



THERMO KING

Maintenance Manual

Container Edition

SG 5000 Series

SGUM 5000 and SGCO 5000 Units

Revision C

January 2021

TK 56740-4-MM-EN

TRANE
TECHNOLOGIES

Introduction

This manual is published for informational purposes only. Thermo King® makes no representations warranties express or implied, with respect to the information recommendations and descriptions contained herein. Information provided should not be regarded as all-inclusive or covering all contingencies. If further information is required, Thermo King Corporation Service Department should be consulted.

Thermo King’s warranty shall not apply to any equipment which has been “so installed, maintained, repaired or altered as, in the manufacturer’s judgment, to affect its integrity.”

Manufacturer shall have no liability to any person or entity for any personal injury, property damage or any other direct, indirect, special, or consequential damages whatsoever, arising out of the use of this manual or any information, recommendations or descriptions contained herein. The procedures described herein should only be undertaken by suitably qualified personnel. Failure to implement these procedures correctly may cause damage to the Thermo King unit or other property or personal injury.

General Information

The maintenance information in this manual covers unit models:	
SGCO 5000 System Number	904167
SGUM 5000 System Number	904168
For further information, refer to:	
SGCO 5000 Parts Manual	TK 56803
SGUM 5000 Parts Manual	TK 56804
Yanmar TNV Series Engine Service Manual	TK 55584
Yanmar TNV Series Engine Troubleshooting Manual	TK 55740
Tool Catalog	TK 5955
EPA and ARB Supplemental Emissions Warranty Statement	TK 56690
The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units.	
Model Nomenclature	SM: Side-mount unit frame CM: Center-mount unit frame CO: Clip-on unit frame
Tools	
TOOL - ECU Diagnostic, YSAD	2041969
TOOL - EGR opener (electronic)	2042980
TOOL - EGR opener (mechanical)	2042998
TOOL - Heated Cleaning Bath	2042379
KIT - Soot Scrubber	2042379

Revision History

Revision A	(04/2020) New manual.
Revision B	(11/2020) YSAD, Telematics, Specification, and Alarms / Messages updates.
Revision C	(01/2021) Specifications and SG+ 1.5 Updates

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Serial Number Location

- **Engine:** Engine identification plate is located on the engine valve cover.
- **Generator:** The generator nameplate is attached to the generator housing. The serial number is located on this nameplate.
- **SGUM Units:** The unit serial number nameplate is attached to the unit frame near the rear mounting bracket or on the air cleaner bracket.
- **SGCO Units:** The unit serial number nameplate is attached to the unit battery box beside the engine compartment.
- **Controller:** The controller serial number nameplate is on the end of the controller and on mounting flange of controller.

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Safety Precautions

Danger, Warning, Caution, and Notice

Thermo King® recommends that all service be performed by a Thermo King dealer and to be aware of several general safety practices.

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this unit depend upon the strict observance of these precautions. The four types of advisories are defined as follows:

⚠ DANGER

Hazard!

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Hazard!

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Hazard!

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury and unsafe practices.

NOTICE

Hazard!

Indicates a situation that could result in equipment or property-damage only accidents.

General Practices

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Always wear goggles or safety glasses and proper PPE when working on a unit. Refrigerant liquid, oil, and battery acid can permanently damage your eyes. When working with or around hazardous chemicals, ALWAYS refer to appropriate Material Data Safety Sheets (MSDS) and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection, and handling instructions.

⚠ WARNING

Equipment Damage and Risk of Injury!

Never drill holes into the unit unless instructed by Thermo King. Holes drilled into high voltage cables could cause an electrical fire, severe personal injury, or even death.

⚠ WARNING

Risk of Injury!

When using ladders to install or service refrigeration systems, always observe the ladder manufacturer's safety labels and warnings. A work platform or scaffolding is the recommended method for installations and servicing.

NOTICE**Equipment Damage!**

All unit mounting bolts must be installed, be the correct length for their application, and torqued to specifications. Missing bolts, incorrect bolt lengths and improper torque specifications can damage equipment and void the warranty.

Electrical Hazards**Electrical Precautions**

- The possibility of serious or fatal injury from electrical shock exists when servicing a Genset unit. Extreme care must be used when working with a refrigeration unit that is connected to its power source.
- Extreme care must be used even if the unit is not running. Lethal voltage potentials can exist at the unit power cord, inside the control box, inside any high voltage junction box, at the motors and within the wiring harnesses.
- In general, disconnect the unit battery and disconnect any power cords before repairing or changing any Genset components.
- Even though the controller is turned off, one of the phases is still live and represents a potential danger of electrocution.

High Voltage**⚠ DANGER****Hazardous Voltage!**

High Voltage is present when engine is running! Disconnect main battery cables to ensure the unit cannot be started!

⚠ DANGER**Hazardous Voltage!**

Lethal amounts of voltage are present in some electrical circuits. Use extreme care when working on an operating unit. If there is a risk of energized electrical contact, arc, or flash, technicians **MUST** put on all PPE in accordance with OSHA, NFPA 70E, or other local, state, or country-specific requirements for arc flash protection **PRIOR** to servicing the unit. **NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASHING CLOTHING. ELECTRICAL METERS AND EQUIPMENT MUST BE PROPERLY RATED FOR INTENDED VOLTAGE.**

⚠ WARNING**Hazardous Voltage!**

Treat all wires and connections as if they were high voltage until a meter and wiring diagram indicate otherwise. Only use tools with insulated handles. Never hold uninsulated metal tools near exposed, energized conductors. If there is a risk of energized electrical contact, arc, or flash, technicians **MUST** put on all PPE in accordance with OSHA, NFPA 70E, or other local, state, or country-specific requirements for arc flash protection **PRIOR** to servicing the unit. **NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASHING CLOTHING. ELECTRICAL METERS AND EQUIPMENT MUST BE PROPERLY RATED FOR INTENDED VOLTAGE.**

⚠ WARNING**Hazardous Voltage!**

Never work alone on high voltage circuits in the unit. Another person should be nearby to shut off the unit and provide aid in the event of an accident. If there is a risk of energized electrical contact, arc, or flash, technicians **MUST** put on all PPE in accordance with OSHA, NFPA 70E, or other local, state, or country-specific requirements for arc flash protection **PRIOR** to servicing the unit. **NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASHING CLOTHING. ELECTRICAL METERS AND EQUIPMENT MUST BE PROPERLY RATED FOR INTENDED VOLTAGE.**

⚠ WARNING**Personal Protective Equipment (PPE) Required!**

In the event of an electrical accident, all required PPE should be near the work area in accordance with OSHA, NFPE 70E, or other local, state, or country-specific requirements for a Category 2 risk.

⚠ WARNING**Hazardous Voltage!**

The unit On/Off switch must be turned Off before connecting or disconnecting the standby power plug. Never attempt to stop the unit by disconnecting the power plug.

⚠ WARNING**Risk of Injury!**

The unit power plug must be clean and dry before connecting it to a power source.

⚠ WARNING**Risk of Injury!**

Do not make rapid moves when working on high voltage circuits in the unit. Do not grab for falling tools because you might accidentally touch a high voltage source.

Low Voltage**⚠ WARNING****Live Electrical Components!**

Control circuits are low voltage (24 Vac and 12 Vdc). This voltage potential is not considered dangerous. Large amount of current available (over 30 amperes) can cause severe burns if shorted to ground. Do not wear jewelry, watch or rings. These items can shortcut electrical circuits and cause severe burns to the wearer.

Battery Installation and Cable Routing**⚠ WARNING****Hazard of Explosion!**

An improperly installed battery could result in a fire, explosion, or injury. A Thermo King approved battery must be installed and properly secured to the battery tray.

⚠ WARNING**Hazard of Explosion!**

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

⚠ WARNING**Fire Hazard!**

Do not attach fuel lines to battery cables or electrical harnesses. This has the potential to cause a fire and could cause serious injury or death.



⚠ WARNING

Hazard of Explosion!

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

⚠ CAUTION

Hazardous Service Procedures!

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

NOTICE

Equipment Damage!

Do not connect other manufacturer's equipment or accessories to the unit or to the TK Batteries unless approved by Thermo King. Failure to do so can result in severe damage to equipment and void the warranty.

Battery Removal

⚠ WARNING

Hazard of Explosion!

When removing battery cables, **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.

This order is important because the frame 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. Metal objects contacting the positive side and the frame simultaneously will cause sparks or arcing. If there are sufficient hydrogen gases emitted from the battery, an explosion might occur, causing equipment damage, serious injury, even death.

Electrostatic Discharge Precautions

Precautions must be taken to prevent electrostatic discharge while servicing the microprocessor controller and related components. The risk of significant damage to the electronic components of the unit is possible if these precautionary measures are not followed. The primary risk potential results from the failure to wear adequate electrostatic discharge preventive equipment when handling and servicing the controller. The second cause results from electric welding on the unit and container chassis without taking precautionary steps.

Electrostatic Discharge and the Controller

You must avoid electrostatic discharges when servicing the controller. Solid-state integrated circuit components can be severely damaged or destroyed with less than a small spark from a finger to metal object. You must rigidly adhere to the following statements when servicing these units. This will avoid controller damage or destruction.

- Disconnect all power to the unit.
- Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
- Do wear a static discharge wrist strap (refer to Tool Catalog) with the lead end connected to the controller's ground terminal. These straps are available at most electronic equipment distributors. *Do not* wear these straps with power applied to the unit.
- Avoid contacting the electronic components on the circuit boards of the unit being serviced.
- Leave the circuit boards in their static proof packing materials until ready for installation.
- Return a defective controller for repair in the same static protective packing materials from which the replacement component was removed.
- Check the wiring after servicing the unit for possible errors. Complete this task before restoring power.

Microprocessor Service Precautions

Take precautions to prevent electrostatic discharge when servicing the microprocessor and its related components. Even tiny amounts of current can severely damage or destroy electronic components.

Observe the following precautions when servicing a microprocessor control system to avoid damaging electronic components. Refer to the appropriate microprocessor diagnosis manual for more information.

- If the microprocessor has a power switch, turn it OFF before connecting or disconnecting the battery.
- Disconnect power to the unit.
- Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
- Wear a wrist strap (P/N 204-622 or equivalent) with the lead end connected to the microprocessor's ground terminal. These straps are available from most electronic equipment distributors. DO NOT wear these straps with power applied to the unit.
- Avoid unnecessary contact with the electronic components.
- Store and ship electronic components in antistatic bags and protective packaging.
- Leave electronic components in their antistatic packing materials until you're ready to use them.
- After servicing any electronic components, check the wiring for possible errors before restoring power to the unit.
- Never use a battery and a light bulb to test circuits on any microprocessor-based equipment.

Welding on Refrigeration Units or Containers

Electric welding can cause serious damage to electronic circuits when performed on any portion of the refrigeration unit, genset, container, or container chassis with the refrigeration unit attached. It is necessary to verify that welding currents are not allowed to flow through the electronic circuits of the unit. The procedures below MUST be strictly followed when servicing units to avoid damage or destruction of the microprocessor.

1. Disconnect the battery connections (if equipped) and lock out - tag out the unit according to local regulations.
2. Disconnect all power to or from the refrigeration unit or genset.
3. Disconnect all quick-disconnect wire harnesses from the back of the controller.
4. Disconnect all wire harnesses from the Remote Monitor Modem (RMM), if equipped.
5. Switch all of the electrical circuit breakers in the control box to the Off position.
6. When steps 1 through 5 are complete, weld the unit and/or container using normal welding procedures. Keep ground return electrode as close to the area to be welded as practical. This will reduce the likelihood of stray welding currents passing through any electrical or electronic circuits.
7. When welding is complete, restore the unit power cables, wiring, and circuit breakers to their normal condition.

High Pressure Fuel Hazards

WARNING

Hazardous Pressures!

After the engine has stopped, wait 10 to 15 minutes before opening the high pressure side of the fuel system.

WARNING

Risk of Injury!

Do not use your fingers to check high pressure joints for leaks. Use a piece of paper or cardboard.

First Aid

ENGINE COOLANT

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention.
- **Skin:** Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.



Safety Precautions

- **Ingestion:** Do not induce vomiting. Immediately contact local poison control center or physician.

BATTERY ACID

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention. Wash skin with soap and water.

ELECTRICAL SHOCK

Take IMMEDIATE action after a person has received an electrical shock. Get quick medical assistance, if possible.

The source of the shock must be quickly stopped, by either shutting off the power or removing the victim. If the power cannot be shut off, the wire should be cut with a non-conductive tool, such as a wood-handle axe or thickly insulated cable cutters. Rescuers should wear insulated gloves and safety glasses, and avoid looking at wires being cut. The ensuing flash can cause burns and blindness.

If the victim must be removed from a live circuit, pull the victim away with a non-conductive material. Use wood, rope, a belt or coat to pull or push the victim away from the current. DO NOT TOUCH the victim. You will receive a shock from current flowing through the victim's body. After separating the victim from power source, immediately check for signs of a pulse and respiration. If no pulse is present, start Cardio Pulmonary Resuscitation (CPR). If a pulse is present, respiration might be restored by using mouth-to-mouth resuscitation. Call for emergency medical assistance.

ASPHYXIATION

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

Specifications

Generator

Type	460/230 Vac, 3 Phase, 60 Hz
Output Power	15 Kw
Kilovolt-Amperes	18.75 kVA
RPM	1800 RPM

Electrical Control System

Controls	SG+ 1.5 Microprocessor Controller	
Voltage	12.5 Vdc (nominal)	
Battery	12 Volts, Group 31, 925 / 950 CCA @ -18 C (0 F)	
Fuse SI1 (Located on Control board)	30 Amp - RL4 Relay Fuse	
Fuse SI2 (Located on Control board)	30 Amp - Battery Charger Fuse	
Fuse SI3 (Located on Control board)	30 Amp - J9 to J13 Controller Fuse	
Fuse FS1 (Located in Control Box)	10 Amp - ECU Fuse	
Fuse FS2 (Located in Control Box)	40 Amp - Starter Solenoid Fuse	
Fuse FS4 (Located in Control Box)	60 Amp - Glow Plug Fuse	
Electrical Components		
NOTE: Disconnect components from unit circuit to check resistance.		
	Current Draw (Amps) at 12.5 Vdc	Resistance – Cold (Ohms)
Glow Plugs (4) Each	4.5	2.8
Starter Motor	350-475*	
* On-the-engine cranking check. Bench test is approximately 140 amps.		



Specifications

Engine

Model	TK488CRG1 (Tier 4)	
Number of Cylinders	4	
Cylinder Arrangement	In-line vertical, number 1 on flywheel end	
Firing Order	1-3-4-2	
Direction of Rotation	Counterclockwise viewed from flywheel end	
Fuel Type	No. 2 diesel fuel under normal conditions No. 1 diesel fuel is acceptable cold weather fuel	
Oil Capacity	12 quarts (11.4 liters) crankcase and oil filter Fill to full mark on dipstick	
Oil Type	API Classification CJ-4 or CK-4 ACEA Rating E6	
Oil Viscosity	14 F to 122 F (-10 C to 50 C): SAE 15W-40 (Synthetic) 5 to 104 F (-15 to 40 C): SAE 15W-40 5 to 104 F (-15 to 40 C): SAE 10W-30 (Synthetic or Synthetic Blend) -13 to 104 F (-25 to 40 C): SAE 10W-40 -13 to 86 F (-25 to 30 C): SAE 10W-30 -22 to 122 F (-30 to 50 C): SAE 5W-40 (Synthetic) Below -22 F (-30 C): SAE 0W-30 (Synthetic)	
Engine RPM	Low Speed Operation High Speed Operation	1500 ± 25 RPM 1800 ± 25 RPM
Engine Oil Pressure	18 psig (127 kPa) minimum in low speed 45 to 57 psig (310 to 390 kPa) in high speed	
Intake Valve Clearance	0.006 to 0.010 in. (0.15 to 0.25 mm)	
Exhaust Valve Clearance	0.006 to 0.010 in. (0.15 to 0.25 mm)	
Valve Setting Temperature	70 F (21 C)	
Low Oil Pressure Switch (Normally Closed)	5.6 – 9.9 psig (38 – 69 kPa)	
Engine Coolant Thermostat	160 F (71 C)	
Engine Coolant Type	<p>Factory filled with Chevron Delo® XLC extended life coolant (ELC). 55/45 glycol/water concentration Freeze protection of -40°F/ -40°C</p> <p>Important: Only OAT extended life coolants (Chevron Delo® XLC or equivalent) should be added to Thermo King systems. Conventional coolants should not be used (Typically identified by green or blue-green color). If a conventional coolant is combined with the Thermo King factory fill up to 25% by volume, the coolant must be changed at the next service opportunity. Above 25%, the coolant must be changed immediately. Conventional coolants dilute/interact with the additive packages of extended life coolant which significantly reduces the service life of the coolant.</p> <p>Compatible coolants: Chevron Delo® XLC Havoline Delo® XLC (Europe) Caltex Delo® XLC (Asia) OR Meets the performance requirements of both ASTM D6210 and ASTM D3306 OAT extended life coolant, nitrite free</p>	
Coolant System Capacity	7.5 quarts (7.1 liters)	
Radiator Cap Pressure	15 psig (103 kPa)	
Drive	Standard Units	Direct Drive to belts, AC generator, alternator, and water pump
Water Pump Belt Tension	New Belt: 126 Hz (40 lbs) Field Reset (used belt): 118 Hz (32 lbs)	

Controller Default Settings

Setting – Menu Location	Default Setting
Tank Size – Commands/System Setup	SGCO Clip-On Units: 125 gallons (473L) SGCM and SGSM Units: 80 gallons (303L), OR 50 gallons (189L), OR 30 gallons (114L)
Date/Time– Commands/System Setup	Software Date
ID Number– Commands/System Setup	00000000
C/F Mode – Misc. Functions	F
HM1 (Hour Meter 1) Threshold – Configuration	0
HM1 (Hour Meter 2) Threshold – Configuration	0
ENG (Engine) Off Hours – Configuration	0
Factory Reset – Configuration	Off
APU Connected – Configuration	Off
Output Voltage – Configuration	460
Fuel Sensor – Configuration	Off
Fuel Level – Configuration	0
Crank Restarts – Configuration	3
Telematic – Configuration	Off

SG 5000 Series Unit Weight

SGCO 5000 Unit Weight (net)	898 Kg (1980 lbs.) - Including oil, coolant, and battery. 1306 Kg (2879 lbs.) - Including oil, coolant, battery, and 473 Liters (125 gal.) of fuel.
SGUM 5000 Weight (net) With 50 Gallon (189 Liter) Fuel Tank	687 Kg (1514 lbs.) - Including oil, coolant, telematics, and battery. 848 Kg (1869 lbs.) - Including oil, coolant, telematics, battery, and 189 Liters (50 gal.) of fuel. 27 Kg (60 lbs.) Total weight of two mounting arms.
SGUM 5000 Weight (net) With 80 Gallon (303 Liter) Fuel Tank	694 Kg (1529 lbs.) - Including oil, coolant, telematics, and battery. 951 Kg (2096 lbs.) - Including oil, coolant, telematics, battery, and 303 Liters (80 gal.) of fuel. 27 Kg (60 lbs.) Total weight of two mounting arms.

Maintenance Inspection Schedule

Pretrip	Every 1,500 Hours	Every 3,000 Hours*	Inspect/Service These Items
			Microprocessor:
•			Run Pretrip Test (see "Performing a Pretrip Test").
			Engine:
•			Check fuel supply.
•			Check engine oil level.
•	•	•	Listen for unusual noises, vibrations, etc.
•	•	•	Inspect belts for condition and proper tension.
•	•	•	Check engine oil pressure hot, on high speed (should display "OK").
•	•	•	Check engine coolant level and antifreeze protection (-30 F [-40 C]).
•	•	•	Drain water from the Primary fuel filter bowl.
	•	•	Drain water from fuel tank and check vent.
	•	•	Inspect/clean electric fuel pump filter.
		•	Check engine mounts for wear.
		•	Replace EMI 3000 air cleaner element (see "EMI 3000 Air Cleaner") at 3,000 hours or two years (whichever occurs first). See note.
		•	Replace EMI 3000 fuel filter/water separator. See note.
		•	Replace Secondary EMI 3000 fuel filter, see note.
		•	Change engine oil and oil filter (hot). Requires oil with API Classification CJ-4 or CK-4. See Note*. NOTE: For high biodiesel use (B20) the engine oil and filter should be changed every 1500 hours.
		•	Inspect/clean EGR system. Cleaning the valve and piping is recommended. Cleaning the cooler is required for emissions compliance.
		•	Adjust engine valve clearance.
			Change ELC (red) engine coolant every 5 years or 12,000 hours. Units equipped with ELC have an ELC nameplate on the expansion tank (see "Engine Cooling System").
			Electrical:
	•	•	Inspect battery terminals and electrolyte level.
	•	•	Inspect wire harness for damaged wires or connections.
	•	•	Inspect AC generator wire connections for tightness.

			Structural:
•	•	•	Visually inspect unit for fluid leaks.
•	•	•	Visually inspect unit for damaged, loose, or broken parts.
	•	•	Clean entire unit including radiator coil.
	•	•	Check all unit and fuel tank mounting bolts, brackets, lines, hoses, etc.

*3000 hours or one year, whichever occurs first.

Unit Description

General Description

Thermo King generator sets (clip-on and under-mount) are self-contained fully-automatic, diesel powered units. The generator sets supply 230 or 460 Vac electrical power for container refrigeration units. Enclosed within the unit frame are the engine, dual voltage alternator, generator battery compartment, battery charging regulator and control panel.

⚠ CAUTION

Risk of Injury!

DO NOT attempt to operate or maintain the generator until you have completely familiarized yourself with the equipment.

This unit uses an engine called TK488CRG1. An EGR (Exhaust Gas Recirculation) system and DOC (Diesel Oxidation Catalyst) exhaust after-treatment system also reduce emissions so the engine is EPA Tier 4 compliant. An ECU (Engine Control Unit) monitors and controls engine operation. The unit controller indirectly monitors and controls the engine through the ECU.

Each unit features a welded, heavy-gauge steel frame with special sea-going finish; non-corrosive fittings, all stainless steel external hardware, brazed aluminum radiator, and poly-vinyl coating on the engine and generator.

Fuel tanks are provided as an integral part of each unit. Fuel capacities are: 473 liter (125 gal.) on SGCO clip-on models; 303 liter (80 gal.), or 189 liter (50 gal.) on SGCM center mount or SGSM side mount models.

The alternator is a brushless, rotating field ac generator. A rectified exciter armature output provides dc power for the field. The exciter field obtains its power from the full wave rectified output of the main generator. The alternator supplies 230 or 460 Vac, 3 phase, 4 wire, 60 Hz power at 1800 RPM.

This equipment develops normal output voltages (below 600 volts) whenever the engine is running. All output voltages normally reach 460 volts. Under malfunction conditions, 575 volts may be produced. Any electric potential more than 50 volts is hazardous. Exercise caution and discretion in the operation and maintenance of the equipment.

SGCO 5000



SGUM 5000





EMI 3000

These units are equipped with an EMI 3000 Extended Maintenance Interval package. The EMI 3000 package will result in lower total unit life cycle cost, because maintenance intervals have an important impact on unit operating costs.

The EMI 3000 package consists of the following key components:

- EMI 3000-Hour Cyclonic Air Cleaner Assembly and Air Cleaner Element
- EMI 3000-Hour 5-Micron Primary Fuel Filter / Water Separator
- EMI 3000-Hour 1-Micron Secondary Fuel Filter (if equipped)
- EMI 3000-Hour Dual Element Oil Filter (blue with white lettering)
- API Classification CJ-4 or CK-4 Oil
- Five Year or 12,000 Hour Extended Life Coolant (ELC)

The EMI package allows standard maintenance intervals to be extended to 3,000 hours, or 2 years, whichever occurs first.

EMI 3000 equipped units are identified by a "ELC" decal tag on the coolant expansion tank, and blue and white colored oil filters. The EMI 3000 package allows standard genset maintenance intervals to be extended to 3000 hours. However, please note that units equipped with the EMI 3000 package still require regular inspection in accordance with Thermo King pretrip inspection and maintenance recommendations (see the Maintenance Inspection Schedule chapter in this manual).

SG Microprocessor Controller

The SG Microprocessor controller controls and monitors unit operation, records system faults and performs an automatic pre-trip check. The controller monitors all unit protection shutdown functions and the exciter system. The controller shuts down unit operation due to low engine oil pressure, low engine oil level, high coolant temperature, or alternator overload. The module also delays excitation power supply for 2 minutes after unit start-up. The SG Microprocessor controller is designed with the capability to have the software flash loaded.



Unit Instruments

Indicator LEDs

- **POWER LED:** A green Power LED lights up while the Unit On/Off Switch is in the ON position. It is located on the controller display.
- **ALARM LED:** A red Alarm LED illuminates when a shutdown condition has occurred. It is located on the controller display.



Unit Protection Devices

⚠ WARNING

Equipment Damage and Risk of Injury!

The unit may start at any time without warning when the unit On/Off switch is in the On position. Units equipped with a SG controller feature a Delayed Restart mode. The controller will make up to three (3) attempts every 20 minutes to restart the unit after a Delay Alarm has occurred. The Delayed Restart mode continues until the unit has been successfully restarted, or until a Shutdown Alarm is generated. Protection shutdown devices that cause an Delayed Restart shutdown condition include low oil pressure, low oil level, and high coolant temperature.

- **Fuses:** The electrical system is equipped with fuses for protection. See the Electrical Maintenance chapter for more information.
- **Coolant Level Switch:** The coolant level switch closes if the coolant level drops below an acceptable level. If it stays closed for a specified time, the microprocessor records and alarm code.
- **Engine Coolant Temperature Sensor:** The microprocessor gets the engine coolant temperature information from the Engine Control Unit (ECU). If the engine coolant temperature rises above an acceptable level, the microprocessor records and alarm code. The microprocessor might also shut the unit down.
- **Low Oil Level Switch:** The low oil level switch closes if the oil drops below an acceptable level. If it stays closed for a specified time, the microprocessor shuts the unit down and records an alarm code.
- **Low Oil Pressure Switch:** The low oil pressure switch closes if the oil pressure drops below an acceptable level. If it stays closed for a specified time, the microprocessor shuts the unit down and records an alarm code.
- **Preheat Buzzer:** The preheat buzzer sounds when the controller energizes the preheat relay. This warns anyone near the unit that the controller is about to start the engine.

Voltage Option

A power cable and receptacle wired for 230 Vac or 460 Vac is supplied as standard equipment with each generator. Genset models can be wired for either receptacles: 230 Vac or 460 Vac.

EcoPower

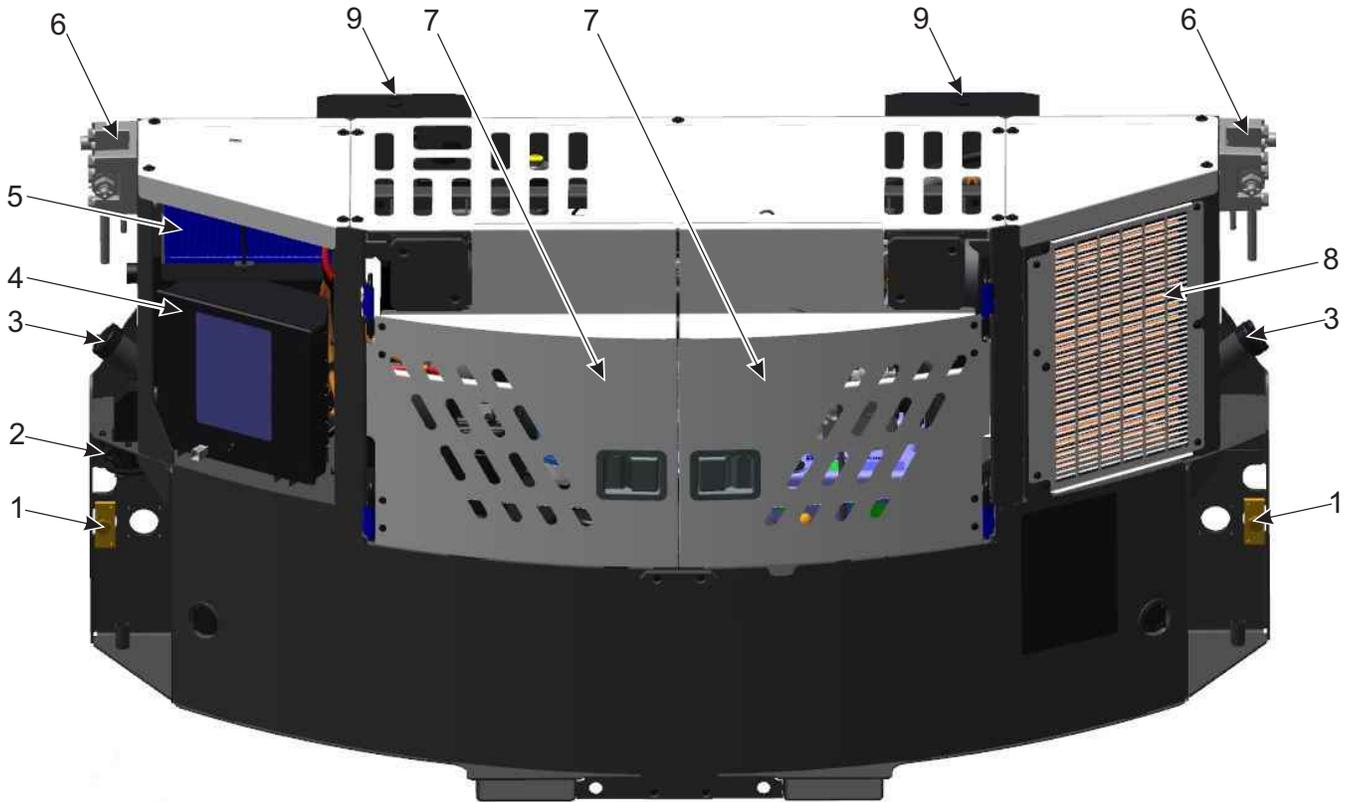
EcoPower is a standard feature on all SG 5000 units - designed to save fuel and meet emissions regulations. The controller monitors the load from the refrigeration unit and determines if the engine should run in high speed (1800 ± 10 RPM), or low speed (1500 ± 5 RPM). The output frequency is 60 Hz in high speed and 50 Hz in low speed. The engine runs in high speed for at least fifteen minutes when it is started, and whenever it shifts from low speed to high speed (ECU controlled).

Fuel Level Sensor Option

The fuel level sensor option allows the controller to monitor and log fuel events. Units equipped with the fuel level sensor option must have the Fuel Sensor turned on in the Configuration Menu, and the fuel tank size set in the System Setup submenu.

SG 5000 Photos, Illustrations, and Measurements

SGCO 5000 Front View

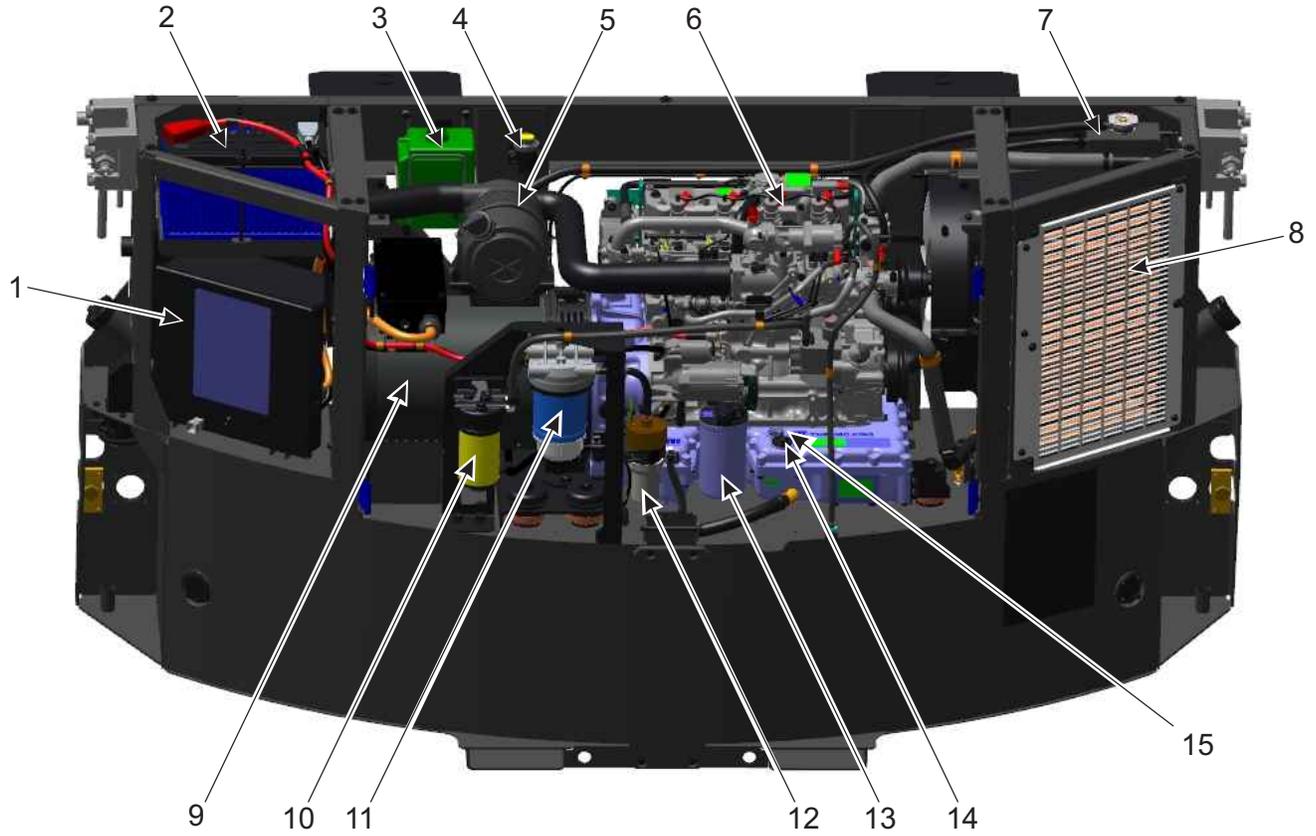


RAJ705

1.	Lower Mounting Hardware	6.	Corner Casting - Pin Mount
2.	460 or 230 VAC Power Receptacle Location	7.	Front Access Doors
3.	Fuel Tank Cap	8.	Radiator Location
4.	Control Box Location	9.	Bracket Clip-On
5.	Battery Location		



SGCO 5000 Front View (Covers Removed)



RAJ706

1.	Control Box Location	9.	Alternator Assembly
2.	Battery Location	10.	Fuel Filter (Secondary)
3.	Coolant Reservoir	11.	Fuel Filter / Water Separator (Primary)
4.	Air Filter Restriction Gauge	12.	Electric Fuel Supply Pump
5.	Air Filter Assembly	13.	Engine Oil Filter
6.	Engine	14.	Engine Oil Cap / Fill Location
7.	Cooling System Degas Tank, Pressure Cap, Coolant Level Switch	15.	Oil Level Switch
8.	Radiator		

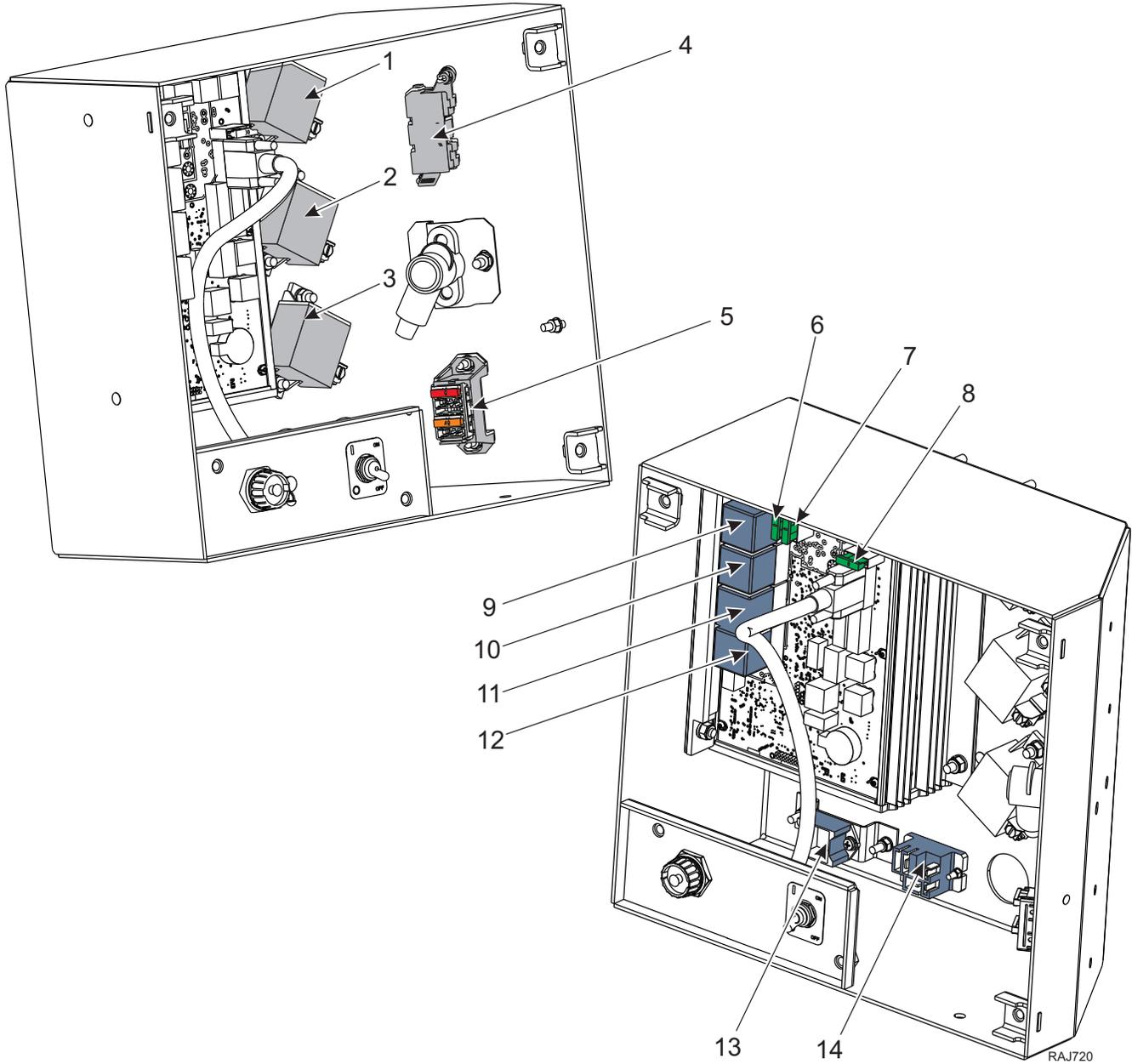
SGCO 5000 Control Box (External)



1.	SG+ 1.5 Controller
2.	Flash Drive USB Port
3.	Unit ON / OFF Switch

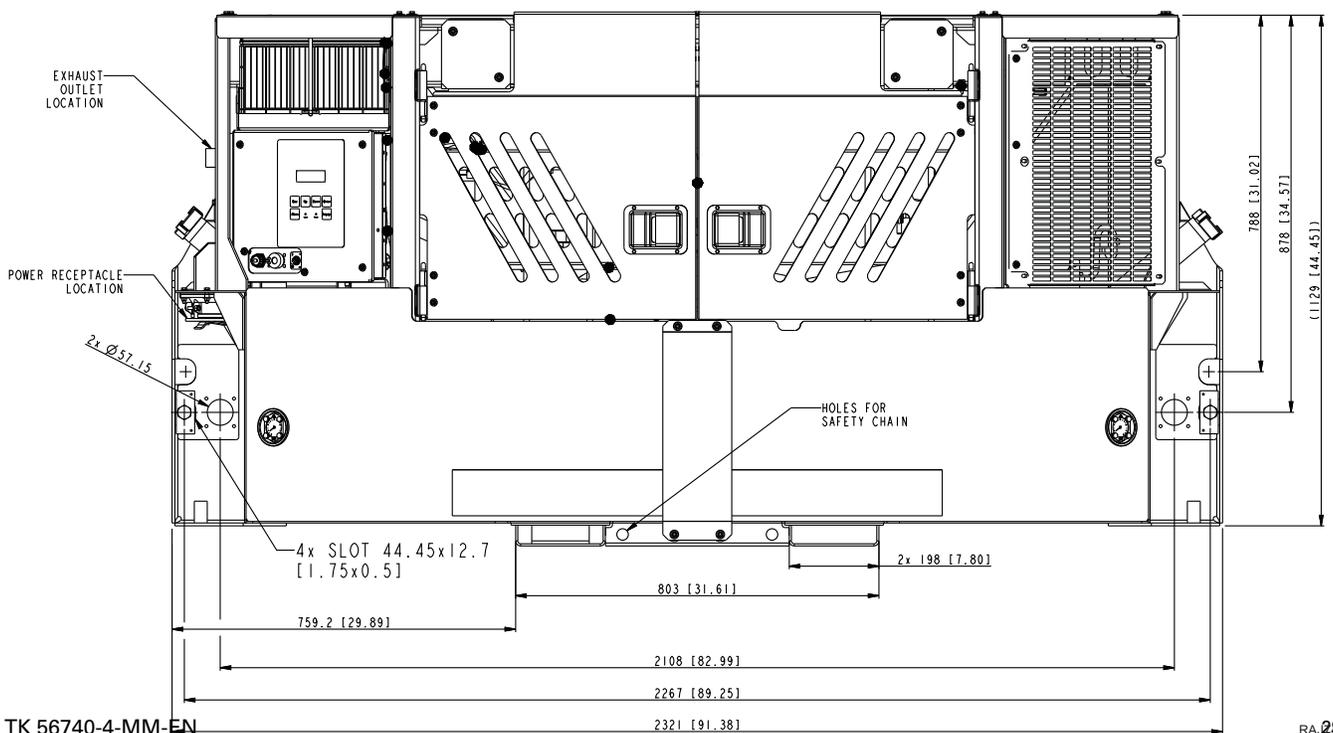
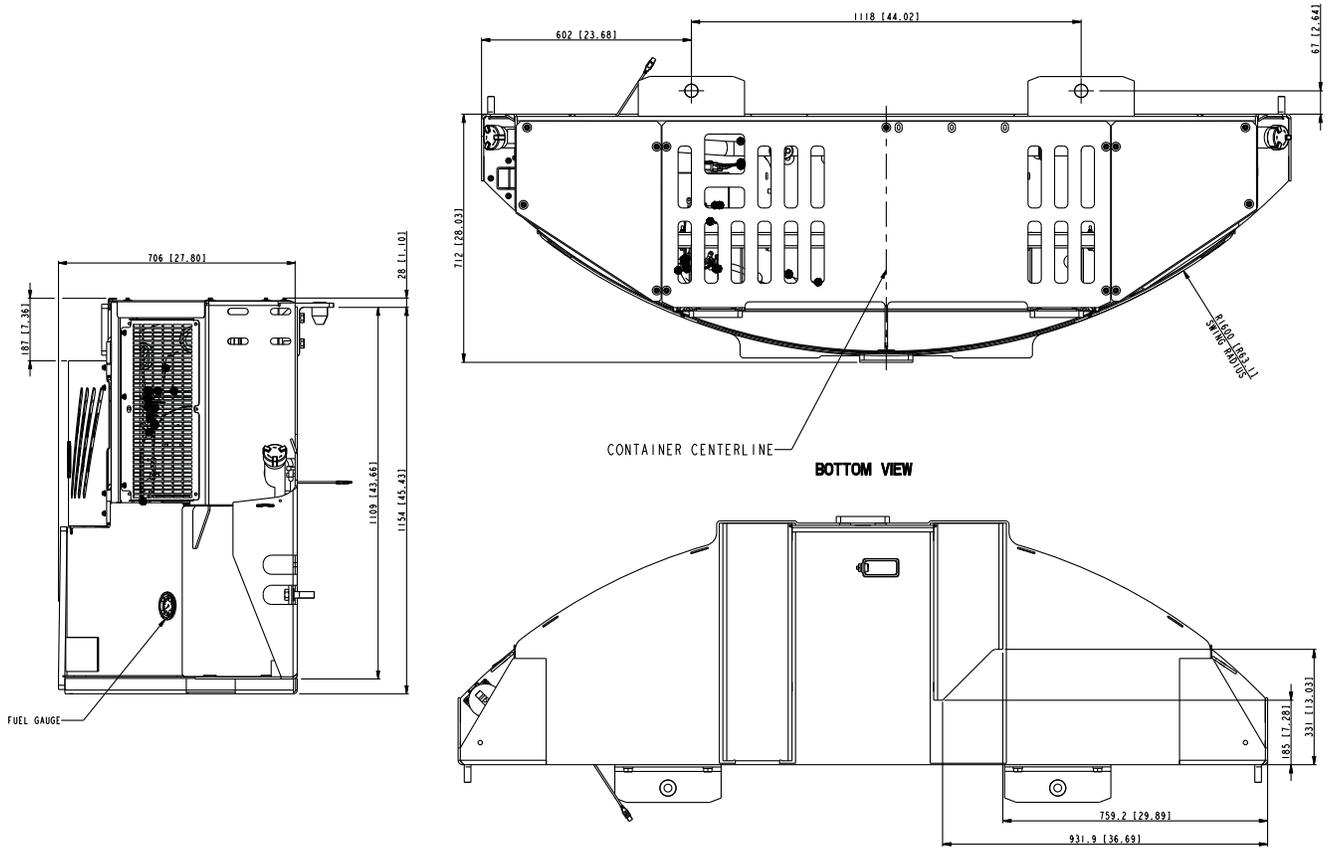


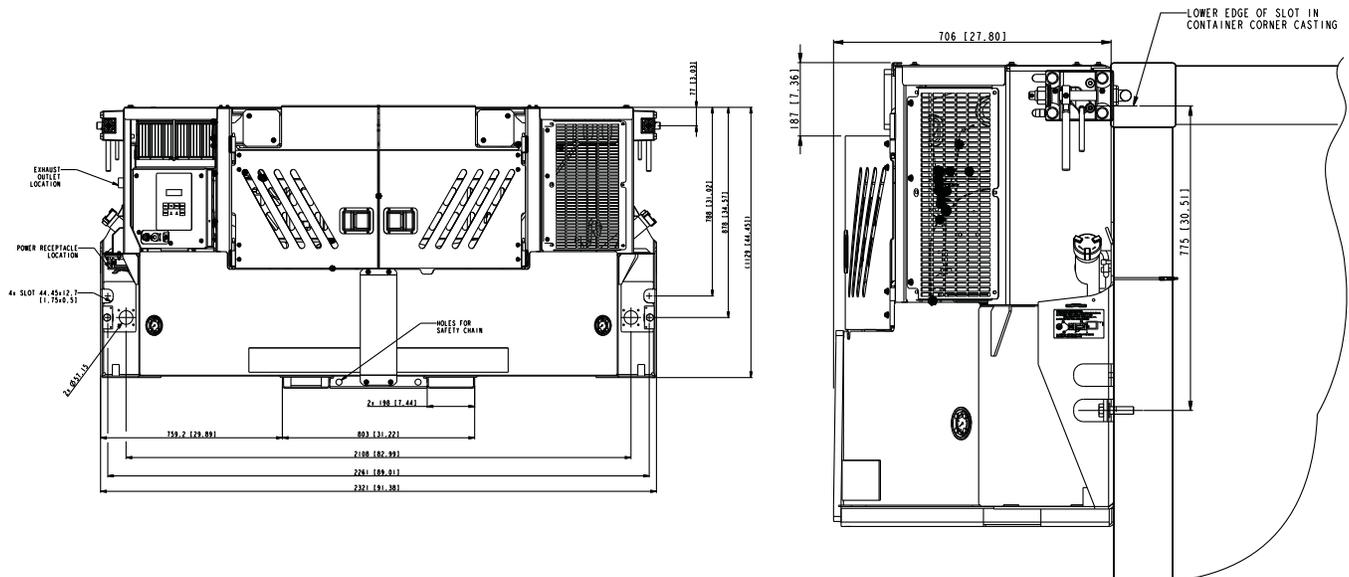
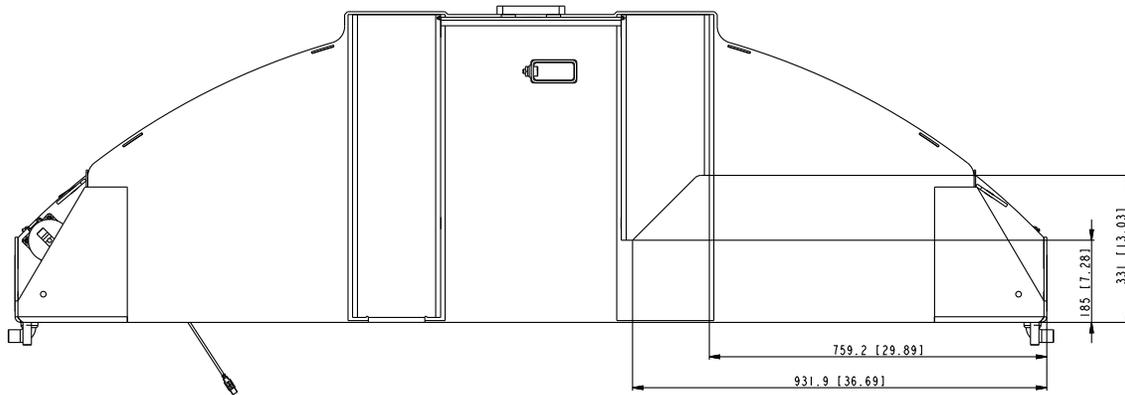
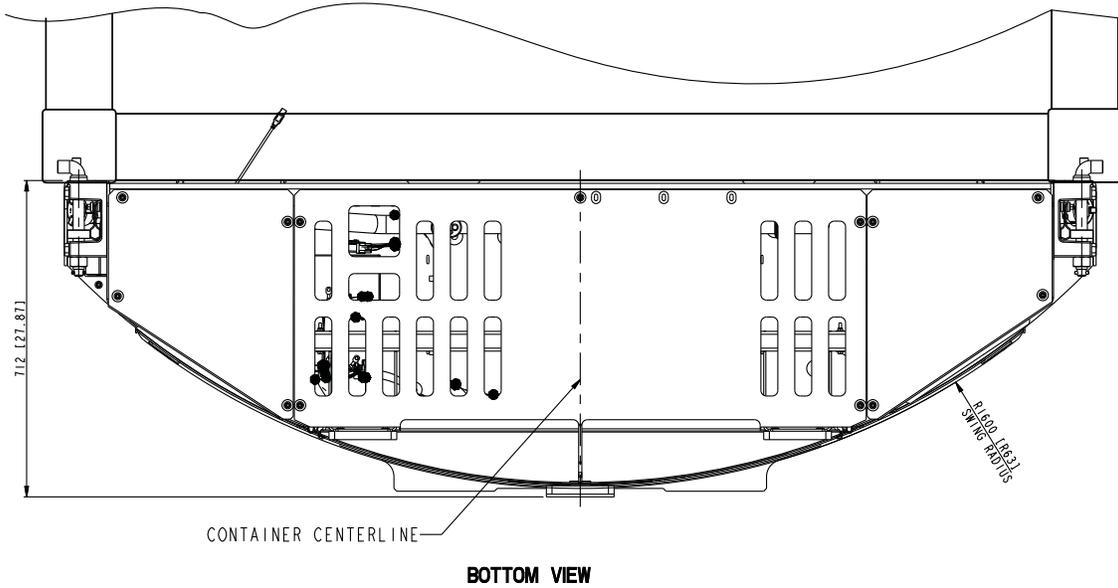
SGCO 5000 Control Box (Internal)

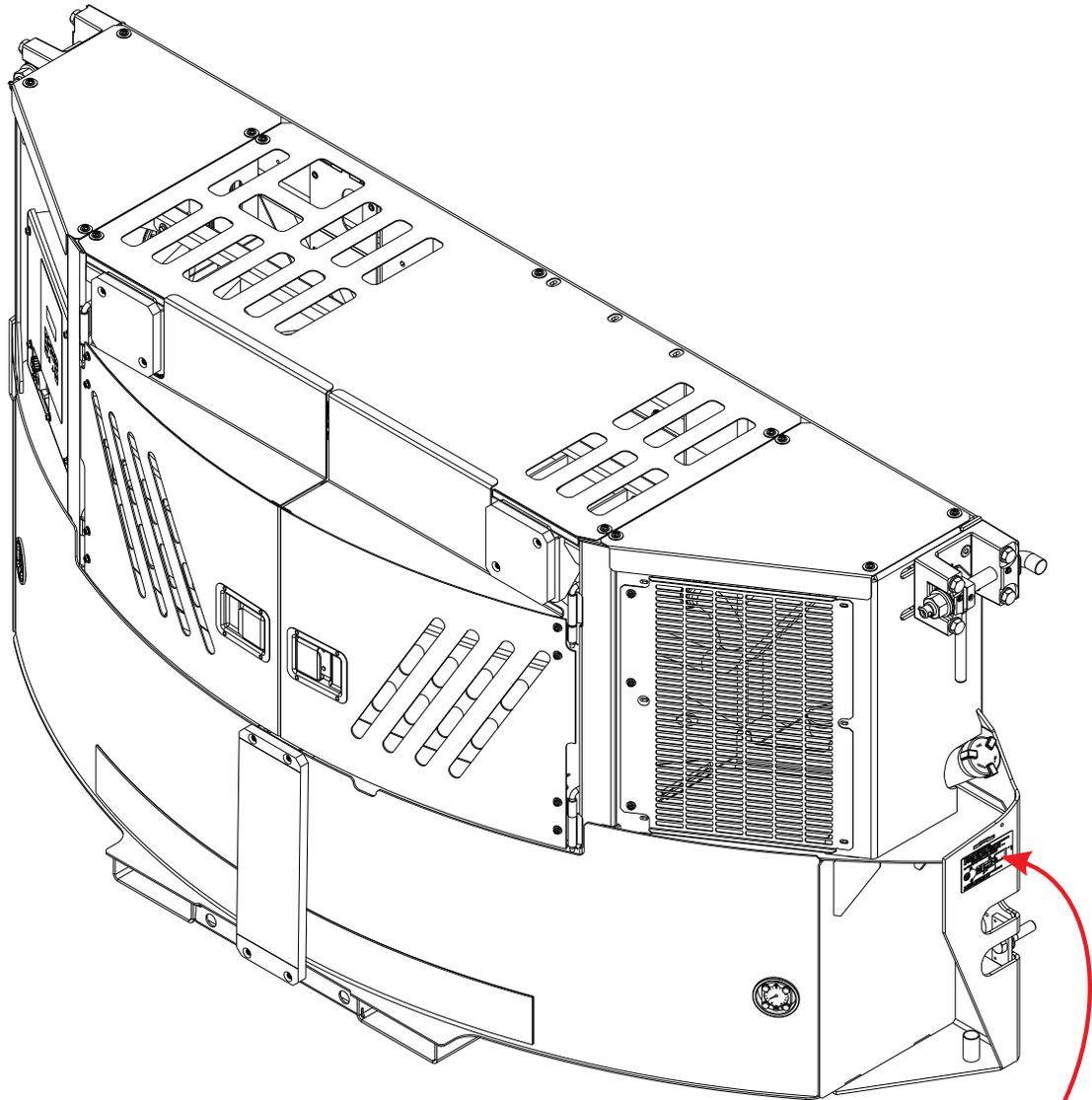


1.	Relay - GPR Glow Plug	8.	S13 - 30A - J9 to J13 Controller Fuse
2.	Relay - EGR	9.	Relay RL4 - Spare
3.	Relay - STR Starter	10.	Relay RL3 - Fuel Pump Relay
4.	FS4 - 60A - FS4 Glow Plug Fuse	11.	Relay RL2 - Run Relay
5.	Fuse Block FS1 - 10A - ECU Fuse FS2 - 40A - Starter Solenoid Fuse	12.	Relay RL1 - Ignition Relay
6.	SI1 - RL1 - RL4 - 30A - Relay Fuse	13.	Opto Isolator
7.	SI2 - 30A - Battery Charger Fuse	14.	Relay - Quad Relay

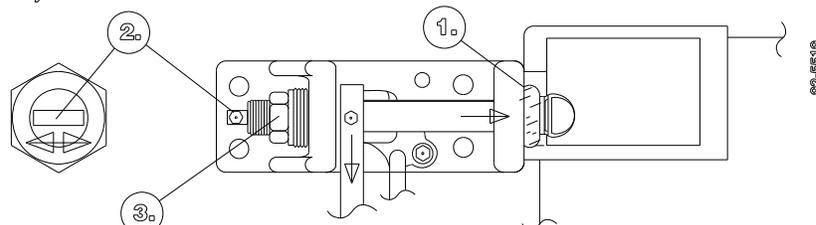
SGCO 5000 Installation / Outline Pin Mounted



SGCO 5000 Installation / Outline Clamp Mounted #1


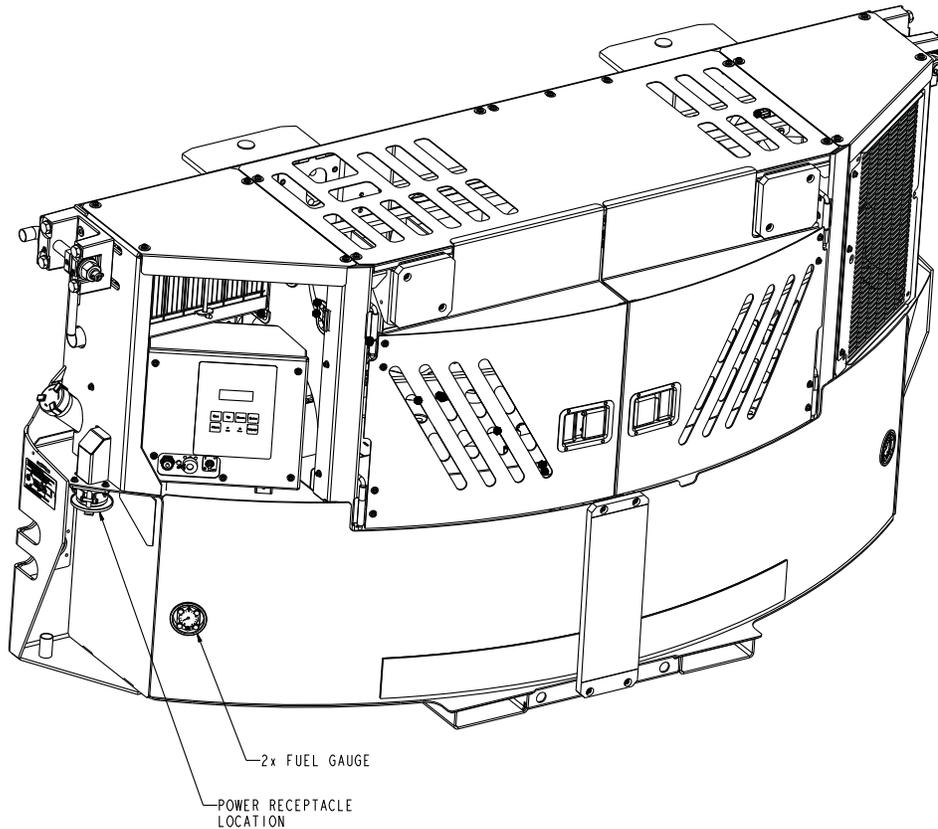
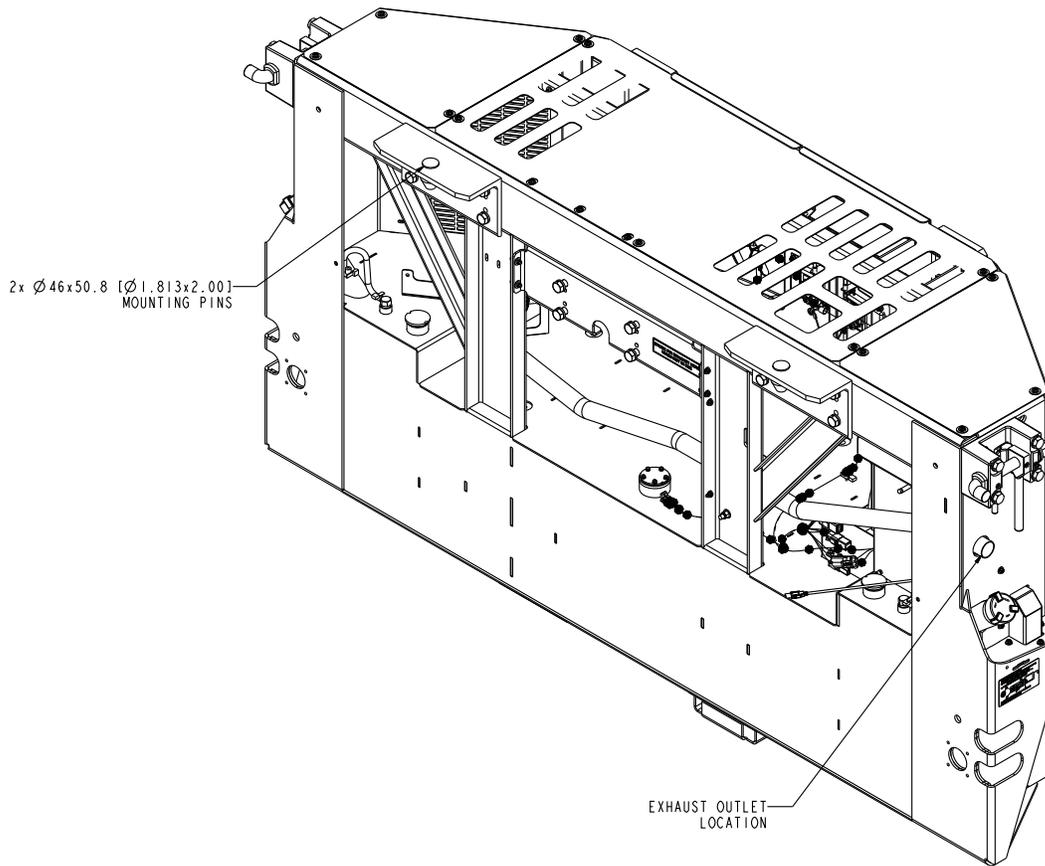
SGCO 5000 Installation / Outline Clamp Mounted #2

INSTALLATION INSTRUCTIONS:

- 1.) CAUTION: INSERT LUG \rightarrow INTO CORNER CASTING.
- 2.) TO LOCK - PULL HANDLE DOWN \downarrow AND CHECK SHAFT END - HORIZONTAL \leftrightarrow .
- 3.) TIGHTEN NUT WITH HAND WRENCH

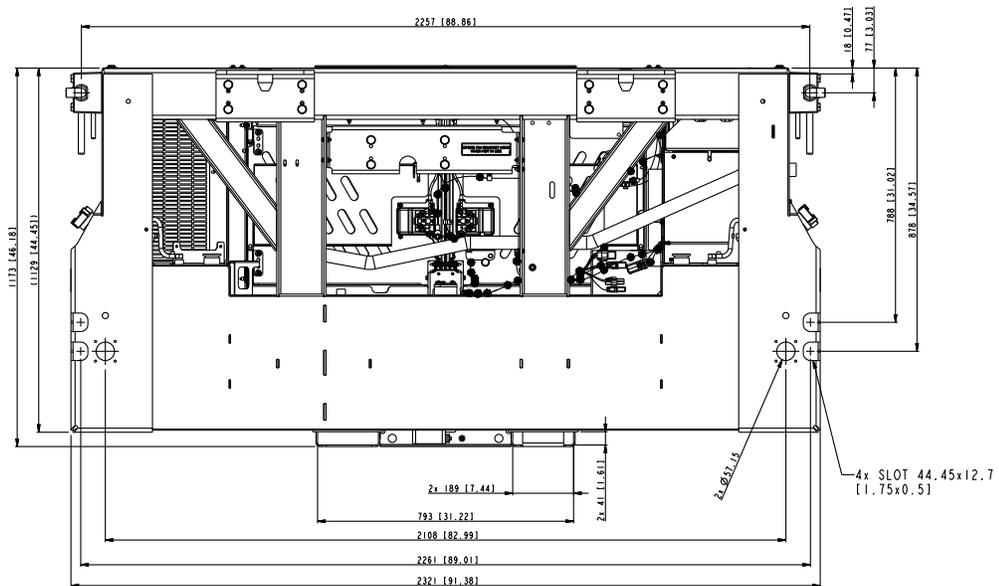
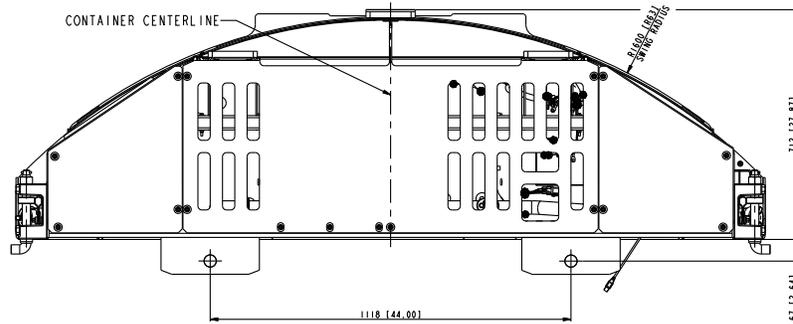


- 4.) INSTALL LOWER UNIT MOUNTING BOLTS (220-280 FT-LBS / 300-330 N-M)

SGCO 5000 Installation / Outline Dual Mount #1



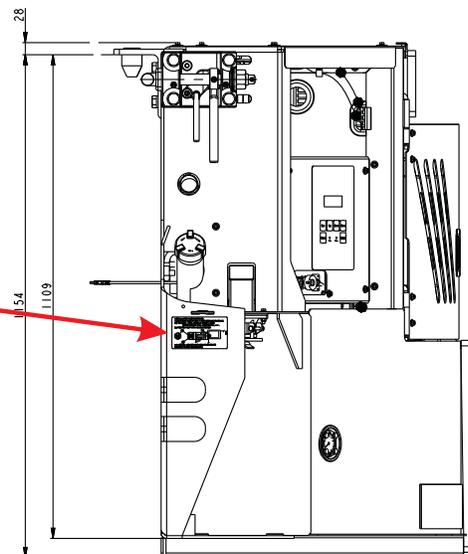
SGCO 5000 Installation / Outline Dual Mount #2



INSTALLATION INSTRUCTIONS:

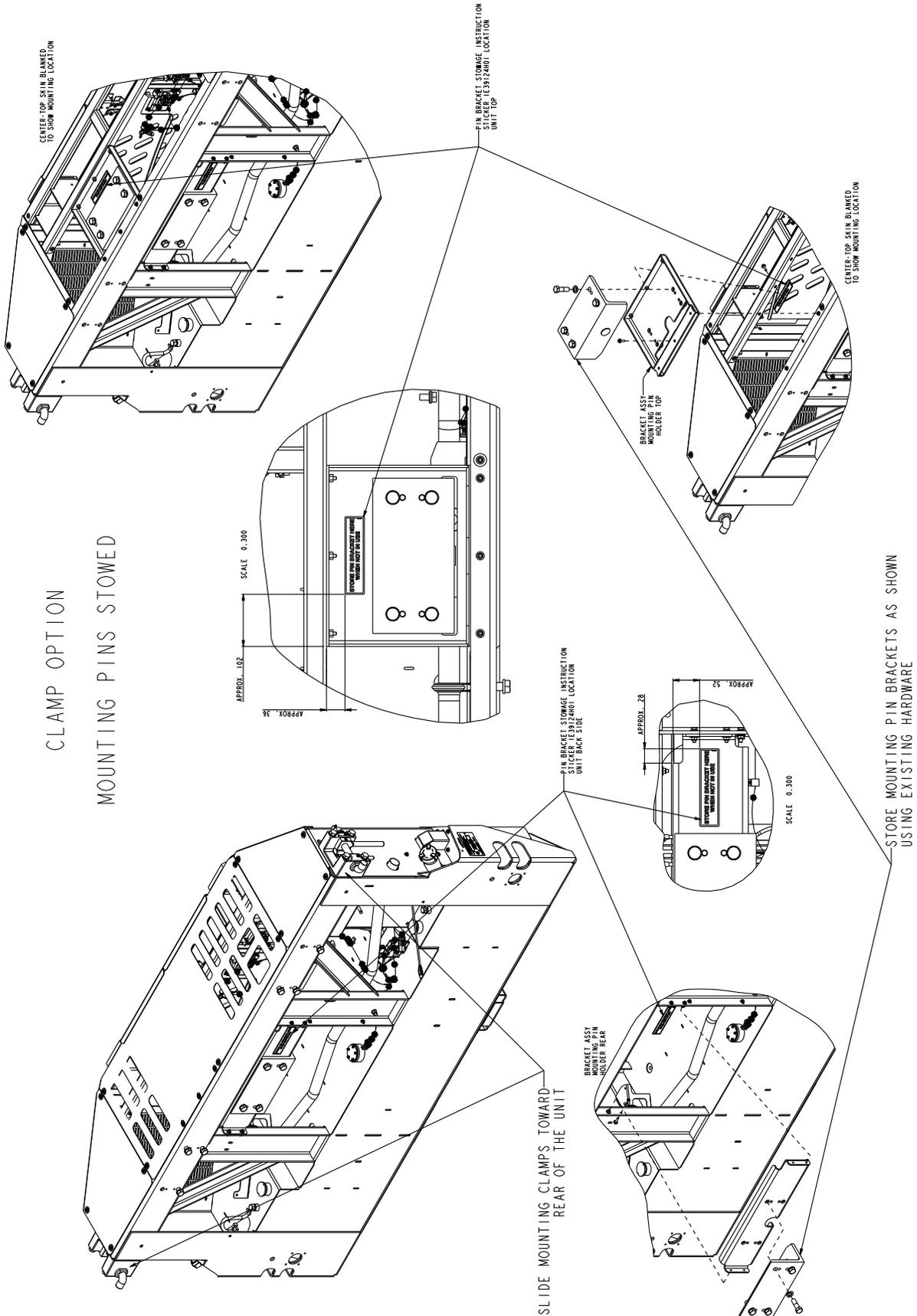
- 1.) CAUTION: INSERT LUG → INTO CORNER CASTING.
- 2.) TO LOCK - PULL HANDLE DOWN ↓ AND CHECK SHAFT END - HORIZONTAL ↔.
- 3.) TIGHTEN NUT WITH HAND WRENCH

