THERMO KING

Maintenance Manual

Container Edition
SG 4000 Series

SGSM 4000, SGCM 4000, and SGCO 4000 Units

Revision A

January 2021

TK 61010-4-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 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 4000 System Number	718208M
SGUM 4000 System Number	718207M
For further information, refer to:	
SGCO 5000 Parts Manual	TK 55683
SGUM 5000 Parts Manual	TK 55682
TKDV6 Engine Repair Manual	TK 55810
Tool Catalog	TK 5955
The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units.	
Model Nomenclature	SM: Side-mount unit frame CM: Center-mount unit frame CO: Clip-on unit frame

Note: *For Parts Manual TK 55683 go to Eletronic Parts Catalog and search for Grid Number "18U85".*

Note: *For Parts Manual TK 55682 go to Eletronic Parts Catalog and search for Grid Number "18U81".*

Revision History

Revision A (01/2021) Updated Manual.

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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.

THERMO KING

Table of Contents

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 the applicable 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 3 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 the unit from starting unexpectedly and causing personal injury.

Notice

Equipment Damage!

Do not connect other manufacturers equipment or accessories to the unit or to the Thermo King 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.

Controller/Microprocessor Service Precautions

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

Observe the following precautions when servicing a controller or microprocessor control system to avoid damaging electronic components. Refer to the applicable unit, controller, or microprocessor diagnostic manual for more information.

- If the unit has a service or microprocessor ON/OFF 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 or unit ground terminal (if equipped). 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 controller or 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.
- **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 an 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

Electrical Control System

Controls	SG+ Microprocessor Controller
Voltage	12.5 Vdc (nominal)
Battery	12 Volts, Group 31, 925 / 950 CCA @ -18 C (0 F)
Fuse SI1	30 Amp
Fuse SI2	30 Amp
Fuse SI3	10 Amp
Electrical Components NOTE: Disconnect components from unit circuit to check resistance.	
	Current Draw (Amps) at 12.5 Vdc
Glow Plugs (4) Each	35 Amp Max
Starter Motor	400 (Cranking) 140 (Bench Test)

Engine

Model		TKDV6 (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
Displacement		1.6L
Combustion Chamber		Direct Injection
Speed Control		Electronic Isochronous speed control
Fuel System		Electronically controlled common rail system, multiple injection
Fuel Type		No. 2 diesel fuel under normal conditions No. 1 diesel fuel is acceptable cold weather fuel ***Note:*** *The sulfur content must be less than or equal to 15 ppm, the fuel must be free of zinc, and comply with the latest release of ASTM D975, EN 590, or JIS K2204.*
Noise		Under 71 dBA under any conditions
Turbocharger		Fixed geometry type with waste gate
Oil Capacity		12.4 quarts (11.7 liters) crankcase and oil filter Fill to full mark on dipstick
Oil Type		API Classification CJ-4 ***Note:*** *This oil type must be used together with ULSD fuel to prevent damage to the DOC.*
Oil Viscosity	Recommended	-13 F to 100 F (-25 C to 38 C) 10W-30 Delo XLE Syntheblend -22 F to 122 F (-30 C to 50 C) 5W-40 Delo 400LE Full Synthetic for Cold Climates
	For Other Climates	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 -13 to 104 F (-25 to 40 C): SAE 10W-40 -13 to 100 F (-25 to 38 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		60 to 80 psig (414 to 552 kPa) maximum in high speed
Engine Coolant Thermostat		160 F (71 C)
Engine Coolant Type **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.**		Chevron/Delo XLC - a nitrite-free Extended Life Coolant (ELC) Use a 50/50 concentration
Coolant System Capacity		7.5 quarts (7.1 liters)
Radiator Cap Pressure		21 psig (145 kPa)

Radiator Fan Motor

Before 6/15	
Voltage / Phase / Frequency	460 Vac / 3 Phase / 60 Hz
Amperes	4.5 - 4.6 Amps
RPM	2890 - 3430 RPM
6/15 and After	
Voltage / Phase / Frequency	460 Vac / 3 Phase / 60 Hz
Amperes	1.3 Amps
RPM	3499 RPM

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

Series Unit Weight

SGCO 4000 Unit Weight (net)	818 Kg (1804 lbs) - Including oil, coolant, battery, and 473 liter (125 gal.) fuel tank (excluding fuel)
SGUM 4000 Weight (net)	678 Kg (1495 lbs) - Including oil, coolant, battery, and 50 liter (50 gal.) fuel tank (excluding fuel)
SGCM 4000 Weight (net)	561 Kg (1237 lbs) - Including oil, coolant, battery, and 50 liter (50 gal.) fuel tank (excluding fuel)

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 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 Primary EMI 3000 fuel filter/water separator. See note.
		•	Replace Secondary EMI 3000 fuel filter. If equipped, 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. Replace EGR hose. Cleaning the cooler is required for emissions compliance.
		—	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 the DV6NR. Common Rail fuel injection system, which used electronically controlled fuel injectors to reduce emissions. 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.

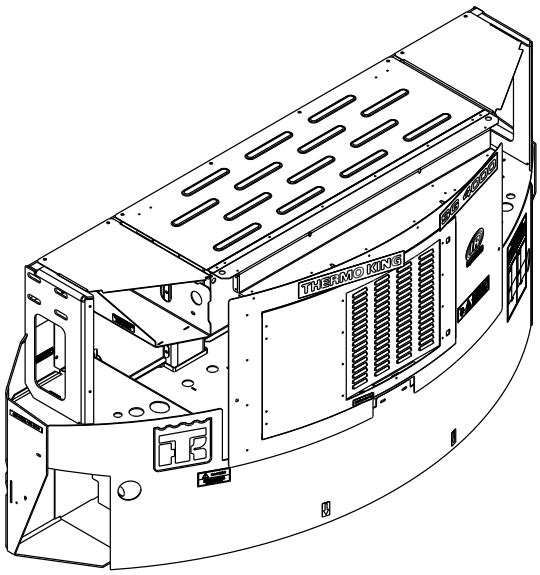
Fuel tanks are provided as an integral part of each unit. Fuel capacities are: 473 liter (125 gal.) on SGCO clip-on models; 303 liter (80 gal.), or 189 liter(50 gal.) on SGCM center mount or SGSM side mount models.

Note: *SGFM flexi mount models has Two tank options offered through aftermarket.*

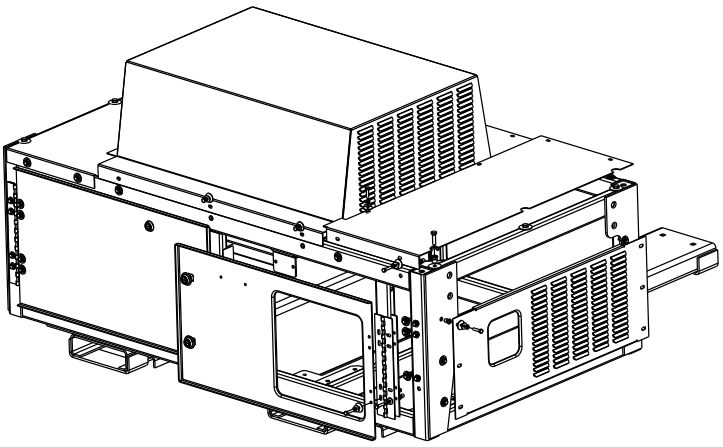
The alternator is a brushless, rotating field ac generator. A rectified exciter armature output provides dc power for the field. The exciter field obtains its power from the full wave rectified output of the main generator. The alternator supplies 460 Vac, 3 phase, 4 wire, 60 Hz power at 1800 RPM.

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 4000



SGUM 4000



RAJ725

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 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.
- **Engine Coolant Temperature Sensor:**The controller will stop the engine if the engine coolant temperature rises to 107 C (225 F) for more than 30 seconds. The controller also records an alarm. The unit will restart when the coolant temperature drops to 88 C (190 F).
- **Low Oil Level Switch:** An oil level switch closes if the oil level drops below 8 qts. (7.6 liters) and the oil pressure drops below 117 ± 21 kPa (Also see low oil pressure switch above). The controller will stop the engine if the switch stays closed for more than 30 seconds. The controller then records an alarm.
- **Low Oil Pressure Switch:** Engine oil pressure should rise immediately on starting. The controller will stop the engine if oil pressure drops below 117 ± 21 kPa, (1.17 ± 0.21 bar), (17 ± 3 psig) for more than 30 seconds, and the oil level drops below 8 qt (7.6 litres) (Also see oil level sensor below). The controller then records an alarm.

EcoPower

EcoPower is an standard feature on all SG 4000 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).

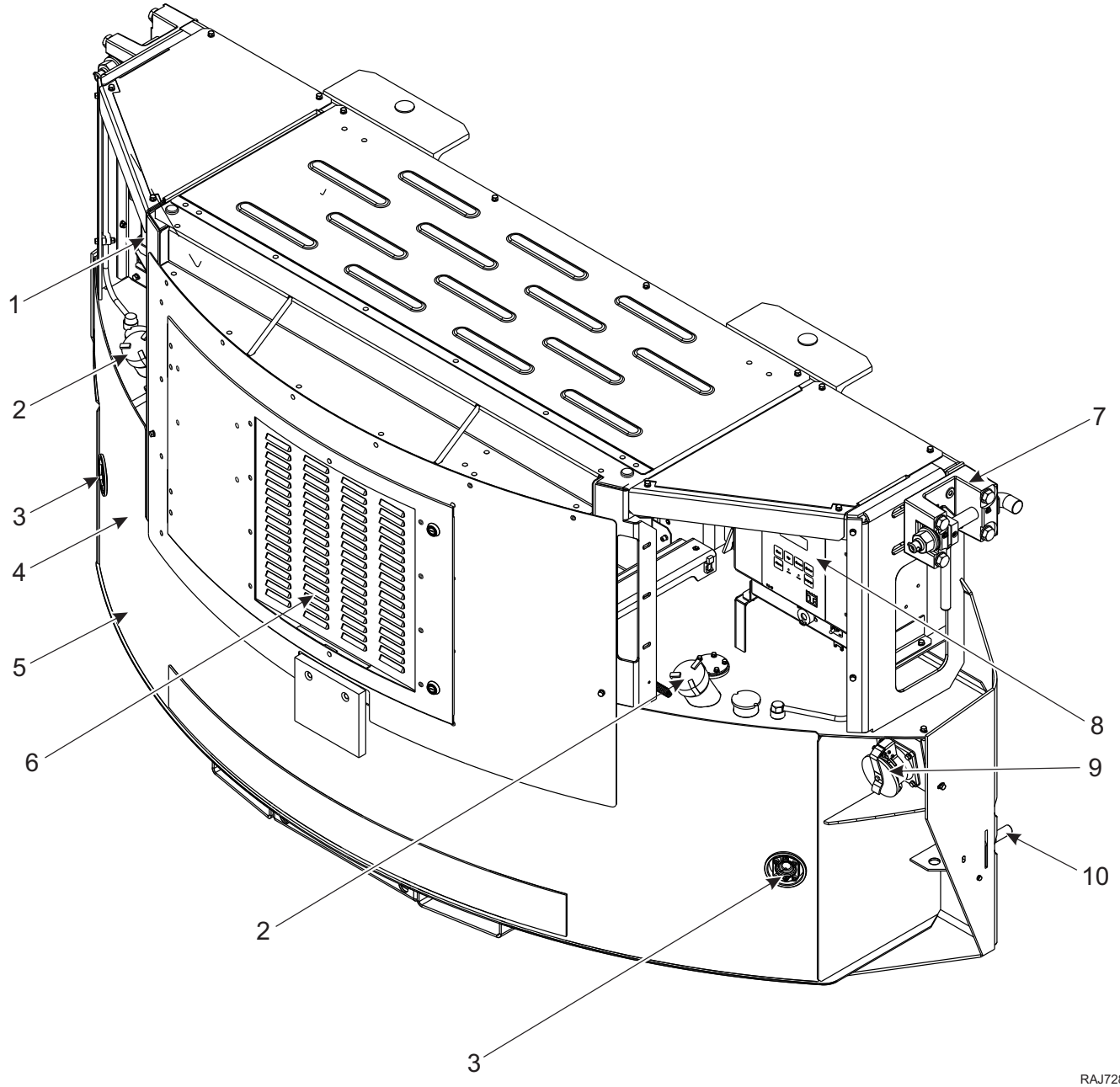
Fuel Level Sensor Option

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.

Note: *Only applies to gensets with the standard ultrasonic fuel sensor connected directly to the SG+1.5 controller, for gensets equipped with telematics the fuel level sensor option needs to be set to NO.*

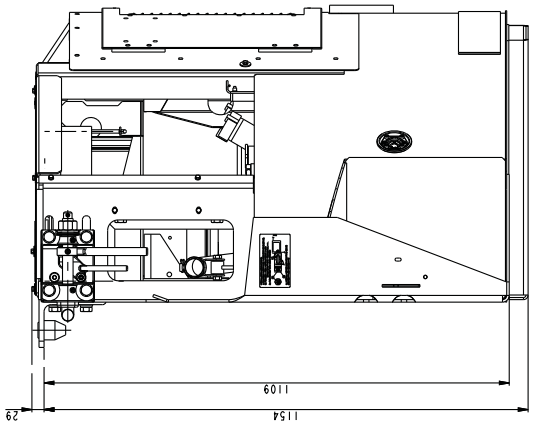
SG 4000 Photos, Illustrations, and Measurements

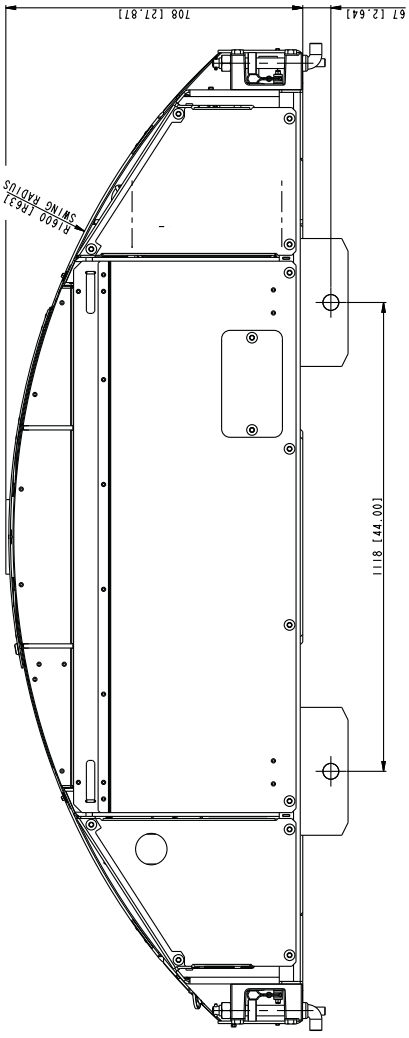
SGCO 4000 Front View

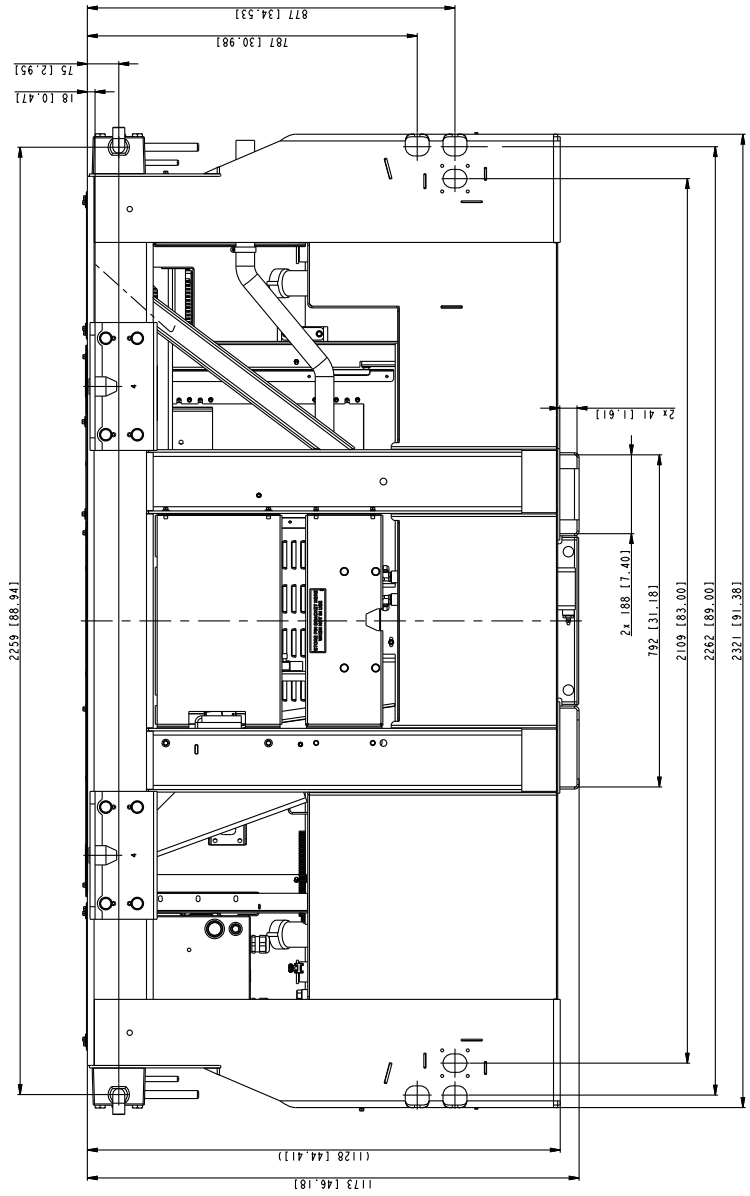


1.	Battery Location	6.	Alternator and Engine Access Door
2.	Fuel Tank Neck and Cap	7.	Bracket Clip-on (one on each side)
3.	Fuel Gauge	8.	Control Box Location
4.	Unit Nameplate Location	9.	460 VAC Power Receptacle Location
5.	Fuel Tank	10.	Lower Mounting Hardware (each side)

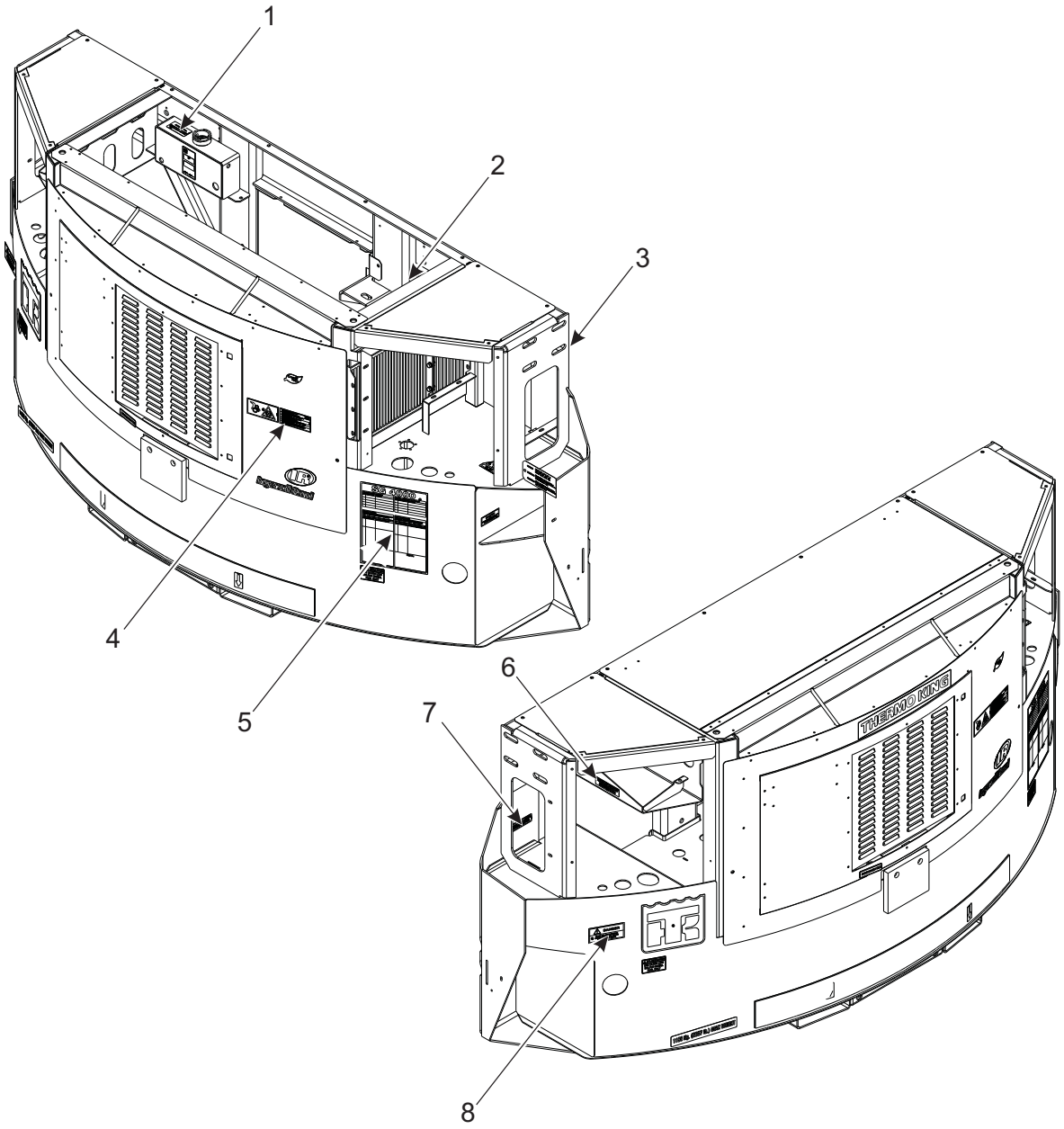
SGCO 4000 Dimensions





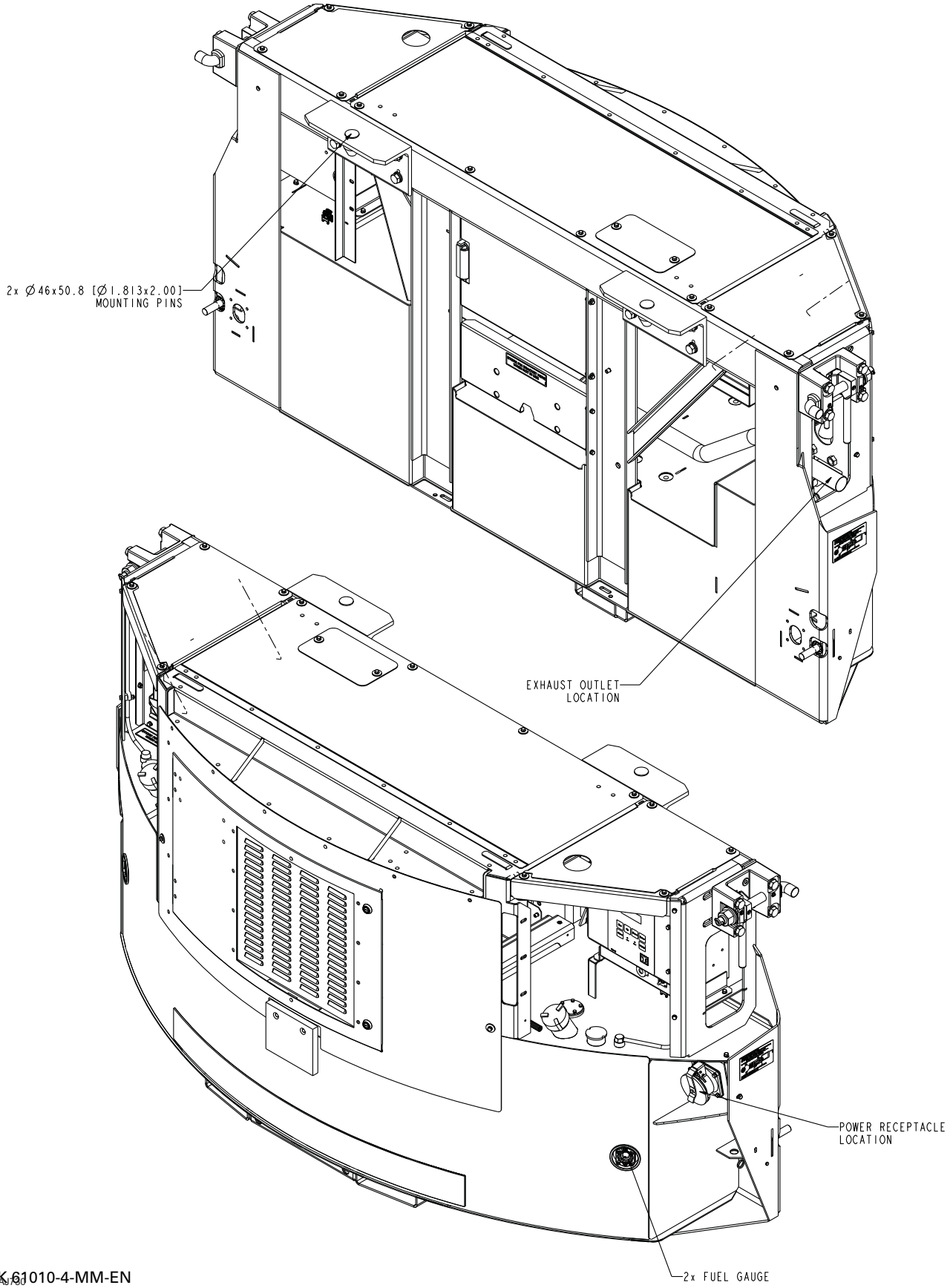


SGCO 4000 Decals

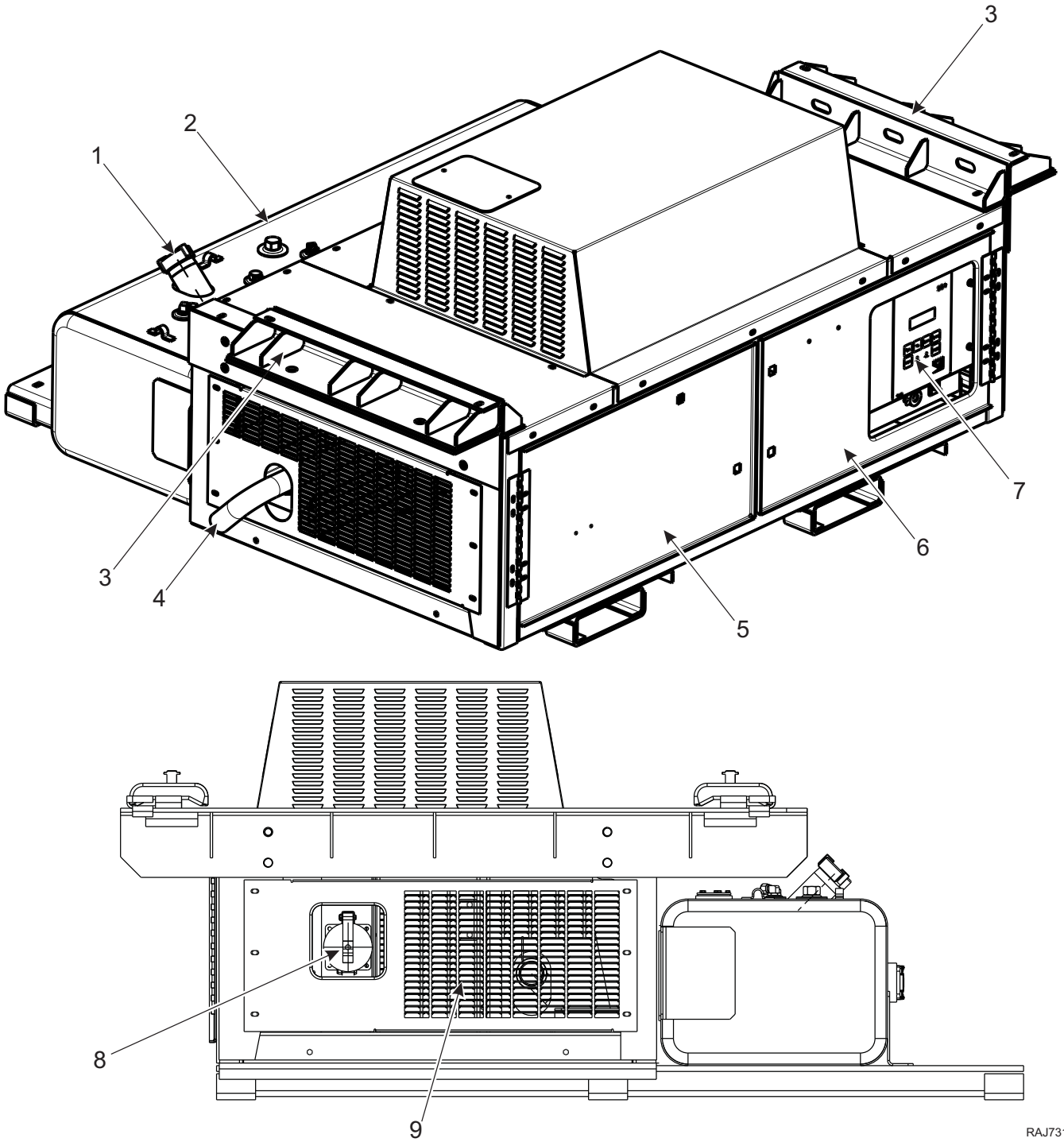


1.	Radiator Fill	5.	Operating Instructions
2.	Universal Fan	6.	Battery 925 CCA
3.	Unit ID	7.	CA Proposition 65
4.	Auto ON / OFF	8.	Warning - Either Use

SGCO 4000 Mounting View

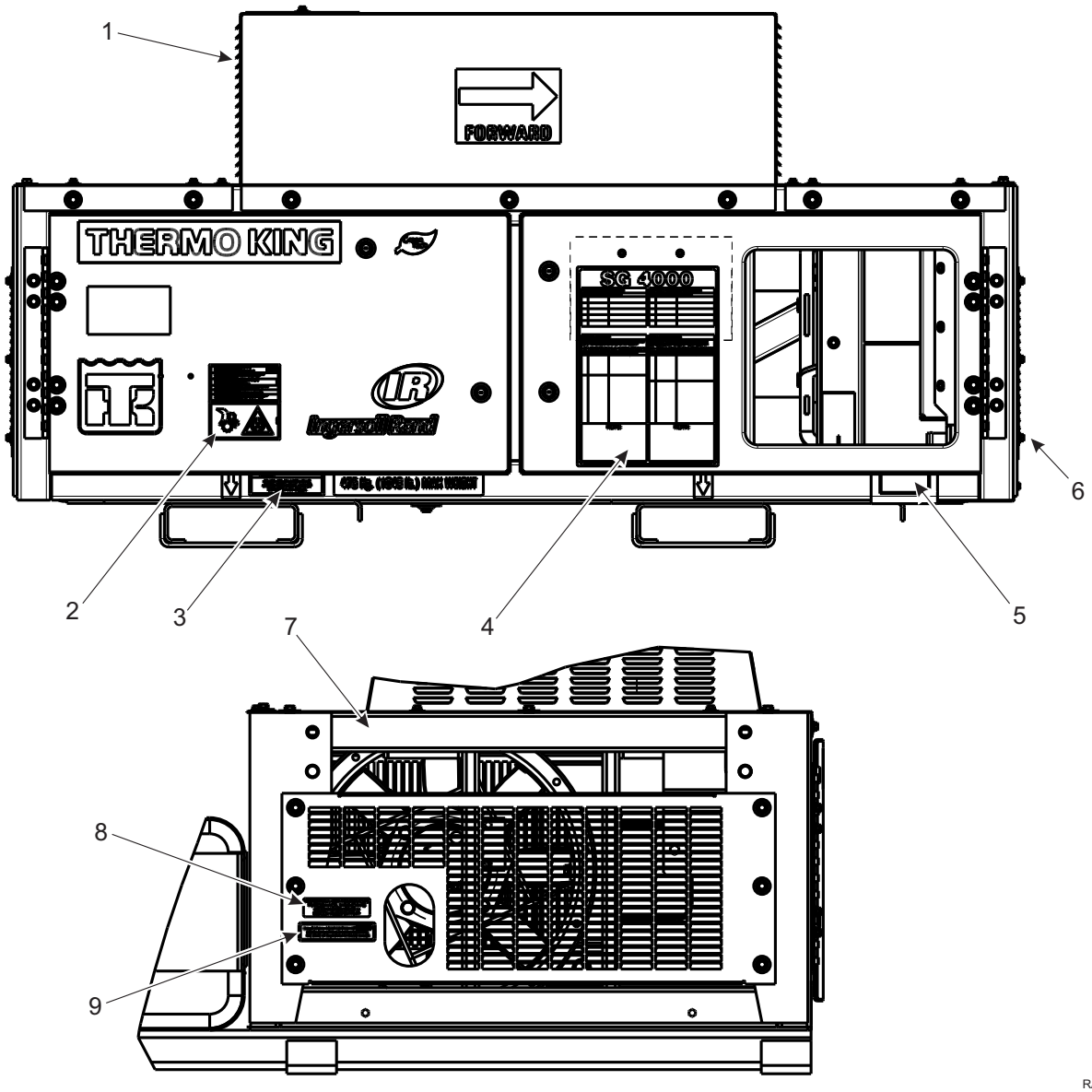


SGUM 4000 Views



1.	Fuel Fill Neck and Cap	6.	Alternator and Control Box Access Door
2.	Fuel Tank	7.	Control Panel
3.	Fuel Gauge	8.	460 VAC Power Receptacle Location
4.	Exhaust Outlet	9.	Radiator Location
5.	Engine Compartment Access Door		

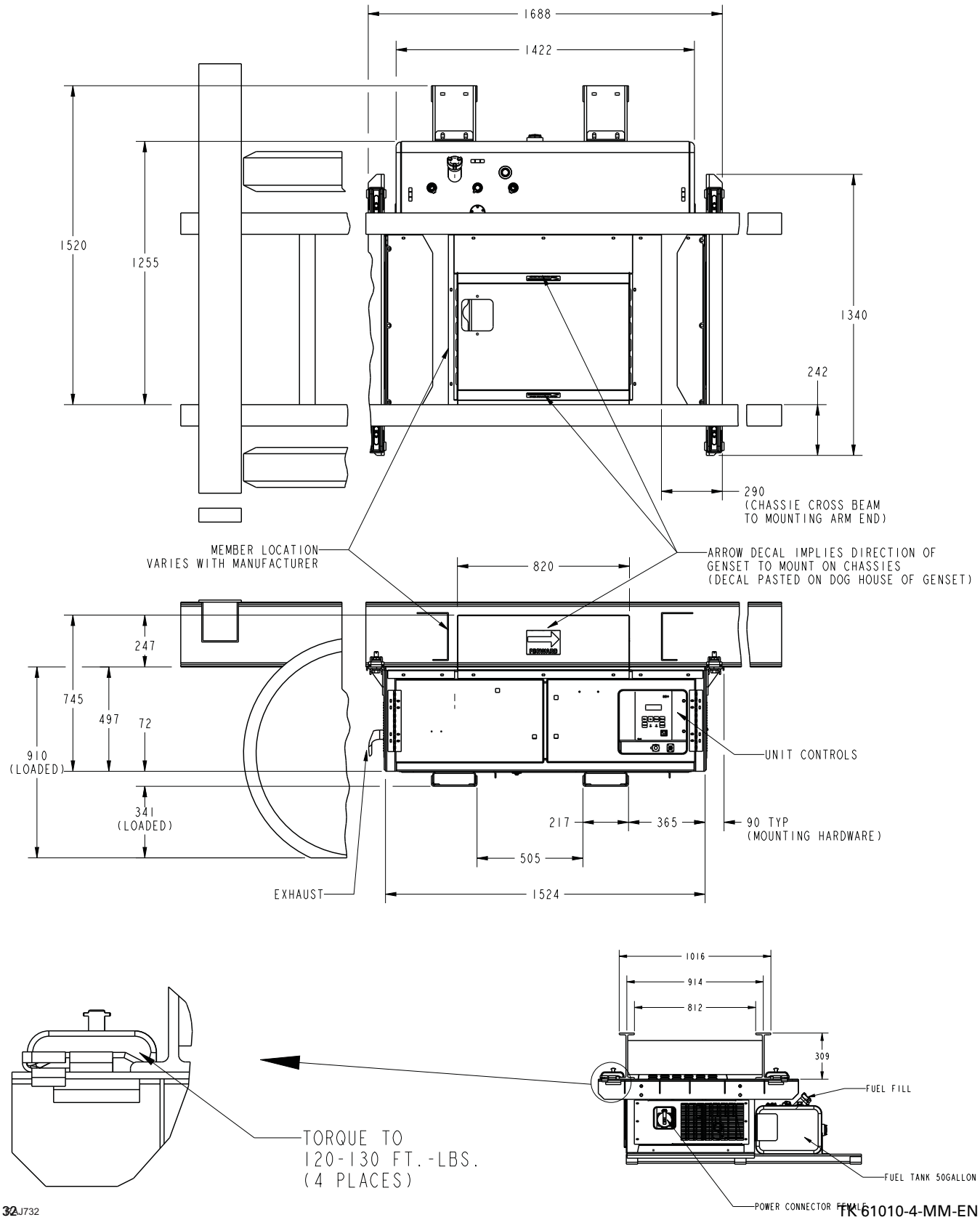
SGCM 4000 Decals



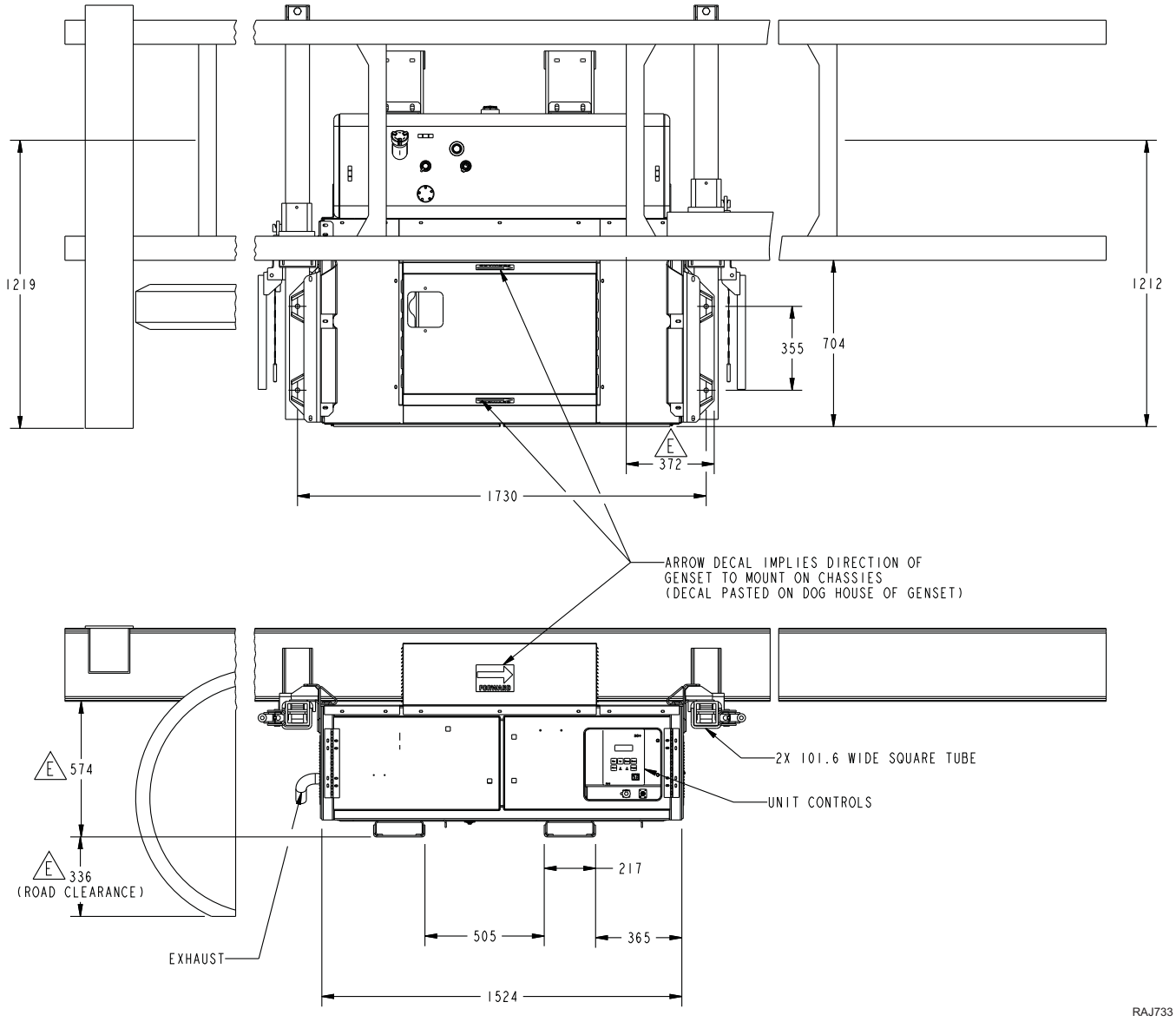
RAJ735

1.	Radiator Fill	6.	Caution 460V
2.	Auto Stop / Start	7.	Fan
3.	Warning - Either Use	8.	Battery 925 CCA
4.	Operating Instructions	9.	CA Proposition 65
5.	Decal Unit ID		

