION

TK Monitor

Description	Features	TK Part #	Interchange with:
43 01	Production release		n/a

Section 8 – TriPac EVOLUTION Drawings

TriPac EVOLUTION Drawings

2E32872 Rev A – Schematic Diagram, TriPac EVOLUTION

2E32871 Rev B – Wiring Diagram, TriPac EVOLUTION

Section 8 – TriPac EVOLUTION Drawings



REV

2E32872

A

CODE IDENT NO

D

DWG NO

2E32872

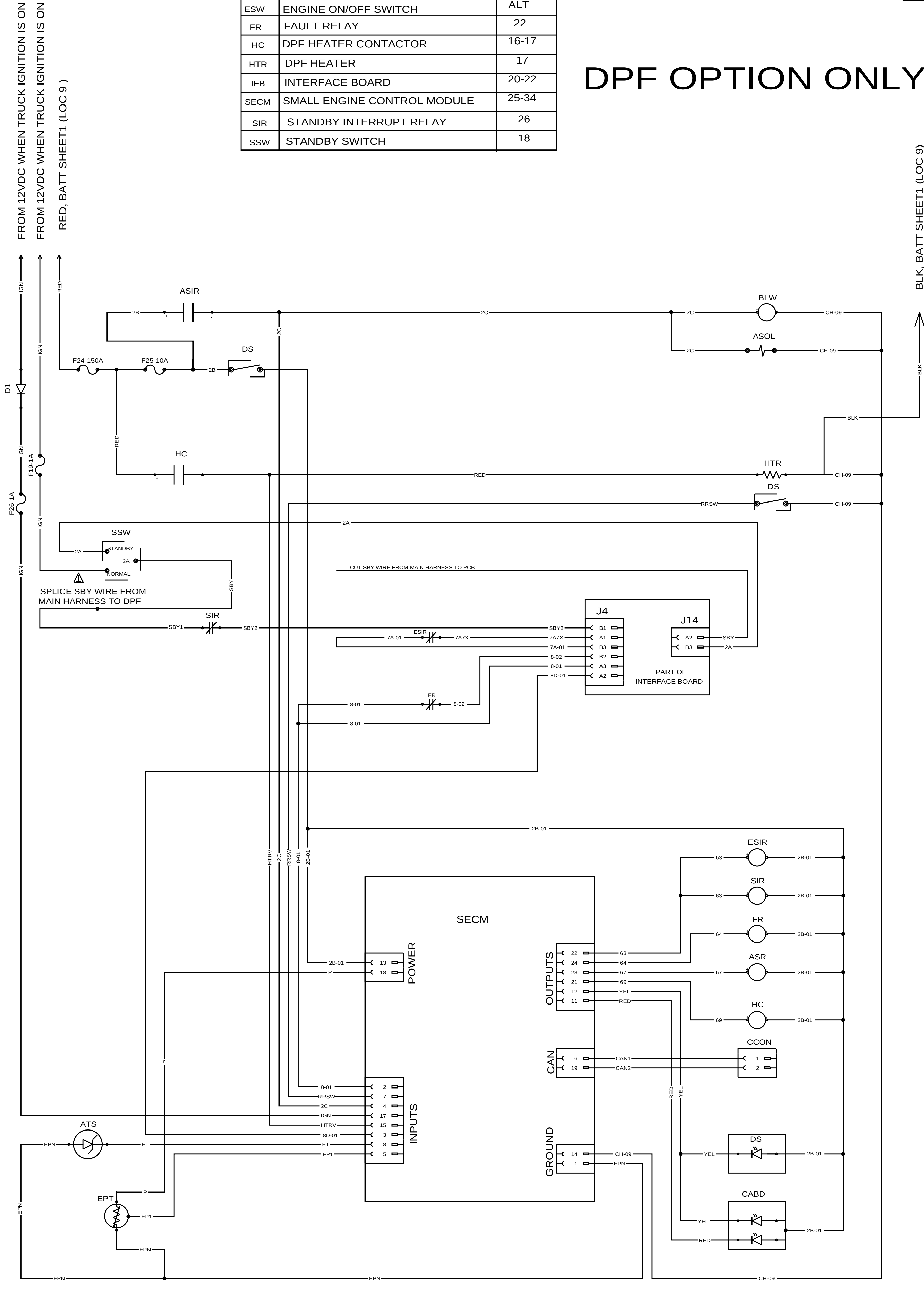
SCALE: NONE

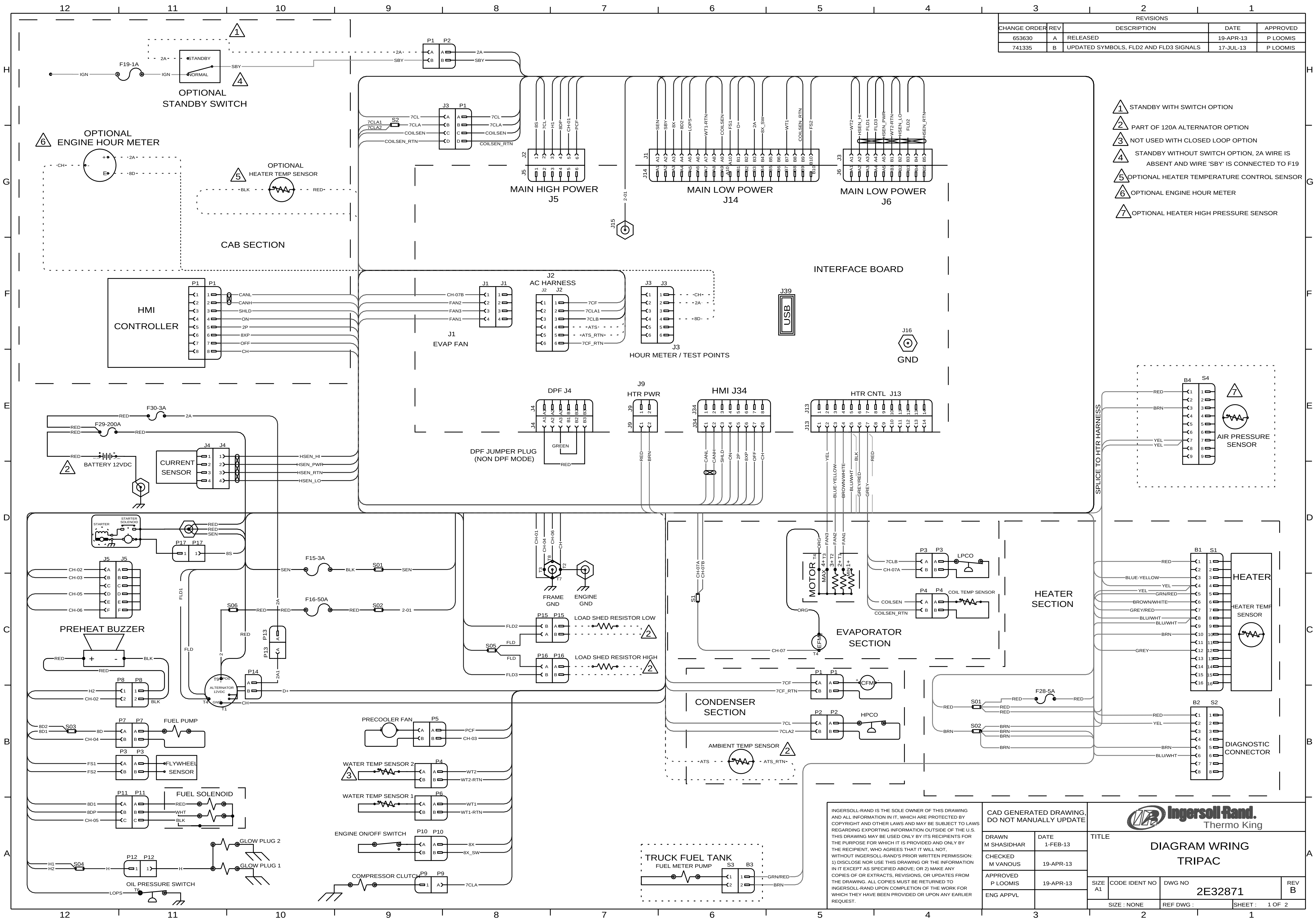
REF DWG:

SHEET 2 OF 2

DPF OPTION ONLY

CODE	DESCRIPTION	LOCATION
ASOL	AIR SOLENOID	13-14
ASR	AIR SOLENOID RELAY	28
ATS	AMBIENT TEMP SWITCH	32
BLW	BLOWER	13
CABD	CAB DISPLAY	33-34
CCON	CAN CONNECTOR	30-31
DS	DRIVER SWITCH	14
EPT	EXHAUST PRESSURE TRANSDUCER	33-34
ESIR	ENGINE START INTERRUPT RELAY	20
ESW	ENGINE ON/OFF SWITCH	ALT
FR	FAULT RELAY	22
HC	DPF HEATER CONTACTOR	16-17
HTR	DPF HEATER	17
IFB	INTERFACE BOARD	20-22
SECM	SMALL ENGINE CONTROL MODULE	25-34
SIR	STANDBY INTERRUPT RELAY	26
SSW	STANDBY SWITCH	18





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TITLE DIAGRAM WRING TRIPAC	
SIZE A1	CODE IDENT NO 2E32871
DWG NO 2E32871	REV B
SIZE : NONE	REF DWG :
SHEET : 1	OF 2