- 4.) INSTALL LOWER UNIT MOUNTING BOLTS (220-230 FT-LBS / 300-330 N-M)





SGCO 5000 Installation / Outline Dual Mount #3



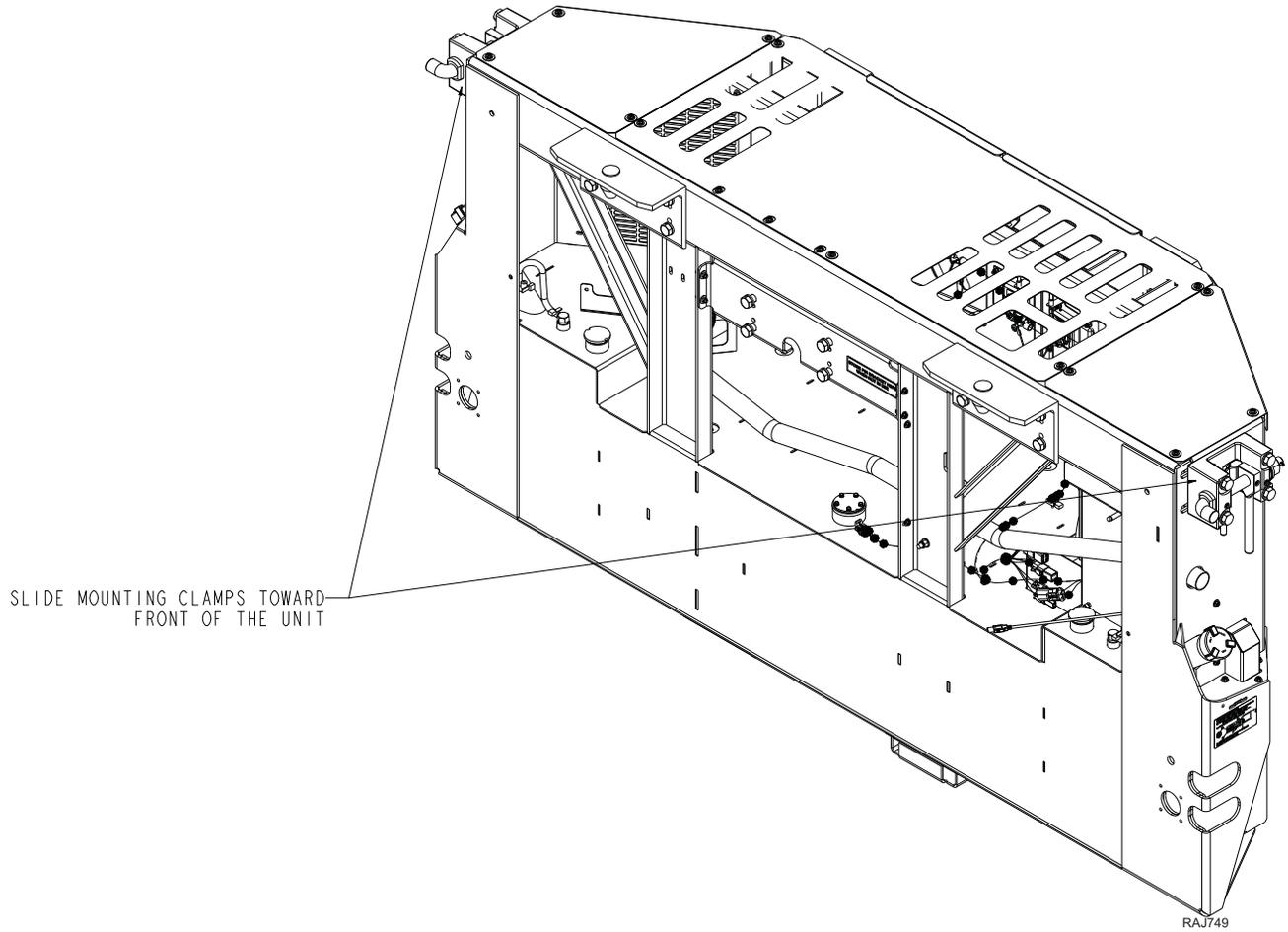
CLAMP OPTION
MOUNTING PINS STOWED

SLIDE MOUNTING CLAMPS TOWARD REAR OF THE UNIT

STORE MOUNTING PIN BRACKETS AS SHOWN USING EXISTING HARDWARE

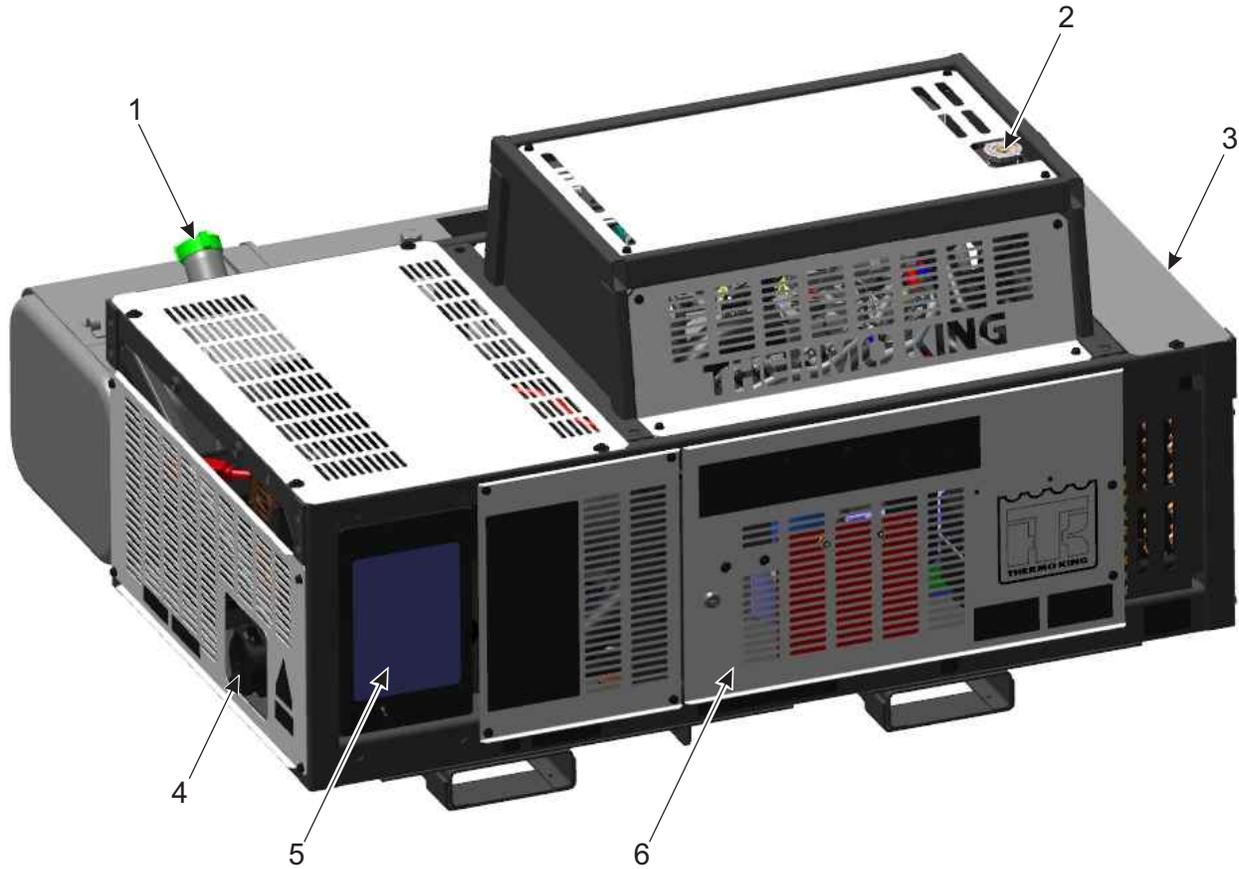
SGCO 5000 Installation / Outline Dual Mount #4

PIN OPTION





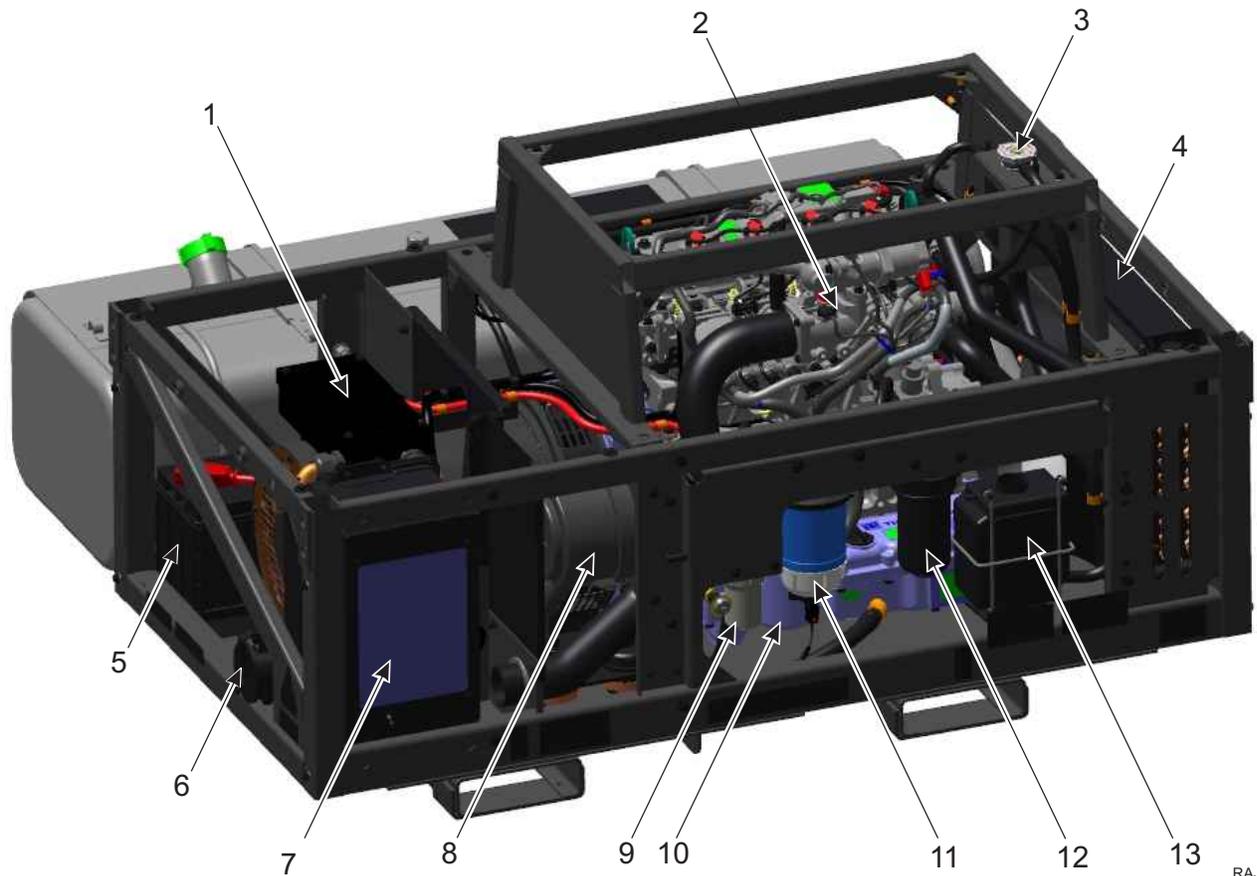
SGUM 5000 Front View



RAJ707

1.	Fuel Tank Cap	4.	460 or 230 VAC Power Receptacle Location
2.	Cooling System Degas Tank and Pressure Cap	5.	Control Box Location
3.	Radiator Location	6.	Front Access Door

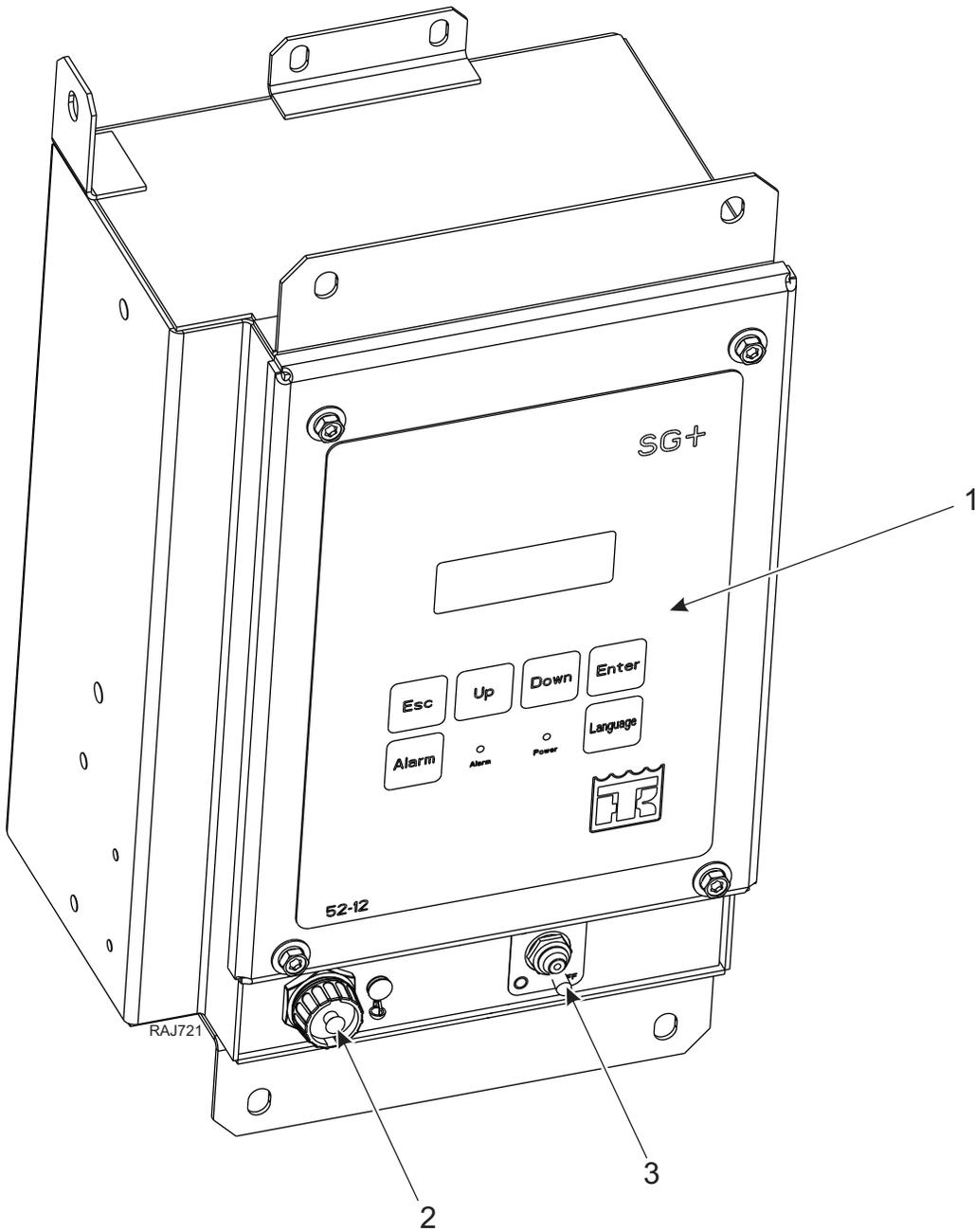
SGUM 5000 Front View (Covers Removed)



RAJ708

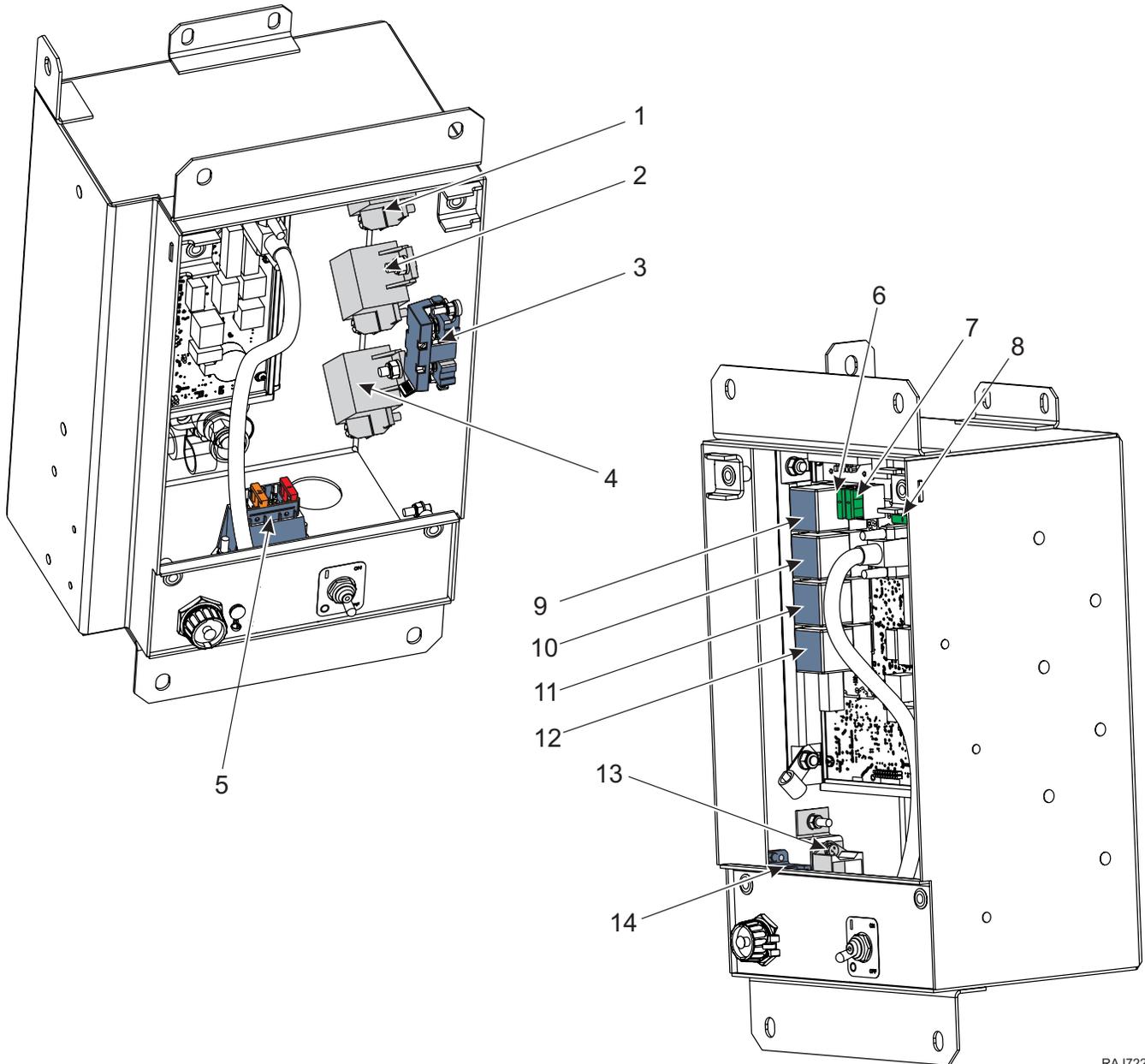
1.	Alternator Assembly	8.	Air Filter Assembly
2.	Engine	9.	Electric Fuel Supply Pump
3.	Cooling System Degas Tank and Pressure Cap	10.	Engine Oil Filter
4.	Radiator	11.	Fuel Filter / Water Separator (Primary)
5.	Battery Location	12.	Fuel Filter (Secondary)
6.	460 or 230 VAC Power Receptacle Location	13.	Coolant Reservoir
7.	Control Box Location		

SGCO 5000 Control Box (External)



1.	SG+ 1.5 Controller
2.	Flash Drive USB Port
3.	Unit ON / OFF Switch

SGCO 5000 Control Box (Internal)

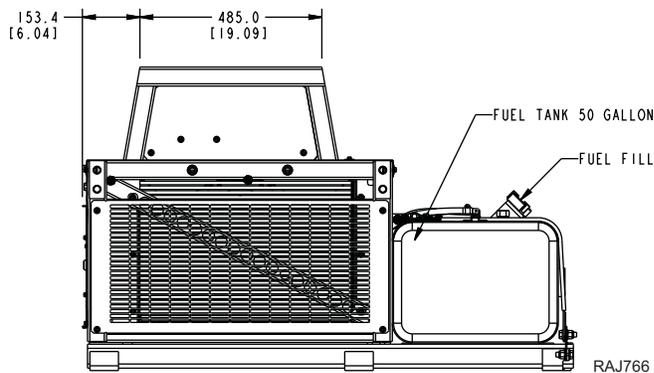
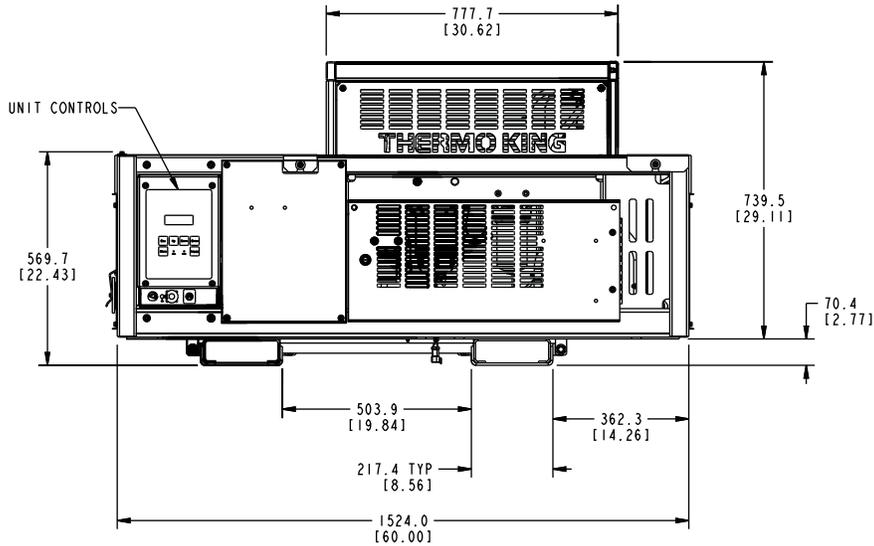
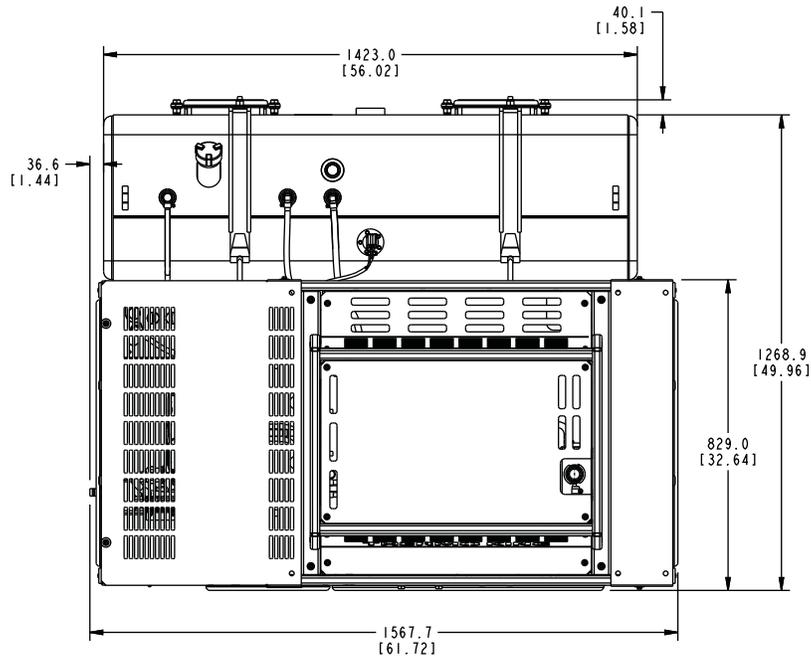


RAJ722

1.	Relay - GPR Glow Plug	8.	S13 - 30A - J9 to J13 Controller Fuse
2.	Relay - EGR	9.	Relay RL4 - Spare
3.	FS4 - 60A - Glow Plug Fuse	10.	Relay RL3 - Fuel Pump Relay
4.	Relay - STR Starter	11.	Relay RL2 - Run Relay
5.	Fuse Block FS1 - 10A - ECU Fuse FS2 - 40A - Starter Solenoid Fuse	12.	Relay RL1 - Ignition Relay
6.	SI1 RL1 - 30A - RL4 Relay Fuse	13.	Opto Isolator
7.	SI2 - 30A - Battery Charger Fuse	14.	Relay - Quad Relay

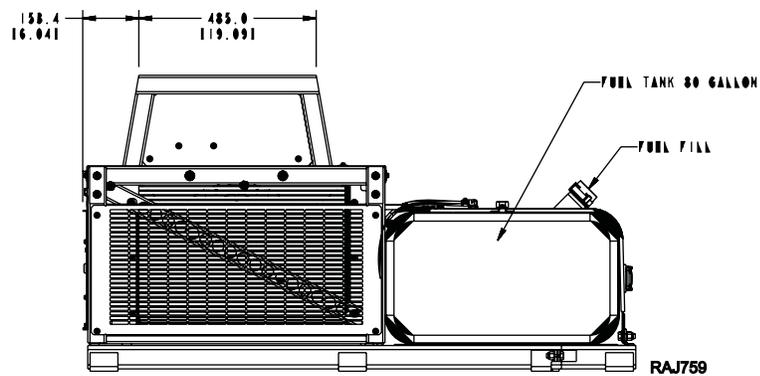
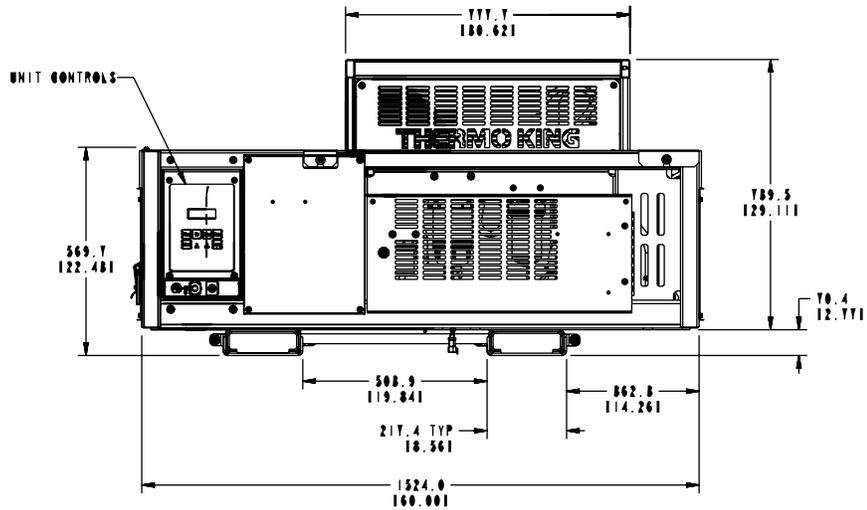
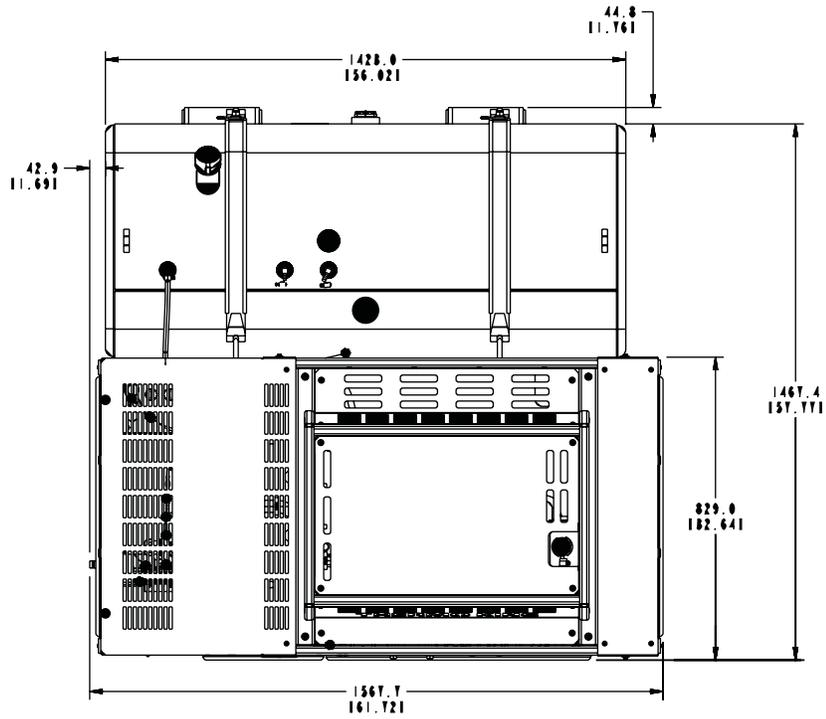


SGUM 5000 Installation / Outline #1



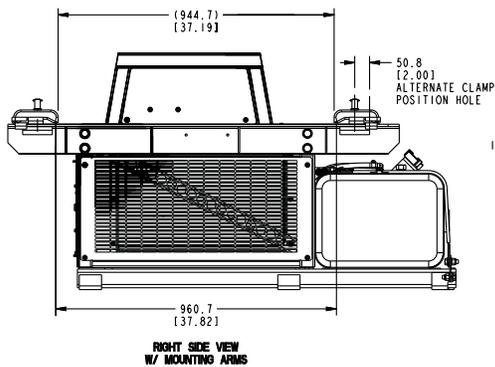
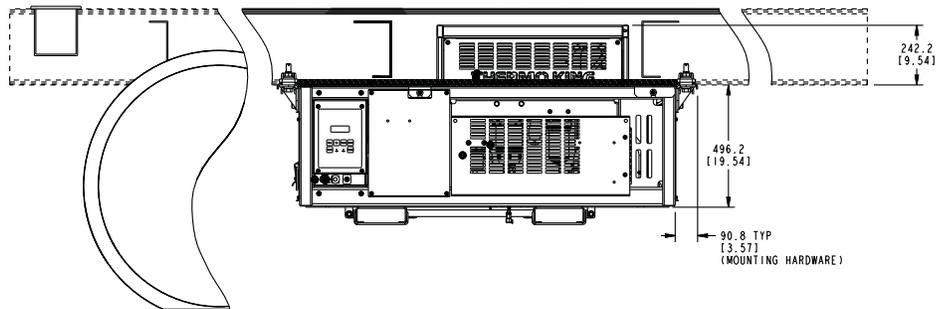
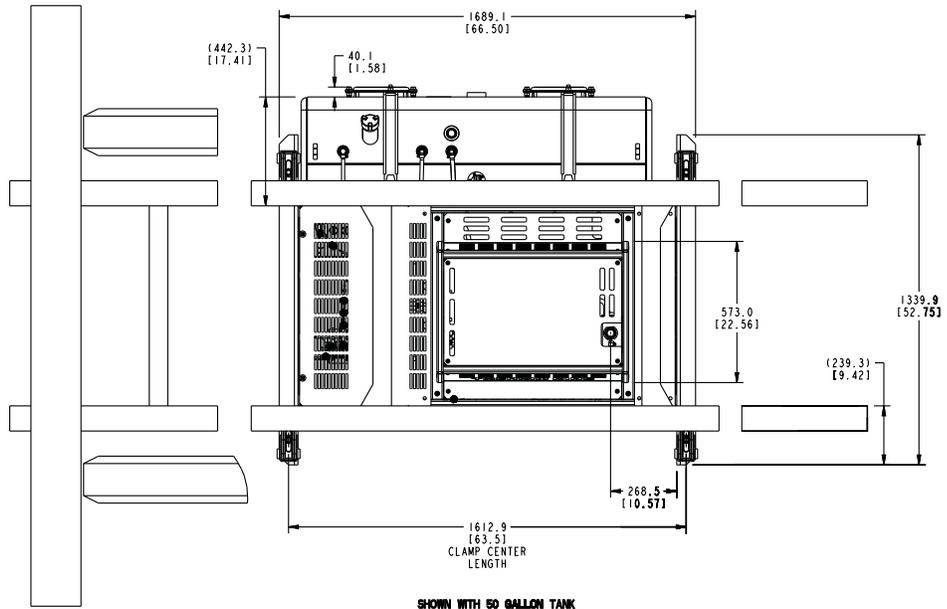
RAJ766

SGUM 5000 Installation / Outline #2

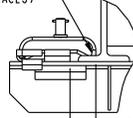




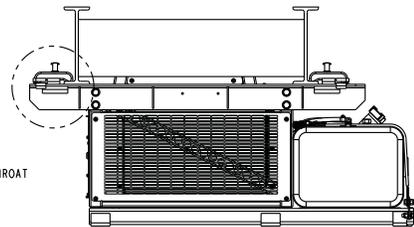
SGUM 5000 Installation / Outline #3



TORQUE TO
120-130 FT.-LBS
(4 PLACES)



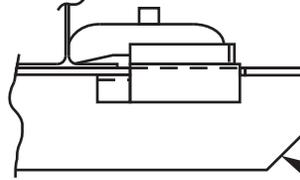
DETAIL A
SCALE 0 240



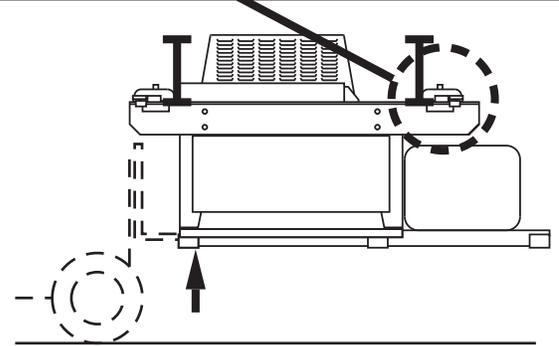
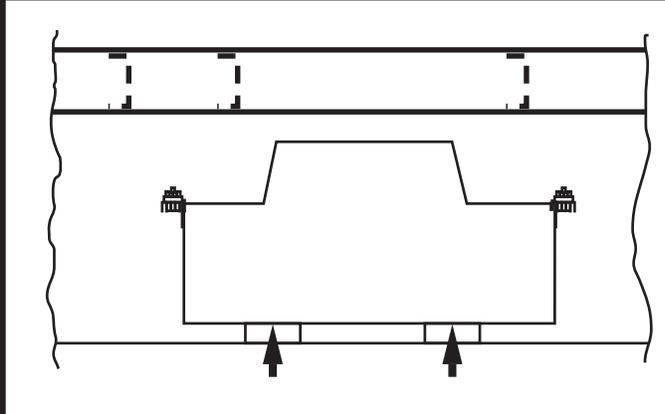
RAJ760

SGUM 5000 Installation Decal

**PAR DE
120-130 FT.-LBS.
(4 POSICIONES)**

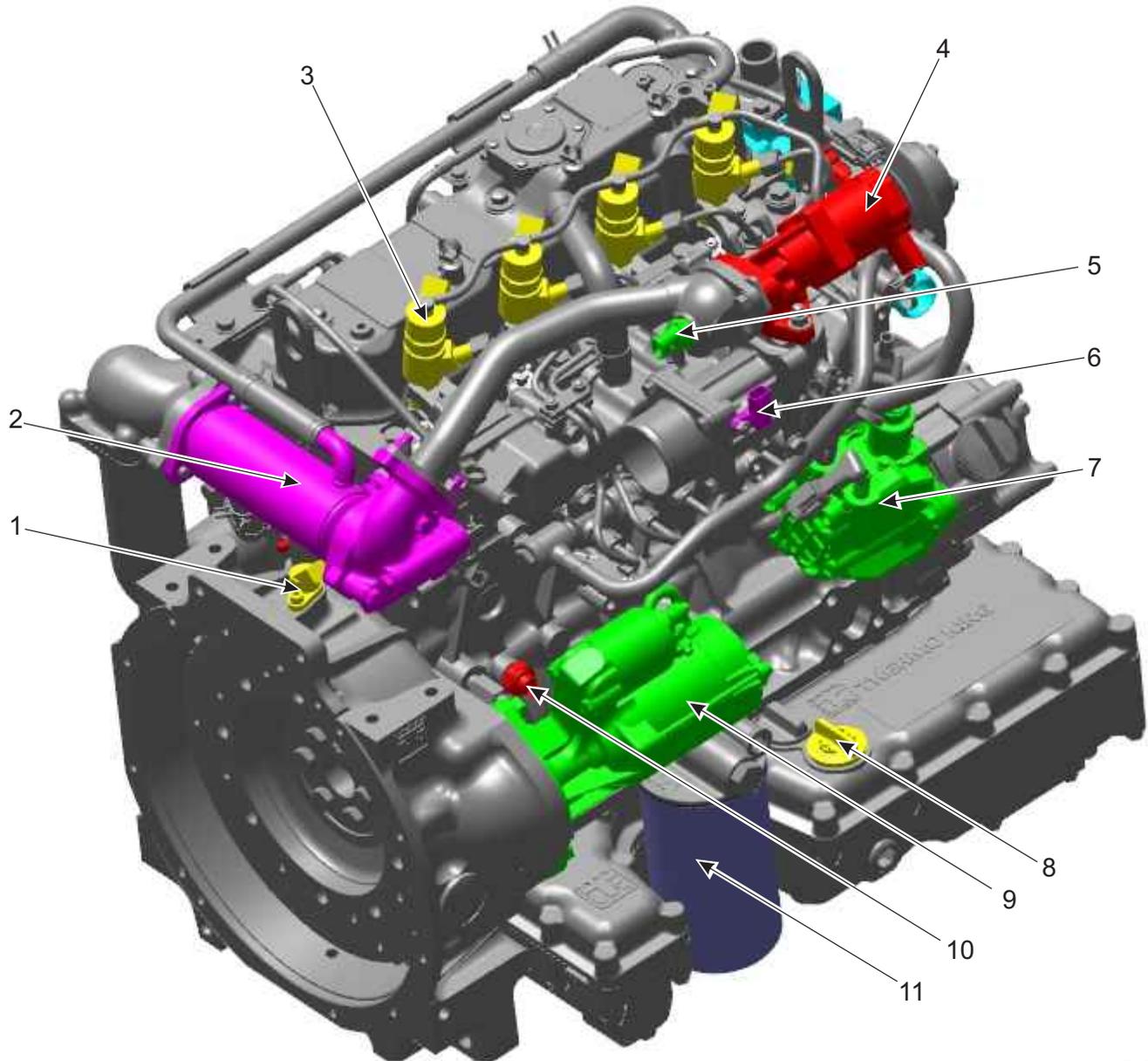


**TORQUE TO
120-130 FT.-LBS.
(4 PLACES)**



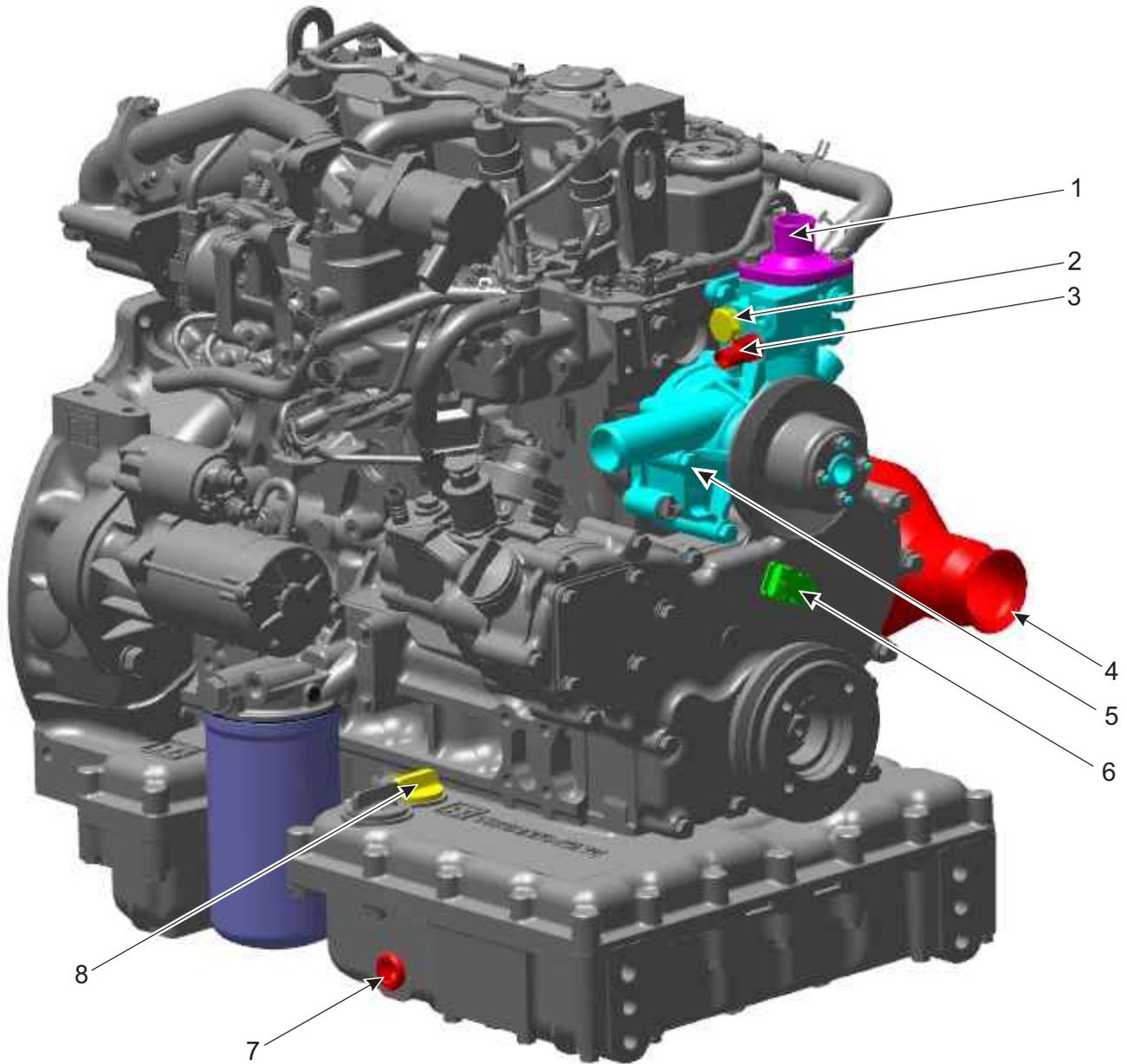
RAJ828

Engine Component Locations #1 (TK488CRG1)



RAJ715

1.	SENSOR - flywheel, rpm	7.	PUMP - fuel high pressure
2.	COOLER - EGR	8.	Oil Fill and Check Cap / Dipstick
3.	INJECTOR (4)	9.	STARTER
4.	VALVE - EGR	10.	SWITCH - oil pressure
5.	SENSOR - EGR gas temperature	11.	FILTER - Engine oil
6.	SENSOR - air temperature, ambient		

Engine Component Locations #2 (TK488CRG1)


RAJ716

1.	Thermostat Location	5.	PUMP - coolant
2.	Coolant Bleed Plug	6.	SENSOR - camshaft
3.	SENSOR - coolant temperature	7.	Oil Drain Location
4.	Exhaust Catalyst	8.	Oil Level Sensor Location (behind dipstick)

Genset Model Features

SGSM 5000	SGCM 5000	SGCO 5000	Model
S	S	S	TK488CRG1 (Tier 4)
S	S	S	460 Vac Output for 15 KW, 18.75 KVA, 3 Phase, 60 Hz, 4 Wire Generator
O	O	O	230 Vac Output for 15 KW, 18.75 KVA, 3 Phase, 60 Hz, 4 Wire Generator
S	S	S	SG+ Control System
S	S	S	Battery with Post
S	S	S	Battery Charging System, Solid-state
S	—	—	Side-mount Unit mounting bracket
—	S	—	Center-mount Unit mounting arms
—	—	S	Clip-on Unit Frame
S	S	S	Combination Fuel Filter/Water Separator
S	S	S	Dry Air Cleaner
S	S	S	Stainless Steel Exhaust System
O	O	O	Fuel Heater Electric
—	—	O	Header Pin, Mounting
S	S	S	EMI 3000 Extended Maintenance Interval Package
O	O	—	Integral 80 Gallon (303 Liter) Aluminum Fuel Tank
—	—	S	Integral 125 Gallon (473 Liter) Steel Fuel Tank
S	S	—	Integral 50 Gallon (190 Liter) Aluminum Fuel Tank
O	O	O	Fuel Monitoring - Monitoring and Recording of fuel level events.
S	S	S	Telematics
O	O	O	Dual Mount
S = Standard O = Optional — = Not Applicable			

SG+ 1.5 Controller and Operating Instructions

SG+ 1.5 Controller Description

The SG+ 1.5 controller is a two-piece, self contained microprocessor for diesel generator sets. The SG+ 1.5 display is mounted on the control box cover. The SG+ 1.5 microprocessor is mounted inside the control box. Three external relays - two ECU Relays and the Start Relay are also mounted inside the control box near the microprocessor. Another Relay - the Preheat Relay, is located in the Engine Compartment.

This system automatically controls generator operation by providing:

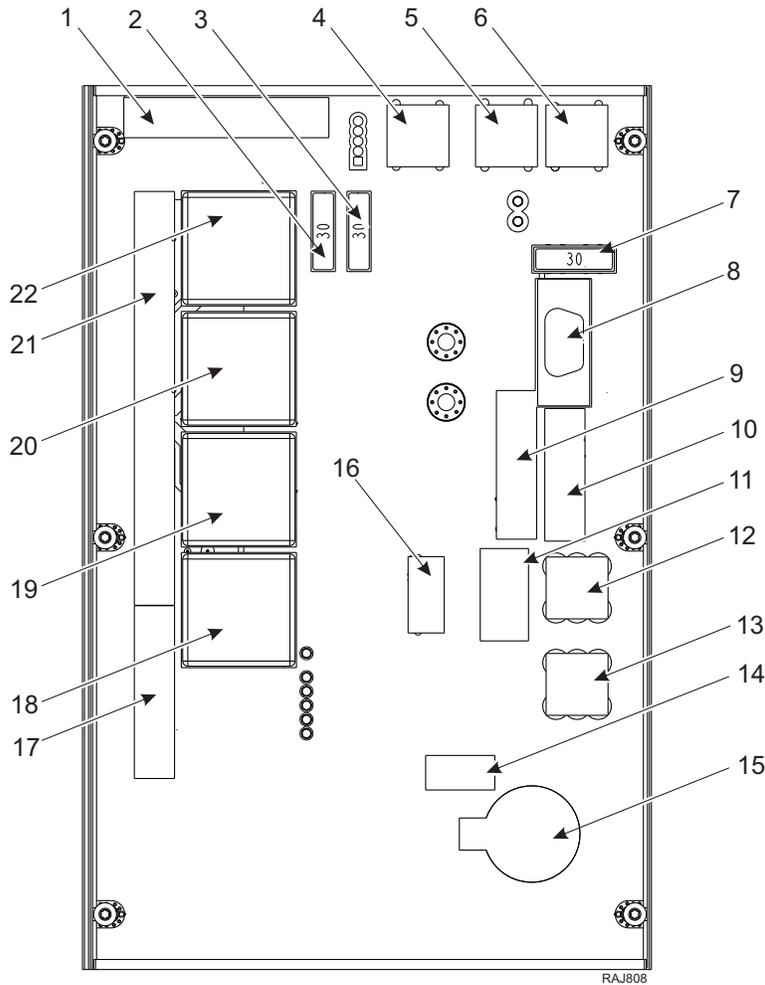
- Automatic unit preheat and engine startup during initial startup or delayed restart
- Variable glow plug preheat time
- Automatic Pretrip Test capability
- Delayed alternator excitation for 2 minutes
- Unit shutdown protection for the engine and alternator. The controller stops the unit due to low engine oil pressure, low engine oil level, high coolant temperature, or alternator overload.
- Automatic unit restart 20 minutes after unit shutdown due to an unknown condition, high engine water temperature, engine failure to start, check fuel alarm, or alternator overload (also low engine oil pressure if enabled). It will attempt one (1) restart and then stop.

Figure 1. SG+ Controller Display





Microprocessor



1.	J6 Connector – To AC Circuits	13.	J12 8 Circuit Connection
2.	Fuse 30A - S11 RL1 – RL4 Relay	14.	J19 USB Connection
3.	Fuse SI2 – 30 Amp Protects Battery Charger Output Circuit	15.	BT1 - Battery RTC Real Time Clock
4.	J9 2A Circuit Connection	16.	J27 - Not Used
5.	J11 CH Circuit Connection	17.	J4 Connector – To External Relay Circuits
6.	J10 GND Circuit Connection	18.	RL1 – Ignition Relay
7.	Fuse 30A - S13 J9 to J13 Controller	19.	RL2 – Run Relay
8.	Serial Port – For Flash Loading Software	20.	RL3 - Fuel Pump Relay
9.	J3 Connector - Telematics	21.	J1 Connector – To Sensor and Fuel Solenoid Circuits
10.	J2 Connector – To SG+ 1.5 Controller Display	22.	RL4 - Spare Relay
11.	J20 Connector to CAN		
12.	J13 2C Circuit Connection		

Controller Overview


1.	Display	A vacuum lucent display on the front panel shows operating information including output voltage, current test state during a Pretrip test and the controller menu. Normally it shows the Output Voltage (this is called the Standard Display). It will be blank when the unit On/Off switch is OFF.
2.	Escape Key	Press this key to escape a new setting or jump to the parent menu.
3.	Up Key	Press this key to scroll UP through the menu display, or increase the value of a setting.
4.	Down Key	Press this key to scroll DOWN through the menu display, or decrease the value of a setting.
5.	Enter Key	Press this key to enter or execute controller menu tasks or commands.
6.	Alarm Key	Press this key to go directly to the Alarm List Menu and view the alarm information in the display.
7.	Alarm LED	Flashes when the controller has detected an alarm condition. It is off when there are no alarms.
8.	Power LED	Lights up while the Unit On/Off Switch is in the ON position. It is off when the Unit On/Off Switch is in the OFF position.
9.	Language Key	Press this key to change the language used on the display. English and Spanish are the languages that are currently available.
10.	Flash Drive USB Port	Is used to download the event logger and flash load new software.
11.	Unit ON / OFF Switch	In the ON position, the electrical control system energizes for unit operation. In the OFF position, the electrical control system including the fuel solenoid de-energizes to stop the engine. The unit will not operate.



Miscellaneous Controller Features

- Internal self-checking/diagnostic capability
- Pretrip test capability
- Hourmeter: The controller has a built-in run hourmeter that can be accessed through the Timers/Counters Submenu under the Misc. Functions Menu.
- The application software version is displayed by selecting the Program Version Submenu under the Misc. Functions Menu.
- Display menus: The SG+ controller contains extensive display menus that can be navigated via the keypad. The display menus are organized into seven Main Menus: Data Menu, Alarm List Menu, Warning List Menu, Commands Menu, Misc. Functions Menu, Configuration Menu, and Event Log Menu.

Microprocessor Inputs:

- Alternator Voltage
- Battery Voltage
- Coolant Level Sensor
- Ignition Relay Feedback
- Run Relay Feedback
- Fuel Sender (Optional)

Microprocessor Outputs:

- Start Relay
- Ignition Relay
- Run Relay
- On Light
- Alarm Light
- Fuel Pump
- Quad Relay

SG+ 1.5 - Navigating the Controller Menus

Controller Display Menus

The SG+ 1.5 controller contains extensive display menus that can be navigated via the keypad. The display menus are organized into the following menus (or groups) in the Main Menu:

- Data Menu
- Alarm List Menu
- Message List Menu
- Commands Menu
- Misc. Functions Menu
- Configuration Menu
- Event Log Menu

The display also has some displays in addition to the Main Menus:

- Standard Display
- Pause Mode Display
- Composite Menu (if TrackKing / Telematics have been added to the unit)

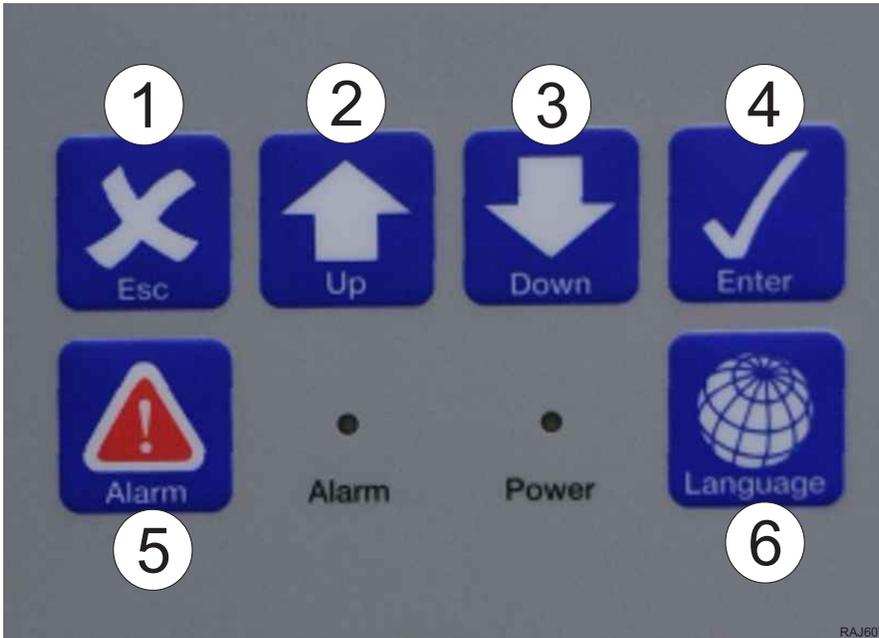
Each menu listed above will be described later in this chapter.

A complete listing of the controller menus is located on the 11 x 17 in. fold outs in the Diagrams section in the back of the manual (see last two pages in the manual). It is designed to be folded out so you can continuously view it as you are learning how to navigate the SG+ 1.5 Controller Menus. It is recommended to fold this flow diagram out and leave it folded out until you become familiar with the controller menus.



Navigating Controller Menus

Moving through the menus and their submenus and entering commands requires the use of the following keys:



1.	Escape Key: Press the ESCAPE key to escape a new setting or jump to the parent menu.
2.	Up Key: Press the UP key each time you want to scroll up to view another item in a menu or submenu), or increase the value of a setting.
3.	Down Key: Press the DOWN key each time you want to scroll down to view another item in a menu (or submenu), or decrease the value of a setting.
4.	Enter Key: Press the ENTER key each time you want to enter or execute controller menu tasks or commands.
5.	Alarm Key: Press the ALARM key to go directly to the Alarm List Menu and view the alarm information in the display.
6.	Language Key: Press the LANGUAGE key to change the language used on the display.

Menu Overview

Press the **UP** or **DOWN** keys to scroll through the Main Menu or a Submenu. Press the **ENTER** key to enter a Submenu or Event. Press the **ESCAPE** key to return to the parent menu.

Main Menu	Submenu	Event
DATA	ENGINE	SHOW OUTPUTS
	ENGINE LAMPS	SHOW STATES
	GENERATOR	SHOW OUTPUTS
	UNIT	SHOW STATES
	INTERNAL STATES / ENGINE OTHER	SHOW STATES
ALARM LIST		Show Alarms
MESSAGE LIST		SHOW MESSAGES
COMMANDS	PTI	PERFORM TEST
	MANUAL FUNCTION TEST	PERFORM 11 DIFFERENT PTI TESTS
	SPEED CONTROL	Temporarily Select Engine Speed
	ECU SERVICE MENU	PERFORM SETUP
	OIL PRIMING	PERFORM SETUP
	FUEL PRIMING	PERFORM SETUP
	CLEAR P-CODES	CLEAR CODES
MISC. FUNCTIONS	C/F MODE	SELECT UNIT
	SW / HW VERSION	VIEW HARDWARE / SOFTWARE VERSIONS
	TIMERS	SHOW TIMERS
	COUNTERS	SHOWS TIMERS
	DATE TIME	CURRENT DATE AND TIME
CONFIGURATION	CONTROLS	SELECT ENGINE SPEED
	UNIT CONFIGURATION	CONFIGURE VALUES
	OPTION CONFIGURATION	CONFIGURE VALUES
	SYSTEM CONFIGURATION	CONFIGURE VALUES
	MISCH CONFIGURATION	CONFIGURE VALUES
EVENT LOG	EVENTS	VIEW EVENTS
	FUEL EVENTS	VIEW EVENTS
	USB COPY EVENTLOG	GENERATE LOG FILE



Data Menu

The Data Menu contains the following submenus.

- **Engine** - Displays engine operating information such as oil pressure and RPM.
- **Engine Lamps** - Displays the status of the different Engine Lamps - i.e protect, amber and stop lamp.
- **Generator** - displays generator operating information such as output voltage and the main battery voltage.
- **Unit** - displays unit operating information such as the status of components, if the unit is running, and the engine RPM.
- **Engine States / Engine Other** - displays ECU modes, unit hours, relay states, and unit operating information such as fuel and intake temperatures.

Alarm List Menu

The Alarm List Menu shows a list of the alarms recorded in the controller memory.

Message List Menu

The Message List Menu shows a list of the messages recorded in the controller memory.

Commands Menu

The Commands Menu contains the following submenus:

- **PTI** - Pretrip Inspection Test is a functional test of the unit.
- **Manual Function Test** - Used to perform 11 individual PTI Tests.
- **Speed Control** - Used to temporarily select engine speed (high speed or low)
- **ECU Service Menu** - Used when the ECU service tool is connected.
- **Oil Priming** - Allows engine to be cranked without starting to prime oil galleries.
- **Fuel Priming** - Allows electric fuel pump to be cycled and engine to be cranked without starting to prime fuel system.
- **Clear P-Codes**- Used clear active and historical engine diagnostic codes.

Misc. Functions Menu

The Misc. Functions Menu contains the following submenus:

- **C/F Mode** - Used to select whether Celsius or Fahrenheit units are used to display temperature readings. This function can also be used to change your Pressure reading unit of measure - i.e. Bars or PSI
- **SW/HW Version** - Displays information about the controller software and hardware.
- **Timers/Counters** - Displays information about the hourmeters and restart counters.
- **Date/Time** - Displays current date and time.

Configuration Menu

The Configuration Menu is used to configure some of the controller functions such as Engine type, and hourmeter thresholds, factory reset, and output voltage system selection 230/460.

- **Controls** - Used to select engine speed (high, low, or Auto based on load).
- **Unit Configuration Menu** - Used to select engine, generator, voltage, and unit type.
- **Option Configuration Menu** - Used to select fuel tank size, fuel sensor option, fuel low limit, and hour meter thresholds.
- **System Configuration** - Shows unit configuration information.
- **Misch Configuration** - Shows Genset ID number.

Event Log Menu

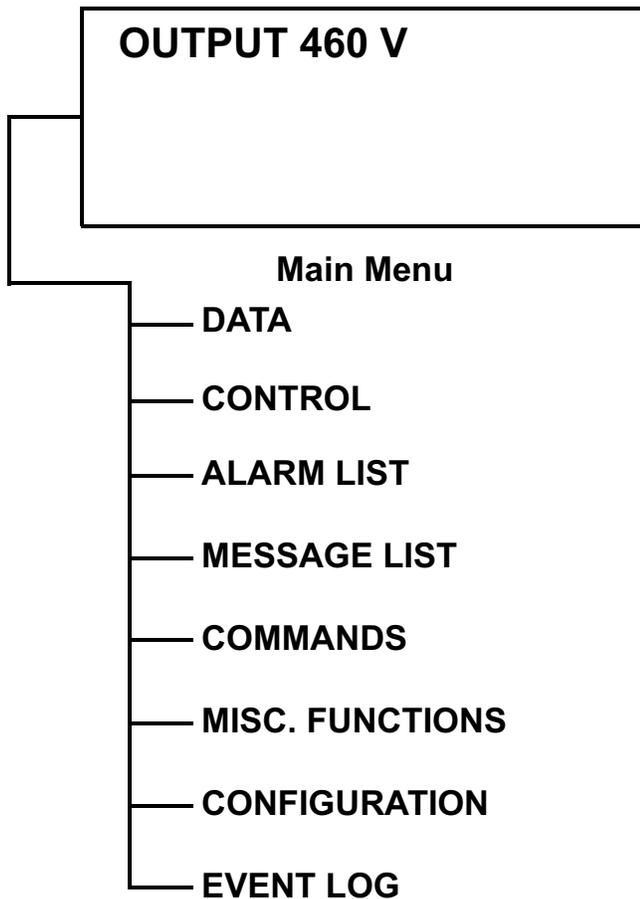
The Event Log Menu contains the following submenus:

- **Events** - Shows a list of events, warnings, and alarms recorded in the controller memory.
- **Fuel Events** - Shows a list of fuel events recorded in the controller memory.
- **USB Copy Eventlog** - Used to generate log file using USB port on control module.

Standard Display

The Standard Display shows the output voltage. It appears approximately one minute after the last key is pressed while the unit is running. The Standard Display floats within the display to prevent burn in.

Press the ENTER key or the ESCAPE key at the Standard Display to enter the Main Menu.



RAJ740



Pause Mode Displays

⚠ WARNING

Risk of Injury!

The engine may start at any time without notice when the unit is in a PAUSE mode.

A Pause mode display appears when normal unit operation has been interrupted because of a warning or alarm. The display will show the cause and controller action. For example, the following display appears if the engine fails to start.

**ENGINE FAILED
TO START**

RESTART IN 20 MIN.

RAJ610

Controller Link Down Display

The Controller Link Down display indicates there is no communication between the SG+ 1.5 controller and the display. This is typically caused by a defective SG+ 1.5 controller, a defective display, a defective cable, or a bad connection on the cable between the SG+ 1.5 controller and the display.

The Controller Link Down display also appears when software is be flash loaded into the controller.



RAJ611



SG+ 1.5 New Controller Set Up

When a new SG+ 1.5 controller is installed and used for the first time, it must be set up for the unit to work properly. This only applies to replacement controllers - new units from Thermo King come with the controllers that are set to the unit.

⚠ WARNING

Equipment Damage and Risk of Injury!

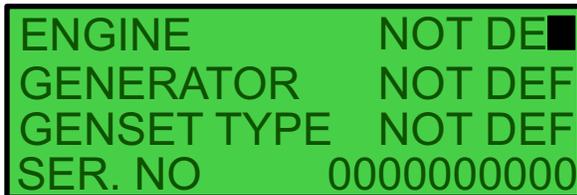
After the unit is configured and the controller exits Configuration Mode, the unit will begin a start sequence.

1. Disconnect the unit battery to ensure the unit cannot operate. Remove the original controller.
2. Install the new SG+ 1.5 controller.
3. Reconnect the unit battery.
4. Turn the unit "ON".
5. The display will show:



RAJ768

- Press the ENTER key.
6. Set ENGINE type:
 - With the cursor on ENGINE, press the ENTER key.



RAJ769

- Use the **UP** and **DOWN** keys to scroll to the correct engine:
 - YANMAR MECH (SG 3000 series units)
 - PCM (SG 4000 series units)
 - YANMAR HPCR (SG 5000 series units)
- When the correct engine is selected, press the **ESC** and **ENTER** keys at the same time to save the engine choice.



RAJ772

7. Set GENERATOR type:
 - Use the **UP** and **DOWN** keys to put the cursor on GENERATOR.
 - Press the ENTER key when the cursor is on GENERATOR.

```
ENGINE      NOT DEF
GENERATOR   NOT DE
GENSET TYPE NOT DEF
SER. NO     0000000000
```

RAJ770

- Use the **UP** and **DOWN** keys to scroll to the correct alternator:
 - MECC ALTE (SG 4000, SG 5000, and SG 3000 after December 2016)
 - STANFORD (SG 3000 Before December 2016)

Note: SG 3000 UNITS: Verify the generator type which is identified on the alternator serial plate.
- When the correct alternator is selected, press the **ESC** and **ENTER** keys at the same time to save the engine choice.

```
GENERATOR
NOT DE
CHANGE: UP/DOWN
SAVE: EXC+ENTER
```

RAJ773

8. Set GENSET TYPE:

- Use the **UP** and **DOWN** keys to put the cursor on GENSET TYPE.
- Press the **ENTER** key when the cursor is on GENSET TYPE.

```
ENGINE      NOT DEF
GENERATOR   NOT DEF
GENSET TYPE NOT DE
SER. NO     0000000000
```

RAJ771

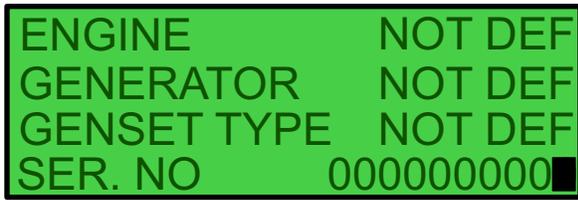
- Use the **UP** and **DOWN** keys to scroll to the correct Genset Type:
 - CLIP ON
 - SIDE
 - CENTER
- When the correct genset type is selected, press the **ESC** and **ENTER** keys at the same time to save the engine choice.

```
GENSET TYPE
NOT DE
CHANGE: UP/DOWN
SAVE: EXC+ENTER
```

RAJ774

9. Set SERIAL NUMBER:

- Use the **UP** and **DOWN** keys to put the cursor on SERIAL NO.
- Press the **ENTER** key when the cursor is on SERIAL NO.



RAJ775

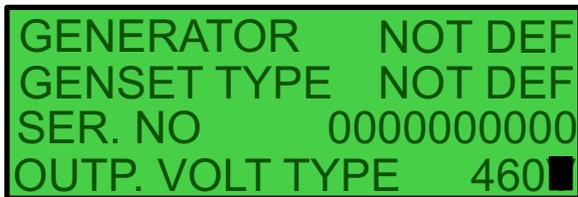
- Enter the unit serial number by:
 - Use the arrow keys to scroll UP and DOWN to select the number or letter.
 - Press the ENTER key to move to the next serial number digit
- When the correct serial number is entered, press the **ESC** and **ENTER** keys at the same time to save the serial number.



RAJ776

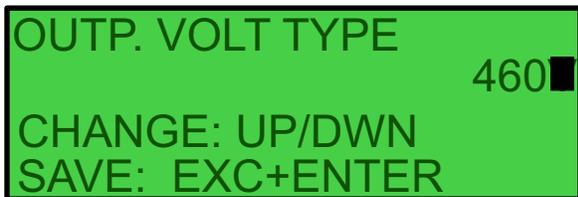
10. Set unit OUTPUT VOLTAGE TYPE.

- Use the **UP** and **DOWN** keys to put the cursor on OUTP. VOLT TYPE.
- Press the ENTER key when the cursor is on OUTP. VOLT TYPE.



RAJ797

- Select the unit output voltage by:
 - Use the arrow keys to scroll UP and DOWN to select the correct output voltage (460V or 230V).
- When the correct voltage is selected, press the **ESC** and **ENTER** keys at the same time to save the voltage.



RAJ798

⚠ WARNING

Equipment Damage and Risk of Injury!

After the unit is configured and the controller exits Configuration Mode, the unit will begin a start sequence.

11. Set genset ID number:

Note: The ID number is not the unit serial #; it is a number created by the unit user, operator, or owner.