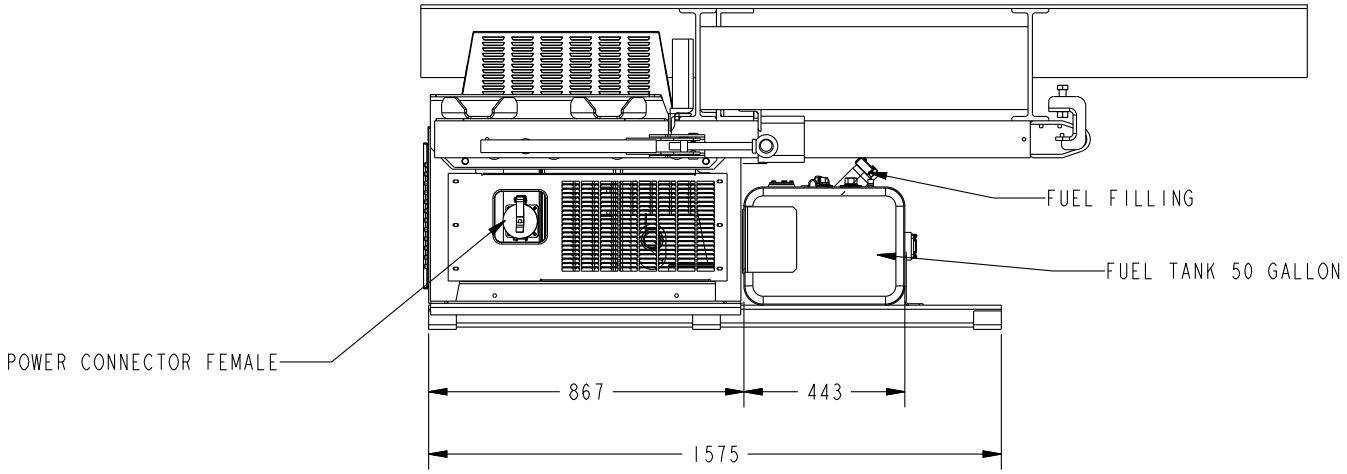
SGCM 4000 Dimensions

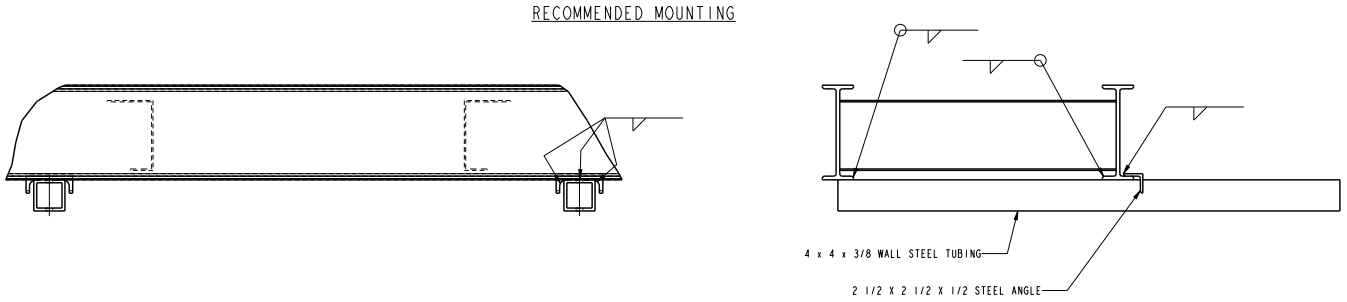


SGSM 4000 Dimensions 1



SGSM 4000 Dimensions 2

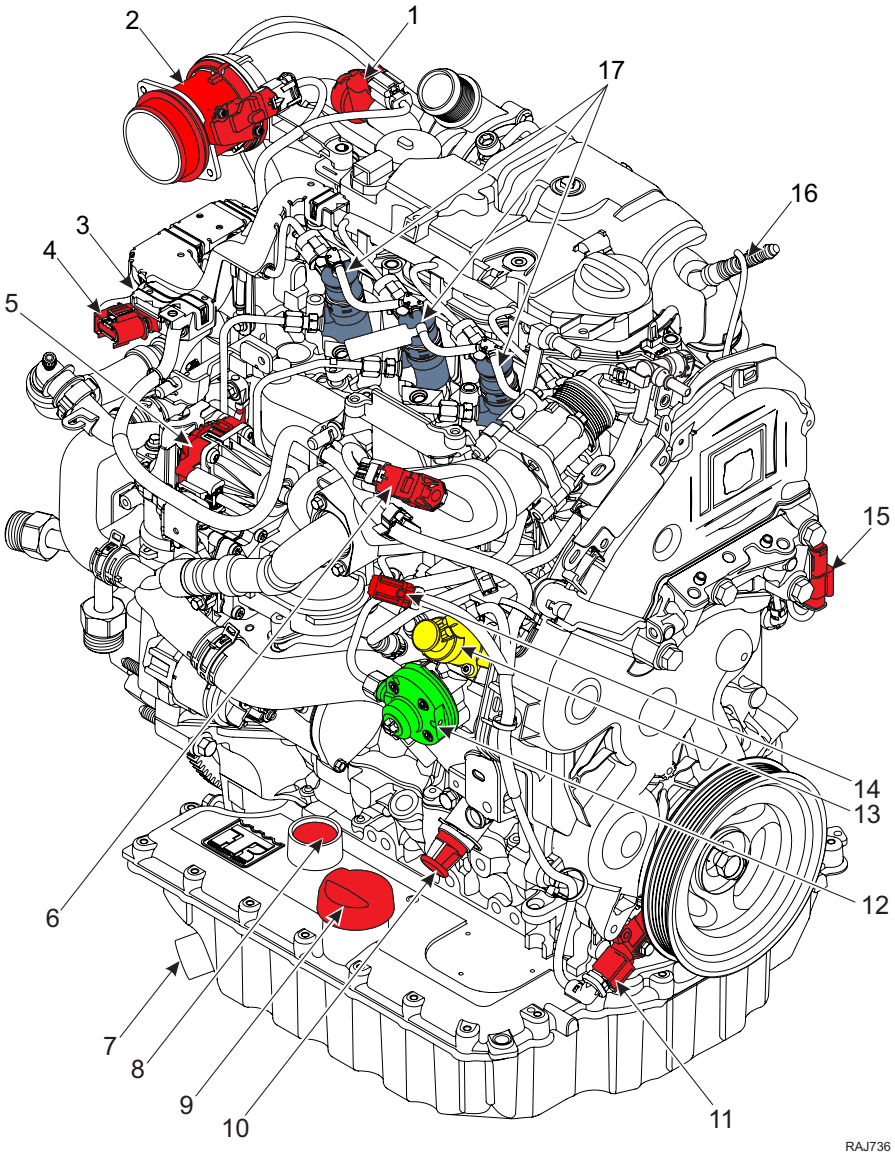




ATTACH GENSET WITH 5/8-11, GRADE 5 HARDWARE
TORQUE TO 150 FT-LBS.

RAJ734

SG 4000 Series Engine



1.	Oil Breather / Blow-By Heater	10.	Coolant Drain
2.	Mass Air Flow / Inlet Air Temperature Sensor	11.	Crankshaft Speed Sensor
3.	Coolant Temperature Sensor	12.	High Pressure Fuel Pump
4.	Glow Plug Harness Connector	13.	Fuel Pressure Regulator
5.	EGR Position Sensor	14.	Fuel Temperature Sensor / Hose Assembly
6.	Temperature and Boost Pressure Sensor	15.	Camshaft Sensor Connector
7.	Oil Drain	16.	Lambda / O2 Sensor
8.	Oil Level Sensor Location	17.	Fuel Injectors
9.	Oil Fill Cap		

Genset Model Features

SGSM 4000	SGCM 4000	SGCO 4000	Model
S	S	S	DV6NR Diesel Engine
S	S	S	460 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	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.
O	O	O	Telematics (ConnectedSuite)
—	—	O	Dual Mount

S = Standard
O = Optional
— = Not Applicable

SG+ Controller and Operating Instructions

SG+ Controller Description

The SG+ controller is a two-piece, self contained microprocessor for diesel generator sets. The SG+ display is mounted on the control box cover. The SG+ 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.

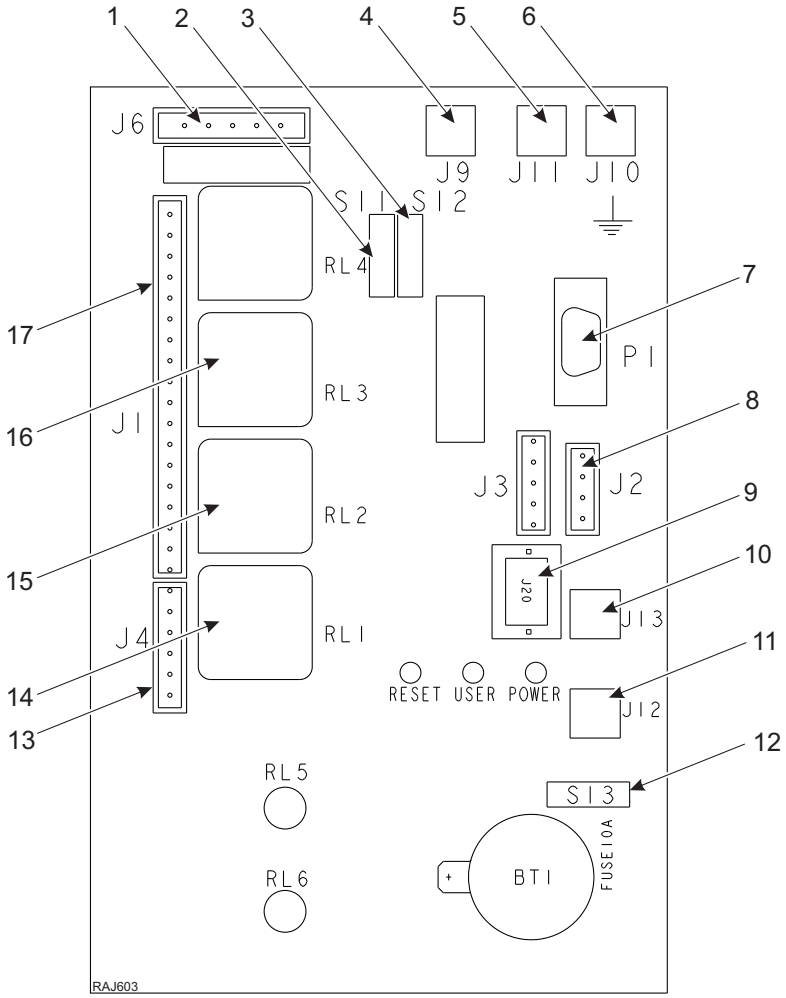
This system automatically controls generator operation by providing:

- 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 three (3) restarts and then stop.

Figure 1. SG+ Controller Display

Microprocessor

Figure 2. SG+ Microprocessor



1.	J6 Connector – To AC Circuits	10.	2C Circuit Connection
2.	Fuse SI1 – 30 Amp Fuse Power Relay	11.	8 Circuit Connection
3.	Fuse SI2 – 30 Amp Protects Battery Charger Output Circuit	12.	Fuse SI3 – 10 Amp Protects Microprocessor Power Input Circuit
4.	2A Circuit Connection	13.	J4 Connector – To External Relay Circuits
5.	CH Circuit Connection	14.	RL1 – Ignition Relay
6.	GND Circuit Connection	15.	RL2 – Run Relay
7.	Serial Port – For Flash Loading Software	16.	RL3 - Fuel Pump Relay
8.	J2 Connector – To SG+ Controller Display	17.	J1 Connector – To Sensor and Fuel Solenoid Circuits
9.	J20 - Connector to CAN		

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.	**Download 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+ Navigating the Controller Menus

Controller Display Menus

The SG+ 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:

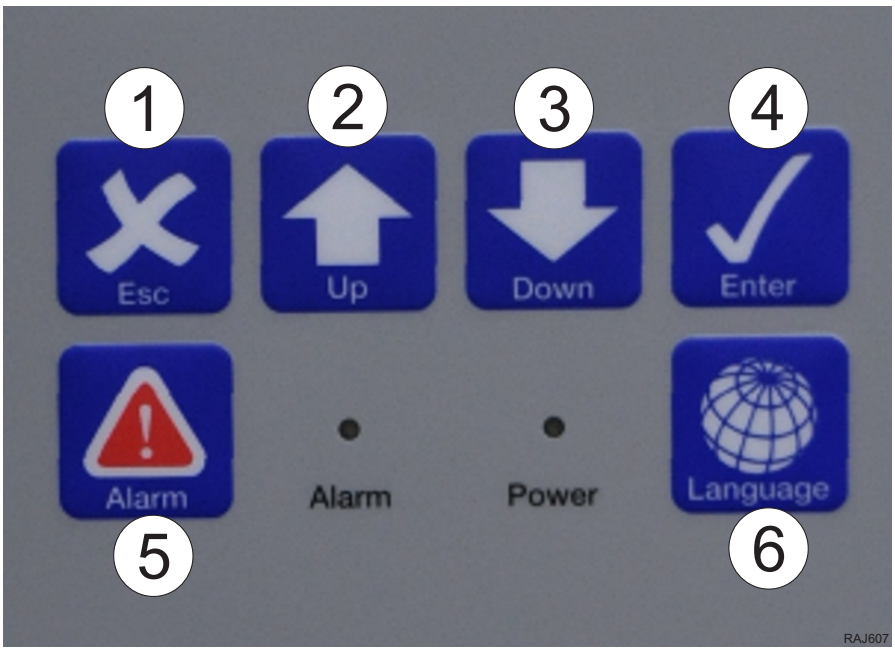
- Standard Display
- Pause Mode Display

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+ 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 SATES / 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
	SYSTEM SETUP	VIEW CURRENT SETTINGS
MISC. FUNCTIONS	C/F MODE	SELECT UNIT
	SW / HW VERSION	VIEW HARDWARE / SOFTWARE VERSIONS
	TIMERS COUNTERS	SHOW TIMERS
	DATE TIME	CURRENT DATE AND TIME
CONFIGURATION		CONFIGURE VALUES AND SETTINGS
EVENT LOG	EVENTS	VIEW EVENTS
	FUEL EVENTS	VIEW EVENTS

Data Menu

The Data Menu contains the following submenus.

- Engine, which displays engine operating information such as oil pressure and RPM.
- Engine Lamps, which displays the status of the different Engine Lamps - i.e protect, amber and stop lamp.
- Generator, which displays generator operating information such as output voltage and the main battery voltage.
- Unit, which displays unit operating information such as the status of components, if the unit is running, and the engine RPM.

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, which is the Pretrip Inspection Test. The PTI is a functional test of the unit.
- Manual Function Test, which is used to perform the individual PTI Test.
- ECU Service Menu, Used when the ECU service tool is connected.
- Oil Priming, allows engine to be cranked without starting to prime oil galleries.
- System Setup, which is used to check the engine speed, Speed Solenoid - can ask the ECU to switch from high or low speed operation, set units Generator and Genset type, set the unit fuel tank size, set the date and time, and set an ID number to identify the unit.

Misc. Functions Menu

The Misc. Functions Menu contains the following submenus:

- C/F Mode, which is used to select whether Celsius or Fahrenheit units are used to display temperature readings. See “C/F Mode” on page 79 for more information. This function can also be used to change your Pressure reading unit of measure - i.e. Bars or PSI
- SW/HW Version, which displays information about the controller software and hardware. See “SW/HW Version” on page 80 for more information.
- Timers/Counters, which displays information about the hourmeters and restart counters. See “Timers/Counters” on page 81 for more information.
- 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.

Event Log Menu

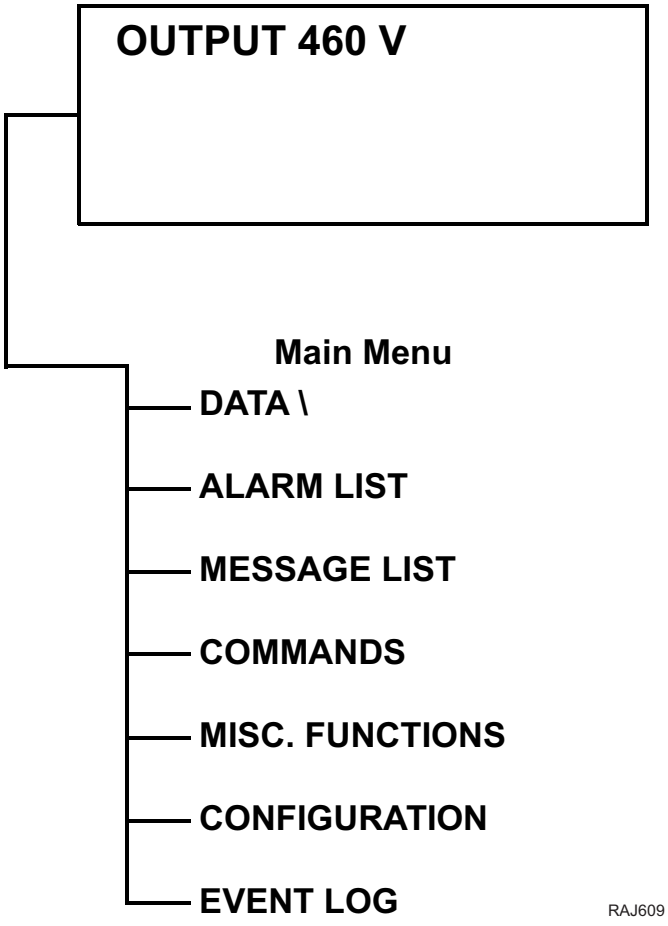
The Event Log Menu contains the following submenus:

- Event Log, which shows a list of events, warnings, and alarms recorded in the controller memory.
- Fuel Events, which shows a list of fuel events recorded in the controller memory.

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.



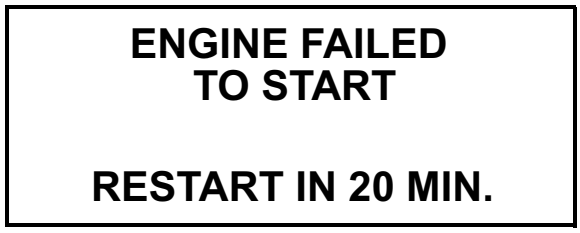
Pause Mode Displays

⚠ 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.



RAJ610

Controller Link Down Display

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

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

RAJ611

SG+ 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.
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 30 (or 30, 29, 28, etc. to 01)

     The delay screen counts down from 30 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.*

Pretrip Inspection Test (PTI)

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 of 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

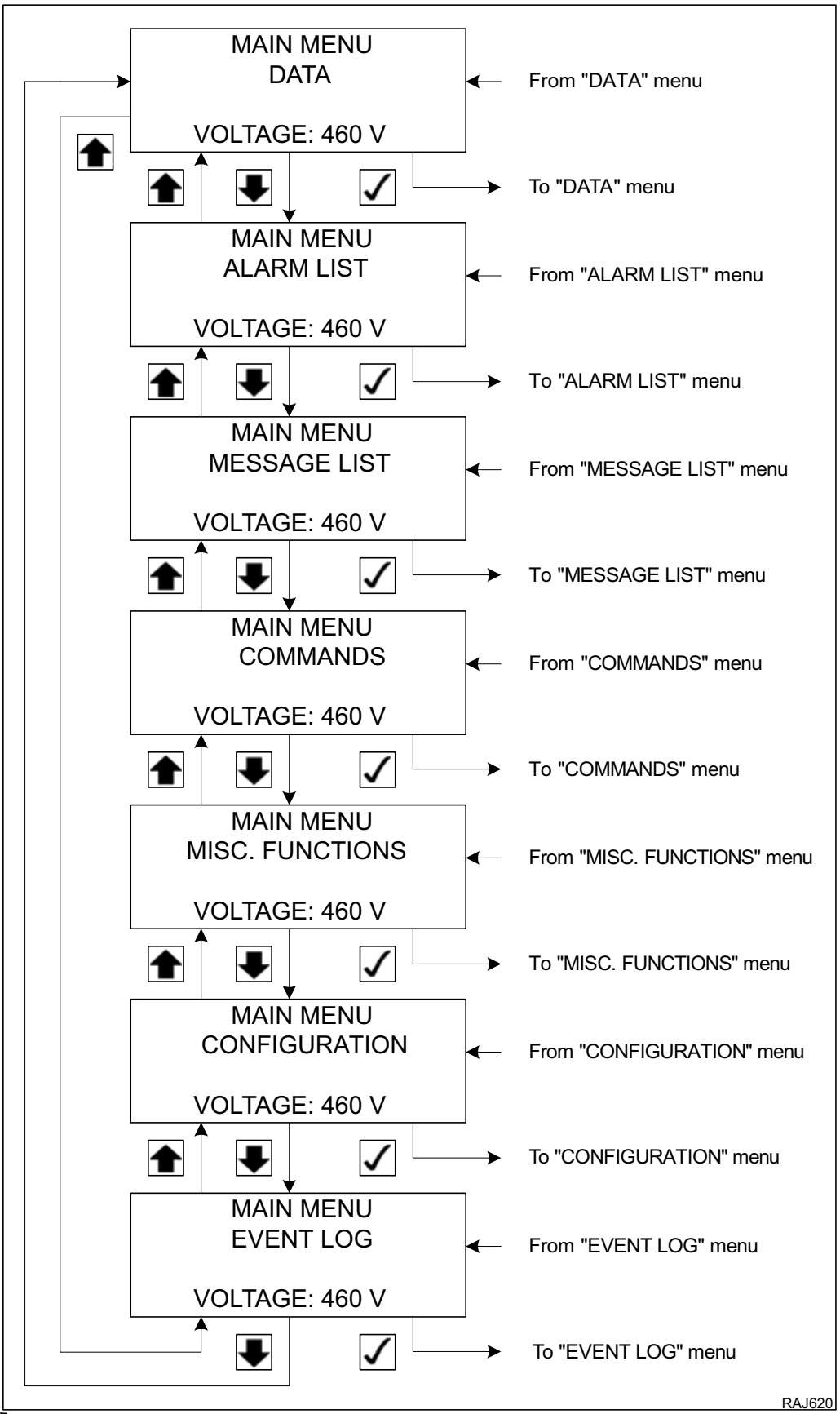
The Main Menu contains the following menus:

- 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 3. 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:

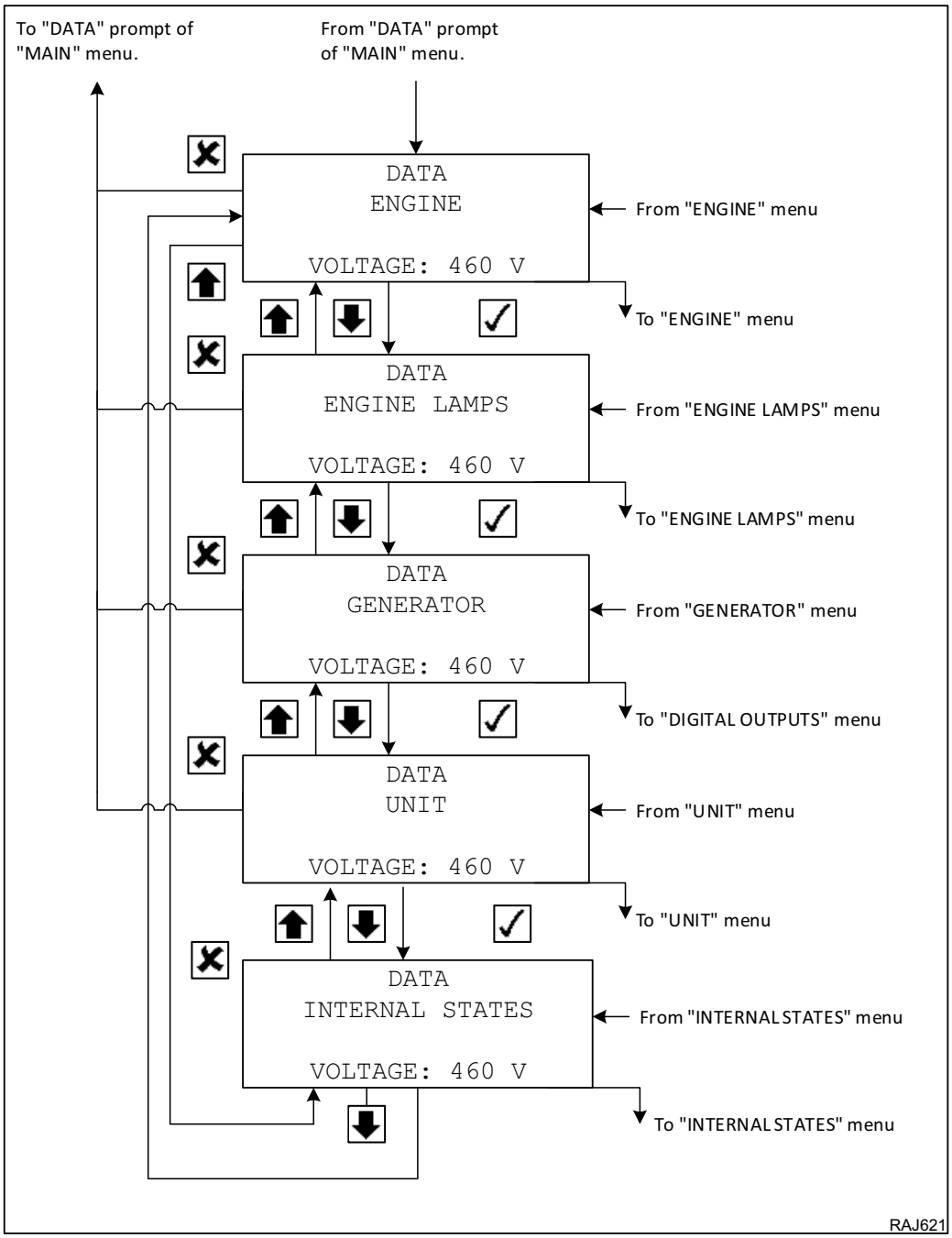
- Engine
- Engine Lamps
- Generator
- Unit
- Internal States

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 4. Data Menu



Engine Menu

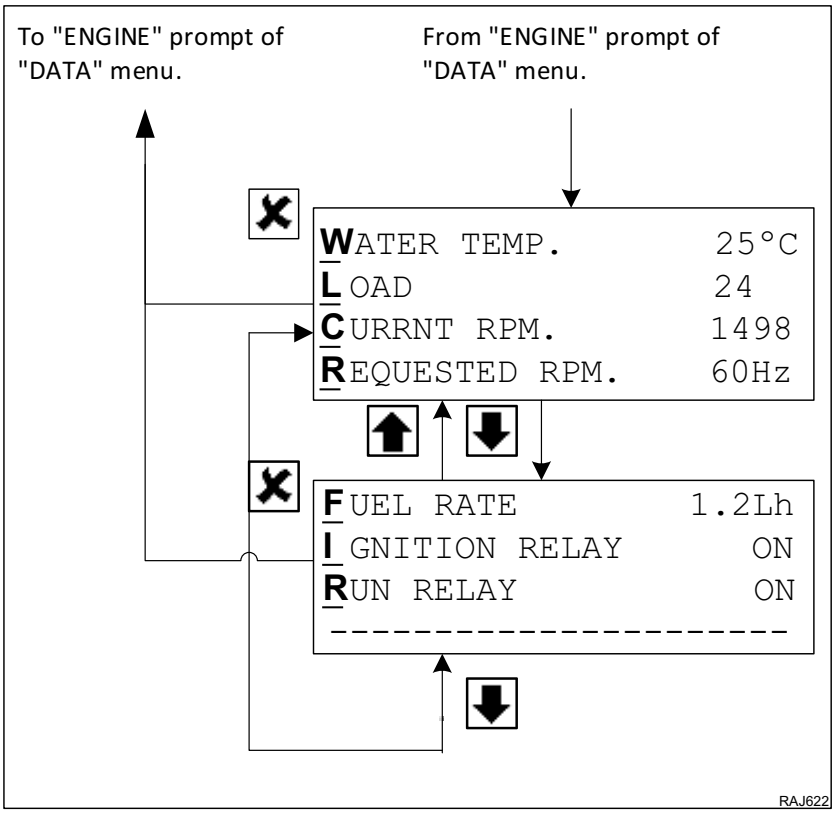
The Engine display the following unit operating information:

- Water Temp. (Engine Coolant Temperature)
- Load (shows percentage engine load)
- Current RPM
- Requested RPM
- Fuel Rate
- Ignition Relay
- Run Relay

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.

Figure 5. Engine Submenu



Engine Lamps

The Engine Lamps submenu displays the following information:

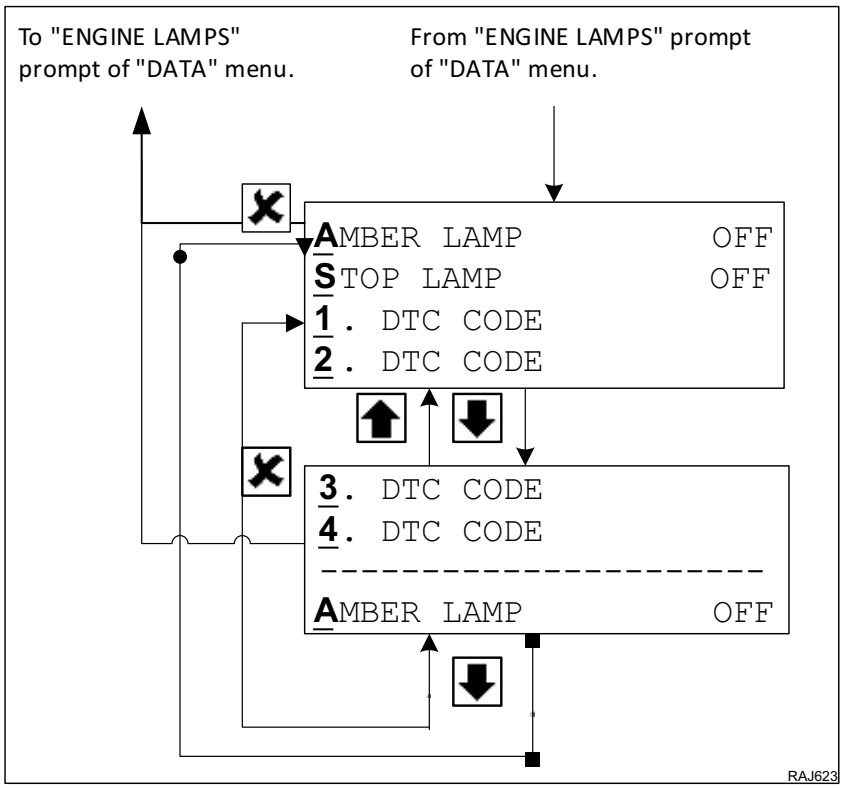
- Amber Lamp on/off
- Stop Lamp on/off
  1. DTC Code - DTC codes are the same has the P-codes out of the ECU. The EXXODiag Diagnostic Tool is needed to clear these codes.
  2. DTC Code
  3. DTC Code
  4. DTC Code

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.

Figure 6. Engine Lamps Submenu



Generator

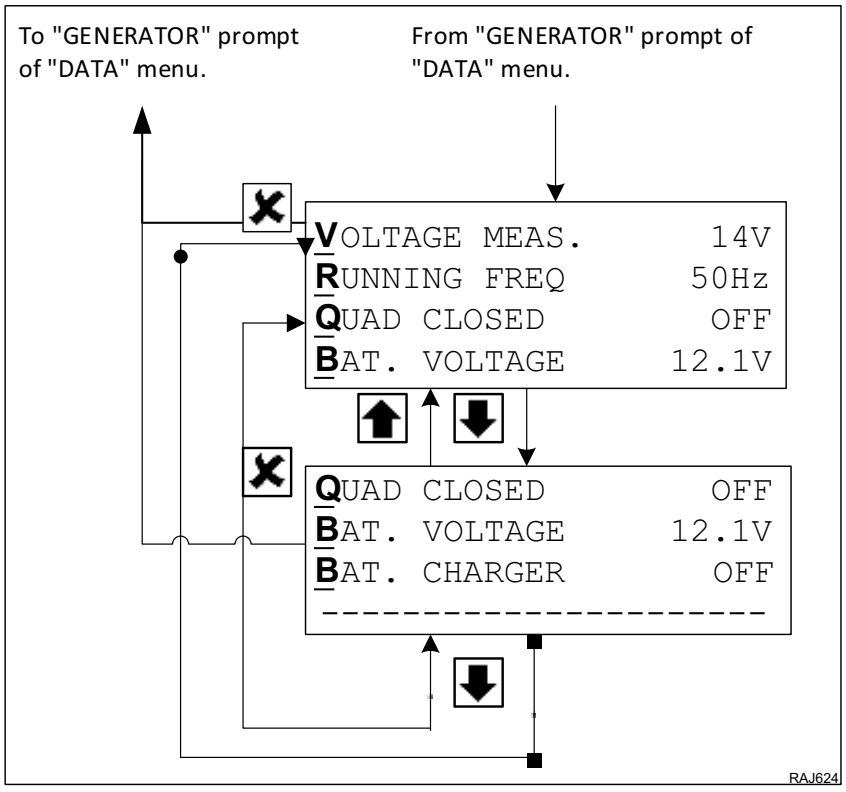
The Generator submenu display the status of the following outputs:

- Voltage Measurement
- Running Frequency
- Quad closed on/off
- Battery Voltage
- Battery Charger on/off

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.

Figure 7. Generator Submenu



Unit

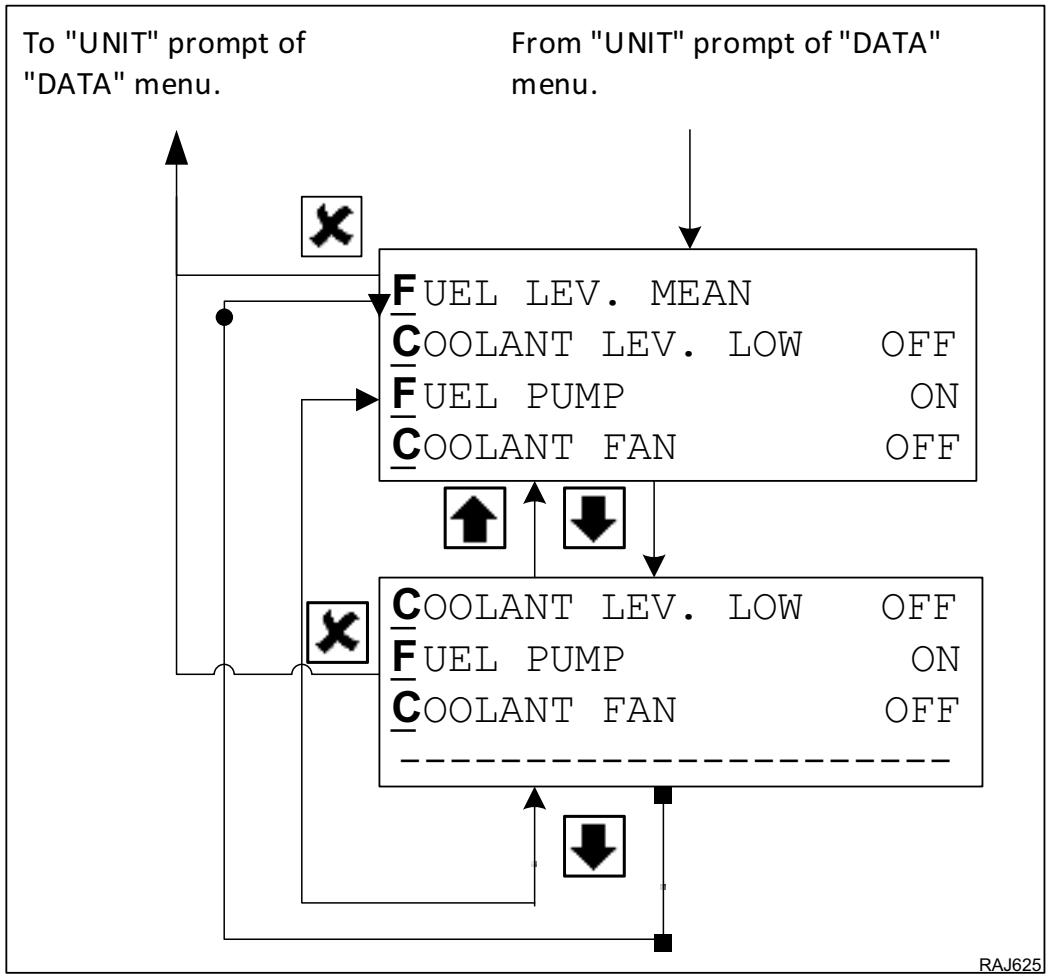
The Unit submenu display the status of the following outputs:

- Fuel Level Average
- Fuel Level Low on/off
- Fuel Pump on/off
- Coolant Fan on/off

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.

Figure 8. Unit Submenu



Internal States

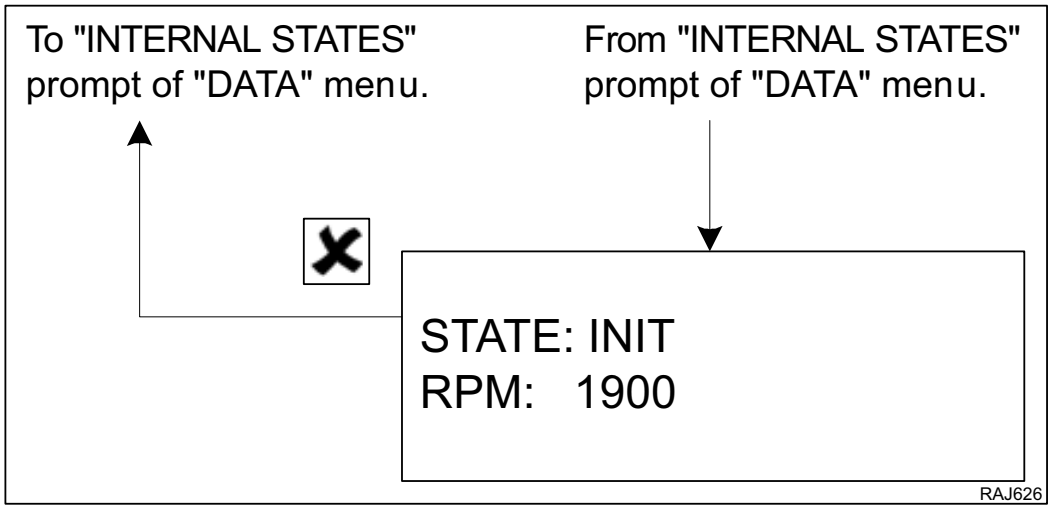
The Internal States displays which of the following states the unit is in as it prepares to start, and after it starts or if it shuts down:

- 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 9. Internal States



Alarm List Menu SG+

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:

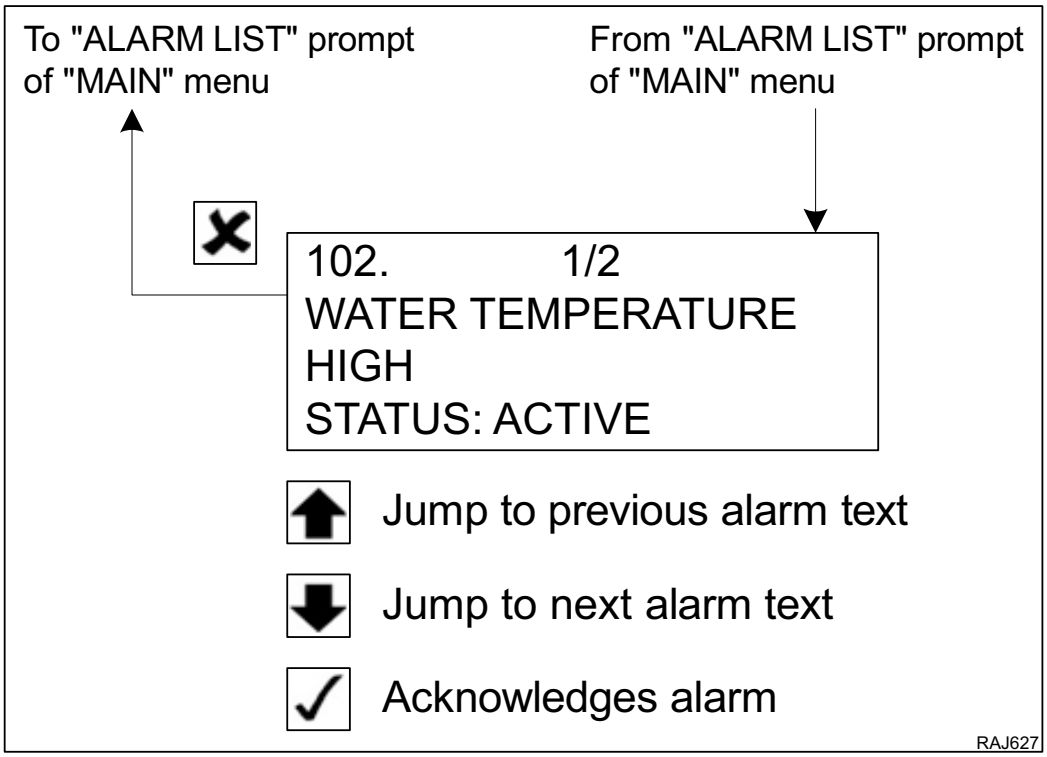
- **Delayed Restart Alarm:** Delayed restart alarms indicate the unit has stopped temporarily because of a problem or to prevent damage to the unit. The unit will attempt to restart in 20 minutes. The display will show information about the unit in the message screen and the time left to the restart 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 (A101 through A126)
   - 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.

Figure 10. Alarm List Menu



Alarm Diagnosis

The Alarm List on the following pages lists the alarms, their causes, and possible diagnosis.

Alarm List			
Alarm Code	**Alarm Text**	**Alarm Type–Cause**	**Diagnostics**
A101	WATER TEMPERATURE HIGH	Delayed Restart Alarm–Engine is running and water temperature is above 107 C (225 F) for 5 seconds. • Engine then stops and then attempts to restart.	1. Check for cause of engine overheating: • Check engine coolant level. • Check water pump belt. • Check radiator for airflow and coolant flow restrictions.
A102	ENGINE FAILED TO CRANK	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.	1. Defective battery, load test battery. 2. Check Battery Charger. 3. Check ground connections at block. 4. Check Battery Charger. 5. Check stater motor.
A103	ENGINE FAILED TO START	Delayed Restart Alarm–Engine failed to crank. Becomes a Shutdown Alarm when number of restart attempts is greater than number of "Crank Restarts" set in Configuration Menu.Warning if the engine reports error during the start sequence.	1. Check fuel level. 2. Check fuel pump, and fuel system both electrically and mechanically. 3. In cold ambient temperatures check for fuel gelling. 4. Check for restricted air cleaner or air intake system. 5. Check intake air heater.
A104	RL2 (FUEL H) FEEDBACK FAILURE	Shutdown Alarm–No feedback when relay is energized, or feedback when relay is not energized.	Check RL2 (Fuel Hold) relay.
A107	EXTERNAL OVERLOAD	Shutdown Alarm–Engine restart if output voltage is short-circuited.	1. Unplug load and attempt restart. 2. Check alternator field circuit. 3. Check alternator output circuit. 4. Check external generator controller electrical system.
A108	ENGINE NOT RUNNING REASON UNKNOWN	Delayed Restart Alarm - Genset stops for restart without any reason with oil pressure but zero RPM when engine should be running. Engine will attempt to restart in 20 minutes.	1. Check fuel level. 2. Check oil level. 3. Check RPM Sensor
A109	LOW OIL LEVEL	If low oil level for 60 seconds.	1. Check oil level. 2. Check Oil Level Switch. 3. Check circuits to Oil Level Switch.
A110	RPM BELOW LIMIT	Shutdown Alarm–Engine stops for restart if speed is below limit i.e, Engine speed is below 1350 RPM.	1. Check engine speed. 2. Check RPM sensor.
A111	FAILED TO START LOW BATTERY	The controller is resetting 3 times during crank caused by low voltage on the battery. The low voltage could be controller not charging the battery, defective battery or cables.	1. Defective battery, load test battery. 2. Check Battery Charger. 3. Check ground connections at block.
A113	COOLANT LEVEL LOW	Coolant level is low.	1. Check coolant level. 2. Check Coolant Level Sensor. 3. Check circuits to Coolant Level Sensor.

A115	EXCITER CONTROL UNIT SHUTDOWN	External controller has not responded within 5 seconds.	1. Check wiring to exciter controller. 2. See "Alternator Diagnosis".
A116	ENGINE CONTROL UNIT SHUTDOWN	The engine is restarted if communication has been lost with the engine controller. External controller has not responded within 5 seconds.	Check wiring to engine controller.
A118	ENGINE STOP LAMP	Engine stop lamp activated	Connect ECU Test Tool to read codes.
A119	LOW OIL PRESSURE	Low oil pressure message active.	Connect ECU Test Tool to read codes.
A120	OUTPUT VOLTAGE HIGH	Output voltage above 500 volts over 15 seconds	See "Alternator Diagnosis".
A121	ENGINE PROTECT LAMP	Engine degraded mode (speed limitation) or starter relay defect.	Connect ECU Test Tool to read codes.
A122	GENERATOR UNIT ERROR	Over excitation or short circuit	See "Alternator Diagnosis".
A123	COOLANT FAN ERROR	Coolant fan klixon is open and coolant temperature is above limit.	1. Check coolant fan klixon. 2. Check circuits to coolant fan klixon.
A124	FUEL TANK EMPTY	Monitoring the engine P-code for low fuel delivery pressure will activate the alarm when the engine is about to shut down due to out of fuel condition.	Check fuel level
A125	TIMING BELT EXPIRED	Timing belt needs replacement due to years of operation or engine run hours.	Replace engine timing belt.
A126	OUTPUT FREQUENCY FAILURE	Output frequency above 99Hz for 5 seconds	See "Alternator Diagnosis".

Message List Menu SG+

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.

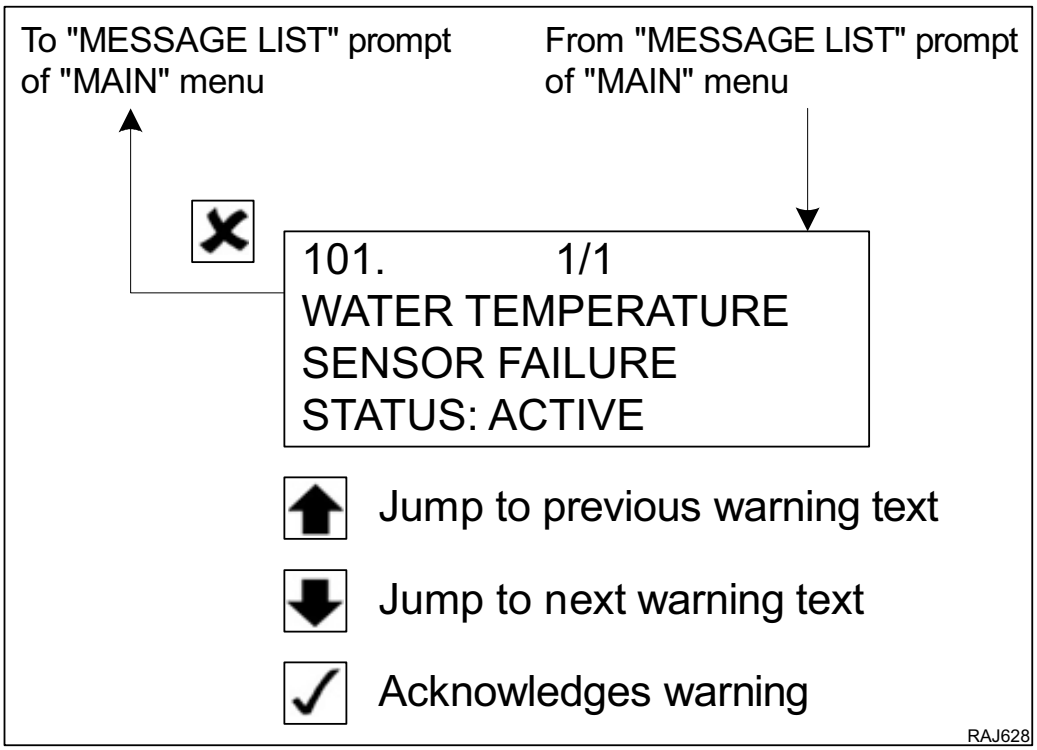
Note: *The unit will not start a PTI until all active messages have been acknowledged. The display will show "ACKNOWLEDGE MESSAGE" if there are messages that have not been acknowledged when trying to start a PTI.*

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 (M101 through M151)
   - 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.

Figure 11. Message List Menu



Message Diagnosis

The Message List on the following pages lists the messages, their causes, and possible diagnosis.

Message List			
Message Code	**Message Text**	**Message Cause**	**Diagnostics**
M101	BAT. VOLTAGE LOW	The battery voltage is reported to be below 12 voltages for 3 minutes. If the air heater is activated the battery voltage should be below 9 voltage for 3 seconds.	1. Check battery. 2. Check battery cables.
M102	DIGITAL INPUT FAILURE	Digital inputs have been changing once a second for the last 100 seconds.	This condition indicates noise on the line, a loose connection, or a bad sensor.
M103	OUTPUT VOLTAGE < 180 V	Exciter field regulation is turned on and voltage measurement is below 360 volts for 30 seconds.	Check alternator for low output.
M106	OUTPUT FREQUENCY LOW	Output frequency is below 45 Hz for 30 seconds (engine RPM below 1350).	Check and adjust engine speed.
M107	OUTPUT FREQUENCY HIGH	Output frequency is above 70 Hz for 30 seconds (engine RPM above 2100).	Check and adjust engine speed.
M108	LOW OIL LEVEL	Oil Level Switch indicates low oil level for 3 minutes.	1. Check oil level. 2. Check Oil Level Switch. 3. Check circuits to Oil Level Switch.
M109	HOUR METER 1 HAS EXCEEDED THRESHOLD	Hour Meter 1 (HM1) has exceeded the threshold set in the Configuration Menu.	Acknowledge message to reset timer.
M110	HOUR METER 2 HAS EXCEEDED THRESHOLD	Hour Meter 2 (HM2) has exceeded the threshold set in the Configuration Menu.	Acknowledge message to reset timer.
M111	FUEL LEVEL LOW	Fuel Level is below "Fuel Level" set in Configuration Menu.	1. Check fuel level. 2. Check Fuel Level Sensor. 3. Check circuits to Fuel Level Sensor.
M112	ENGINE RPM SENSOR FAILURE	Engine speed below 800 RPM and oil pressure high while running or the engine speed is not zero before the starter energizes.	Inspect and text engine RPM sensor and wiring.
M114	LOW OIL PRESSURE	No oil pressure.	1. Check oil level. 2. Check oil pressure using the Engine submenu of the Data Menu. 3. Check Oil Pressure Switch. 4. Check Oil Pressure Switch circuit.
M116	COUNTDOWN TIMER HAS EXPIRED	If hour counter exceeds user setup.	Acknowledge message and reset timer.
M119	WATER TEMPERATURE HIGH	If water temp. >107 C for 5 sec. - restarting.	1. Check water temperature sensor. 2. Check WTP/WTN circuit.
M121	ENGINE FAILED TO START	No oil pressure and did not reach 800 RPM - restarting.	1. Check fuel level. 2. Check fuel pump, and fuel system both electrically and mechanically. 3. In cold ambient temperatures check for fuel gelling. 4. Check for restricted air cleaner or air intake system. 5. Check glow plugs.

M122	EXTERNAL OVERLOAD	If output is short-circuited - restarting.	1. Unplug load and attempt restart. 2. Check alternator field circuit. 3. Check alternator output circuit.
M123	ENGINE STOPPED REASON UNKNOWN	Oil pressure good and no RPM - restarting.	1. Check fuel level. 2. Check fuel pump, and fuel system both electrically and mechanically. 3. In cold ambient temperatures check for fuel gelling. 4. Check for seized engine or alternator.
M126	FUEL LEVEL SENSOR OUT OF RANGE	Fuel level reading is 90 Gallons above then maximum tank size.	1. Check fuel level sensor. 2. 2. Check FPOS, FNEG, and FOUT circuits. 3. Check fuel tank size setting in System Setup submenu.
M127	FUEL LEVEL CHANGE TO FAST	Fuel level reading decreased faster than normally expected. ***Note:*** *Must use password (0007) to clear this message.*	1. Check for leak in fuel tank. 2. Check to see if fuel has been removed from fuel tank.
M128	SPEED SOLENOID FAILURE	The difference between the high and low RPM is measured below 100 RPM.	Inspect and text engine speed solenoid and wiring.
M129	RPM BELOW LIMIT	RPM is below 1350 for 5 sec.	1. Check engine speed. 2. Check RPM sensor.
M130	DELAYED OUTPUT TIMED OUT	Water temperature sensor is below 32 C (90 F) for 5 minutes.	1. Check water temperature sensor. 2. Check WTS circuit.
M133	EXCITER CONTROL SHUTDOWN	External controller has not responded within 5 sec.	See Alternator Diagnosis
M135	ENGINE CONTROL UNIT SHUTDOWN	Exciter voltage below 20V.	See Alternator Diagnosis
M137	ENGINE AMBER LAMP	On for defects that could lead to degraded mode (speed limitation), and for Starter relay defect (because impacting safety)	Connect ECU Test Tool to read codes.
M138	ENGINE STOP LAMP	On for defects that could lead to engine stop mode.	Connect ECU Test Tool to read codes.
M140	DSR CHECKSUM WARNING	Regulator running with default parameters.	See Alternator Diagnosis
M141	DSR CHECKSUM WARNING	Output is short-circuited	See Alternator Diagnosis
M142	DSR EXCITATION OVERCURRENT WARNING	Exciter current exceeds the damage threshold	See Alternator Diagnosis
M143	DSR UNDER OR OVER SPEED WARNING	Speed is below or above threshold.	See Alternator Diagnosis
M144	DSR OVER CURRENT AND SPEED WARNING	Current and speed above limits.	See Alternator Diagnosis
M146	OUTPUT VOLTAGE HIGH	Output voltage above 500 volts over 15 seconds	See Alternator Diagnosis
M148	EXCITER PROTECTION ACTIVATED	HRG exciter protection gizmo has been activated	See Alternator Diagnosis
M149	COOLANT FAN FAILURE	Coolant fan klixon open for 5 seconds	1. Check coolant fan klixon. 2. Check circuits to coolant fan klixon.

M150	ENGINE P-CODE INFO	Generated for engine P-codes that do not activate any engine lamps.	Connect ECU Test Tool to read codes.
M151	TIMING BELT EXPIRED	Timing belt needs replacement due to years of operation or engine run hours.	Replace engine timing belt.

Commands Menu

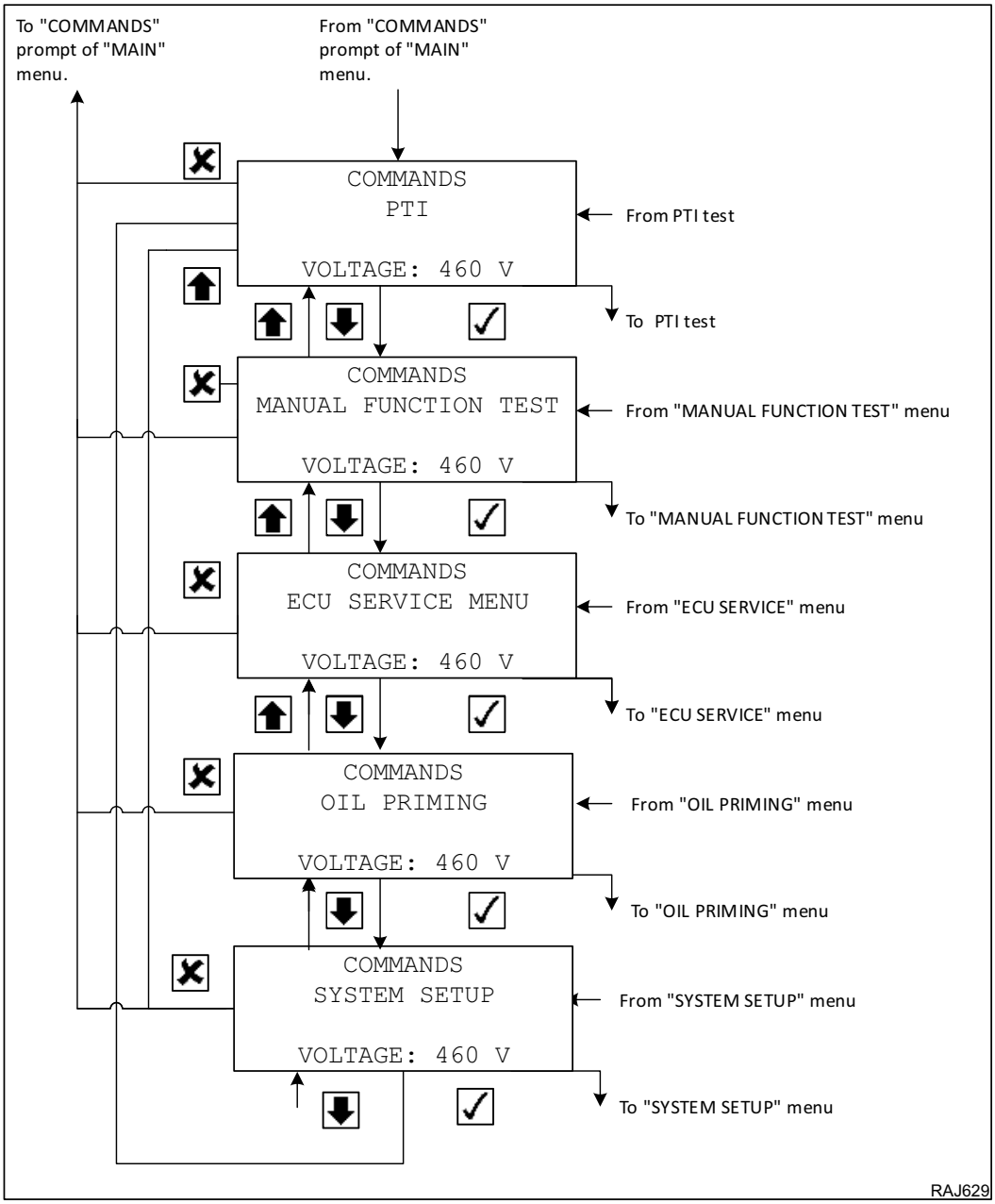
The Commands Menu contains the following submenus that are used to test the operation or the unit and controller:

- PTI (Pretrip Inspection Test)
- Manual Function Test
- ECU Service Menu
- Oil Priming
- System Setup

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.

Figure 12. Commands 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 of 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.

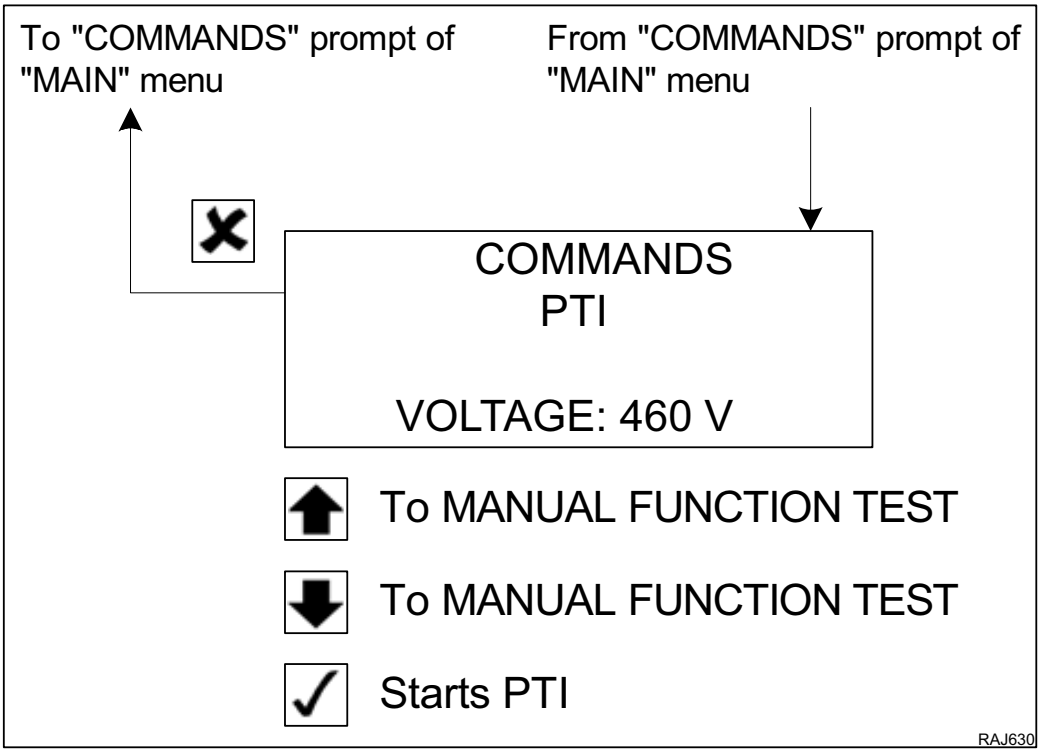
Note: *If a component fails its test, the PTI will stop at that point and display "FAILED - REBOOT". Correct the problem and repeat the PTI by pressing the ENTER Key.*

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 13. PTI Submenu



Manual Function Test

The Manual Function Test submenu contains the following component tests:

- Display Test
- ECU Ignition Test
- ECU Run Relay Test
- ECU Fuel Relay Test
- DSR Quad Relay Test

The test result (PASSED of 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 14. Manual Function Test Example

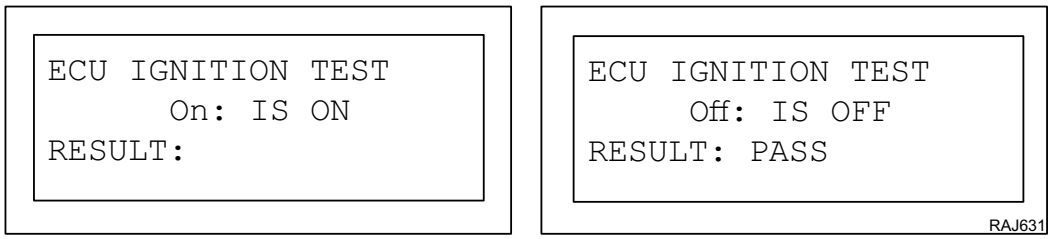
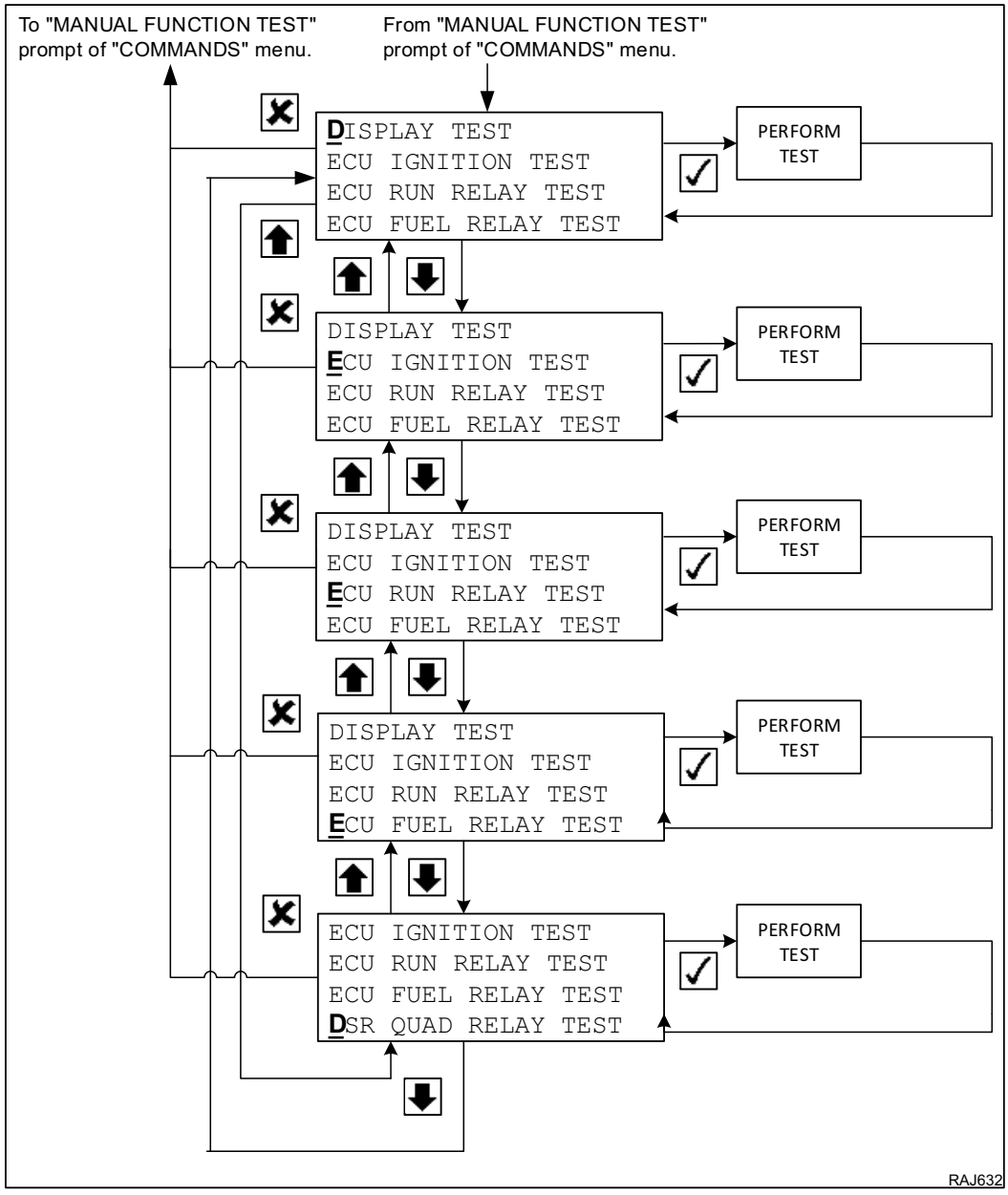


Figure 15. Manual Function Test Submenu



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+ 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+ Controller and is a program with is opened on your PC. This software tool comes in a Diagnostic kit which is called EXXODiag Diagnostic Tool. See the EXXODiag Diagnostic Tool Manual (which you can find on the help link within the tool itself - see arrow below) on how to install and operate this tool, and “Using EXXODiag to Connect to ECU”.

RAJ788

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.

System Setup

The System Setup submenu contains the following:

- Current RPM, which is used to check the engine speed.
- Speed Solenoid, which is used to request a speed change to the ECU.
- Tank Size (50/75/80/125), which is used to set the unit fuel tank size.
- Fuel Sensor (Yes/No), which is used to setup units with a fuel sensor. Unit with fuel sensor Yes, unit without fuel sensor No.
- Date, which is used to set the date. See "Misc. Functions Menu" on page 78 for information about setting the date.
- Time, which is used to set the time. See "Misc. Functions Menu" on page 78 for information about setting the time.
- ID Number, which is used to set an ID number to identify the unit when downloading the event logger.
- Serial Number, which is used to set the unit serial number in the controller menu.

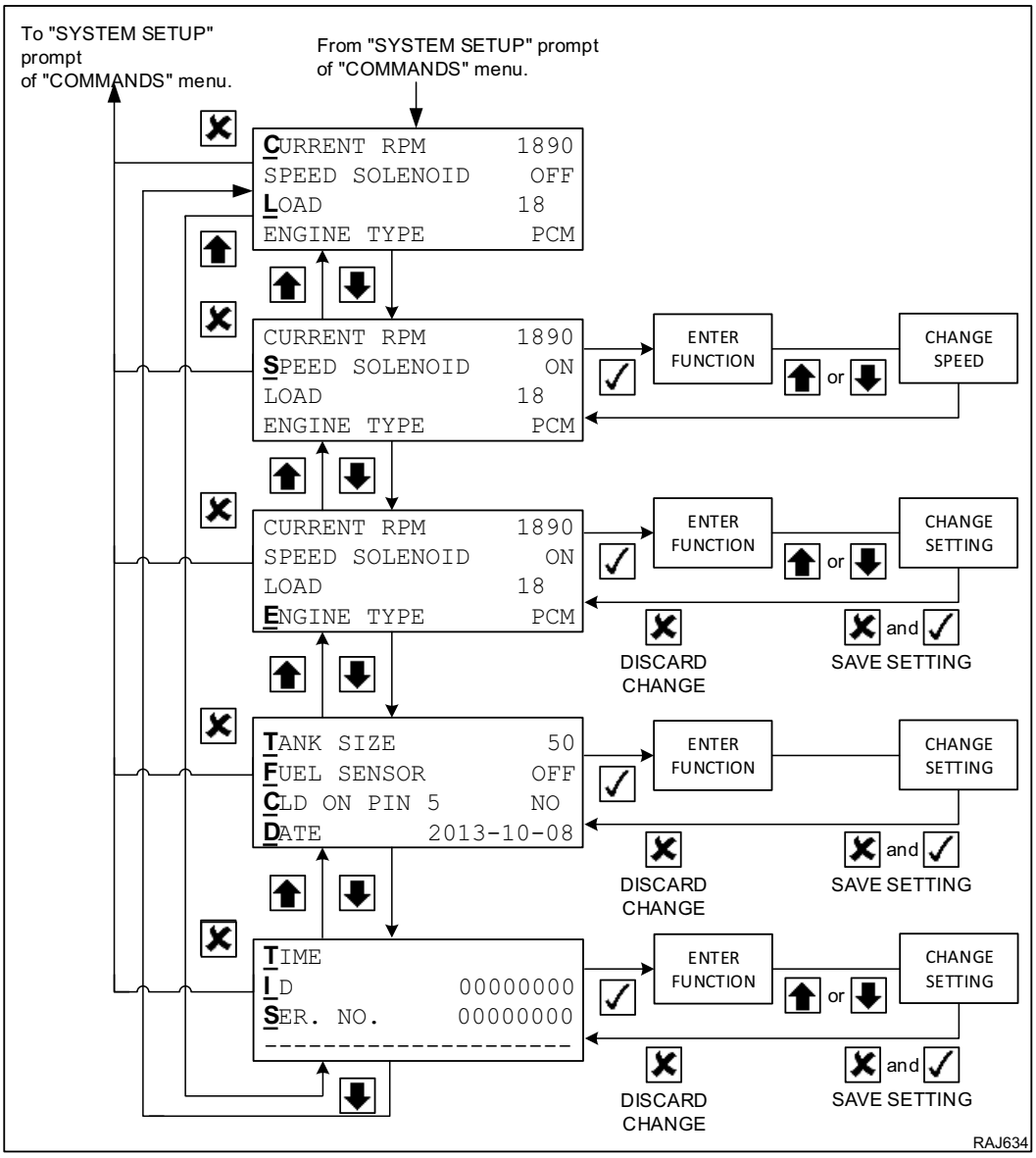
To enter the System Setup submenu complete the following steps:

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 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 System Setup submenu.
7. Press the ENTER key to enter the System Setup submenu.
8. Press the UP or DOWN key to scroll up or down through the System Setup submenu.
9. Press the ENTER key to enter the selected function.
   - Press the UP or DOWN key to change the value of the selected function.

     Note: *The engine speed will change when the UP or DOWN key is pressed.*
   - Press the ESCAPE key and the ENTER key at the same time to save the new Tank Size setting.

     Note: *Press the ESCAPE key to return to the System Setup submenu without saving the new settings.*
   - Press the ESCAPE key to return to the System Setup submenu.

Figure 16. System Setup Submenu



Misc. Functions Menu

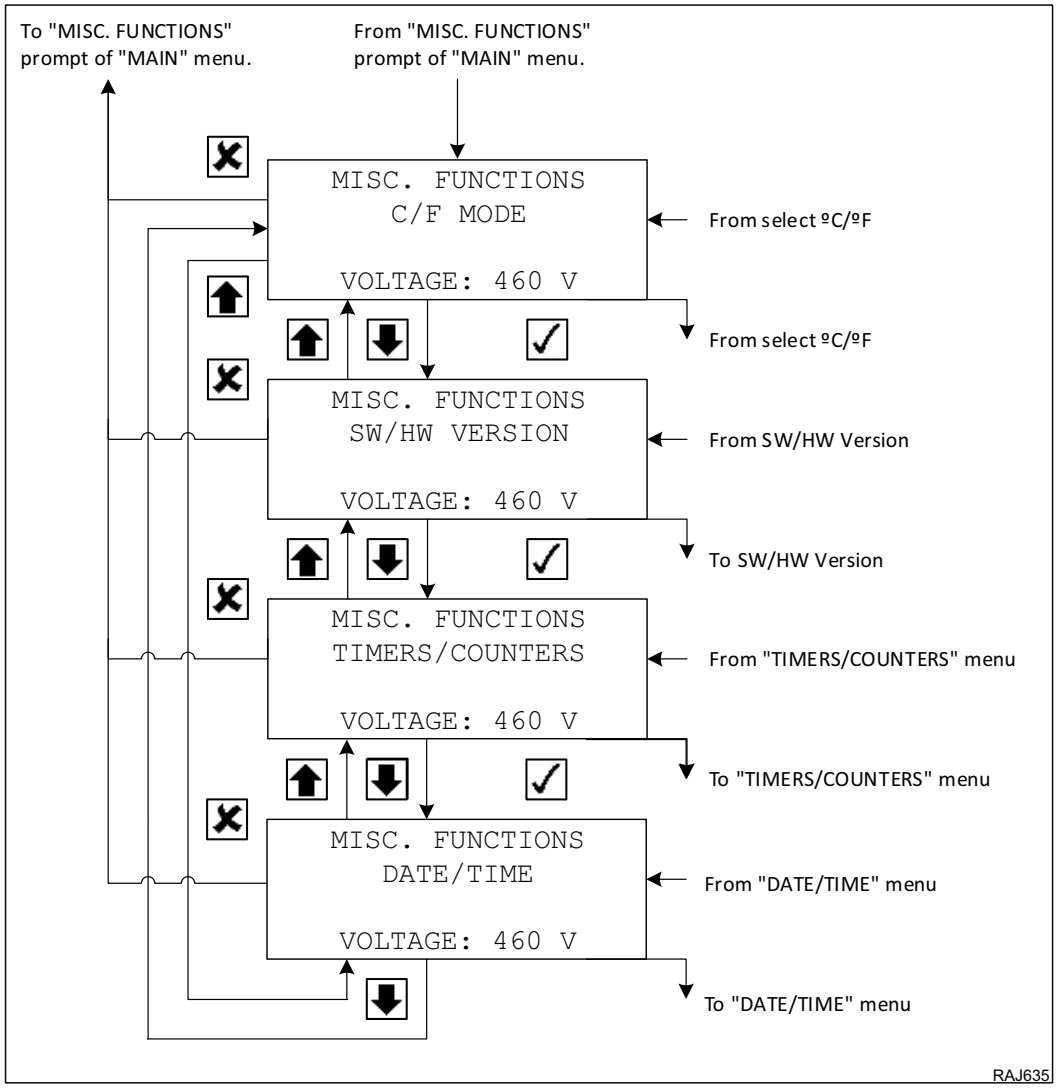
The Misc. Functions Menu contains the following submenus:

- 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.