- From the MAIN MENU, use the **UP** and **DOWN** keys to find CONFIGURATION.
- Press the ENTER key.



RAJ777

- Use the **UP** and **DOWN** keys to SYSTEM CONFIGURATION.
- Press the ENTER key.



RAJ778

- Use the **UP** and **DOWN** keys to ensure the cursor is on ID NO.
- Press the ENTER key when the cursor is on ID NO.



RAJ779

- Enter the unit ID number by:
 - Use the arrow keys to scroll UP and DOWN to select the number or letter.
 - Press the ENTER key to move to the next ID number digit
- When the correct ID number is entered, press the **ESC** and **ENTER** keys at the same time to save the ID number.



RAJ780



SG+ 1.5 Operating Instructions

Pretrip Inspection

The pretrip inspection is an important part of the preventive maintenance program. It's designed to head off operating problems and breakdowns before they happen. The Pretrip Inspection is not a substitute for a regularly scheduled maintenance.

Visual Inspection

The following inspections should be made before loading the container or trailer:

- **FUEL:** The diesel fuel supply must be sufficient to guarantee engine operation to the next check point.
- **Engine Oil:** Engine oil level should be at the FULL mark. Never overfill. The dipstick is attached to the filler cap.
- **Coolant:** Engine coolant must be above the ADD mark with antifreeze protection of -34 C (-30 F). Check and add coolant in the expansion tank.
- **Battery:** Terminals must be clean. Electrolyte should be at the full mark.
- **Electrical:** Electrical connections should be securely fastened. Check wires and terminals for corrosion, cracks or moisture. Repair or replace if necessary.
- **Structural:** Visually inspect the unit for leaks, loose or broken parts and other damage. The radiator coil should be clean and free of debris. Clean if necessary. Use an air or water spray jet directed against the coil from the air discharge side.
- **Mounting Bolts:** Check the mounting bolts on the unit and engine. Tighten if necessary.

⚠ CAUTION

Hazardous Pressures!

Do not remove expansion tank cap while coolant is hot.

⚠ CAUTION

Risk of Injury!

Do not remove the radiator cap while the engine is hot.

NOTICE

System Contamination!

Do not add "GREEN" or "BLUE-GREEN" conventional coolant to cooling systems using "RED" Extended Life Coolant, except in an emergency. If conventional coolant is added to Extended Life Coolant, the coolant must be changed after 2 years instead of 5 years.

NOTICE

Equipment Damage!

Air pressure or water spray must not be high enough to damage coil fins.

Starting the Unit

Generator sets are designed to provide power for a refrigeration unit. Before starting the generator set, make sure the refrigeration unit power cord is connected to the generator set electric power receptacle. To operate the refrigeration unit on shore power, disconnect the power cord from the generator set and plug it into the proper power supply.

⚠ CAUTION

Risk of Injury!

The unit may start automatically and at any time when the unit switches are On. Be sure to turn switches Off before inspecting or working on any part of the unit.

1. Turn unit ON/OFF switch to On. The switch is located below the SG+ 1.5 controller.
2. A series of displays called the Start Sequence appears on the display as follows:

- DISPLAY UNIT
REV 1.0.0
- SG+
X.X.X.X YYMMDD
- MAIN MENU
DATA
DELAY 20 (or 19, 18, 17, etc. to 01)
The delay screen counts down from 20 to 01 while the controller performs some self checks.
- MAIN MENU
DATA
INIT
The controller energizes the glow plugs for preheat (if necessary). The preheat buzzer is energized during the preheat period. Preheat time ranges from 5 to 120 seconds, depending on the engine temperature. Preheat may continue until after the engine starts.
- MAIN MENU
DATA
FUEL RELAY ON
The controller energizes the fuel relay.
- MAIN MENU
DATA
GLOW PLUG ON
The glow plugs are energized.
- MAIN MENU
DATA
STARTER
The engine begins cranking. The glow plug and pre-heat buzzer may remain energized during the cranking period.
- MAIN MENU
DATA
DELAYED OUTPUT
This display appears while the controller delays energizing the alternator output for approximately 2 minutes.

NOTICE

Equipment Damage!

Never use starting fluid. Damage to the engine can occur.

After Start Inspection

After the engine has started:

1. Listen for abnormal noises.
2. Check for any alarms or messages using the Alarm List Menu and the Message List Menu.

Note: *The engine must operate for approximately 2 minutes before the exciter circuit and battery charging circuits are energized.*



Functional Inspection

To properly perform a PTI (Pretrip Inspection Test) on units equipped with a SG+ controller, do not apply a load to the alternator.

1. Start the unit.

2. Initiate an automatic PTI:

Note: Correct all existing alarm conditions and clear the alarm codes before performing a PTI.

- Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
- Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
- Press the ENTER key to enter the Commands Menu.
- The PTI submenu will be displayed.
- Press the ENTER key to start the PTI.

3. The controller then performs the PTI. Observe the unit for proper operation and functions during the PTI. The display shows which component is being tested, and the test result (PASSED or FAILED):

- "Please Wait"
- The engine stops.
- A display test is performed. Watch the display to verify it is operating properly.
- The controller beeps to test the buzzer.
- The ECU ignition is tested.
- The ECU run relay is tested.
- The ECU fuel relay is tested.
- The ECU CAN connect is tested.
- Engine Start is tested. The engine starts, The display says:
"START ENGINE TEST (beep on, then off, then start appears briefly)
(the result of the test - i.e. RUNNING 1491)
RESULT: "PASS" if the result is acceptable.
- Low/High speed is tested. (Engine still running - similar results screen and test sequence to point above)
- The output voltage is tested, (Engine still running - similar results screen and test sequence to point above)

Note: If a component fails its test, the PTI will stop at that point and display "FAILED - REBOOT". Correct the problem and repeat the PTI by pressing the ENTER Key.

4. When the PTI is complete, the test ends automatically and the controller display shows "PTI PASSED (or FAILED) - REBOOT". Turn the On/Off Switch Off and back On to reboot and return the unit to normal operation.

5. If an operating problem occurs during the PTI, view and correct any alarms or messages. Then acknowledge the alarms or messages and repeat the PTI.

Note: Acknowledge the alarms or messages ONLY after the alarm codes are documented and problems repaired.

Main Menu

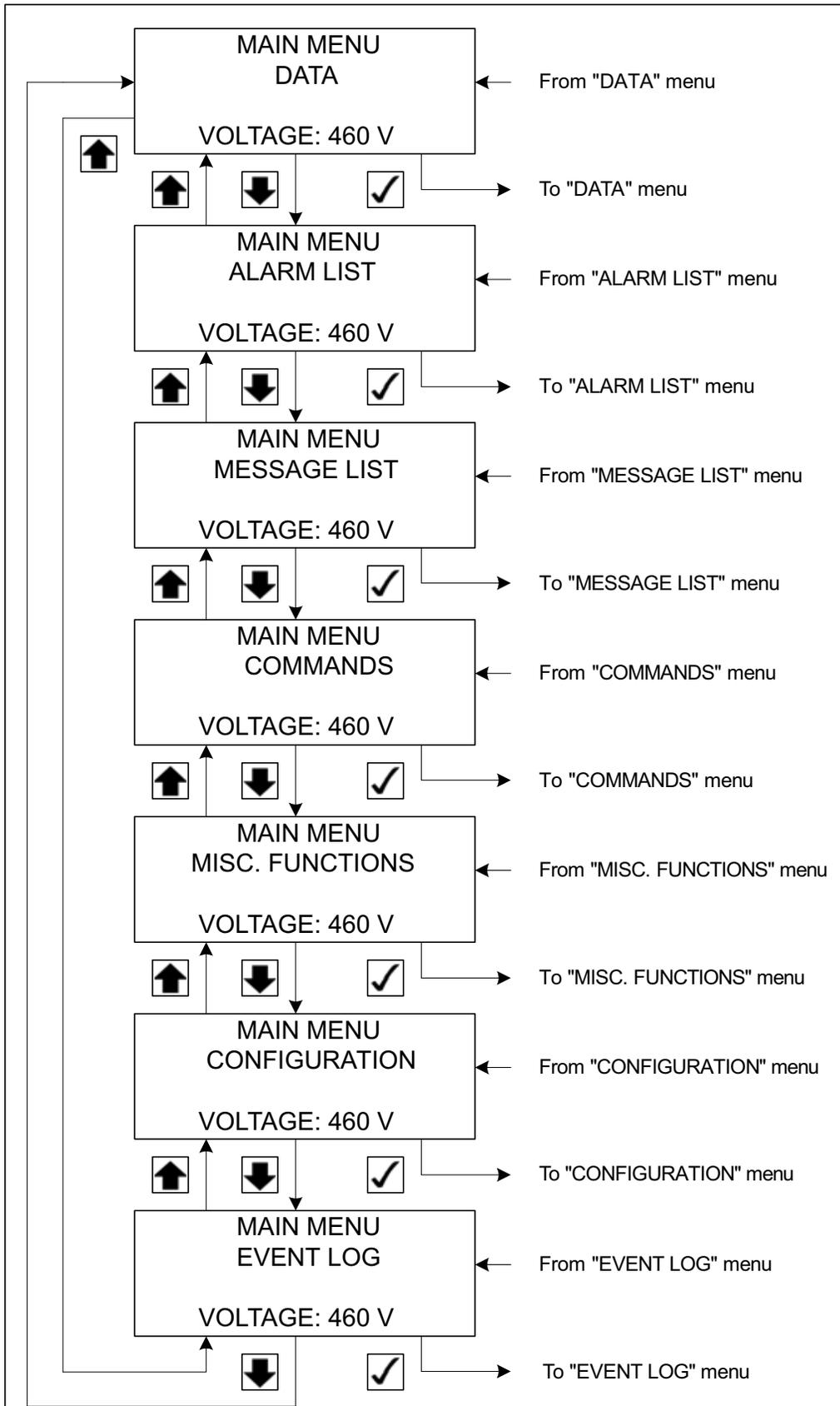
The Main Menu contains the following menus:

- Data Menu
- Alarm List Menu
- Message List Menu
- Commands Menu
- Misc. Functions Menu
- Configuration Menu
- Event Log Menu

To enter the Main Menu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if it is not displayed.
3. The Data Menu is typically the first menu displayed in the Main Menu.
 - Press the ENTER key to enter the Data Menu.
 - Press the UP or DOWN key to scroll up or down through the Main Menu.

Figure 2. Main Menu



Data Menu

Note: The Data Menu only displays information, items can NOT be changed.

The Data Menu displays general unit operating information including electrical data, temperatures, etc. It contains the following submenus:

- Engine
- Engine Lamps
- Generator
- Unit
- Internal States

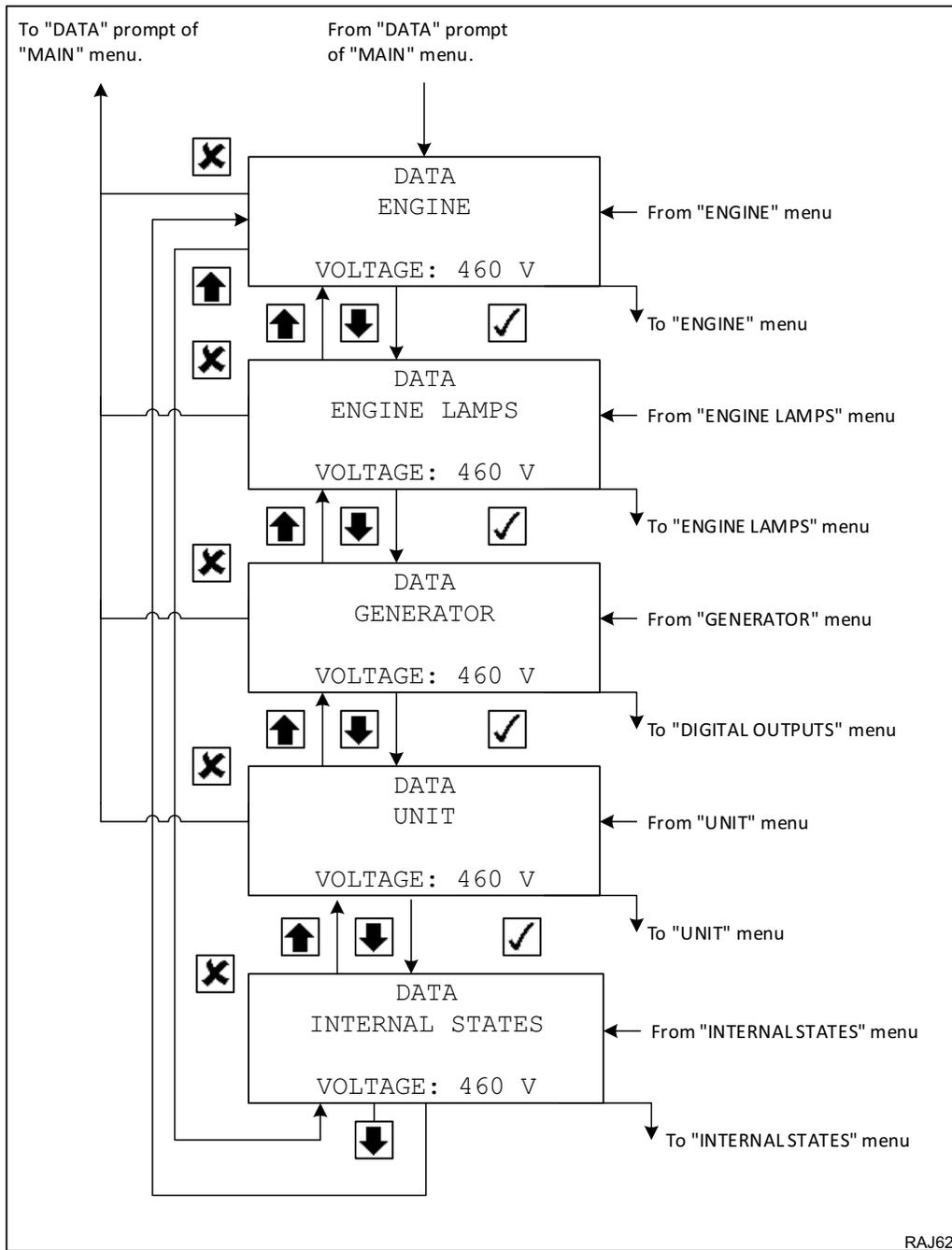
To enter the Data Menu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. The Data Menu is typically the first menu displayed in the Main Menu.

Note: Press the UP or DOWN key to scroll up or down through the Main Menu to the Data Menu, if necessary.

4. Press the ENTER key to enter the Data Menu.
5. The Engine submenu will be displayed.
 - Press the ENTER key to enter Engine Submenu.
 - Press the UP or DOWN key to scroll up or down through the Data Menu.
 - Press the ESCAPE key to return to the Main Menu.

Figure 3. Data Menu



Engine Menu

The Engine display the following unit operating information:

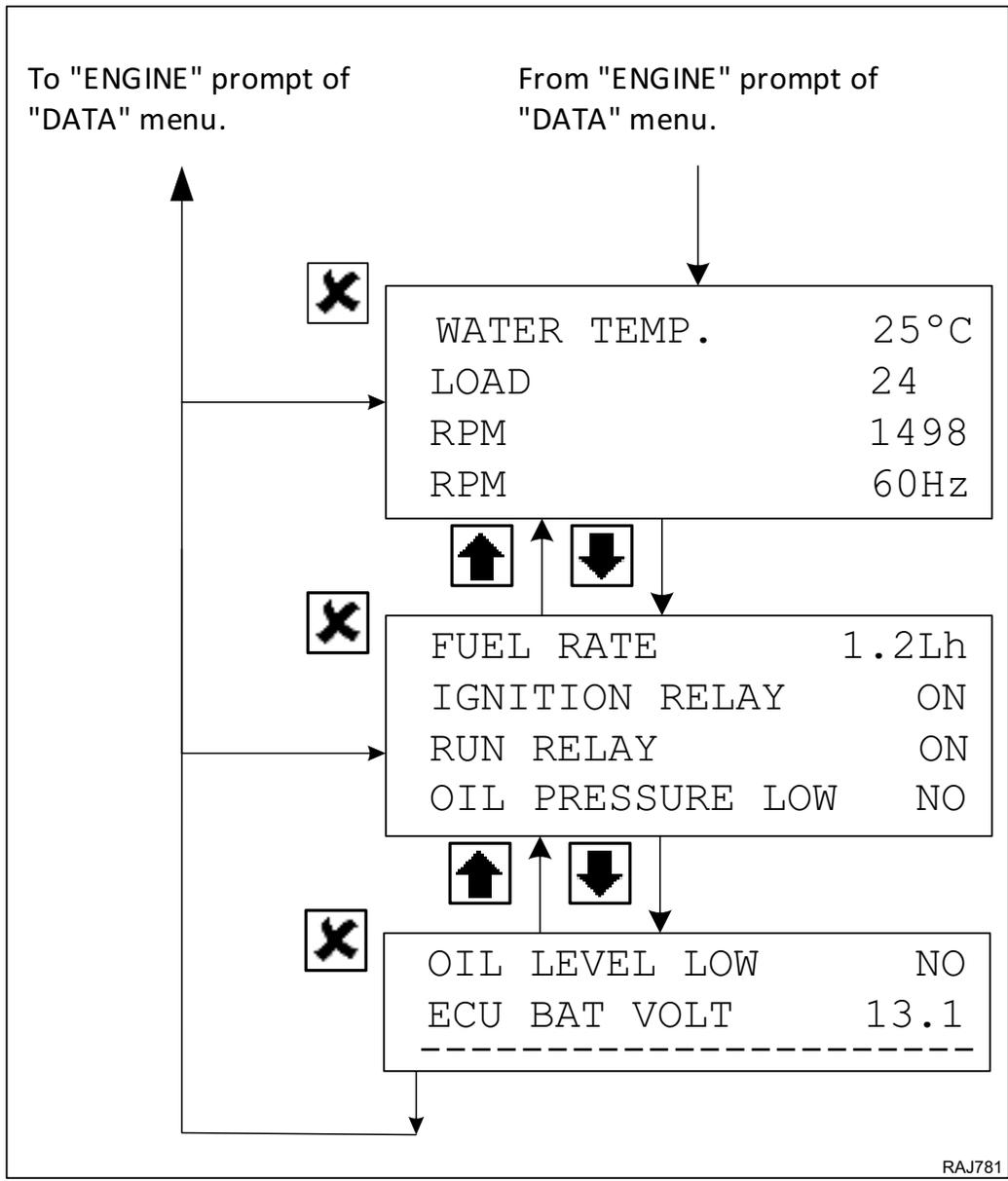
- Water Temp. (Engine Coolant Temperature)
- Load (shows percentage engine load) (SG 4000 and SG 5000 Only)
- RPM
- RPM Requested (SG 4000 and SG 5000 Only)
- Fuel Rate (SG 4000 Only)
- Ignition Relay (SG 4000 and SG 5000 Only)
- Run Relay (SG 4000 and SG 5000 Only)
- Oil Pressure Low
- Oil Level low

To enter the Engine Submenu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. The Data Menu is typically the first menu displayed in the Main Menu.

Note: Press the UP or DOWN key to scroll up or down through the Main Menu to the Data Menu, if necessary.

4. Press the ENTER key to enter the Data Menu.
5. The Engine submenu will be displayed.
6. Press the ENTER key to enter the Engine submenu.
 - Press the UP or DOWN key to scroll up or down through the Engine submenu.
 - Press the ESCAPE key to return to the Data Menu.



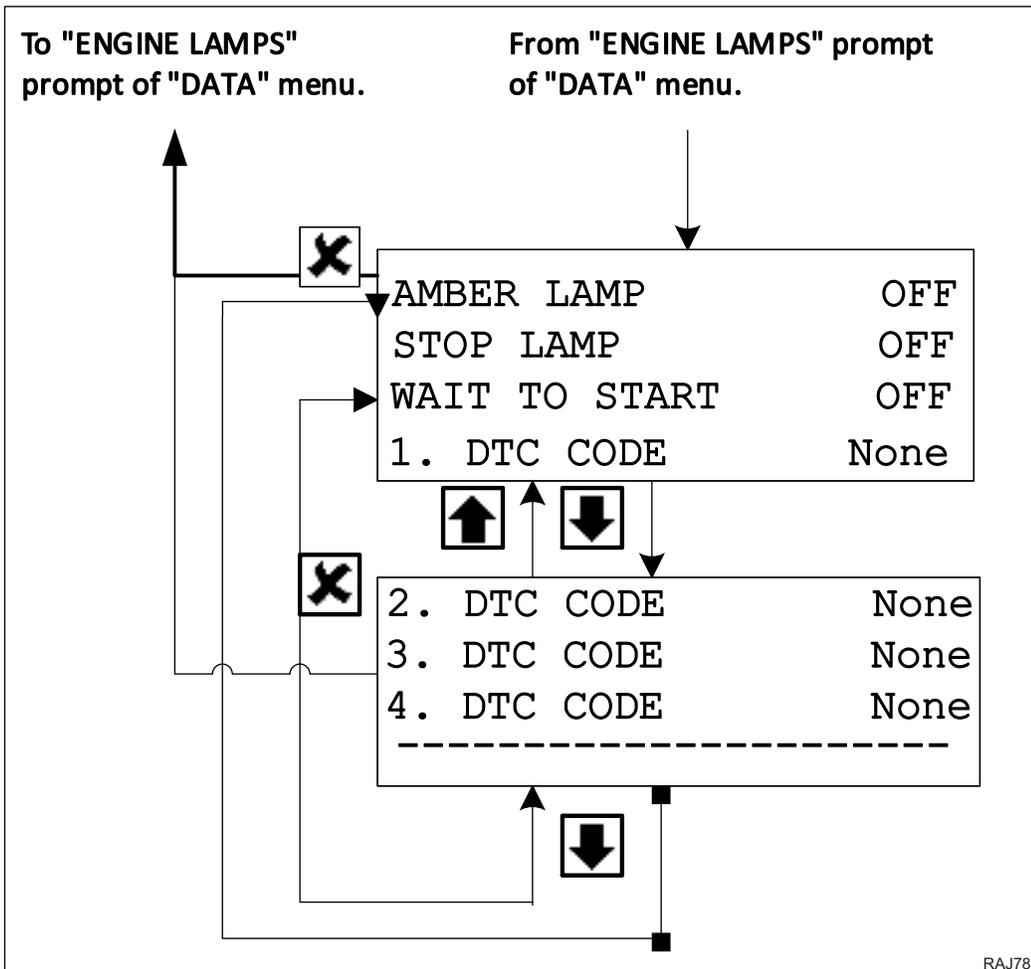
Engine Lamps

The Engine Lamps submenu displays the following information:

- Amber Lamp on/off (SG 3500, SG 4000 and SG 5000 Only)
- Stop Lamp on/off (SG 3500, SG 4000 and SG 5000 Only)
- Wait To Start (SG 3500, SG 4000 and SG 5000 Only)
 1. DTC Code - DTC codes are the same as the P-codes out of the ECU. The Yanmar Smart Assist Direct (YSAD) diagnostic tool is needed to clear these codes. (SG 4000 and SG 5000 Only)
 2. DTC Code (SG 3500, SG 4000 and SG 5000 Only)
 3. DTC Code (SG 3500, SG 4000 and SG 5000 Only)
 4. DTC Code (SG 3500, SG 4000 and SG 5000 Only)

To enter the Engine Lamps submenu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. The Data Menu is typically the first menu displayed in the Main Menu.
Note: Press the UP or DOWN key to scroll up or down through the Main Menu to the Data Menu, if necessary.
3. Press the ENTER key to enter the Data Menu.
4. Press the UP or DOWN key to scroll up or down through the Data Menu to the Engine Lamps submenu.
5. Press the ENTER key to enter the Engine Lamps Submenu.
 - Press the UP or DOWN key to scroll up or down through the Engine Lamps submenu.
 - Press the ESCAPE key to return to the Data Menu.



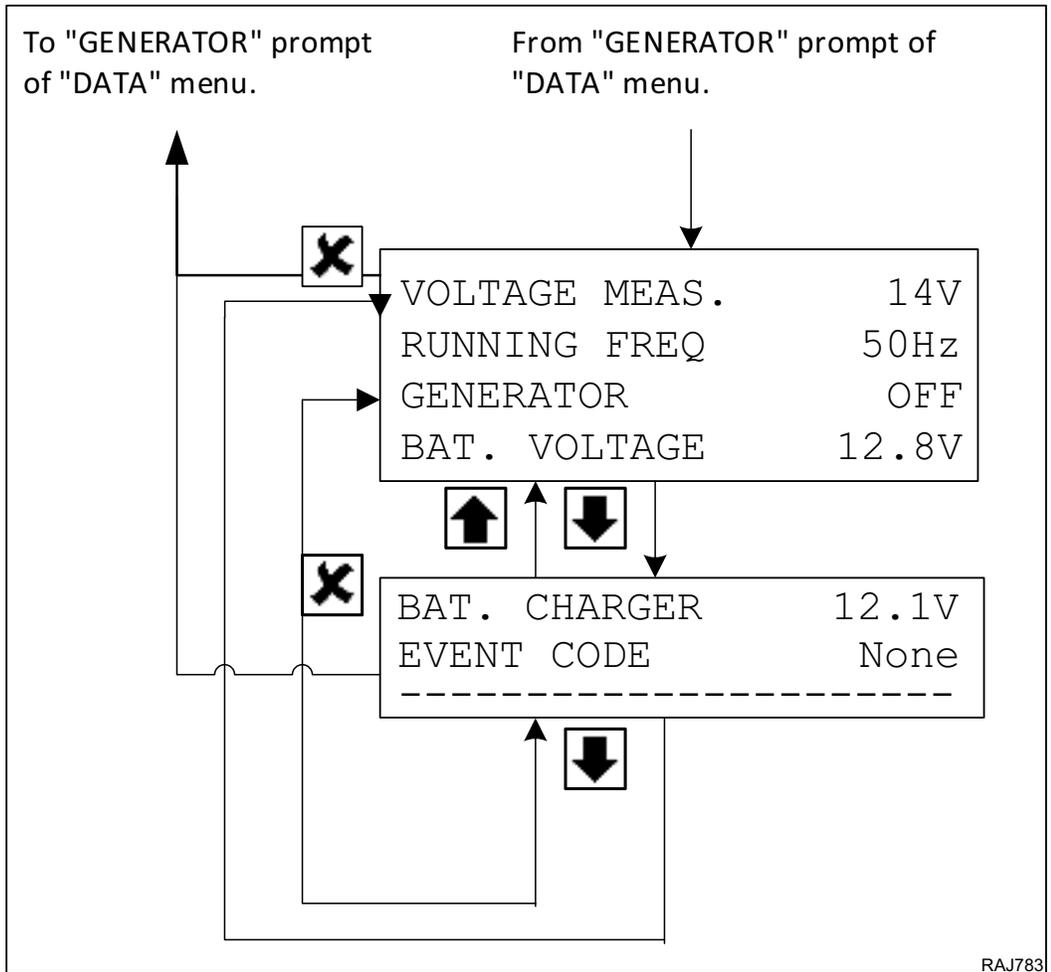
Generator

The Generator submenu display the status of the following outputs:

- Voltage Measurement
- Running Frequency
- Generator
- Battery Voltage
- Battery Charger on/off
- Event Code

To enter the Generator submenu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. The Data Menu is typically the first menu displayed in the Main Menu.
Note: Press the UP or DOWN key to scroll up or down through the Main Menu to the Data Menu, if necessary.
4. Press the ENTER key to enter the Data Menu.
5. Press the UP or DOWN key to scroll up or down through the Data Menu to the Generator submenu.
6. Press the **ENTER** key to enter the Generator submenu.
 - Press the UP or DOWN key to scroll up or down through the Generator submenu.
 - Press the ESCAPE key to return to the Data Menu.



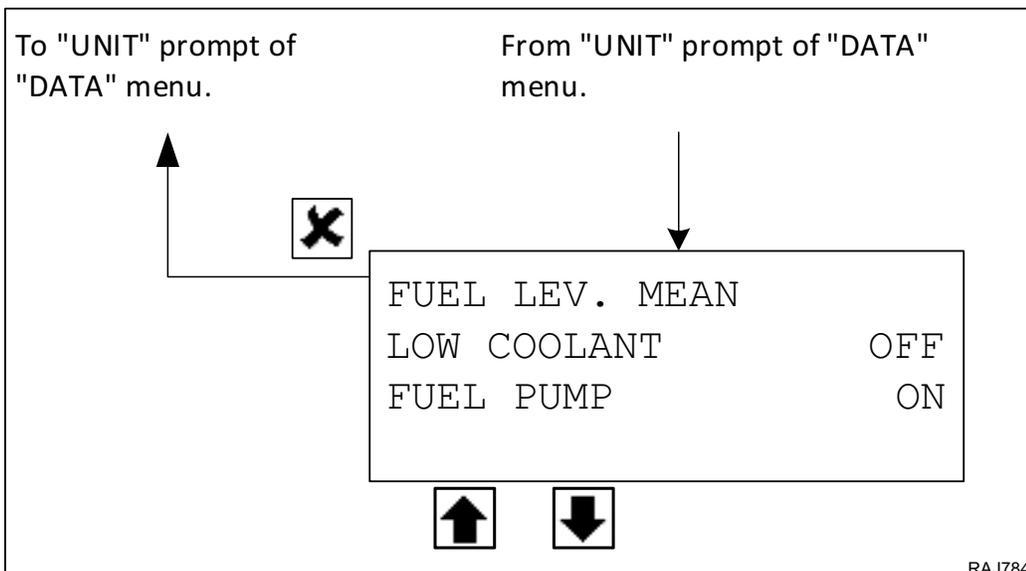
Unit

The Unit submenu display the status of the following outputs:

- Battery Voltage
- Battery Charger
- Fuel Level Mean (average)
- Low Coolant
- Fuel Pump (SG 3500, SG 4000 and SG 5000 Only)

To enter the Unit submenu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. The Data Menu is typically the first menu displayed in the Main Menu.
Note: Press the UP or DOWN key to scroll up or down through the Main Menu to the Data Menu, if necessary.
4. Press the ENTER key to enter the Data Menu.
5. Press the UP or DOWN key to scroll up or down through the Data Menu to the Unit submenu.
6. Press the ENTER key to enter the Unit submenu.
 - Press the UP or DOWN key to scroll up or down through the Unit submenu.
 - Press the ESCAPE key to return to the Data Menu.



Internal States

The Internal States displays which of the following states the unit is in as it prepares to start, and after it starts or if it shuts down:

- INIT (Initiation Checks)
- Fuel Relay On
- Preheat On
- Preheat Off
- Restart 20 MI (Minutes)
- Running
- Shutdown
- HW Error
- Delay
- PTI
- RPM (Displayed Below the State)

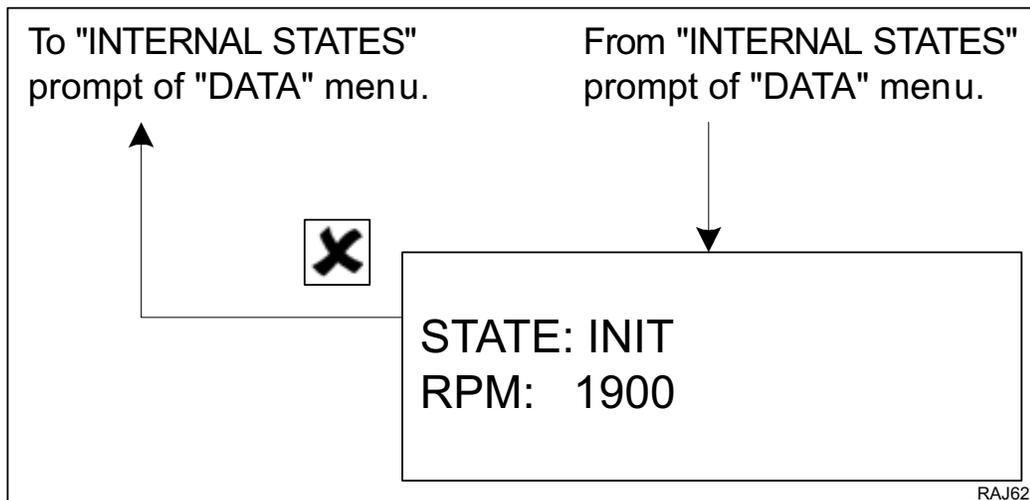
To enter the Internal States complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. The Data Menu is typically the first menu displayed in the Main Menu.

Note: Press the UP or DOWN key to scroll up or down through the Main Menu to the Data Menu, if necessary.

4. Press the ENTER key to enter the Data Menu.
5. Press the UP or DOWN key to scroll up or down through the Data Menu to the Internal States submenu.
6. Press the ENTER key to enter the Internal States.
7. Press the ESCAPE key to return to the Data Menu.

Figure 4. Internal States



Alarm List Menu SG+ 1.5

The Alarm List Menu displays alarms. Alarms are recorded in the controller memory to simplify unit diagnostic procedures. The alarms are listed in the reverse order of their occurrence. The Alarm LED flashes if a shutdown alarm is present. Enter the Alarm List Menu to view the and acknowledge the alarms.

Alarm Types

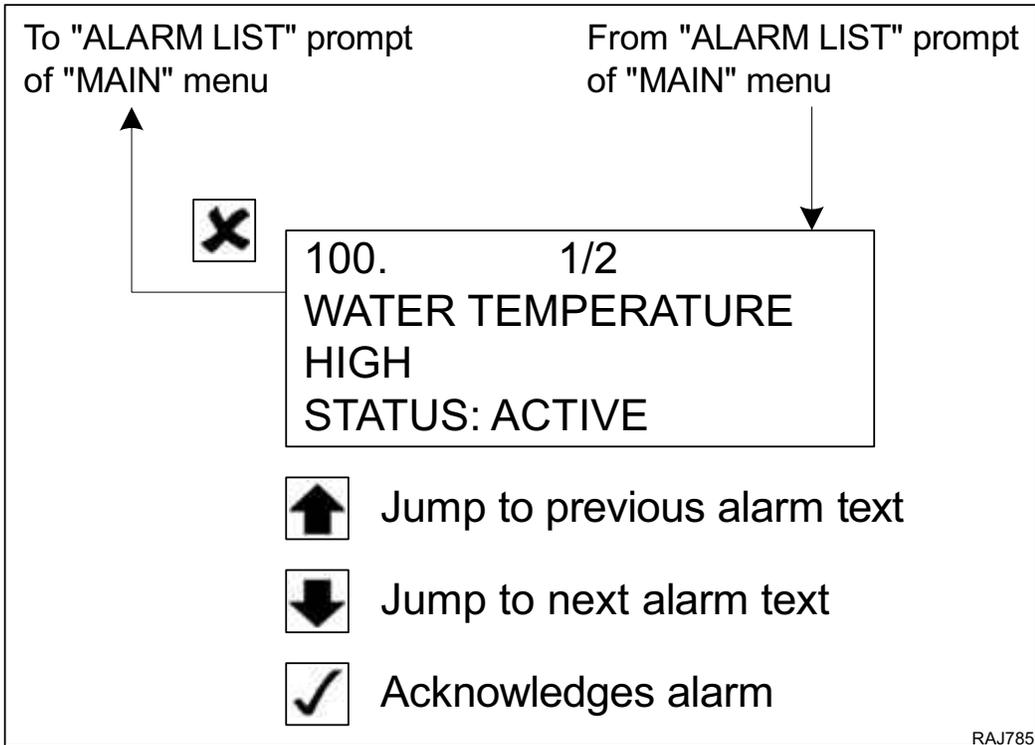
There are two types of alarms:

- **Delayed Restart Alarm:** Delayed restart alarms indicate the unit has stopped temporarily because of a problem or to prevent damage to the unit. The unit will attempt to restart in 20 minutes. The display will show information about the unit in the message screen and the time left to the restart attempt. A delayed restart alarm becomes a shutdown alarm after the third failed restart attempt in an hour.
- **Shutdown Alarm:** The Alarm LED flashes and unit stops. Shutdown alarms indicate the unit has been stopped to prevent damage to the unit. The condition must be corrected before restarting the unit.

Displaying and Acknowledging Alarms

Enter the Alarm List Menu to view and acknowledge the alarms as follows:

1. Place the On/Off switch in the "ON" position.
2. Press the ALARM key to enter the Alarm List Menu directly. **Or** Enter the Alarm List Menu through the Main Menu as follows:
 - Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
 - Press the UP or DOWN key to scroll up or down through the Main Menu to the Alarm List Menu.
 - Press the ENTER key to enter the Alarm List Menu.
3. The Alarm List Menu will appear on the display. It shows the most recent alarm and the following information:
 - The alarm code (100 through 604).
 - The position of the alarm in the list of recorded alarms. For example, 1/2 means alarm one of two.
 - The alarm text.
 - The alarm status (Active or Acknowledged).
 - Write down the alarm code and the alarm text.
4. Write down the alarm code and the alarm text.
5. Press the ENTER key to acknowledge the alarm. The Alarm LED will continue flashing until the active alarms (and messages) have been acknowledged.
6. Press the DOWN key to scroll down to the next alarm, if necessary.
7. Write down the alarm code and the alarm text.
8. Press the ENTER key to acknowledge the alarm.
9. Repeat steps 6 through 8 until all active alarms have been written down and acknowledged.
10. Press the ESCAPE key to return to the Main Menu.



Alarm Diagnosis

The Alarm List details the alarms, their causes, and possible diagnosis.

Alarm List			
Alarm Code	Alarm Text	Alarm Type–Cause	Diagnostics
A100	WATER TEMPERATURE HIGH	<p>Operation Delayed Restart Alarm – Engine is running and water temperature is above 107 C (225 F) for 5 seconds.</p> <ul style="list-style-type: none"> Engine then stops and then attempts to restart. 	<ol style="list-style-type: none"> Check for cause of engine overheating: <ul style="list-style-type: none"> Check engine coolant level. Check water pump belt. Check radiator for airflow and coolant flow restrictions. Check for faulty water temperature sensor.
A101	FAILED TO CRANK	<p>Operation Alarm if Engine did NOT achieve 800 rpm within 12 seconds. Becomes a Shutdown Alarm when number of restart attempts is greater than number of "Crank Restarts" set in Configuration Menu.</p>	<ol style="list-style-type: none"> Defective battery, load test battery. Check battery charger. Check ground connections at block. Check starter motor. Check starter relay, circuit.
A102	FAILED TO START	<p>PTI Warning if the engine failed to enter running state or reports error during the start sequence</p>	<ol style="list-style-type: none"> Check fuel level. Check fuel pump, and fuel system both electrically and mechanically. In cold ambient temperatures check for fuel gelling. Check for restricted air cleaner or air intake system. Check glow plugs and circuit.
A104	ENGINE RPM BLOW LIMITS	<p>Operation General: Warning If the engine speed gets below 800rpm for 10 sec. PCM, Y-HPCR, Y-MECH Engine: Warning if the engine is not capable to maintain high speed RPM. Alarm if the engine is not capable to maintain low speed RPM.</p>	<ol style="list-style-type: none"> Check RPMs. Check RPM sensor. Check for overload on generator. Check restriction in fuel supply. Check for restricted air cleaner or air intake system
A105	LOW OIL LEVEL	<p>Operation If low oil level for 60 seconds.</p>	<ol style="list-style-type: none"> Check oil level. Check Oil Level Switch. Check circuits to Oil Level Switch.
A108	COOLANT LEVEL LOW	<p>Operation Coolant level low detected before engine start.</p>	<ol style="list-style-type: none"> Check coolant level. Check Coolant Level Sensor. Check circuits to Coolant Level.
A110	ENGINE STOP	<p>Operation Alarm If Engine is stopped to safe mode. Due to ECU shutdown codes.</p>	<p>Connect ECU Test Tool to Read Engine Codes. Refer to Yanmar TNV Service TK55740 manual for troubleshooting guide.</p>
A200	GENERATOR SHORT CIRCUIT	<p>Operation DSR has detected short circuit.</p>	<p>See "Alternator Diagnosis".</p>
A201	GENERATOR EXTERNAL OVERLOAD	<p>Operation DSR has detected over excitation.</p>	<ol style="list-style-type: none"> Unplug load and attempt restart. See "Alternator Diagnosis".
A301	ENGINE STOP LAMP	<p>Operation ECU stop lamp activated.</p>	<p>Connect ECU Test Tool to Read Engine Codes</p>
A410	LINE VOLTAGE HIGH	<p>Operation Output voltage >500 VAC for 15 seconds</p>	<p>See "Alternator Diagnosis".</p>



SG+ 1.5 Controller and Operating Instructions

A411	LINE VOLTAGE LOW	Operation Message, if in the start sequence the controller is not able see >300 VAC after the two run time in Low Speed. Alarm if generator is not cable of producing min 200 VAC for 4 seconds.	See "Alternator Diagnosis".
A422	LINE FREQUENCY LOW	Operation / PTI Line frequency <35 Hz for 5 seconds	See "Alternator Diagnosis".
A423	LINE FREQUENCY HIGH	Operation / PTI Line frequency > 75 Hz for 5 seconds	See "Alternator Diagnosis".
A601	DIGITAL OUTPUT	Operation / PTI No feedback when relay energized, RL1, 2, 3, 4, 5, 6.	<ol style="list-style-type: none">1. Look in event log to see what relay is failing.2. Test relay replace if bad.3. Test controller using manual function test, replace controller if relay is good.
A604	BATTERY CHARGER	PTI Message if battery charger does not increase the battery voltage.	<ol style="list-style-type: none">1. Check battery.2. Check battery connections.3. Check ground connections from control box to battery.

Message List Menu SG+ 1.5

The Message List Menu displays messages. Messages are recorded in the controller memory to simplify unit diagnostic procedures. The messages are listed in the reverse order of their occurrence. Enter the Message List Menu to view the and acknowledge the messages. Acknowledging a message clears it from the list.

Note: *The unit will not start a PTI until all active messages have been acknowledged. The display will show "ACKNOWLEDGE MESSAGE" if there are messages that have not been acknowledged when trying to start a PTI.*

Displaying and Acknowledging Messages

Enter the Message List Menu to view and acknowledge the messages as follows:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Message List Menu.
4. Press the ENTER key to enter the Message List Menu.
5. The Message List Menu will appear on the display. It shows the most recent message and the following information:
 - The message code (109 through 803).
 - The position of the message in the list of recorded messages. For example, 1/1 means message one of one.
 - The message text.
 - The message status (Active or Acknowledged).
6. Write down the message code and the message text.
7. Press the ENTER key to acknowledge the message. The Alarm LED will continue flashing until the active messages (and alarms) have been acknowledged.
8. Press the DOWN key to scroll down to the next message, if necessary.
9. Write down the message code and the message text.
10. Press the ENTER key to acknowledge the message.
11. Repeat steps 8 through 10 until all active messages have been written down and acknowledged.
12. Press the ESCAPE key to return to the Main Menu.
13. The unit will then enter the Start Sequence and start the engine.

To "MESSAGE LIST" prompt of "MAIN" menu

From "MESSAGE LIST" prompt of "MAIN" menu

101. 1/1
BAT. VOLTAGE LOW

STATUS: ACTIVE

 Jump to previous warning text

 Jump to next warning text

 Acknowledges warning

RAJ786

Message Diagnosis

The Message List details the messages / warnings, their causes, and possible diagnosis.

Message List			
Message Code	Message Text	Message Type–Cause	Diagnostics
M109	Water IN FUEL	Operation Warning if water in fuel is detected.	<ol style="list-style-type: none"> 1. Drain water from primary filter bowl. 2. Check water sensor for proper operation.
M111	OIL PRESSURE LOW	Operation Low oil pressure message active.	Connect ECU Test Tool to Read Engine Codes <ol style="list-style-type: none"> 1. Check oil pressure switch. 2. Check oil pressure circuit: <ul style="list-style-type: none"> • Unit OFF switch open • Unit running switch closed to ground
M112	FUEL LEVEL ERROR	PTI Fuel sensor is out of range based on tank size. Measurement below empty or above full.	<ol style="list-style-type: none"> 1. Check fuel sensor: 12 VDC on Red wire, 1-4 VDC on Yellow wire. 2. Check fuel sensor circuit.
M113	SPEED CONTROL ERROR	PTI RPM is not controllable within range 1500/1800 +/- 50 RPM.	Connect ECU Test Tool to Read Engine Codes
M114	VOLTAGE CONTROL ERROR	PTI Voltage is not controller within range. Low speed 400, High speed 460 +/- 30 VAC	See "Alternator Diagnosis".
M115	FUEL LEVEL CHANGE TO FAST	Operation Fuel level decrease more than 10 gallons.	<ol style="list-style-type: none"> 1. Check for leak in fuel tank. 2. Check to see if fuel has been removed from fuel tank.
M300	ENGINE EVENT	Operation ECU P-Code event sent by the ECU	Connect ECU Test Tool to Read Engine Codes.
M302	ENGINE SERVICE LAMP	Operation ECU Service lamp activated.	Connect ECU Test Tool to Read Engine Codes.
M720	MAIN BATTERY FAILURE	PTI Battery voltage is below 12.2 volts for 3 min. when genset is outputting power. During preheat or engine running no output voltage is below 9.0 for 3 sec.	Check battery connection Load test battery replace if defective. Check the S12 30 amp fuse
M803	ARV COMM ERROR	Operation DSR reporting Shorted or Open condition in alternator.	See "Alternator Diagnosis"



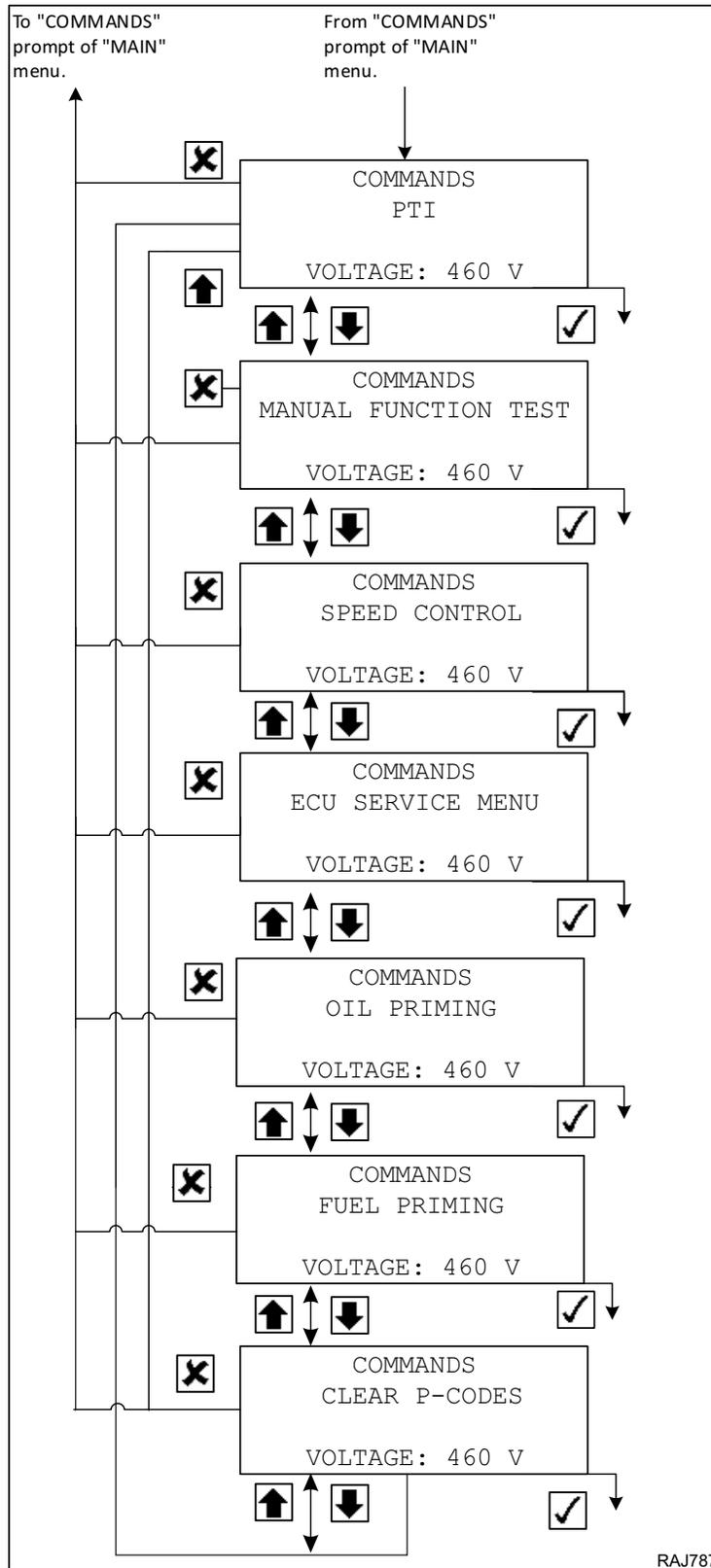
Commands Menu

The Commands Menu contains the following submenus that are used to test the operation of the unit and controller:

- PTI (Pretrip Inspection Test)
- Manual Function Test
- Speed Control
- ECU Service Menu (SG 3500, SG 4000 and SG 5000 Only)
- Oil Priming (SG 3500, SG 4000 and SG 5000 Only)
- Fuel Priming (SG 3500, SG 4000 and SG 5000 Only)
- Clear P-Codes (SG 3500, SG 4000 and SG 5000 Only)

To enter the Commands Menu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
4. Press the ENTER key to enter the Commands Menu.
5. The PTI submenu will be displayed.
 - Press the ENTER key to start the PTI.
 - Press the UP or DOWN key to scroll up or down through the Commands Menu.
 - Press the ESCAPE key to return to the Main Menu.





Pretrip Inspection Test (PTI)

The PTI (Pretrip Inspection Test) initiates a test of the unit's electrical, engine, and alternator system components. To perform a PTI complete the following steps:

Note: *The unit will not start a PTI until all active messages have been acknowledged. The display will show "ACKNOWLEDGE MESSAGE" if there are messages that have not been acknowledged when trying to perform a PTI.*

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
4. Press the ENTER key to enter the Commands Menu.
5. The PTI submenu will be displayed.
6. Press the ENTER key to start the PTI.
7. The controller then performs the PTI. Observe the unit for proper operation and functions during the PTI. The display shows which component is being tested, and the test result (PASSED or FAILED).
 - The engine stops.
 - The controller beeps to test the buzzer.
 - A display test is performed. Watch the display to verify it is operating properly.
 - The PTI test is run in the following order:
 - ECU Ignition Test
 - ECU Run Relay Test
 - ECU Fuel Relay Test
 - ECU CAN Connect Test
 - Start Engine Test
 - Low High Speed Test
 - Output Voltage Test
 - When it comes to the "Start Engine Test, the display shows BEEP ON (and you can hear the beep) and then BEEP OFF and the Engine starts. The Engine remains on for the rest of the PTI.
 - For the last three tests, the display shows the results readings as well as the PASS or FAIL. i.e.
 - For "START ENGINE TEST", the display shows "RUNNING 1491" for example above the RESULT: PASS (or fail if applicable).
 - For "LOW SPEED HIGH SPEED TEST" the display shows "1508 1802" for example to signify the low and high speed in RPMs. The display says "RESULT: PASS" if the speeds are acceptable.
 - For "OUTPUT VOLTAGE TEST" the display shows "0429 0476" in the middle. The display says "RESULT: PASS" if the output voltage is acceptable.

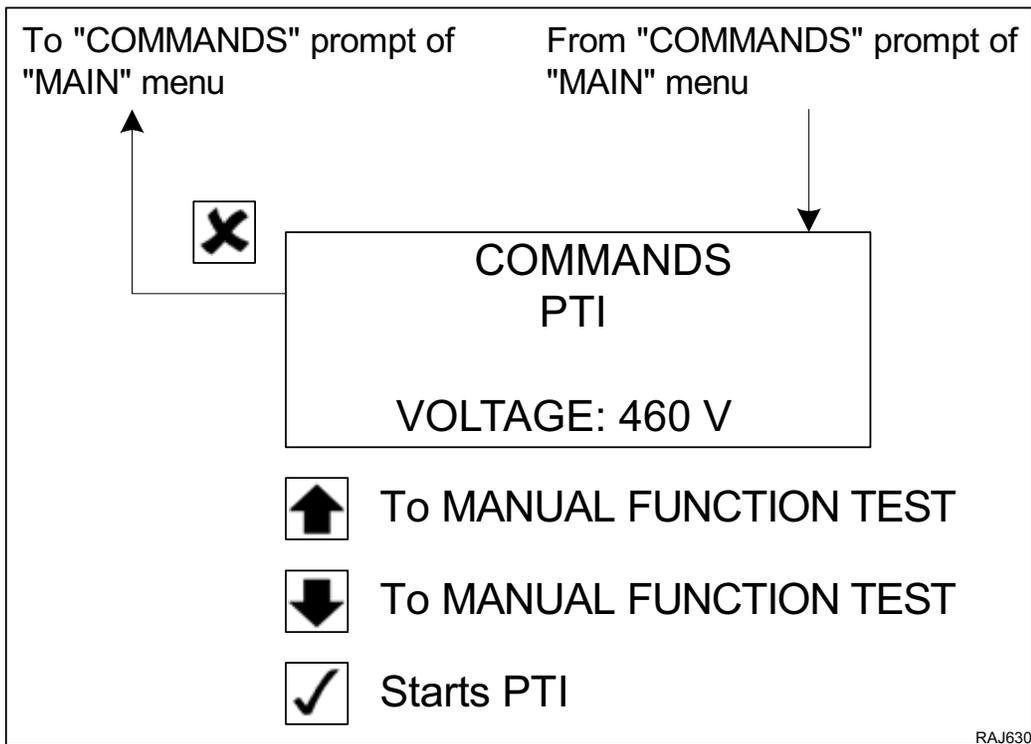
Note: *If a component fails its test, the PTI will stop at that point and display "FAILED - REBOOT". Correct the problem and repeat the PTI by pressing the ENTER Key.*

8. When the PTI is complete, the test ends automatically and the controller display shows "PTI PASSED (or FAILED) - REBOOT". Turn the On/Off Switch Off and back On to reboot and return the unit to normal operation.

If an operating problem occurs during the PTI, view and correct any alarms or messages. Then acknowledge the alarms or messages and repeat the PTI.

Note: *Acknowledge the alarms or messages ONLY after the alarm codes are documented and problems repaired.*

Figure 5. PTI Submenu





Manual Function Test

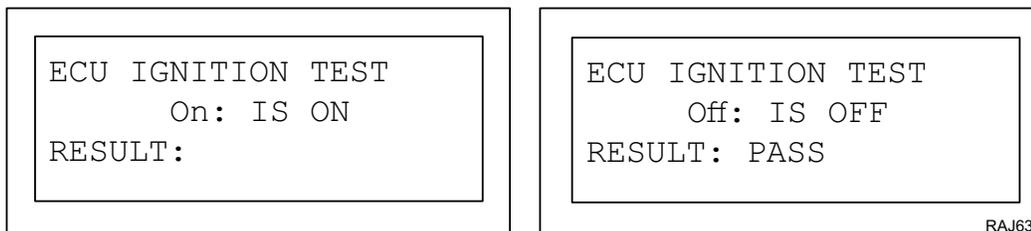
The Manual Function Test submenu contains the following component tests:

- Display Test
- RLI ECU Ignition Test
- RL2 ECU Run Relay Test
- RL3 ECU Fuel Relay Test
- RL5 DSR Test

The test result (PASSED or FAILED) is displayed after a test is performed. To enter the Manual Function Test complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
4. Press the ENTER key to enter the Commands Menu.
5. The PTI submenu will be displayed.
6. Press the UP or DOWN key to scroll up or down through the Commands Menu to the Manual Function Test submenu.
7. Press the ENTER key to enter the Manual Function Test.
 - The engine will stop if it is running.
 - The Display Test is the first to appear. Press the ENTER key to perform the Display Test.
 - Press the UP or DOWN key to scroll up or down through the Manual Function Test submenu. Press the ENTER key to perform the selected test.
 - Press the ESCAPE key to return to the Commands Menu.

Figure 6. Manual Function Test Example



Speed Control

Speed control is used to temporarily set engine speed (either high or low speed) to aid in unit testing for 180 seconds. After 180 seconds the unit will return to normal operating RPM and the controller will exit to the main menu.

- HIGH
 - LOW
1. Place the On/Off switch in the "ON" position.
 2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
 3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
 4. Press the ENTER key to enter the Speed Control menu.
 5. Press the UP or DOWN key to scroll up or down between HIGH rpm and LOW rpm.
 6. Press the ESCAPE key to return to the Commands Menu.



ECU Service Menu

The ECU Service Menu is used when the ECU Service Tool needs to be used to communicate with the Engine ECU for troubleshooting.

First enter the ECU Service Menu on the SG+ 1.5 Controller. You will get the following messages:

- ECU SERVICE MODE
- ENGINE OFF
- CONTROLLER ON
- ECU ON

The ECU Service Tool is software that is independent of the SG+ 1.5 Controller and is a program with is opened on your PC. This software tool comes in a Diagnostic kit which is called Yanmar Smart Assist Direct (YSAD). Use the Yanmar SmartAssist Direct (YSAD) Diagnostic Tool to determine what DTC Codes are set. For corrective actions, refer to the Yanmar Troubleshooting Guide. See the “Yanmar YSAD Diagnostic Engine Service” chapter.

Oil Priming

Oil Priming is typically used when changing the engine oil / filter and cranks the engine without starting to prime oil galleries. The controller has a sequence and count down timers to properly prime the engine.

After the oil priming process is complete, turn the unit OFF to exit.

1. Place the On/Off switch in the “ON” position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
4. Press the ENTER key to enter the Oil Priming menu.
5. The oil priming sequence will begin, the engine will crank 3 times for 12 seconds, but the unit will not start.
6. View the on screen status. When the oil priming process is complete. turn the unit switch OFF to exit.

Fuel Priming

Fuel Priming is typically used when changing the fuel filters or servicing the fuel system. It turns the fuel pump ON without starting the engine to prime / bleed the fuel system.

After the fuel priming process is complete, turn the unit OFF to exit.

1. Place the On/Off switch in the “ON” position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
4. Press the ENTER key to enter the Fuel Priming menu.
5. The fuel priming sequence will begin, the electric fuel pump will run for 120 seconds (2 minutes), but the unit will not start.
6. View the on screen status. When the fuel priming process is complete. turn the unit switch OFF to exit.

Clear P Codes

Clear P Codes is used to view and clear active and historical P codes.

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
4. Press the ENTER key to enter the Clear P Codes menu.
5. Press the UP or DOWN key to scroll up or down between saved codes.
6. Follow the on screen steps to clear / delete active and view historical codes.
7. Press the ESCAPE key to return to the Commands Menu.



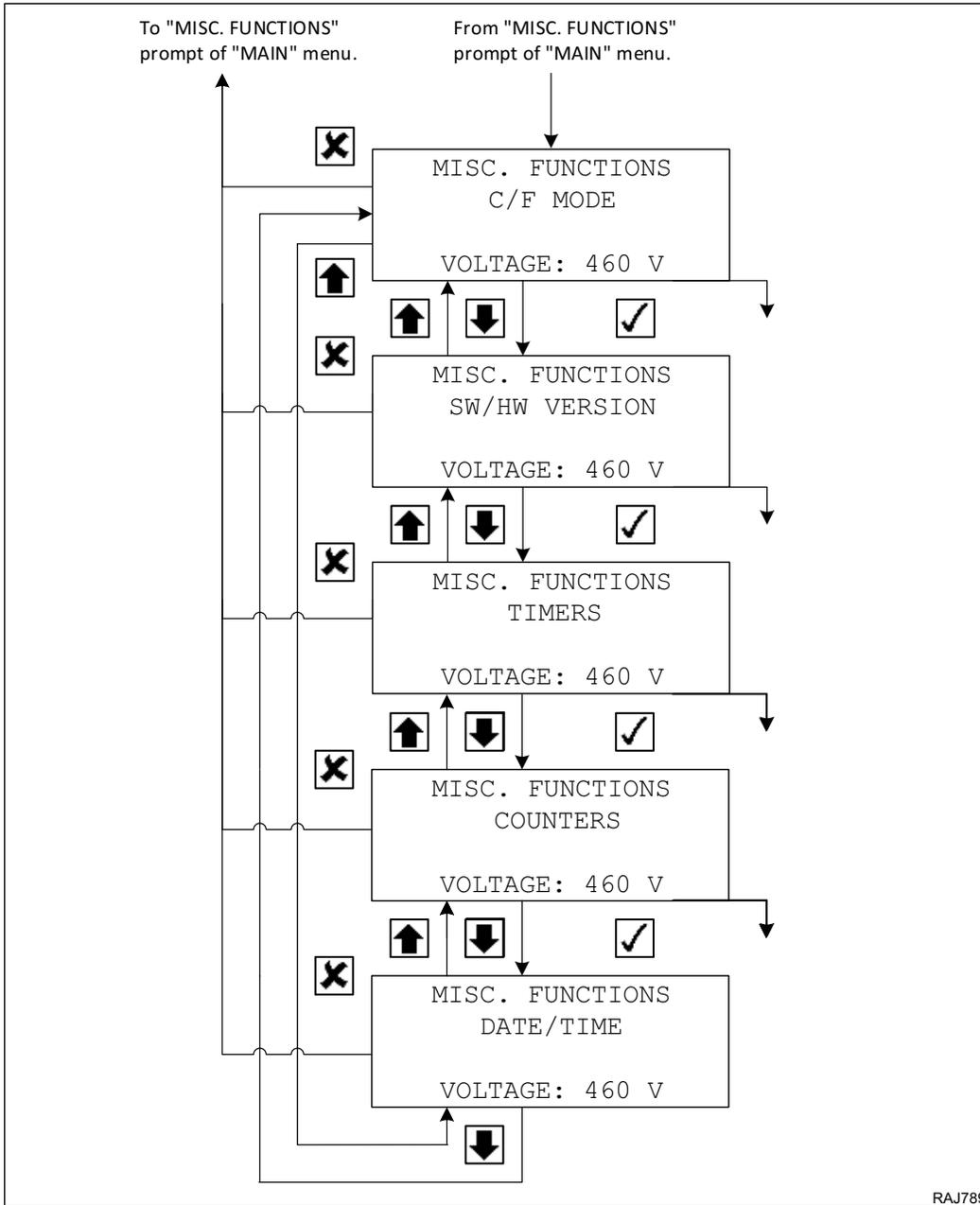
Misc. Functions Menu

The Misc. Functions Menu contains the following submenus:

- C/F Mode
- SW / HW (Software/Hardware) Version
- Timers
- Counters
- Date / Time

To enter the Misc. Functions complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Misc. Functions Menu.
4. Press the ENTER key to enter the Misc. Functions Menu.
5. The C/F Mode submenu will be displayed.
 - Press the ENTER key to enter C/F Mode submenu to set the controller for Celsius or Fahrenheit units.
 - Press the UP or DOWN key to scroll up or down through the Misc. Functions Menu.
 - Press the ESCAPE key to return to the Main Menu.





C/F Temperature and Language Mode

The C/F Mode submenu is used to change:

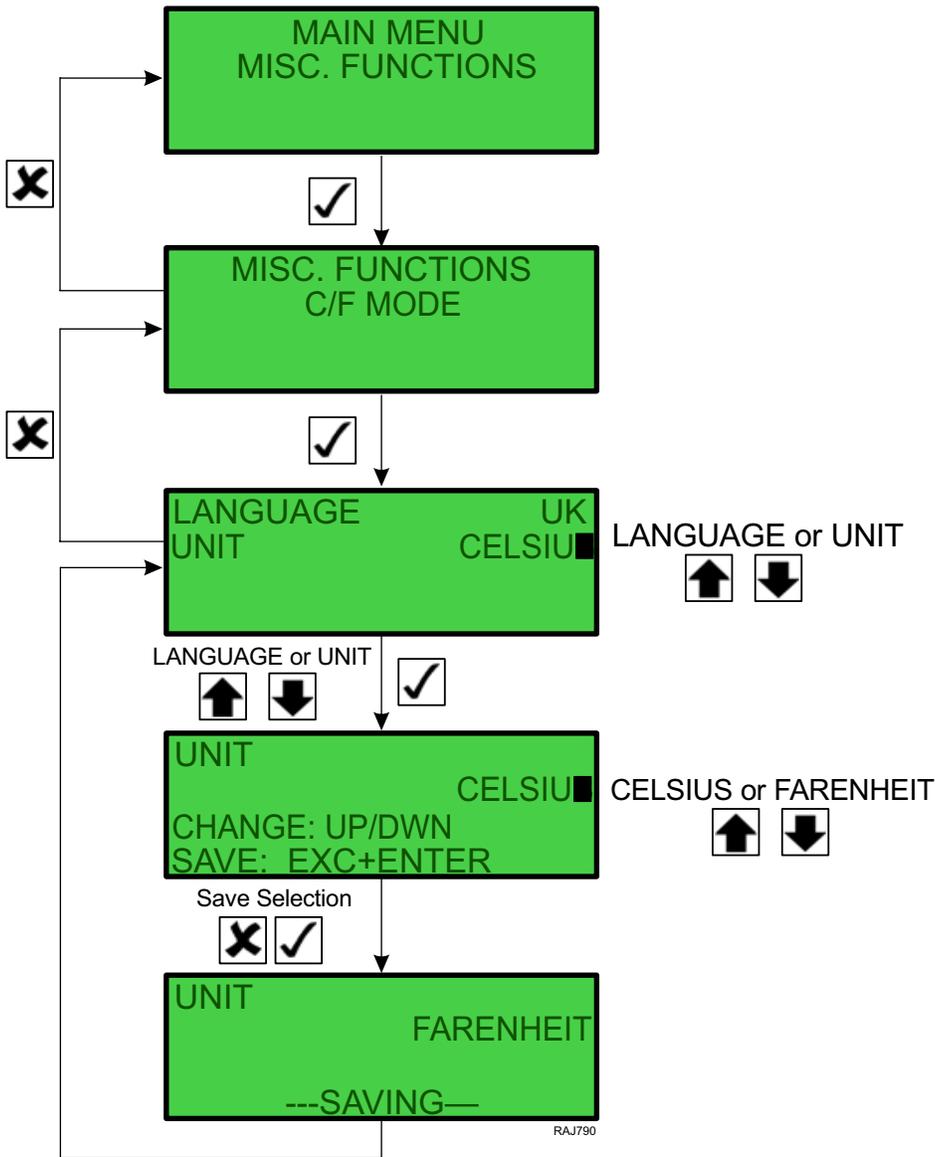
- **Language:** Allows unit to display English, Spanish, or Danish for all screens.
- **C/F:** Allows unit to display Celsius or Fahrenheit display temperature readings.

To enter the C/F Mode submenu and change the language or units displayed complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Misc. Functions Menu.
4. Press the ENTER key to enter the Misc. Functions Menu.
5. The C/F Mode submenu will be displayed.
6. Press the ENTER key to enter C/F Mode to change the units displayed.
7. Press the UP or DOWN key to toggle between UNITS and LANGUAGE. Press ENTER.
8. Press the UP or DOWN key to toggle between the Celsius and Fahrenheit settings or the available languages.
9. Press the ESCAPE key and the ENTER key at the same time to save the new setting and return to the Misc. Functions Menu.

Note: Press the ESCAPE key to return to the Misc. Functions Menu without saving the new setting.

Note: If you select C (Celsius) C for temperature and bars for pressure. If F (Fahrenheit) is selected then you'll get F for temperature and PSI for pressure reading.



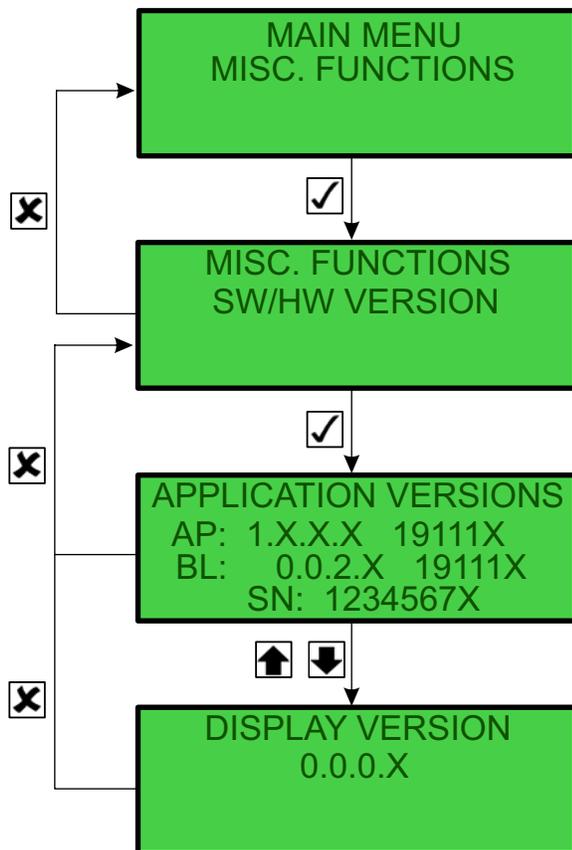
SW/HW Version (Software / Hardware)

The SW/HW Application Version submenu displays the following information about the controller:

- AP (Application)
- BL (Build)
- SN (Serial Number)
- Display version

To enter the Program Version submenu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Misc. Functions Menu.
4. Press the ENTER key to enter the Misc. Functions Menu.
5. Press the UP or DOWN key to scroll up or down through the Misc. Functions Menu to the Program Version submenu.
6. Press the ENTER key to enter the Program Version submenu.
7. Press the ESCAPE key to return to the Misc. Functions Menu.