Figure 17. Misc. Functions Menu



C/F Temperature Mode

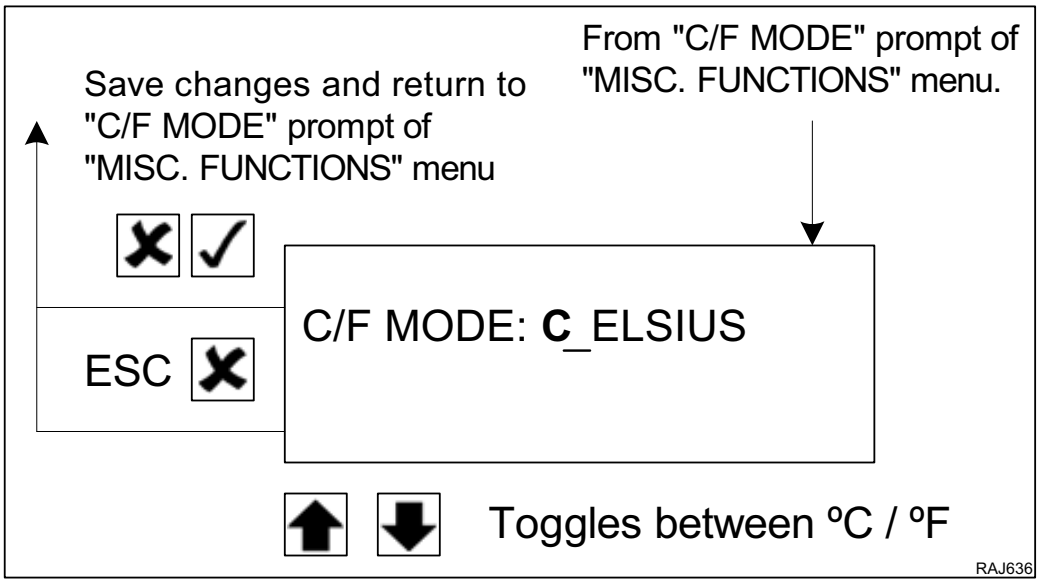
The C/F Mode submenu is used to select whether Celsius or Fahrenheit units are used to display temperature readings. To enter the C/F Mode submenu and change the units displayed complete the following steps:

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 the Celsius and Fahrenheit settings.
8. 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.*

Figure 18. C/F Temperature Mode



SW/HW Version (Software / Hardware)

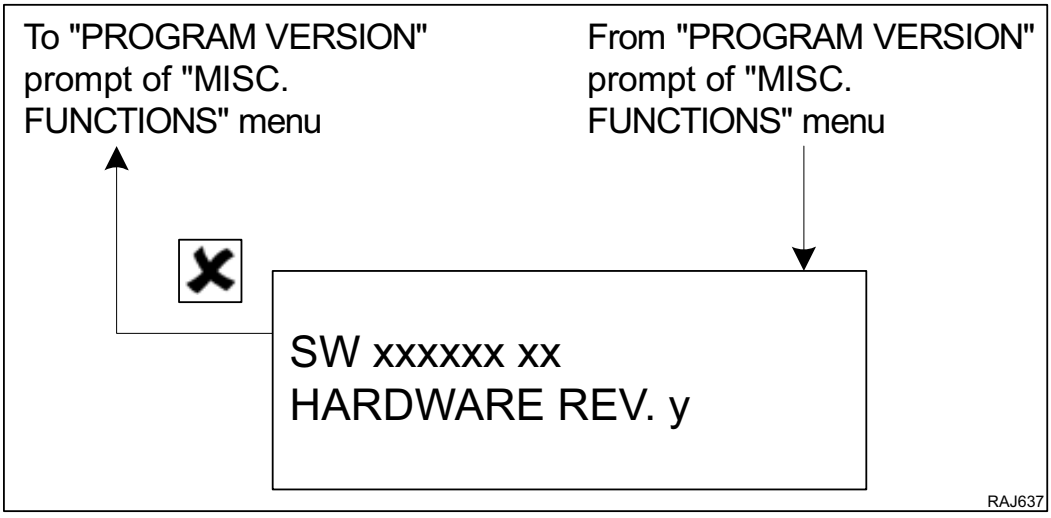
The SW/HW Version submenu displays the following information about the controller:

- SW (Software Version)
- HARDWARE REV. (Hardware Revision)

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.

Figure 19. SW/HW Version



Timers and Counters

The Timers/Counters submenu displays the following information about the hourmeters and restart counters:

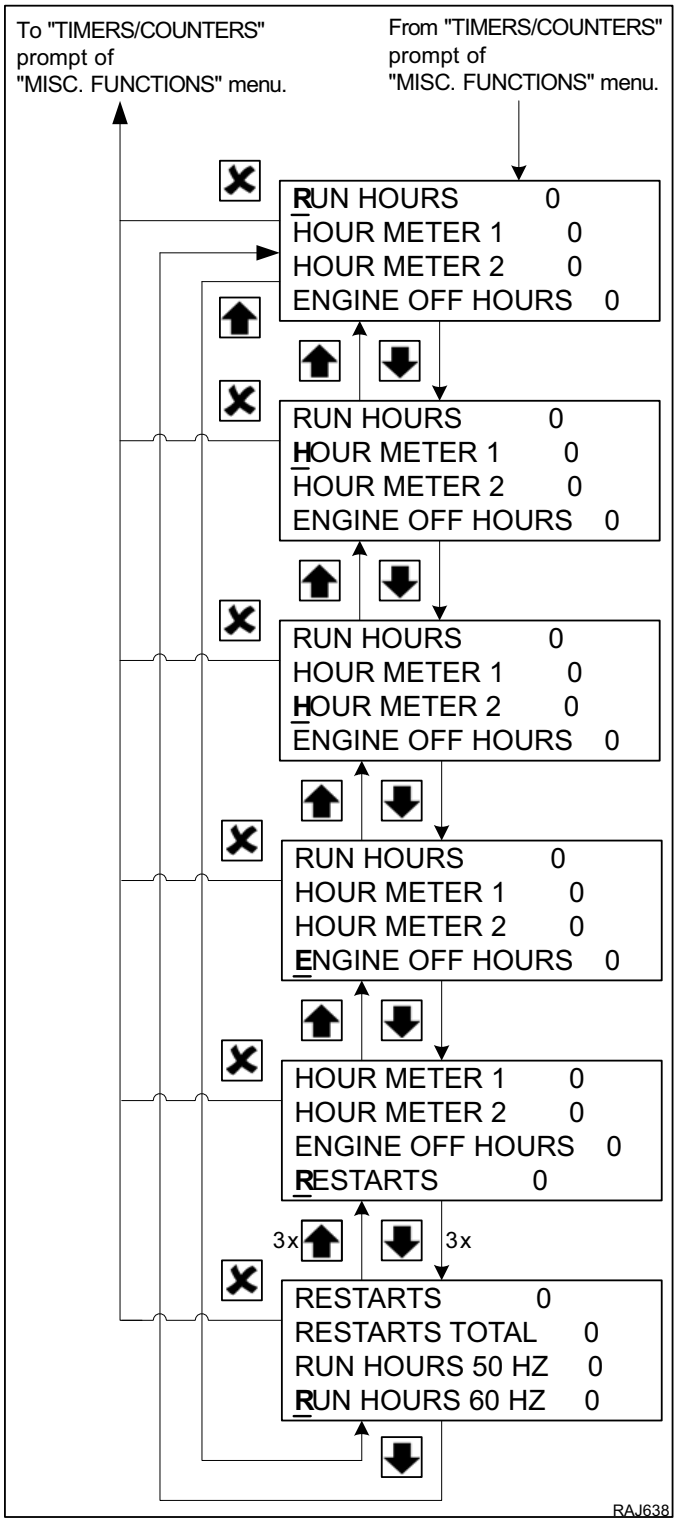
- Run Hours – The number of hours the unit has been running.
- Hour Meter 1 – The number of hours the unit has been running since Hour Meter 1 was cleared. A message is generated when the reading reaches the threshold set in the Configuration Menu.
- Hour Meter 2 – The number of hours the unit has been running since Hour Meter 2 was cleared. A message is generated when the reading reaches the threshold set in the Configuration Menu.
- 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.
- Restarts – The number of restarts the controller has made since the last power up.
- Total Restarts – The total number of restarts.
- Run Hours 50 Hz – The number of hours the unit has been running at 50 Hz (low speed).
- Run Hours 60 Hz – The number of hours the unit has been running at 60 Hz (high speed).

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/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 Timers/Counters submenu.
6. Press the ENTER key to enter the Timers/Counters submenu.
   - Press the UP or DOWN key to scroll up or down through the Timers/Counters.
   - Press the ESCAPE key to return to the Misc. Functions Menu.

Figure 20. Timers/Counters



Date and Time

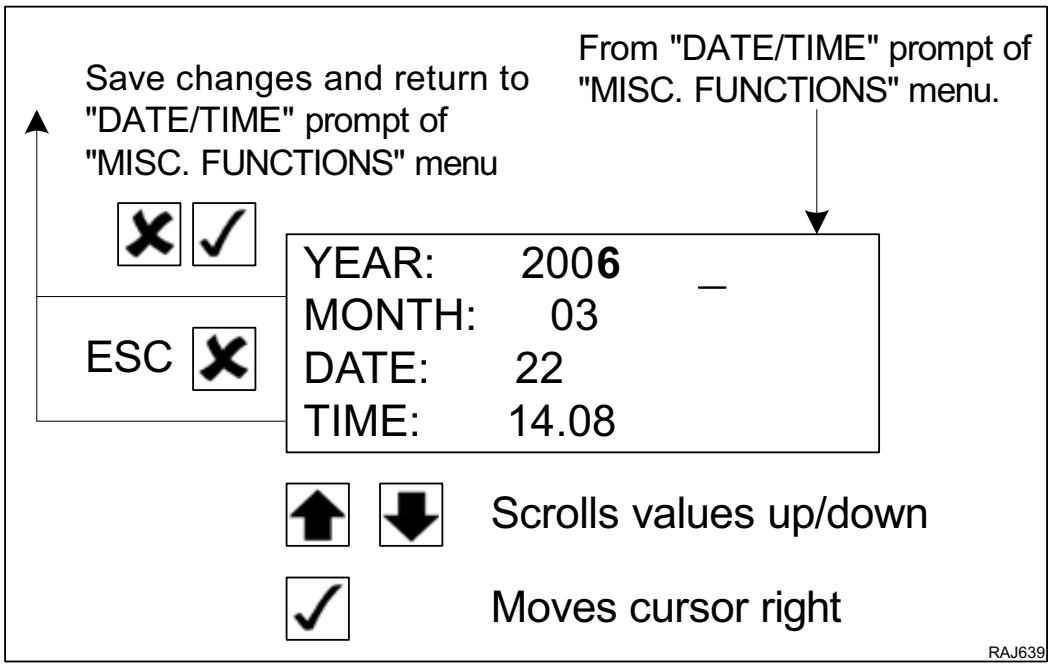
The Date/Time submenu is used to set the clock in the controller. To enter the Date/Time submenu and set the clock complete the following steps:

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 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 System Setup submenu.
7. Press the ENTER key to enter the System Setup submenu.
8. Press the UP or DOWN key to scroll up or down through the MISC. FUNCTIONS submenu to the Date/Time submenu.
9. Press the ENTER key to enter the Date/Time submenu to set the clock.
10. Press the ENTER key to move the cursor (to the right or down at the end of a row) 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.*
11. Press the UP or DOWN key to scroll the selected value up or down to the new setting.
12. Repeat steps 10 and 11 until you have changed all the values to the new settings.
13. 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.*

Figure 21. Date / Time



Configuration Menu

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

Note: *The Configuration Menu requires that a password (0007) be used change a setting. See "Setting Hour Meter Thresholds and Resetting Hour Meters" on page 87 for an example of how change a setting.*

- ENGINE TYPE - Yanmar or PCM
- HM1 (Hour Meter 1) Threshold – The default setting is 0. When this is set to anything other than 0, it sets the threshold that generates the message "113. HOUR METER 1 HAS EXCEEDED THRESHOLD".
- HM2 (Hour Meter 2) Threshold – The default setting is 0. When this is set to anything other than 0, it sets the threshold that generates the message "114. HOUR METER 2 HAS EXCEEDED THRESHOLD".
- ENG (Engine) Off Hours – The default setting is 0. When this is set to anything other than 0, it sets the threshold that generates the alarm "110. ENGINE STOPPED DUE TO USER SETUP".
- Factory Reset – 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.
- GENERATOR - generator type (M.ALTE or STAMFRD)
- GENSET - Clip-ON, Side or centre
- OUTPUT VOLTAGE - The default setting is 460. The other selection is 230, which is used is the alternator is configured for an output voltage of 230 Vac.
- FUEL LEVEL - The default setting is 0. Possible settings are 1 to 400 gallons. This sets the threshold that generates the alarm "115. FUEL LEVEL LOW".
- CRANK RESTARTS - The default setting is 3. Possible settings are 0 to 15, and 0 equals infinite. This sets the number of restart attempts that are allowed.
- COMPOSIT - Yes or No (Telematics)
- RMM MASTER - Yes or No
- FUEL PUMP TIME - Fuel pump enabled delay (0 = disabled / always on).

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. See "Setting Hour Meter Thresholds and Resetting Hour Meters" for an example of how change a setting.

Figure 22. Configuration Menu (Page 1)

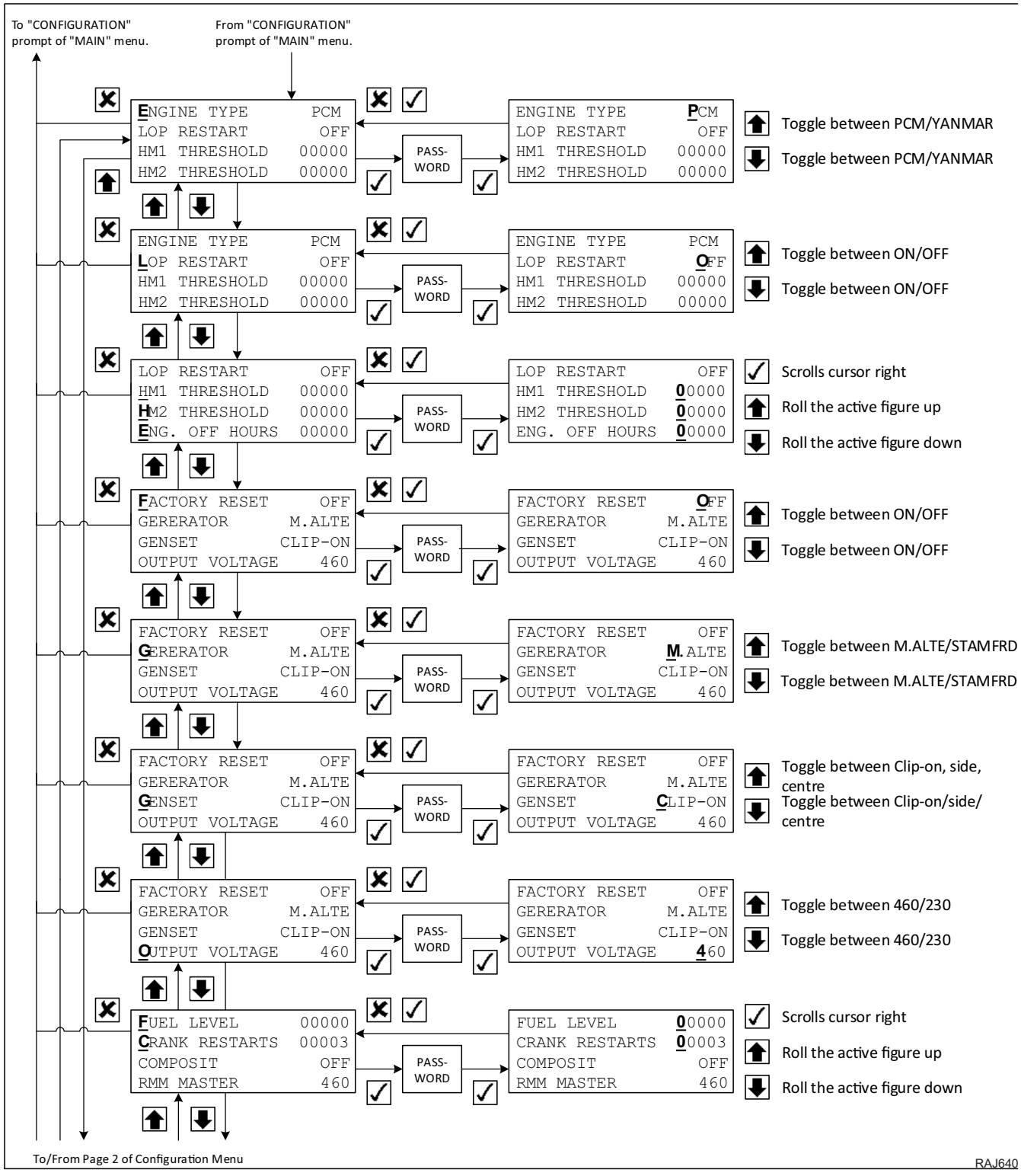
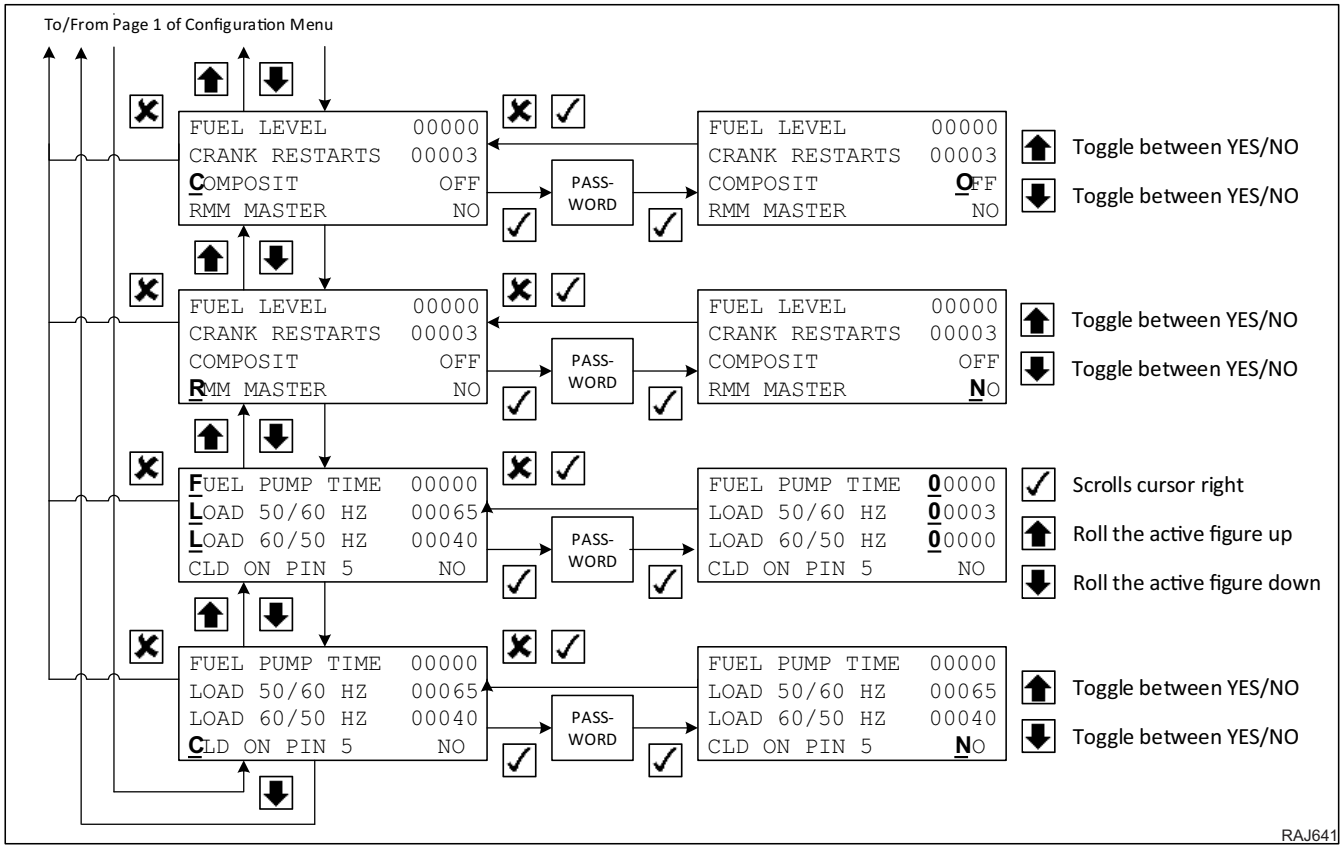


Figure 23. Configuration Menu (Page 2)



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 ENTER key to enter the Configuration Menu.
5. The Configuration Menu will be displayed. with the cursor on LOP Restart.
6. Press the UP or DOWN key to scroll up or down through the Configuration Menu to HM1 Threshold, HM2 Threshold, Run Hours, Run Hours 50 Hz, or Run Hours 60 Hz.
7. Press the ENTER key to display the Password screen.
8. Enter the password, which is 0007. To enter the password press the ENTER key to move the cursor to the last value and press the UP or DOWN key to scroll the value to 7. Press the ESCAPE key and the ENTER key at the same time to enter the password.
9. The cursor will be under the H of the HM1 or HM2 Threshold selection, or under the R of the Run Hours, Run Hours 50 Hz or Run Hours 60 Hz selection.
10. Press the ENTER key to move the cursor to select the value you want to change.

    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.*
11. Press the UP or DOWN key to scroll the selected value up or down to the new setting.
12. Repeat steps 10 and 11 until you have changed all the values to the new settings.
13. Press the ESCAPE key and the ENTER key at the same time to save the new settings and return to the Configuration Menu.

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

Event Log Menu

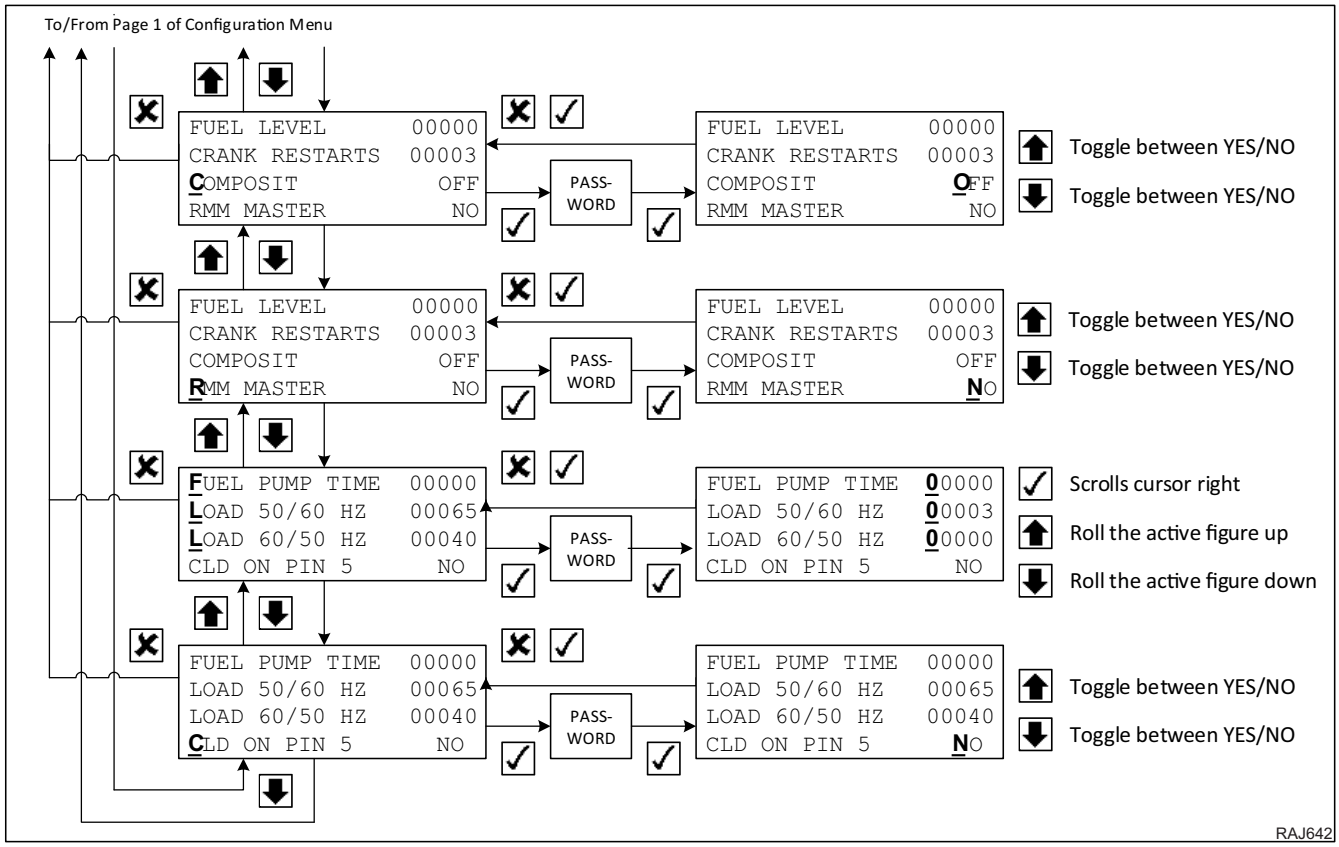
The Event Log Menu contains the following submenus that show events that are recorded in the controller memory:

- Event Log
- Fuel Events

To enter 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.
4. Press the ENTER key to enter the Event Log Menu.
5. The Event Log submenu will be displayed.
   - Press the ENTER key to enter the Event Log submenu.
   - Press the UP or DOWN key to scroll up or down to the Fuel Events submenu.
   - Press the ESCAPE key to return to the Main Menu.

Figure 24. Event Log Menu



Event Log

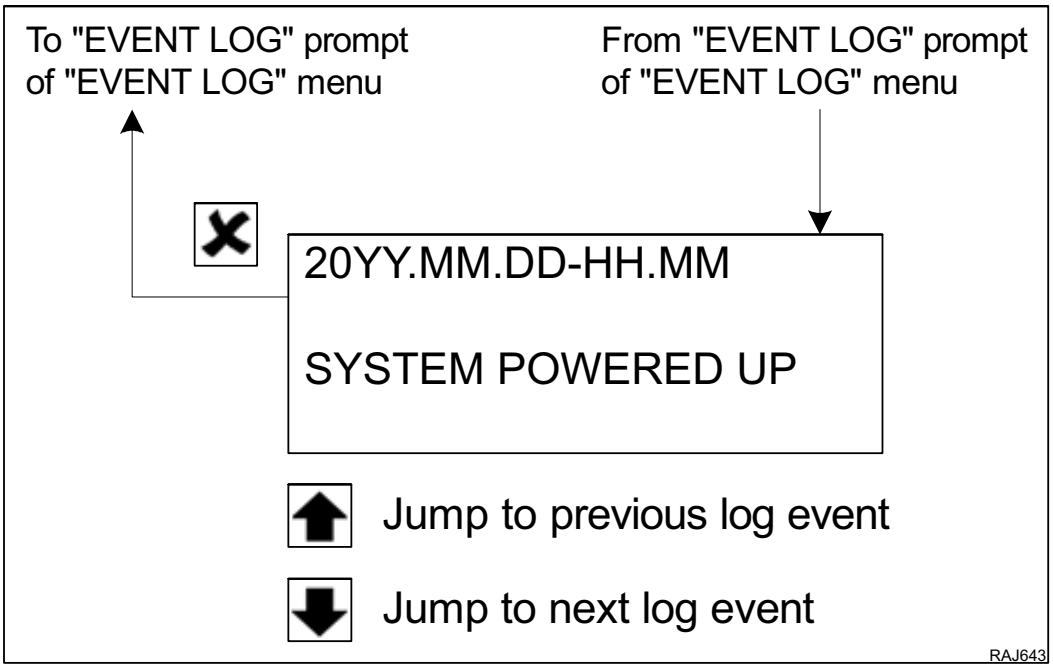
The Event Log is a list of events that are recorded in the controller memory. Examples of recorded events are a system power up, alarms, and messages. Events are listed in the reverse order of their occurrence. Viewing the event log can be helpful when diagnosing a problem.

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.

Figure 25. Event Log Submenu



Fuel Events

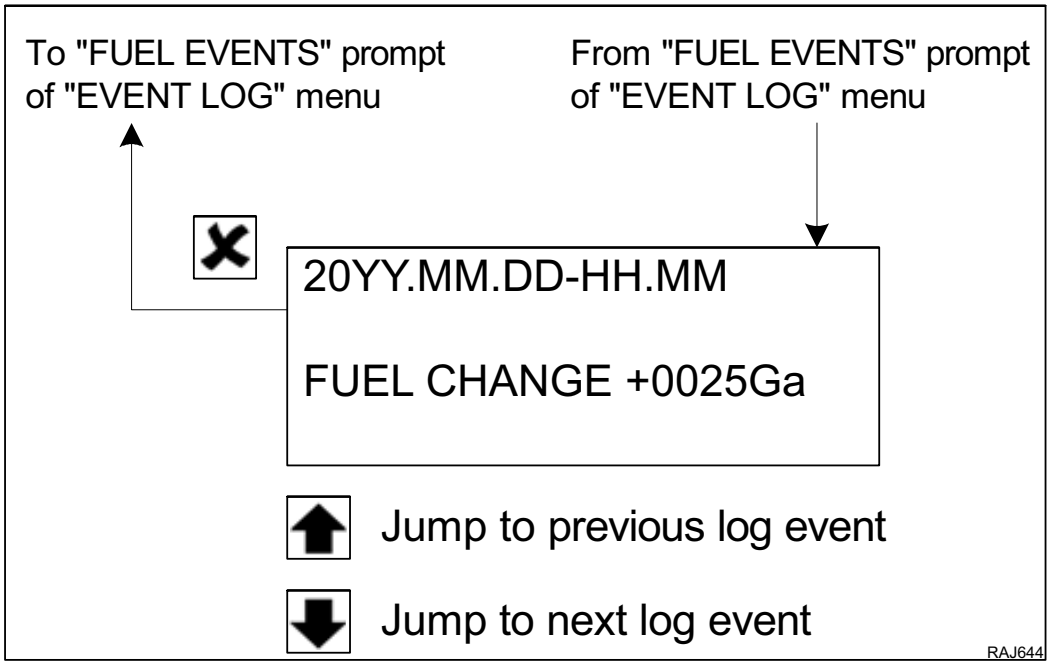
The Fuel Events is a list of fuel events that are recorded in the controller memory on units equipped with the fuel level sensor option. An example of a recorded event is when fuel is added to the fuel tank. Fuel Events are listed in the reverse order of their occurrence.

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.

Figure 26. Fuel Events Submenu



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 now to use LogView refer to the Help file found within LogView.

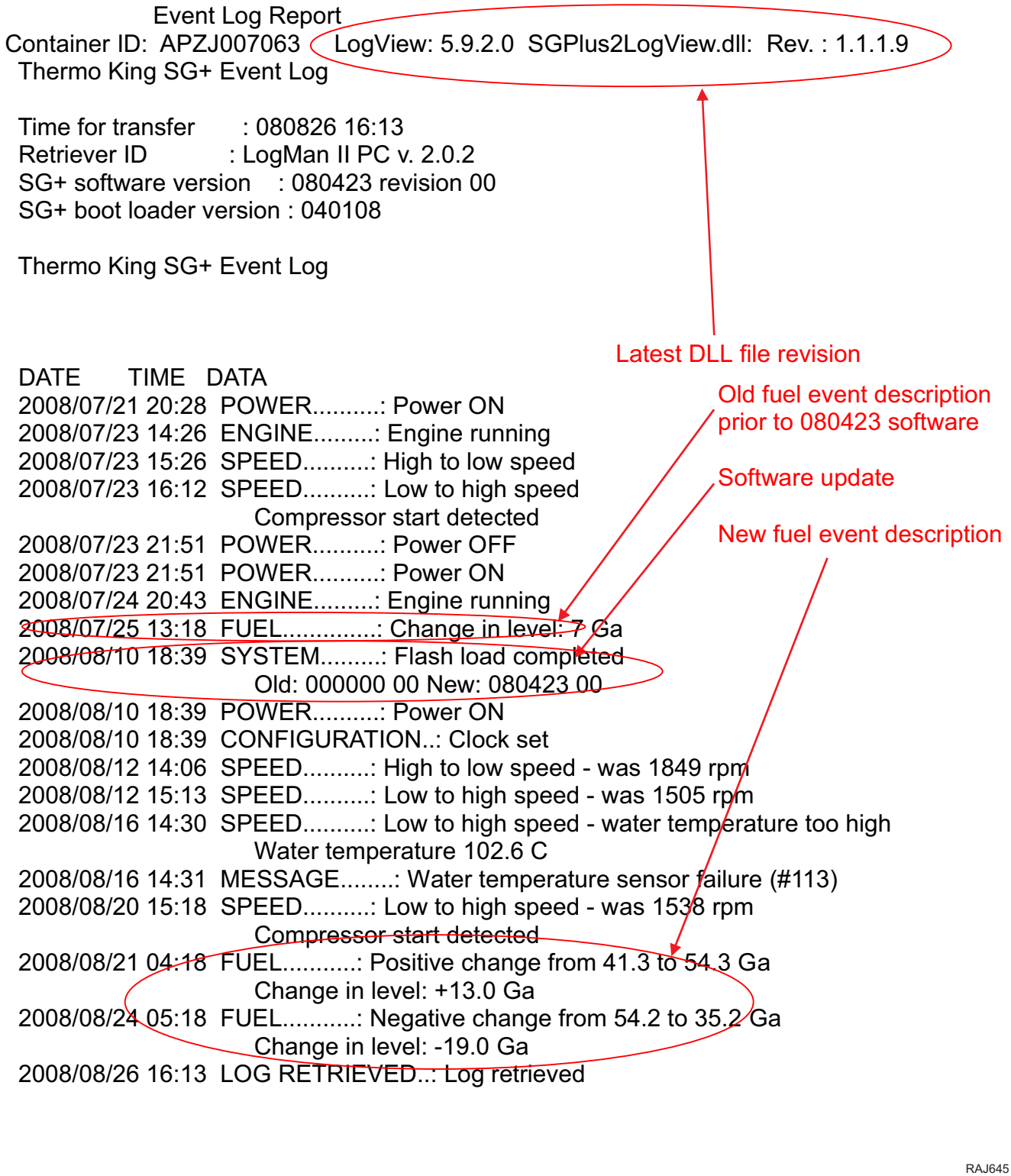
The SG+ log can store up to 128 Event logs. The oldest events will be over written in the log automatically.

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 27. Example of SG+ Log



RAJ645

SG+ 1.5 Controller and Operating Instructions

SG+ 1.5 Controller Description

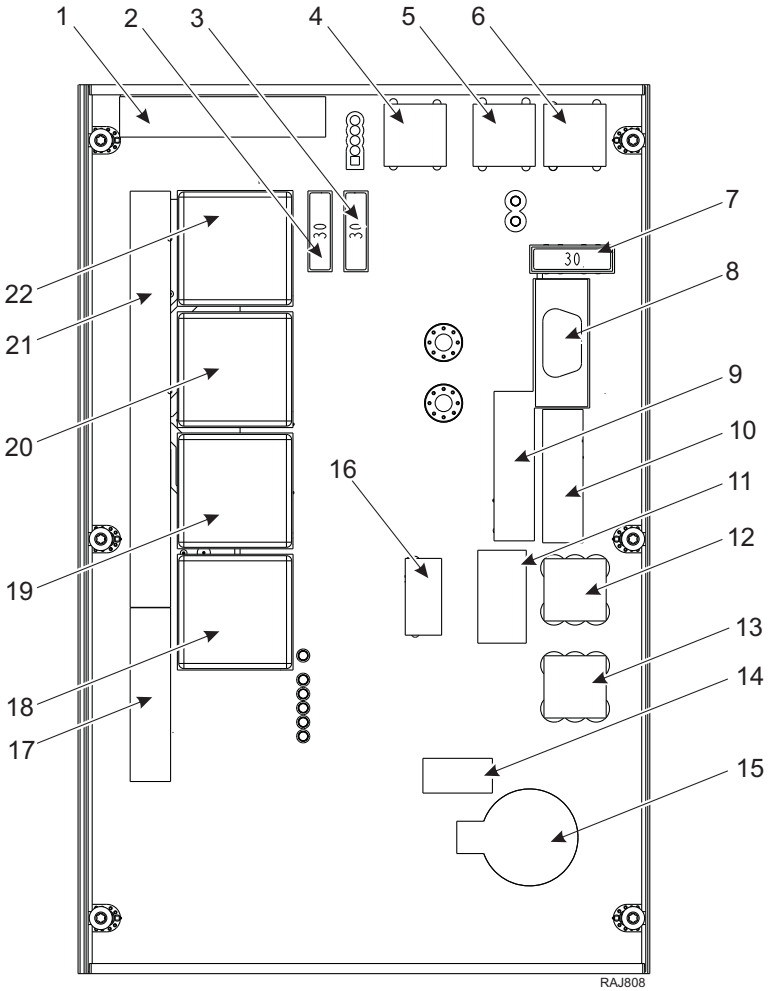
The SG+ 1.5 controller is a two-piece, self contained microprocessor for diesel generator sets. The SG+ 1.5 display is mounted on the control box cover. The SG+ 1.5 microprocessor is mounted inside the control box. Three external relays - two ECU Relays and the Start Relay are also mounted inside the 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 28. SG+ Controller Display

Microprocessor



1.	J6 Connector – To AC Circuits	13.	J12 8 Circuit Connection
2.	Fuse 30A - SI1 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.	**Download 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:

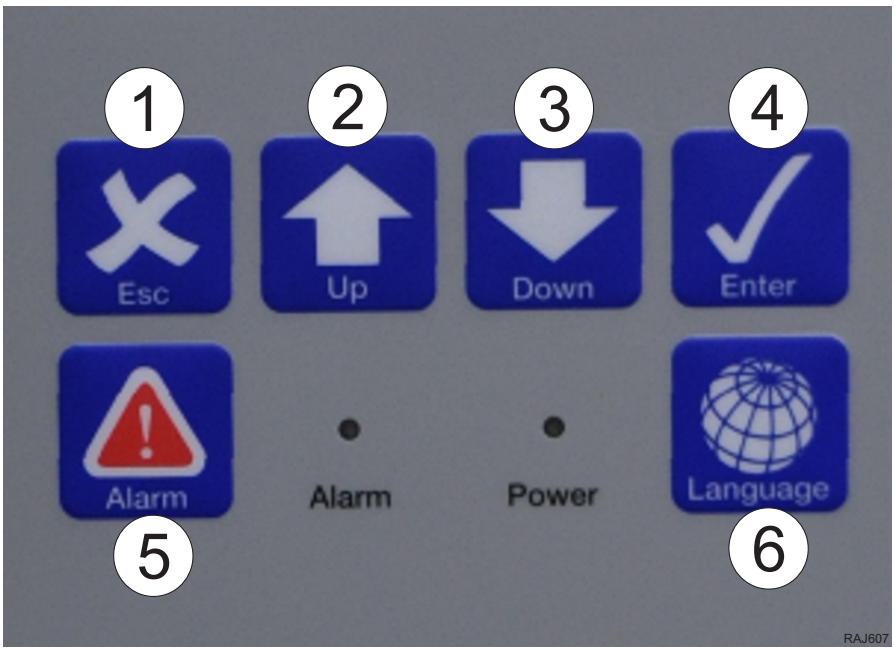
- Standard Display
- Pause Mode Display
- Composite Menu (if TrackKing / Telematics have been added to the unit)

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 SATES / 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

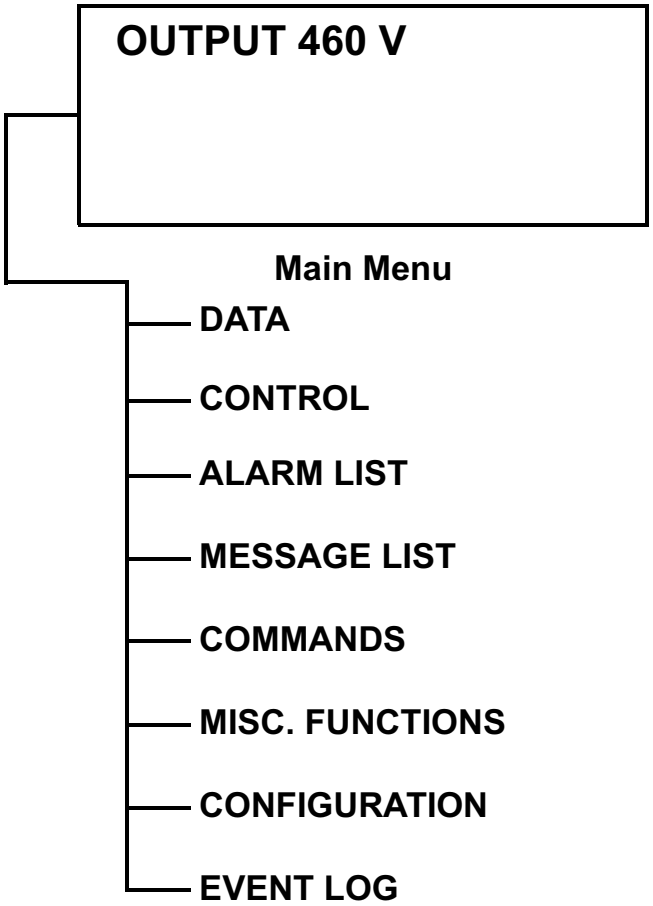
The Event Log Menu contains the following submenus:

- **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

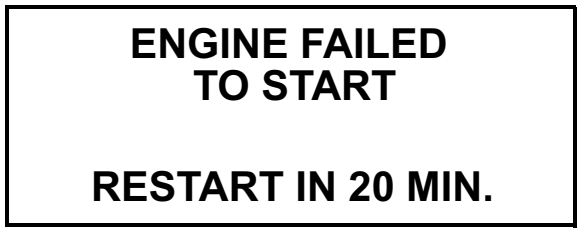
Pause Mode Displays

⚠ 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.



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

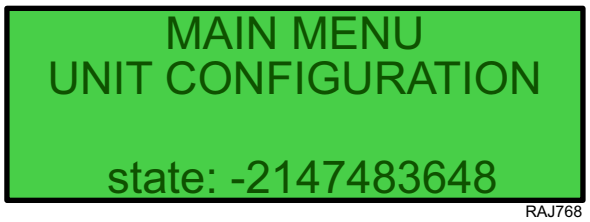
When a new SG+ 1.5 controller is installed and used for the first time, it must be set up for the unit to work properly. This only applies to replacement controllers - new units from Thermo King come with the controllers that are set to the unit.

⚠ Warning

Equipment Damage and Risk of Injury!

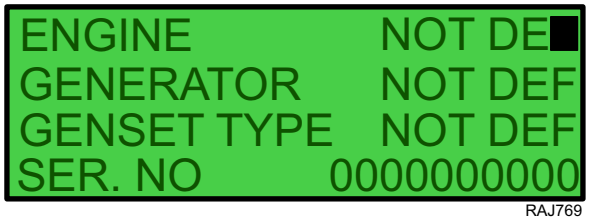
After the unit is configured and the controller exits Configuration Mode, the unit will begin a start sequence.

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:



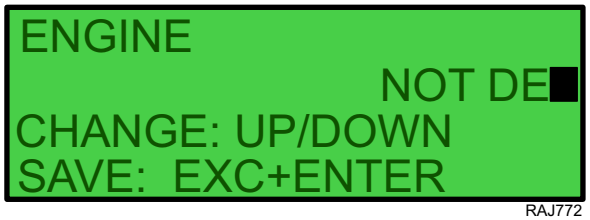
RAJ768

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



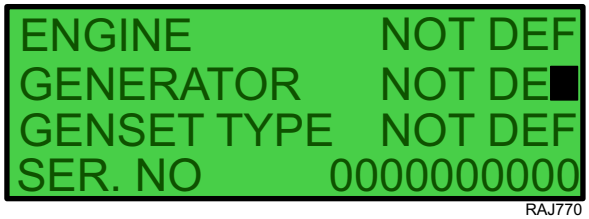
RAJ769

   - Use the **UP** and **DOWN** keys to scroll to the correct engine:
     - YANMAR MECH (SG 3000e 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

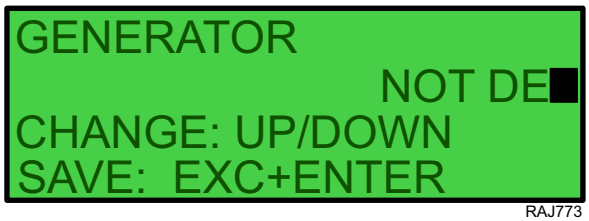
7. Set GENERATOR type:
   - Use the **UP** and **DOWN** keys to put the curser on GENERATOR.
   - Press the ENTER key when the curser is on GENERATOR.



RAJ770

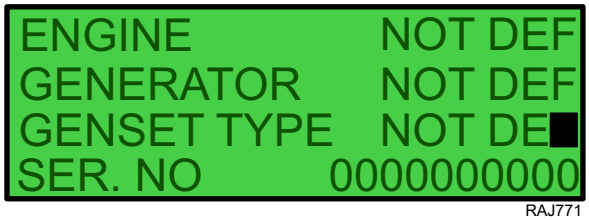
- Use the **UP** and **DOWN** keys to scroll to the correct alternator:
  - MECC ALTE (SG 4000, SG 5000, and SG 3000e after December 2016)
  - STANFORD (SG 3000e Before December 2016)

  Note: *SG 3000e 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.



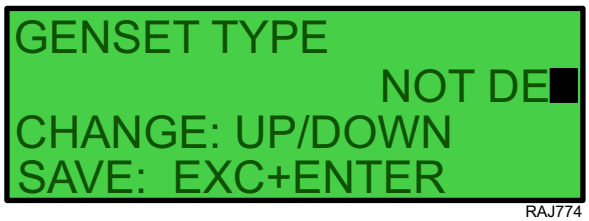
RAJ773

8. Set GENSET TYPE:
   - Use the **UP** and **DOWN** keys to put the curser on GENSET TYPE.
   - Press the ENTER key when the curser is on GENSET TYPE.



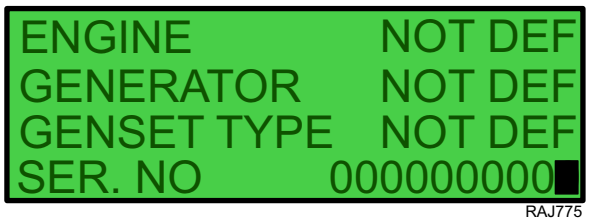
RAJ771

   - 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.



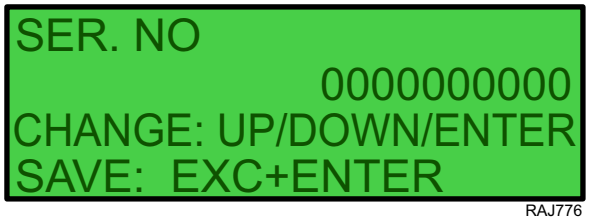
RAJ774

9. Set SERIAL NUMBER:
   - Use the **UP** and **DOWN** keys to put the curser on SERIAL NO.
   - Press the ENTER key when the curser is on SERIAL NO.



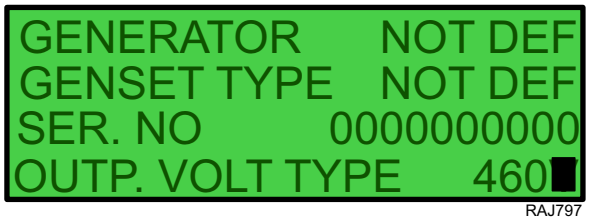
RAJ775

   - 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.



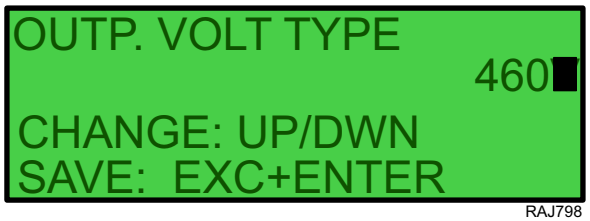
RAJ776

10. Set unit OUTPUT VOLTAGE TYPE.
    - Use the **UP** and **DOWN** keys to put the curser on OUTP. VOLT TYPE.
    - Press the ENTER key when the curser 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

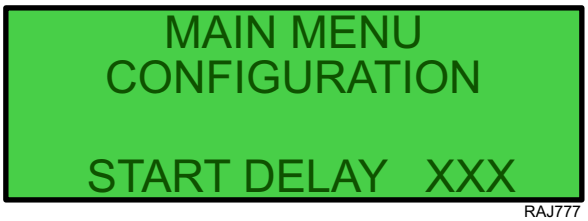
Equipment Damage and Risk of Injury!

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

11. Set genset ID number:

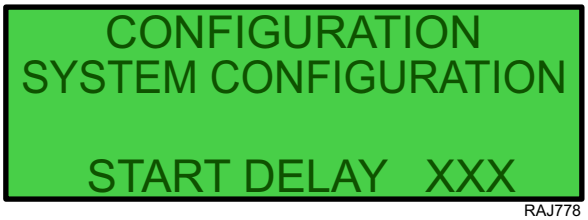
Note: *The ID number is not the unit serial #; it is a number created by the unit user, operator, or owner.*

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



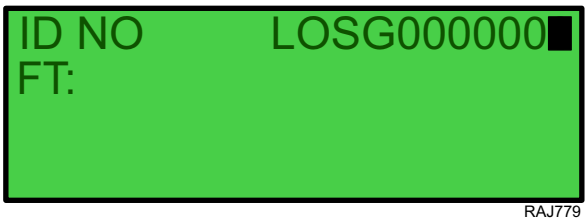
RAJ777

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



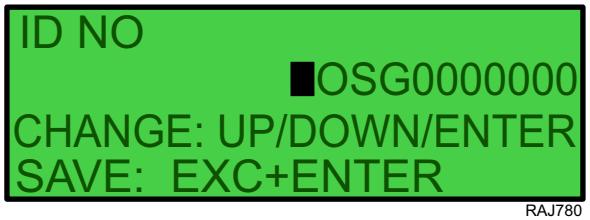
RAJ778

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

Pretrip Inspection Test (PTI)

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 of 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

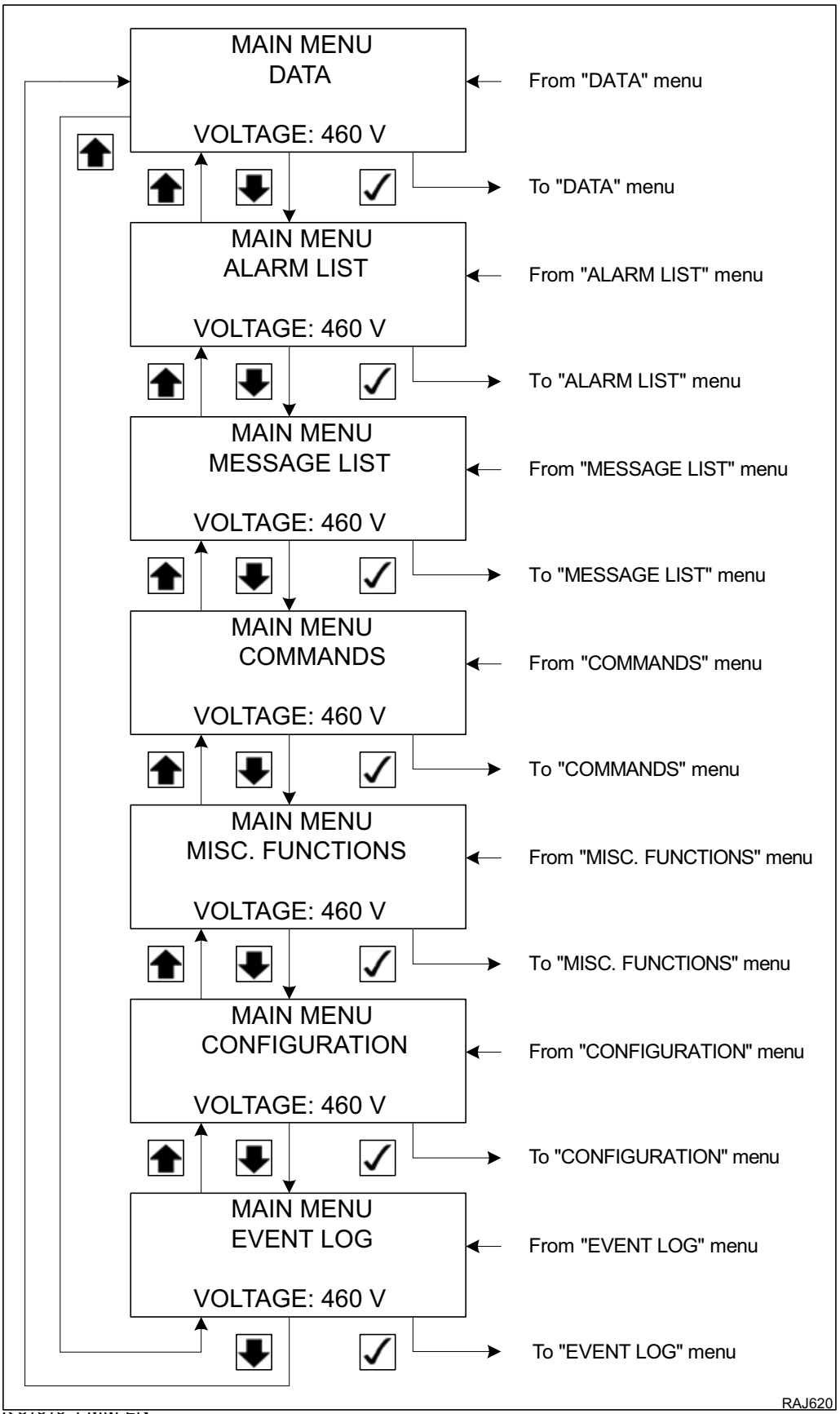
The Main Menu contains the following menus:

- 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 29. 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:

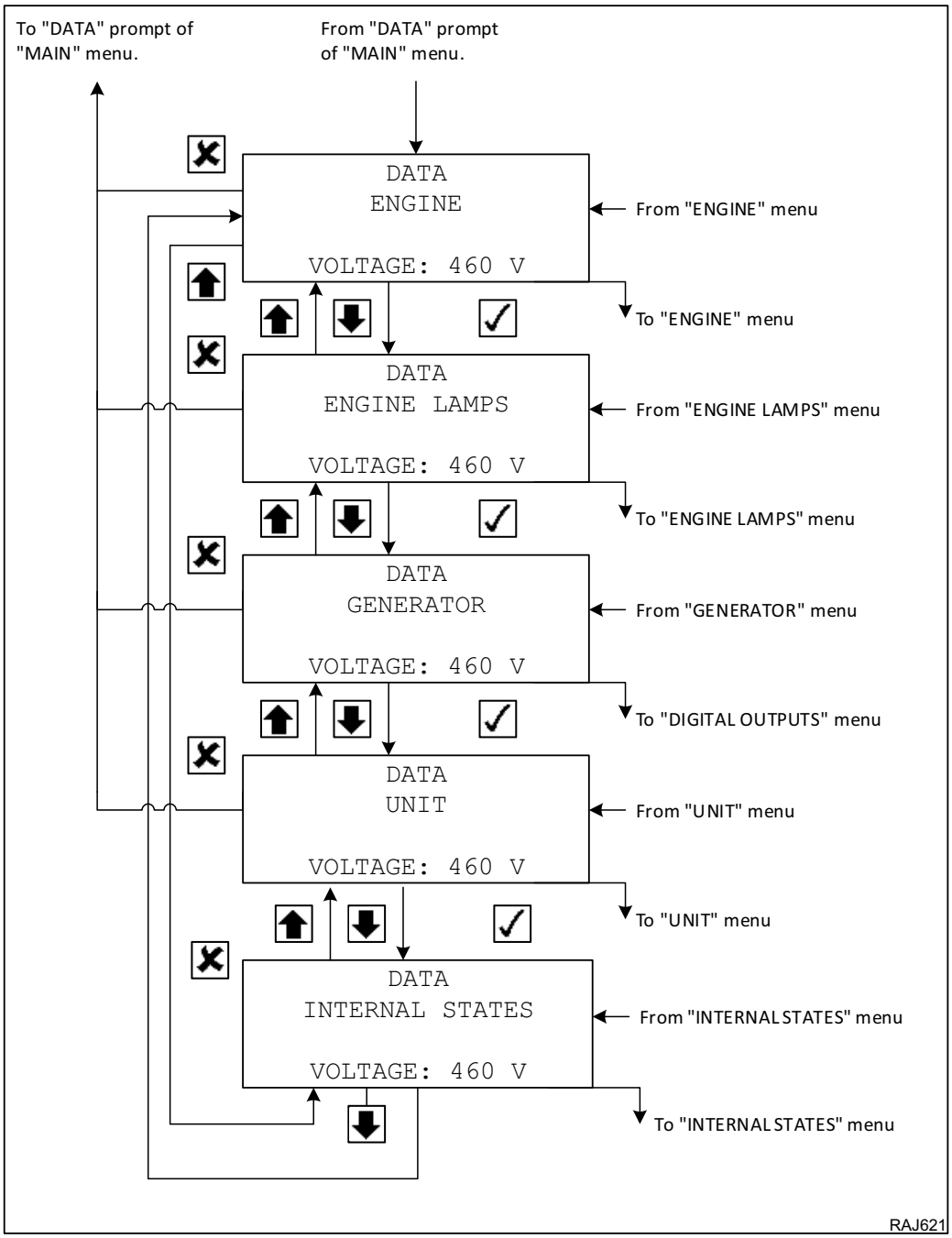
- Engine
- Engine Lamps
- Generator
- Unit
- Internal States

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 30. Data Menu



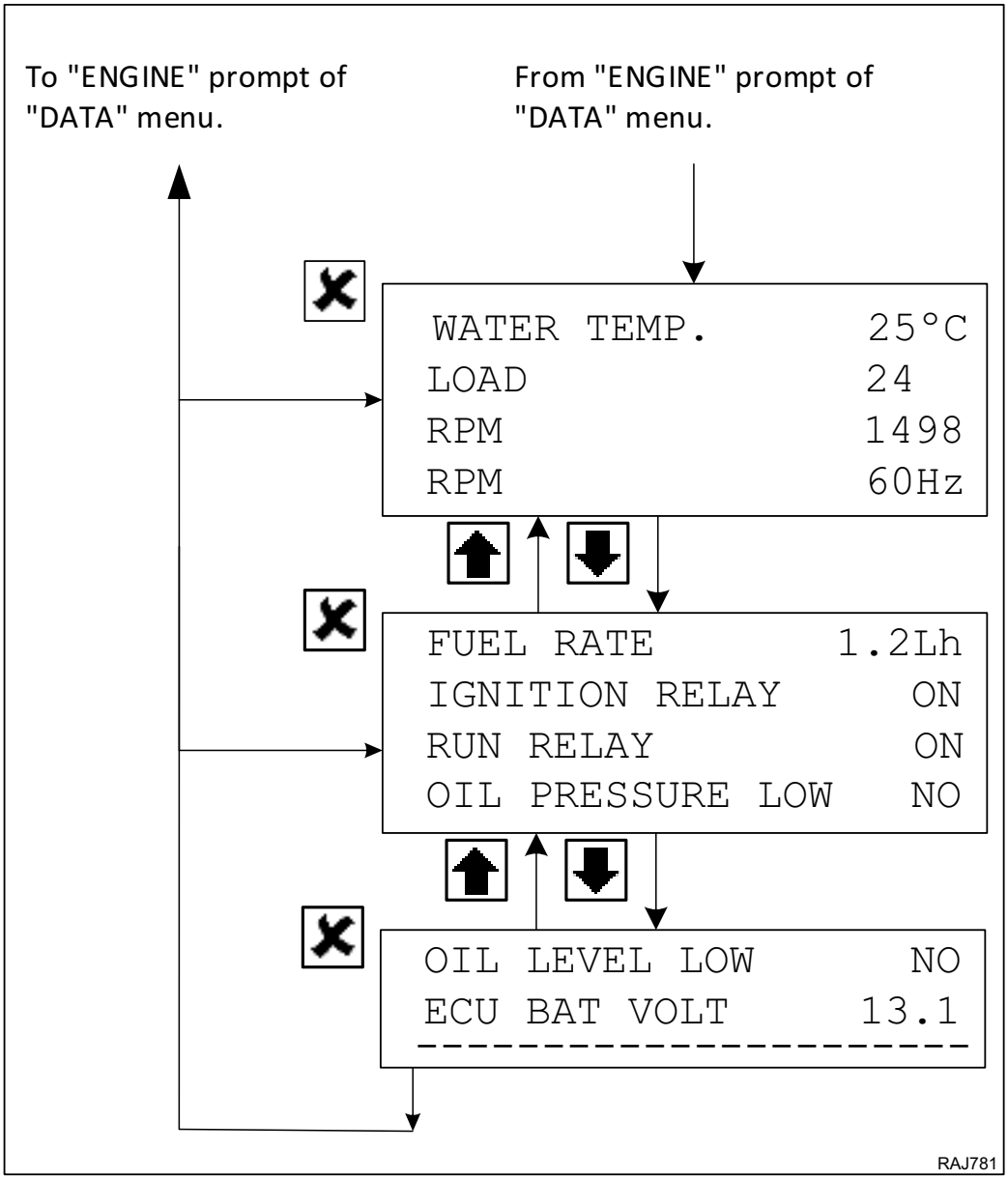
Engine Menu

The Engine display the following unit operating information:

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

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.


To "ENGINE" prompt of "DATA" menu.
From "ENGINE" prompt of "DATA" menu.
WATER TEMP. 25°C
LOAD 24
RPM 1498
RPM 60Hz
FUEL RATE 1.2Lh
IGNITION RELAY ON
RUN RELAY ON
OIL PRESSURE LOW NO
OIL LEVEL LOW NO
ECU BAT VOLT 13.1
RAJ781

Engine Lamps

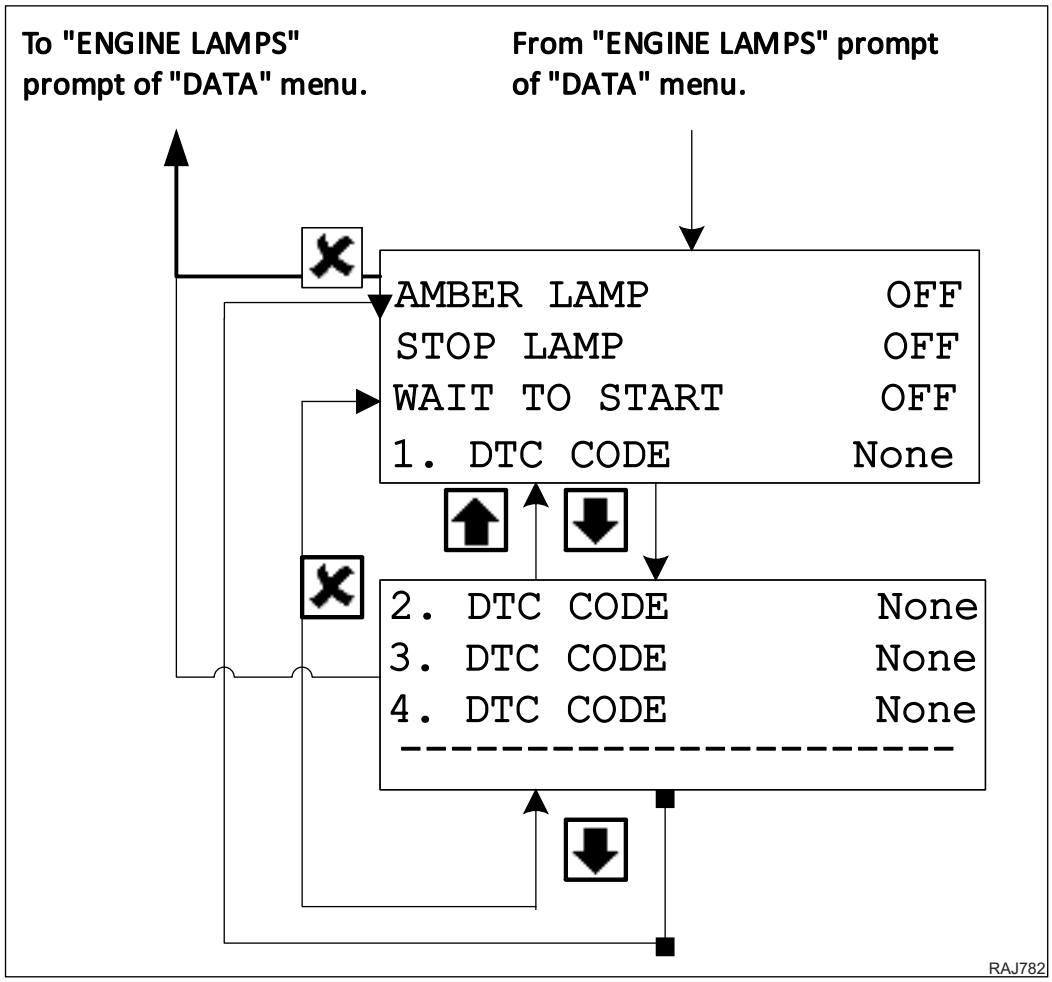
The Engine Lamps submenu displays the following information:

- Amber Lamp on/off (SG 3000e, SG 4000 and SG 5000 Only)
- Stop Lamp on/off (SG 3000e, SG 4000 and SG 5000 Only)
- Wait To Start (SG 3000e, SG 4000 and SG 5000 Only)
    1. DTC Code - DTC codes are the same has 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 3000e, SG 4000 and SG 5000 Only)
    3. DTC Code (SG 3000e, SG 4000 and SG 5000 Only)
    4. DTC Code (SG 3000e, 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.


To "ENGINE LAMPS" prompt of "DATA" menu.
From "ENGINE LAMPS" prompt of "DATA" menu.
AMBER LAMP OFF
STOP LAMP OFF
WAIT TO START OFF
1. DTC CODE None
2. DTC CODE None
3. DTC CODE None
4. DTC CODE None
RAJ782

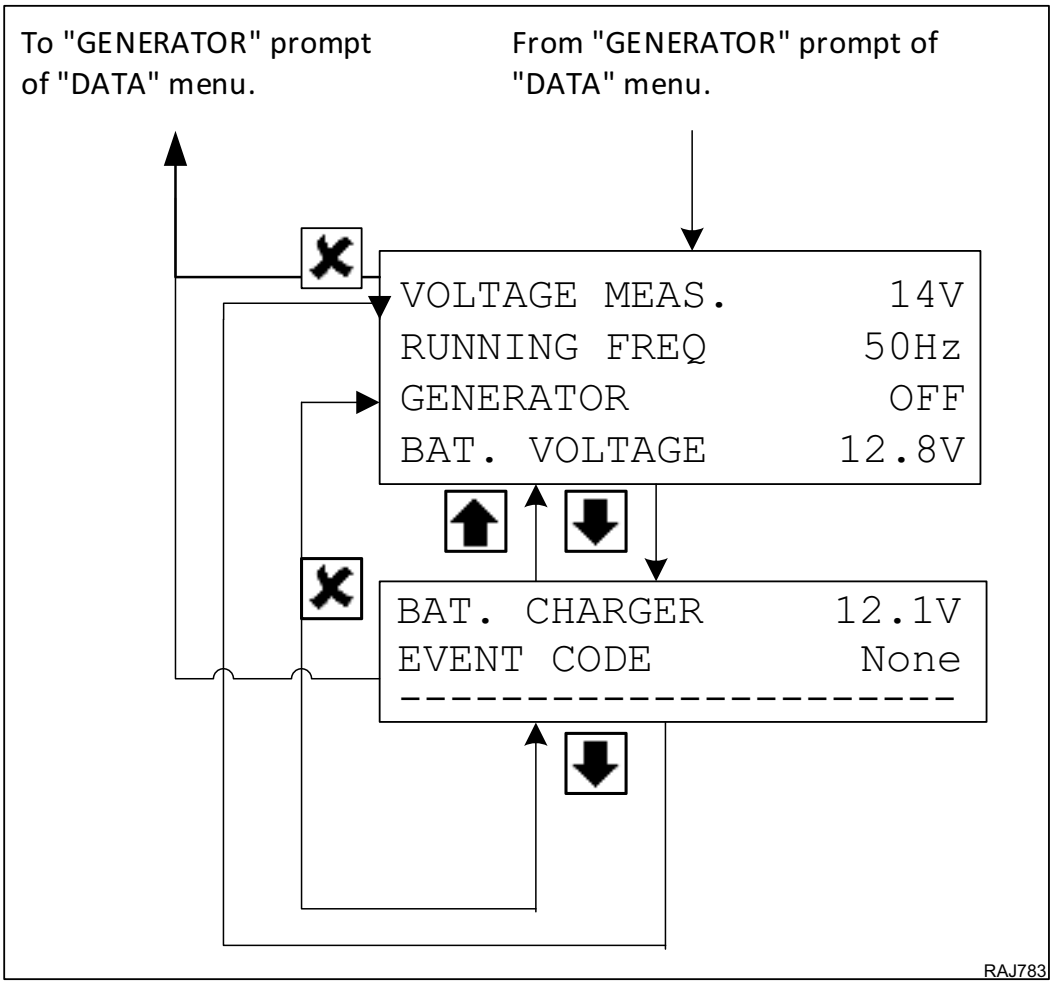
Generator

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.


To "GENERATOR" prompt of "DATA" menu.
From "GENERATOR" prompt of "DATA" menu.
VOLTAGE MEAS. 14V
RUNNING FREQ 50Hz
GENERATOR OFF
BAT. VOLTAGE 12.8V
BAT. CHARGER 12.1V
EVENT CODE None

RAJ783

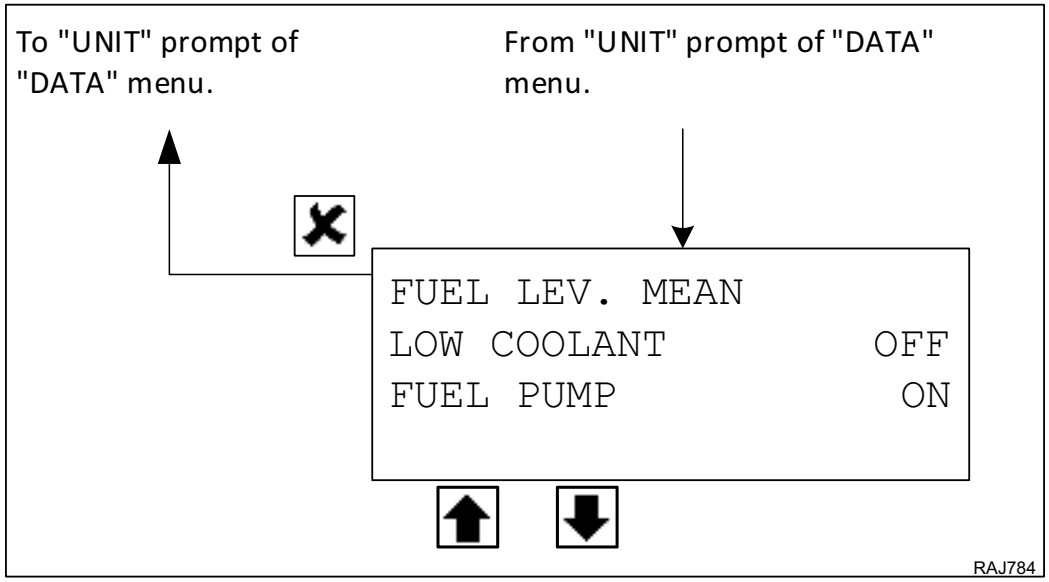
Unit

The Unit submenu display the status of the following outputs:

- Battery Voltage
- Battery Charger
- Fuel Level Mean (average)
- Low Coolant
- Fuel Pump (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

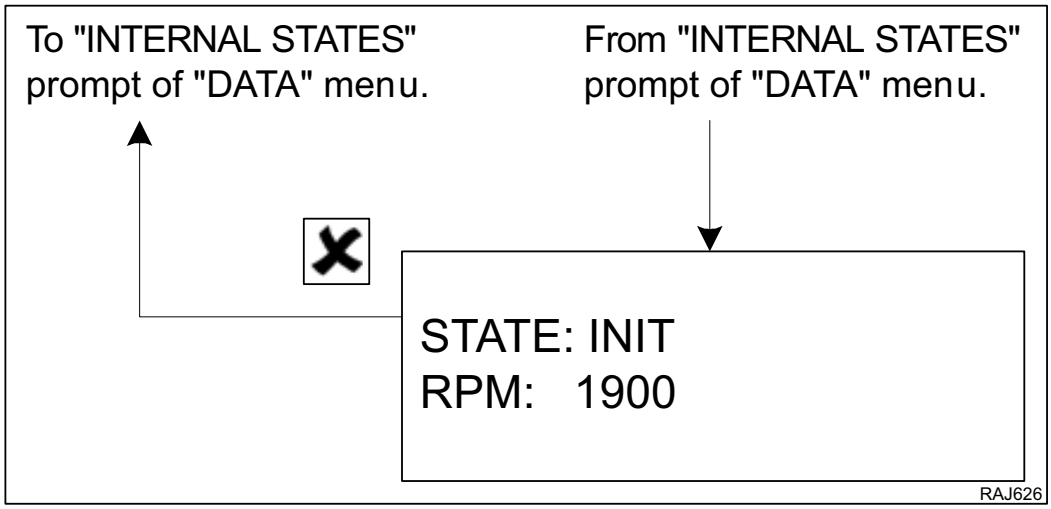
The Internal States displays which of the following states the unit is in as it prepares to start, and after it starts or if it shuts down:

- 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 31. 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

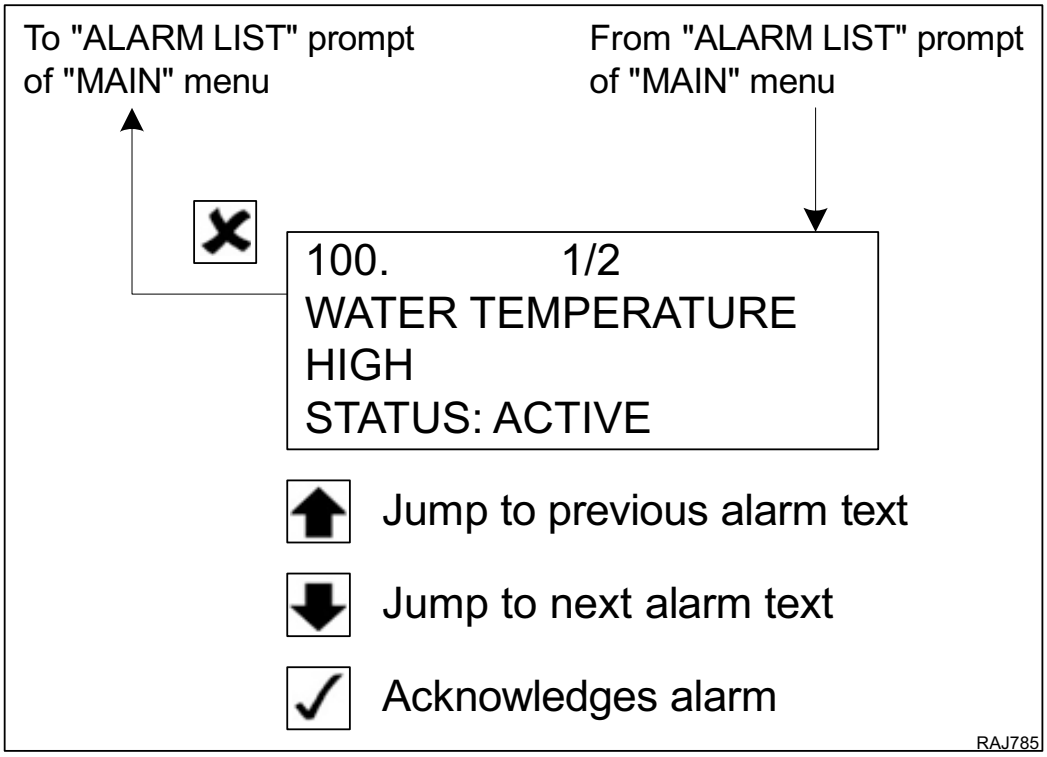
There are two types of alarms:

- **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	Operation Delayed Restart Alarm – Engine is running and water temperature is above 107 C (225 F) for 5 seconds. • Engine then stops and then attempts to restart.	1. Check for cause of engine overheating: • Check engine coolant level. • Check water pump belt. • Check radiator for airflow and coolant flow restrictions. 2. Check for faulty water temperature sensor.
A101	FAILED TO CRANK	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.	1. Defective battery, load test battery. 2. Check battery charger. 3. Check ground connections at block. 4. Check starter motor. 5. Check starter relay, circuit.
A102	FAILED TO START	PTI Warning if the engine failed to enter running state or reports error during the start sequence	1. Check fuel level. 2. Check fuel pump, and fuel system both electrically and mechanically. 3. In cold ambient temperatures check for fuel gelling. 4. Check for restricted air cleaner or air intake system. 5. Check glow plugs and circuit.

A104	ENGINE RPM BLOW LIMITS	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.	1. Check RPMs. 2. Check RPM sensor. 3. Check for overload on generator. 4. Check restriction in fuel supply. 5. Check for restricted air cleaner or air intake system
A105	LOW OIL LEVEL	Operation If low oil level for 60 seconds.	1. Check oil level. 2. Check Oil Level Switch. 3. Check circuits to Oil Level Switch.
A108	COOLANT LEVEL LOW	Operation Coolant level low detected before engine start.	1. Check coolant level. 2. Check Coolant Level Sensor. 3. Check circuits to Coolant Level.
A110	ENGINE STOP	Operation Alarm If Engine is stopped to safe mode. Due to ECU shutdown codes.	Connect ECU Test Tool to Read Engine Codes. Refer to Yanmar TNV Service TK55740 manual for troubleshooting guide.
A200	GENERATOR SHORT CIRCUIT	Operation DSR has detected short circuit.	See “Alternator Diagnosis”.
A201	GENERATOR EXTERNAL OVERLOAD	Operation DSR has detected over excitation.	1. Unplug load and attempt restart. 2. See “Alternator Diagnosis”.
A301	ENGINE STOP LAMP	Operation ECU stop lamp activated.	Connect ECU Test Tool to Read Engine Codes
A410	LINE VOLTAGE HIGH	Operation Output voltage >500 VAC for 15 seconds	See “Alternator Diagnosis”.
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.	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.	1. Check 30 amp fuse on controller. 2. Check battery. 3. Check battery connections. 4. Check ground connections from control box to battery.