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Timers

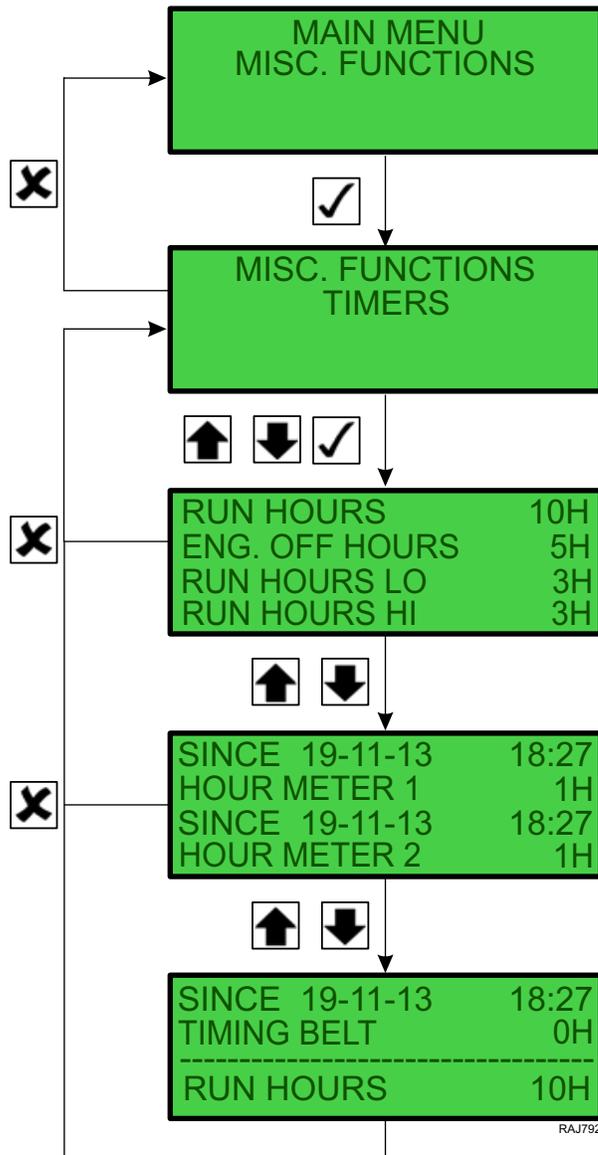
The Timers submenu displays the following hour meters:

- Run Hours – The number of hours the unit has been running.
- Engine Off Hours – The number of hours the unit has been running since Engine Off Hours was cleared. An alarm is generated when the reading reaches the threshold set in the Configuration Menu.
- Engine Run Hours Low Speed – The number of hours the unit has been running at 50 Hz (low speed).
- Engine Run Hours High Speed – The number of hours the unit has been running at 60 Hz (high speed).
- Hour Meter 1 – The number of hours the unit has been running since Hour Meter 1 was cleared. A message is generated when the reading reaches the threshold set in the Configuration Menu.
- Hour Meter 2 – The number of hours the unit has been running since Hour Meter 2 was cleared. A message is generated when the reading reaches the threshold set in the Configuration Menu.

Note: *The readings for Run Hours, Run Hours 50 Hz, and Run Hours 60 Hz can be adjusted. See “Setting Hour Meter Thresholds and Resetting Hour Meters” .*

To enter the Timers submenu complete the following steps:

1. Place the On/Off switch in the “ON” position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Misc. Functions Menu.
4. Press the ENTER key to enter the Misc. Functions Menu.
5. Press the UP or DOWN key to scroll up or down through the Misc. Functions Menu to the Timers/Counters submenu.
6. Press the ENTER key to enter the Timers submenu.
 - Press the UP or DOWN key to scroll up or down through the Timers.
 - Press the ESCAPE key to return to the Misc. Functions Menu.



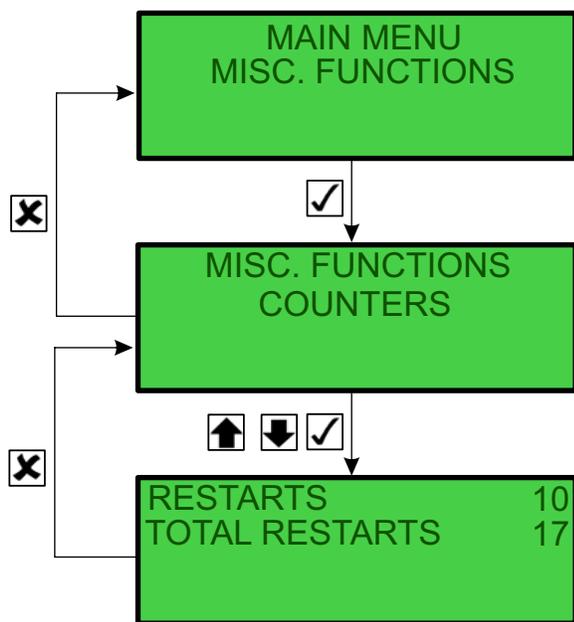
Counters

The Counters submenu displays the following event counters:

- Restarts – The number of restarts the controller has made since the last power up.
- Total Restarts – The total number of restarts.

To enter the Counters submenu complete the following steps:

1. Place the On/Off switch in the “ON” position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Misc. Functions Menu.
4. Press the ENTER key to enter the Misc. Functions Menu.
5. Press the UP or DOWN key to scroll up or down through the Misc. Functions Menu to the Counters submenu.
6. Press the ENTER key to enter the Counters submenu.
 - Press the UP or DOWN key to scroll up or down through the Timers.
 - Press the ESCAPE key to return to the Misc. Functions Menu.



RAJ793



Date and Time

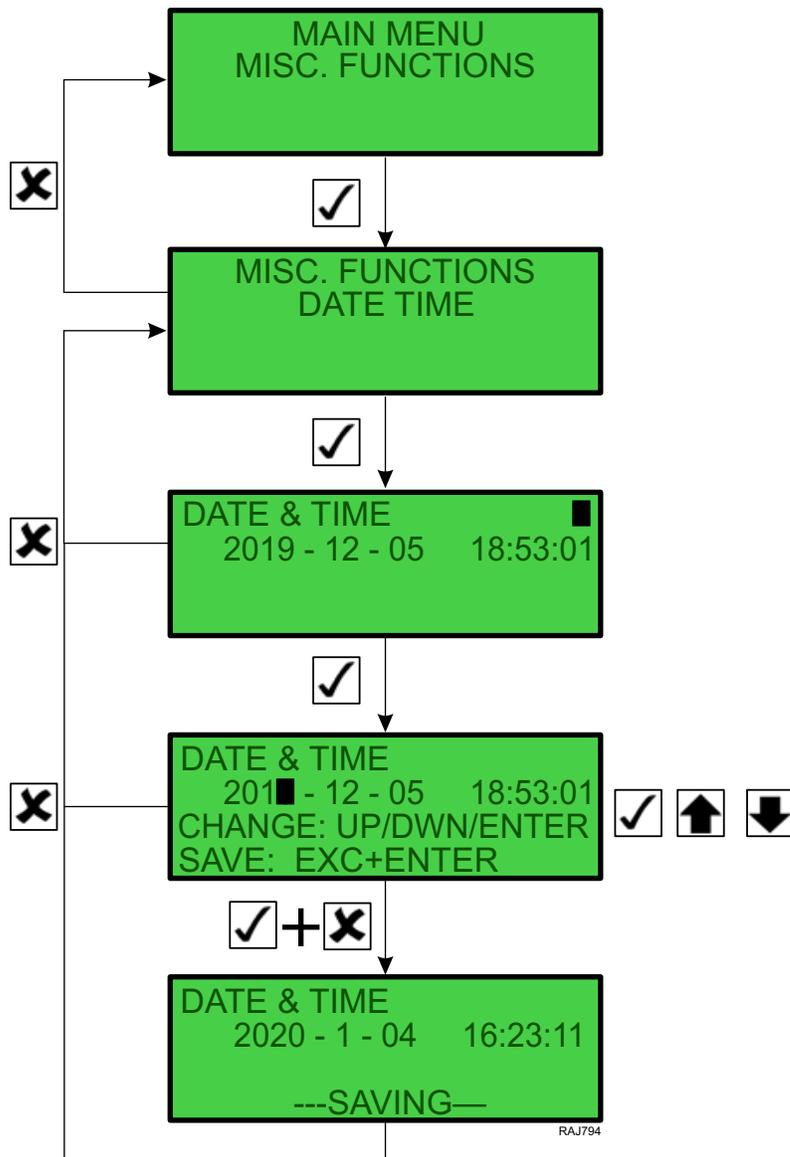
The Date and Time submenu is used to set the date clock in the controller. To enter the Date/Time submenu and set the clock complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Misc. Functions Menu.
4. Press the ENTER key to enter the Misc. Functions Menu.
5. Press the UP or DOWN key to scroll up or down through the MISC. FUNCTIONS submenu to the Date Time submenu.
6. Press the ENTER key to enter the Date Time submenu to set the date and clock.
7. Press the ENTER key to enable the edit the date and time.
8. Use the ENTER key to move the cursor (to the right) to select the value you want to change.

Note: *The ENTER key does not move the cursor to the right in the Time value. You must use the UP or DOWN keys to scroll the total Time value up or down.*

9. Press the UP or DOWN key to scroll the selected value up or down to the new setting.
10. Repeat steps 8 and 9 until you have changed all the values to the new settings.
11. Press the ESCAPE key and the ENTER key at the same time to save the new settings and return to the System Setup submenu.

Note: *Press the ESCAPE key to return to the Misc. Functions submenu without saving the new settings.*






 Use ENTER, and the UP / DOWN keys to set date and time.



Configuration Menu

The Configuration Menu is used to configure the following controller functions (also see the flowcharts on the following pages):

⚠ WARNING

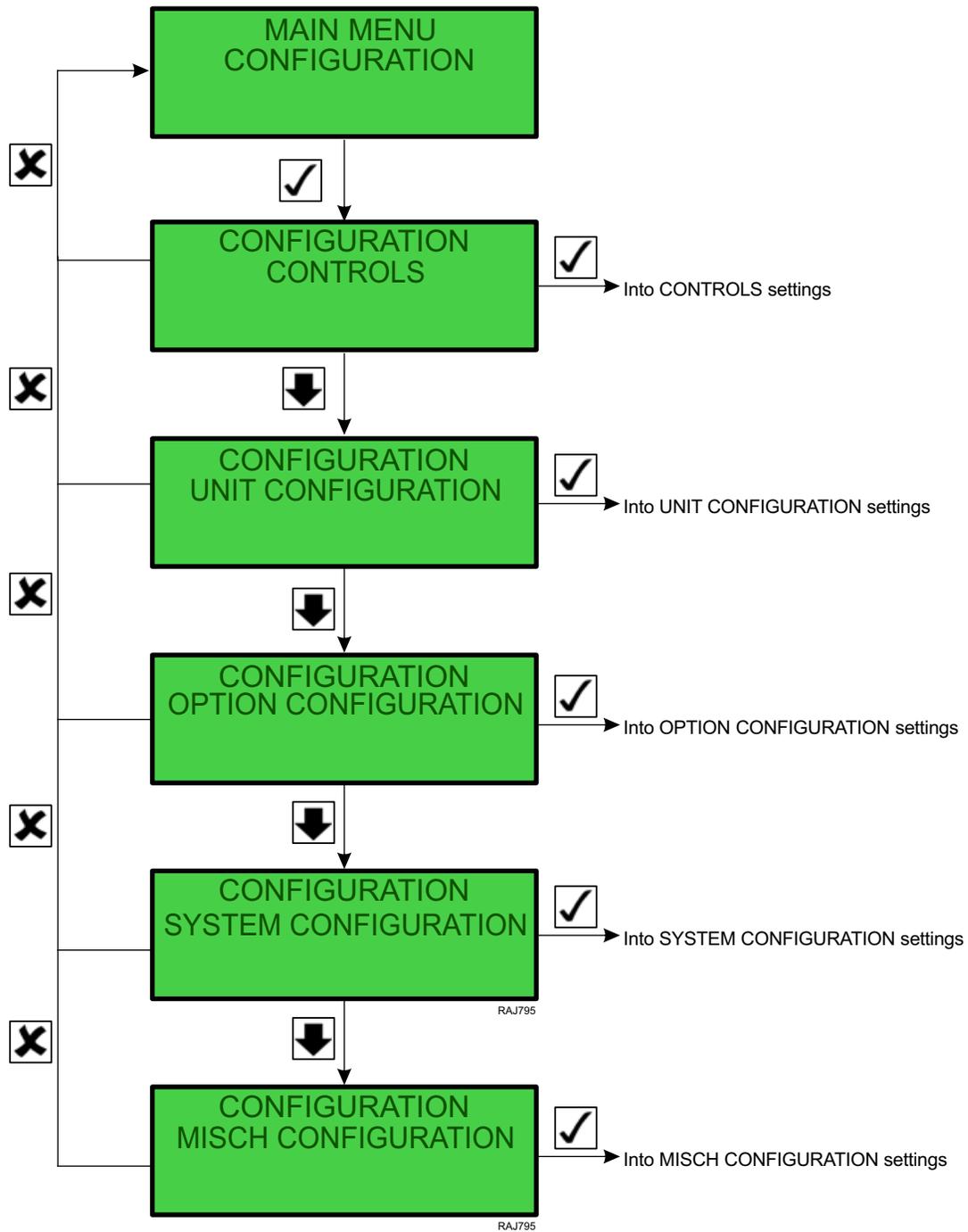
Equipment Damage and Risk of Injury!

The unit will begin a start sequence and attempt to start when Configuration Mode is exited on the controller.

- Controls - Set engine RPM control mode to AUTO / HIGH / LOW for service procedures.
- Unit Configuration - Set unit Engine type, Generator type, Genset type, Serial Number, and Output Voltage settings.
- Option Configuration - Set controller selectable options such as Tank Size, Fuel Sensor, Low Fuel Limit, Restarts, Speed Solenoid, HRG Gizmo, Water in Fuel, Composite, HM1 Threshold, HM2 Threshold.
- System Configuration - Set the unit ID number. The ID number is not the unit serial #; it is a number created by the unit user, operator, or owner.
- MISCH Configuration - The default setting is OFF. When this is set to ON, the controller will reset all run timers to 0 when the unit is turned Off and then back On.

To enter the Configuration Menu, complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Configuration Menu.
4. Press the ENTER key to enter the Configuration Menu.



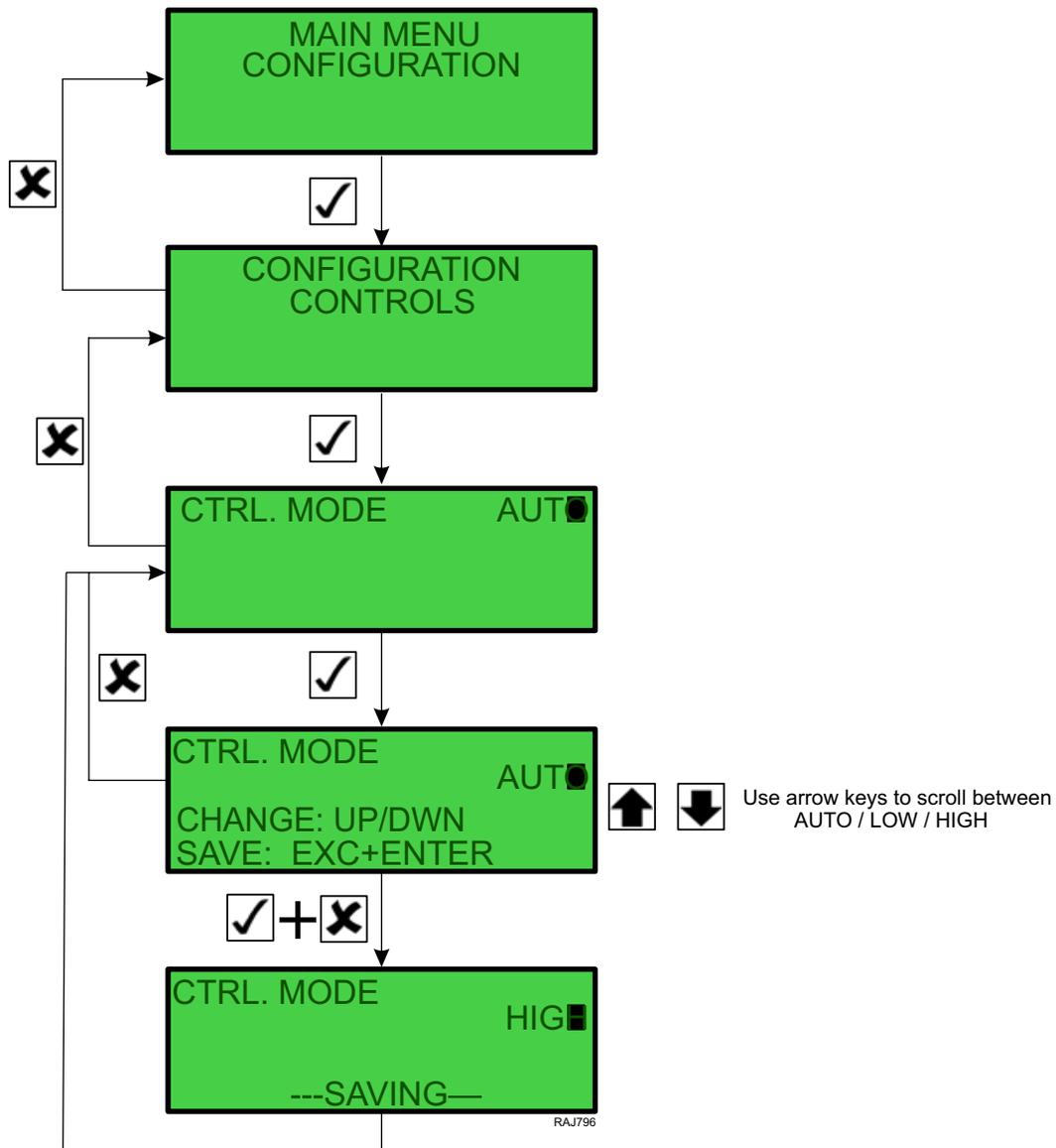


Controls

The Controls submenu is used to temporary set engine RPM to AUTO / HIGH / LOW for service purposes. To enter the Controls submenu, complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the CONFIGURATION Menu.
4. Press the ENTER key to enter the CONFIGURATION Menu.
5. Press the UP or DOWN key to scroll up or down through the CONFIGURATIONS submenu to the CONTROLS submenu.
6. Press the ENTER key to enter the CONTROLS submenu.
7. Press the ENTER key again to enable CONTROL setting changes.
8. Press the UP or DOWN key to change the setting between AUTO, HIGH, and LOW.
9. Press the ESCAPE key and the ENTER key at the same time to save the new settings and return to the System Setup submenu.

Note: Press the ESCAPE key to return to the Misc. Functions submenu without saving the new settings.





Unit Configuration

The unit configuration submenu contain the following settings and is used to set up the controller for the specific unit it is controlling:

- Engine - Select the specific engine type in the unit.
- Generator - Select the specific generator type in the unit.
- Genset Type - Select the specific genset type of the unit (side, center, clip on mount)
- Serial Number - Enter the correct serial number of the unit which is found on the unit's serial number tag.
- Output Voltage Type - Select the unit output voltage (460V or 230V)

⚠ WARNING

Equipment Damage and Risk of Injury!

After the unit is configured and the controller exits Configuration Mode, the unit will begin a start sequence.

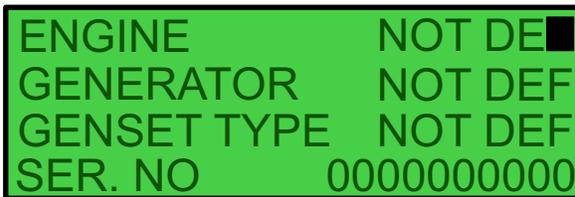
Follow the steps below to ensure the unit is configured correctly.

1. Turn the unit "ON".
2. Use the UP and DOWN arrows to view the MAIN MENU, UNIT CONFIGURATION submenu.
 - Press the ENTER key.



RAJ799

3. Set ENGINE type:
 - With the cursor on ENGINE, press the ENTER key.



RAJ769

- Use the UP and DOWN keys to scroll to the correct engine:
 - YANMAR MECH (SG 3000 series units)
 - PCM (SG 4000 series units)
 - YANMAR HPCR (SG 5000 series units)
- When the correct engine is selected, press the ESC and ENTER keys at the same time to save the engine choice.



RAJ772

4. Set GENERATOR type:

- Use the **UP** and **DOWN** keys to put the cursor on GENERATOR.
- Press the ENTER key when the cursor is on GENERATOR.

```
ENGINE          NOT DEF
GENERATOR      NOT DE█
GENSET TYPE    NOT DEF
SER. NO        0000000000
```

RAJ770

- Use the **UP** and **DOWN** keys to scroll to the correct alternator:
 - MECC ALTE (SG 5000, SG 4000, SG 3500 and SG 3000 after December 2016)
 - STANFORD (SG 3000 Before December 2016). Could be MECC ALTE if generator has been replaced, see not below.

Note: SG 3000 UNITS: Verify the generator type which is identified on the alternator serial plate.
- When the correct alternator is selected, press the **ESC** and **ENTER** keys at the same time to save the engine choice.

```
GENERATOR
                                NOT DE█
CHANGE: UP/DOWN
SAVE: EXC+ENTER
```

RAJ773

5. Set GENSET TYPE:

- Use the **UP** and **DOWN** keys to put the cursor on GENSET TYPE.
- Press the ENTER key when the cursor is on GENSET TYPE.

```
ENGINE          NOT DEF
GENERATOR      NOT DEF
GENSET TYPE    NOT DE█
SER. NO        0000000000
```

RAJ771

- Use the **UP** and **DOWN** keys to scroll to the correct Genset Type:
 - CLIP ON
 - SIDE
 - CENTER
- When the correct genset type is selected, press the **ESC** and **ENTER** keys at the same time to save the engine choice.

```
GENSET TYPE
                                NOT DE█
CHANGE: UP/DOWN
SAVE: EXC+ENTER
```

RAJ774

6. Set SERIAL NUMBER:



SG+ 1.5 Controller and Operating Instructions

- Use the **UP** and **DOWN** keys to put the cursor on SERIAL NO.
- Press the **ENTER** key when the cursor is on SERIAL NO.

```
ENGINE      NOT DEF
GENERATOR   NOT DEF
GENSET TYPE NOT DEF
SER. NO     000000000
```

RAJ775

- Enter the unit serial number by:
 - Use the arrow keys to scroll **UP** and **DOWN** to select the number or letter.
 - Press the **ENTER** key to move to the next serial number digit
- When the correct serial number is entered, press the **ESC** and **ENTER** keys at the same time to save the serial number.

```
SER. NO
                000000000
CHANGE: UP/DOWN/ENTER
SAVE:  EXC+ENTER
```

RAJ776

7. Set unit OUTPUT VOLTAGE TYPE.

- Use the **UP** and **DOWN** keys to put the cursor on OUTP. VOLT TYPE.
- Press the **ENTER** key when the cursor is on OUTP. VOLT TYPE.

```
GENERATOR   NOT DEF
GENSET TYPE NOT DEF
SER. NO     000000000
OUTP. VOLT TYPE 460
```

RAJ797

- Select the unit output voltage by:
 - Use the arrow keys to scroll **UP** and **DOWN** to select the correct output voltage (460V or 230V).
- When the correct voltage is selected, press the **ESC** and **ENTER** keys at the same time to save the voltage.

```
OUTP. VOLT TYPE
                460
CHANGE: UP/DWN
SAVE:  EXC+ENTER
```

RAJ798

⚠ WARNING

Equipment Damage and Risk of Injury!

After the unit is configured and the controller exits Configuration Mode, the unit will begin a start sequence.

8. After all the unit configuration settings are set and saved, press the ESC key twice to return to the main menu screen



RAJ799

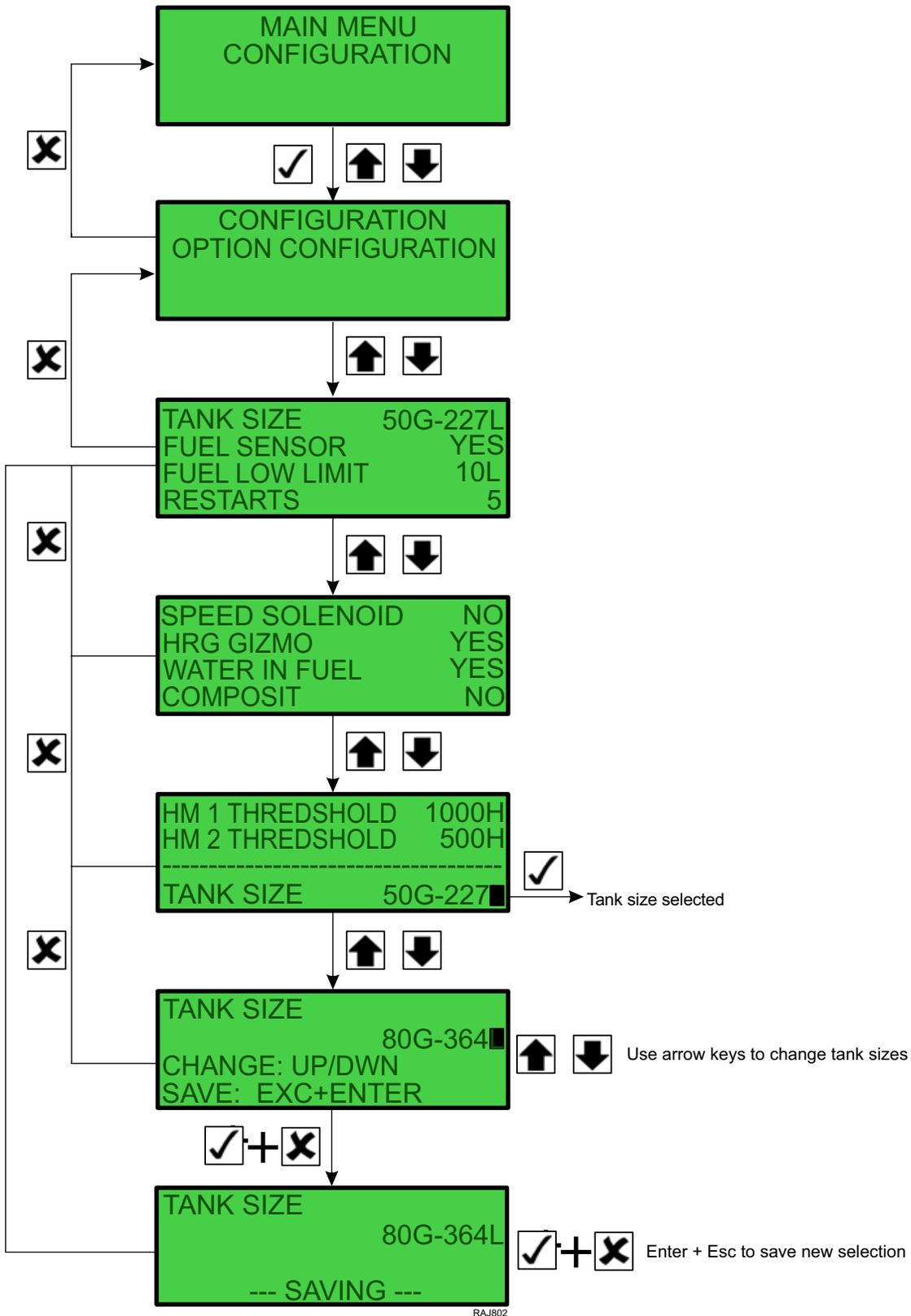
Option Configuration

The Option Configuration submenu allows setting values for the following unit options:

- Fuel Tank Size – Select the correct fuel tank size for the unit (50, 75, 80, 125 gallon).
- Fuel Level Sensor – Select if the unit is equipped with a fuel level sensor (YES / NO).
- Fuel Low Limit - Set fuel level at which a fuel level warning is set.
- Restarts - Set number of times the unit will attempt to restart after a failed start (default 1).
- Speed Solenoid - Select if the unit is equipped with a speed solenoid (YES / NO) (SG 3000 Only).
- HRG Gizmo - Select if the unit is equipped with a HRG Gizmo (YES / NO).
- Water in Fuel - Select if the unit is equipped with a water level sensor in the fuel filter (SG 3500, SG5000 Only)
- Composit - Telematics installed, will auto select (Yes / No).
- HM1 Thredshold - Set the number of hours for the HM1 hour meter.
- HM2 Thredshold - Set the number of hours for the HM2 hour meter.

To enter the Option Configuration submenu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Configuration option.
4. Press the ENTER key to enter the Configuration menu.
5. Press the UP or DOWN key to scroll up or down through the Configuration Menu to the Option Configuration submenu.
6. Press the ENTER key to enter the Option Configuration submenu.
 - Press the UP or DOWN key to scroll up or down through the options.
 - Press the ESCAPE key to return to the Option Configuration Menu.



RAJ802

System Configuration

The System Configuration submenu allows the use to set the unit ID number.

Note: The ID number is not the unit serial #; it is a number created by the unit user, operator, or owner.

Follow the steps below to set the unit ID number:

1. From the MAIN MENU, use the **UP** and **DOWN** keys to find CONFIGURATION.
2. Press the ENTER key.



RAJ777

3. Use the **UP** and **DOWN** keys to SYSTEM CONFIGURATION.
4. Press the ENTER key.



RAJ778

5. Use the **UP** and **DOWN** keys to ensure the cursor is on ID NO.
6. Press the ENTER key when the cursor is on ID NO.



RAJ779

7. Enter the unit ID number by:
 - Use the arrow keys to scroll UP and DOWN to select the number or letter.
 - Press the ENTER key to move to the next ID number digit



THERMO KING

SG+ 1.5 Controller and Operating Instructions

8. When the correct ID number is entered, press the **ESC** and **ENTER** keys at the same time to save the ID number.



RAJ780

9. After the unit ID number is entered and saved, press the **ESC** key twice to return to the main menu screen.



RAJ777

MISCH Configuration

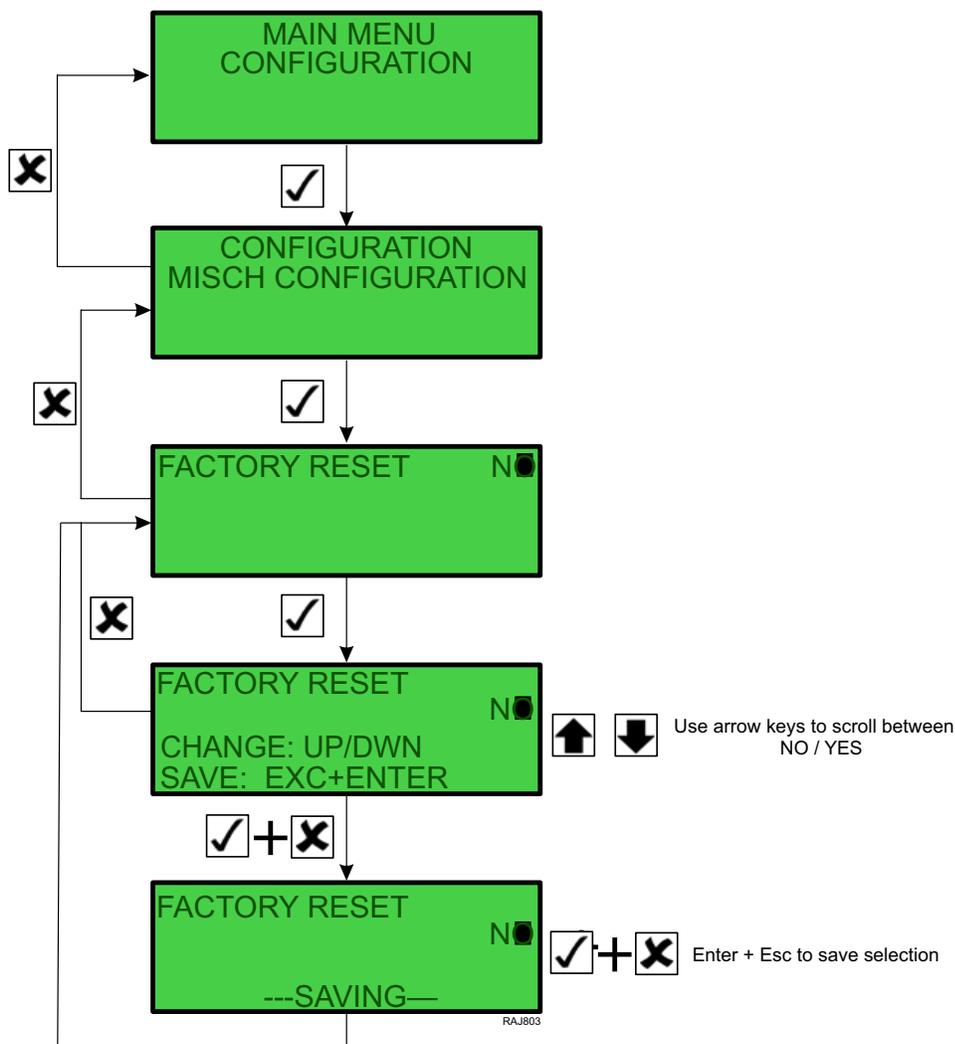
The MISCH Configuration is used as a factory reset for all settings. The function will set all custom settings back to the factory original settings.

The MISCH Configuration submenu allows setting values for the following unit options:

- Factory Reset – Select YES to activate a factory reset of all settings.

To enter the MISCH Configuration submenu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Configuration option.
4. Press the ENTER key to enter the Configuration menu.
5. Press the UP or DOWN key to scroll up or down through the Configuration Menu to the MISCH Configuration submenu.
6. Press the ENTER key to enter the MISCH Configuration submenu.



Event Log Menu

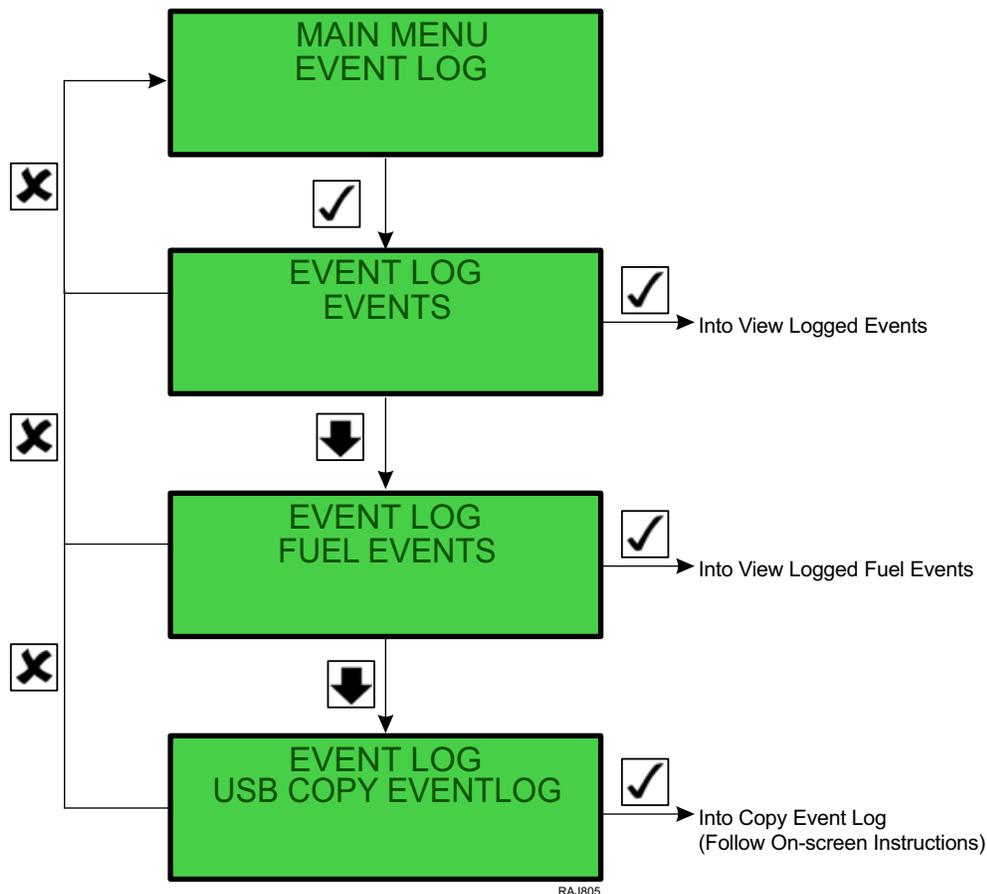
The Event Log Menu allows user access to view saved events and to perform a USB download.

The Event Log menu has these submenus:

- Events - View configuration, settings changes, and messages saved by the controller.
- Fuel Events - View fuel system messages and events.
- USB Copy Event Log - Allows user to generate a log file of all events onto a USB device for PC viewing.

To enter and use the Event Log Menu, complete the following steps:

1. Place the On/Off switch in the "ON" position.
 2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
 3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Event Log menu.
- Press the ENTER key to enter the Event Log submenu.
 - Press the UP or DOWN key to scroll up or down through submenu.
 - Press the ESCAPE key to return to the Main Menu.



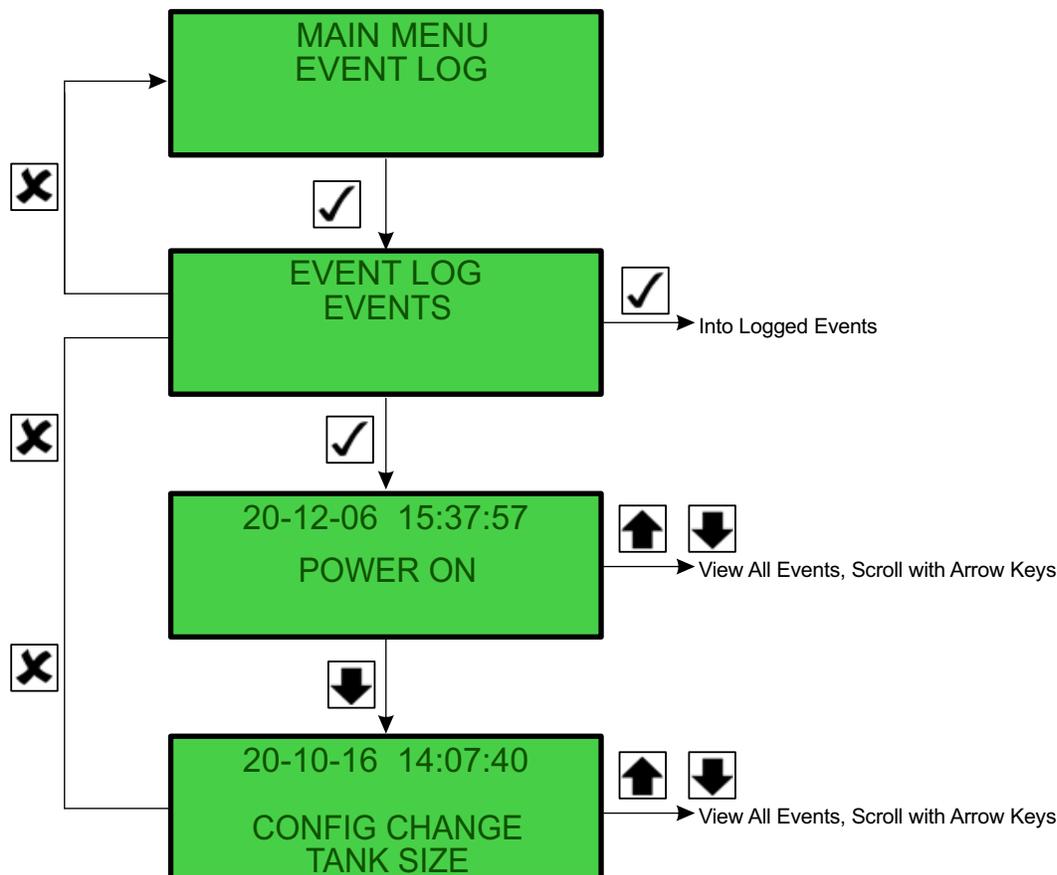
Events

The Event Log is a list of events that are recorded in the controller memory. Examples of recorded events are a system power up, alarms, and messages. Events are listed in the reverse order of their occurrence. Viewing the event log can be helpful when diagnosing a problem.

Note: The Event Log will log 128 events. When full, the controller uses a first in first out overwriting of events.

To enter the Event Log submenu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Event Log Menu.
4. Press the ENTER key to enter the Event Log Menu.
5. The Event Log submenu will be displayed.
6. Press the ENTER key to enter the Event Log submenu.
7. The Event Log will appear on the display. It shows the most recent event and the date and time of that event.
8. Press the DOWN key to scroll down to the next event.
9. Press the UP or DOWN key to scroll up or down through the event log.
10. Press the ESCAPE key to return to the Event Log Menu.





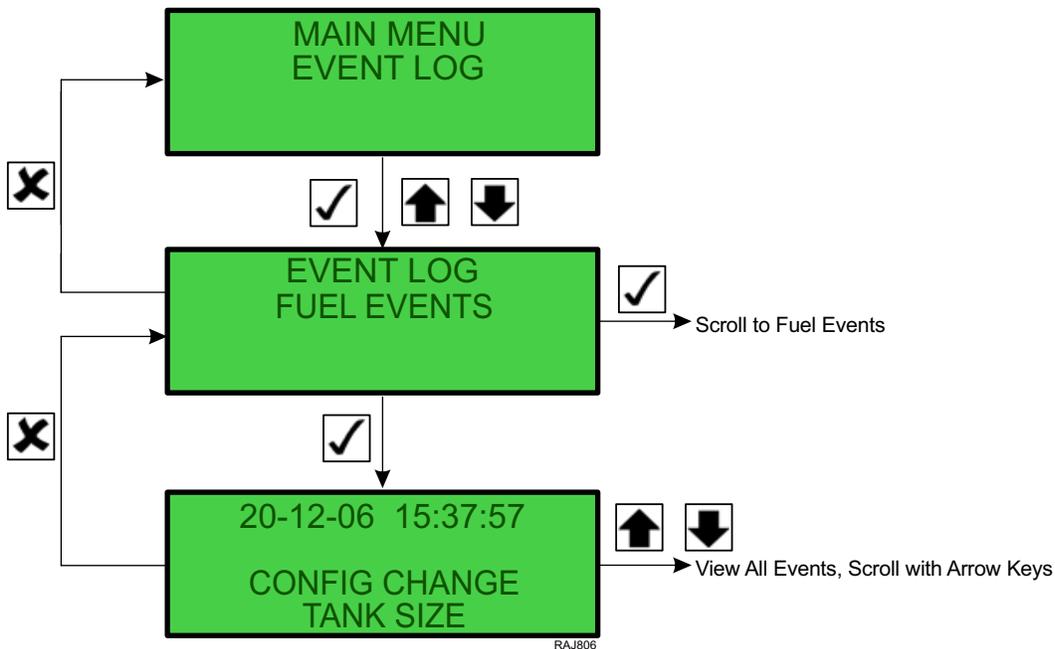
Fuel Events

The Fuel Events is a list of fuel events that are recorded in the controller memory on units equipped with the fuel level sensor option. An example of a recorded event is when fuel is added to the fuel tank. Fuel Events are listed in the reverse order of their occurrence.

Note: The Fuel Events will log 128 events. When full, the controller uses a first in first out overwriting of events.

To enter the Fuel Events submenu complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Event Log Menu.
4. Press the ENTER key to enter the Event Log Menu.
5. The Event Log submenu will be displayed.
6. Press the UP or DOWN key to scroll up or down to the Fuel Events submenu.
7. Press the ENTER key to enter the Fuel Events submenu.
8. The Fuel Events will appear on the display. It shows the most recent fuel event and the date and time of that event.
9. Press the DOWN key to scroll down to the next fuel event.
10. Press the UP or DOWN key to scroll up or down through the fuel events.
11. Press the ESCAPE key to return to the Event Log Menu.



USB Copy Event Log

The USB Copy Event Log is a function that allows the download of all logged events onto a USB drive located on the controller board.

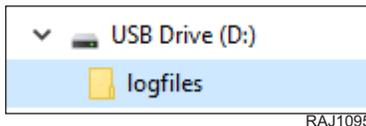
Format USB drive to Fat 32 system. Use a blank USB drive.

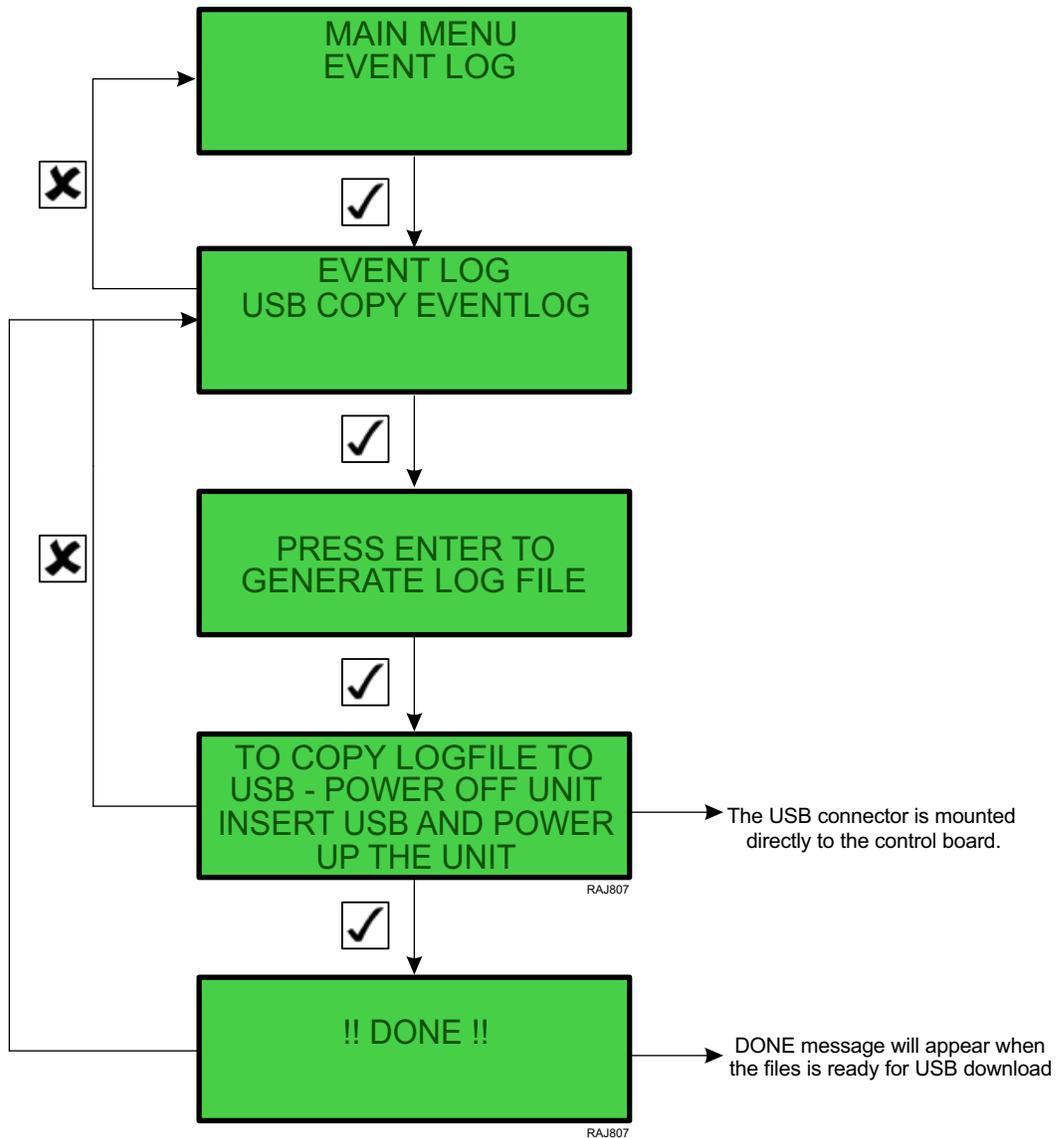
Note: A Logman II PC 2.8.1 can also be used to download the log.

To enter the USB Copy Event Log submenu and complete ad download, complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Event Log Menu.
4. Press the ENTER key to enter the Event Log Menu.
5. The Event Log submenu will be displayed.
6. Press the UP or DOWN key to scroll up or down to the USB Copy Event Log submenu.
7. Press the ENTER key to enter the USB Copy Event Log submenu.
8. Press ENTER to generate log file.
9. Wait for display to show !!DONE!!.
10. Turn genset OFF, insert USB drive, turn genset ON.
11. DO NOT turn genset OFF until it starts to count down on the display.
12. Turn genset OFF and remove USB drive.
13. Press the ESCAPE key to return to the Event Log Menu.

Log files are saved on the USB drive under "logfiles".





LogView and Viewing SG+ Logs

With the release of LogView software version 5.9.2.0 (or later), you can now view SG+ Event logs. The following will outline how to interpret the SG+ log. To understand how to use LogView refer to the Help file found within LogView.

The SG+ log can store up to 128 Event logs. The oldest events will be over written in the log automatically.

The latest LogView files can be found on our Web site under Global Marine Solutions Info Central.

Note: Logman II PC Rev. 2.7.0 (or later) is required to flashload software or to download the data logger.

Event Description		
Alarm	Alarm Code	An alarm is activated, see "Alarm List" on page 63 for alarm descriptions
Message	Message code	A message is activated, see "Message List" for message descriptions
Engine	Shutdown alarm	If an alarm is active and entering shutdown state
	Engine running	The engine is running
	Restart engine	Restart sequence started
Pre Trip	PTI started	PTI start event
	PTI failed	PTI failed
	PTI OK	PTI completed
Configura- tion	Factory reset	Factory reset initiated by user
	Clock set	Time and date adjusted
Power	Power off	Time and date for controller power off
	Power on	Time and date for controller power on
Log retrieved	Log retrieved	The event log is retrieved from the unit
Speed	High to low speed - was XXX RPM	RPM above shift point
	Low to high speed - was XXX RPM	RPM below shift point
	Low to high speed RPM below limit	RPM below 1500 RPM
	High to low speed MAGNUM unit detected	A TK MAGNUM unit is detected
	Low to high speed compressor start detected	Reefer unit controller is resetting
	Low to high speed water temperature to high Water temperature XXX	If water temperature is above 5 C below alarm high limit
	Failed to detect speed solenoid	This event is set in the state "LOAD MEAS" if it fails to detect the speed change
Fuel	Positive change from X.X to X.X Ga Change in level; +X.X Ga	Positive fuel change detected
	Negative change from X.X to X.X Ga Change in level; - X.X Ga	Negative fuel change detected
System	Flashload completed OLD: XXX to NEW: XXX	A new version of the application is loaded



Figure 7. Example of SG+ Log

Event Log Report
 Container ID: APZJ007063 LogView: 5.9.2.0 SGPlus2LogView.dll: Rev. : 1.1.1.9
 Thermo King SG+ Event Log

Time for transfer : 080826 16:13
 Retriever ID : LogMan II PC v. 2.0.2
 SG+ software version : 080423 revision 00
 SG+ boot loader version : 040108

Thermo King SG+ Event Log

DATE	TIME	DATA
2008/07/21	20:28	POWER.....: Power ON
2008/07/23	14:26	ENGINE.....: Engine running
2008/07/23	15:26	SPEED.....: High to low speed
2008/07/23	16:12	SPEED.....: Low to high speed Compressor start detected
2008/07/23	21:51	POWER.....: Power OFF
2008/07/23	21:51	POWER.....: Power ON
2008/07/24	20:43	ENGINE.....: Engine running
2008/07/25	13:18	FUEL.....: Change in level: 7 Ga
2008/08/10	18:39	SYSTEM.....: Flash load completed Old: 000000 00 New: 080423 00
2008/08/10	18:39	POWER.....: Power ON
2008/08/10	18:39	CONFIGURATION...: Clock set
2008/08/12	14:06	SPEED.....: High to low speed - was 1849 rpm
2008/08/12	15:13	SPEED.....: Low to high speed - was 1505 rpm
2008/08/16	14:30	SPEED.....: Low to high speed - water temperature too high Water temperature 102.6 C
2008/08/16	14:31	MESSAGE.....: Water temperature sensor failure (#113)
2008/08/20	15:18	SPEED.....: Low to high speed - was 1538 rpm Compressor start detected
2008/08/21	04:18	FUEL.....: Positive change from 41.3 to 54.3 Ga Change in level: +13.0 Ga
2008/08/24	05:18	FUEL.....: Negative change from 54.2 to 35.2 Ga Change in level: -19.0 Ga
2008/08/26	16:13	LOG RETRIEVED...: Log retrieved

Latest DLL file revision

Old fuel event description prior to 080423 software

Software update

New fuel event description

Setting Hour Meter Thresholds and Resetting Hour Meters

The Hour Meter Threshold feature sets the controller to alert the user that the unit has operated for a defined number of hours. The number of operating hours are entered in the controller in the Hour Meter Threshold display. The controller then generates a message when the hour meter reaches the threshold setting.

Note: *If the user does not desire to use the Hour Meter Threshold feature to measure maintenance intervals, etc., leave the settings at "00000" to avoid nuisance messages.*

The readings for Run Hours, Run Hours 50 Hz, and Run Hours 60 Hz can be adjusted.

To set the HM1 Threshold or the HM2 Threshold, or to reset Run Hours, Run Hours 50 Hz, or Run Hours 60 Hz, complete the following steps.

1. Place the On/Off switch in the "ON" position.
2. Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
3. Press the UP or DOWN key to scroll up or down through the Main Menu to the Configuration Menu.
4. Press the UP or DOWN key to scroll up or down through the Configuration Menu to the Option Configuration menu.
5. Press the ENTER key to enter the Option Configuration menu.
6. The Option Configuration menu will be displayed.
7. Press the UP or DOWN key to scroll up or down through the Option Configuration menu to HM1 Threshold and HM2 Threshold.
8. Press the ENTER key to select HM1 or HM2. Use the ENTER and UP or DOWN keys to set the desired hour interval.
Note: *For example, to change the setting for the HM1 Threshold to 400 hours, press the ENTER key until the cursor is under the third digit from the right. Then press the UP key until that value reads 4.*
9. Press the UP or DOWN key to scroll the selected value up or down to the new setting.
10. Repeat steps 8 and 9 until you have changed all the values to the new settings.
11. Press the ESCAPE key and the ENTER key at the same time to save the new settings and return to the Option Configuration menu.

Note: *Press the ESCAPE key to return to the Configuration Menu without saving the new settings.*

Electrical Maintenance

Battery

⚠ CAUTION

Risk of Injury!

Place the unit On/Off switch in the "OFF" position, Before connecting or disconnecting the unit battery.

Inspect and clean the battery terminals, check the electrolyte level during scheduled maintenance inspections. The minimum specific gravity should be 1.235. Add distilled water as necessary to maintain the proper water level.

A dead or low battery can be the cause of an ammeter indicating discharge due to lack of initial excitation of the alternator.

Note: If the battery was discharged enough that a boost was needed, the alternator may not recharge the battery. This is because there may not be adequate current to excite the alternator field.

12 Vdc Charging System

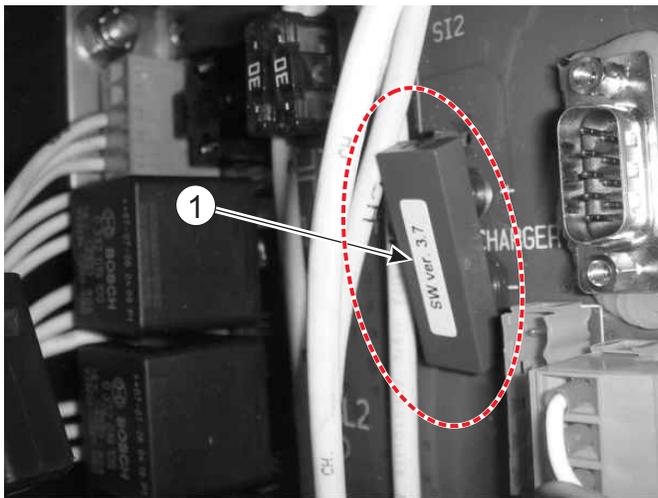
Battery charging current is supplied by Controller. The battery charging circuit provides current to the battery until the proper charge level is attained (13.1 to 14.6 volts).

The alternator exciter field is controlled by the DSR. This initiates battery charging approximately 15 seconds after unit has output voltage.

Note: The engine must run for approximately 120 seconds before the battery charging circuit is energized.

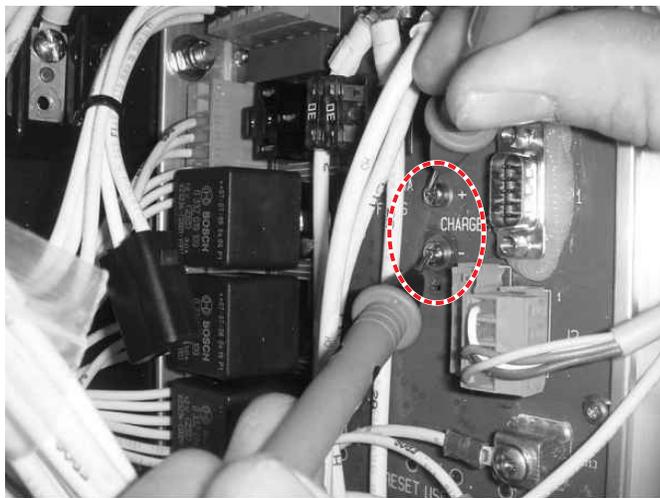
Controller Battery Charger Test

1. Ensure unit is off.
2. Verify the J6 connection is connected to controller.
3. Measure the voltage across the battery and record (12.5 Vdc).
4. Remove and check the 30 amp battery charger fuse S12 from the controller.
5. With fuse S12 removed from the controller, start the unit and measure voltage at terminals J15 and J16 located under blue cap (see images below). If the voltage is 16.1 to 16.8 Vdc, the controller is good. If voltage is the same as battery voltage, replace controller.
6. Reinstall fuse S12 and take the same readings at J15 and J16. If voltage reading is 16.1 to 16.8 Vdc, check the CH (10 ga) wire from J11 to the engine frame.
7. If battery voltage in steps 5 and 6 are higher than voltage recorded in step 3, the charging circuit is working properly.



RAJ682

1.	Blue Cap
----	----------



RAJ683

Fuses

ECU Fuses

Several ECU fuses are located inside of the control box and on the control board. See the unit wiring and schematic diagrams for detailed information.

Fuse SI1 (Located on Control board)	30 Amp - RL4 Relay Fuse
Fuse SI2 (Located on Control board)	30 Amp - Battery Charger Fuse
Fuse SI3 (Located on Control board)	30 Amp - J9 to J13 Controller Fuse
Fuse FS1 (Located in Control Box)	10 Amp - ECU Fuse
Fuse FS2 (Located in Control Box)	40 Amp - Starter Solenoid Fuse
Fuse FS4 (Located in Control Box)	60 Amp - Glow Plug Fuse

Relays

All the relays are 12 Vdc relays. The relays on the microprocessor PC board are interchangeable. The relays mounted on the inside of the control box are interchangeable. The relays on the microprocessor PC board are not interchangeable with the relays mounted on the inside of the control box. Test a relay by interchanging it with a known good relay.

Ignition Relay

The Ignition relay (RL1) is located on the PC board. It supplies power to the ECU. The RL1 LED on the PC board will light up when the Ignition relay is energized.

Run Relay

The Run relay (RL2) is located on the PC board. It supplies power to the ECU. The RL2 LED on the PC board will light up when the Run relay is energized.

Fuel Pump Relay

The Fuel Pump relay (RL3) is located on the PC board. It supplies power to the fuel pump. The RL3 LED on the PC board will light up when the fuel pump relay is energized.

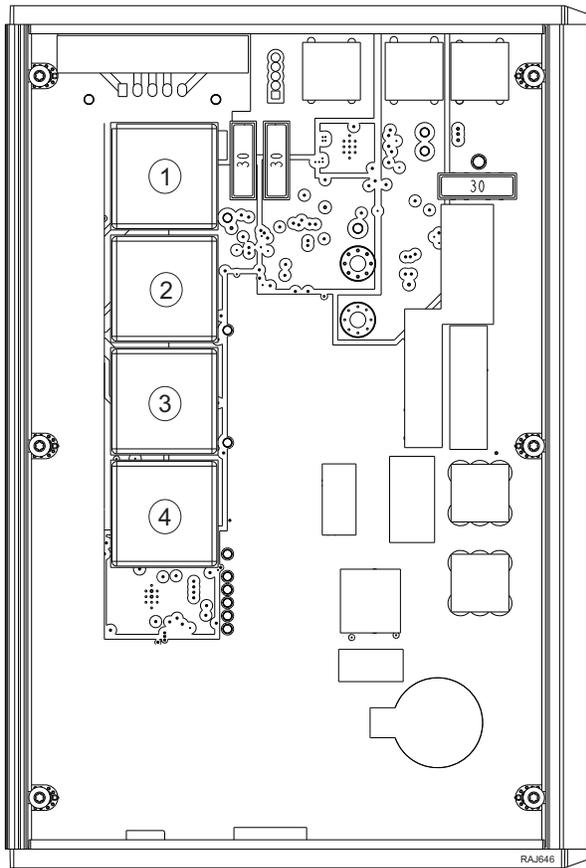
Start Relay

The start relay is mounted on the inside of the control box. It is energized by the controller after proper preheat time has occurred. When this relay energizes, the starter solenoid receives power and the engine cranks. If the start relay fails in the open position, the engine would not crank. If the relay failed in the closed position, the starter would continue to crank after the unit started.

Preheat Relay

The preheat relay is mounted on the inside of the engine compartment. It supplies power to the glow plugs. If the preheat relay fails a P code will be generated in the ECU and the controller will display a message.

Figure 8. PC Board Relays



1.	Spare Relay (If Installed)	3.	Relay RL2 - Run Relay
2.	Relay RL3 - Fuel Pump Relay	4.	Relay RL1 - Ignition Relay

Unit Wiring

Inspect the unit wiring and wire harnesses during scheduled maintenance inspections for loose, chaffed or broken wires. This will protect against unit malfunctions due to open or short circuits.

Wire Harness Routing

Do not change the factory routing of the wire harnesses inside the unit.

Glow Plugs

Glow plugs heat the combustion chambers to help the engine start in cold weather. The glow plugs are energized by the microprocessor during preheat, just before the engine is started.

A defective glow plug (burned out) can be detected by placing a clamp-on ammeter on the H wire to the glow plugs. Normal current draw during preheat is approximately 14 to 16 amps. A current draw in this range means all four glow plugs are working. If the current draw during preheat is less than this, at least one glow plug is bad.

To isolate an open circuit glow plug, remove the wires and test each glow plug individually with an ohmmeter or a jumper wire and ammeter. Each glow plug should have a resistance of approximately 2.8 ohms. The current draw for each glow plug should be approximately 4.5 amps.

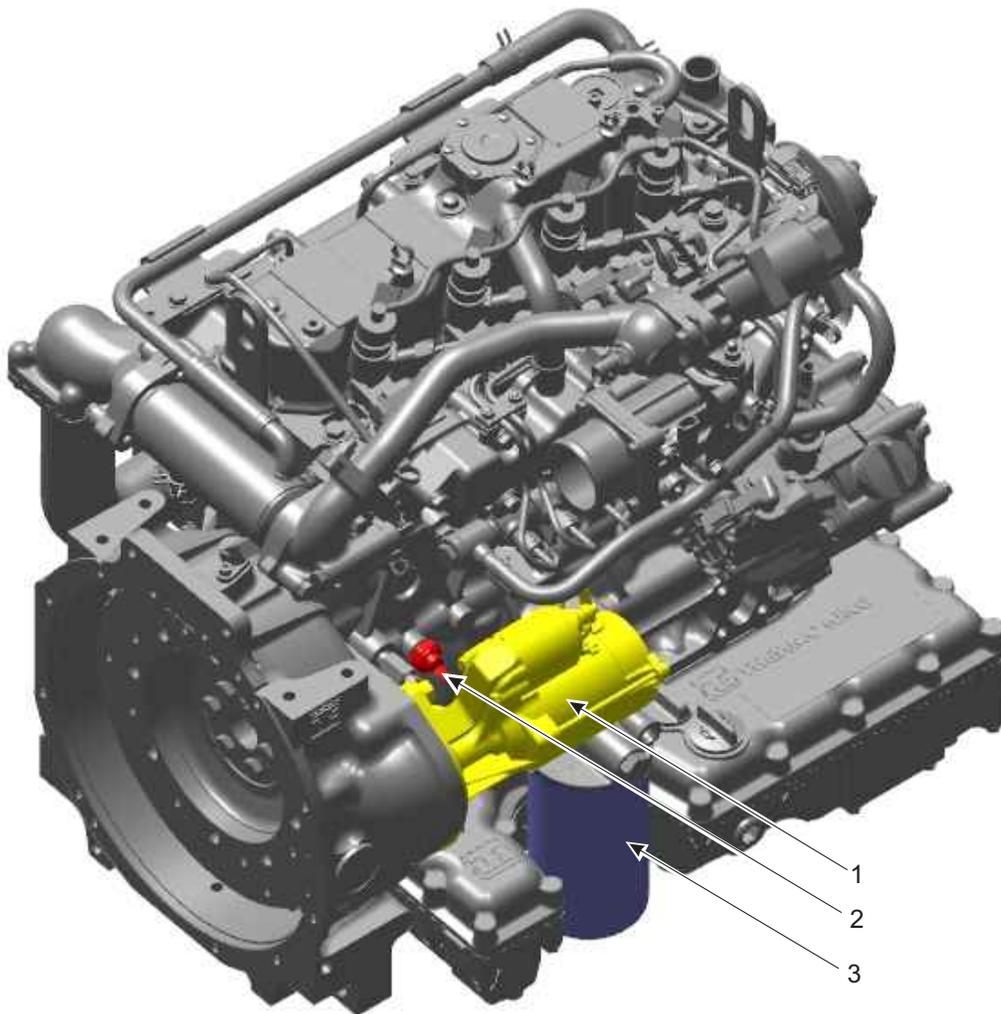
Engine Oil Sensors

Engine Low Oil Pressure Switch

Note: The engine oil pressure switch is located near the oil filter, behind the starter motor.

Engine oil pressure should rise immediately when the engine starts. This causes the oil pressure switch to open. If the oil pressure drops below 5.6 – 9.9 psig (38 – 69 kPa), the switch will close. This causes the ECU to signal a shutdown to stop the engine. A continuity tester is needed to check the oil pressure switch. To check switch continuity complete the following steps when the engine is OFF:

1. Remove wire connector from the switch.
2. Continuity tester should indicate a complete circuit between the terminal and ground.
3. Start the engine. Tester should show an open circuit between each terminal and ground. Repair consists of replacing the switch.



RAJ717

1.	Engine Starter
2.	Engine Oil Pressure Switch
3.	Oil Filter

Engine Oil Level Sensor

If the engine oil level drops below a safe level, the low oil level sensor (OLS) switch will close. This will cause the ECU to signal to shutdown to stop the engine. The oil level switch is located in the oil pan on the front side of the engine near the oil filter.



1.	Oil Level Switch Location
----	---------------------------

Switch Test:

1. Turn the unit ON/OFF switch to the "OFF" position.
2. Disconnect the switch wires from the main wire harness.
3. Connect a continuity tester to the two sockets in the low oil level switch wire connector.
4. Check the oil level with the dipstick. Make sure that it is between the low mark and the full mark. Add oil if necessary.
5. The switch should be open and there should be no continuity between the switch wires. (When the oil level is between the low mark and the full mark on the dipstick).

Bench test the switch if there is continuity between the OLS and CH wires and there are no short circuits in the wires.

Switch Removal and Installation:

1. Disconnect the switch wires from the main wire harness before removing the switch.
2. Remove the screw-in style switch by carefully turning it out of the oil pan with a wrench.
3. To install the screw-in style switch, first lubricate the O-ring on the switch with engine oil. Then screw the switch into the oil pan.
4. Connect the switch wires to the main wire harness after installing it.

Bench Test:

1. Disconnect the switch wires from the main wire harness. Remove the switch from the oil pan.
2. Use a small container partially filled with engine oil to check the float. Make sure that it floats in engine oil and that it slides freely between the upper and lower stops.
3. Slide the float up to the upper stop. Check the continuity through the switch (between OLS and CH wires). The switch should be open.
4. Slide the float down to the lower stop. Check the continuity through the switch. The switch should be closed.
5. Replace the switch if the float sinks or does not slide freely, or if the switch does not open and close properly.

Engine Maintenance

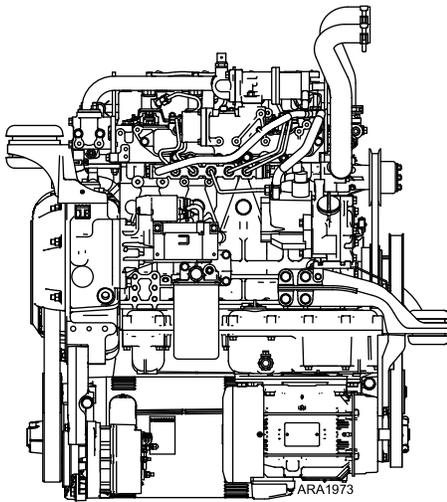
TK488CR/CRH Diesel Engine

Important: Many engine components are not interchangeable between the different engine models. See the appropriate parts manual or the EPC (Electronic Parts Catalog) to identify the correct service parts.

These units use new engines called the TK488CR/CR1 and TK488CRH/CRH1. The TK488CRH/CRH1 is the high output version and runs at higher speeds. CR stands for “Common Rail” fuel injection system, which used electronically controlled fuel injectors to reduce emissions. An Exhaust Gas Recirculation (EGR) system and Diesel Oxidation Catalyst (DOC) exhaust after-treatment system also reduce emissions so the engine is EPA Tier 4 compliant. An Engine Control Unit (ECU) monitors and controls engine operation. The unit controller indirectly monitors and controls the engine through the ECU.

Other than the fuel system, EGR, and DOC, the TK488CR/ CR1/CRH/CRH1 engine is mechanically similar to the TK486. The bore of the TK488CR/CR1/CRH/CRH1 is 88 mm versus 86 mm for the TK486, so the displacement for the TK488CR/CR1/CRH/CRH1 is 2.2 liters versus 2.1 liters for the TK486.

Figure 9. TK488CR/CRH



TK488CR/CRH Engine Service

Refer to the Yanmar TNV Series Engine Service Manual (TK 55584) for engine service information not included in this manual.

Connect a PC with the Yanmar Smart Assist Direct (YSAD) diagnostic tool to the ECU to view the Yanmar engine Diagnostic Trouble Codes (DTC) and troubleshoot engine problems.

Engine Lubrication System

The TK488CR/CR1 engine uses a pressure lubrication system similar to the that in the TK486.

Engine Oil Change

The engine oil should be changed according to the Maintenance Inspection Schedule.

1. Drain the oil only when the engine is hot to verify that all the oil drains out.
2. When changing oil, keep unit and trailer level so all the oil can flow from the oil pan.

Note: It is important to get as much of the oil out as possible because most of the dirt particles are contained in the last smallest quantity of oil that drains out of the pan.

3. Refill the pan with oil and check the dipstick level. The new oil filter must also be filled with oil before it is installed, therefore use a total of approximately to fill the oil filter and refill the pan.
4. Run the unit, and recheck the oil level.
5. The engine oil level should be at the FULL mark with the dipstick turned (threaded) into the oil pan. Never overfill.
6. See Specifications for correct type of oil.

Oil Filter Change

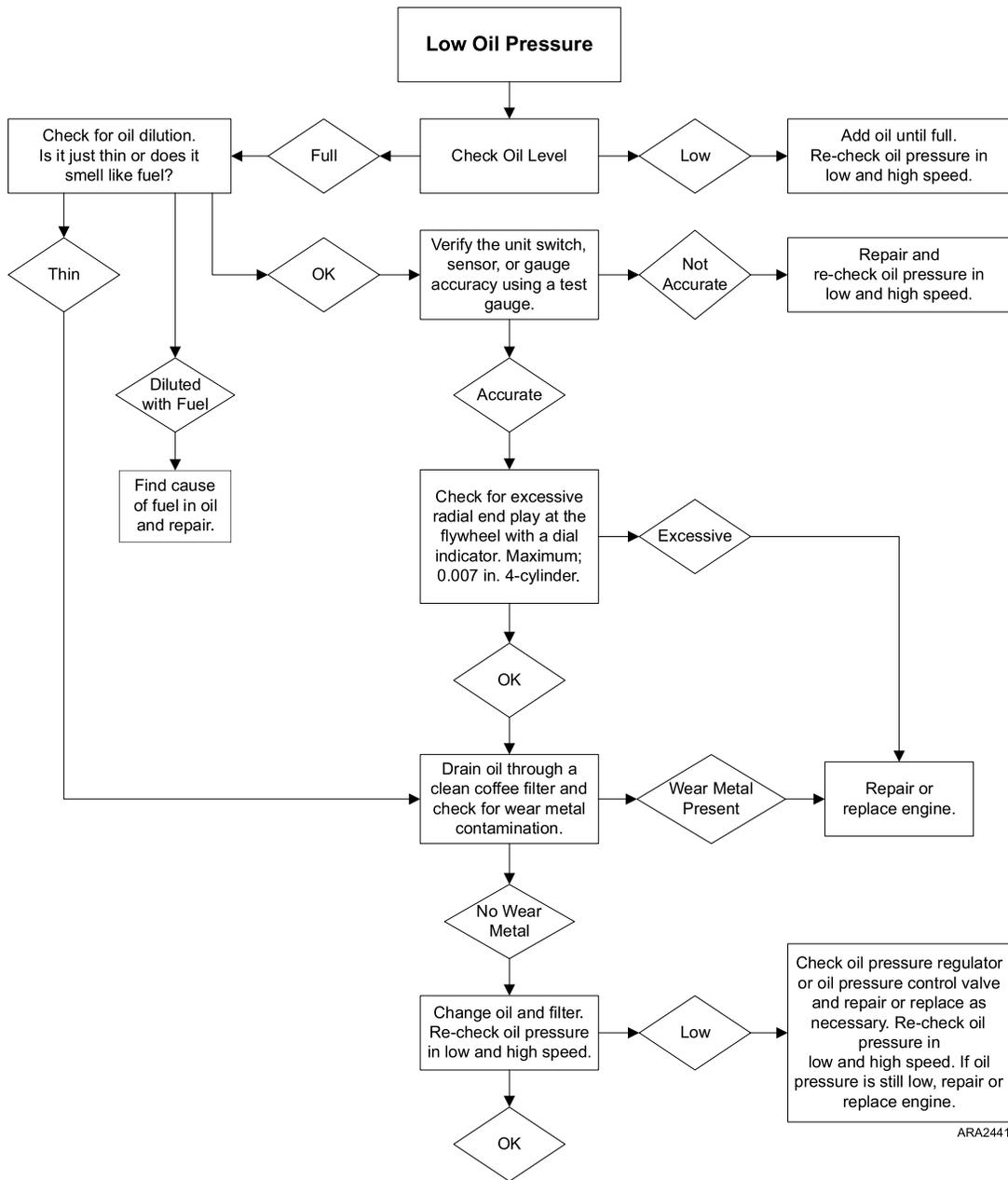
The oil filter should be changed along with the engine oil. Use a genuine Thermo King extended maintenance oil filter.

1. Remove the filter.
2. Fill the new oil filter with clean engine oil.
3. Apply oil to the two inner O-rings of the new filter and install the filter.
4. Hand tighten the filter until it seats firmly. The exposed dust seal ring, if equipped, does not need to be compressed.
5. Start the unit and check for leaks.

Low Oil Pressure

Oil pressure is affected by oil temperature, oil viscosity, and engine speed.

- Low oil pressure can usually be traced to the lack of oil, a faulty oil pressure regulating valve, or worn bearings.
- Low oil pressure is not normally caused by a faulty oil pump.
- Use the "Low Oil Pressure Flow Chart" (Figure 10, p. 132) to help diagnose low oil pressure.

Figure 10. Low Oil Pressure Flow Chart


ARA2441

Engine Cooling System

The engine employs a closed, circulating type, pressurized cooling system. Correct engine temperatures are controlled and maintained by a radiator, fan, and thermostat. The coolant is circulated through the system by a belt driven centrifugal pump. The pump draws the coolant from the side of the radiator, circulates it through the cylinder block and head and returns it to the radiator. A thermostat mounted in the coolant outlet line from the cylinder head to the radiator automatically maintains coolant temperature within the specified temperature range.

All water cooled engines are shipped from the factory with a 50 percent permanent type antifreeze concentrate and 50 percent water mixture in the engine cooling system.

This provides the following:

1. Prevents freezing down to -30 F (-34 C).
2. Retards rust and mineral scale that can cause engine overheating.
3. Retards corrosion (acid) that can attack accumulator tanks, water tubes, radiators, and core plugs.
4. Provides lubrication for the water pump seal.

Extended Life Coolant (ELC)

Chevron/DeLo XLC is currently the only Extended Life Coolant approved by Thermo King for use in these units for five years or 12,000 hours:

NOTICE

System Contamination!

Do not add other types of coolant to cooling systems using Chevron/DeLo XLC except in an emergency. If another type of coolant is added, the coolant must be changed to Chevron/DeLo XLC when available.

Note: The use of 50/50 percent pre-mixed Extended Life Coolant (ELC) is recommended to assure that de-ionized water is being used. If 100 percent full strength concentrate is used, de-ionized or distilled water is recommended over tap water to insure the integrity of the cooling system is maintained.

Antifreeze Maintenance Procedure

As with all equipment containing antifreeze, periodic inspection on a regular basis is required to verify the condition of the antifreeze. Inhibitors become worn out and must be replaced by changing the antifreeze. Change ELC (red) engine coolant every five years or 12,000 hours (whichever occurs first).

Do not mix green or blue-green engine coolant with ELC (red) engine coolant. See "Extended Life Coolant (ELC)" for more information about ELC.

The factory recommends the use of a 50/50 antifreeze mixture in all units even if they are not exposed to freezing temperatures. This antifreeze mixture will provide the required corrosion protection and lubrication for the water pump.

Checking the Antifreeze

Check the solution concentration by using a temperature compensated antifreeze hydrometer or a refractometer (P/N 204-754) designed for testing antifreeze. Maintain a minimum of 50 percent permanent type antifreeze concentrate and 50 percent water solution to provide protection to -30 F (-34 C). Do not mix antifreeze stronger than 68 percent permanent type coolant concentrate and 32 percent water for use in extreme temperatures.

Changing the Antifreeze

1. Run the engine until it is up to its normal operating temperature. Stop the unit.

▲ CAUTION

Risk of Injury!

Avoid direct contact with hot coolant.

2. Open the engine block drain and completely drain the coolant. Observe the coolant color. If the coolant is dirty, proceed with steps a, b, and c. Otherwise proceed to step 3.
 - a. Run clear water into the radiator and allow it to drain out of the block until it is clear.
 - b. Close the block drain and install a commercially available radiator and block flushing agent, and operate the unit in accordance with instructions of the flushing agent manufacturer.

⚠ CAUTION**Risk of Injury!**

Avoid direct contact with hot coolant.

- c. Open the engine block drain to drain the water and flushing solution.
3. Inspect all hoses for deterioration and hose clamp tightness. Replace if necessary.
4. Inspect the radiator cap. Replace the cap if the gasket shows any signs of deterioration.
5. If using ELC concentrate, mix one gallon of ELC concentrate and one gallon of de-ionized or distilled water in a container to make a 50/50 mixture (Do not add antifreeze and then water to the unit. This procedure may not give a true 50/50 mixture because the exact cooling system capacity may not always be known).
6. Refill the radiator with the 50/50 antifreeze mixture and verify to bleed the air from the cooling system as needed.

Bleeding Air from the Cooling System**NOTICE****Equipment Damage!**

Do not start the engine without bleeding the air out of the block.

Important: If an engine runs with air trapped in the block, the engine may be damaged. The high water temperature switch may not protect an engine that has air trapped in the block, because the high water temperature switch is designed to protect an engine from overheating due to failures in the cooling system.

1. Remove the plug (1) from the front end of the water pump below the thermostat housing as shown ().

Figure 11. Side Mount Units (Cover Removed)

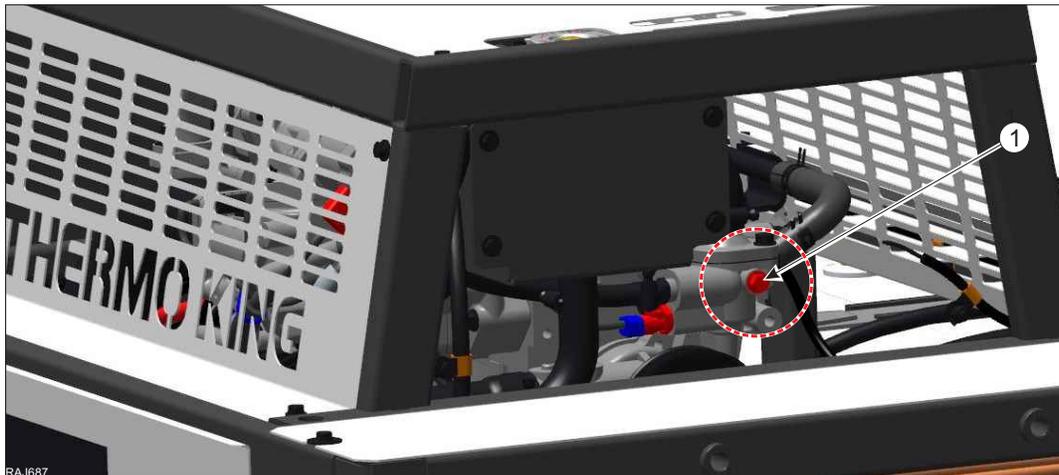
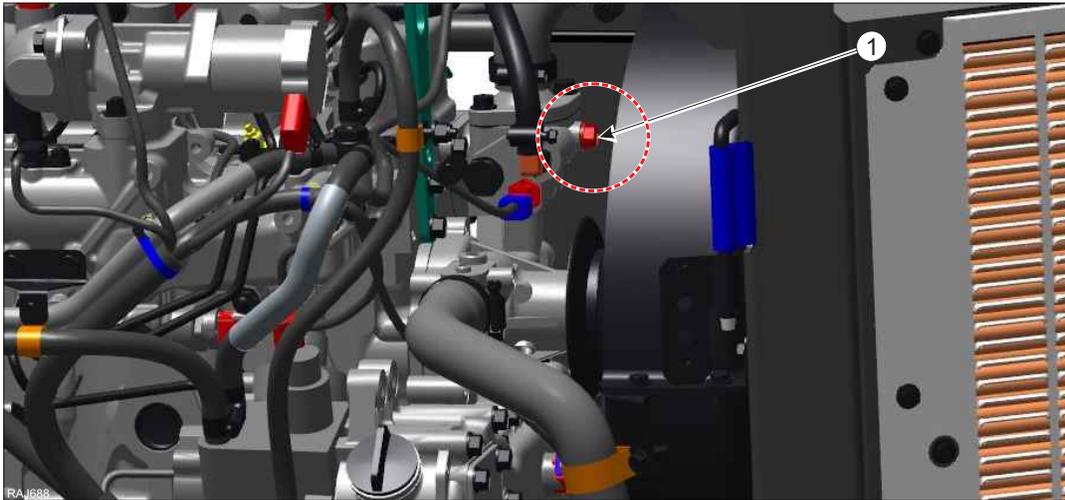


Figure 12. Under Mount Units (Right Side Door Open)



1.	Plug
----	------

2. Slowly pour the coolant into the system until you see coolant at the plug fitting.
3. Reinstall the plug.
4. Pour coolant into the system until it appears to be full.
5. Verify that the amount of coolant that goes back into the system is approximately equal to the amount of coolant that came out of the system.
6. Start the engine and monitor the coolant temperature with the unit engine coolant temperature gauge, or by using a non-contact thermometer pointed at the thermostat housing in the location of the high water temperature switch or sensor.
 - a. When the temperature reaches 150 F (66 C), shut the engine off for two minutes.

Note: This allows time for the thermostat to heat soak and open fully, ensuring that any remaining air will be purged out of the engine block when the engine is restarted.
7. Restart the engine and run it in low speed.
 - a. Remove the cap from the expansion tank and slowly pour coolant into expansion tank until it is full, then reinstall the expansion tank cap.
8. Repeat steps 6 and 7 until the coolant level stabilizes.

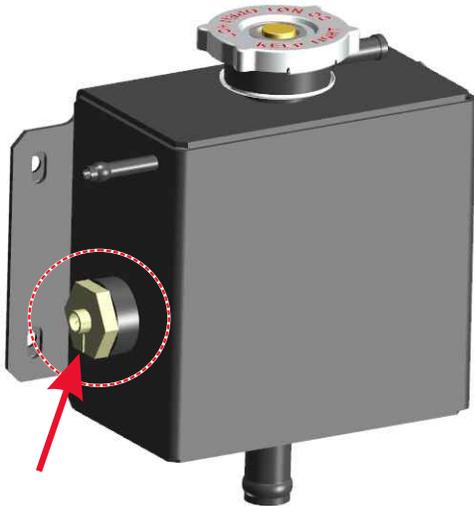
Engine Thermostat

For the best engine operation, use a thermostat year-round.

Coolant Level Switch

The coolant level switch is a float and needs to be positioned correctly. The notch needs to be in the **6 o'clock position** when mounted in the tank.

The metal degas tank uses a reed type coolant level switch. The coolant level switch senses the position of the magnetic float inside the tank. When the coolant level is above the switch, the float is in the upper position and the switch is closed. When the coolant level is below the switch, the float is in the lower position and the switch is open.



RAJ711

Testing the Coolant Level Switch

Testing the switch in the unit is accomplished by adjusting the coolant level or alternatively by removing the expansion tank from the unit, then flipping the tank upside down or right side up (depending on the step from the procedure below).

1. Remove the wire harness connector from the coolant level switch.
2. Use an ohmmeter to check the continuity of the switch at the connection pins.
3. Verify the coolant level is above the switch and check the continuity of the switch. The switch should be closed. If the tank was removed from the unit, accomplish this check with the tank upside down.
4. Drain coolant from the expansion tank until the coolant level is well below the switch level and check continuity of the switch. The switch should be open. If the tank was removed from the unit, accomplish this check with the tank right side up.
5. Replace the switch if it does not close in step 3 and does not open in step 4.

Checking the Float

The float is made of polypropylene foam. It is unlikely that the float would fail unless it sticks inside the tank so it cannot move.

1. Verify the coolant level is above the float.
2. Slowly drain coolant from the expansion tank and watch the float. The float should drop with the coolant level.
3. If the float did not drop with the coolant level, remove the expansion tank from the unit.
4. Flip the expansion tank upside down and right side up to see if the float moves inside the expansion tank. Replace the expansion tank with a new one if the float is stuck or does not move with the coolant level.

Replacing the Coolant Level Switch

1. Disconnect the wire harness connector from the coolant level switch.
2. Unscrew the coolant level switch to loosen it and remove it from the tank.
3. Place the new coolant level switch in the tank. Tighten the switch so the slot is at the **6 o'clock position**.
4. Connect the wire harness connector to the coolant level switch.

Engine Fuel System

The TK488CR/CR1 engines use a common rail fuel system.

The components of the fuel system are:

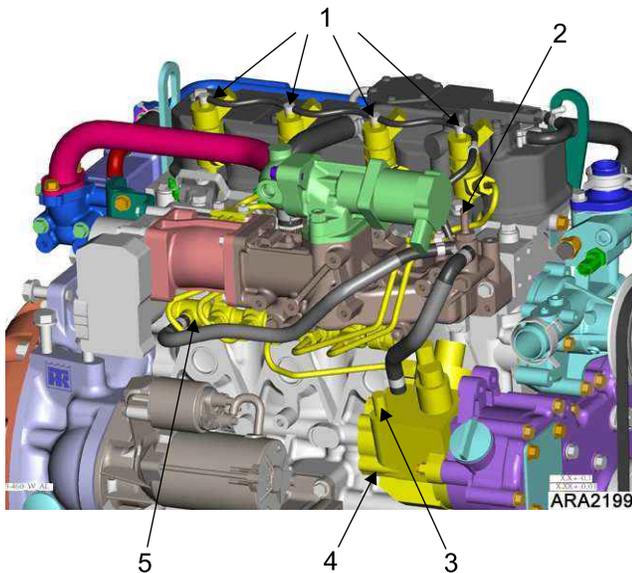
- Fuel tank
- Electric fuel pump (with pre-filter, 40 micron)
- Primary Fuel filter/water separator (5 micron)
- Secondary fuel filter (3 micron)
- High pressure fuel pump
- Common (high pressure fuel) rail
- Electronic injection nozzles

Operation

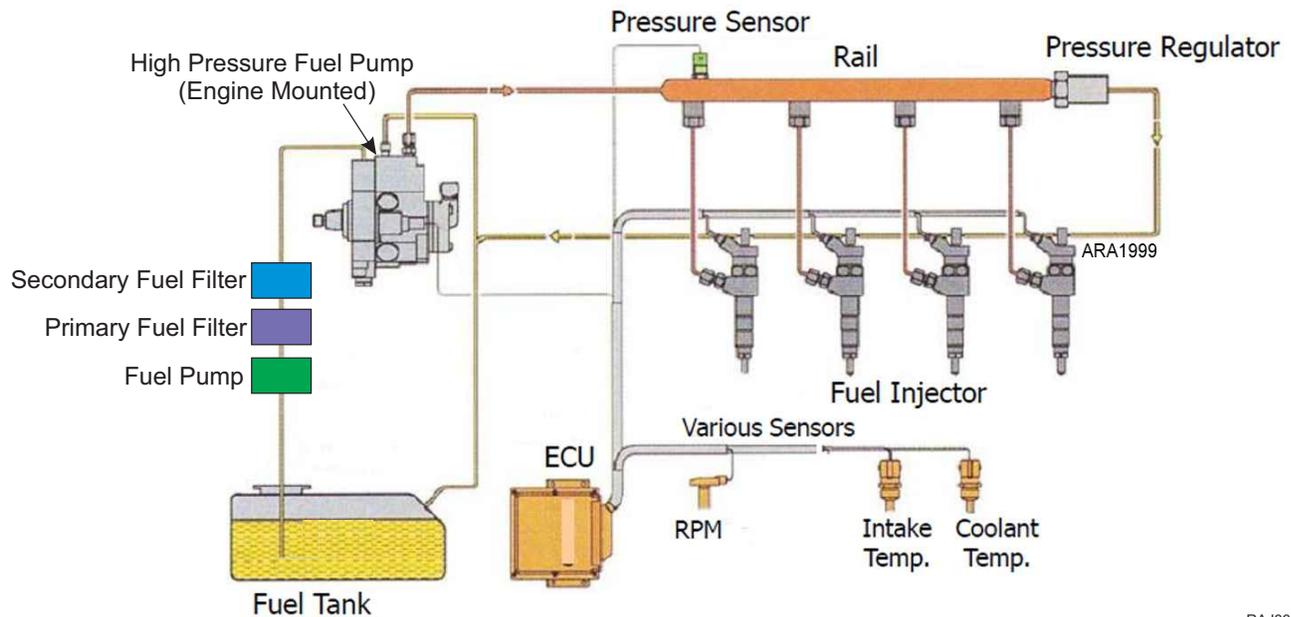
Fuel is drawn from the fuel tank by the electric fuel pump, which pushes fuel to the fuel filter/water separator. Filtered fuel passes through a line from the outlet fitting on the filter base to the high pressure fuel pump.

The high pressure fuel pump supplies high pressure fuel to the common rail. The common rail acts as a reservoir for the high pressure fuel and supplies the high pressure fuel to the electronic injection nozzles, which inject fuel when energized by the ECU. The ECU monitors multiple sensors to determine the timing and duration of the fuel injection pulses.

Figure 13. TK488CR / TK488CRH Engines: Fuel Injection Components on Engine



1.	Electronic Injection Nozzles
2.	Return Fuel Port
3.	Supply Fuel Port
4.	High Pressure Fuel Pump (Fuel Supply Pump)
5.	Common Rail



RAJ830

Fuel Line Routing

The fuel lines from the fuel tank connect to fittings on the electric fuel pump and the fuel filter. Do not change the factory routing of the fuel lines from the electric fuel pump to the fuel filter or from the fuel filter to the high pressure fuel pump.

Fuel System Fittings

Important: Using the wrong fuel system fittings may void your engine warranty! All Thermo King supplied fuel line fittings (except fuel line connector) are nickel plated brass.

DO NOT use fuel fittings (main body) made of brass, copper, zinc, zinc plated or galvanized steel where it would make direct contact with flowing diesel fuel. Diesel fuel flowing through these types of fittings allows those metals to leach into the fuel forming deposits on the injector tips which fouls them prematurely.

Fuel fitting nuts, compression sleeves, and fuel line connectors made of brass are acceptable because diesel fuel does not flow across their surfaces.

Do not use PTFE (Polytetrafluoroethylene) thread sealing tape. PTFE tape may allow strands into the fuel system that could plug up the tight clearance fuel injectors causing failures.

Maintenance

Important: *It is extremely important to keep the fuel system clean while servicing components.*

Contamination is the most common cause of fuel system problems. To ensure best operating results, the fuel must be clean and fuel tanks free of contaminants. Change the fuel filter/water separator regularly and inspect/clean the electric fuel pump filter.

Important: *Do not open the fuel system unless required.*

Whenever the fuel system is opened, take the following precautions to prevent dirt from entering the system:

- Cap all fuel lines.
- Work in a relatively clean area whenever possible.
- Complete the work in the shortest possible time.

The following procedures can be accomplished under field conditions:

- Bleeding air from the fuel system.
- Fuel tank and filter system maintenance.
- Electric fuel pump replacement or repair.
- High pressure fuel pump replacement or repair.
- Injection line replacement.
- Common (high pressure fuel) rail replacement.
- Electronic injection nozzles replacement.

Draining Water from Fuel Tank

Water run through the system may damage the fuel injection system components. Damage to the fuel injection system will subsequently cause more expensive damage to the engine. A large accumulation of water in the bottom of the fuel tank will stop a diesel engine. Water should be drained during scheduled maintenance inspections to prevent breakdowns. Drain the water after the fuel tank and unit have remained idle for an hour.

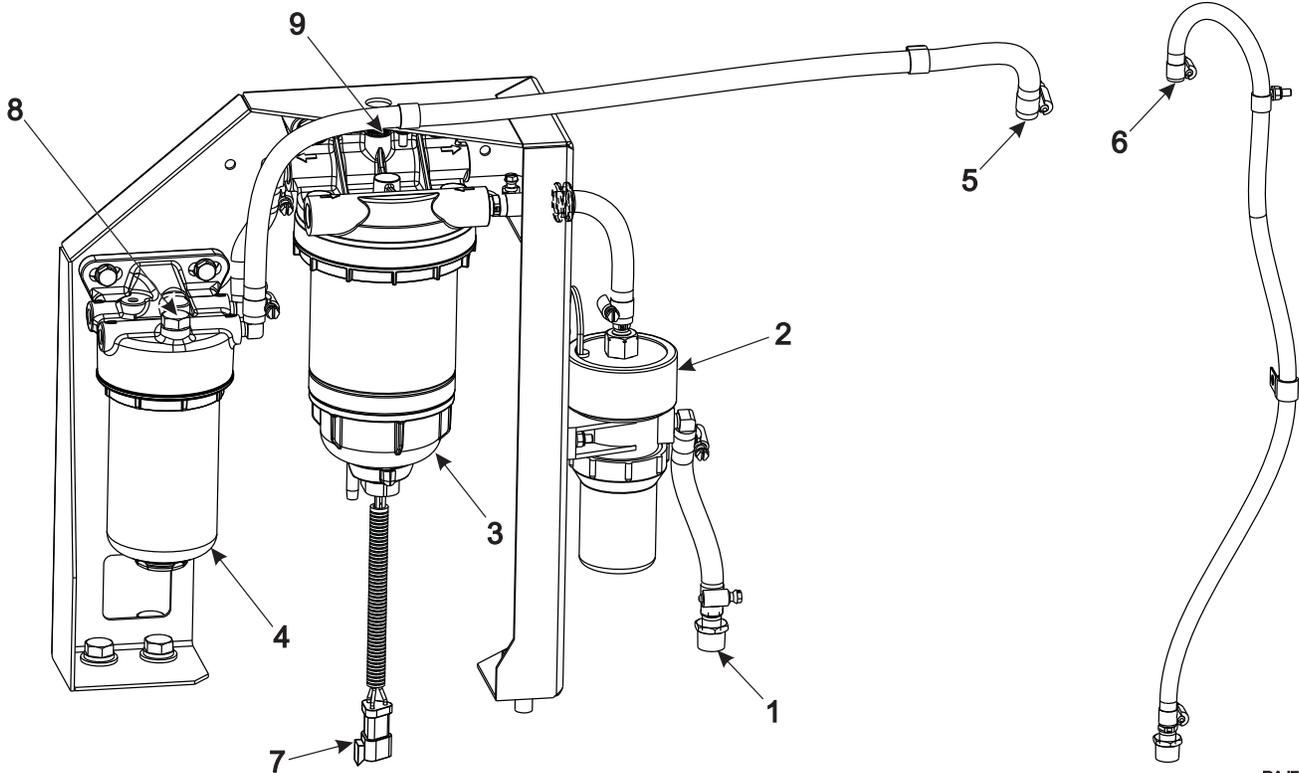
1. Place a container under the fuel tank to catch the draining water and fuel.
2. Remove the drain plug from the bottom of the fuel tank.

Note: *Some fuel tanks have a check valve in the drain plug fitting. Push the check valve open with a small screwdriver to drain the tank.*

3. Let the water and fuel drain into the container until no water is visible in the fuel draining from the tank.
 - a. If the water and fuel do not drain freely, the vent may be plugged. If so, clean or replace the vent.
4. Install the drain plug.

Fuel System Diagrams

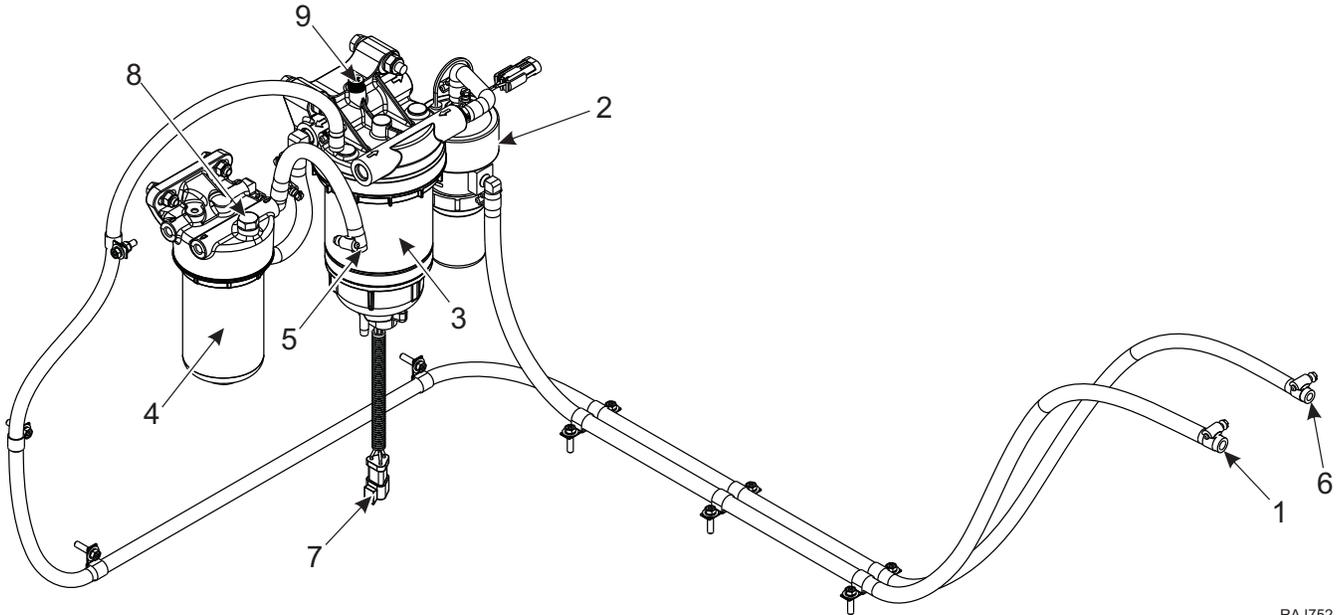
SGCO 5000 Unit Fuel System



RAJ753

1.	Fuel Inlet From Fuel Tank to Fuel Pump	6.	Fuel Return to Tank
2.	Fuel Pump	7.	Fuel Water Level Sensor Connector
3.	Primary Fuel Filter / Water Separator / Water Level Sensor	8.	Fuel System Bleed Screw
4.	Secondary Fuel Filter	9.	Fuel System Bleed Screw
5.	Fuel Outlet to Engine		

SGUM 5000 Unit Fuel System



RAJ752

1.	Fuel Inlet From Fuel Tank to Fuel Pump	6.	Fuel Return to Tank
2.	Fuel Pump	7.	Fuel Water Level Sensor Connector
3.	Primary Fuel Filter / Water Separator / Water Level Sensor	8.	Fuel System Bleed Screw
4.	Secondary Fuel Filter	9.	Fuel System Bleed Screw
5.	Fuel Outlet to Engine		

Fuel Filter/Water Separator

The fuel filter/water separator filters the fuel, and removes water from the fuel. Water will not be returned to the fuel tank, it will be collected in the fuel separator bowl and must be drained daily.

Fuel Filter and Water Separator Service

Replace the fuel filter/water separator at intervals according to the Maintenance Inspection Schedule.

Important: Replace the primary and secondary filters as a pair. Do not replace just one filter.

Primary Fuel Filter / Water Separator

Removal

1. Turn the unit OFF and disconnect the negative battery terminal to ensure unit cannot be operated.
2. Unscrew the water level sensor (5) 1/4 - 1/2 turn and drain the fuel into a suitable container. Dispose of the drained fuel according to local regulations.

Note: A hose can be attached to the water level sensor fitting (6) to help drain the bowl.

3. Remove the water level sensor (5) from the fuel filter bowl (4). Inspect the gasket and replace if necessary.
4. Unscrew and remove the fuel filter bowl (4). Inspect the O-ring and float and replace if necessary.
5. Unscrew the and remove the fuel filter (3). Discard the fuel filter according to local regulations.
6. Clean the water level sensor, filter bowl and filter head.

Installation

7. Lubricate the new fuel filter O-ring with clean engine oil.
8. Install the new fuel filter into the filter head and hand tighten. Then tighten the filter to specification: **27 Nm (20 ft-lbs)**.

Important: A filter wrench can only be used on black plastic filter ring, NOT on the filter body.

9. Lubricate the fuel filter bowl O-ring with clean engine oil.
10. Install the fuel filter bowl onto the new fuel filter and hand tighten. Then tighten the filter bowl to specification: **27 Nm (20 ft-lbs)**.
11. Install the water level sensor onto the bowl and hand tighten. Then tighten to specification: **7 Nm (5 ft-lbs)**.

Important: Do not pre-fill the fuel filter or bowl.

12. Replace the secondary fuel filter, then prime the fuel system as shown in this chapter.



1.	Bleed Screw	4.	Fuel Filter Bowl Assembly
2.	Filter Head	5.	Water Level Sensor
3.	Fuel Filter Assembly	6.	Water Level Sensor Fitting

Secondary Fuel Filter

Removal

1. Turn the unit OFF and disconnect the negative battery terminal to ensure unit cannot be operated.
2. Place a suitable drain pan under the fuel filter.

Important: ONLY use a filter wrench on the black plastic threaded ring to loosen the filter. DO NOT grab the filter body with a filter wrench or strap wrench.

3. Use a filter wrench on the black threaded ring to unscrew the filter 1 - 2 turns. Drain the fuel from the filter head into a suitable container.
4. Remove the filter from the filter head (3). Dispose of fuel and filter according to local regulations.
5. Clean the filter head.

Installation

Important: Do not pre-fill the fuel filter.

6. Lubricate the new fuel filter O-ring with clean engine oil.
7. Install the new fuel filter into the filter head and **hand tighten** until the fuel filter contacts the filter head.

Important: Do not use a filter wrench to install fuel filter - hand tighten only.

8. Prime the fuel system as shown in this chapter.

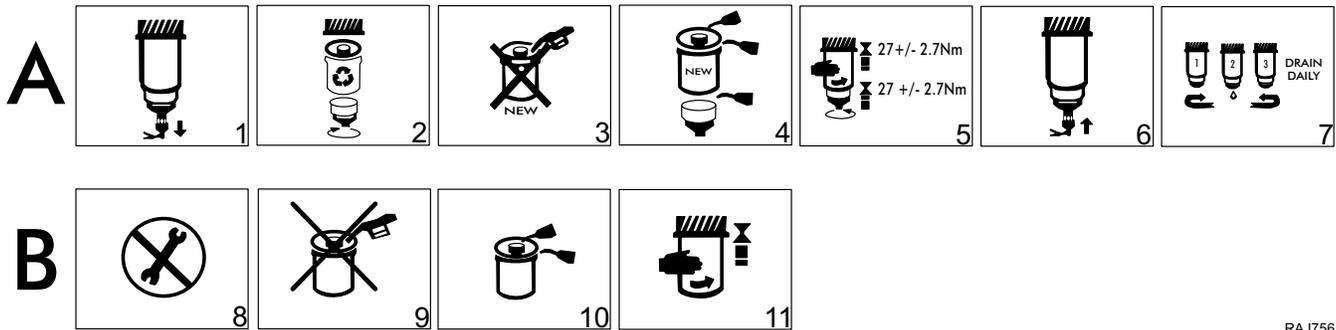


RAJ755

1.	Bleed Screw	3.	Filter Threaded Ring - Use to loosen filter with filter wrench
2.	Filter Head	4.	Fuel Filter Body - DO NOT use filter wrench on filter body

Filter Icon Identification

The icons shown below are located on the fuel filter label. Use the table below for label identification.



RAJ756

Primary Filter (A)		Secondary Filter (B)	
1.	Drain Bowl /Remove Water Sensor	8.	Do Not Use Tools for Service
2.	Remove Filter Bowl and Filter	9.	Do not Pre-Fill New Filter
3.	Do not Pre-Fill New Filter	10.	Lubricate O-rings and Threads with Fresh Engine Oil
4.	Lubricate O-rings and Threads with Fresh Engine Oil	11.	Hand Tighten Filter Until Filter Contacts Filter Head
5.	Filter and Bowl Torque Specification		
6.	Install Bowl Drain / Water Sensor		
7.	Drain Water Daily		

Electric Fuel Pump

Operation

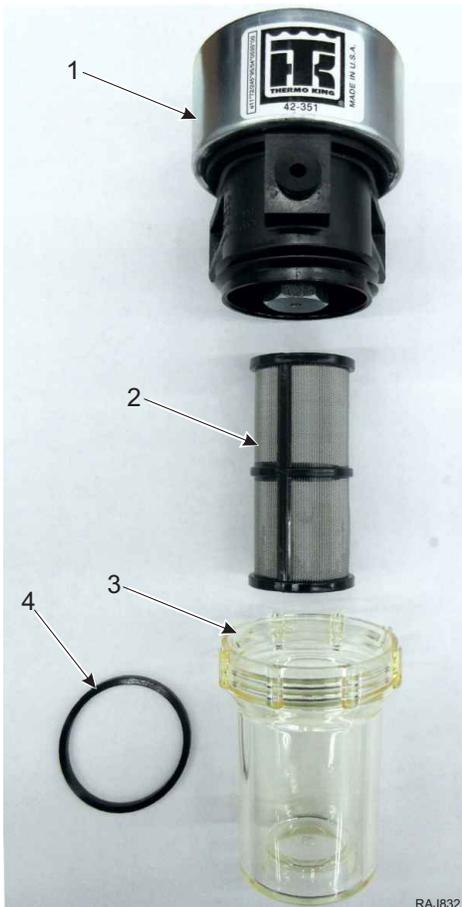
The electric fuel pump is mounted in the engine compartment. This pump is designed to push fuel rather than pull fuel. Make sure the GND wire completes a good ground with the battery. Check the voltage at the FP wire in the harness. The pump will not operate at less than 9 Vdc. The pump is self priming.

Maintenance

The fuel pump filter should be cleaned whenever the oil is changed. The filter and gasket are replaceable but the pump cannot be repaired. It must be replaced if it is defective.

Disassembly

1. Unscrew and remove the fuel filter bowl.
2. Remove the fuel filter.
3. Wash the fuel filter in cleaning solvent and blow out the dirt and cleaning solvent with compressed air.
4. Clean the fuel filter bowl.
5. Check the fuel filter bowl gasket and replace if necessary.



1.	Pump Housing	3.	Fuel Filter Bowl
2.	Fuel Filter	4.	Fuel Filter Bowl Gasket

Assembly

1. Install the fuel filter up into the pump housing.
2. Place the fuel filter bowl gasket in place on the bowl.
3. Install the bowl onto the pump housing and hand tighten, or torque to 100 in-lbs (11.3 Nm).

If the pump does not operate, check for:

- A good ground on the black wire pin of the pump harness.
- More than 9 Vdc on the red wire pin of the pump harness.
- Clean and tighten the electrical connections.
- The pump voltage and polarity must be the same as the unit system.

If the pump operates but does not deliver fuel, check for:

- Air leaks in the fuel lines or connections.
- Kinks or other restrictions in the fuel lines.
- A leaking or distorted fuel bowl gasket.
- A clogged or dirty filter.

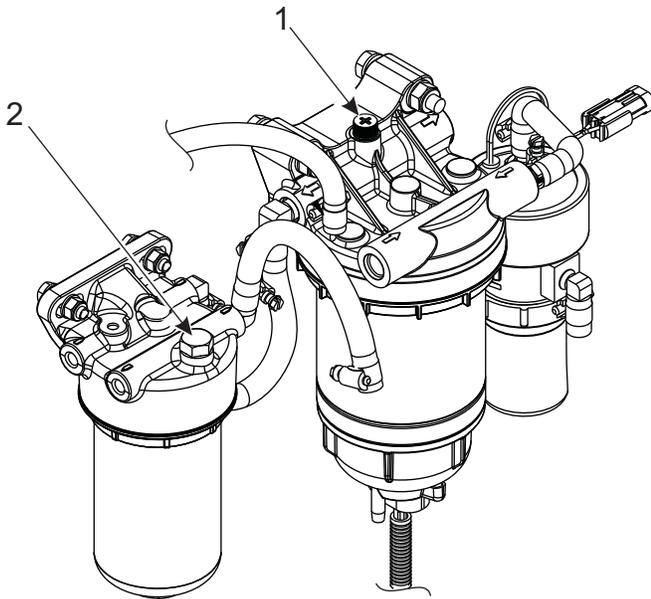
Bleeding the Fuel System

SG 5000 Series

If the engine runs out of fuel, fuel filters replaced, repairs are made to the fuel system, or air gets into the system for any other reason, air must be bled out of the fuel system to prevent interrupted unit operation or possibly severe damage to the high pressure fuel pump. Never attempt to purge air and prime the high pressure fuel pump by cranking the engine with the starter.

To bleed air from the fuel system:

1. Reconnect the battery.
2. Place a proper fuel catch pan under the primary and secondary fuel filter location.
3. Turn the unit on. **Do not allow the engine to start.**
4. From the MAIN MENU, scroll down to the COMMANDS MENU.
5. From the COMMANDS MENU, scroll down and select the FUEL PRIMING option.
6. When the electric fuel pump turns ON, open the bleed screws on the top of the primary and secondary fuel filter heads.
7. Air from the fuel system will escape through the open bleed screws. When all the air has escaped, and a constant flow of fuel is existing the open bleed screws:
 - 1 - Tighten the primary fuel filter bleed screw first (1).
 - 2 - Tighten the secondary fuel filter bleed screw second (2)



RAJ761

8. Turn the unit OFF and clean any spilled fuel. Dispose of fuel and filter according to local regulations.
9. Turn the unit ON and allow the engine to start. Observe the engine run for a few minutes. If the engine fails to start, or starts but stops in a few minutes, repeat the fuel bleeding procedure.

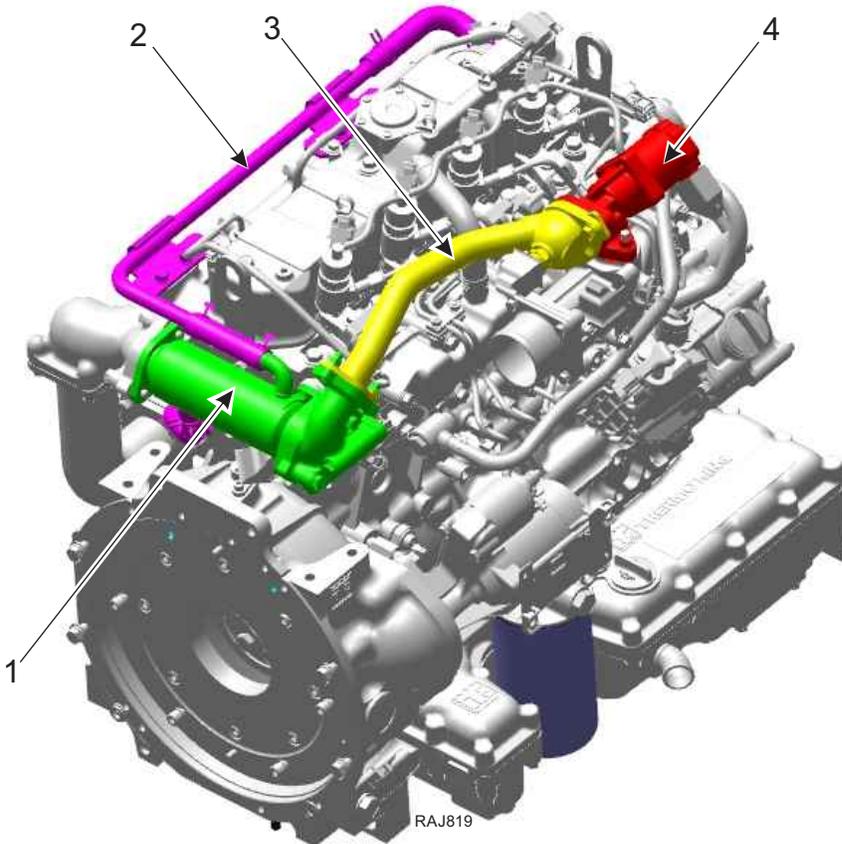
Exhaust Gas Recirculation (EGR) System

The Exhaust Gas Recirculation (EGR) system recirculates cooled exhaust gas to engine intake to reduce NOx emissions. The EGR system should be inspected and cleaned (if necessary) every 3,000 hours.

Important: Always wear appropriate Personal Protective Equipment (PPE) when cleaning the EGR system. This includes safety glasses, rubber gloves, and a respirator.

1. Remove the EGR pipe from between the EGR cooler and the EGR valve.
2. Inspect the EGR pipe and other components for carbon deposits and clean as necessary.
3. Reinstall the EGR pipe (and other components if removed) and only use new gaskets.

Figure 14. EGR Components



1.	EGR Cooler
2.	Coolant Pipe to EGR Cooler
3.	EGR Pipe
4.	EGR Valve

Cleaning EGR Valve

⚠ CAUTION

Risk of Injury!

Do not insert your finger into the space between the valve face and valve seat. The valve may close unexpectedly and injure your finger.

EGR Cleaning Information

The EGR Valve should be visually inspected and cleaned if there is an active Diagnostic Trouble Code (DTC) associated with the EGR Valve. Cleaning the EGR valve restores the initial position, relative to the valve seat, eliminates the DTC, and allows the engine to remain emissions compliant. Important Notice: Once the DTC for the EGR Valve Out of Range is active, the EGR valve is electronically disabled, and YSAD Active Control cannot be used to open a disabled valve. A disabled EGR valve must be first opened using a TK Service Parts Tool (either 2042998 or 2042980) then cleaned to remove deposits from between the valve and seat, according to the EGR Valve Cleaning Notes.

Use Active Control in YSAD to open the EGR valve after removing it from the engine as shown in the following drawing. See "Using YSAD to Connect to ECU" for more information about connecting YSAD.

Important Notes About Cleaning the EGR Valve:

- Do not dismantle the EGR valve to clean it. The valve may not function properly when reassembled.
- Do not use liquid solvent to soak the valve, or spray liquid solvent into the valve. If liquid enters the valve motor it may be damaged and will not function properly.
- Use a soft or plastic brush. Do not use a metal brush. A metal brush will scratch the valve face and valve seat, which will cause the valve to leak when fully closed. This will reduce engine performance.
- Use a soft or plastic brush to remove carbon from valve face and valve seat. Carbon deposits on the valve face and valve seat will cause the valve to leak when fully closed. This will reduce engine performance.

EGR Service Tool Kit 2042980

This EGR Service Tool Kit includes a EGR 12V Opener Tool (2042980) and a EGR Mechanical Opener Tool. These tools will aid the technician in safe and effective cleaning of the EGR valve

The EGR 12V opener tool is the primary tool recommended by Thermo King for opening the EGR valve for cleaning. This tool allows the technician to evenly drive the EGR valve open electrically while having both hands free to handle and clean the EGR assembly. The opener can be connected directly to the unit battery or to a separate 12V power source.

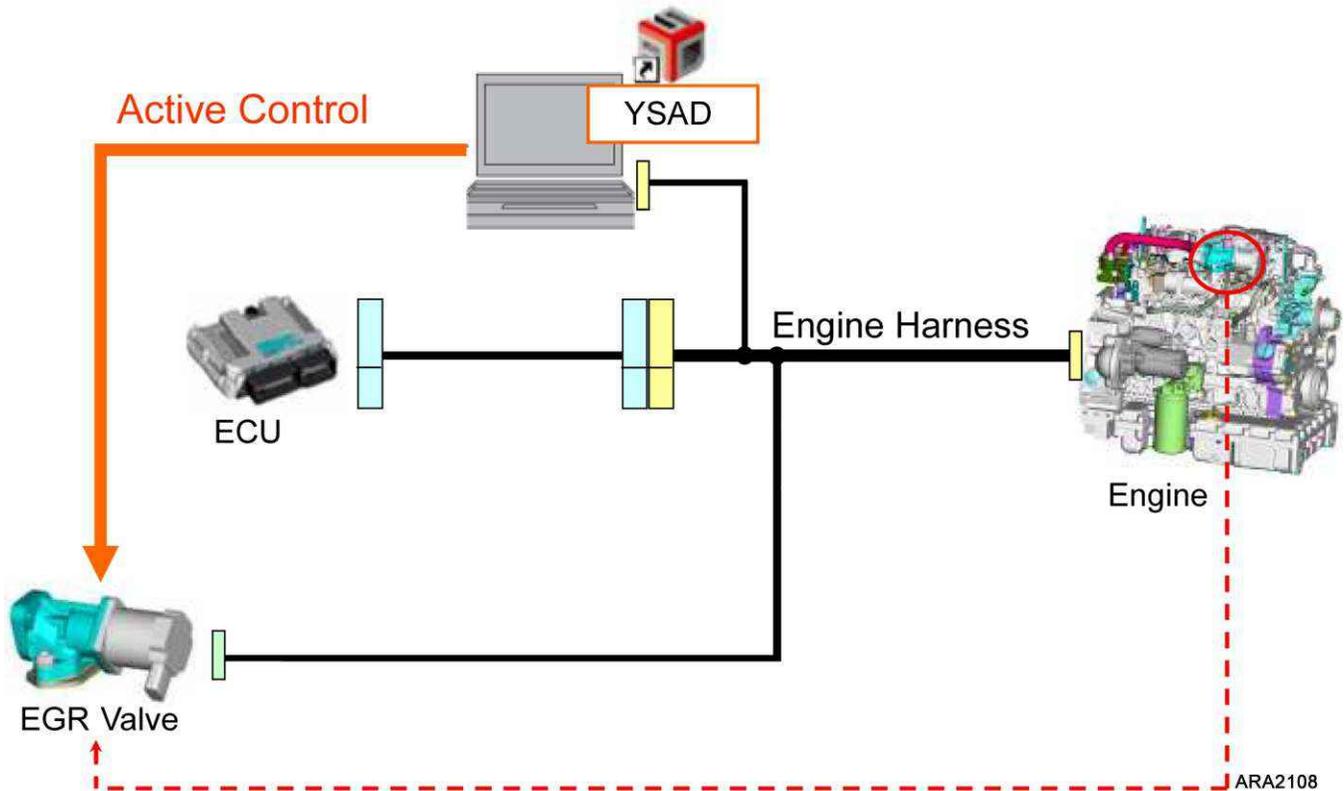
In the event the EGR valve assembly is locked up in the fault mode, the EGR mechanical tool (2042998) can be used to safely and evenly push open the EGR valve plate manually so that it may be cleaned.

Figure 15. Kit 2042980



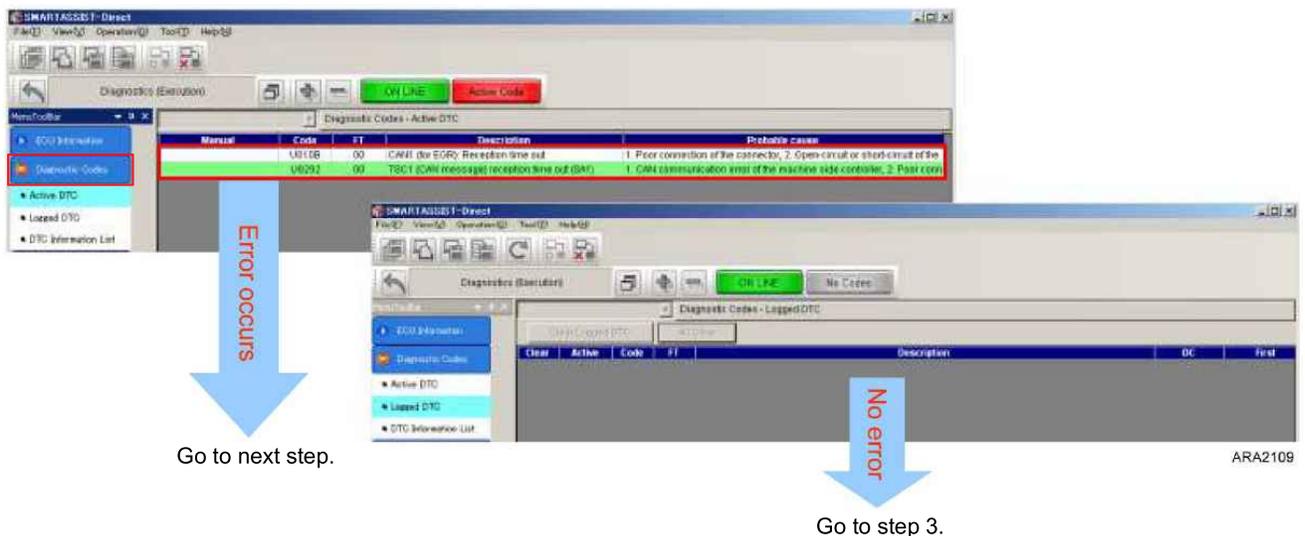
Using Active Control (YSAD) to Open EGR Valve

Figure 16. Using Active Control to Open EGR Valve



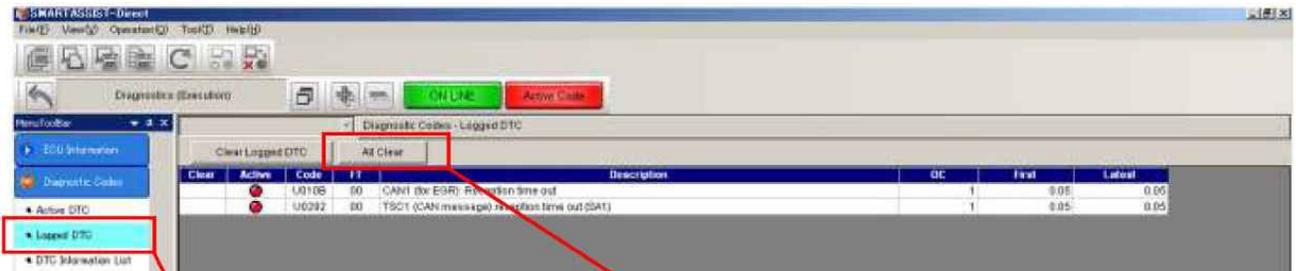
1. Attach YSAD to the ECU/engine harness.
2. Check and clear any Diagnostic Trouble Codes (DTC) as required.
 - a. Click on Diagnostic Codes to view any active DTCs.

Figure 17. Check for Active DTCs

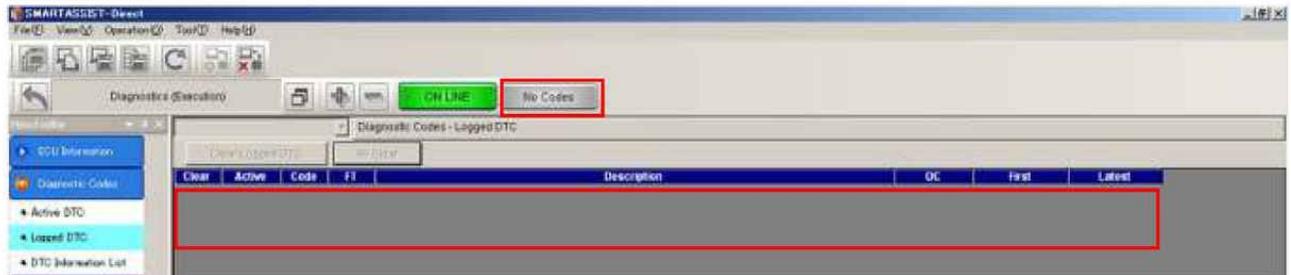


- b. Clear the active DTCs as shown below.

Figure 18. Clear Active DTCs



- (1) Click the item 「Logged DTC」 in the menu 【Diagnostic Codes】
- (2) Press the button 「All Clear」



(3) The errors disappear from the 「logged DTC」

ARA2110

3. Detach the EGR valve from the collector, but keep the EGR valve connected to the harness.
4. Use YSAD Active Control to open the EGR valve for inspection and cleaning as shown below.

Figure 19. Use YSAD Active Control to Open EGR Valve

(1) Diagnostic Test → Active Control

Maximal	Minimal	Test Status	Description	ENG Run	Measured	Desired	Unit
STOP	START	START	DIRECT EGR VALVE CONTROL	off		0	
STOP	START	START	Direct EGR Valve Test			0000	

(2) Press the [RUN] button of Direct EGR Valve Control

(3) Press the button ▲▼ to input desired value

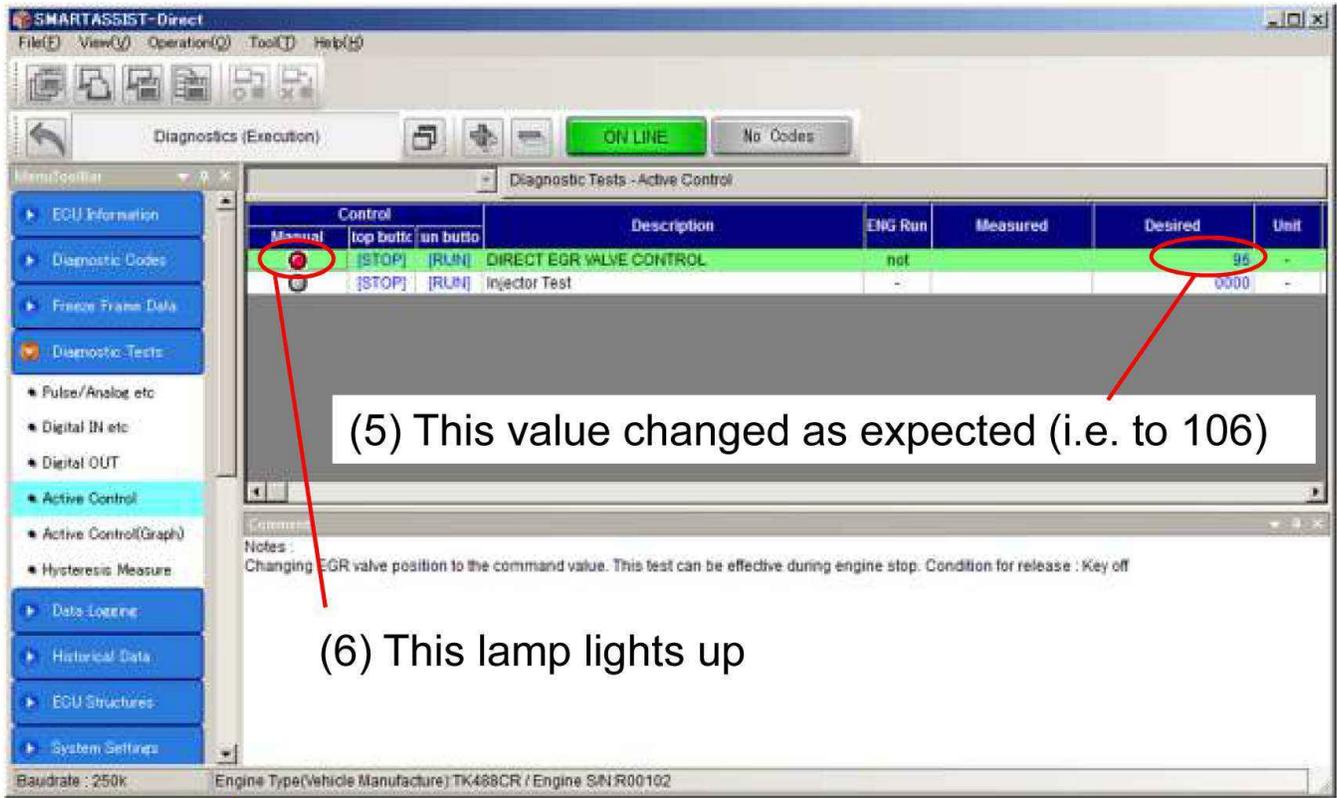
106: Full open

16: Full close

(4) Press the set button

ARA2111

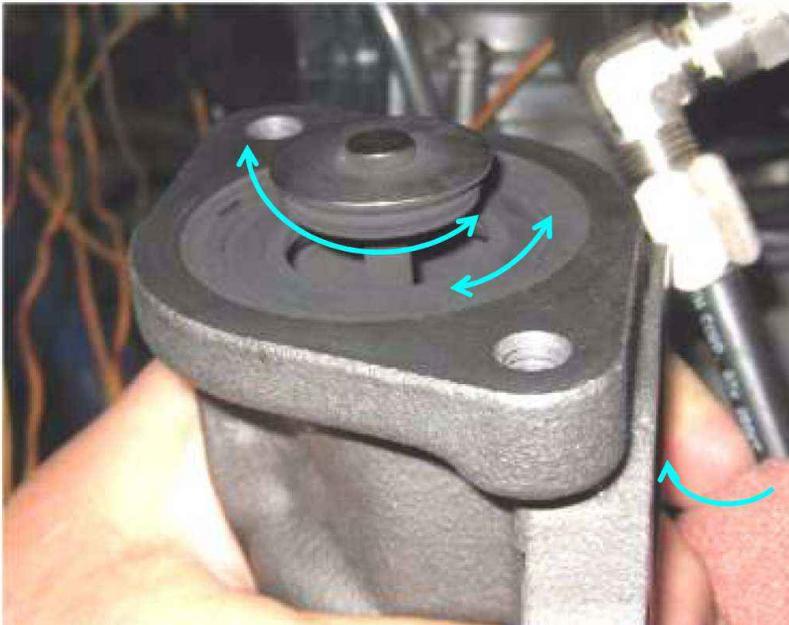
Figure 20. YSAD Showing EGR Valve Opened with Active Control



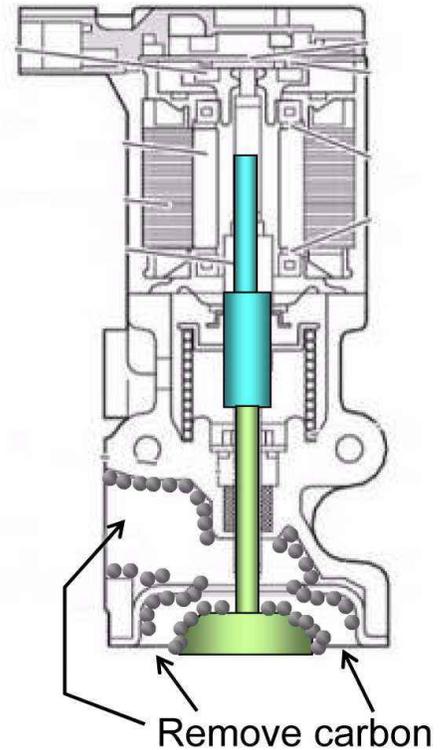
NOTE: Do not close the ERG valve during cleaning!!!

- Using a soft or plastic brush, remove stubborn deposits (e.g., carbon) from the surfaces of the EGR valve, valve seat, and housing as shown below. Do not use a metal brush or scraper or damage will result. Visually inspect the EGR valve

Figure 21. Removal of Stubborn Deposits

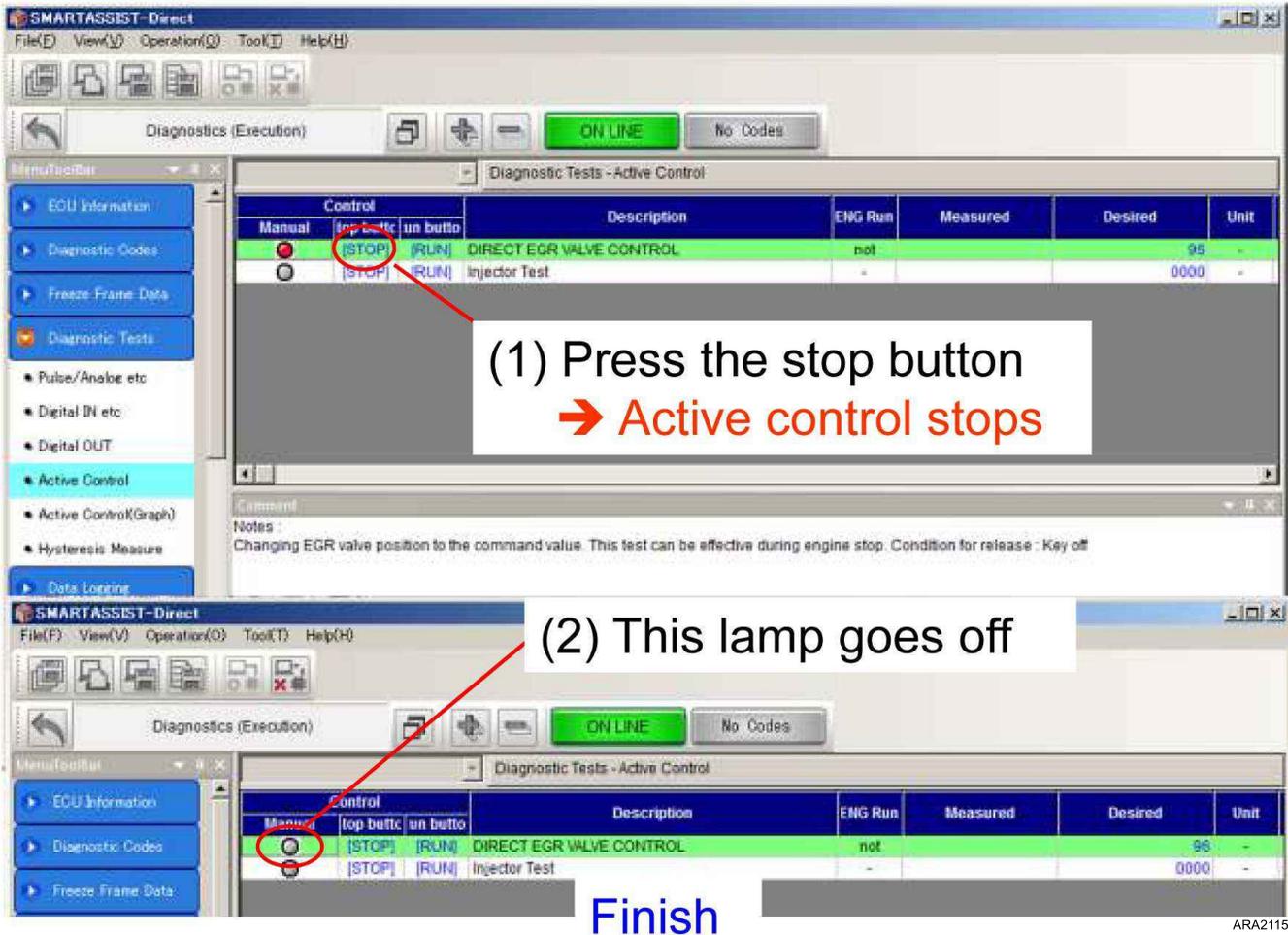


ARA2113



6. Once the deposits are removed from the EGR valve, wipe the valve and seat interface clean using a shop rag dampened with brake parts cleaner or similar solvent. Do not soak the valve guide and valve shaft interface, and do not spray the EGR valve with parts cleaner or damage will result.
7. Dry the EGR valve and return it to service by reattaching it to the collector.
8. Use YSAD to stop Active Control of the EGR valve as shown below.