Message List Menu SG+ 1.5

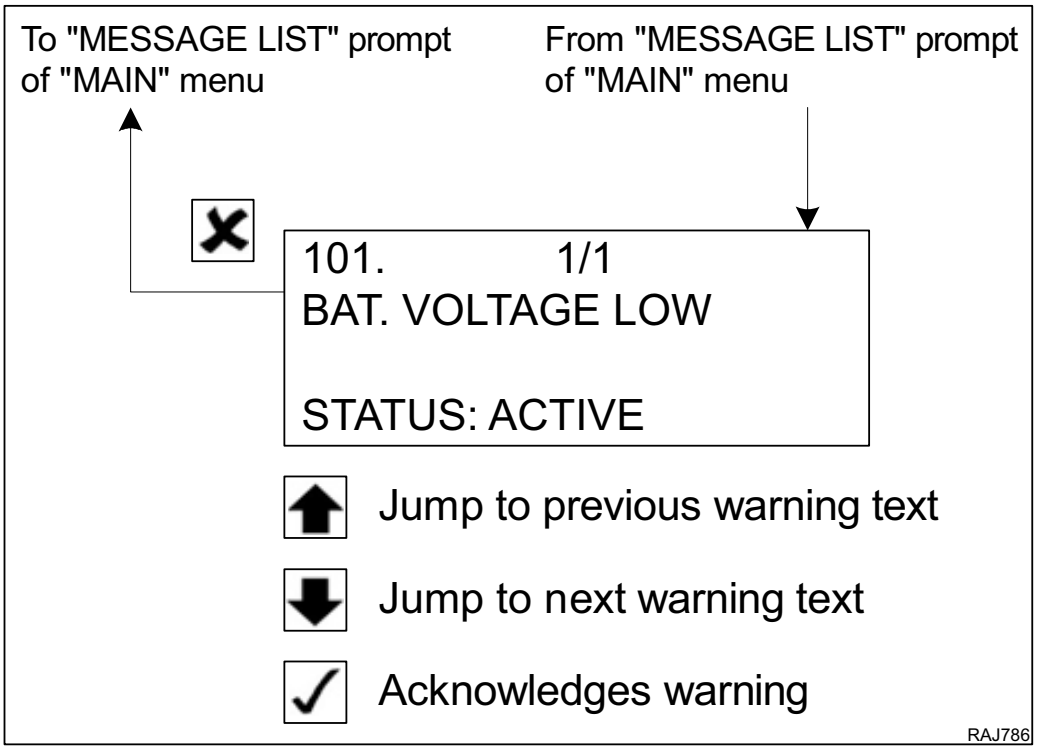
The Message List Menu displays messages. Messages are recorded in the controller memory to simplify unit diagnostic procedures. The messages are listed in the reverse order of their occurrence. Enter the Message List Menu to view the and acknowledge the messages. Acknowledging a message clears it from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



Message Diagnosis

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

Message List			
Message Code	**Message Text**	**Alarm Type–Cause**	**Diagnostics**
M106	FUEL LEVEL LOW	Operation Low fuel detected by ECU, codes P0087 or P1113.	Connect ECU Test Tool to Read Engine Codes
M109	FUEL SYSTEM LEAK	Operation Duel leak detected by ECU, codes P0093.	Connect ECU Test Tool to Read Engine Codes
M111	OIL PRESSURE LOW	Operation Low oil pressure message active.	Connect ECU Test Tool to Read Engine Codes 1. Check oil pressure switch. 2. Check oil pressure circuit: • 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.	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 controlled within range. Low speed 400, High speed 460 +/- 30 VAC	See “Alternator Diagnosis”.

M115	FUEL LEVEL CHANGE TO FAST	Operation Fuel level decease more than 10 gallons.	1. Check for leak in fuel tank. 2. Check to see if fuel has been removed from fuel tank.
M302	ENGINE SERVICE LAMP	Operation ECU Service lamp activated.	Connect ECU Test Tool to Read Engine Codes.
M303	ENGINE TIMING BELT	Operation Timing belt expired caused by hours of operation. Message after 8500 Alarm after 9000 Hours	Replace timing belt. See procedure in the Engine Maintenance Chapter.
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”

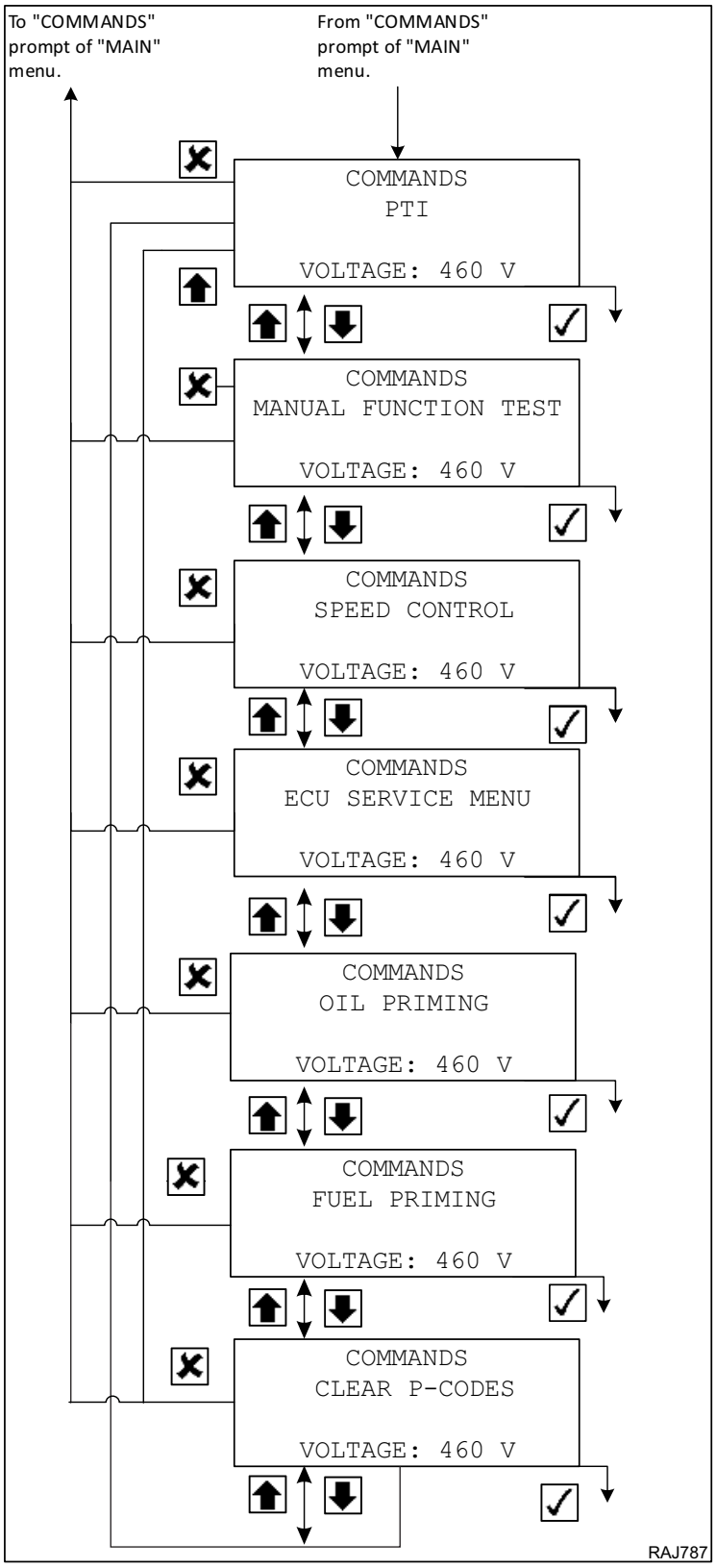
Commands Menu

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

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


To "COMMANDS" prompt of "MAIN" menu.
From "COMMANDS" prompt of "MAIN" menu.
COMMANDS
PTI
VOLTAGE: 460 V
COMMANDS
MANUAL FUNCTION TEST
VOLTAGE: 460 V
COMMANDS
SPEED CONTROL
VOLTAGE: 460 V
COMMANDS
ECU SERVICE MENU
VOLTAGE: 460 V
COMMANDS
OIL PRIMING
VOLTAGE: 460 V
COMMANDS
FUEL PRIMING
VOLTAGE: 460 V
COMMANDS
CLEAR P-CODES
VOLTAGE: 460 V
RAJ787

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 of 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.

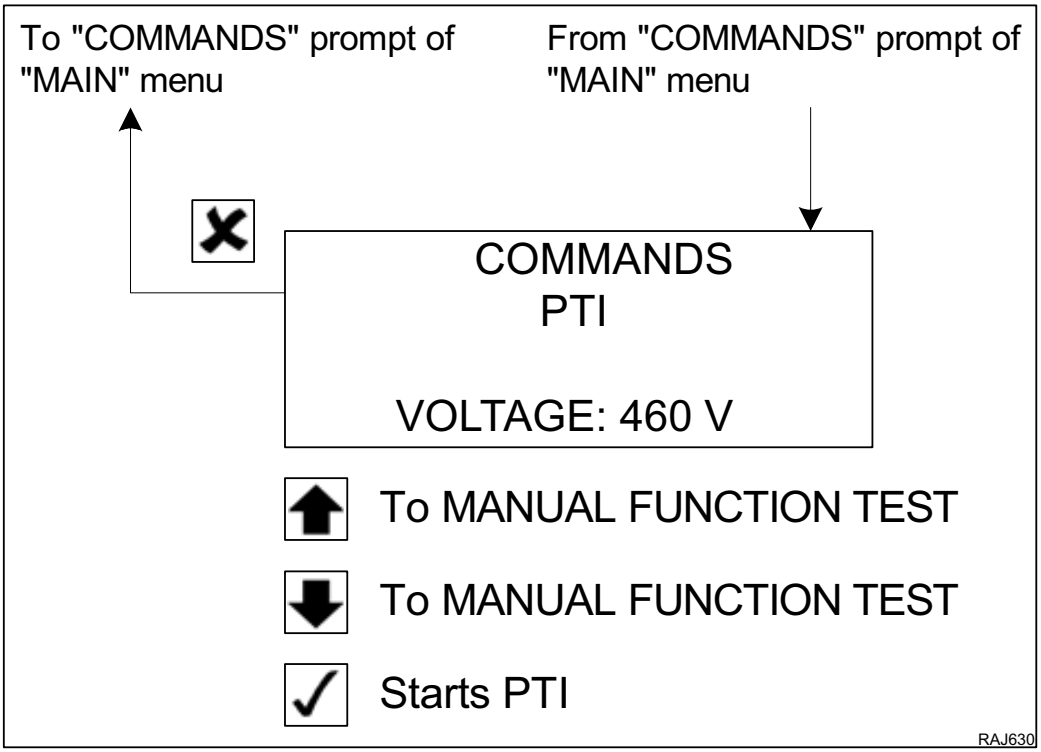
Note: *If a component fails its test, the PTI will stop at that point and display "FAILED - REBOOT". Correct the problem and repeat the PTI by pressing the ENTER Key.*

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 32. PTI Submenu



Manual Function Test

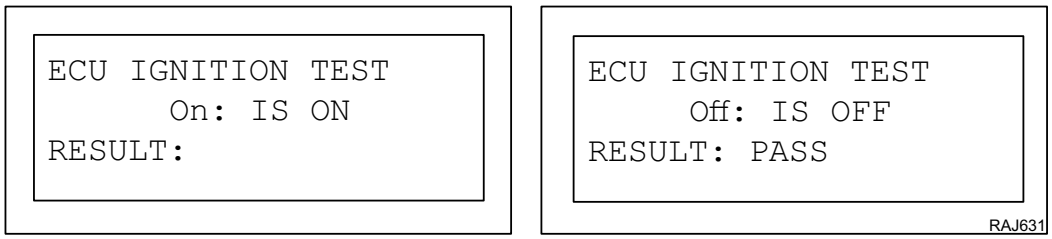
The Manual Function Test submenu contains the following component tests:

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

The test result (PASSED of 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 33. 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.

Timing Belt

The timing belt selection is only used on SG 4000 units.

Timing Belt is used to clear and reset the timing belt replacement interval counters.

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 timing belt menu.
5. Press the UP or DOWN key to view the counters.
6. Follow the on screen steps to clear / delete, active and view timing belt counters.
7. Press the ESCAPE key to return to the Commands Menu.

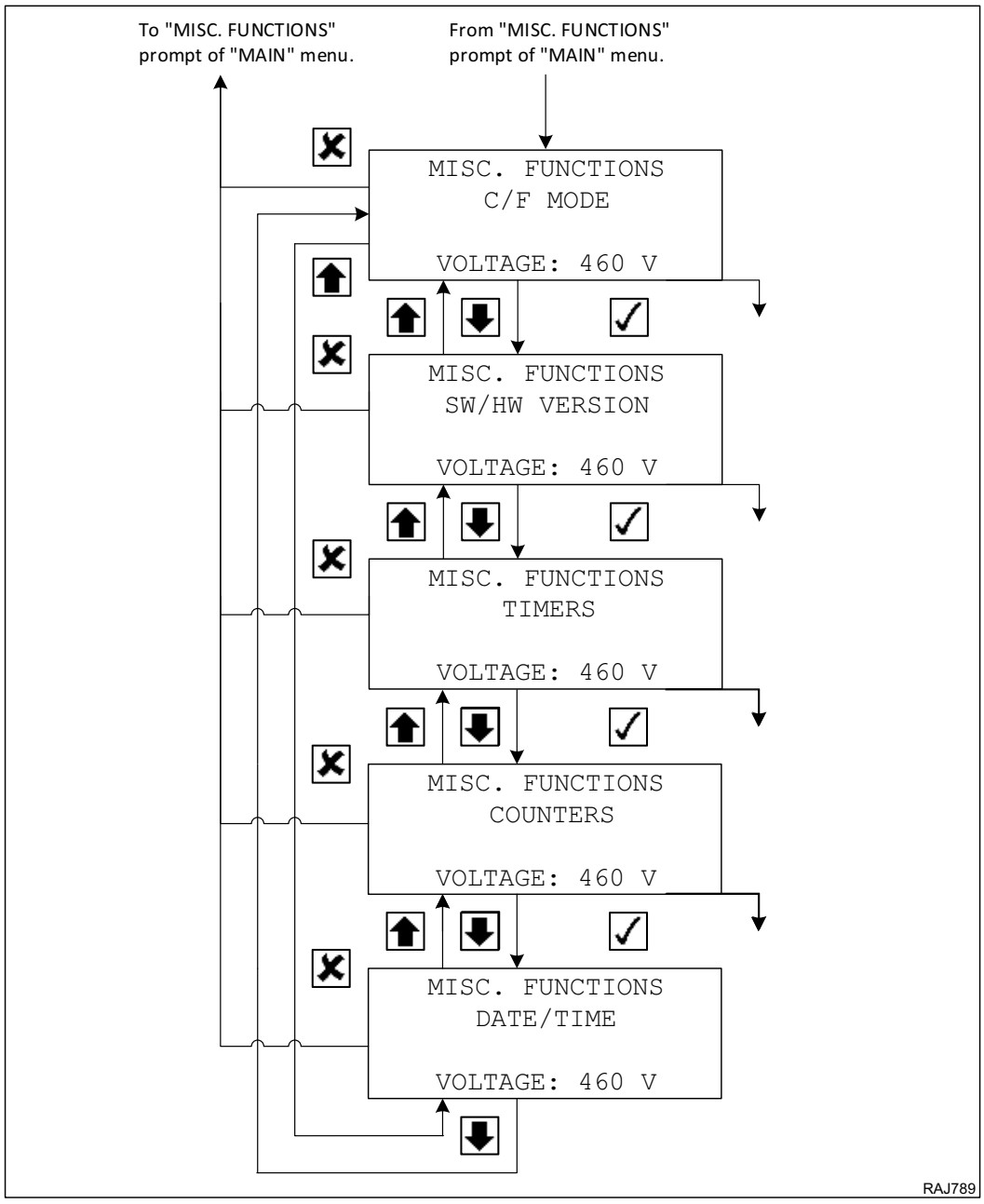
Misc. Functions Menu

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.


To "MISC. FUNCTIONS" prompt of "MAIN" menu.
From "MISC. FUNCTIONS" prompt of "MAIN" menu.
MISC. FUNCTIONS
C/F MODE
VOLTAGE: 460 V
MISC. FUNCTIONS
SW/HW VERSION
VOLTAGE: 460 V
MISC. FUNCTIONS
TIMERS
VOLTAGE: 460 V
MISC. FUNCTIONS
COUNTERS
VOLTAGE: 460 V
MISC. FUNCTIONS
DATE/TIME
VOLTAGE: 460 V
RAJ789

C/F Temperature and Language Mode

The C/F Mode submenu is used the change:

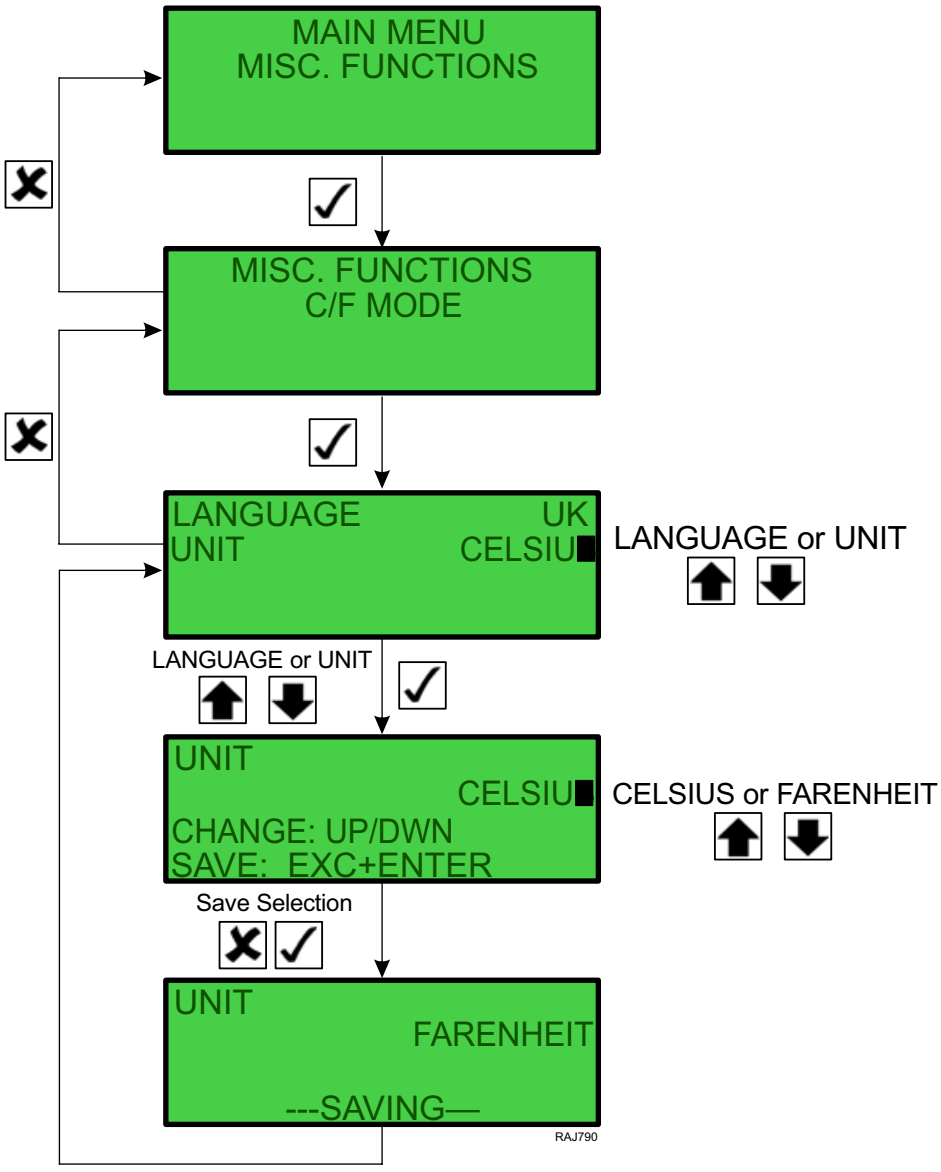
- **Language:** Allows unit to display English, Spanish, or Danish for all screens.
- **C/F**: Allows unit to display Celsius or Fahrenheit display temperature readings.

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.*


MAIN MENU
MISC. FUNCTIONS
MISC. FUNCTIONS
C/F MODE
LANGUAGE UK
UNIT CELSIU
LANGUAGE or UNIT
LANGUAGE or UNIT
UNIT
CELSIU
CELSIUS or FARENHEIT
CHANGE: UP/DWN
SAVE: EXC+ENTER
Save Selection
UNIT
FARENHEIT
---SAVING—
RAJ790

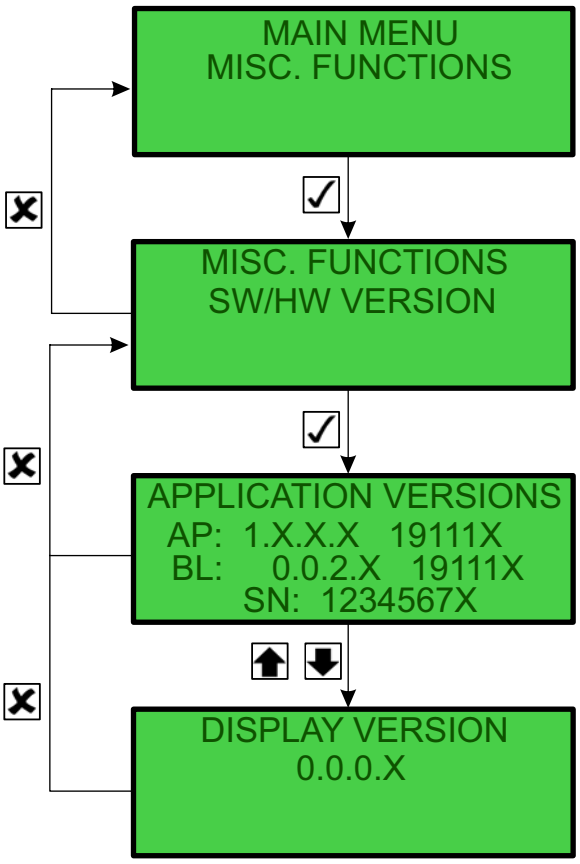
SW/HW Version (Software / Hardware)

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.



RAJ791

Timers

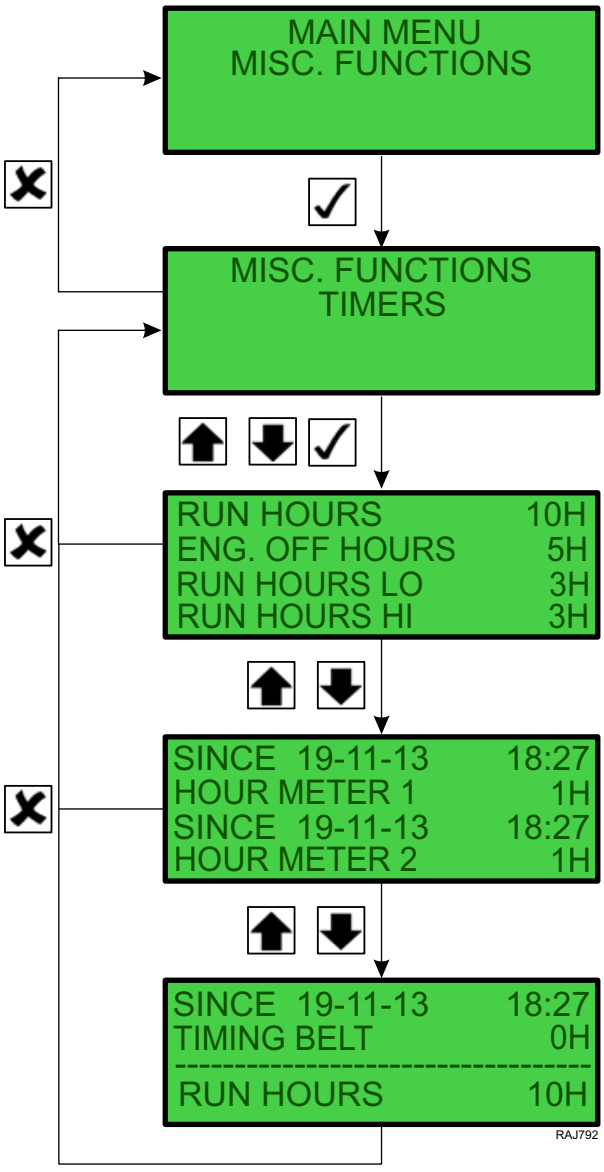
The Timers submenu displays the following hour meters:

- 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.
- Timing Belt – The number of hours the current engine timing belts has left until replacement needed (if equipped).

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.


MAIN MENU
MISC. FUNCTIONS
MISC. FUNCTIONS
TIMERS
RUN HOURS 10H
ENG. OFF HOURS 5H
RUN HOURS LO 3H
RUN HOURS HI 3H
SINCE 19-11-13 18:27
HOUR METER 1 1H
SINCE 19-11-13 18:27
HOUR METER 2 1H
SINCE 19-11-13 18:27
TIMING BELT 0H
RUN HOURS 10H
RAJ792

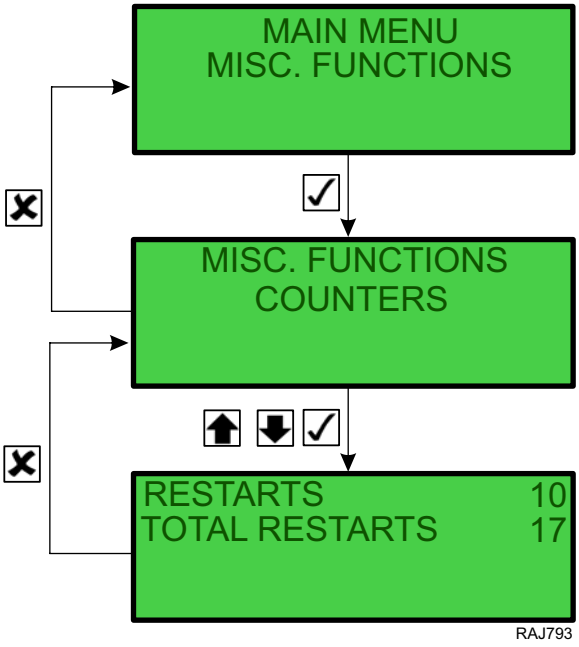
Counters

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.



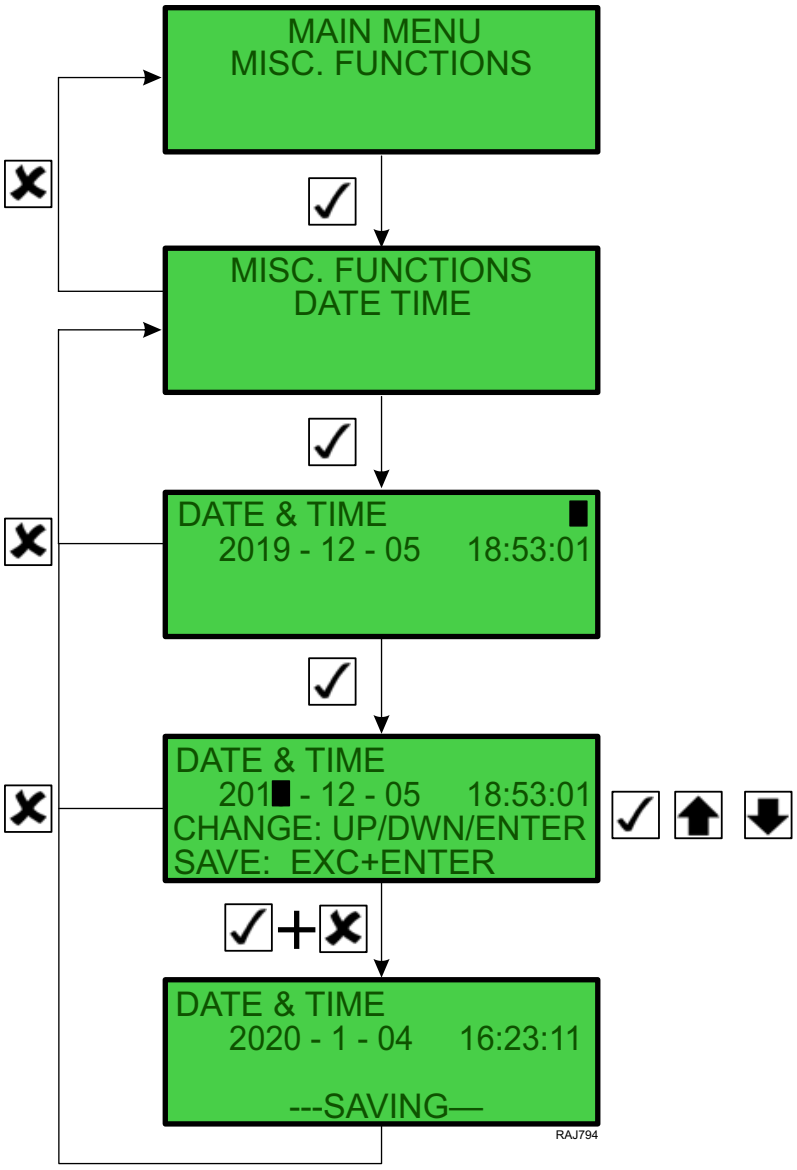
Date and Time

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

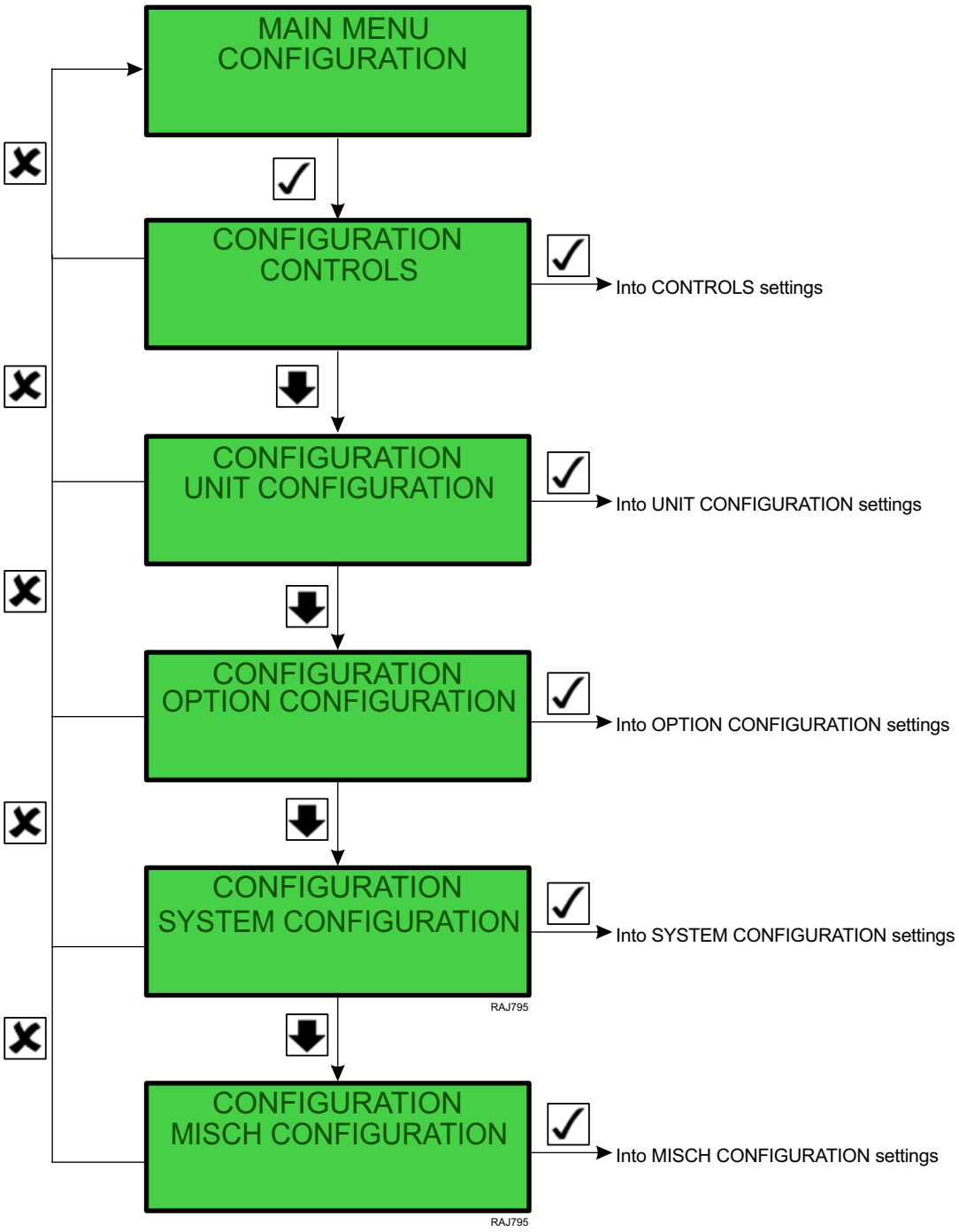
Equipment Damage and Risk of Injury!

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.

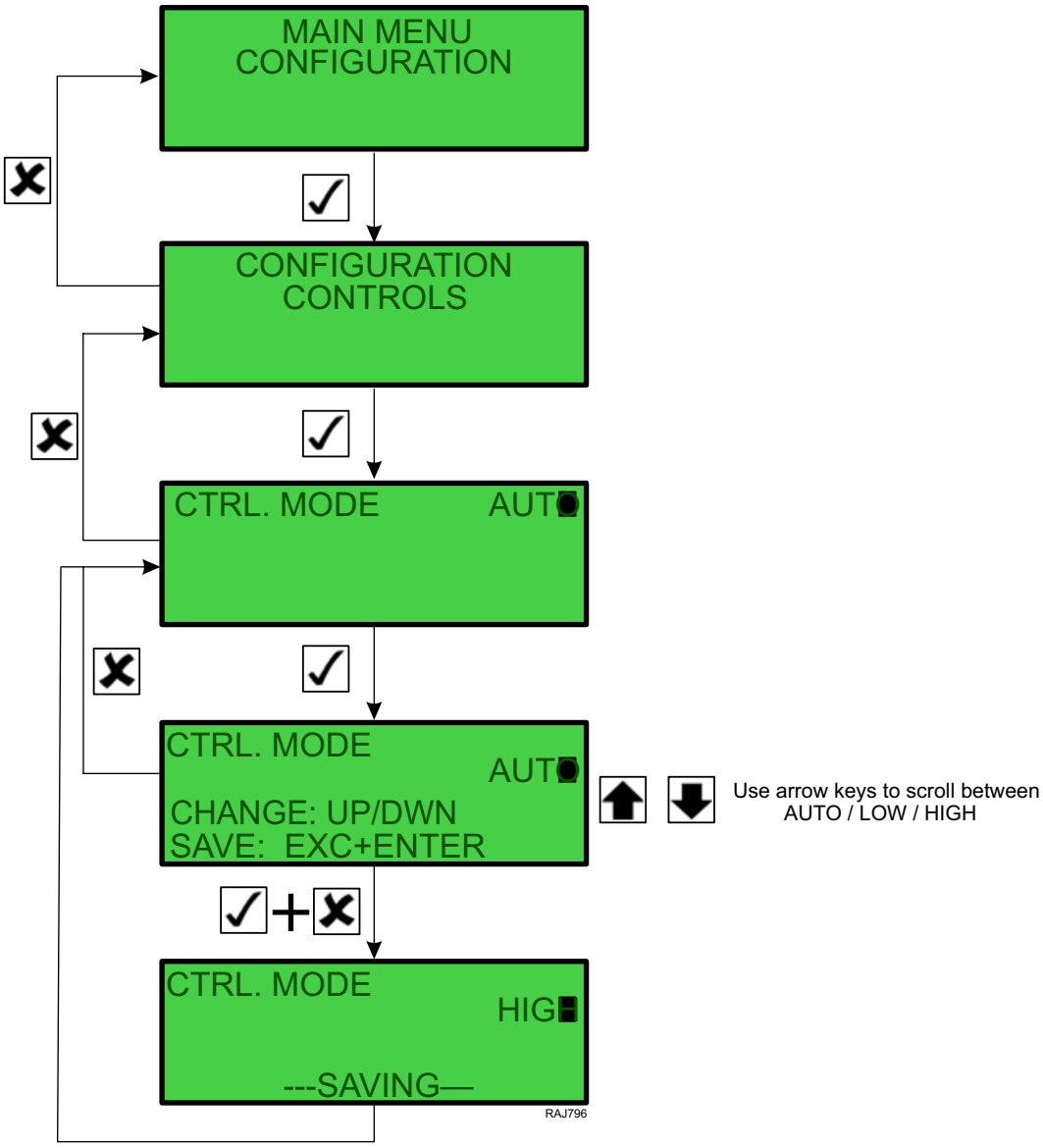

MAIN MENU CONFIGURATION
CONFIGURATION CONTROLS
Into CONTROLS settings
CONFIGURATION UNIT CONFIGURATION
Into UNIT CONFIGURATION settings
CONFIGURATION OPTION CONFIGURATION
Into OPTION CONFIGURATION settings
CONFIGURATION SYSTEM CONFIGURATION
Into SYSTEM CONFIGURATION settings
RAJ795
CONFIGURATION MISCH CONFIGURATION
Into MISCH CONFIGURATION settings
RAJ795

Controls

The Controls submenu is used to temporary set engine RPM to AUTO / HIGH / LOW for service purposes. To enger the Controls submenu, complete the flowing 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 the 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.*


MAIN MENU
CONFIGURATION
CONFIGURATION
CONTROLS
CTRL. MODE
AUTO
CTRL. MODE
AUTO
CHANGE: UP/DWN
SAVE: EXC+ENTER
CTRL. MODE
HIGH
---SAVING—
RAJ796
Use arrow keys to scroll between
AUTO / LOW / HIGH

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)

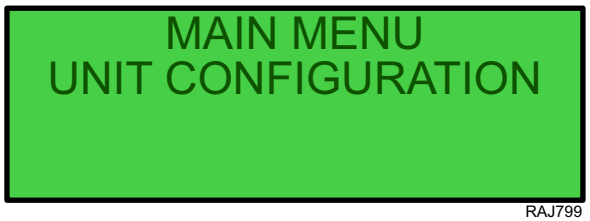
⚠ Warning

Equipment Damage and Risk of Injury!

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

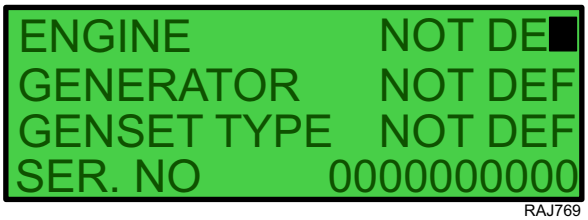
Follow the steps below to ensure the unit is configured correctly.

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



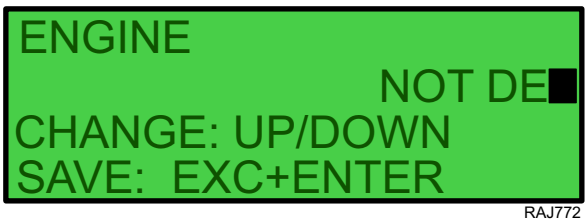
RAJ799

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



RAJ769

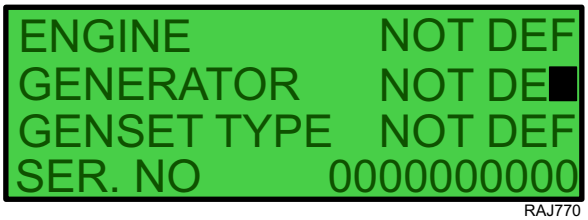
   - Use the **UP** and **DOWN** keys to scroll to the correct engine:
     - YANMAR MECH (SG 3000e series units)
     - PCM (SG 4000 series units)
     - YANMAR HPCR (SG 5000 series units)
   - When the correct engine is selected, press the **ESC** and **ENTER** keys at the same time to save the engine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



RAJ772

4. Set GENERATOR type:

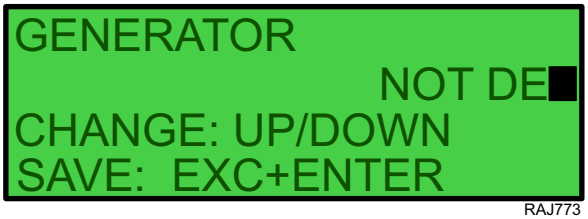
- Use the **UP** and **DOWN** keys to put the curser on GENERATOR.
- Press the ENTER key when the curser is on GENERATOR.



RAJ770

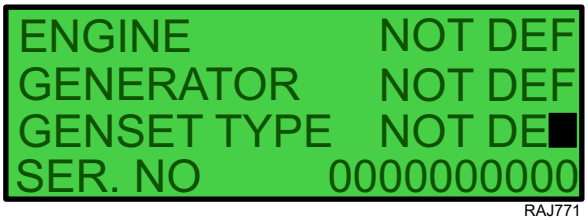
- Use the **UP** and **DOWN** keys to scroll to the correct alternator:
  - MECC ALTE (SG 5000, SG 4000, and SG 3000e after December 2016)
  - STANFORD (SG 3000e Before December 2016). Could be MECC ALTE if generator has been replaced, see not below.