Figure 22. Use YSAD to Stop Active Control of EGR Valve



ARA2115

9. Close and disconnect YSAD, and reassemble the EGR system components.

Using the EGR 12V Opener Tool (2042980)

1. Attach the 4-pin female connector to the EGR assembly.
2. Place the tool's toggle switch in the CLOSE position.
3. Connect the red positive (+) lead to a positive power source or unit battery.
4. Connect the black negative (-) lead to a negative power source or unit battery.
5. Place the toggle switch in the OPEN position. The EGR valve should open fully within 1 to 3 seconds. The EGR valve is now ready to be cleaned.



6. Use a plastic brush to remove stubborn deposits from the EGR valve, then visually inspect it. Do not use a metal brush or scraper; otherwise, damage will result.
7. Once deposits are removed from the EGR valve, wipe the valve and seat interface clean using a shop rag dampened with brake parts cleaner or similar solvent. Do not soak the valve guide and valve shaft interface, and do not spray the EGR valve with parts cleaner; otherwise, damage will result.
8. Place the tool's toggle switch in the **CLOSE** position. The EGR valve should close fully within 1 to 3 seconds.
9. Disconnect the 4-pin connector from the tool to the EGR assembly.
10. Reinstall the EGR assembly onto the engine and reconnect the 4-pin connector harness.
11. Return the unit to service.

Using the Mechanical EGR Opener Tool (2042998)

1. With the EGR valve assembly removed from the unit, insert the tool into the side opening as shown. Ensure the valve stem is perfectly centered between the opener's two pins.
2. Firmly press down on the tool handle towards the body of the EGR. This will open the EGR to allow for cleaning.

Note: *NOTE: The EGR valve is a spring loaded valve, therefore downward pressure must be maintained on the tool handle to keep the valve open while cleaning.*

3. Use a plastic brush to remove stubborn deposits from the EGR valve, then visually inspect it. Do not use a metal brush or scraper; otherwise, damage will result.
4. Once deposits are removed from the EGR valve, wipe the valve and seat interface clean using a shop rag dampened with brake parts cleaner or similar solvent. Do not soak the valve guide and valve shaft interface, and do not spray the EGR valve with parts cleaner; otherwise, damage will result.
5. Reinstall the EGR assembly onto the engine and reconnect the 4-pin female connector harness.
6. Return the unit to service.



Ensure the EGR valve stem is perfectly centered between the opener's two pins

Mechanical EGR Opener Tool (2042998)



Mechanical EGR Tool shown properly positioned into the side opening of EGR valve.

RAJ867

Cleaning EGR Cooler

The EGR cooler must be cleaned each 3000 hours for the engine to remain emissions compliant. If an EGR cooler remains in service longer than 3000 hours, the difficulty and time required to clean the EGR cooler increases.

The following procedure along with the Soot Scrubber cleaning solution, is the only approved method to clean the EGR cooler. Soot Scrubber and the black rubber stoppers are included in the EGR System Cleaning Kit (P/N 203-799).

Important:

1. Always wear appropriate Personal Protective Equipment (PPE) when cleaning the EGR Cooler and the EGR system. This includes safety glasses, rubber gloves, and a respirator.
2. Dispose of used soot scrubber solution in accordance with local environmental regulations. The used solution may contain heavy metals and petroleum products. The used solution should be considered hazardous waste unless declared otherwise by your local environmental agency.

NOTICE

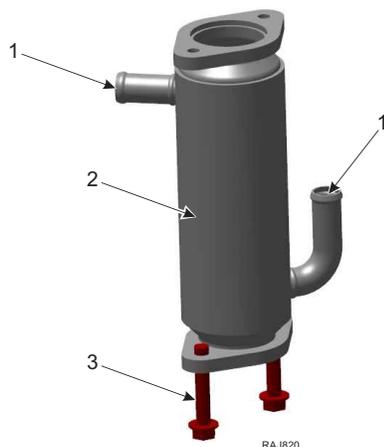
Equipment Damage!

Never use the Soot Scrubber cleaning solution on any material except stainless steel. It will cause accelerated corrosive damage of the material, especially the aluminum body of the EGR Valve.

1. Remove the EGR cooler from the engine.
2. Use the two provided black rubber stoppers to plug coolant inlet and outlet.
3. Thread two screws (use the two screws which mount the EGR cooler to the outlet tube) into the flange end. These serve to space the flanged end of the EGR cooler off of the bottom of the heated bath, allowing natural circulation during the chemical reaction of the Soot Scrubber on the deposits.
4. Mix 1-part standard concentration Soot Scrubber with 3-parts water at 120 F. Use one quart Soot Scrubber for 1-gallon final volume.

Note: Thermo King recommends using the TK heated cleaning bath tool (P/N 204-2379) to keep the cleaning solution at 120 F.

5. Orientate the EGR cooler vertically in the cleaning bath as shown () to allow the soot deposits to fall out and not get trapped in the EGR cooler. Continuously heat the solution to 120 F with the EGR cooler submerged.
6. Soak for 2.5 hours.
7. Drain the solution from the EGR cooler and visually inspect.
8. Once the deposits are removed from the EGR cooler, rinse clean with water.
9. Dry the EGR cooler and reinstall on the engine.

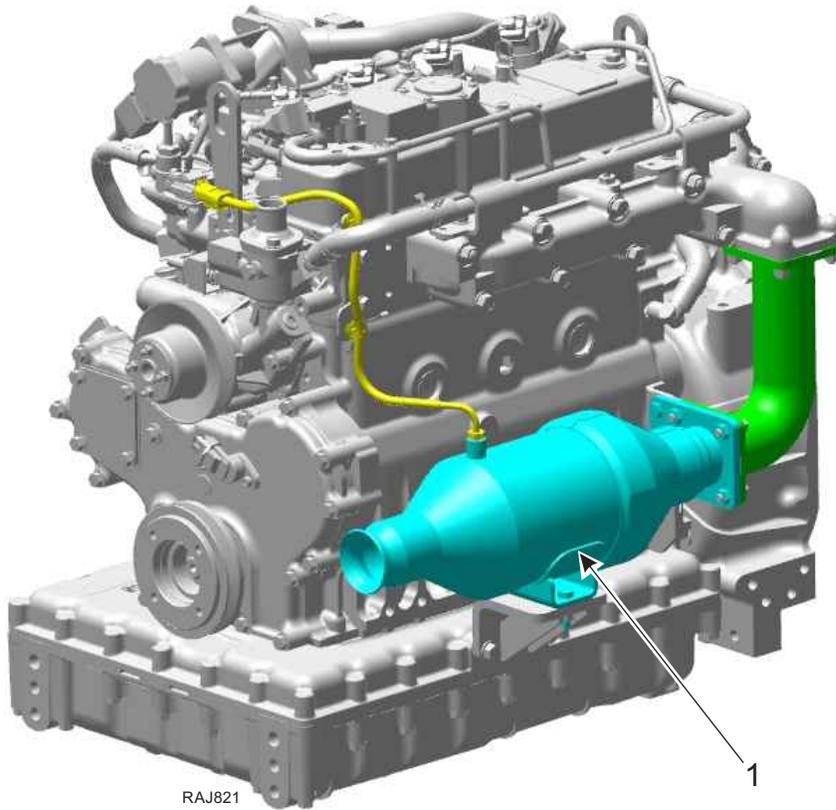


1.	Plug coolant inlet and outlet ports.	3.	Thread the two M8 screws which mount the EGR cooler to the outlet tube into flange end.
2.	EGR Cooler		

Diesel Oxidation Catalyst (DOC) System

The Diesel Oxidation Catalyst (DOC) is an exhaust after-treatment system similar to a catalytic converter used on a gasoline engine in a car. It is located on the back of the engine.

Figure 23. Back View of Engine



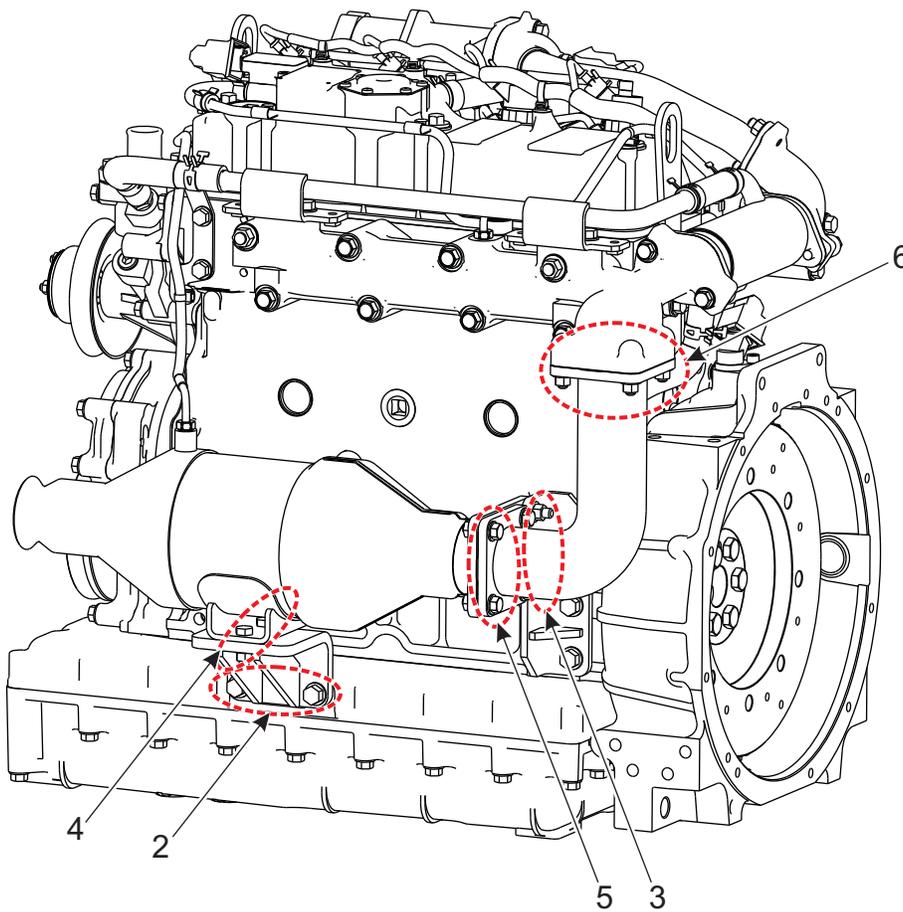
1.	DOC
----	-----

Diesel Oxidation Catalyst (DOC) Installation

The DOC must be installed in the correct sequence to ensure proper fitment.

1. Install all DOC mounting hardware to the engine and brackets - **hand tight only**.
2. Torque the DOC bracket to the oil pan - 30 ft-lbs (40 Nm).
3. Torque the DOC to engine block bracket - 25 ft-lbs (19 Nm).
4. Torque the DOC to the oil pan bracket - 25 ft-lbs (19 Nm).
5. Torque the DOC to the exhaust elbow - 25 ft-lbs (19 Nm).
6. Torque the exhaust elbow to the exhaust manifold - 25 ft-lbs (19 Nm).

Figure 24. DOC Torque Sequence



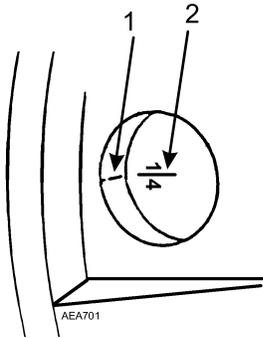
RAJ767

Engine Valve Clearance Adjustment

The valve clearance should be adjusted every 3,000 hours.

1. Remove the rocker arm cover.
2. Remove the round cover (plug) from the timing mark access hole on the front of the bell housing.
3. Place the engine at top dead center of the compression stroke for the number one cylinder. See steps a through d.
 - a. Rotate the engine in the normal direction of rotation (clockwise viewed from the water pump end) until the 1-4 timing mark on the flywheel lines up with the index mark in the timing mark access hole.

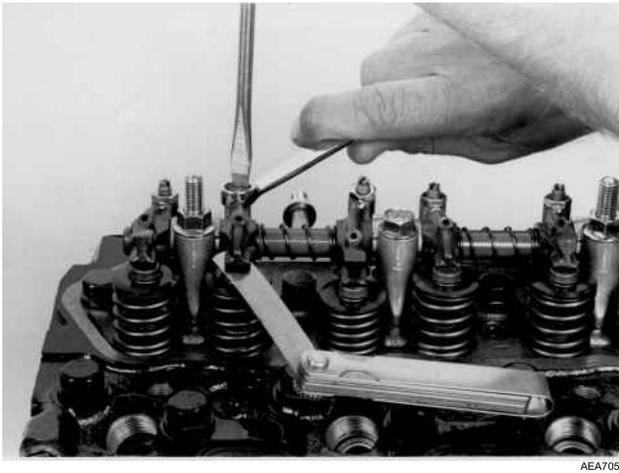
Figure 25. Top Dead Center One and Four



1.	Index Mark
2.	Top Dead Center Mark for 1 and 4

- b. Check the rocker arms on the number one cylinder to see if they are loose.
 - c. If the rocker arms are loose, the engine is at top dead center of the compression stroke for the number one cylinder.
 - d. If the rocker arms are tight, the engine is at top dead center of the exhaust stroke for the number one cylinder. Rotate the engine 360 degrees to place the engine at top dead center of the compression stroke for the number one cylinder.
4. Use a feeler gauge to check the valve clearance on both valves for the number one cylinder, the intake valve for the number two cylinder, and the exhaust valve for the number three cylinder. The valve clearance for both the intake valve and the exhaust valve should be 0.006 to 0.010 in. (0.15 to 0.25 mm).
 - a. Check to verify that the valve stem cap is in good condition and is positioned squarely on the top of the valve stem. Replace the valve stem cap if it shows significant wear.
 5. Adjust the valves if necessary by loosening the locknut and turning the adjustment screw until the valve clearance is correct.

Figure 26. Adjusting the Valve Clearance



6. Hold the adjustment screw in place and tighten the locknut.
7. Recheck the valve clearance.
8. Rotate the engine one full turn (360 degrees) in the normal direction of rotation (clockwise viewed from the water pump end), and align the 1-4 timing mark on the flywheel with the index mark in the timing mark access hole. This is top dead center of the compression stroke for the number four cylinder.
9. Check and adjust the exhaust valve for the number two cylinder, the intake valve for the number three cylinder, and both valves for the number four cylinder.
10. Replace the rocker arm cover, the cover for the timing mark access hole, and tighten the fuel injection lines when finished.

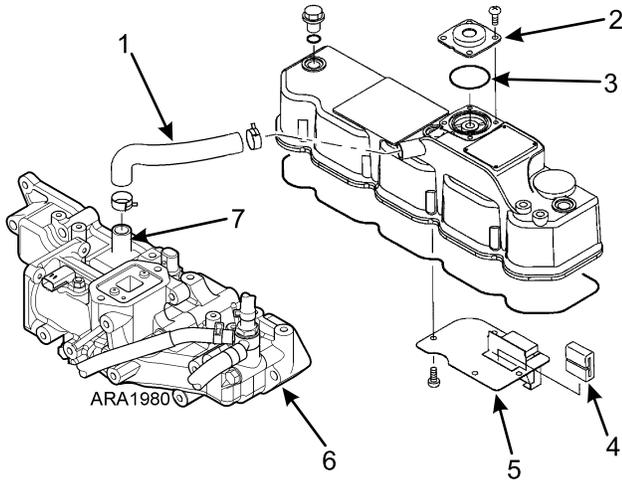
Valve Adjustments and Cylinder Configurations								
	Rear Flywheel End				Front Pulley End			
Cylinder Number	1		2		3		4	
Valve arrangement	E	I	E	I	E	I	E	I
Piston in No. 1 cylinder is at TDC on compression stroke	○	○		○	○			
Piston in No. 4 cylinder is at TDC on compression stroke			⊙			⊙	⊙	⊙

Crankcase Breather

Gases formed in the crankcase are directed to the intake manifold. Harmful vapors that would otherwise collect in the crankcase and contaminate the oil, or escape to the outside, are drawn back into the engine and burned.

The crankcase breather is located in the valve cover. A restrictor is cast into the fitting for the breather hose on the intake manifold. The restrictor limits the flow of gases from the crankcase to the intake manifold and keeps the crankcase pressure from getting too low in vacuum. A breather hose connects the crankcase breather to the intake manifold.

Figure 27. Crankcase Breather



1.	Breather Hose	5.	Baffle Plate
2.	Breather Cover	6.	Intake Manifold
3.	O-Ring	7.	Restrictor Location
4.	Baffle Breather		

Normal crankcase pressures with a new air cleaner are 0 to 12 in. (0 to 300 mm) H₂O of vacuum. The vacuum will increase as the air cleaner gets dirty and becomes more restrictive. Check the air restriction indicator before checking the crankcase pressure. Replace the air cleaner if the reading on the air restriction indicator exceeds 20 in. (508 mm) H₂O of vacuum. A dirty air cleaner may cause excessive vacuum, leading to oil carry over and high oil consumption.

The crankcase breather and the breather hose should be inspected when the air cleaner element is replaced to verify they are not plugged or damaged. Inspect the insulation to verify it is in place and undamaged. The insulation is used to prevent freezing in cold weather.

The following items can affect the crankcase pressure readings:

Crankcase Pressure Effect	Typical Cause
Increase	Piston Rings Stuck or Worn
Increase	Breather Hose or Restrictor Plugged with Dirt or Ice
Decrease	Air Cleaner Dirty or Plugged

EMI 3000 Air Cleaner

The EMI 3000 air cleaner is a dry element air cleaner. Replace the EMI 3000 air cleaner element at 3,000 hours or 2 years, whichever occurs first.

Note: *The severe duty air cleaner is similar to the EMI 3000 air cleaner but allows the air cleaner element to be replaced at 4,000 hour intervals under normal operating conditions.*

Figure 28. EMI 3000 Air Cleaner Assembly

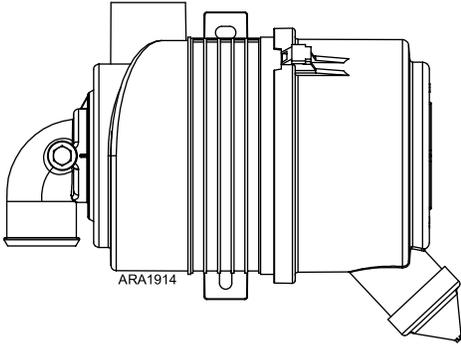


Figure 29. EMI 3000 Air Filter Element



Water Pump Belt Service

Water Pump Belt Service

The water pump pulley is a split type. Adjust the belt tension by adding or removing shims between the water pump pulley sheaves.

⚠ WARNING

Risk of Injury!

The unit can start at any time without warning. Press the OFF key on the HMI control panel, place the unit On/Off switch in the Off position, and disconnect the battery before inspecting or servicing any part of the unit.

⚠ CAUTION

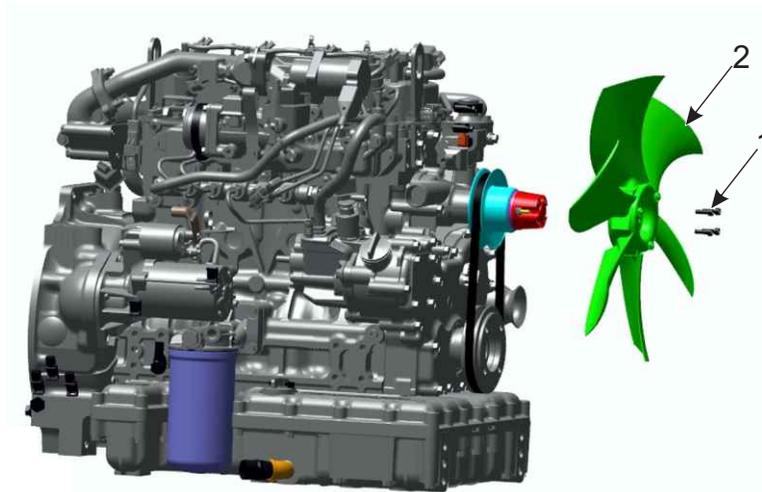
Risk of Injury!

Do not attempt to adjust belts with the unit running.

SGCO 5000 Units

Belt Removal

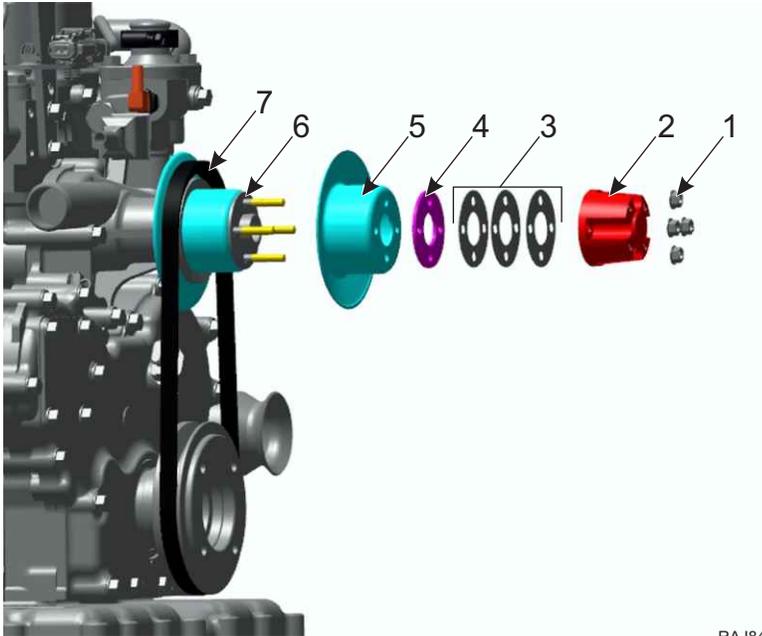
1. Turn the unit OFF and disconnect the negative battery terminal to ensure unit cannot be operated.
2. Access the front of the engine.
3. Remove the (4) fan to spacer bolts. It may be necessary to loosen the fan shroud mounts to allow better access the bolts.



RAJ840

1.	Fan to Spacer Bolts (4)	2.	Fan
----	-------------------------	----	-----

4. Move the fan forward into the shroud. DO NOT allow the fan to contact the radiator fins.
5. Remove the (4) fan spacer nuts, spacer, pulley shims, washer, and outer pulley sheave. Make note of position and thickness of all pulley shims for reuse.



RAJ841

1.	Spacer Nuts (4)	5.	Outer Pulley Sheave
2.	Fan Spacer	6.	Shims that Set Belt Tension
3.	Extra Shims for Belt Tension Setting	7.	Belt
4.	Washer		

6. Remove the belt from the unit and inspect all pulley sheaves. Replace if excessive wear is found.

Belt Installation and Tension Setting

7. Install the belt around the crankshaft pulley and water pump inner sheave hub.
8. Install the outer pulley sheave, washer, extra shims, fan spacer, and (4) spacer nuts. Torque the nuts to specification: 6.6 ft-lbs (9 Nm).

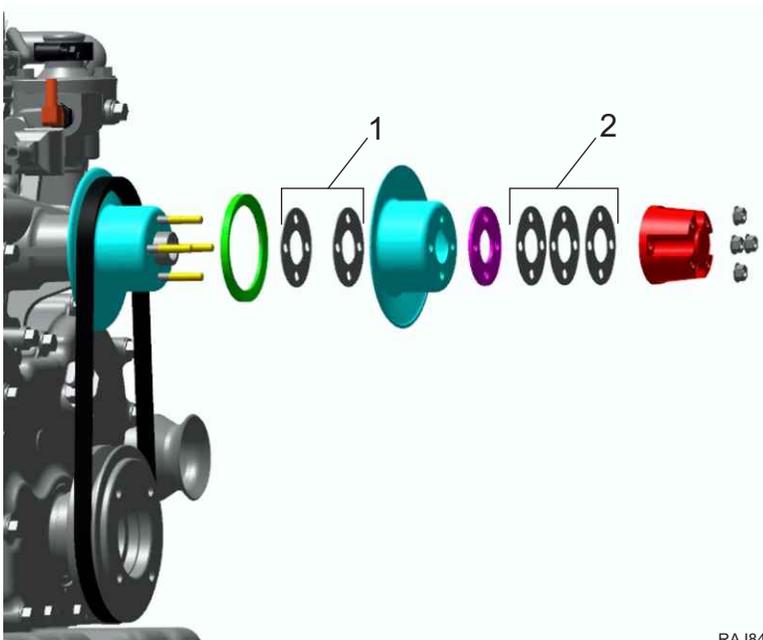
Important: *Belt tension is adjusted by adding, removing, or changing the thickness of shims between the water pump pulley sheaves. It is important to note the number of and thickness of any shims that are removed during service procedures.*

9. Check belt tension using a commercially available belt tension tool.

Water Pump Belt Tension Specification	
New Belt	126 Hz (40 lbs)
Field Reset (used belt)	118 Hz (32 lbs)

10. Adjust shims as necessary by removing the (4) fan spacer nuts, spacer, washer, and outer sheave. Change the thickness or number of shims in Location 1. Extra shims are found and stored at Location 2 .

- Additional shims can be purchased and are found in the unit's parts manual.



RAJ842

Location 1: Shims To Adjust Belt Tension	Location 2: Spare Shims Kept Here
--	---

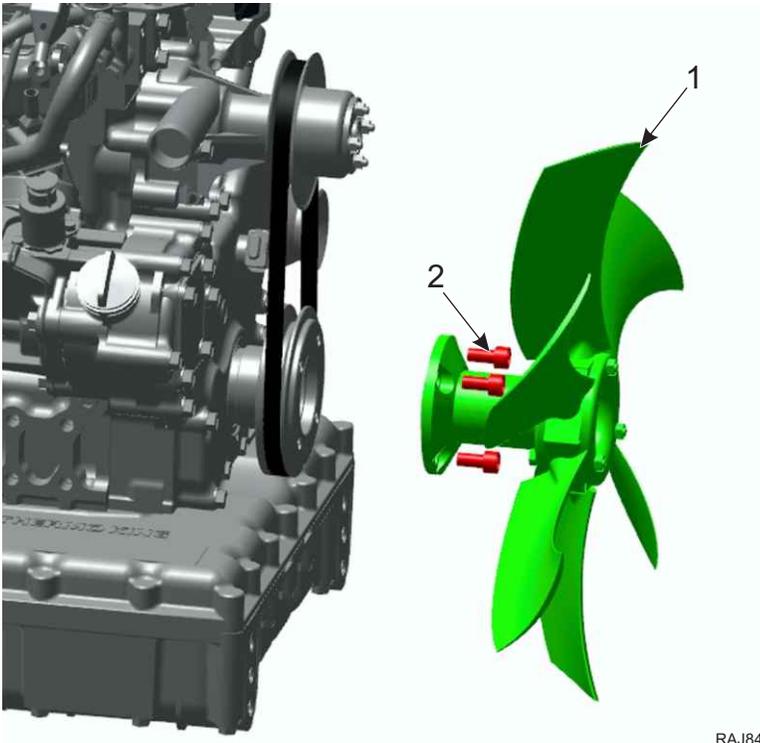
11. After belt tension is set correctly, ensure the (4) spacer nuts are torqued to specification: 6.6 ft-lbs (9 Nm).
12. Rotate the engine 1/4 turn and re-torque the (4) spacer nuts are torqued to specification: 6.6 ft-lbs (9 Nm).
13. Position the fan back onto the fan spacer. Install the (4) fan to spacer bolts and torque to specification: 6.6 ft-lbs (9 Nm).
14. Install fan shroud hardware (if removed).
15. Connect battery terminals and verify unit function.

SGUM 5000 Units

Fan removal is not necessary to adjust water pump belt tension on SGUM 5000 units. Go to step 10 for the belt tension adjustment procedure. The water pump pulley is a split type. Adjust the belt tension by adding or removing shims between the water pump pulley sheaves.

Belt Removal

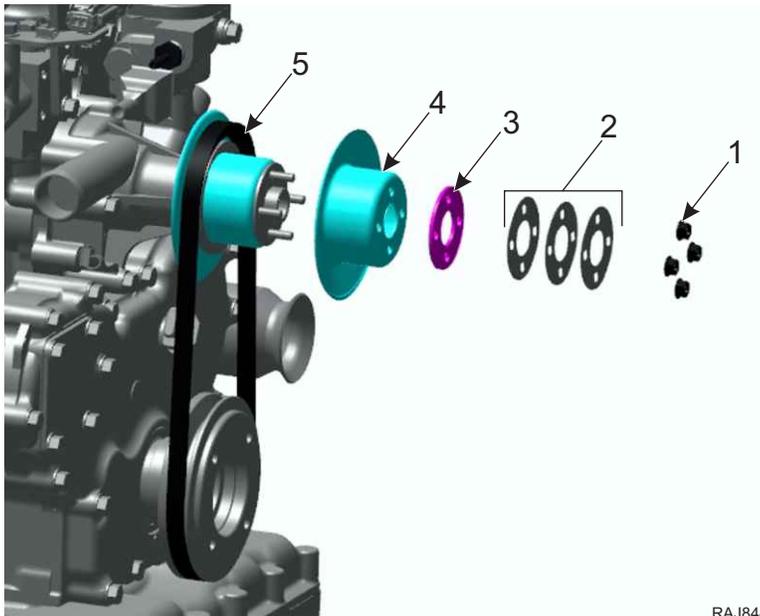
1. Turn the unit OFF and disconnect the negative battery terminal to ensure unit cannot be operated.
2. Access the front of the engine.
3. Remove the (4) fan hub to crankshaft bolts.



1.	Fan Assembly	2.	Fan Hub to Crankshaft Bolts (4)
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4. Move the fan forward into the shroud. DO NOT allow the fan to contact the radiator fins.

5. Remove the (4) nuts from the water pump pulley.
6. Remove the pulley shims, washer, and outer pulley sheave.



RAJ844

1.	Pulley Nuts (4)	4.	Outer Pulley Sheave
2.	Extra Shims for Belt Tension Setting	5.	Belt
3.	Washer		

7. Remove the belt from the unit and inspect all pulley sheaves. Replace if excessive wear is found.

Belt Installation and Tension Setting

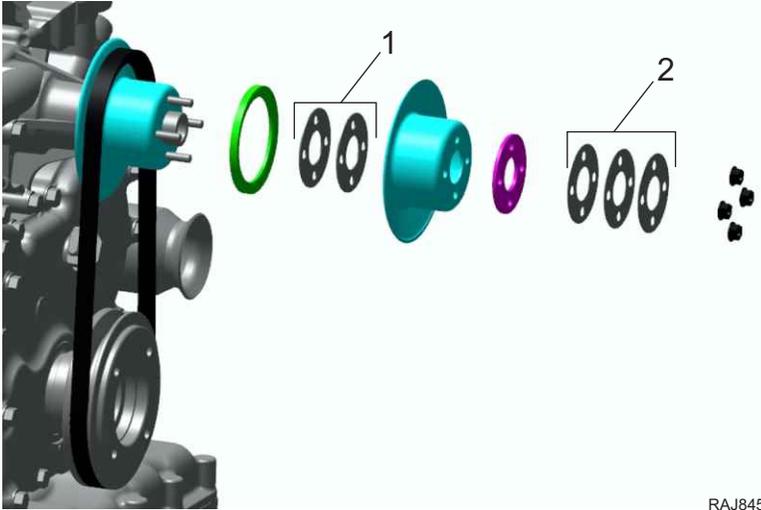
8. Install the belt around the crankshaft pulley and water pump inner sheave hub.
9. Install the outer pulley sheave, washer, extra shims, and (4) pulley nuts. Torque the nuts to specification: 6.6 ft-lbs (9 Nm).

Important: Belt tension is adjusted by adding, removing, or changing the thickness of shims between the water pump pulley sheaves. It is important to note the number of and thickness of any shims that are removed during service procedures.

10. Check belt tension using a commercially available belt tension tool.

Water Pump Belt Tension Specification	
New Belt	126 Hz (40 lbs)
Field Reset (used belt)	118 Hz (32 lbs)

11. Adjust shims as necessary by removing the (4) pulley nuts, shims, washer, and outer sheave. Change the thickness or number of shims in Location 1. Extra shims are found and stored at Location 2 .
- Additional shims can be purchased and are found in the unit’s parts manual.



Location 1: Shims To Adjust Belt Tension	Location 2: Spare Shims Kept Here
--	---

12. After belt tension is set correctly, ensure the (4) pulley nuts are torqued to specification: 6.6 ft-lbs (9 Nm).
13. Apply blue thread locking compound to the (4) Fan Hub to Crankshaft Bolts.
14. Position the fan assembly back onto the crankshaft. Install the (4) Fan Hub to Crankshaft Bolts and torque to specification: 47.2 ft-lbs (64 Nm).
15. Connect battery terminals and verify unit function.

Radiator and Fan Service

Radiator

Clean the radiator every 1,000 operating hours. Blow compressed air from the outside of the coil in toward the fan to clean coil (the direction opposite the normal air flow). Inspect the coil and fins for damage and repair if necessary.

NOTICE

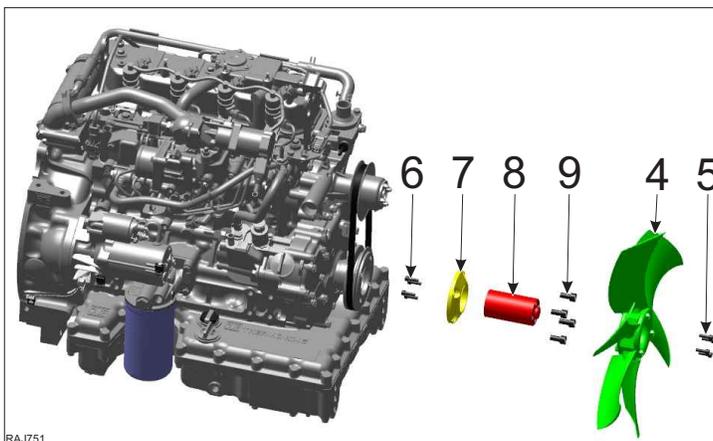
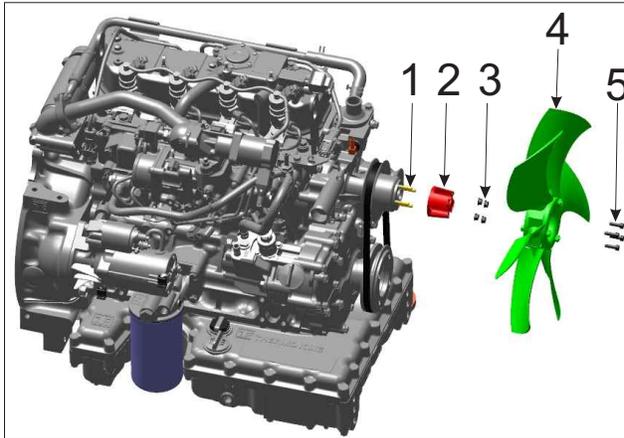
Equipment Damage!

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

Radiator Cooling Fan

The radiator cooling fan on SG units are driven directly off of the engine.

- SGCO - The fan is driven off of the coolant pump pulley.
- SGUM - The fan is driven directly off of the crankshaft pulley.



1.	SGCO Fan Studs (4)	6.	SGUM Hub to Spacer Bolts (4)
2.	SGCO Fan Spacer	7.	SGUM Fan Hub
3.	SGCO Spacer Nuts (4)	8.	SGUM Fan Spacer
4.	Fan Assembly	9.	SGUM Hub to Crankshaft Bolts (4)
5.	Fan to Spacer Mounting Bolts (4)		

Fan and Shroud Adjustment

SGCO and SGUM Units: The fan depth into the shroud is not adjustable.

SGCO Unit: The fan shroud mounting points are slotted to allow for adjustment. If the fan or shroud is removed or replaced, adjust the shroud positioning so the fan is centered in the shroud opening. The distance from each fan blade tip to the shroud must be equal around the circumference of the opening to allow proper cooling. Adjust the shroud as needed so the fan is centered in the opening.

SGUM Unit: The fan shroud is mounted directly to the radiator and is not adjustable.

Yanmar YSAD Diagnostic Engine Service

Part Number 2041969 - Tool Kit, YSAD Expert

Refer to the Yanmar TNV Series Engine Troubleshooting Manual (TK 55740) and the Yanmar TNV Series Engine Service Manual (TK 55584) for engine service information not included in this manual.

Connect a PC with the Yanmar Smart Assist Direct (YSAD) diagnostic tool to the ECU to view the Yanmar engine Diagnostic Trouble Codes (DTC) and troubleshoot engine problems.

Engine Control Unit (ECU) software updates are flash loaded and Engine Control Module (ECM) software revisions are checked using the Yanmar Smart Assist Direct Tool.

Yanmar Diagnostic Trouble Codes (DTC)

Alarm Codes are triggered by Yanmar Common Rail Engine ECU Diagnostic Trouble Codes.

If the Yanmar Engine Control Unit (ECU) determines a problem exists, one or more DTCs will be set. Engine DTCs are viewed by means of the Yanmar Engine Diagnostic Tool

Use the Yanmar SmartAssist Direct (YSAD) Diagnostic Tool to determine what DTC Codes are set. For corrective actions, refer to the Yanmar Troubleshooting Guide.

Yanmar Diagnostic Trouble Codes (DTC) and Associated Thermo King Alarm Codes

When a Yanmar DTC Code is set, a corresponding 600 Series Thermo King Alarm Code is also set. The 600 Series Alarm Code is a general indication of what issues may exist. Always connect the Yanmar Service Tool and read all existing DTC codes. Use this information to diagnose the problem using the Yanmar Service documentation.

Clearing Yanmar DTC Codes and Associated Thermo King Alarm Codes

Yanmar DTC Codes are cleared using the Yanmar Service tool. When the Yanmar Fault Codes are cleared, the associated Thermo King Alarm Code is also cleared. The codes are still available by downloading the ServiceWatch Data Logger using the WinTrac Service Tool.

Connecting and Using the Yanmar Engine Diagnostic Tool

The Connect Engine Service Tool feature allows the unit to be powered down but maintains power to the Engine Control Unit (ECU) for diagnostic purposes. This allows the Yanmar Smart Assist Direct (YSAD) Diagnostic Tool to be connected to the Yanmar Engine Control Unit without having the rest of the unit powered up.

Purpose:

To connect and use the Yanmar Diagnostic Tool.

Materials Required:

- Yanmar Diagnostic Tool
- Yanmar SmartAssist Direct Diagnostic Software installed on a PC

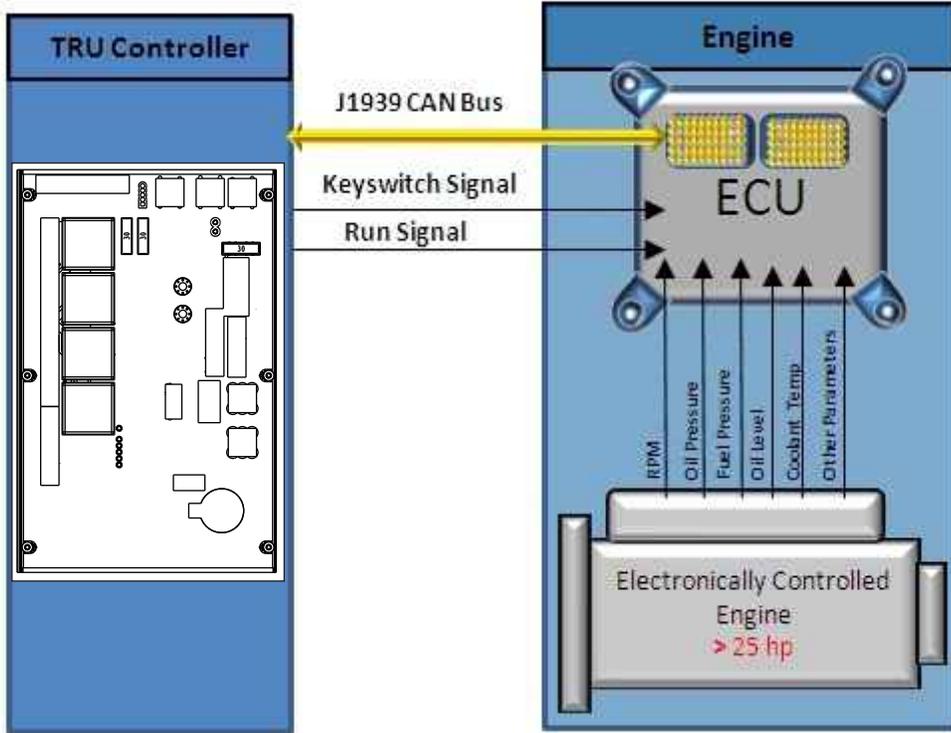
Operation:

The Yanmar Diagnostic Tool is used to connect the Computer USB Port to the Yanmar Engine Control Unit data connector located in the Unit Control Box. Yanmar SmartAssist Direct (YSAD) Software installed on the Computer is used to communicate with the Yanmar Engine Control Unit (ECU). This allows ECU information to be retrieved, Yanmar Fault Codes to be read, operational data to be examined and updated and other diagnostic functions to be performed.

Connection:

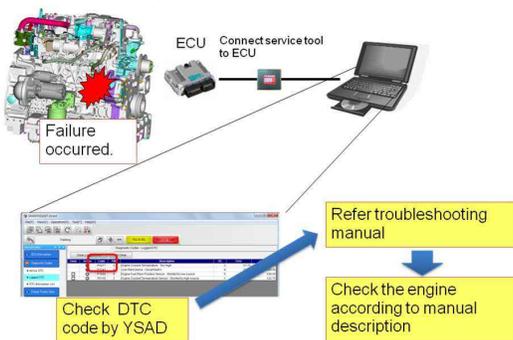
There are three connections from the Thermo King Base Controller to the Yanmar Engine Control Unit (ECU):

- Keyswitch Signal – This signal sends power to the ECU.
- Run Signal – This signal is high when the Base Controller is requesting the engine to run.
- CAN Bus – All other communications between the Base Controller and the ECU are via the CAN Bus.



Diagnostic Process:

Diagnostic Process using YSAD



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55633-2-5-1



Table 1. Procedure

Step	Action	Result	Comments
1	The unit battery must be connected and the Microprocessor Power Switch must be turned on.		
2	Turn the unit on and enter the Maintenance Menu.		
3	In the Maintenance Menu, scroll to and select Connect Engine Service Tool.		Connect Engine Service Tool is the last item in the Maintenance Menu.

Table 1. Procedure (continued)

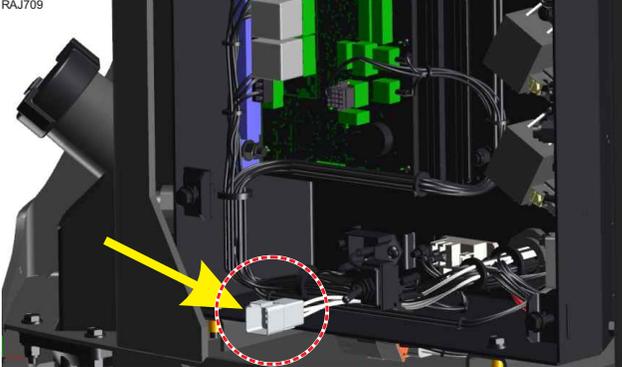
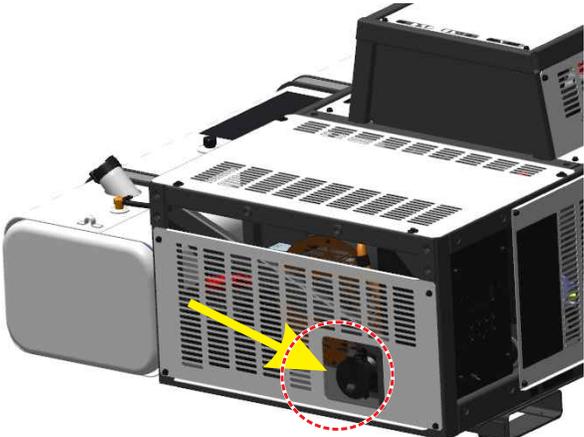
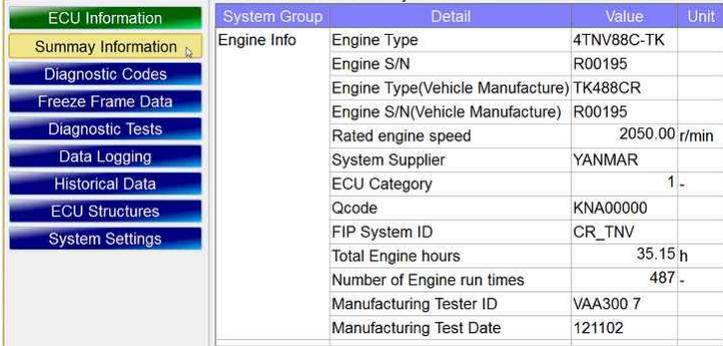
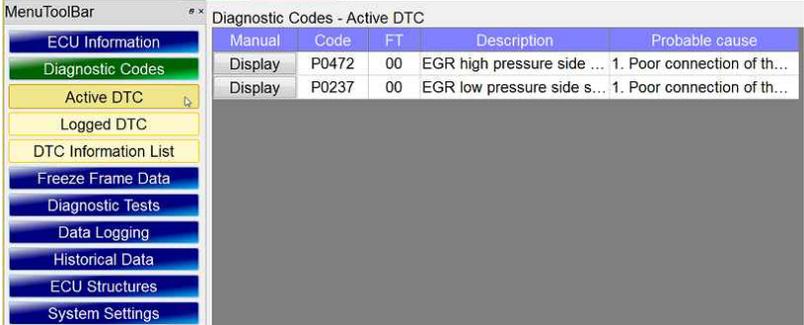
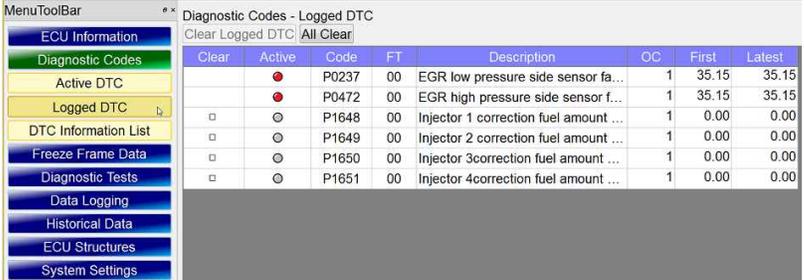
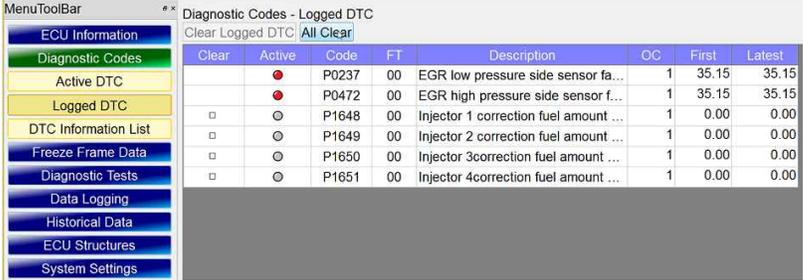
Step	Action	Result	Comments
4	<p>Open the Control Box and locate the Yanmar Diagnostic Connector near the fuse panel.</p> <p>Note: Some early build SGUM units (before November 2020) have the YSAD connector located under the alternator near the power receptacle - NOT in the control box.</p>	<p>Figure 30. SGCO</p> <p>RAJ709</p> 	
		<p>Figure 31. SGUM</p>  <p>RAJ710</p>	
		<p>Figure 32. SGUM 5000 (early units, see note)</p>  <p>RAJ1056</p>	



Table 1. Procedure (continued)

Step	Action	Result	Comments
5	Connect the Yanmar Diagnostic Tool to the Yanmar Diagnostic Connector in the unit Control Box using the supplied cable.		
6	Connect the Yanmar Diagnostic Tool to the PC using the supplied cable.		This cable is a standard USB cable. Excessive cable length of the USB cable may affect operation.
7	Start the Yanmar SA-Direct (YSAD) software.	To maintain current status, the Yanmar SmartAssist Direct (YSAD) software must be started every 90 days while the PC is connected to the internet.	This verifies the YSAD software and extends the license for another 90 days.
8	Complete the login information as shown.		
9	Select ECU Access, then select Diagnostics (Execution).		<p><Operations that are performed when communicating with ECU></p> <p>The communication connection to the center is included and a necessary function is not included.</p> <hr/> <p><<Operations, data and adjustments used during maintenance or error diagnostics>></p> <p>View data from the ECU, save ECU data and perform operational tests and adjustment.</p>
10	Click OK.		
11	Click Start.		
12	Select ECU Information - Summary Information.		This displays engine information, such as the engine serial number, run hours, and start cycles.

Table 1. Procedure (continued)

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		 <table border="1"> <thead> <tr> <th>System Group</th> <th>Detail</th> <th>Value</th> <th>Unit</th> </tr> </thead> <tbody> <tr> <td>Engine Info</td> <td>Engine Type</td> <td>4TNV88C-TK</td> <td></td> </tr> <tr> <td></td> <td>Engine S/N</td> <td>R00195</td> <td></td> </tr> <tr> <td></td> <td>Engine Type(Vehicle Manufacture)</td> <td>TK488CR</td> <td></td> </tr> <tr> <td></td> <td>Engine S/N(Vehicle Manufacture)</td> <td>R00195</td> <td></td> </tr> <tr> <td></td> <td>Rated engine speed</td> <td>2050.00</td> <td>r/min</td> </tr> <tr> <td></td> <td>System Supplier</td> <td>YANMAR</td> <td></td> </tr> <tr> <td></td> <td>ECU Category</td> <td></td> <td>1 -</td> </tr> <tr> <td></td> <td>Qcode</td> <td>KNA00000</td> <td></td> </tr> <tr> <td></td> <td>FIP System ID</td> <td>CR_TNV</td> <td></td> </tr> <tr> <td></td> <td>Total Engine hours</td> <td></td> <td>35.15 h</td> </tr> <tr> <td></td> <td>Number of Engine run times</td> <td></td> <td>487 -</td> </tr> <tr> <td></td> <td>Manufacturing Tester ID</td> <td>VAA300 7</td> <td></td> </tr> <tr> <td></td> <td>Manufacturing Test Date</td> <td>121102</td> <td></td> </tr> </tbody> </table>	System Group	Detail	Value	Unit	Engine Info	Engine Type	4TNV88C-TK			Engine S/N	R00195			Engine Type(Vehicle Manufacture)	TK488CR			Engine S/N(Vehicle Manufacture)	R00195			Rated engine speed	2050.00	r/min		System Supplier	YANMAR			ECU Category		1 -		Qcode	KNA00000			FIP System ID	CR_TNV			Total Engine hours		35.15 h		Number of Engine run times		487 -		Manufacturing Tester ID	VAA300 7			Manufacturing Test Date	121102		
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15	To clear all fault codes, click the All Clear button. Enter your password in the popup window when prompted.		<p>All fault codes in the ECU will be cleared.</p> <p>Operation must be performed in Connect Engine Service Tool mode. YSAD will not allow codes to be cleared while engine is operating.</p>																																																								

For additional information, refer to the Yanmar Diagnostic Documentation.

Software Download for Flash to Replacement ECU

Purpose:

Preparing ECU for Replacement.

Materials Required:

- Yanmar Diagnostic Tool
- Computer with current Yanmar SmartAssist Direct Diagnostic Software

Operation:

The Yanmar Diagnostic Tool is used to connect the computer USB Port to the Yanmar Engine Control Unit data connector located in the Unit Control Box. Yanmar SmartAssist Direct (YSAD) Software installed on the computer is used to communicate with the Yanmar Engine Control Unit (ECU). This allows ECU information to be retrieved, Yanmar Fault Codes to be read, operational data to be examined and updated, and other diagnostic functions to be performed.

Table 2. Procedure

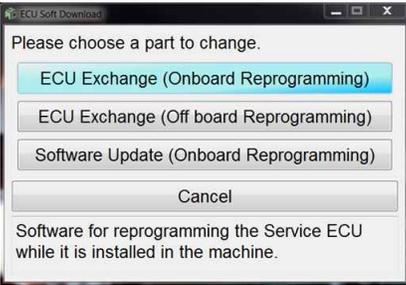
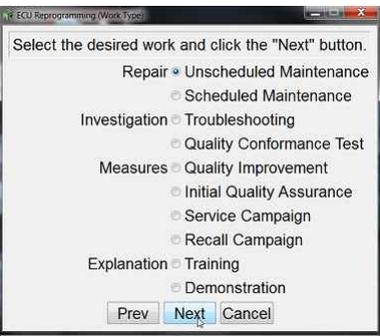
Step	Action	Result	Comments
1	With an internet connection, open YSAD, select Data Management tab, and click on ECU Soft Download.		<p><Operations that can be performed without the ECU connected></p> <p>The communication connection to the center is included and a necessary function is included.</p> <p><<ECU Software Download>></p> <p>Performed in case of ECU exchange or software updates.</p>
2	Select ECU Exchange (Onboard Reprogramming)		Onboard programming is currently not supported.
3	Choose the reason for reprogramming the ECU and click Next.		This information is only used for data collection purposes, and does not affect the version of software downloaded.

Table 2. Procedure (continued)

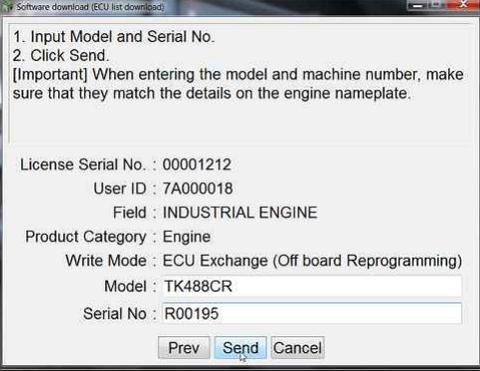
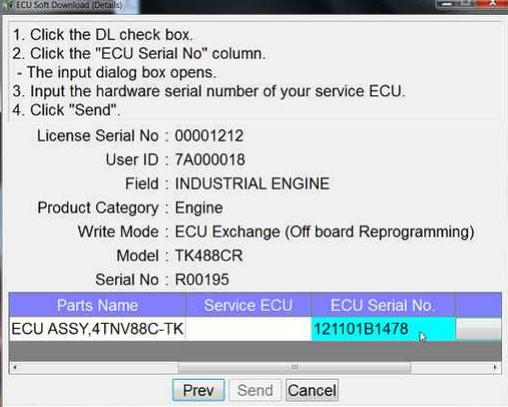
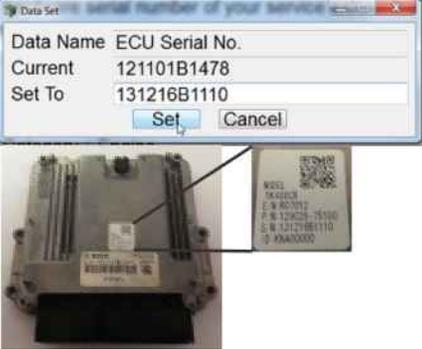
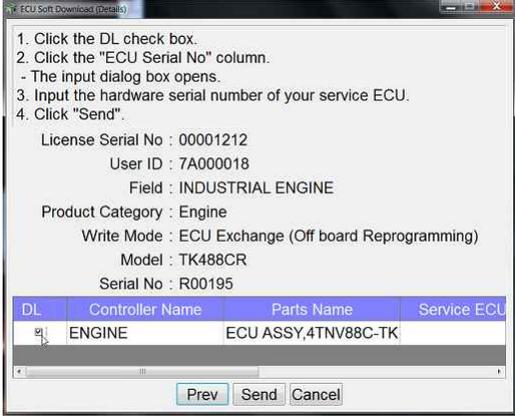
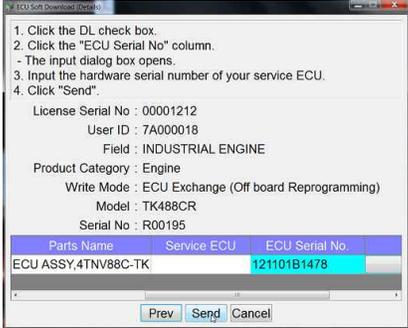
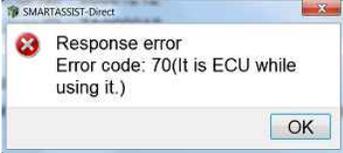
Step	Action	Result	Comments
4	Locate engine model number, serial number, and enter the values into data fields. Click Send when finished. Note: Use upper case letters when entering values.		This information is used to compare ECU and engine serial number data against Yanmar's database.
5	Click the ECU Serial No field. Note: Use scroll bar located at bottom of screen if required.		
6	Enter the serial number of the new ECU and click Set.		



Table 2. Procedure (continued)

Step	Action	Result	Comments
7	Click the DL check box.		
8	Verify Serial Number entered is correct and click Send. Download will start.	<p>ECU software has been downloaded to PC.</p> 	<p>If the following error is shown, the ECU serial number is already programmed to a different engine serial number.</p> 
9	Proceed to step 9 of Service Procedure F06A to continue.		

Uploading Information to Yanmar

Purpose:

To send ECU software back to database after ECU flash or if flash was cancelled.

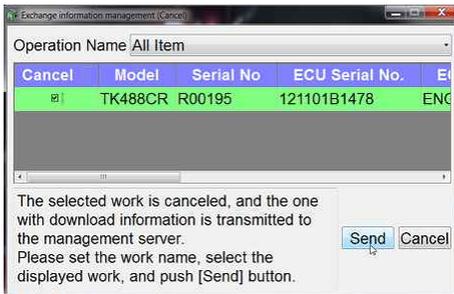
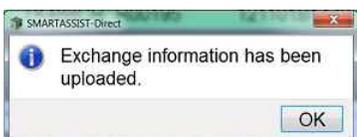
Materials Required:

- Yanmar Diagnostic Tool
- Computer with current Yanmar SmartAssist Direct Diagnostic Software

Operation:

The Yanmar Diagnostic Tool is used to connect the Computer USB Port to the Yanmar Engine Control Unit data connector located in the Unit Control Box. Yanmar SmartAssist Direct (YSAD) Software installed on the computer is used to communicate with the Yanmar Engine Control Unit (ECU). This allows ECU information to be retrieved, Yanmar Fault Codes to be read, operational data to be examined and updated, and other diagnostic functions to be performed.

Table 3. Procedure

Step	Action	Result	Comments
1	Select Data Management, click on Exchange Information, then choose either Exchange Complete or Exchange Cancel.		Choose Exchange Complete after ECU flash or use Exchange Cancel if ECU flash was not performed.
2	Click check box to select software and click Send.		
3	ECU software is being sent back to the Yanmar core.		
4	Upload complete.		

Updating ECU Software From Yanmar Core Database

Purpose:

To reprogram ECU / Required Data Exchange.

Materials Required:

- Yanmar Diagnostic Tool
- Computer with current Yanmar SmartAssist Direct Diagnostic Software

Operation:

The Yanmar Diagnostic Tool is used to connect the Computer USB Port to the Yanmar Engine Control Unit data connector located in the Unit Control Box. Yanmar SmartAssist Direct (YSAD) Software installed on the computer is used to communicate with the Yanmar Engine Control Unit (ECU). This allows ECU information to be retrieved, Yanmar Fault Codes to be read, operational data to be examined and updated, and other diagnostic functions to be performed.

Table 4. Procedure

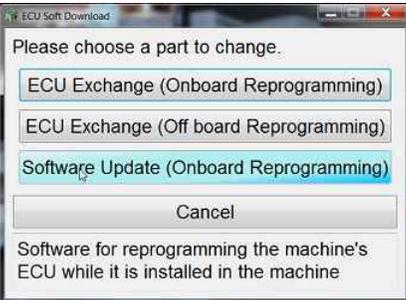
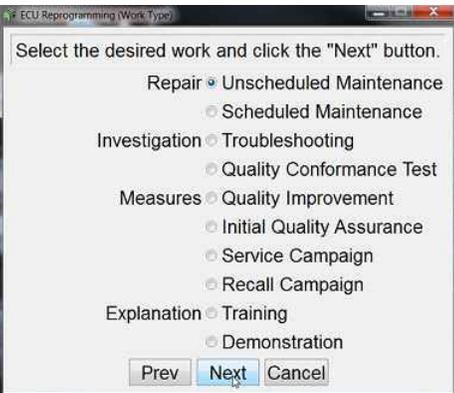
Step	Action	Result	Comments
1	With an internet connection, open YSAD, select Data Management, and click on ECU Soft Download.		<p><Operations that can be performed without the ECU connected></p> <p>The communication connection to the center is included and a necessary function is included.</p> <hr/> <p><<ECU Software Download>></p> <p>Performed in case of ECU exchange or software updates.</p>
2	Choose Software Update (Onboard Reprogramming) and click Select.		
3	Choose reason for ECU Reprogramming (Quality Improvement) and click Next.		

Table 4. Procedure (continued)

Step	Action	Result	Comments
4	<p>Enter Engine Model Number and Serial Number into data boxes and click Send.</p> <p>Note: Use upper case letters when entering values.</p>		
5	<p>Click on the Details button underneath the Notes heading.</p> <p>Note: Use scroll bar located at bottom of screen if required.</p>		
6	<p>Compare MapSoftPno Pre Code and New Code. New code should be a different number if there is a software update available. Click OK.</p>		
7	<p>Click the DL check box and click Send.</p>		



Table 4. Procedure (continued)

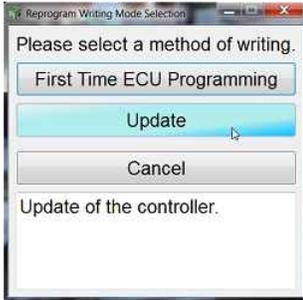
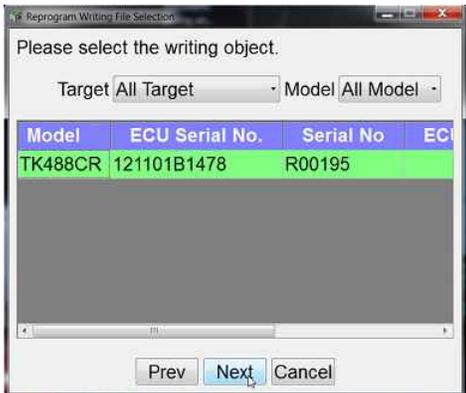
Step	Action	Result	Comments
8	Software update has been downloaded. Click OK.		Begin to write software to ECU using YSAD.
9	Connect YSAD to unit. Important: Unit must be in Connect Engine Service Tool mode.		Use Service Procedure A60A steps 1 to 8.
10	From the YSAD Main Menu, click the ECU Access tab and click ECU Programming.		<p><Operations that are performed when communicating with ECU></p> <p>The communication connection to the center is included and a necessary function is not included.</p> <hr/> <p><<ECU software writing>></p> <p>Performed in case of ECU exchange or software updates.</p>
11	If ECU replacement, select First Time ECU Programming. If software update only, select Update.		
12	Click on correct engine serial number and click Next.		

Table 4. Procedure (continued)

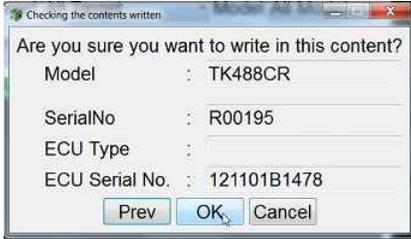
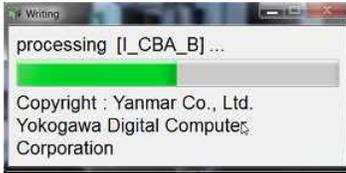
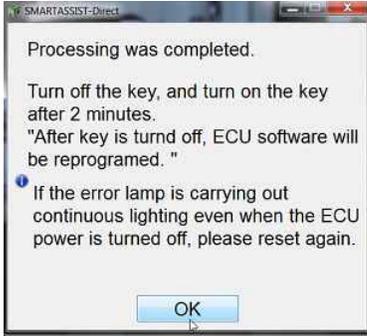
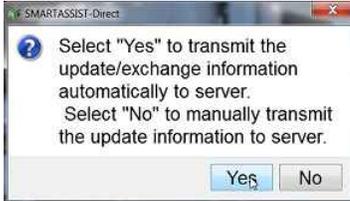
Step	Action	Result	Comments
13	Click OK.		
14	Click OK.		
15	Progress bar is shown as ECU is being flashed. This may take over 10 minutes.		Programming will not initiate if YSAD is not properly connected.
16	Processing completed. Turn the unit off for a minimum of two minutes. Click OK.		
17	Click Yes.		



Table 4. Procedure (continued)

Step	Action	Result	Comments
18	Exchange information is being transmitted to the YSAD core. Uploaded screen is displayed.		
19	Click No.		

ECU Recovery/Failures During Flash Load Procedures

Purpose:

In case of power failure or accidental disconnect etc. while performing F01A, F05A, or F06A.

Materials Required:

- Yanmar Diagnostic Tool
- Computer with current Yanmar SmartAssist Direct Diagnostic Software

Operation:

The Yanmar Diagnostic Tool is used to connect the computer USB Port to the Yanmar Engine Control Unit data connector located in the Unit Control Box. Yanmar SmartAssist Direct (YSAD) Software installed on the computer is used to communicate with the Yanmar Engine Control Unit (ECU). This allows ECU information to be retrieved, Yanmar Fault Codes to be read, operational data to be examined and updated, and other diagnostic functions to be performed.

Important Notes:

- The procedures below include four types of ECU programming failure.

ECU Programming or ECU Updating of Software Failure During Flash

Table 5. Procedure

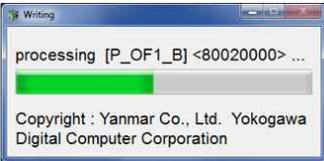
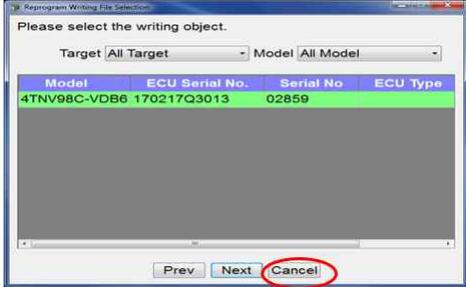
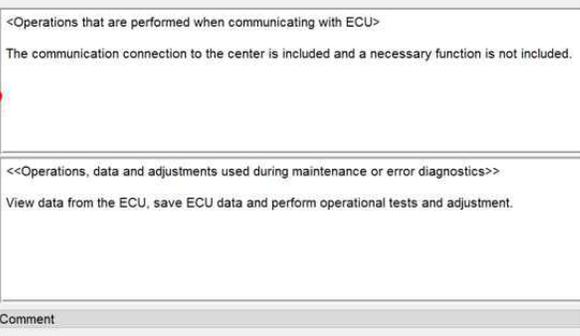
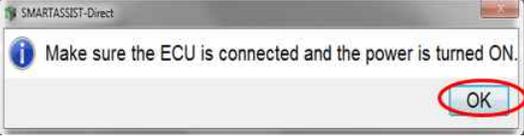
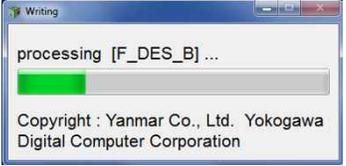
Step	Action	Result	Comments
1	Download of object failed during ECU update/flash. Click OK.	  	
2	Click Cancel.		
3	From ECU Access, select ECU Reprogramming (Flash).	 	



Table 5. Procedure (continued)

Step	Action	Result	Comments								
4	Select Re-write (When error occurs while writing it).										
5	Select engine model to begin re-write and click Next.	<table border="1"> <thead> <tr> <th>Model</th> <th>ECU Serial No.</th> <th>Serial No</th> <th>ECU Type</th> </tr> </thead> <tbody> <tr> <td>4TNV98C-VDB6</td> <td>170217Q3013</td> <td>02859</td> <td></td> </tr> </tbody> </table>	Model	ECU Serial No.	Serial No	ECU Type	4TNV98C-VDB6	170217Q3013	02859		
Model	ECU Serial No.	Serial No	ECU Type								
4TNV98C-VDB6	170217Q3013	02859									
6	Verify engine model and serial number and click OK.										

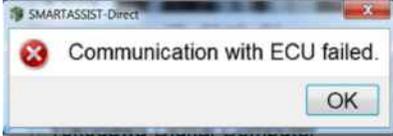
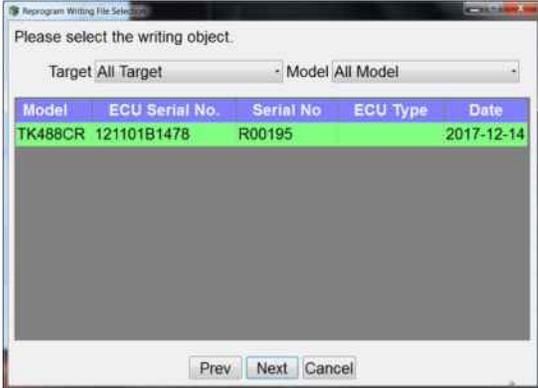
Table 5. Procedure (continued)

Step	Action	Result	Comments
7	Verify and click OK.		
8	ECU activation flashing process is resumed.		



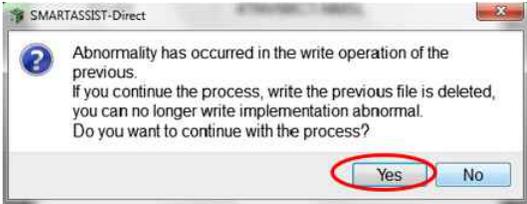
Communication Interruption During Flashing Process

Table 6. Procedure

Step	Action	Result	Comments
1	Communication with ECU failed message is displayed. Click OK.		
2	Select the engine model to begin reprogramming and click Next.	Reprogramming will be restarted. 	

Abnormality Occurrence During Flashing Process

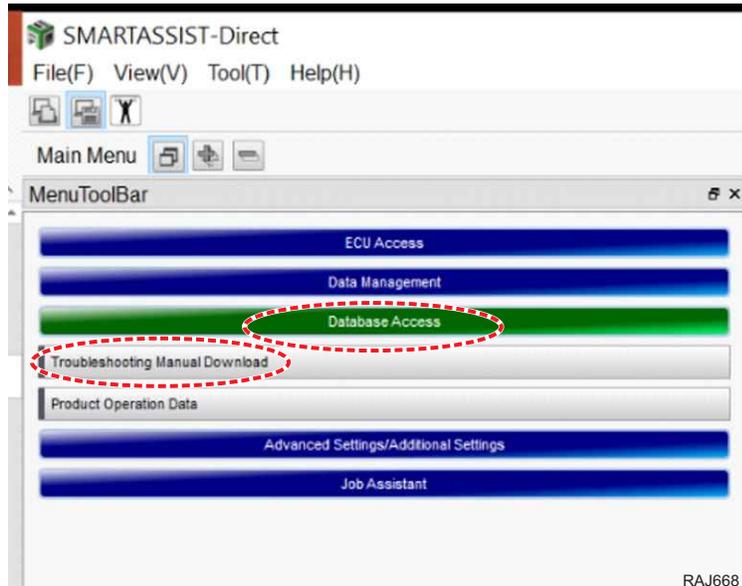
Table 7. Procedure

Step	Action	Result	Comments
1	Abnormality message is displayed. Click Yes and flash process should continue.		

Accessing and Downloading YSAD Troubleshooting Manual

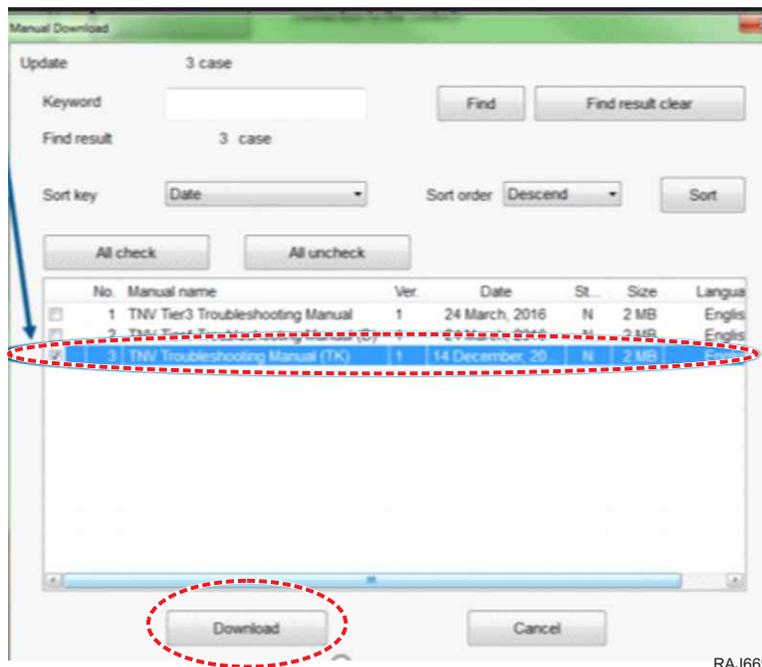
Downloading this manual will allow the technician to access much more information while diagnosing engine trouble codes.

1. Open YSAD and log in using your ID and Password.
2. Click the "Database Access" tab on the left side of the screen, then click "Troubleshooting Manual Download" tab.

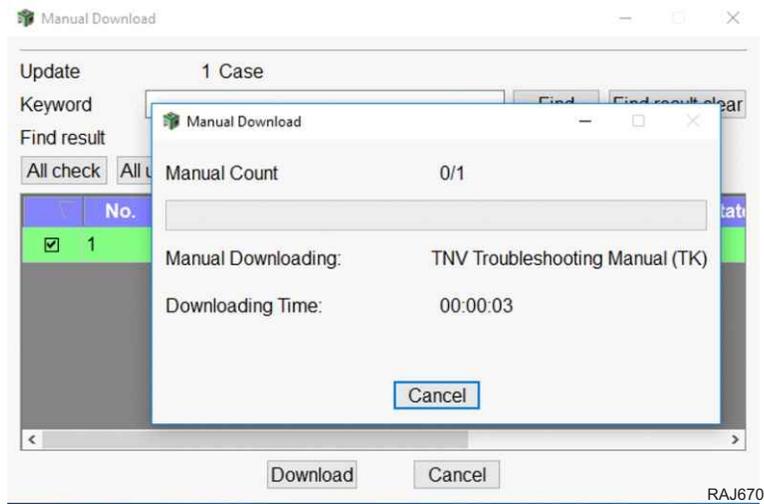


3. Check the box for "TNV Troubleshooting Manual (TK)", then click download.

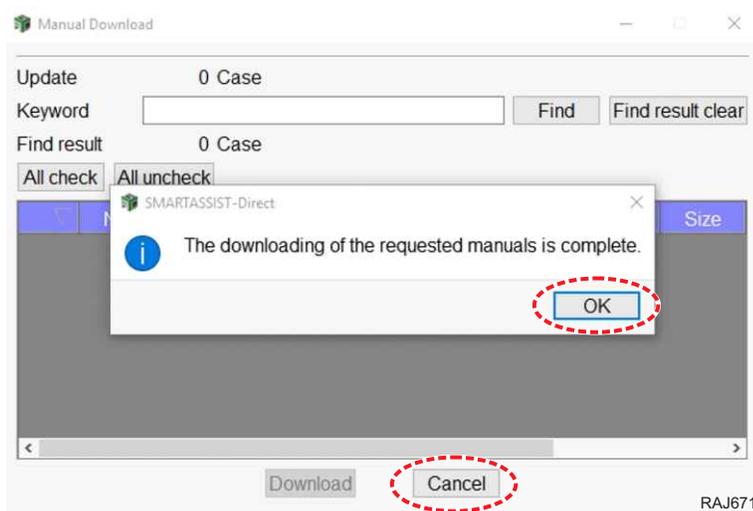
Note: If the manual was previously downloaded the manual will not show up here, skip to step 6 for manual viewing instructions.



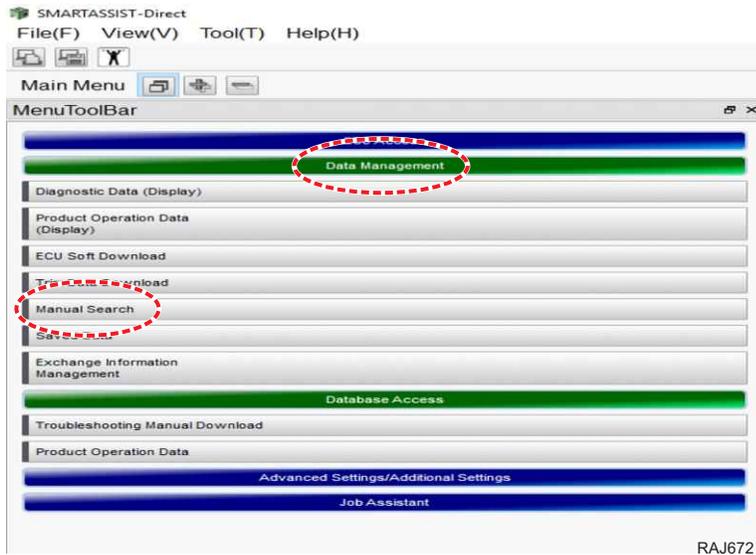
4. A pop-up will appear and show status of the download.



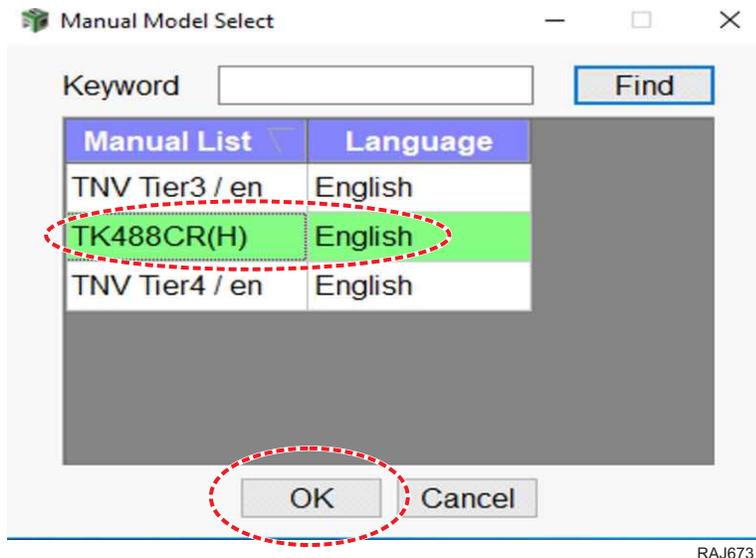
5. When Download is complete, click "OK", then click "Cancel".



6. Open the manual by clicking the "Data Management" tab and choose "Manual Search".



7. Click the “TK488CR (English)” Manual, then click “OK”.



8. The manual will open within the web browser.

Note: Add the webpage to your Favorites for quick access.

Note: Next time you need to access a manual you will not need to go through the download process. Simply open your web browser (Ex - Internet Explorer) and open the Favorite link you created for the manual .

Note: You do not need internet access to open the manual within your web browser once it has been downloaded to your computer .

Alternator Operation and Diagnosis

Megohmmeter

The use of a megohmmeter can be a valuable addition to the repair and maintenance of the generator set. The megohmmeter is essentially a high-range resistance meter (ohmmeter) with a built-in direct-current generator. This meter is of special construction with both current and voltage coils-enabling true ohms to be read directly, independently of the actual voltage applied.

The meter gives you a direct reading of insulation resistance in “ohms” or “megohms” (1 megohm = 1,000,000 ohms). For good insulation, the resistance usually reads in the megohm range.

Normally, good insulation has high resistance; poor insulation, relatively low resistance. The actual resistance values can be higher or lower, depending upon such factors as the temperature or moisture content of the insulation (resistance decreases with increase in temperature or moisture). They can be quite different for a generator tested three days in a row, yet not mean bad insulation. What really matters is the trend in readings over a time period, showing lessening resistance and warning of coming problems. Periodic testing is, therefore, your best approach to preventive maintenance.

Maintenance Procedures

The following paragraphs cover detailed maintenance procedures, including disassembly and assembly of equipment for necessary component removal and replacement. Many repair or replacement operations can be performed without extensive disassembly of the generator.

⚠ WARNING

Risk of Injury!

DO NOT attempt adjustments or changes in wiring while a unit is in operation. The unit generates sufficient voltage to cause severe and possible fatal shock. Use extreme caution when operating in wet or damp locations.

General Inspection

Inspect the entire unit to see that controls are in order and that there are no loose nuts, bolts, electrical connections or fittings. Inspect for secure engine to generator mountings. Remove any waste material from area around the unit. Check battery connections.

Insulation

Inspect insulation on wires, coils and control components. See that insulation is not frayed, broken or deteriorated. Replace wire having damaged insulation.

Field Coils, Stator Windings

Visually inspect the field coils and stator windings, their leads and connections to determine if they are electrically and mechanically satisfactory. Look for any evidence of overheating, burned or frayed insulation, loose connections, foreign matter, etc.

Generator Housing

Feel the alternator housing cautiously for abnormal temperatures as determined by previous experience with the unit. If the generator is overheated, check the winding temperature with thermometer, locate the cause such as lack of ventilation, overload, etc., and correct the condition or shut down the generator. Inspect the generator housing for obstruction of air passages.

Generator Bearing

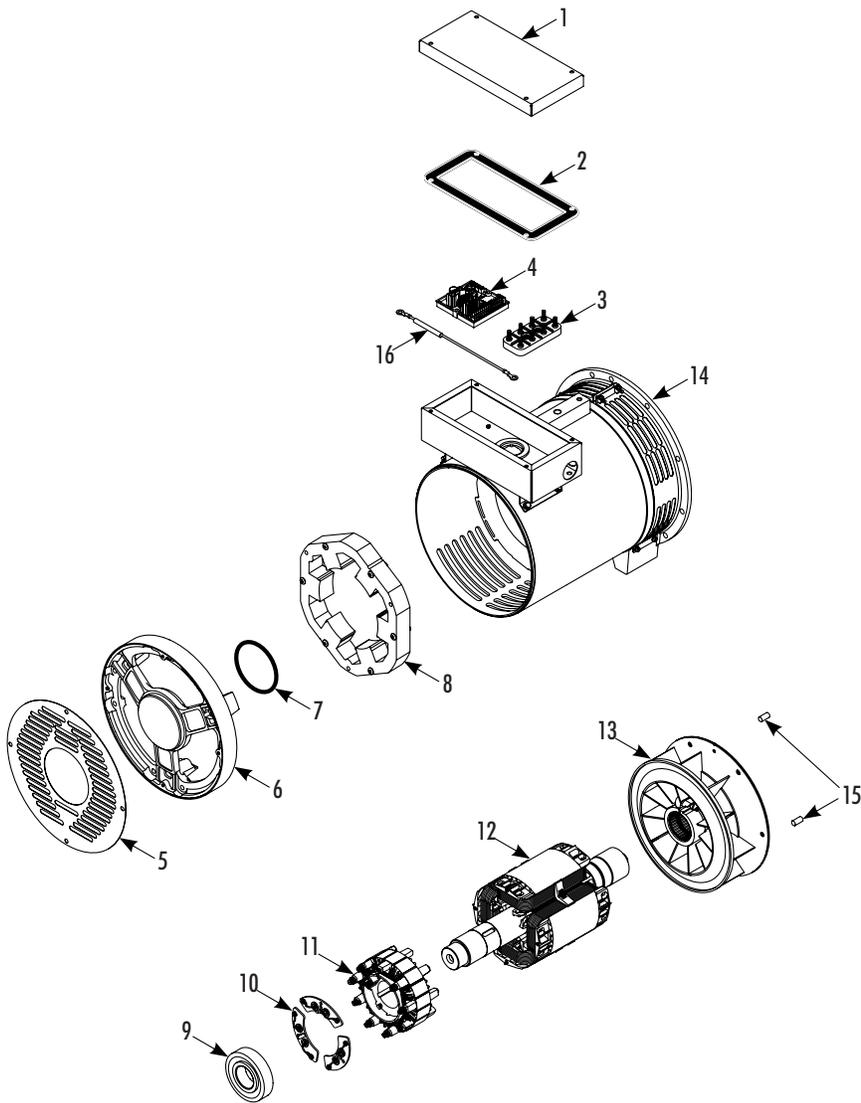
All alternators covered in this manual are fitted with a permanently lubricated bearing which requires no maintenance in normal service.

Impeller Fan

Visually inspect the impeller fan to ascertain that no vanes are missing. Visually inspect the fan is not encrusted with dirt or other foreign matter to the point where it will not function properly.

Coupling

Disc type coupling. Inspect to see that coupling bolts are tight and that the generator is solidly secured to the engine.

Figure 33. Alternator Assembly


RAJ659

1.	Rotor Assembly	9.	Rear Bearing
2.	Gasket - cover	10.	Rectifier
3.	Terminal Board	11.	Armature
4.	DSR Regulator	12.	Rotor
5.	Rear Grille	13.	Blower, Generator
6.	End Bracket	14.	Alternator Frame
7.	O-Ring	15.	Dowel Pin
8.	Stator Bracket		

General Description

The 460/230 Vac alternator consists of three principal components: the main alternator, the integral direct-connected exciter, and an externally mounted excitation control system.

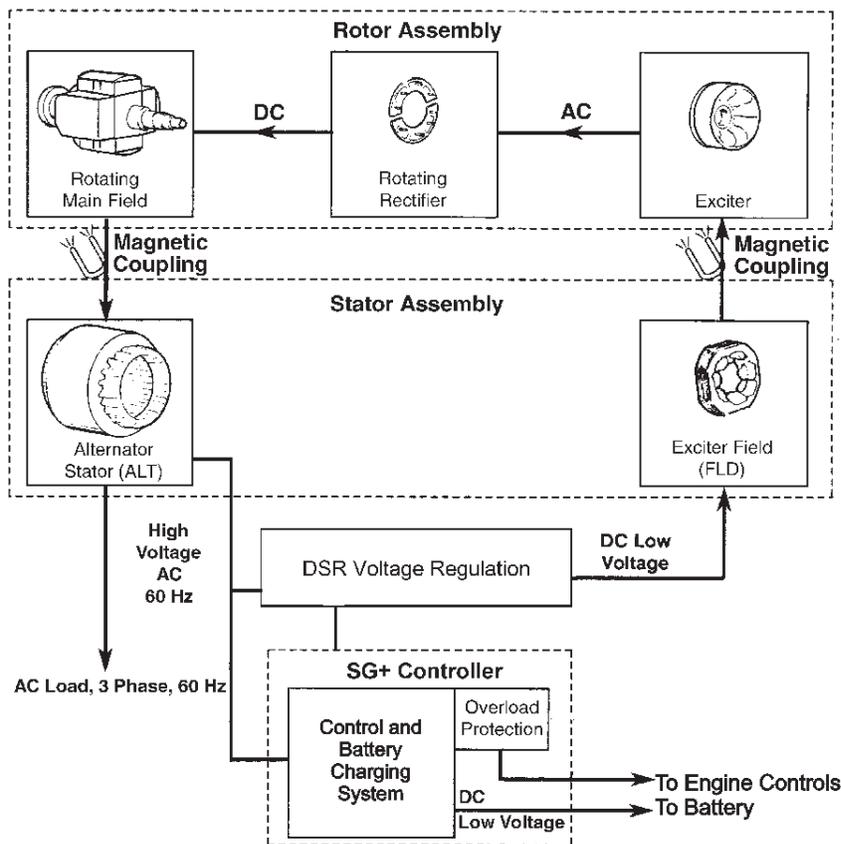
The main alternator may be subdivided into the 4-pole rotating main field and the alternator stator (ALT). The rotating main field, the rotating rectifier and the exciter armature are all mounted on a common shaft. Output of the exciter is rectified by the shaft mounted rotating bridge rectifier to provide the rotating main field excitation.

The externally mounted excitation control system is energized from the alternator output through an digital simplified regulator (DSR). Excitation power is derived from a separate 2-lead stator winding. Positive voltage build up from residual levels is provided through the semiconductor power circuitry of the DSR. The rotor contains a magnetism to maintain a residual voltage level.

The residual voltage supplies initial excitation power to the DSR. The initial excitation power increases alternator output until steady state output voltage is reached. The DSR derives a sample voltage from the output windings for voltage control purposes. In response to this sample voltage, the DSR controls the power fed to the exciter field (FLD) and thereby the rotating main field. The DSR provides closed loop control of the output voltage within the specified limits, compensating for load, speed, temperature and power factor of the generator.

Note: The generator set is factory wired for 460V power output.

Figure 34. 460/230 Vac Alternator Component Function



RAJ654



Alternator Function

Starting Excitation

The initial excitation for the alternator is supplied by residual magnetism in the main field. Residual main stator voltage provides initial excitation power to the digital simplified regulator (DSR) from a separate 2-lead stator quad winding. The controller energizes Quad Relay 2 minutes after the engine starts. Energizing the Quad Relay starts current flow from the DSR to yellow wire. The yellow wire sends the current through the exciter field to build voltage in the stator windings. The exciter field current then returns through the blue wire to chassis ground.

Running Excitation and Control

When the alternator output reaches the rated voltage, excitation is provided by the alternator excitation winding. The magnetic field that was formed in the exciter field winding induces voltage in the exciter rotating winding. This output voltage is changed from three-phase ac to dc by the rotating rectifier. The dc current is transferred to the rotating main field winding. The rotating main field now becomes magnetized. The magnetic field formed in the rotating main field winding induces a voltage in the alternator stator windings. This voltage is sent out of the alternator stator leads to the power plug and load. 460 Vac, 3-phase output can be measured at the power plug. In addition to being powered from the stator excitation winding, the DSR monitors the stator output for voltage control purposes. The DSR controls the voltage fed to the exciter field to maintain the alternator output voltage within specified limits.

Overload

For temporary overloads (such as refrigeration unit start up), the DSR controls the voltage fed to the exciter field to maintain the alternator output voltage. Over voltages caused by open circuit sensing terminals are avoided by loss detection sensing circuitry that reduces the alternator terminal voltage to a safe fixed level.

Overload Shutdown

The overload shutdown is provided by the controller.

If an overload condition becomes more than temporary, the reduction in alternator output voltage due to the overload causes the DSR to increase field current through yellow wire. The DSR senses the overload current and sends a signal out through the Open Collect circuit. The controller reads this signal and shuts down the engine. A 20 minute restart is initiated.

If the controller shuts down unit operation, it indicates one of the following:

1. There is a malfunction in the load causing the load to fail to start or to draw single phase current.
2. The engine speed or power is low due to improper speed adjustment, fuel supply problems or other mechanical conditions while the generator is supplying motor starting current to the load.
3. Internal component failure in the excitation control system, resulting in excessive field current. This includes possible malfunction of protective elements in the excitation control.
4. Failure in the alternator rotating elements (exciter armature, rotating diode assemblies or main field) can cause the regulator to supply excessive exciter field current.
5. Engine shutdown on low engine oil level, low oil pressure or high water temperature.

Alternator Diagnosis

Preliminary Checks

⚠ WARNING

Risk of Injury!

Extreme care must be used when working with an operating generator set. Lethal voltage potentials exist inside the control box, at terminals on the DSR and at the power receptacle.

Before attempting the more complicated diagnosis procedures, check the following items to ensure a superficial problem is not overlooked.

Note: Further diagnosis is a waste of time until these items are checked, since a problem in one of these areas will influence test results.

1. If the generator malfunction is accompanied by excessive black exhaust smoke and engine lugging, double check all possible engine problems such as fuel supply, injection timing, engine speed, restricted air cleaner, etc.
2. Disconnect the refrigeration unit from the generator and check the output voltage at the plug. Voltage between the three phases should be between 230 to 250 Vac or 400 to 500 Vac depending on engine speed and whether the alternator stator is wired for 230 or 460 Volt operation. All three phases should be within 3% of each other. If the voltages appear normal, make sure the refrigeration unit is not at fault. Reconnect refrigeration unit and run in Cool mode. Check the amperage draw with an induction type ammeter (amprobe), and compare it with the load plate on the refrigeration unit.
3. Check all push-in plugs on control circuits for loose pins or sockets. Make sure all wire terminals are tight. Be sure J6 connector is plugged in to controller, if disconnected can cause a Message 122.

Test Instruments

If the preceding checks did not uncover the cause of the malfunction, more extensive diagnosis procedures will be required. The following tests will require various electrical test instruments, and the technician performing the tests should have a good working knowledge of their basic electrical principles.

The tests are intended to determine whether the source of difficulty lies in the generator itself or in the excitation control system. Following the procedures carefully will, in many cases, avoid unnecessary dismantling and reassembly of the generator when easily corrected problems may exist in the external circuitry.

The test instruments required:

1. AC-DC voltmeter 2.5 Volts to 500 V ranges ($\pm 2\%$ max. error)
2. AC induction ammeter (amprobe)
3. DC ammeter (preferably induction type TK No. 204-947)
4. Ohmmeter
5. Megohmmeter (Megger®)

Alternator Troubleshooting

⚠ WARNING

Risk of Injury!

WARNING: When servicing or repairing a generator set, the possibility of serious or even fatal injury from electrical shock exists. Extreme care must be used when working with an operating generator set. Lethal voltage potentials can exist at the unit power cord, inside the exciter control box, inside any high voltage junction box and within the wiring harnesses.

Normal alternator output voltage is 460 +/- 10 VAC with engine rpm 1800 +/- 25 rpm and no load applied. If the generator produces no or low voltage output at the plug, perform the tests listed below to identify the component that may be causing a generator malfunction.

- Symptom: Low Output Voltage—0 to 100 Vac

Note: The DSR has a glass fuse (5AF 250 Volt) on the board. Check fuse - if this fuse is blown, replace it and check output voltage.



Note: Using a flashlight visually inspect exciter rotor for signs of being burnt, if burnt replace alternator.

Test 1 - Determine if problem is with the DSR or the Alternator

During the 2 minute delayed output, perform the following steps:

1. Turn unit OFF.
2. Open the junction box on the alternator and disconnect the Blue and Yellow wires from the DSR pins 1 and 2. Connect jumper wire from 12 VDC positive post of unit battery to the Yellow wire. Connect another jumper wire to the Blue wire.
Note: Do not connect blue wire to ground yet.
3. Connect an AC volt meter to the output terminals U1 and V1.
 - Start genset - engine will be in low speed.
4. Momentarily connect the jumper wire from the Blue wire to negative post of battery and monitor the output voltage. Output voltage should be >400 VAC.

Note: If output voltage is not >400 VAC go to Test 2

5. If the output is >400 VAC,
 - a. Stop genset and check the resistance on the Quad winding.
 - b. Disconnect the Red wire on Pin 3 and Red wire to DSR wire,
 - c. Check resistance between the Red wires, should be 1.6 ohms.
 - d. If resistance is correct go to step 6.
6. Check the Quad relay circuit. Connect the ohm meter to the DSR wire and Quad wire. Turn genset on and go to Commands/Manual Function Test, select Quad relay test. Observe if ohm meter changes when relay turns ON and OFF. If relay is working replace DSR.

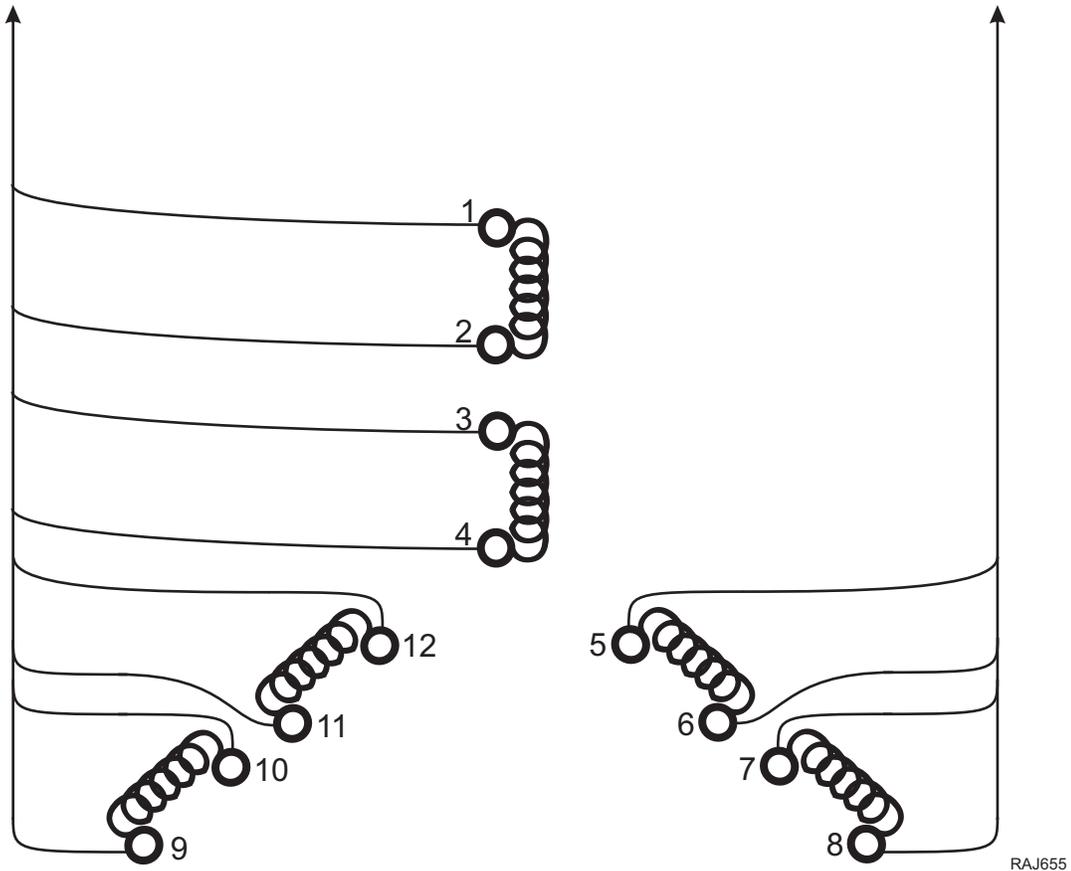
Test 2 - Alternator Exciter Field Testing

1. Disconnect the Blue and Yellow wires from pin 1 and 2 on the DSR field wire. Measure the resistance of the field circuit (Blue to Yellow). The standard value is 9.7 ($\pm 10\%$) ohms at 77 F (25C). If field is open or resistance value is low replace exciter field.
2. Measure Blue or yellow wires to GND for possible shorted to ground coils. Megger blue to stator case to check for insulation break down, @ 500 Volts must be more than 1 M ohm. If exciter field is OK, go to test 3.

Test 3 - Alternator Stator Testing

Test 3 covers testing the main alternator stator, the rotating rectifier, the rotating exciter field, and the rotating field armature.

1. Main alternator stator windings
 - a. Disconnect the stator leads from the terminal board and neutral stud in the terminal box. Check for continuity between the following pairs. 1-2, 3-4, 5-6, 7-8, 9-10, 11-12. The resistance between any of the pairs should be 0.239 ($\pm 10\%$) Ohms at 25 C (77 F).
 - b. Check resistance between the pairs of coils (example: 1-3, 1-5, 1-7, 1-9, 1-11, then 3-5, 3-7, etc...). If any continuity or resistance is found, there is a short between pairs (leg to leg) and the alternator needs to be replaced.
 - c. Using a megger meter, check for insulation break down between each pair (1 to gnd, 3 to gnd, 5 to gnd, etc...)of leads to the stator case. @ 500 Volts must be more than 1 M Ohms. If less than 1 M Ohms, replace alternator.

Figure 35. Alternator Stator


RAJ655

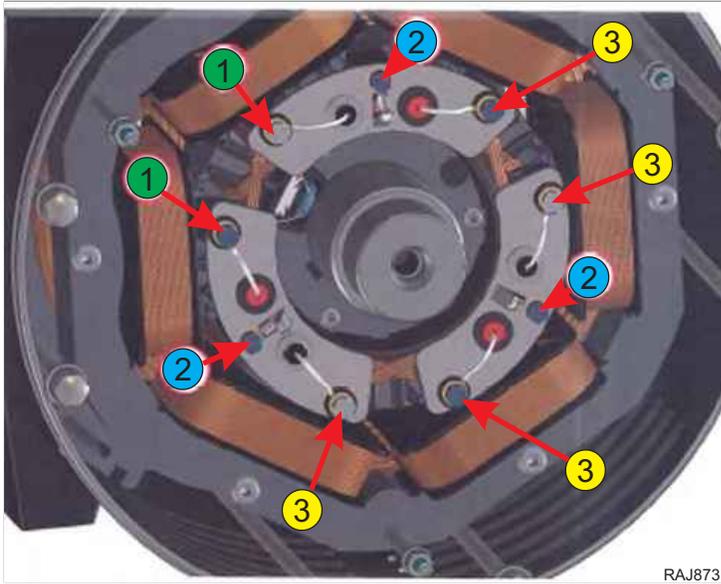
1-12

Disconnect all 12 stator leads to test the stator.

Test 4- Exciter and Diode Test

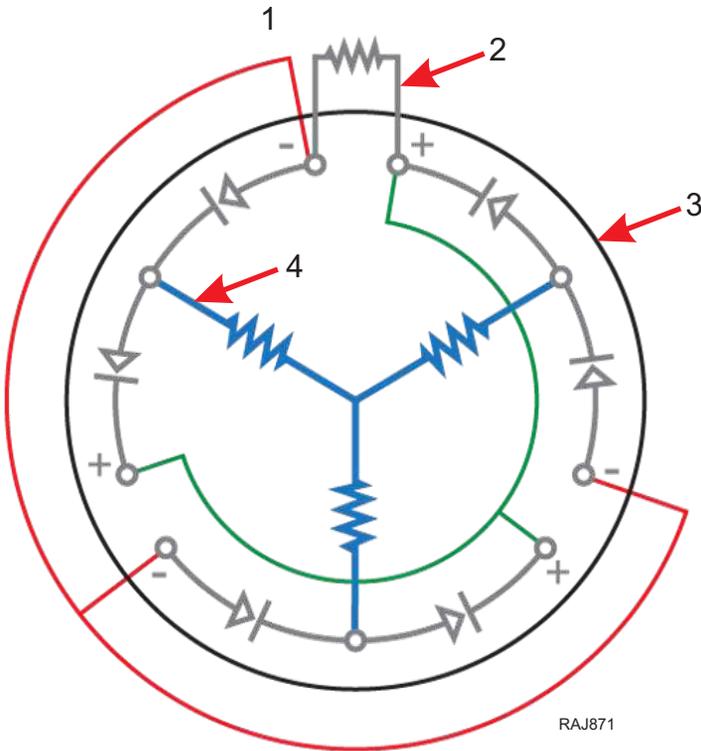
Test 4 covers testing the exciter and diodes. Each plate has one positive and one negative diode mounted to it. Disconnect the main alternator field leads to test the diodes.

1. Remove rear grille from the alternator.
2. Disconnect wires from 1, 2, and 3.
3. Measure the resistance between 1 and 1. The main field resistance should be **1.3 Ohms +/- 10%**.
4. Use a megger meter to check for a break in the insulation from 1 to rotor case.
5. Measure the resistance between 2 to 2, 2 to 2, and 2 to 2. The rotating field and exciter armature resistance should be **0.420 Ohms +/- 10%**.



RAJ873

Figure 36. Exciter Rotor Components



RAJ871

1.	Main Field
2.	DC Voltage
3.	Exciter Rotor
4.	AC Voltage

6. Unbolt the main field armature leads. Along with the main field armature leads are leads to a MOV. The MOV is a high voltage suppression device. When measured it will show open, it closes with peak voltage more than 600V cannot test.
7. Test rectifier. Each plate as one positive and one negative diode mounted to it. Use a volt /ohm meter in the diode test setting to check each diode in the forward and reverse direction. A good diode will have a high resistance reading in one direction and no reading when ohmmeter leads are reversed. Replace if a short is found or the diode flows in both directions.



RAJ872

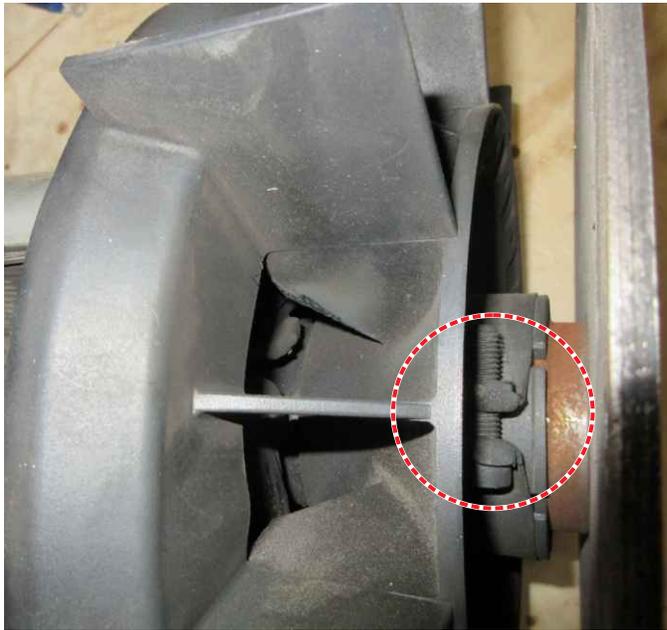
Alternator Replacement

Alternator Removal

When removing the alternator from the engine do not separate the stator and rotor, remove as one assembly.

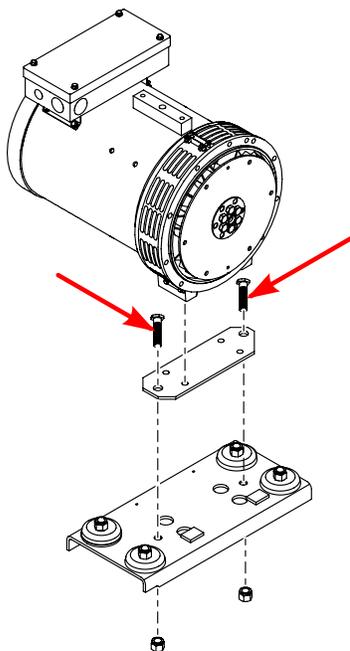
1. Remove the grill from around the alternator. Remove all but one of the bolts holding the alternator to the flywheel housing.
2. Remove the bolts holding the flex plate to the flywheel. If fan blade is blocking access to bolts, loosen fan blade clamp and rotate fan to gain access. Remember to re-tighten fan clamp when servicing is complete.

Figure 37. Fan Clamp



RAJ831

3. Remove the two bolts holding the alternator mount plate to the engine alternator support mount.



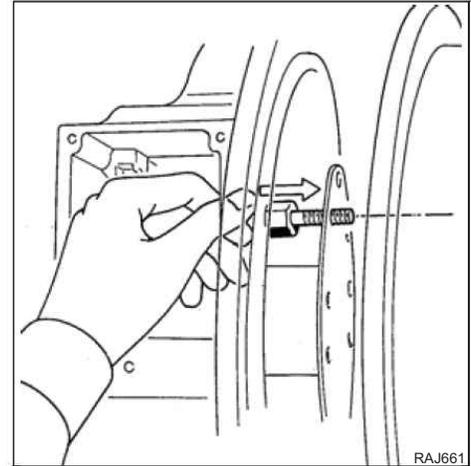
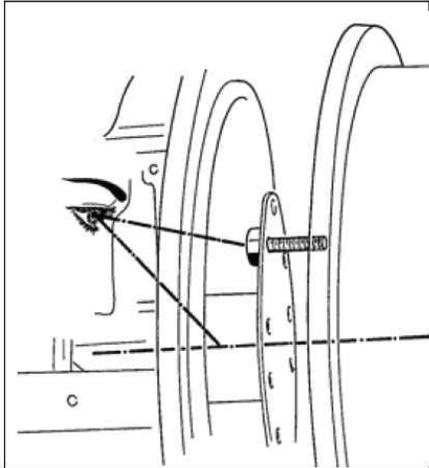
RAJ937

- Once all flex plate bolts are removed, be sure to support engine and alternator, remove the last bolt holding the alternator to flywheel housing and remove alternator from engine.

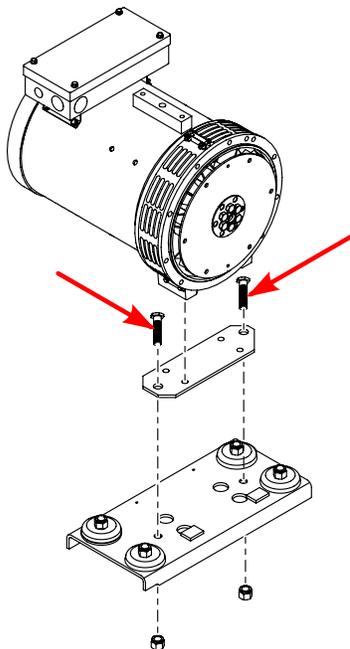
Alternator Installation

Note: A bad alignment may cause vibrations and bearing damage. It is advisable to verify the compatibility of the generator torsional characteristic's and the Engine.

- Position the alternator assembly up to the flywheel housing. Align the 2 dowel pins in the flywheel to the holes in the flex plate. Start to install the bolt through the alternator outer ring to the flywheel housing. Install bolts at the 10 and 4 o'clock position.



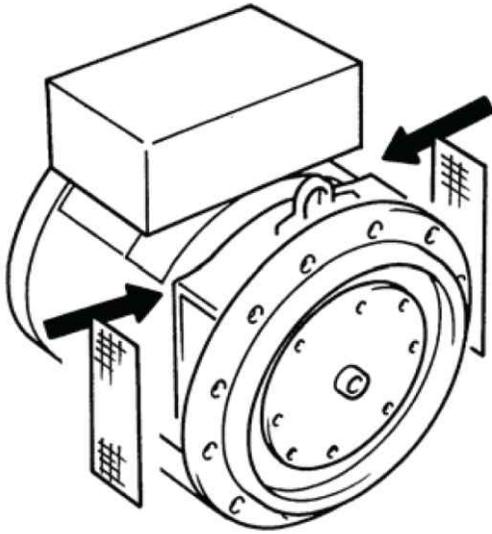
- Start to install the bolts through the flex plate to the flywheel. Rotate engine to install all the bolts. Loosen fan and rotate if needed. Torque bolts to 16 Nm (12 ft-lbs). If fan blade is blocking access to bolts, loosen fan blade clamp and rotate fan to gain access. Re-tighten fan clamp if loosened.
- Install the two bolts holding the alternator mount plate to the engine alternator support mount and torque to specification: 127 ft-lbs (172 Nm).



RAJ937

Alternator Operation and Diagnosis

4. Install the alternator to flywheel housing bolt and torque to 45 Nm (33 ft-lbs).
5. Install grills.



RAJ662

Structural/Accessory Maintenance

Unit Inspection

Inspect the unit during unit pre-trip inspection and scheduled maintenance intervals. Look for loose or broken wires or hardware, and other physical damage which might affect unit performance. Repair if required.

Note: See *Maintenance Inspection Schedule* chapter in this manual for the correct service interval for your unit. 250 or 500 hour inspection/service intervals are required in extreme operating conditions.

Mounting Bolts

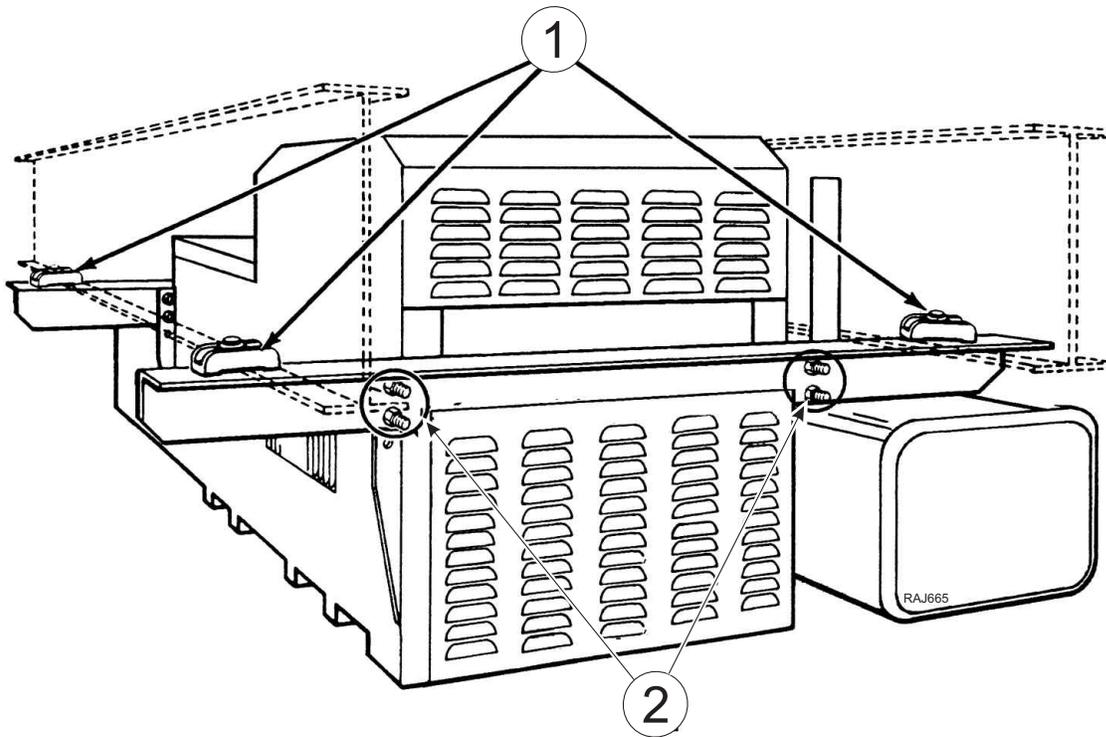
Check and tighten all engine and control box mounting bolts every 1,000 operating hours. Unit mounting hardware should be inspected for tightness during every pretrip.

Mounting Bolt	Torque Specification
SGCM	
Mounting Arm to Unit Frame	88 to 115 Nm (65 to 85 ft-lbs)
Chassis Clip Bolt	162 to 176 Nm (120 to 130 ft-lbs)
SGCO	
Upper Clamp	Lock Clamp with Lock Pawl
Lower Mounting Bolts	300 to 380 Nm (220 to 280 ft-lbs)
All Units	
Engine Mounting Bolts	172 Nm (127 ft-lbs)
Exciter Control Box	20 to 27 Nm (15–20 ft-lbs)



SGCM Unit Installation

1. Loosen mounting bolt and rotate clip 90 degrees.



1.	Fasten Chassis Clips on the Outside Edge of each I-Beam and Tighten Bolts
2.	Tighten Mounting Arm to Unit Bolts

2. Move the unit under container or trailer chassis. Rotate each mounting clip on top of a chassis frame member. Locate each clip as close to the vertical web of the chassis member as possible.

⚠ CAUTION

Service Procedures!

Keep all container or trailer electrical lines and air lines away from the clips to prevent damage during unit installation and operation.

3. Torque the mounting bolts:
 - Chassis Clip Bolt: 162 to 176 Nm (120 to 130 ft-lb)

SGCO Clip-on Corner Clamp Unit Installation

⚠ CAUTION

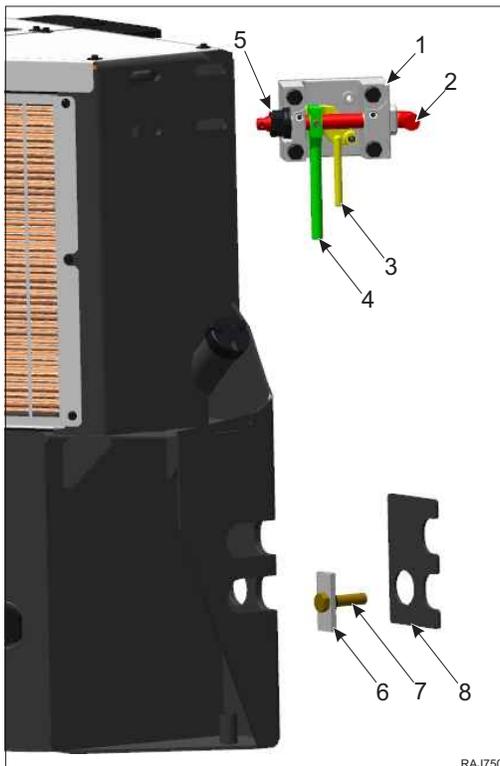
Risk of Injury!

Take adequate precautions when lifting and mounting the generator set to prevent personal injury or unit damage.

⚠ CAUTION

Service Procedure!

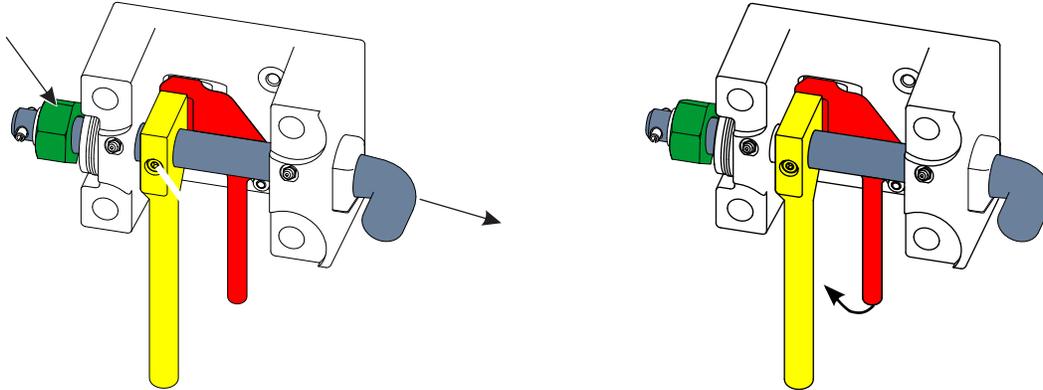
Excessive vibration or unit malfunction can occur if mounting clamps are not properly secured. The generator set **MUST** be tight against the container.



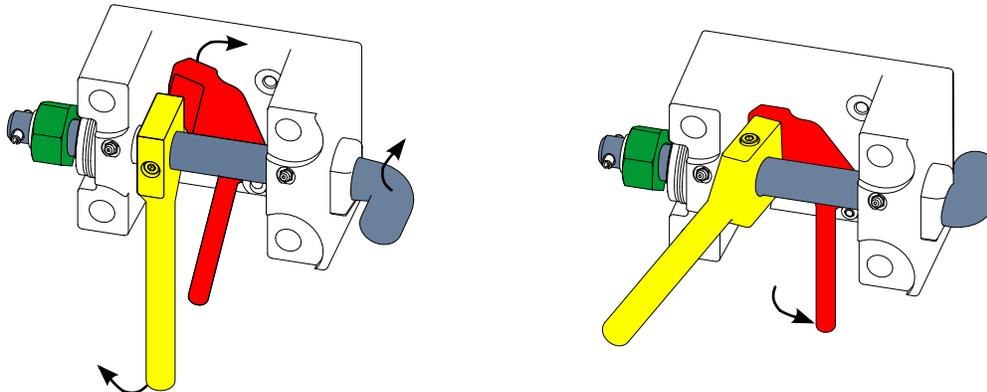
1.	Unit Mounting Bracket Assembly (one per side)	5.	Lock Nut
2.	Clamp Shaft	6.	Washer
3.	Clamp Paw	7.	Lower Mounting Bolt
4.	Clamp Handle	8.	Door



1. Loosen the locking nut (5) so the clamp shaft (2) can extend to the rear of the unit.
2. Pull the clamp pawl handle (3) towards the front of the unit to unlock the clamp handle (4).

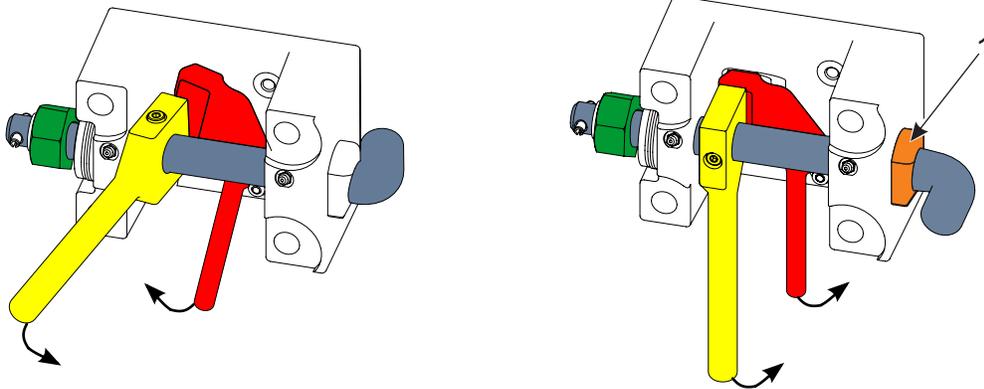


3. Lift the clamp handle (4) upwards to rotate the clamp shaft foot (2) 90 degrees upwards.
4. Let the clamp pawl (3) drop down to hold the clamp handle (4) in position.



5. Use appropriate heavy equipment to lift the unit into mounting position on front wall of the container. The foot of the mount clamp (5) should fit into corner casting on each side of the container.
6. Ensure the angled foot of the clamp shaft (5) fits properly into the container corner casting on each side of the unit.

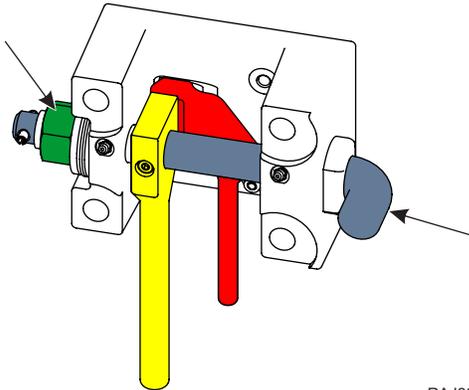
7. Pull lock pawl handle (3) towards the front of the unit to unlock the clamp handle (4).
8. Pull the clamp handle (4) downward to rotate the clamp shaft (2) 90° and clamp generator set to container.
9. Release the clamp pawl handle (3) so it is back into locking position and holds the clamp handle (4) in the locked (down) position.
10. Ensure the generator set frame fits tightly against the container. Turning the mounting clamp handle should pull the generator set frame tight against the container corner casting. Be sure the clamp boss (shown below) is sitting inside the container corner casting hole. The clamp shaft can be tightened or loosened by turning the nut on the head of the clamp shaft.



RAJ837

1.	Clamp Boss
----	------------

11. Tighten the locking nut (5) with hand wrench. The mounting clamp can be tightened or loosened by turning the lock nut (5) on the head of the clamp shaft.



RAJ839

12. Install the lower mounting bolts:
 - a. Open door flap. Remove lower mounting bolts from storage tube. Install bolts into the container post.
 - b. Tighten the lower mounting bolts to 300 to 380 Nm (220 to 280 ft-lb).
 - c. Close the door flap.



SGCO Clip-on Corner Header Pin Unit Installation

1. Lift the unit into mounting position on front wall of the container. Both header pins of generator set mounting channel should fit into mounting holes on top of the container.

⚠ CAUTION

Risk of Injury!

Take adequate precautions when lifting and mounting the generator set to prevent personal injury or unit damage.

2. Check to be sure the generator set frame fits tightly against the container.

⚠ CAUTION

Service Procedure!

Excessive vibration or unit malfunction can occur if mounting clamps are not properly secured. The generator set **MUST** be tight against the container.

3. Install the lower mounting bolts:
 - a. Open door flap. Remove lower mounting bolts from storage tube. Install bolts into the container post.
 - b. Tighten the lower mounting bolts to 300 to 380 Nm (220 to 280 ft-lb).
 - c. Close the door flap.

Telematics Information

Telematics General Description

The telematics system allows the unit owner real-time remote genset monitoring and management access. This system monitors and communicates the following information to the unit owner through the Thermo King Telematics System:

- Asset Name
- Unit Location (GPS Tracking)
- Genset Status (ON/OFF)
- Battery Voltage
- Fuel Level
- Engine RPM
- Engine Load %
- Engine Temperature
- Generator Voltage
- Generator Hz
- Total Hours

Important: Typically technicians and repair facilities will not have access to the information the telematics system is transmitting. This special access is controlled and managed by the genset unit owner.

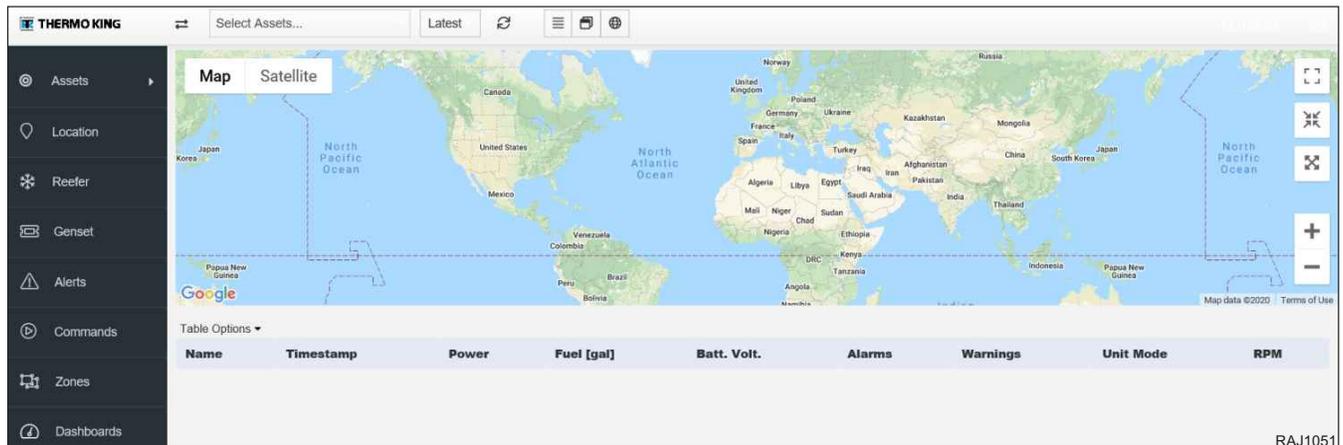
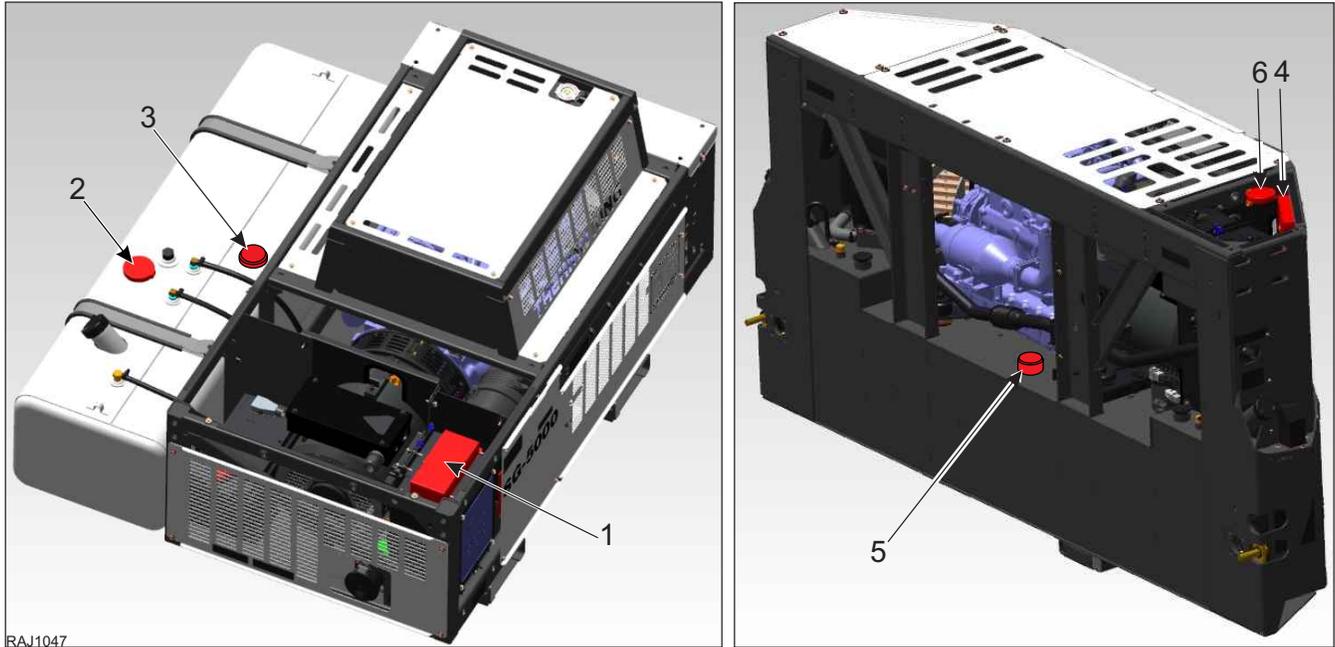


Table Options								
Name	Timestamp	Power	Fuel [gal]	Batt. Volt.	Alarms	Warnings	Unit Mode	RPM

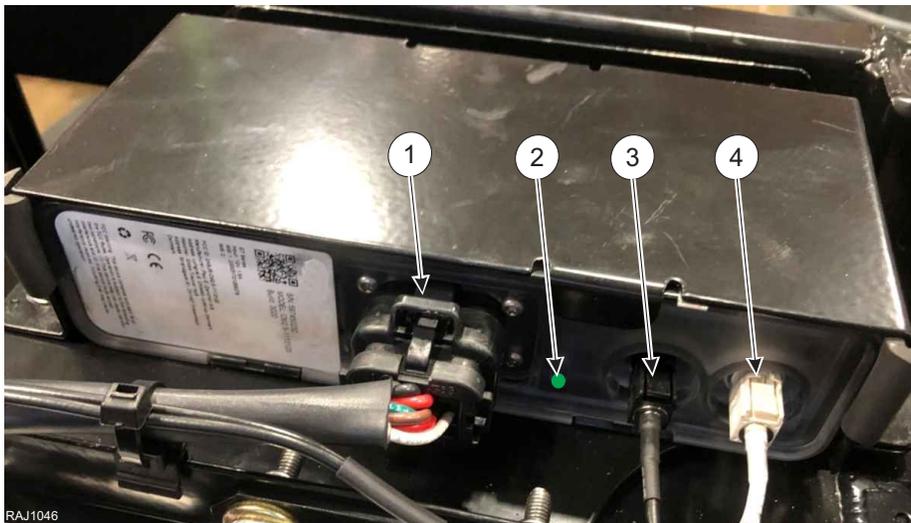
Telematics Component Locations

Figure 38. SGUM and SGCO 5000 (Covers Removed)



1.	SGUM 5000 Control Module Location	4.	SGCO 5000 Control Module Location (attached to cover)
2.	SGUM 5000 Antenna Location	5.	SGCO 5000 Antenna Location (attached to cover)
3.	SGUM 5000 Fuel Level Sensor Location	6.	SGCO 5000 Fuel Level Sensor Location

Figure 39. Telematics Module



1.	Main Control Harness Connection / Unit Data	3.	GPS Antenna Connector (from antenna)
2.	Diagnostic LED (can flash red, green, or yellow in color)	4.	LTE / Cell Connection (from antenna)

Telematics Module Cycle Identification (LED Flash)

Important: When the unit is ON the telematics system will communicate with the unit owner at least every 15 minutes (see the communication schedules below). When the units is turned OFF, the telematics system sends only GPS, battery voltage, and fuel level information once a day.

Important: Typically, service technicians will not know there is an issue with the telematics system until the unit owner reports unit problems. If telematics issues are reported by the unit owner, the technician can perform some diagnostic checks and repair on the unit and/or telematics system.

The telematics module features an LED flashing sequence that can be used to check the operation mode. The LED is located on the front of the device in between the antenna connectors and the main connector.

The telematics module goes through three communication cycles (the unit can be ON or OFF):

- **CELL COMMUNICATION CYCLE** - The telematics module communicates to the server to transmit location and reefer data once **every 15 minutes**.
- **GPS COMMUNICATION CYCLE** - The telematics module communicates to GPS satellites to obtain location data once **every 10 minutes**.
- **GENSET COMMUNICATION CYCLE** - The telematics module communicates to the controller to obtain data **every 30 seconds**.

Communication cycles can be identified by a unique flashing sequence of the LED on the front of the telematics module. This flashing sequence is repeated three times for each communication cycle:

CELL COMMUNICATION CYCLE: A call is made every 15 minutes which can be identified by:

- 3 short orange flashes - The telematics module is busy making a call
- 3 short green flashes - The telematics module has successfully made a call
- 3 short red flashes - The telematics module is unable to call in

CELL COMMUNICATION CYCLE (every 15 minutes)										
LED Flashes	■	■	■	■	■	■	■	■	■	Module has successfully called in
	■	■	■	■	■	■	■	■	■	Module was not able to call in

RAJ1052

Important: The ability of the device to call in depends on the availability and strength of the GSM / CELL signal. A missing or bad signal can result in 3 red flashes. This does not mean that there is a problem with the telematics module. Allow the module to go through several call cycles before continuing diagnostics or module replacement.

Important: The GPS / CELL antenna may not be able to receive signal indoors (shop bay). The function must be verified outdoors where good signal can be reached.

Note: Verify CELL signal by viewing your mobile phone signal level. This check will give an estimate on CELL signal strength level, but can be inaccurate due to the many telecom providers.

Telematics Information

GPS COMMUNICATION CYCLE: Location records are obtained every 10 minutes which can be identified by:

- 2 short orange flashes - The telematics module is obtaining GPS data
- 2 short green flashes - The telematics module has successfully obtained GPS data
- 2 short red flashes - The telematics module is unable to obtain GPS data

GPS CYCLE (every 10 minutes)											
LED Flashes	Orange	Orange	White	Orange	Orange	White	Green	Green	White	Green	Module has successfully obtained GPS data
	Orange	Orange	White	Orange	Orange	White	Red	Red	White	Red	Module was not able to obtain GPS data

RAJ1053

Important: The ability of the device to obtain GPS data depends on the availability and strength of the GPS signal. A missing or bad signal can result in 2 red flashes. This does not mean that there is a problem with the telematics module. Allow the module to go through several GPS cycles before continuing diagnostics or module replacement.

Important: The GPS / CELL antenna may not be able to receive signal indoors (shop bay). The function must be verified outdoors where good signal can be reached.

Note: Verify CELL signal by viewing your mobile phone signal level. This check will give an estimate on CELL signal strength level, but can be inaccurate due to the many telecom providers.

GENSET COMMUNICATION CYCLE: Genset data is obtained every 30 seconds which can be identified by:

- 1 short orange flash - The telematics module is obtaining data from the unit controller
- 1 short green flash - The telematics module has successfully obtained data from the unit controller
- 1 short red flash - The telematics module is unable to obtain data from the unit controller

GENSET COMMUNICATION CYCLE (every 30 seconds)											
LED Flashes	Orange	White	Orange	White	Orange	White	Green	White	Green	White	Module has successfully obtained genset data
	Orange	White	Orange	White	Orange	White	Red	White	Red	White	Module was not able to obtain genset data

RAJ1054

Important: Sometimes the device cannot obtain genset data from the unit controller due to various reasons. This will result in 1 red flash. This does not mean that there is a problem with the telematics module. Allow the telematics module to go through several cycles before continuing diagnostics or module replacement.

Telematics Diagnostic Information

Important: The telematics system (when operating normally) will communicate with the unit owner non-stop - even when the SG unit is turned OFF. Typically, service technicians will not know there is an issue with the telematics system until the unit owner reports problems. If telematics issues are reported by the unit owner, the technician can perform some diagnostic checks and repair on the unit and/or telematics system.