  Note: *SG 3000e 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.



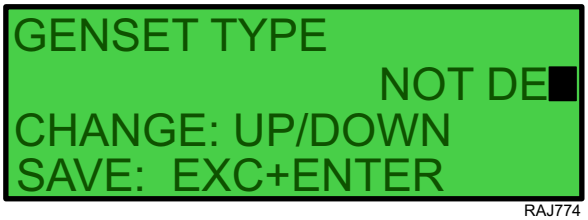
RAJ773

5. Set GENSET TYPE:
   - Use the **UP** and **DOWN** keys to put the curser on GENSET TYPE.
   - Press the ENTER key when the curser is on GENSET TYPE.



RAJ771

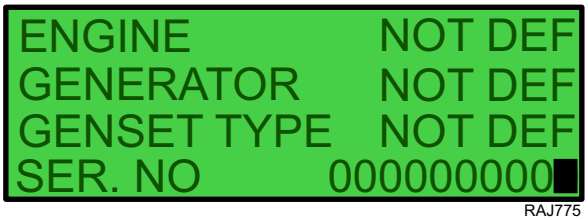
   - Use the **UP** and **DOWN** keys to scroll to the correct Genset Type:
     - CLIP ON
     - SIDE
     - CENTER
   - When the correct genset type is selected, press the **ESC** and **ENTER** keys at the same time to save the engine choice.



RAJ774

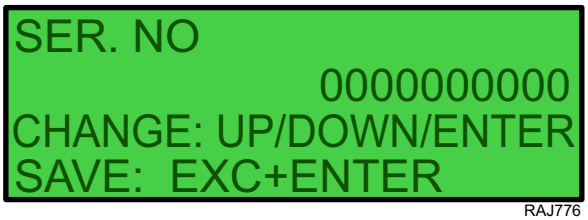
6. Set SERIAL NUMBER:

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



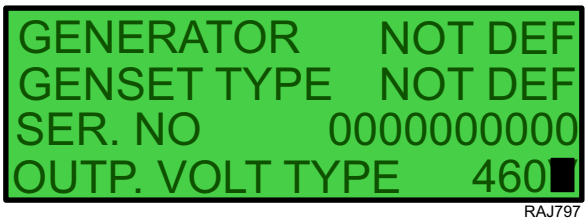
RAJ775

- 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.



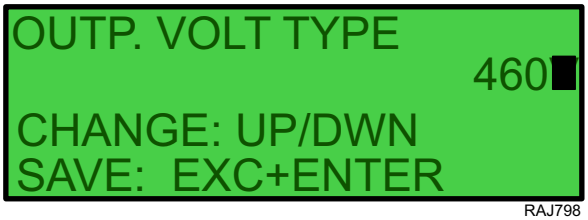
RAJ776

7. Set unit OUTPUT VOLTAGE TYPE.
   - Use the **UP** and **DOWN** keys to put the curser on OUTP. VOLT TYPE.
   - Press the ENTER key when the curser 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.



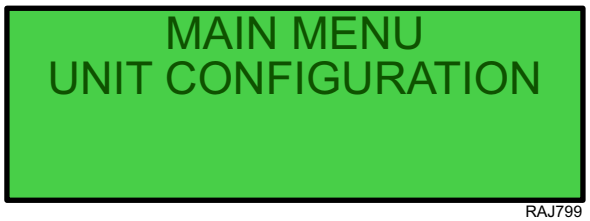
RAJ798

⚠ 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.

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



RAJ799

Option Configuration

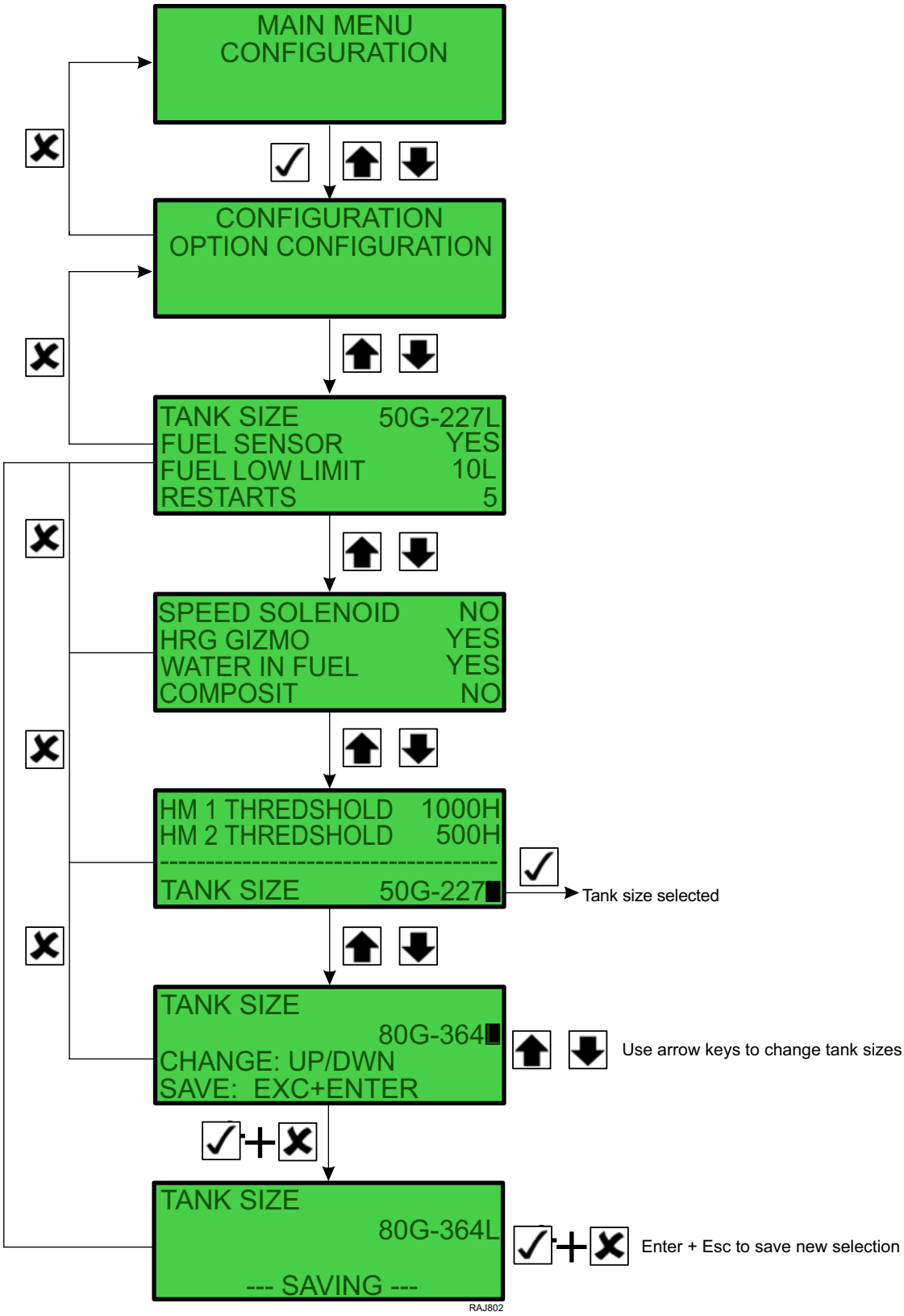
The Option Configuration submenu allows setting values for the following unit options:

- 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).

  Note: *Only applies to gensets with the standard ultrasonic fuel sensor connected directly to the SG+1.5 controller, for gensets equipped with telematics fuel level sensor option needs to be set to 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 3000e 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 (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.


MAIN MENU
CONFIGURATION
CONFIGURATION
OPTION CONFIGURATION
TANK SIZE 50G-227L
FUEL SENSOR YES
FUEL LOW LIMIT 10L
RESTARTS 5
SPEED SOLENOID NO
HRG GIZMO YES
WATER IN FUEL YES
COMPOSIT NO
HM 1 THREDSHOLD 1000H
HM 2 THREDSHOLD 500H
TANK SIZE 50G-227
Tank size selected
TANK SIZE
80G-364
CHANGE: UP/DWN
SAVE: EXC+ENTER
Use arrow keys to change tank sizes
TANK SIZE
80G-364L
--- SAVING ---
Enter + Esc to save new selection
RAJ802

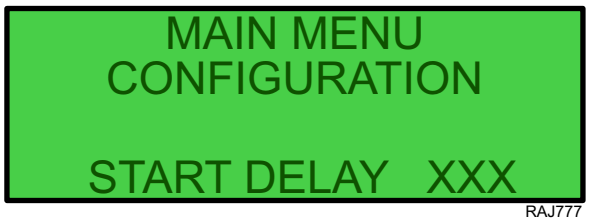
System Configuration

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.*

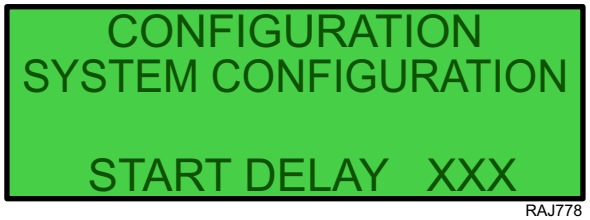
Follow the steps below to set the unit ID number:

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



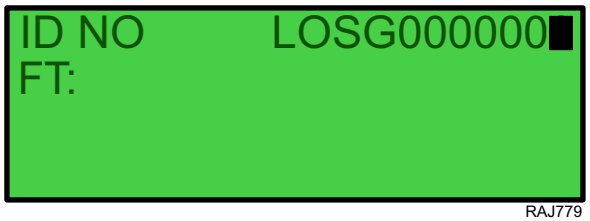
RAJ777

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



RAJ778

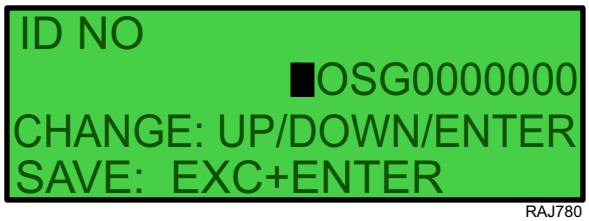
5. Use the **UP** and **DOWN** keys to ensure the curser is on ID NO.
6. Press the ENTER key when the curser is on ID NO.



RAJ779

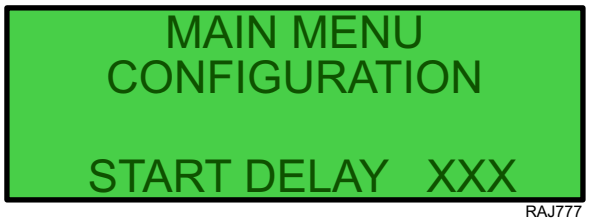
7. Enter the unit ID number by:
   - Use the arrow keys to scroll UP and DOWN to select the number or letter.
   - Press the ENTER key to move to the next ID number digit

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

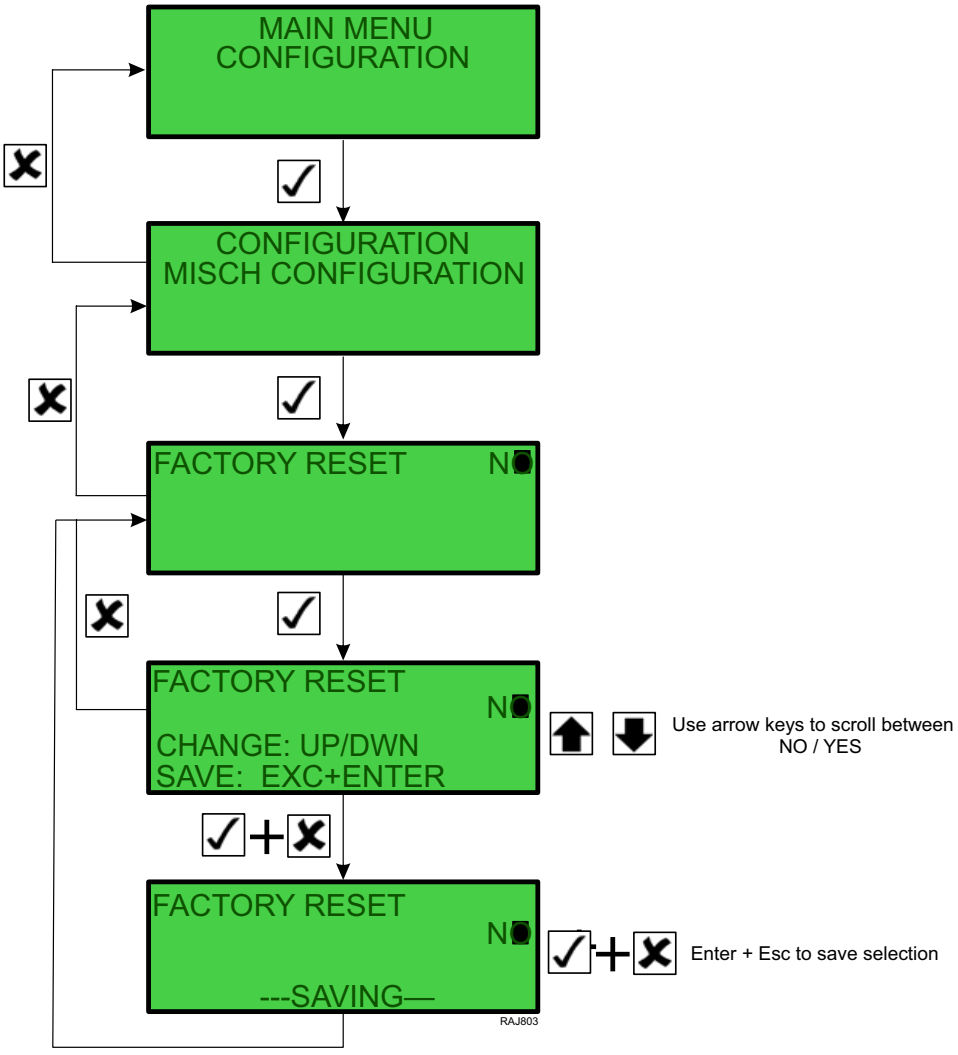
The MISCH Configuration is used as a factory reset for all settings. The function will set all custom settings back to the factory original settings.

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.

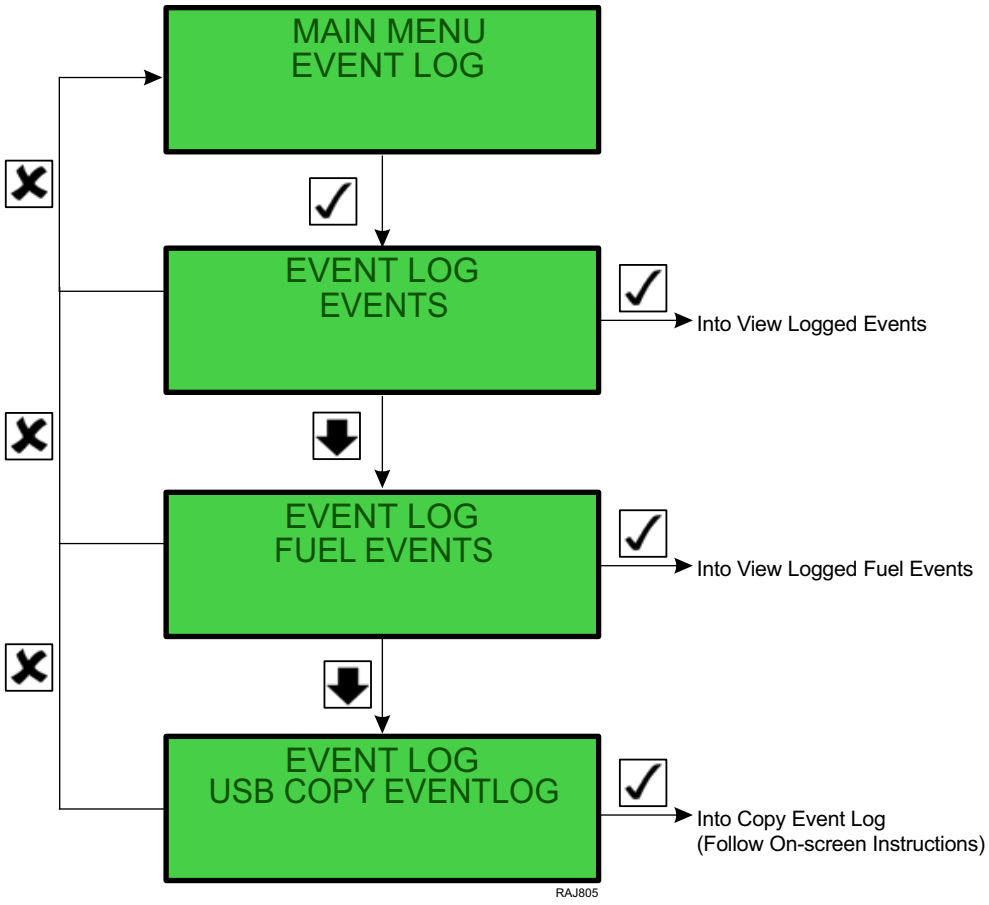
The Event Log menu has these submenus:

- 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.



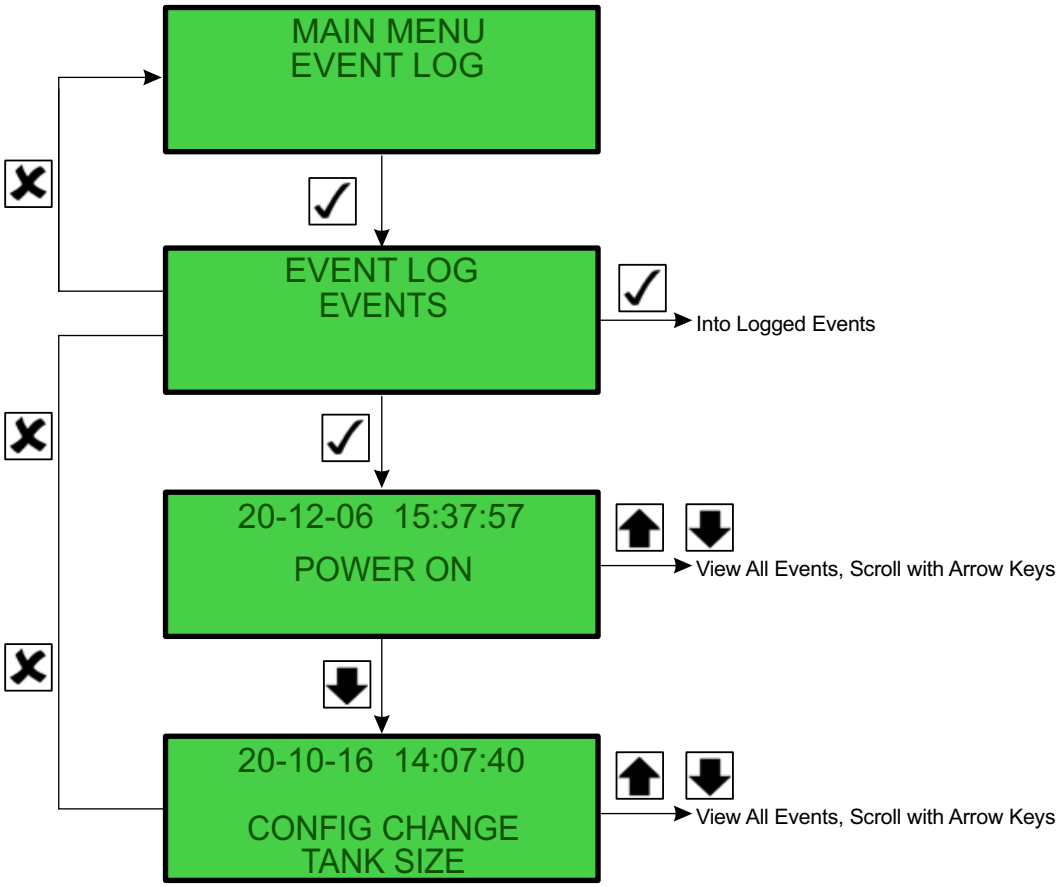
Events

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

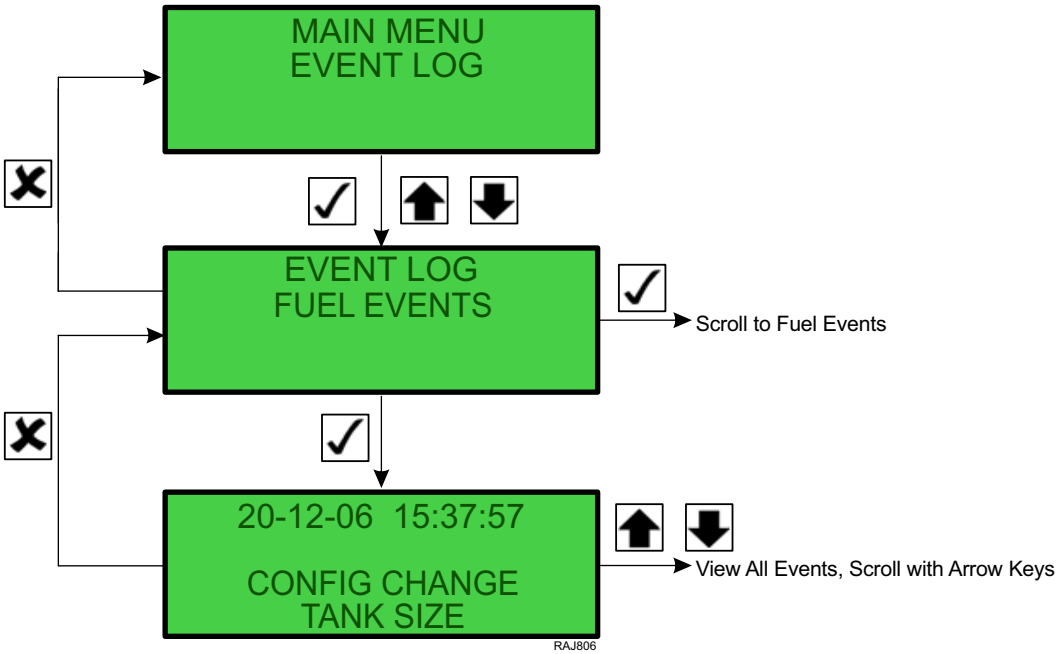
The Fuel Events is a list of fuel events that are recorded in the controller memory on units equipped with the fuel level sensor option. An example of a recorded event is when fuel is added to the fuel tank. Fuel Events are listed in the reverse order of their occurrence.

Note: *Only applies to gensets with the standard ultrasonic fuel sensor connected directly to the SG+1.5 controller, for gensets equipped with telematics fuel level sensor option needs to be set to NO.*

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.

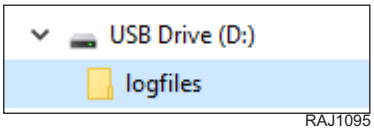
Format USB drive to Fat 32 system. Use a blank USB drive.

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. Log files are saved.
14. Press the ESCAPE key to return to the Event Log Menu.

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



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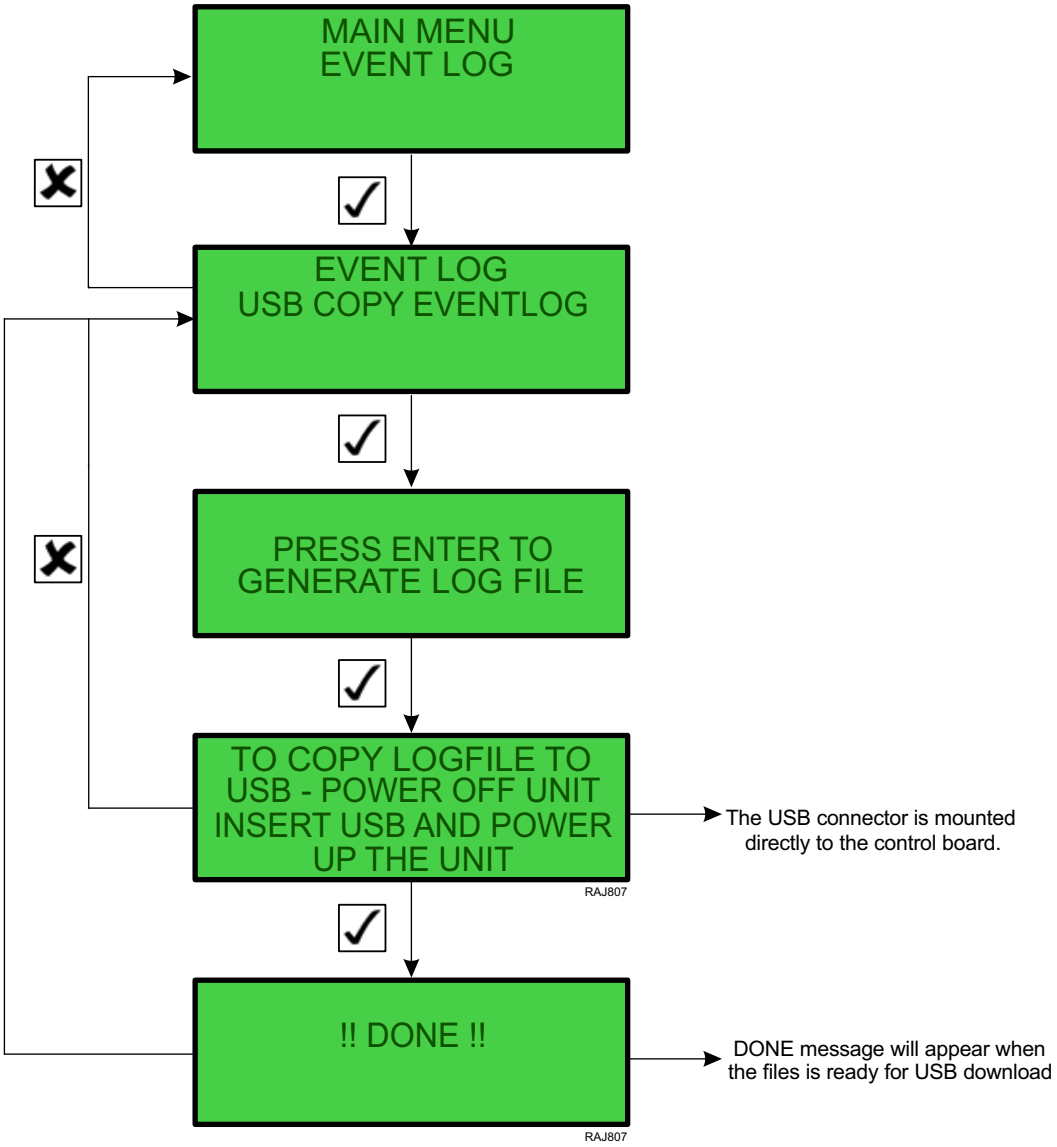

MAIN MENU
EVENT LOG
EVENT LOG
USB COPY EVENTLOG
PRESS ENTER TO
GENERATE LOG FILE
TO COPY LOGFILE TO
USB - POWER OFF UNIT
INSERT USB AND POWER
UP THE UNIT
RAJ807
!! DONE !!
RAJ807
The USB connector is mounted directly to the control board.
DONE message will appear when the files is ready for USB download

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 now to use LogView refer to the Help file found within LogView.

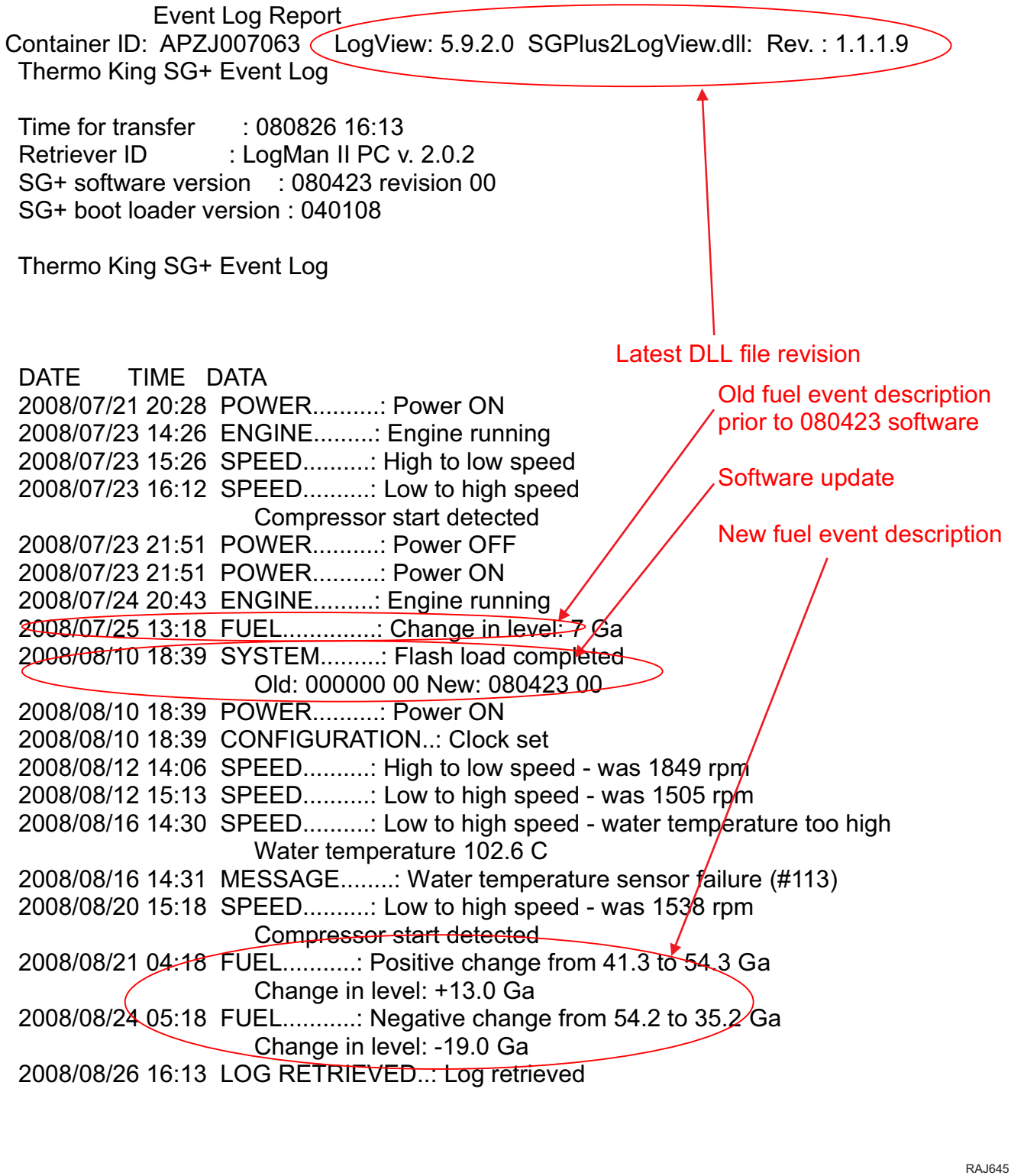
The SG+ log can store up to 128 Event logs. The oldest events will be over written in the log automatically.

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 34. Example of SG+ Log



RAJ645

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.*

Relays SG+

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

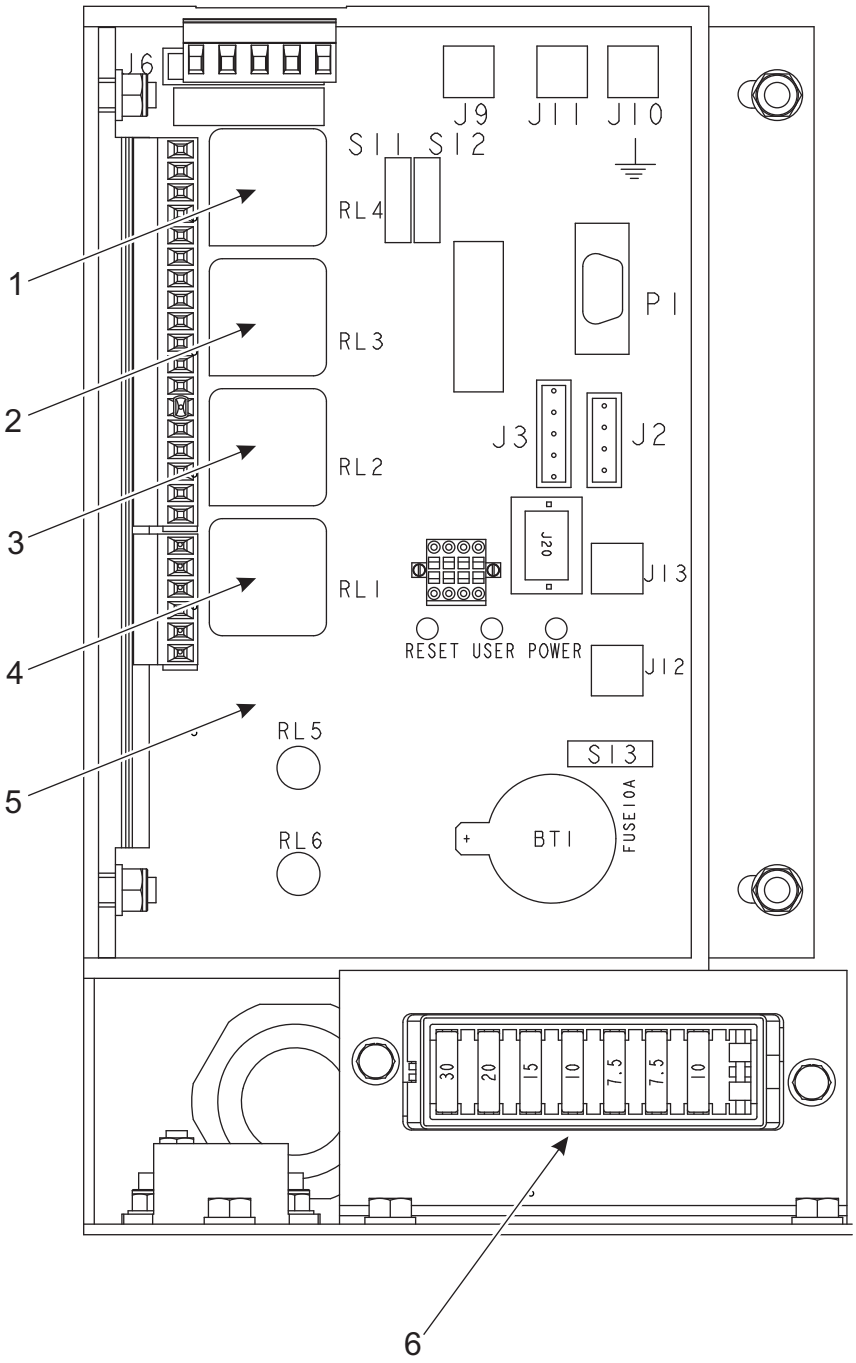
The Ignition relay (RL1) is located on the PC board. It supplies power to the ECU. The RL1 LED on the PC board will light up when the Ignition relay is energized.

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.

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.



1.	Spare Relay (If Installed)	4.	Ignition Relay (RL1)
2.	Fuel Pump Relay	5.	PC Board
3.	Run Relay (RL2)	6.	ECU Fuses

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.

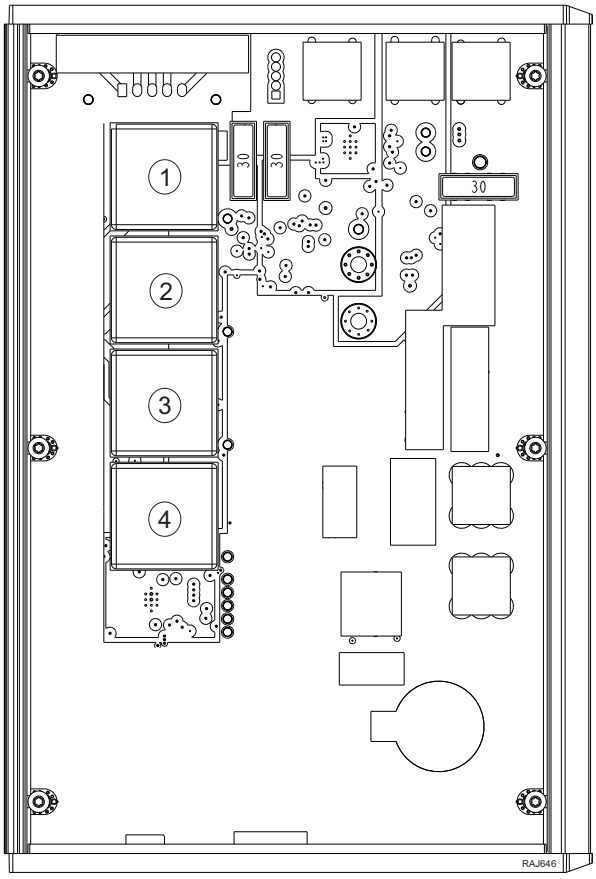
Start Relay

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 35. PC Board Relays



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

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

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.

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.*

Glow Plugs

Glow plugs heat the combustion chambers to help the engine start in cold weather. The glow plugs are energized by the ECU (Engine Control Unit) through the glow relay during preheat, just before the engine is started.

The ECU controls glow plug operation in three phases based on Engine Coolant Temperature and Barometric Pressure.

State of Operation	Voltage at Glow Plugs	Coolant Tempera-ture	Time Limit
Pre-Heat 100% Boost (Engine not Running)	12 Volts	Less than 68 F (20 C)	0-1.9 Seconds
Pre Heat Maintain (Engine not Running)	5 Volts	Less than 77 F (25 C)	1-8 Seconds
Post Heat (Engine Running)	4 Volts	Less than 140 F (60 C)	Up to 900 Seconds

Notice

Equipment Damage!

Applying battery voltage to glow plugs for extended durations can damage the glow plugs.

The glow relay detects electrical defects in the relay itself and in individual glow plugs. It provides diagnostic feedback to the ECU, which communicates with the microprocessor to record Alarm Code 811 Glow Plug Circuit Error.

Use EXXODiag to view the DTCs (Diagnostic Trouble Codes) and diagnose the problem. Refer to Service Procedure A60A in the SR-4 Trailer Multi-Temp Diagnostic Manual (TK 55788-2-OD) for more information about using the Peugeot EXXODiag Diagnostic Tool to connect to the ECU.

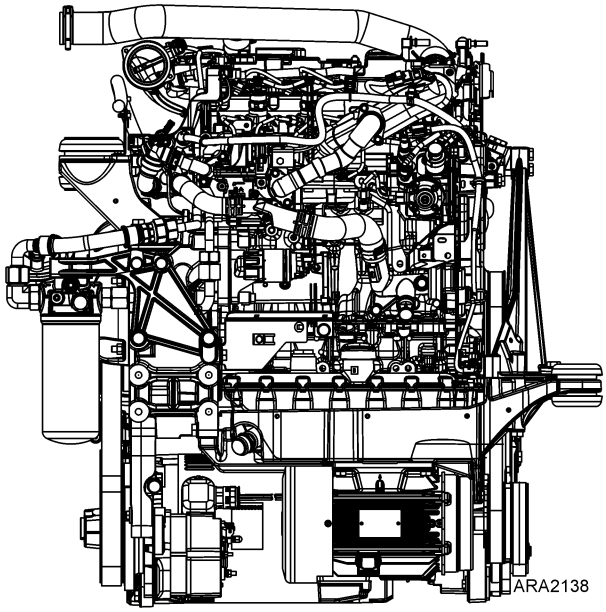
Engine Maintenance

TKDV6 Diesel Engine

This unit uses a new engine called the TKDV6. The engine is turbocharged and has a "Common Rail" fuel injection system, which used electronically controlled fuel injectors to reduce emissions. 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.