Important: Each unit is uniquely paired to a telematics module on the assembly line:

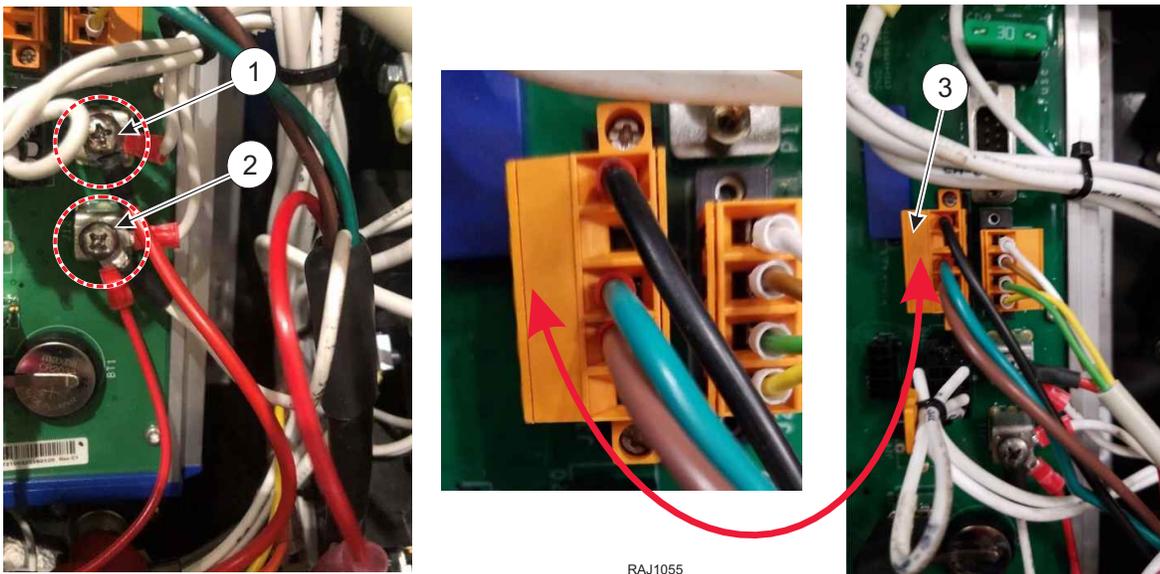
- Do not swap telematics modules between units.
- If the telematics module is replaced, it must be uniquely paired to the unit using an app and a compatible device.

If the telematics system is not working correctly, perform the following steps before replacing the telematics module:

1. Put the unit into ECU SERVICE MODE found in the COMMANDS MENU:
 - Place the SG unit main On/Off switch in the "ON" position.
 - Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
 - Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
 - Press the ENTER key to enter the Commands Menu.
 - The PTI submenu will be displayed.
 - Press the UP or DOWN key to scroll up or down through the Commands Menu and select the ECU SERVICE MODE.

Putting the SG unit into ECU SERVICE MODE allows the telematics system to operate normally, and will prevent the engine from starting.

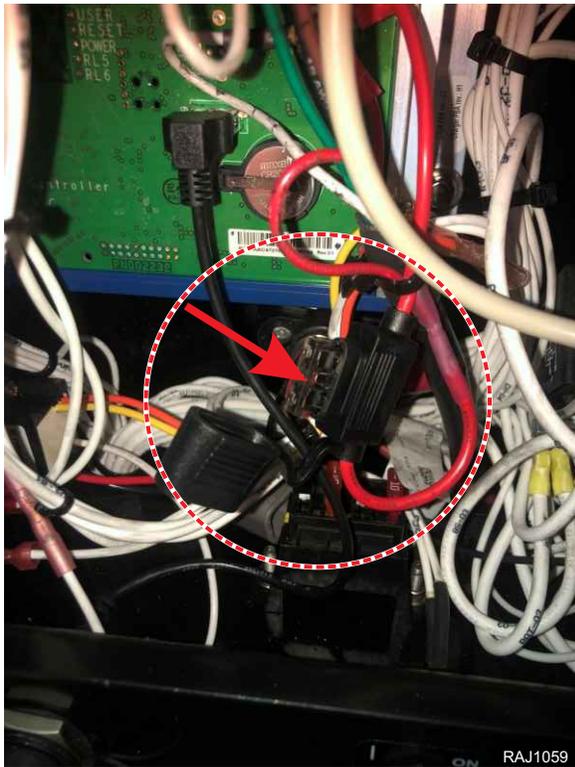
2. Verify the SG unit is supplying battery voltage to the telematics system on connections J12 (switched B+ with unit ON/OFF switch) and J13 (B+) on the controller. If battery voltage is not present, diagnose the issue with the SG unit.
3. Verify all other telematics connections are correct and tight at the controller:



RAJ1055

1.	J13 Connection - Red Power Supply Wire Connection for Telematics System with Fuse (B+)
2.	J12 Connection - White Power Supply Wire Connection for Telematics System (B+ switched by unit On / Off switch)
3.	J3 Connection - Telematics Connector Location

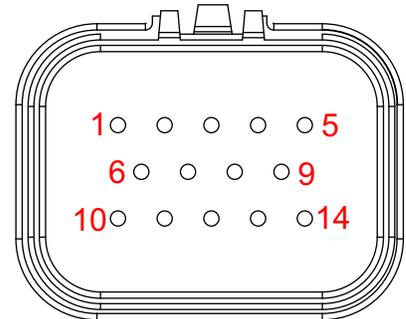
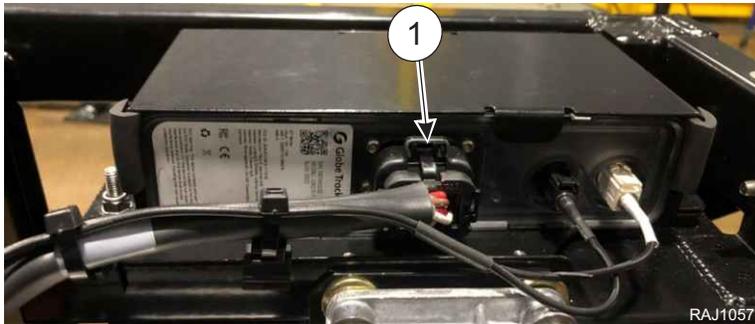
4. Check the telematics system 2A fuse located on the telematics J13 connection in an individual fuse holder near the control module and replace if necessary:



5. Turn the SG unit OFF. Disconnect the telematics module main connector and check main harness wiring continuity from the control box to the telematics module. Ensure the terminals inside the main connector are tight and the connector is engaged firmly to the module. Check the module pins and verify that are not bent out of place.
6. Put the SG unit into ECU SERVICE MODE found in the COMMANDS MENU:
 - Place the SG unit main On/Off switch in the "ON" position.
 - Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
 - Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
 - Press the ENTER key to enter the Commands Menu.
 - The PTI submenu will be displayed.
 - Press the UP or DOWN key to scroll up or down through the Commands Menu and select the ECU SERVICE MODE.

Putting the SG unit into ECU SERVICE MODE allows the telematics system to operate normally, and will prevent the engine from starting.

7. With the main connector disconnected, verify battery voltage (B+) is present on pin 2 and 10. Verify ground (B-) is present on pin 1. Replace the telematics harness if continuity or power and ground supply are not present at the telematics module.



Back of Connector

Main Connector Pin Information			
Pin 1	Black Wire - B- Ground	Pin 8	Not Used
Pin 2	Red Wire - B+ Voltage	Pin 9	Not Used
Pin 3	Not Used	Pin 10	White Wire - B+ Voltage (switched by unit On / Off switch)
Pin 4	Not Used	Pin 11	Not Used
Pin 5	Not Used	Pin 12	Not Used
Pin 6	Green Wire - Unit Information Signal	Pin 13	Red Wire - Fuel Sender Signal
Pin 7	Brown Wire - Unit Information Signal	Pin 14	White Wire - Fuel Sender Signal

8. Turn the SG unit OFF and reconnect all telematics connections.
9. Put the SG unit into ECU SERVICE MODE found in the COMMANDS MENU:
- Place the SG main On/Off switch in the "ON" position.
 - Press the ENTER key or the ESCAPE key to enter the Main Menu, if necessary.
 - Press the UP or DOWN key to scroll up or down through the Main Menu to the Commands Menu.
 - Press the ENTER key to enter the Commands Menu.
 - The PTI submenu will be displayed.
 - Press the UP or DOWN key to scroll up or down through the Commands Menu and select the ECU SERVICE MODE.

Putting the SG unit into ECU SERVICE MODE allows the telematics system to operate normally, and will prevent the engine from starting.

10. Observe the telematics module LED flash sequence:

- If the LED is NOT flashing a sequence and the connections, harness, power and ground supply are all verified good, replace the telematics module.
- If the LED is flashing RED in any of the three sequences (CELL, GPS, GENSET), allow the system to go through a few communications cycles. Ensure the unit is outside and has access to CELL and GPS signal.
Note: Verify CELL signal by viewing your mobile phone signal level. This check will give an estimate on CELL signal strength level, but can be inaccurate due to the many telecom providers.
- If LED RED flashes continue for the GPS and CELL, verify the antenna pod and harness are not damaged. Verify the antenna connections at the telematics module are tight. Replace the antenna if necessary.
- If LED RED flashes continue for the GENSET cycle and all connections and harness have been verified good, the telematics module may need replacement.

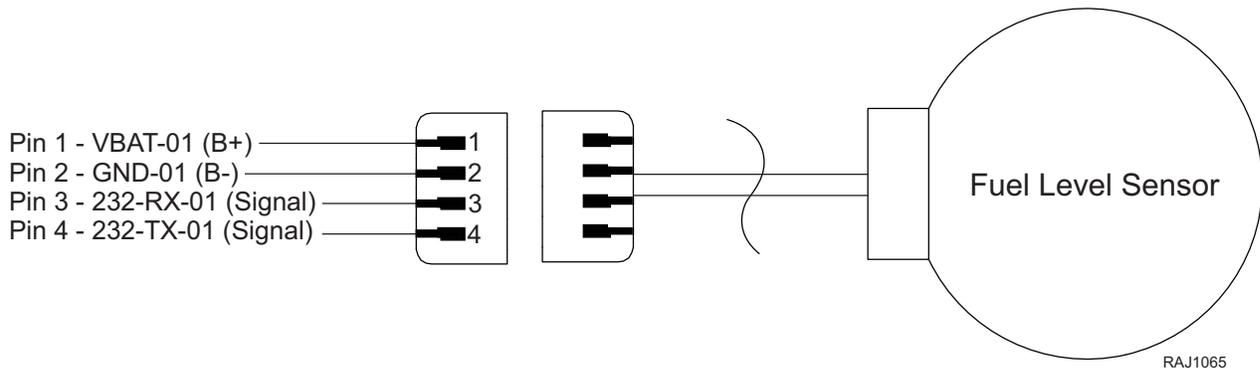
Note: The SG controller will show a communication error on the screen of the microprocessor is not communicating. In that case, the microprocessor must be replaced. If the SG controller is working normally, but GENSET LED RED flashes persist, the issue is with the telematics module.

11. Exit ECU SERVICE MODE when service procedures are complete, turn the SG unit main switch off.

Telematics Fuel Level Sensor (optional)

The fuel level sensor is a captive type sensor that transmits a signal to the telematics module. If the unit owner reports fuel level information faults, first perform these electrical checks on the system:

1. Verify the SG unit is supplying battery voltage and ground to the telematics system and the fuel level sensor. If battery voltage and ground are not present, diagnose the issue with the SG unit or harness.
2. Check the telematics 2A fuse.
3. Verify the sensor is receiving battery power (B+) on pin 1 and has a good ground (B-) on pin 2 at the connector.
4. Verify the pins are tight in the harness connectors.
5. Verify the harness continuity between the sensor, unit controller, and the telematics module (see the wiring diagram in the back of this manual).



After the electrical side of the fuel level sensor is verified as working properly, there could be debris and sludge causing issues that need to be inspected.

6. Cut the fuel level sensor anti-tamper device to allow sensor removal.

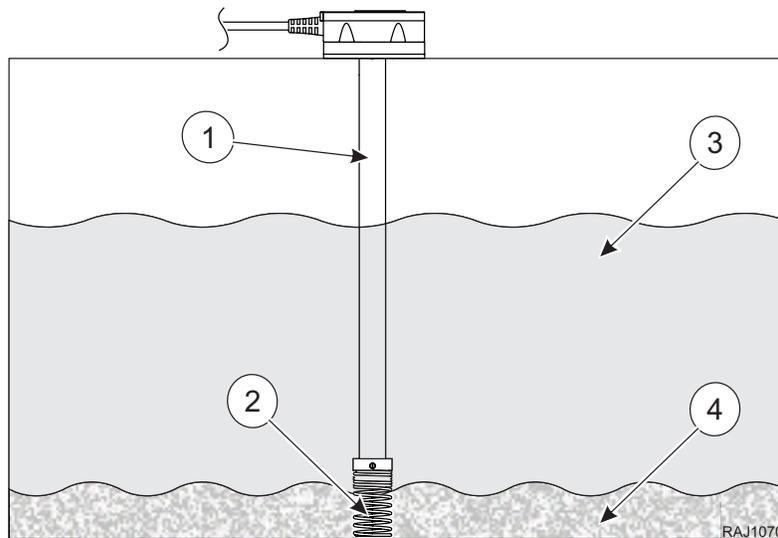
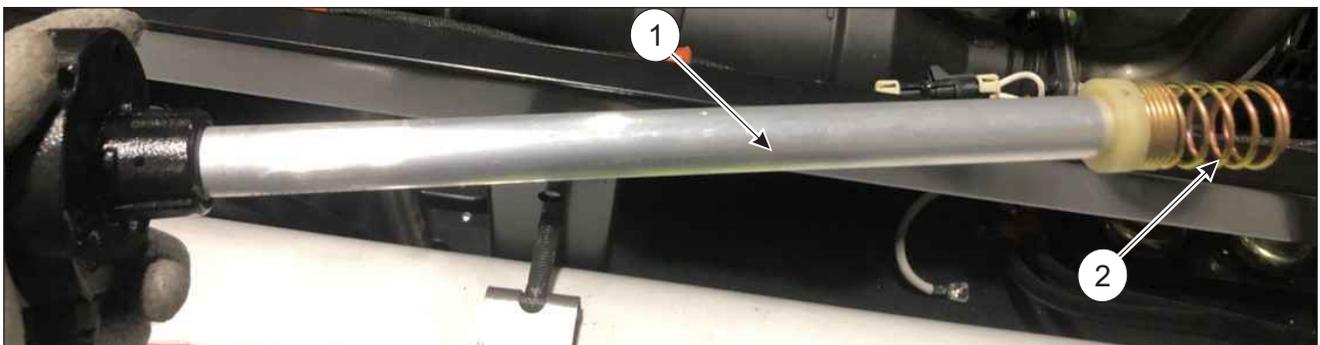


7. Cut the bandwraps securing the sensor harness. Unplug the sensor from the unit wiring.

8. Turn the sensor 30 degrees counter clock wise to disengage the retaining lugs. Remove the sensor by lifting it upward out of the tank.



9. Inspect the sensor and fuel tank for sludge and debris that can block the pipe and cause incorrect fuel level readings. Clean the sensor and fuel tank if needed.



1.	Fuel Sensor Pipe	3.	Clean Diesel Fuel
2.	Fuel Sensor Pipe Spring	4.	Possible Debris / Sludge



10. Inspect O-ring and replace if necessary.
11. Reinstall the sensor after cleaning by rotating it 30 degrees clockwise until the anti-tamper lock features align.
12. Connect sensor and verify (with the unit owner) that the telematics fuel level system is operating correctly.
13. Install anti-tamper device, secure the sensor harness with bandwraps.

If the electrical components are verified good, the sensor and tank are free of sludge / debris, and fuel level issues are still reported, replace the fuel level sensor and verify operation with the unit owner.

Telematics Antenna

The telematics antenna transmits GPS and CELL signal to the telematics module. If the module cannot connect to GPS or CELL according to the flash codes, or if the unit owner reports connection or data issues:

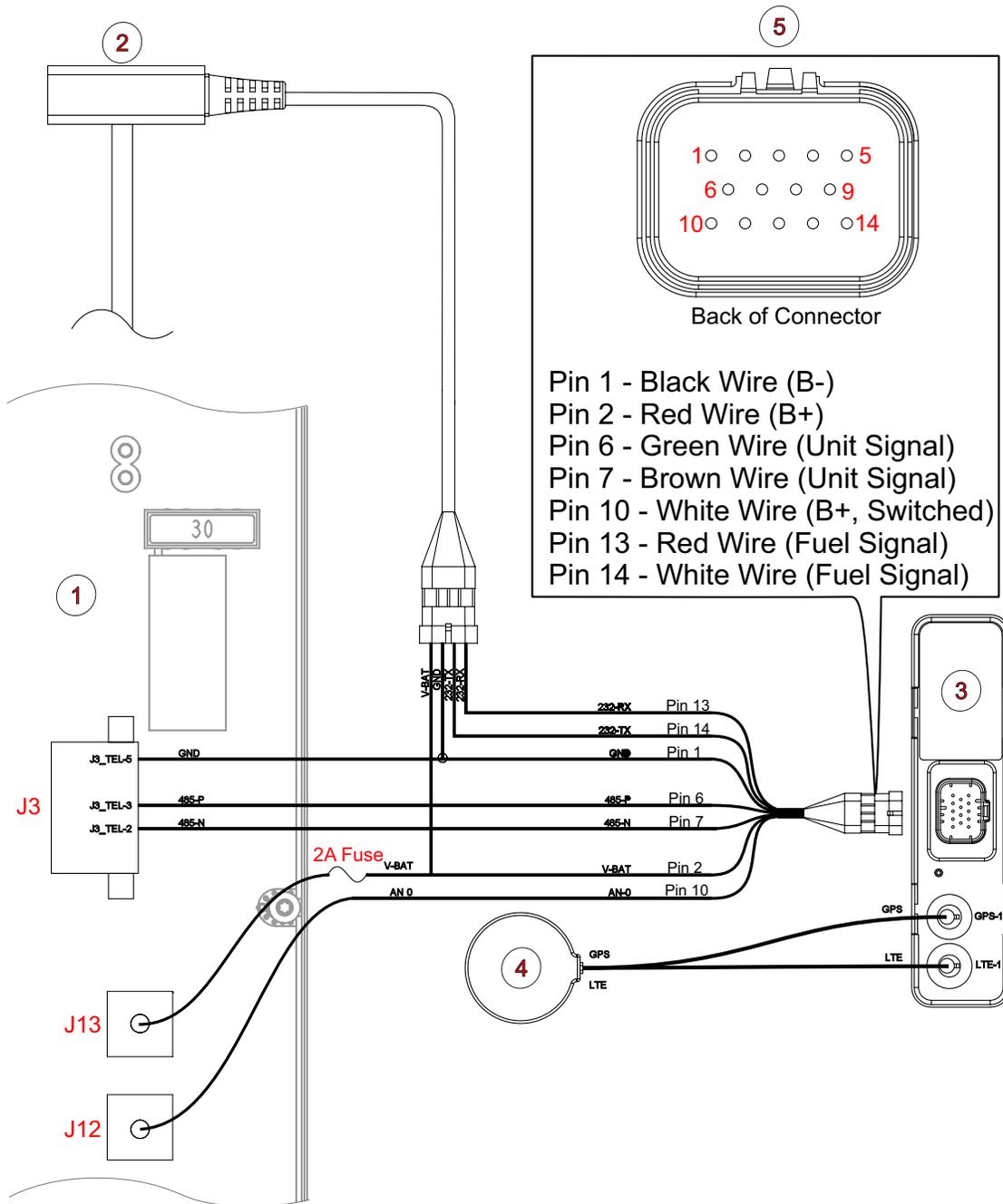
- Verify the SG unit is supplying battery voltage and ground to the telematics system. If battery voltage and ground are not present, diagnose the issue with the SG unit or harness.
- Check the telematics 2A fuse.
- View the LED flash sequence.
- Check the connections at the telematics module.
- Verify the pins are tight in the harness connectors.
- Verify the antenna harness is not damaged.

If problems are not found with the fuse, wire harness, or connections, replace the antenna. If communication or connectivity issues persist, replace the telematics module.

Important: *The GPS / CELL antenna may not be able to receive signal indoors (shop bay). The function must be verified outdoors where good signal can be reached. See the flash code descriptions in this chapter.*

Note: *Verify CELL signal by viewing your mobile phone signal level. This check will give an estimate on CELL signal strength level, but can be inaccurate due to the many telecom providers.*

Figure 40. Telematics Simplified Circuit View



1.	Controller (inside control box)	4.	Antenna (GPS and CELL)
2.	Fuel Level Sensor	5.	14 Pin Main Harness Connector (Pin view from the BACK of connector)
3.	Telematics Module		

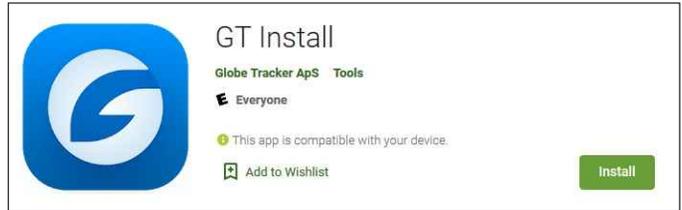
Pairing Telematics Module to SG Unit

Important: Each SG unit is uniquely paired to a telematics module on the assembly line:

- Do not swap telematics modules between SG units.
- If the telematics module is replaced, it must be uniquely paired to the SG unit using an app and a compatible device.

Before a new telematics module will activate, it must be paired with the SG unit.

1. Install the following FREE app on a smart phone or other compatible device: **GT Install Globe Tracker ApS:**

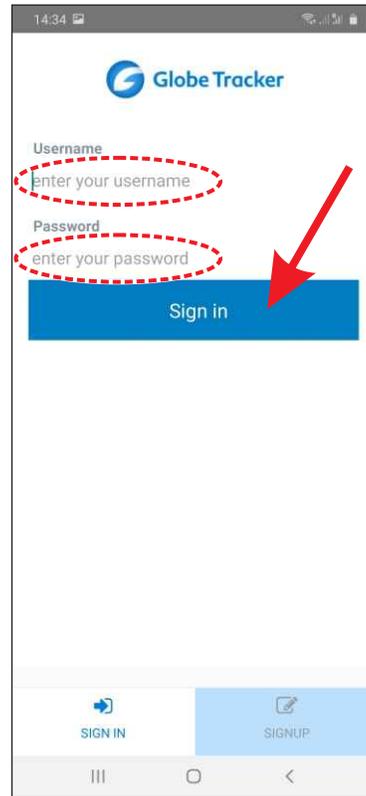


2. Open the app. Create an account (new users) or sign in (existing users):

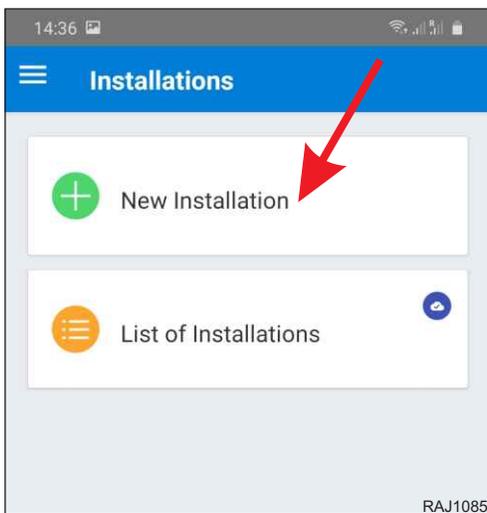
- First time users will need to create an account. Enter username, password, email address and tap the **SIGNUP** button.
- DO NOT enter TOTP Code if shown, this is not used.



RAJ1084



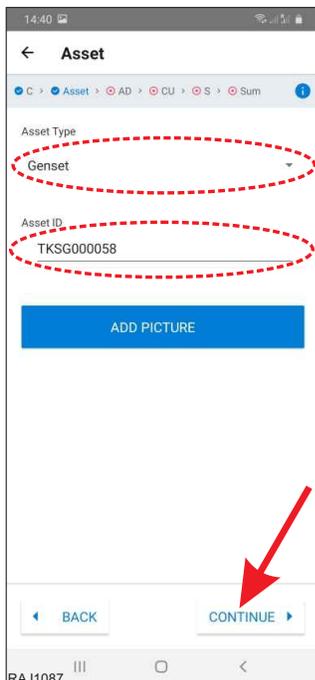
3. Select **New Installation**.



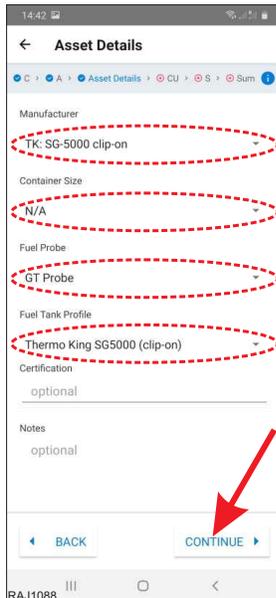
4. Tap **Company** and choose the customer / unit owner from the list. If the unit owners company is not listed, contact: **support@globetracker.com**.
5. Tap **Continue**.



6. Tap **Asset Type** and choose **Genset**.
7. Tap **Asset ID** and enter the **customers Genset number**. Optional: You can also add a picture of the Genset and add it into the telematics system by selecting **ADD PICTURE**.
8. Tap **Continue**.

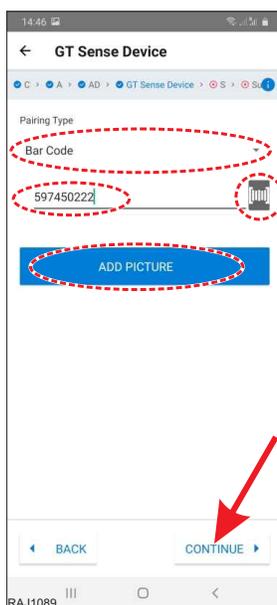


9. Tap **Manufacturer** and choose the correct SG genset type: TK: SG clip-on or TK: SG under-mount.
10. Tap **Container Size** and select **Container Size Not Applicable**.
11. Scroll down and tap **Fuel Probe** and select **GT Probe** if the unit is equipped with the optional fuel level sensor.
12. Scroll down and tap **Fuel Tank Profile** and select **Thermo King SG (Clip-On) or SG (undermount)**.
13. DO NOT enter certification, or notes. Leave these blank.
14. Tap **Continue**.

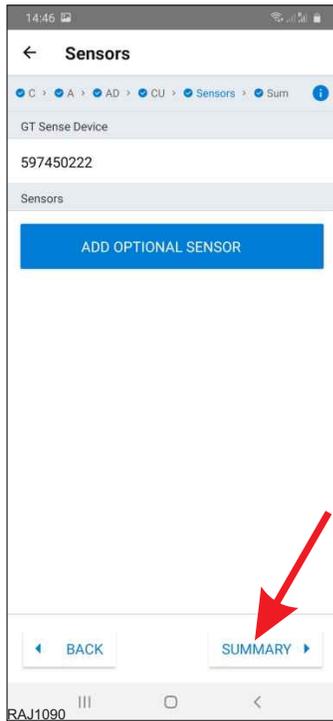
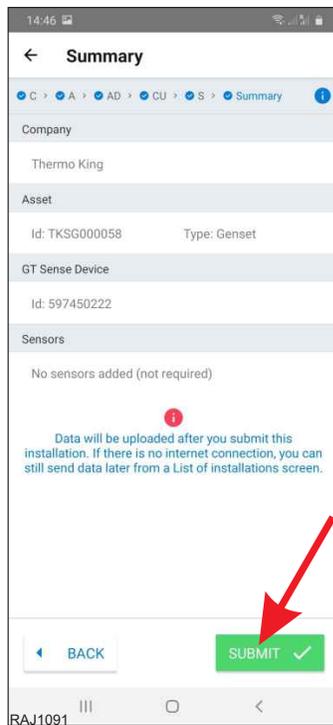


15. Scan the QR-code on the telematics module by pressing the barcode icon **OR** manually enter the telematics module serial number printed on the module nameplate.
16. Tap **ADD PICTURE** and take picture of the QR code and serial number.
17. Tap **Continue**.

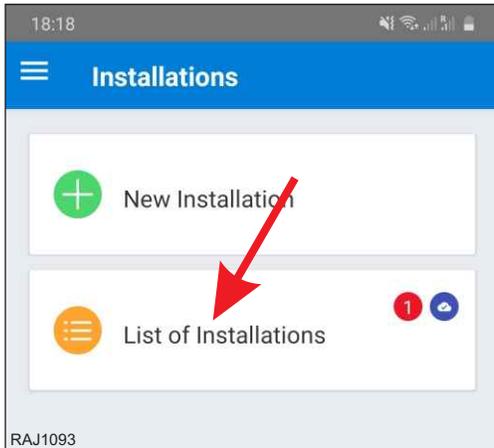
Important: This installation can be done remotely once all information is available.



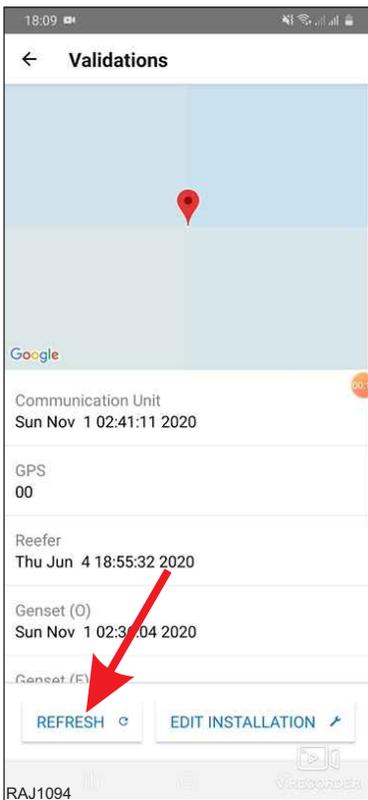
18. DO NOT choose any optional sensor. Leave this blank.

19. Tap Summary.**20. Verify all information is correct, then tap Submit.**

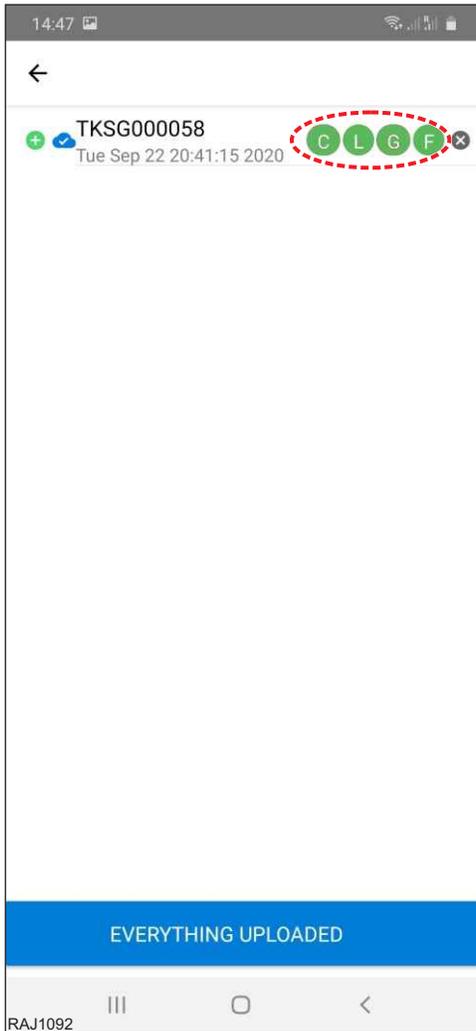
21. Leave the app running.
22. Install the new telematics module. Verify all electrical connections are secure, check the telematics fuse, and wire harnesses.
23. Go back to the home screen and tap **List of Installations**.



24. Select the unit just entered and press **REFRESH**. This retrieves data from the telematics unit.



25. Start the SG unit and let it run until all four indicators have turned green in the app.



26. Verify the flash codes on the module indicate normal operation.

27. Pairing is now complete.

Mechanical Diagnosis

Table 8. Diagnosing Unit Conditions

CONDITION	POSSIBLE CAUSE	REMEDY
Engine will not crank	Electrical problem	Check and repair electrical system
	Defective starter solenoid	Replace solenoid
	Defective starter	Repair starter
	Water in cylinders	Check for hydrostatic lock. Remove injectors and turn engine slowly
Starter motor turns but engine does not crank	Starter clutch defective	Replace
Engine cranks but fails to start	Voltage falls below 6 Vdc at ECU while starter cranking	Repair cause of low voltage at ECU while starter cranking
	Problem with ECU controlled engine function	Use YSAD engine diagnostic tool to diagnose problem
	Electric fuel pump not energized	Check 8DF and CHFP circuits
	Electric fuel pump defective	Replace electric fuel pump
	Air in fuel system	Bleed air
	Compression low	Overhaul engine
	Air cleaner clogged	Replace air filter
	Exhaust plugged	Clean exhaust
Engine stops after starting	Air in fuel system	Bleed fuel system
	Fuel filter obstructed	Replace filter element
	Vent of fuel tank obstructed	Unclog vent
	Clogged fuel tank or fuel lines	Clean fuel tank and fuel lines
	High head pressure	Eliminate cause of high head pressure
Engine does not develop full power	Air intake system clogged	Clean air intake system
	Fuel tank vent clogged	Unclog vent
	Clogged fuel tank or fuel lines	Clean fuel tank and fuel lines
	Insufficient fuel volume leaving filter	Check for dirty filter or air in system
	Air cleaner clogged	Replace air filter
	Delivery of electric fuel pump insufficient	Repair pump
	Problem with ECU controlled engine function	Use YSAD engine diagnostic tool to diagnose problem
	Compression low or unbalanced	Overhaul engine
Engine speed too high	Problem with ECU controlled engine function	Use YSAD engine diagnostic tool to diagnose problem
Engine fails to stop when unit is OFF	Problem with ECU controlled engine function	Use YSAD engine diagnostic tool to diagnose problem
Engine knocks heavily	Air in system	Bleed fuel system
	Wrong fuel	Change fuel
	Compression too low	Overhaul engine



Table 8. Diagnosing Unit Conditions (continued)

CONDITION	POSSIBLE CAUSE	REMEDY
	Valve out of adjustment	Adjust valves
	Fuel return line plugged	Remove return line restriction
	Rod or main bearing worn	Replace rod or main bearings
Engine runs hot	Dirty radiator	Wash radiator
	Coolant level is low	Add coolant
	Cooling system heavily scaled	Cleaning cooling system
	Cylinder head gasket leaks	Replace cylinder head gasket. Use correct gasket
	Faulty thermostat	Check or replace thermostat
	Loose or worn water pump belt	Replace belt
Oil pressure low	Insufficient oil in pan	Add oil
	Faulty oil pressure switch	Check oil pressure switch. Replace if necessary
	Oil control valve defective	Check oil pressure control valve
	Worn oil pump, camshaft, main or connecting rod bearings, loose oil gallery plug	Repair engine
High oil consumption	10 hour engine break in running was not successfully completed	Run unit for 10 hours in continuous high speed with varying load.
	Oil leakage	Check and eliminate possible causes at rocker arm cover, oil lines, oil filter, front timing cover or crankshaft seals
	Damaged valve seals	Replace seals on valve stem
	Worn valve stem	Replace valves
	Broken piston rings or cylinder bore worn or scored	Have engine repaired and rebored. Replace broken piston rings
	Clogged air cleaner system	Unclog air cleaner

Table 9. Engine Emits Excessive Smoke

White Smoke	Black Smoke	Blue Smoke
Fuel is not burning	Excessive Fuel to Air Ratio	Oil Consumption
<ul style="list-style-type: none"> Air or water in fuel Incorrect timing Poor compression Faulty injectors 	<ul style="list-style-type: none"> Type of fuel used Cold engine Excessive load Clogged air intake system Faulty nozzles Poor compression Restricted exhaust 	<ul style="list-style-type: none"> Poor compression Defective valve seals

Diagram Index

The following table lists the diagrams that are relevant to this unit.

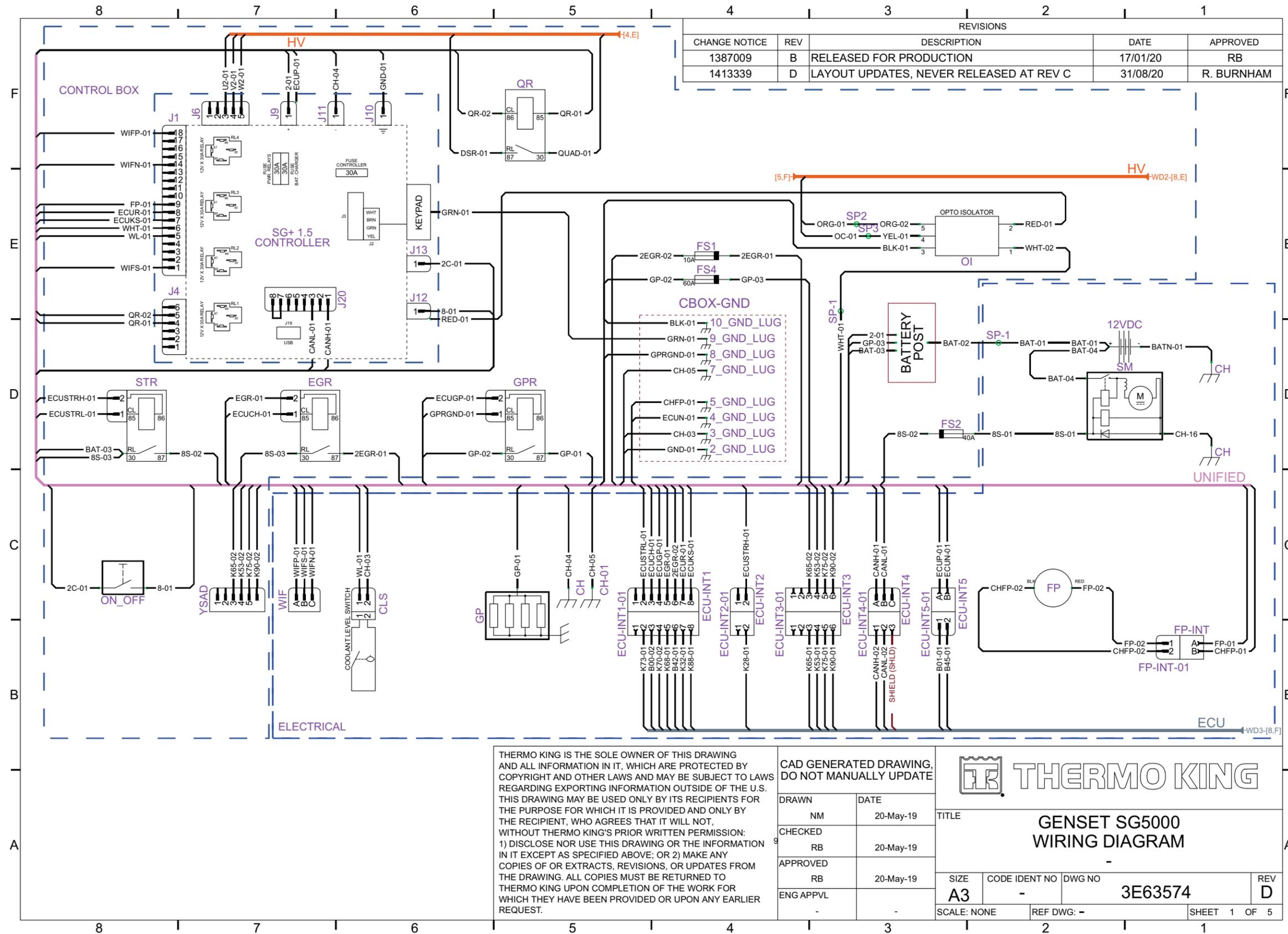
Drawing No.	Drawing Title
3E63574	DIAGRAM WIRING, GENSET SG5000 (5 pages)
3E63575	DIAGRAM SCHEMATIC, GENSET SG5000 (3 pages)



THERMO KING

Diagram Index

Figure 41. 3E63574 Page 1



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DRAWN	DATE
NM	20-May-19
CHECKED	DATE
RB	20-May-19
APPROVED	DATE
RB	20-May-19
ENG APPVL	

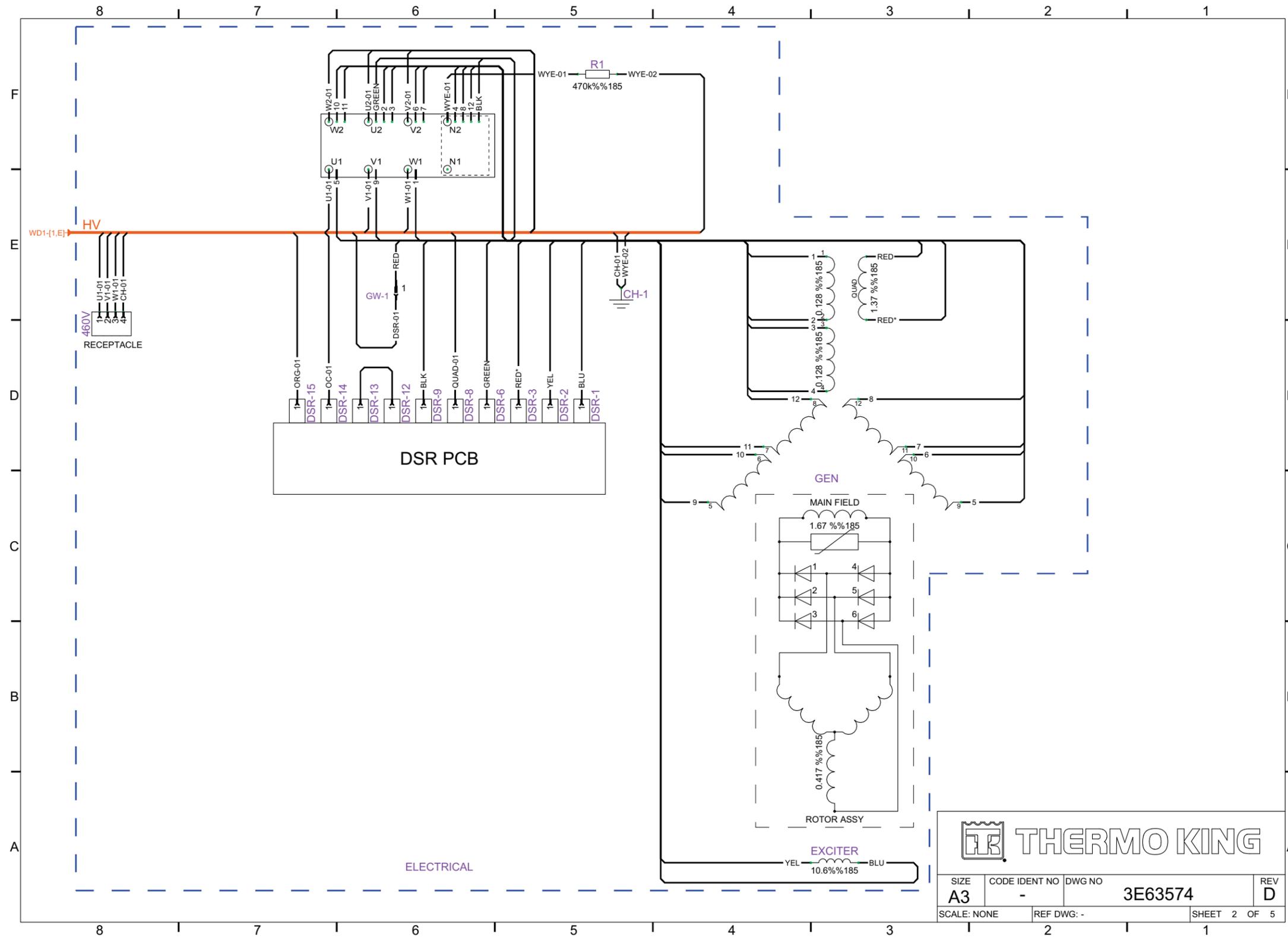


TITLE
GENSET SG5000 WIRING DIAGRAM

SIZE	CODE IDENT NO	DWG NO	REV
A3	-	3E63574	D
SCALE: NONE	REF DWG: -	SHEET 1 OF 5	

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Figure 42. 3E63574 Page 2

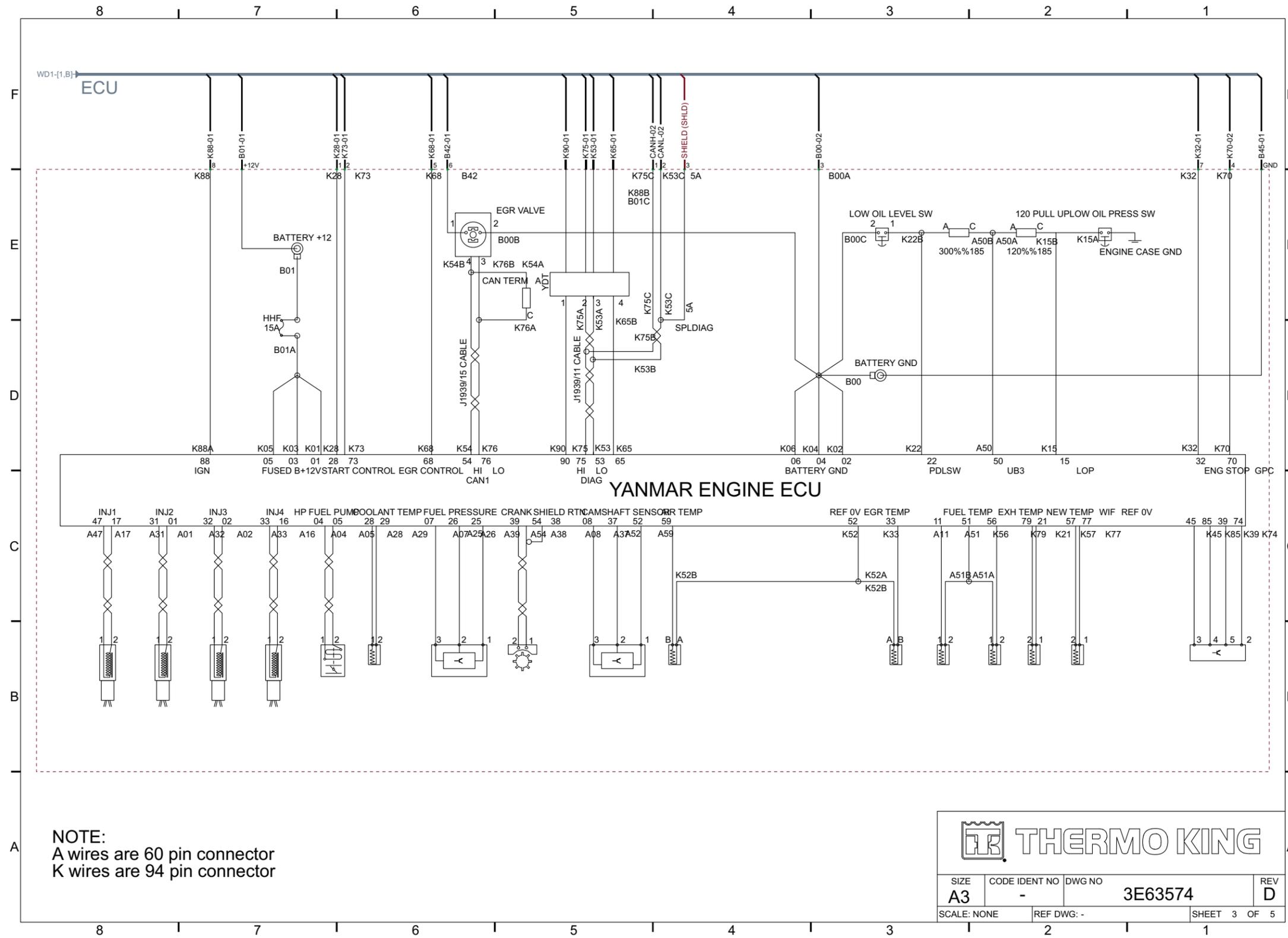


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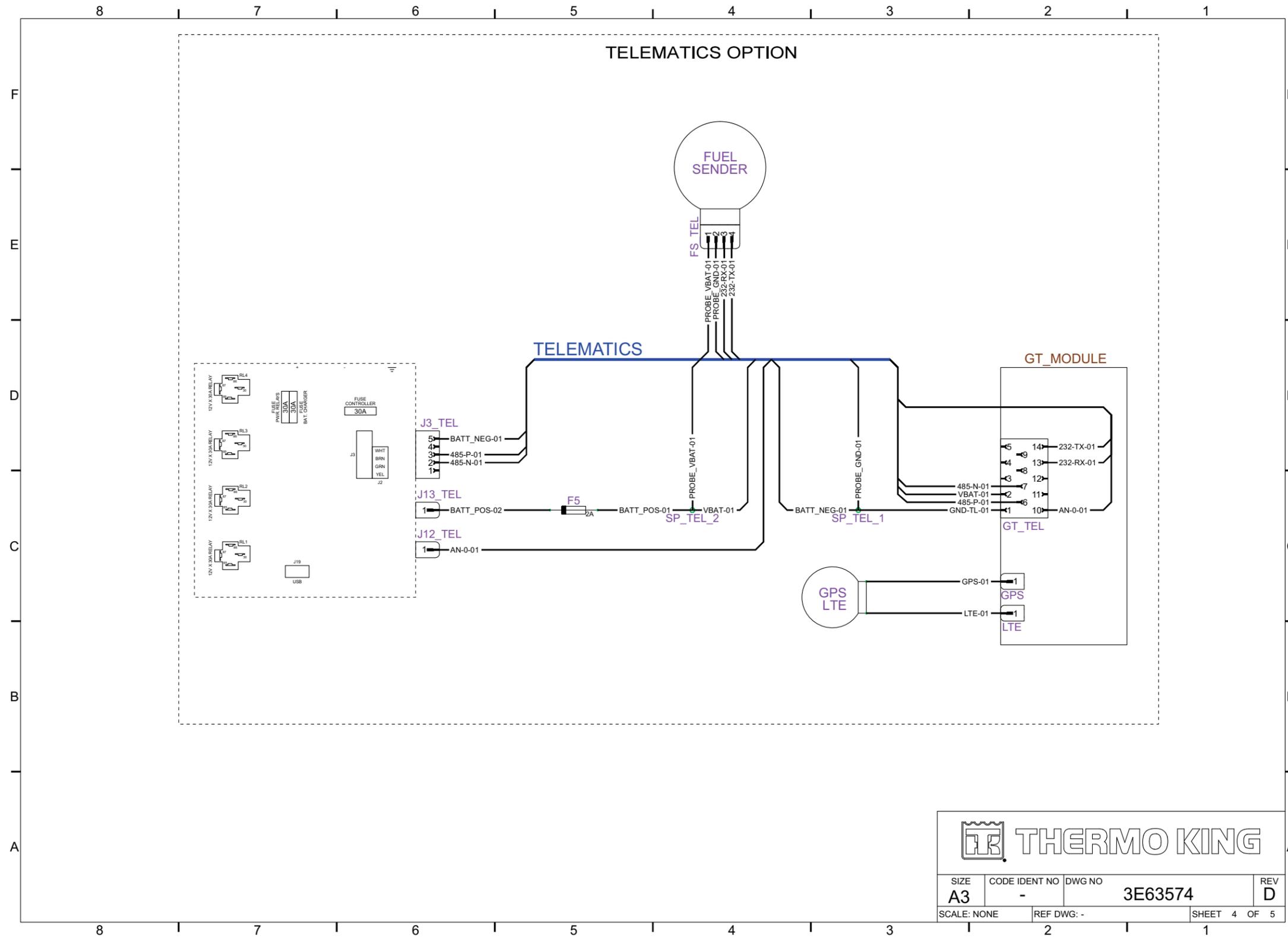
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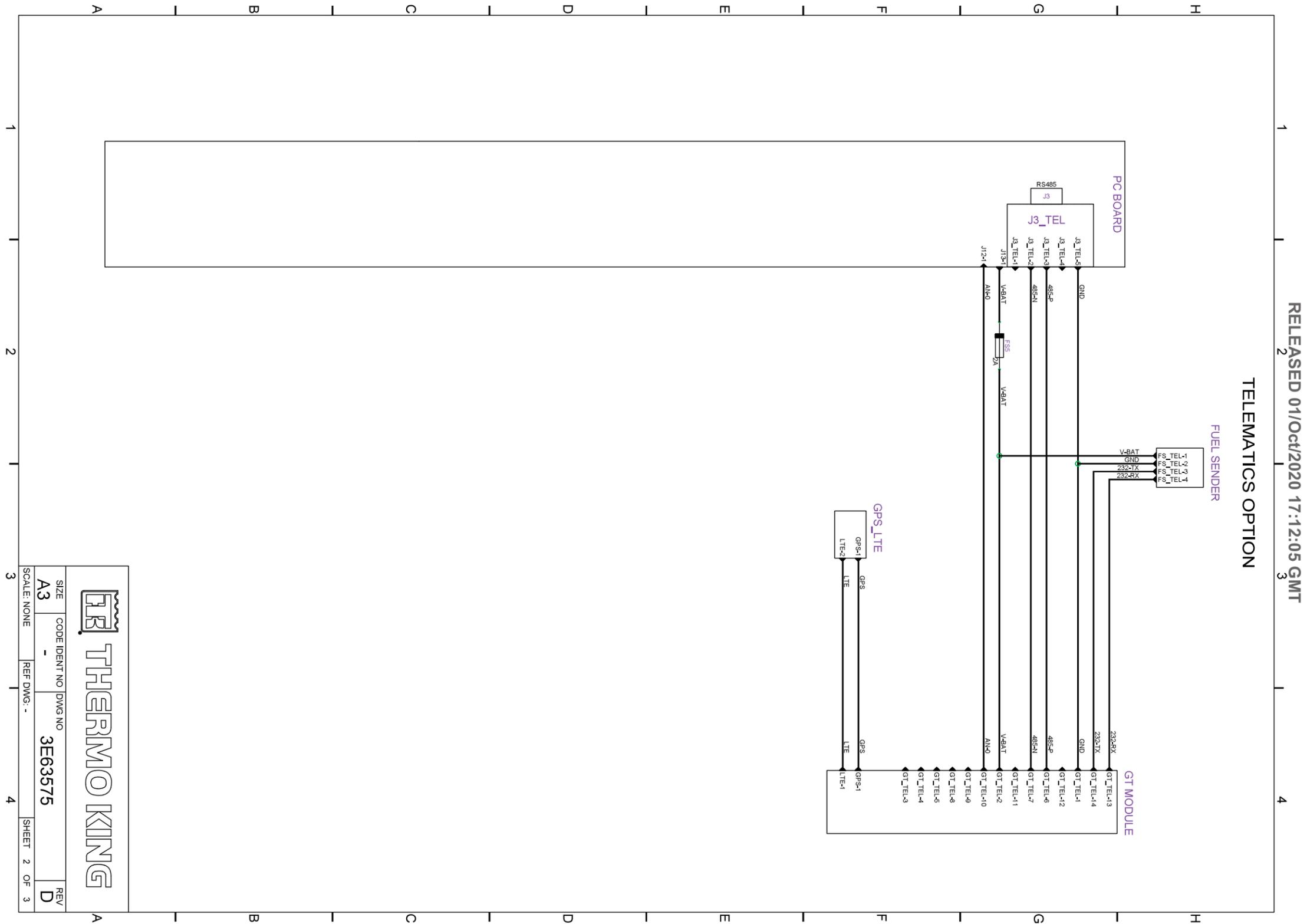
Wire Name	From Component	From Port	To Component	To Port	Wire Name	From Component	From Port	To Component	To Port
2-01	J9	1	BAT-POST-01	1	K75-02	ECU-INT3	5	YSAD	5
2C-01	ON_OFF	1	J13	1	K90-02	ECU-INT3	6	YSAD	6
2EGR-01	FS1-1	1	EGR-87	1	OC-01	DSR-14	1	OC	1
2EGR-02	FS1-2	1	ECU-INT1	6	ORG-01	DSR-15	1	ORG	1
8-01	ON_OFF	2	J12	1	QR-01	QR-85	1	J4	4
8S-01	FS2-1	1	8S	1	QR-02	QR-86	1	J4	5
8S-02	STR-87	1	FS2-2	1	U1-01	U1-2	1	U1	1
8S-03	STR-30	1	EGR-30	1	U2-01	U2	1	J6	3
BAT-01	BAT+	1	SP-1	1	V1-01	V1-2	1	V1	1
BAT-02	SP-1	2	BAT-POST-04	1	V2-01	J6	4	V2	1
BAT-03	STR-30	1	BAT-POST-05	1	W1-01	W1-2	1	W1	1
BAT-04	BAT+	1	STR	1	W2-01	W2	1	J6	5
BATN-01	BAT-	1	CH	1	WHT-01	J1	6	SP-1	1
CANH-01	J20	1	ECU-INT4	A	WIFN-01	J1	14	WIF	C
CANL-01	J20	3	ECU-INT4	B	WIFP-01	J1	18	WIF	A
CH-01	CH-2	1	CH-1	1	WIFS-01	J1	1	WIF	B
CH-03	CLS	2	3_GND_LUG	1	WL-01	J1	5	CLS	1
CH-04	J11	1	CH	1					
CH-05	7_GND_LUG	1	CH-01	1					
CHFP-01	FP-INT	B	5_GND_LUG	1					
ECUCH-01	ECU-INT1	3	EGR	1					
ECUGP-01	ECU-INT1	4	GPR	2					
ECUKS-01	ECU-INT1	8	J1	7					
ECUN-01	4_GND_LUG	1	ECU-INT5	B					
ECUP-01	J9-2	1	ECU-INT5	A					
ECUR-01	ECU-INT1	7	J1	8					
ECUSTRH-01	ECU-INT2	2	STR	2					
ECUSTRL-01	ECU-INT1	2	STR	1					
EGR-01	ECU-INT1	5	EGR	2					
FP-01	FP-INT	A	J1	9					
GND-01	J10	1	2_GND_LUG	1					
GP-01	GP	1	GP-87	1					
GP-02	FS4-1	1	GP-30	1					
GP-03	BAT-POST-02	1	FS4-2	1					
GPRGND-01	GPR	1	8_GND_LUG	1					
JMP-01	J20	7	J20	8					
K53-02	ECU-INT3	4	YSAD	4					
K65-02	ECU-INT3	3	YSAD	3					

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SIZE A3	CODE IDENT NO -	DWG NO 3E63574	REV D
SCALE: NONE		REF DWG: -	SHEET 5 OF 5

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SCHEMATIC LEGEND		LOCATION
REF DES	DESCRIPTION	
12VDC	BATTERY	TK_Circuit/SD1-13,D]
J3	RS485	TK_Circuit/SD1-11,H]
J19	USB	TK_Circuit/SD1-11,D]
J21	RS232	TK_Circuit/SD1-11,D]
J3	RS485	TK_Circuit/SD2-11,G]
FS1	FS1-10A	TK_Circuit/SD1-14,D]
FS2	FS2-40A	TK_Circuit/SD1-12,D]
FS5	FS5-2A	TK_Circuit/SD2-12,G]
FS4-2	FS5-50A	TK_Circuit/SD2-12,G]
FS4	FS4-60A	TK_Circuit/SD1-12,E]
FS4-2	FS5-50A	TK_Circuit/SD1-12,E]
GEN	GENERATOR	TK_Circuit/SD1-14,G]
GP	GLOW PLUGS	TK_Circuit/SD1-14,E]
GND	GROUND	TK_Circuit/SD1-14,B]
F12	30 AMP	TK_Circuit/SD1-11,E]
F11	30 AMP	TK_Circuit/SD1-11,C]
F13	30 AMP	TK_Circuit/SD1-11,F]
CLS	COOLANT LEVEL SWITCH	TK_Circuit/SD1-12,G]
WIF	WATER IN FUEL	TK_Circuit/SD1-12,G]
ON_OFF	UNIT ON/OFF SWITCH	TK_Circuit/SD1-12,F]
OI	OPTO ISOLTAOR	TK_Circuit/SD1-12,F]
YSAD	ENGINE TEST PLUG	TK_Circuit/SD1-11,E]
QR	QUAD RELAY	TK_Circuit/SD1-12,D]
QR-30	QUAD RELAY	TK_Circuit/SD1-13,G]
EGR	EGR RELAY	TK_Circuit/SD1-13,B]
GPR	GLOW PLUG RELAY	TK_Circuit/SD1-12,B]
GPR	GLOW PLUG RELAY	TK_Circuit/SD1-14,C]
STR	STARTER RELAY	TK_Circuit/SD1-11,A]
SM	STARTER MOTOR	TK_Circuit/SD1-14,D]

		THERMO KING	
SIZE A3	CODE IDENT NO -	DWG NO 3E63575	REV D
SCALE: NONE	REF DWG: -	SHEET 3 OF 3	



Controller Menu Guide



Keypad Operating Tips

Text Input:

- To enter a number: Press the **UP** or **DOWN** key to increase or decrease the value of a digit in the display.
- Press the **ENTER** key to scroll the cursor to the right.

To Enter a Controller Menu or Submenu:

- Press **ALARM** key to directly enter the Alarm List Menu.
- Press the **ENTER** key or the **ESCAPE** key to enter the Main Menu.
- Press **ENTER** key to enter a menu from the Main Menu, or a submenu from its parent menu.
- Press **ESCAPE** key to return to the Main Menu from a menu, or a menu from a submenu.

To Scroll in a menu:

- Press **UP** key to scroll up.
- Press **DOWN** key to scroll down.

To Enter a Command or execute a task:

- Press **ENTER** key.

To Enter a New Value in a Screen:

- Press **ENTER** key and **ESCAPE** key at the same time.

To change language

- Press **LANGUAGE** key.

Footnotes:

¹"dELAY/ AC." screen indicates controller has a 2 minute delay.
²"RESTART IN XX MIN." screen indicates controller has stopped unit operation due to an alarm. Controller will attempt to restart unit in the time shown.

STANDARD DISPLAY



MAIN MENU

DATA MENU

ALARM LIST MENU

MESSAGE LIST MENU

COMMANDS MENU

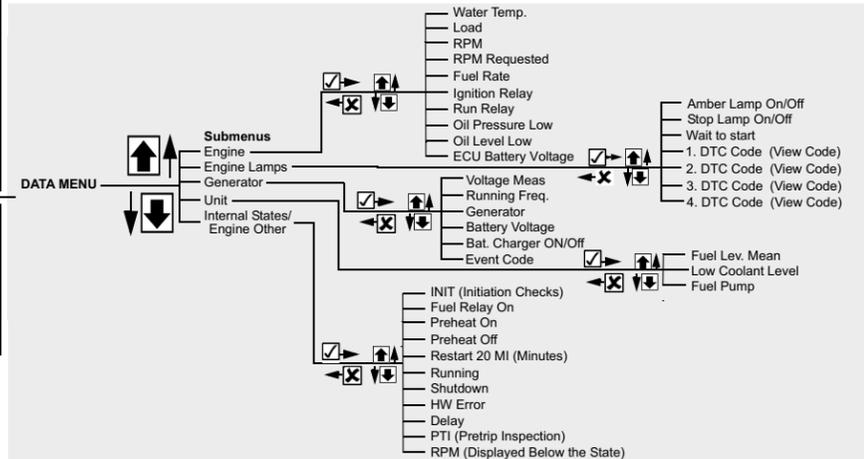
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CONTROLLER MENU GUIDE

PAUSE MODE DISPLAYS ———— deLAY / AC¹ ———— RESTART IN XX MIN.²

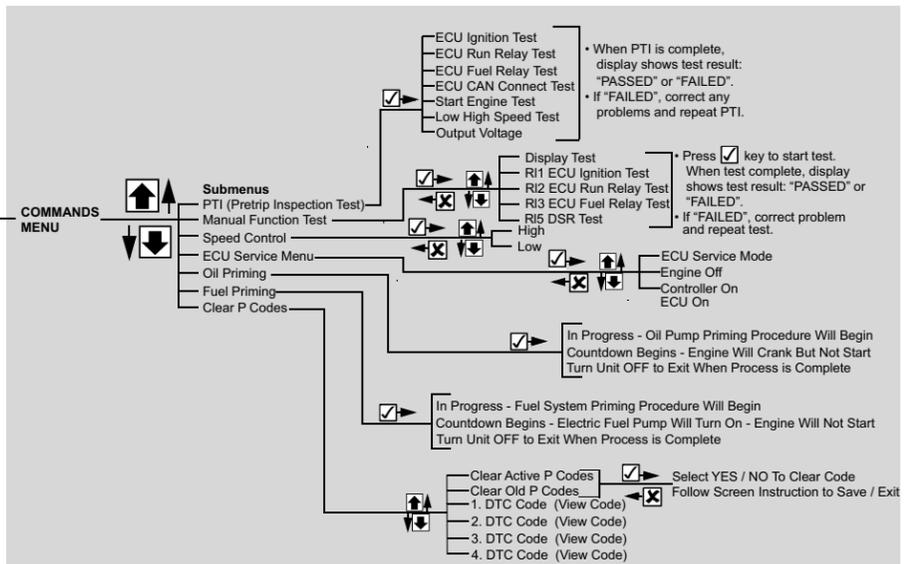
ALARM LIST MENU

- Top line shows Alarm Code, and the position of the alarm and number of alarms stored in memory (e.g. "1/2").
- Middle lines show alarm text.
- Bottom line shows alarm status.
- View and write down all alarms before acknowledging.
- Press **ENTER** key to view additional alarms.
- Press **ENTER** key to acknowledge the alarm being displayed.
- Correct all problems before returning the unit to service.



MESSAGE LIST MENU

- Top line shows Message Code, and the position of the message and number of messages stored in memory (e.g. "1/2").
- Middle lines show message text.
- Bottom line shows message status.
- View and write down all messages before acknowledging.
- Press **ENTER** key to view additional messages.
- Press **ENTER** key to acknowledge the message being displayed.
- Correct all problems before returning the unit to service.

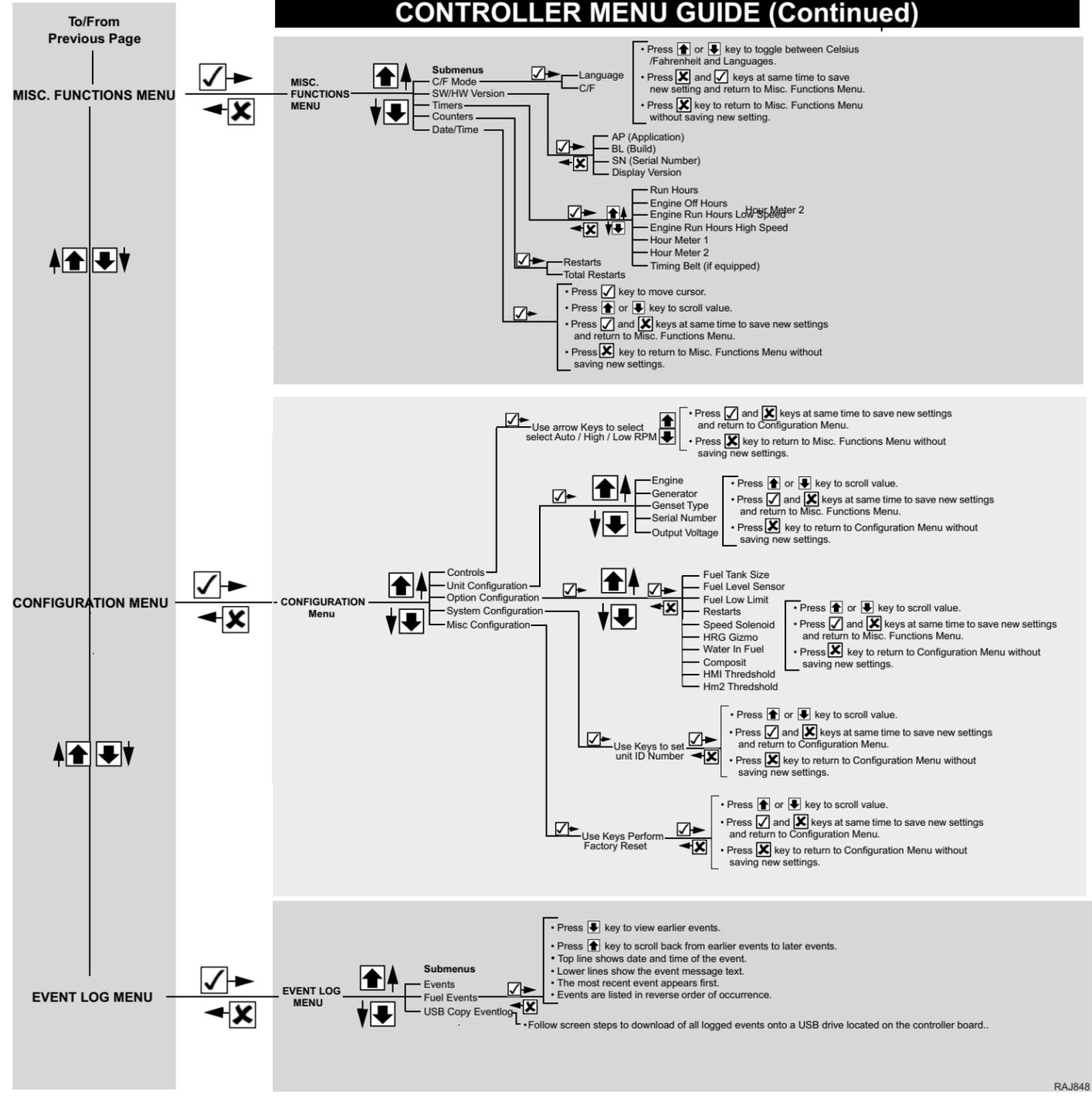


RAJ847

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CONTROLLER MENU GUIDE (Continued)



RAJ848

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