An intercooler is used between the turbocharger and the engine air inlet. It cools the inlet air to improve the power and efficiency. The intercooler is located behind the curbside grille in the lower part of the condenser coil/intercooler assembly.

Figure 36. TKDV6



TKDV6 Engine Service

Refer to the TKDV6 Repair Manual (TK 55810) for engine service information not included in this manual.

Connect a PC with the Peugeot EXXODiag Diagnostic Software to the ECU to view the TKDV6 engine DTCs (Diagnostic Trouble Codes) and troubleshoot engine problems.

Engine Lubrication System

The TKDV6 engine use a pressure lubrication system similar to the that in other 4-cylinder diesel engines.

Engine Oil Change

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

Note: *See Specifications chapter for correct oil type.*

Important: *Never overfill the engine oil. Overfilling the oil can result in increased oil consumption, high oil temperature, accelerated oil degradation rate, and increase engine load.*

1. Verify the unit is on a level surface for draining and oil level checking. The engine should be warm when draining the oil.
2. Turn the Service Switch (Unit ON/OFF switch) to the OFF position.
3. Drain the engine oil into a suitable container.

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.*

4. Refill the oil sump with fresh engine oil. A new oil filter must also be filled with oil before it is installed; therefore, use a total oil volume required to fill the filter and sump, approximately: . Fully thread the dipstick back into the oil pan, then remove it to check oil level.
5. Turn the Service Switch (Unit ON/OFF switch) to the ON position.
6. Start and run the unit and check for oil leaks.
7. Shut unit off.
8. Remove the dipstick from the oil pan and wipe it clean. Fully thread the dipstick back into the oil pan, then remove it to check oil level.
9. Add oil if needed. The oil level must be within the cross-hatch area of the dipstick. **Never overfill the engine oil.**
10. Properly dispose of the used engine oil and filter.

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.

Prime Lubrication System

After changing the oil and oil filter, the lubrication system should be primed before starting the engine. Prime the lubrication system by selecting Prime Oil Filter in the Maintenance Menu on the HMI. This function turns the engine over for a fixed time without starting, thus priming the lubrication system.

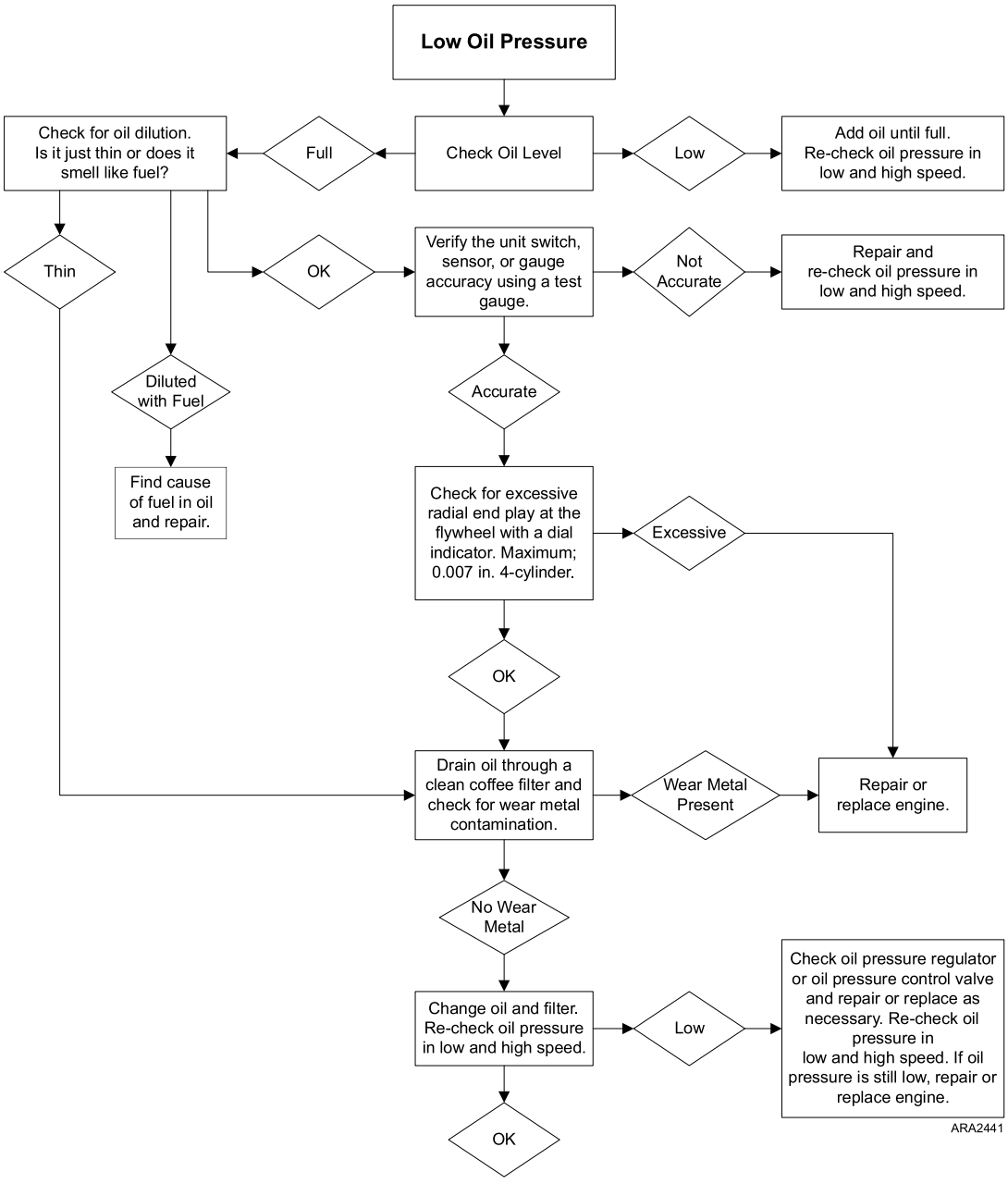
Note: *Make sure the fuel supply line is connected and primed before running the Prime Oil Filter feature.*

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 37, p. 178) to help diagnose low oil pressure.

Figure 37. Low Oil Pressure Flow Chart



Engine Cooling System

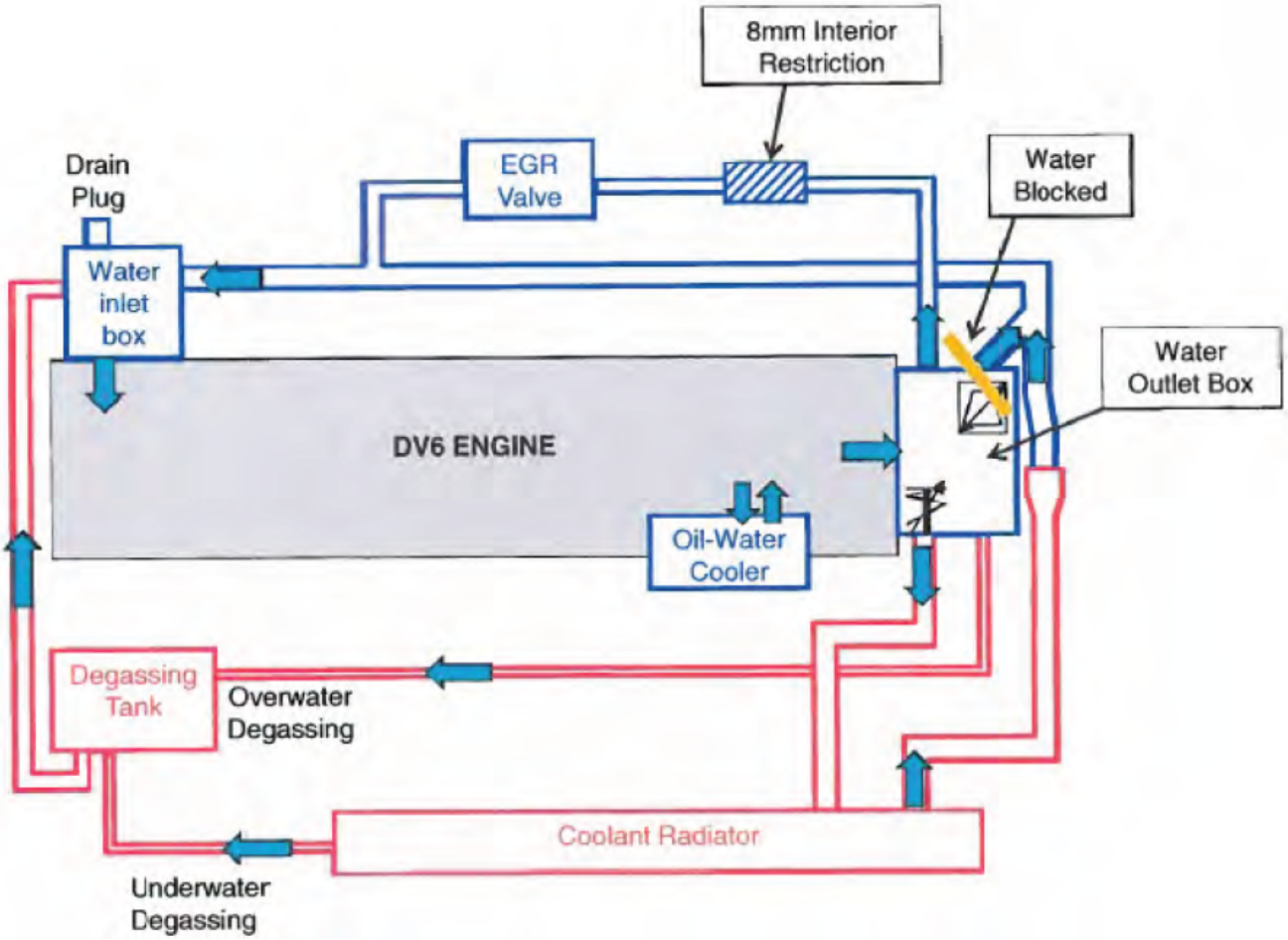
The engine employs a closed, circulating type, pressurized cooling system. Correct engine temperatures are controlled and maintained by a radiator, fan, and thermostat. The coolant is circulated through the system by an internal coolant pump driven by the timing belt. The pump draws the coolant from 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 housing 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

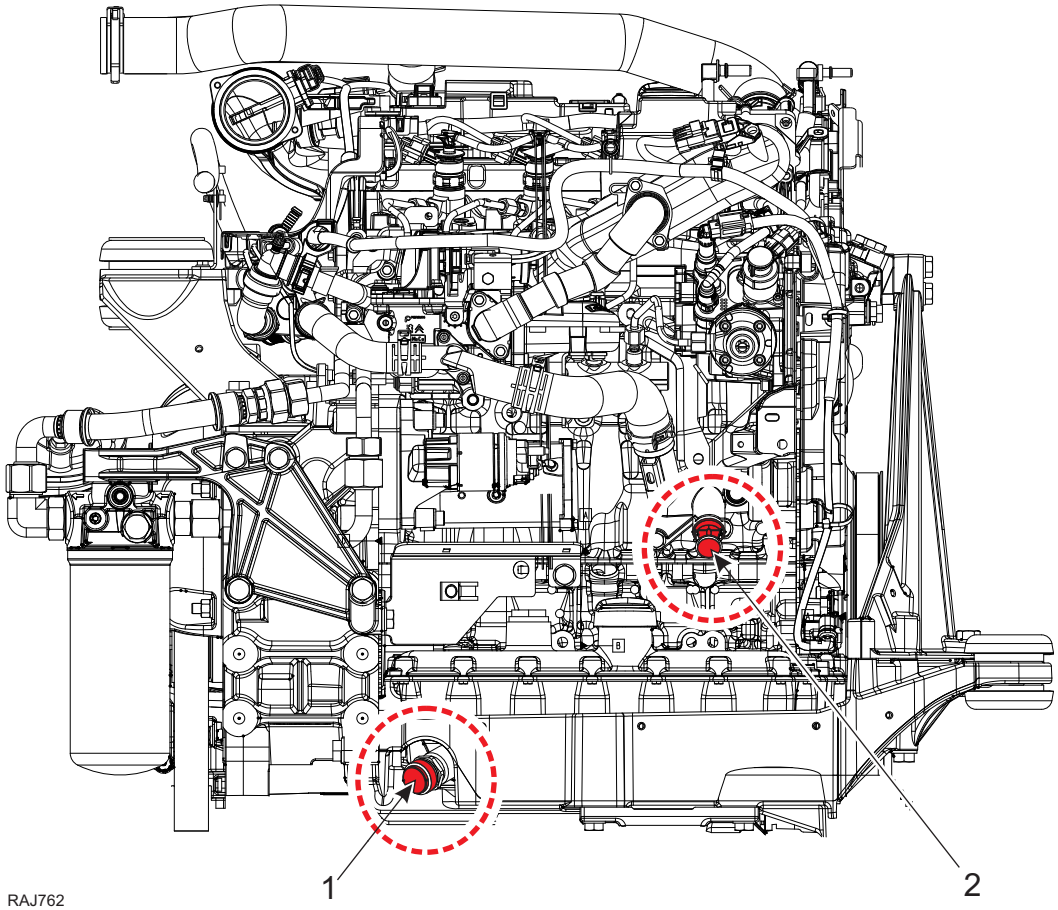
1. Run the engine until it is up to its normal operating temperature. Stop the unit.

⚠ Caution

Risk of Injury!

Avoid direct contact with hot coolant.

2. Open the engine block drain (located behind and above the dipstick) 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.



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1.	Engine Oil Drain Location
2.	Engine Block Coolant Drain

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. Run clear water into the radiator, and allow it to drain out of the block until it is clear.
4. Inspect all hoses for deterioration and hose clamp tightness. Replace if necessary.
5. Inspect the radiator cap. Replace the cap if the gasket shows any signs of deterioration.
6. 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).
7. 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

Normally, all but about 1.5 qt (1.4 liters) of coolant drain out of the cooling system when it is drained. If approximately half of the Cooling System Capacity (see Specifications Chapter) seems to fill the cooling system after it has been drained, air has been trapped in the block. Bleed the air out of the block using the following procedure:

Important: *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. Pour coolant into the system until it appears to be full. The amount of coolant that goes back into the system is approximately equal to the amount of coolant that came out of the system.
2. Start the engine. 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. When the temperature reaches 150 F (66 C), shut the engine off for 2 minutes. 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.
3. Restart the engine and run it in low speed. Remove the cap from the expansion tank and slowly pour coolant into expansion tank until it is full, then reinstall the expansion tank cap.
4. Repeat steps 2 and 3 until the coolant level stabilizes.

Engine Thermostat

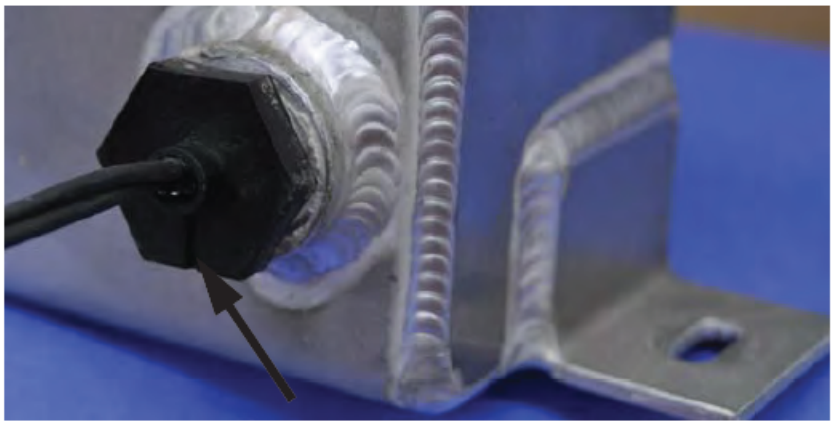
Thermostat is molded in the water outlet box.

For the best engine operation, use a 160 F (71 C) 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.



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 is 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. Turn the coolant level switch 1/4 turn to loosen it and remove it from the tank.
3. Place the new coolant level switch in the tank. Align the tabs on the switch with the slots in the tank and turn the switch 1/4 turn to tighten it.
4. Connect the wire harness connector to the coolant level switch.

Engine Fuel System

Important: ***DO NOT*** *reuse high pressure fuel pipes that have been removed from the engine for service procedures. If a high pressure fuel pipe was removed for an engine service procedures, replace it with a new pipe to prevent fuel leaks due to sealing surface working face deformation.*

The TKDV6 engine uses a common rail fuel system.

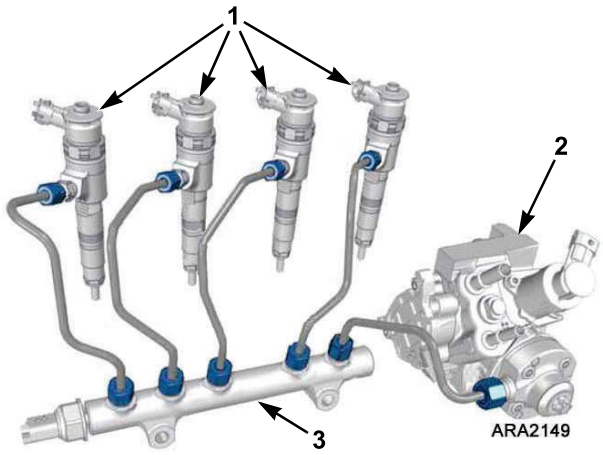
The components of the fuel system are:

- 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 38. Fuel Injection Components on Engine



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

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 Filter/Water Separator

The fuel filter/water separator filters the fuel, removes water from the fuel, and returns only fuel to the tank.

Fuel Filter and Water Separator Service

Primary Fuel Filter / Water Separator

Removal

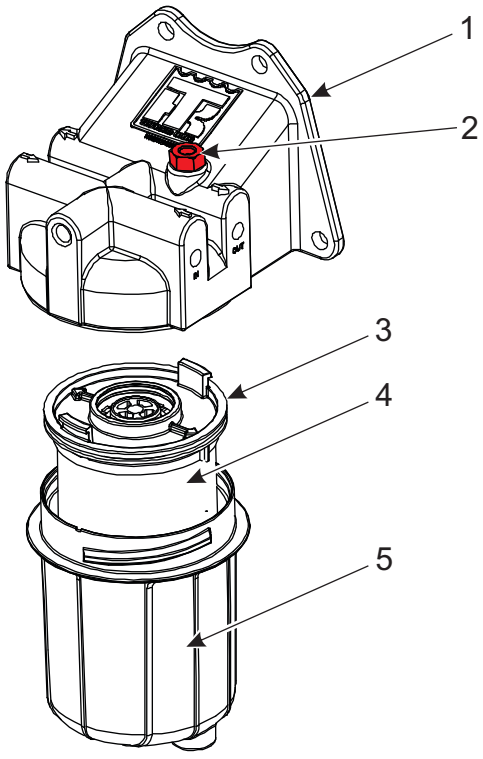
1. Turn the unit OFF and disconnect the negative battery terminal to ensure unit cannot be operated.
2. Unscrew the filter bowl 1/4 turn. Drain the fuel into a suitable container.
3. Remove the bowl and it and filter element. Drain the fuel from the filter bowl. Dispose of the drained fuel and filter according to local regulations.
4. Clean the filter head.

Installation

5. Lubricate the top inside edge of the filter bowl with clean engine oil.
6. Lubricate the O-ring in the top of the filter element with clean engine oil.
7. Place the filter element in the filter head with the tabs (and arrows) on the filter element aligned with the slots (and arrows) in the filter bowl. Verify that the filter element is fully seated in the filter bowl.
8. Install and tighten the filter bowl about 1/4 turn until you hear and/or feel it click.

   Note: *Do not fill the filter bowl with fuel before installing it.*
9. Replace the secondary fuel filter as shown in this chapter (if equipped), then prime the fuel system as shown in this chapter.

Figure 39. Fuel Filter/Water Separator Assembly



RAJ763

1.	Filter Head	4.	Filter Element
2.	Bleed Screw	5.	Filter Bowl
3.	Filter Element Tab		

Secondary Fuel Filter (if equipped)

Removal

1. Turn the unit OFF and disconnect the negative battery terminal to ensure unit cannot be operated.
2. Unscrew the filter 1 - 2 turns and drain the fuel from the filter head into a suitable container.
3. Remove the filter from the filter head (3). Dispose of fuel and filter according to local regulations.
4. Clean the filter head.

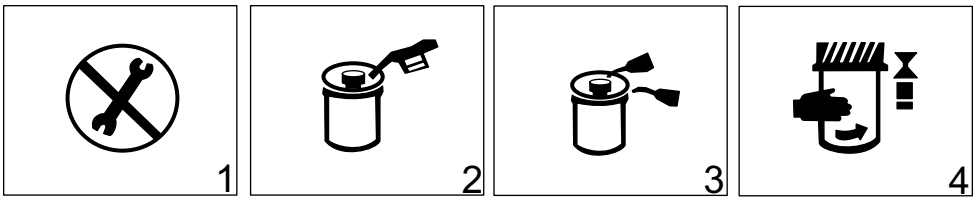
Installation

5. Lubricate the new fuel filter O-ring with clean engine oil.
6. Pre-fill the new fuel filter with fresh diesel fuel.
7. Install the new fuel filter into the filer 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.

1.	Bleed Screw
2.	Filter Head
3.	Fuel Filter Assembly

Secondary Filter Icon Identification (if equipped)

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



RAJ764

Secondary Filter	
1.	Do Not Use Tools for Service
2.	Pre-fill New Filter
3.	Lubricate O-rings and Threads with Fresh Engine Oil
4.	Hand Tighten Filter Until Filter Contacts Filter Head

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.

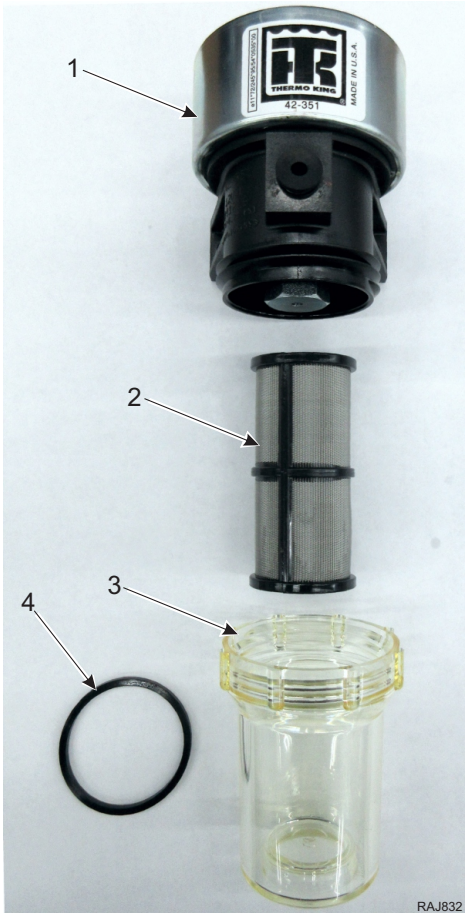
Make sure the GND wire completes a good ground with the battery. Check the voltage at the FP wire in the harness. The pump will not operate at less than 9 Vdc. The pump is self priming.

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 4000 Series with SG+ and One Fuel Filter

If the engine runs out of fuel, repairs are made to the fuel system, or if air gets into the system for any other reason, the 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. Turn the unit on and go to Manual Function Test and select ECU Fuel Relay Test. Run the fuel pump for 1-2 minutes.
5. When the electric fuel pump turns ON, open the bleed screw on the top of the fuel filter head.
6. Air from the fuel system will escape through the open bleed screw. When all the air has escaped, tighen the bleed screw on the filter head.
7. Turn the unit off and clean any spilled fuel. Dispose of fuel and filter according to local regulations.
8. 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.

SG 4000 Series with SG+ and Two Fuel Filters

If the engine runs out of fuel, repairs are made to the fuel system, or if air gets into the system for any other reason, the 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 Manual Function Test and select ECU Fuel Relay Test. Run the fuel pump for 1-2 minutes.
5. When the electric fuel pump turns ON, open the bleed screws on the top of the primary and secondary fuel filter heads.
6. 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:

- Tighten the primary fuel filter bleed screw first.
- Tighten the secondary fuel filter bleed screw second.

7. Turn the unit off and clean any spilled fuel. Dispose of fuel and filter according to local regulations.
8. 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.

SG 4000 Series with SG+ 1.5 and Two Fuel Filters

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:
   - Tighten the primary fuel filter bleed screw first.
   - Tighten the secondary fuel filter bleed screw second.
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. See the maintenance inspection schedule.

The EGR system should be inspected and cleaned (if necessary) every 3,000 hours.

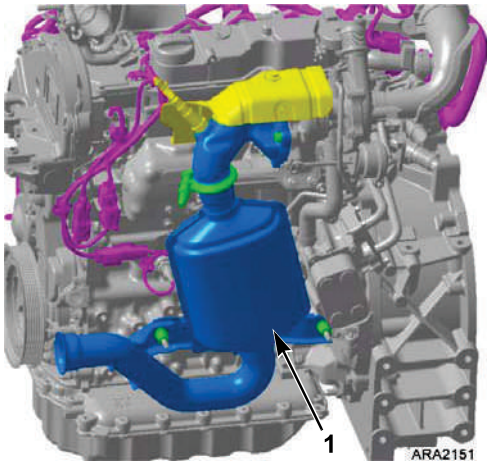
Important: *Always wear appropriate Personal Protective Equipment (PPE) when cleaning the EGR system. This includes safety glasses, rubber gloves, and a respirator.*

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.
4. Remove the EGR tube from between the EGR cooler and the exhaust manifold.
5. Clean the carbon deposits from inside the EGR tube.
6. Reinstall EGR tube and make sure to use a new O-ring and gasket.

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 40. Back View of Engine



1.	DOC

Timing Belt Replacement

The timing belt, water pump, belt tensioner, and idler pulley should be replaced every 6,000 hours. These components are all included in the Timing Belt Kit. The first 6,000 hour timing belt replacement is typically covered under the unit's basic warranty.

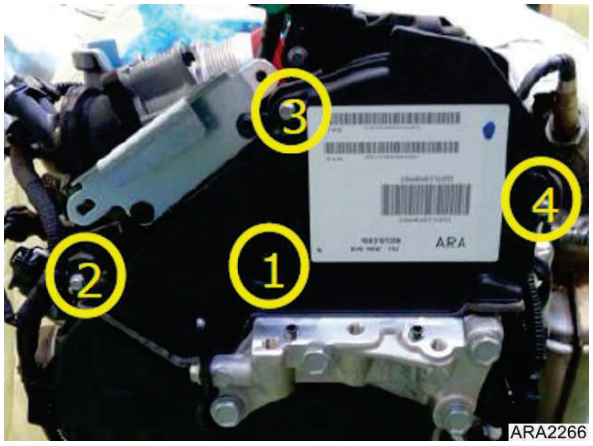
Note: *Replacement is necessary any time oil, fuel, or coolant contaminates the timing belt.*

See the following procedure to replace the timing belt and related components. The procedure requires the use of the following tools:

- Flywheel Locking Tool P/N 204-2971
- Timing Belt Tool Kit P/N 204-2979 (includes the following)
  - Locator Pin 5 mm P/N 204-2977
  - Locator Pin 8 mm P/N 204-2978

1. Disconnect the battery from the unit.
2. Drain the engine cooling system.
3. Remove the generator belt and A-frame mount from the front of engine.
4. Remove the top timing cover (four bolts).

Figure 41. Remove Top Timing Cover



5. Rotate the crankshaft clockwise using an 18 mm socket to align the camshaft pulley to the pegging position. The pegging position is reached when the hole in the camshaft pulley is aligned with the corresponding hole in the cylinder head. This position is located to the upper right of the axis of the pulley.

   Note: *Do not turn the engine counter clockwise. If the position is exceeded, do not turn back, turn two crankshaft revolutions, always clockwise until you reach the correct position.*

Figure 42. Rotate Crankshaft Clockwise

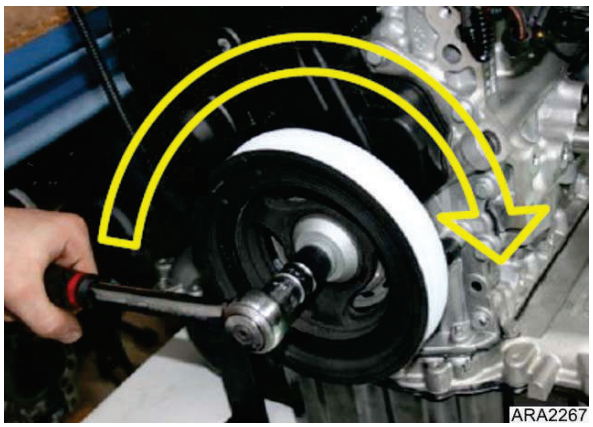
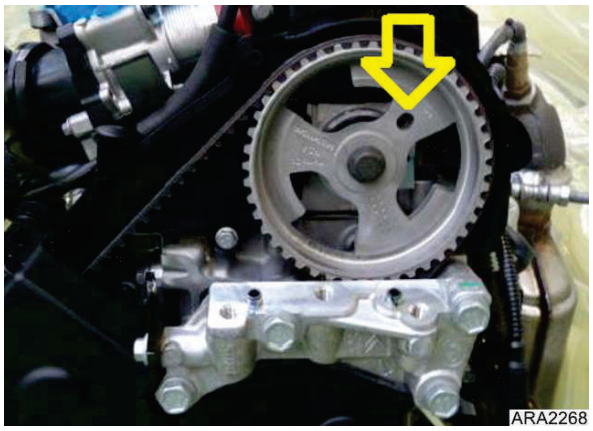
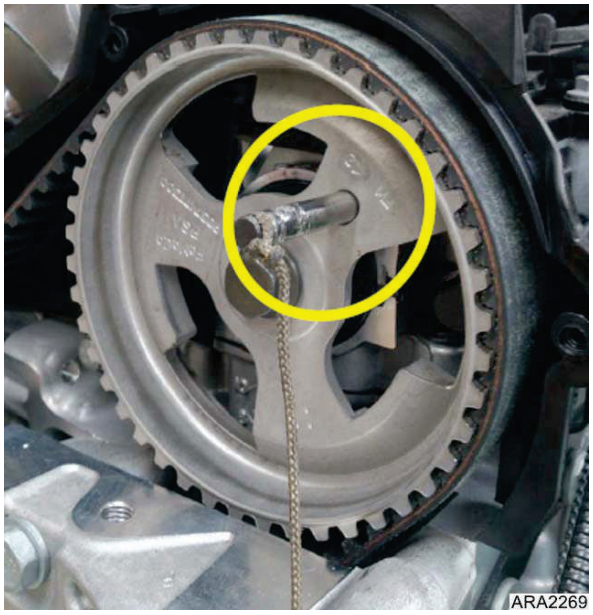


Figure 43. Align Hole in Camshaft Pulley with Corresponding Hole in Cylinder Head



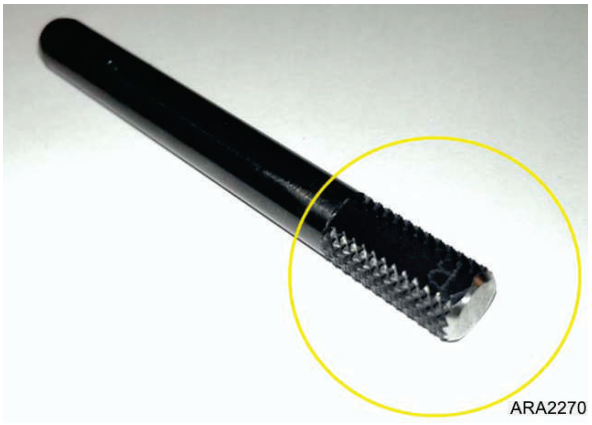
6. Peg the camshaft pulley using tool P/N 204-2978.

Figure 44. Place Peg in Camshaft and Cylinder Head



Note: *Tool P/N 204-2978 may need to be trimmed so it will fit between the unit frame and the engine. See the picture below. If needed, trim the knurled end of peg.*

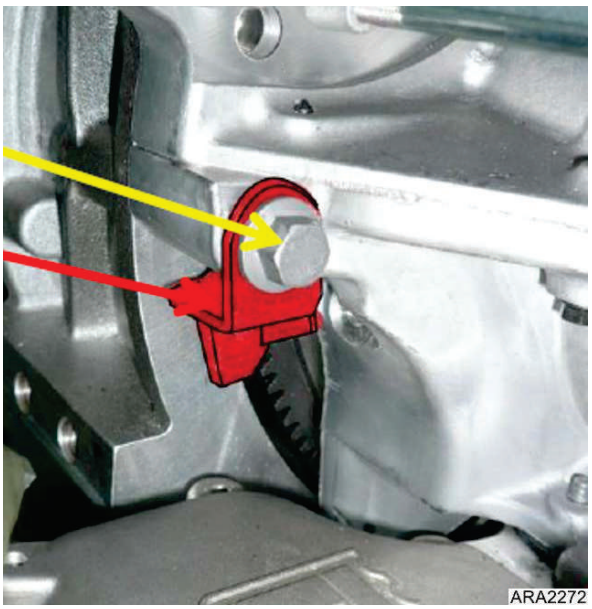
Figure 45. Trim Knurled End if Necessary



7. Remove shield below starter and install a flywheel locking tool P/N 204-2971.

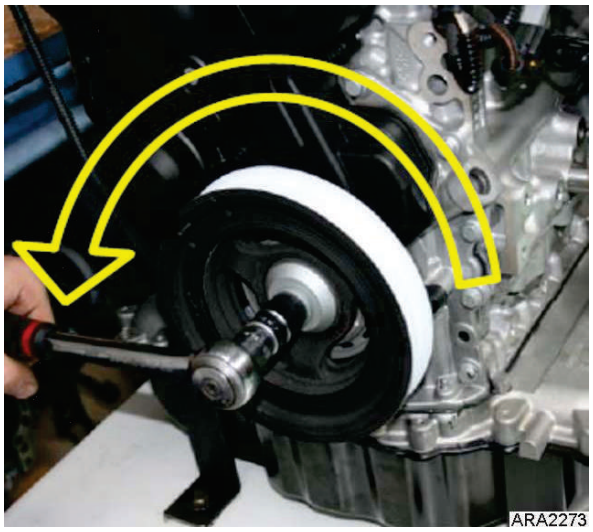
Figure 46. Flywheel Locking Tool

Figure 47. Install Flywheel Locking Tool



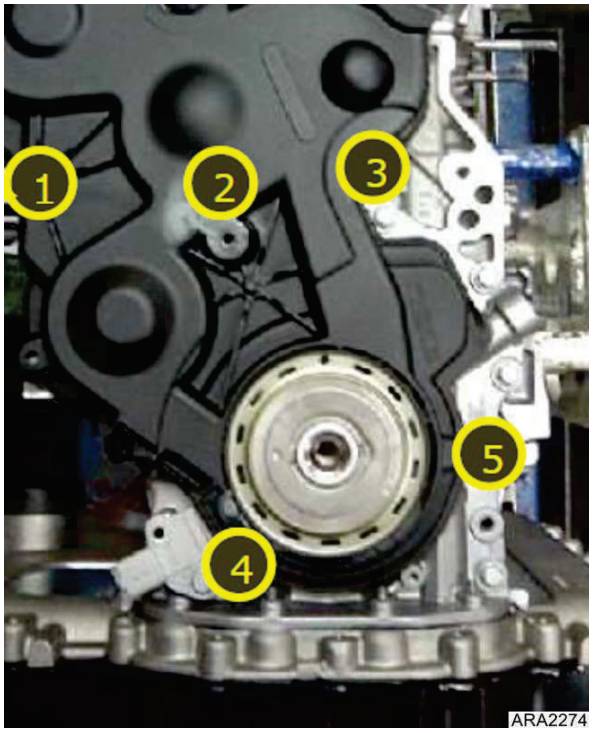
8. Remove the crankshaft bolt and pulley, and set aside.

Figure 48. Remove Crankshaft Bolt



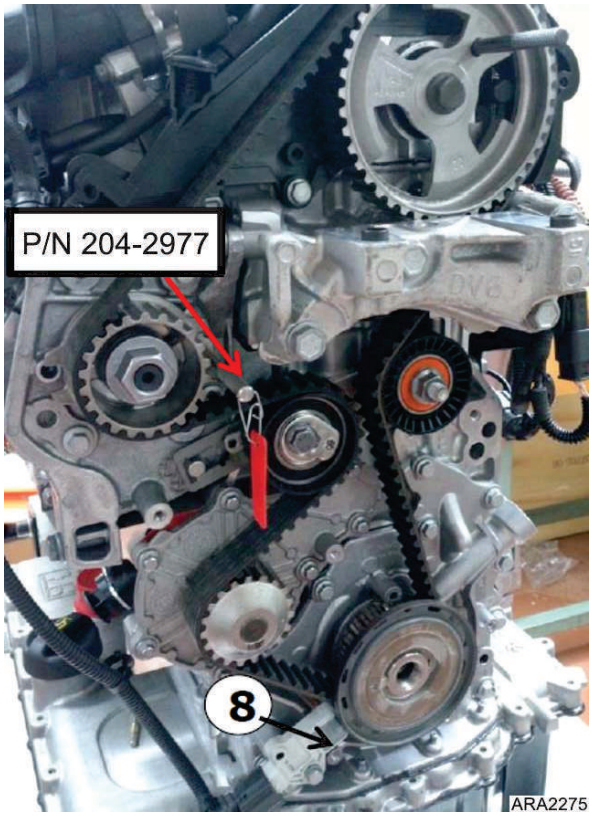
9. Remove the five bolts, disconnect the wiring harness, and remove the lower timing cover.

Figure 49. Remove The Lower Timing Cover



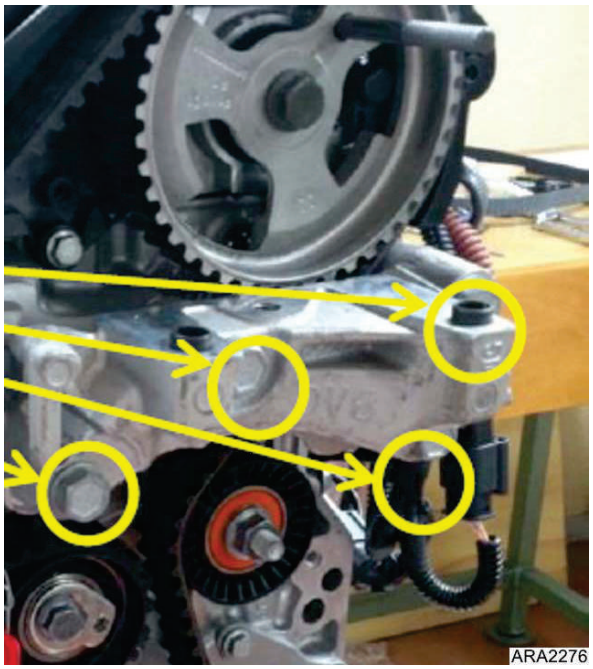
10. Peg the injection pump gear using tool P/N 204-2977.
11. Remove bolt (8) and the engine speed sensor.

Figure 50. Peg Injection Pump Gear and Remove Engine Speed Sensor



12. Remove the top engine bracket.

Figure 51. Remove Top Engine Bracket

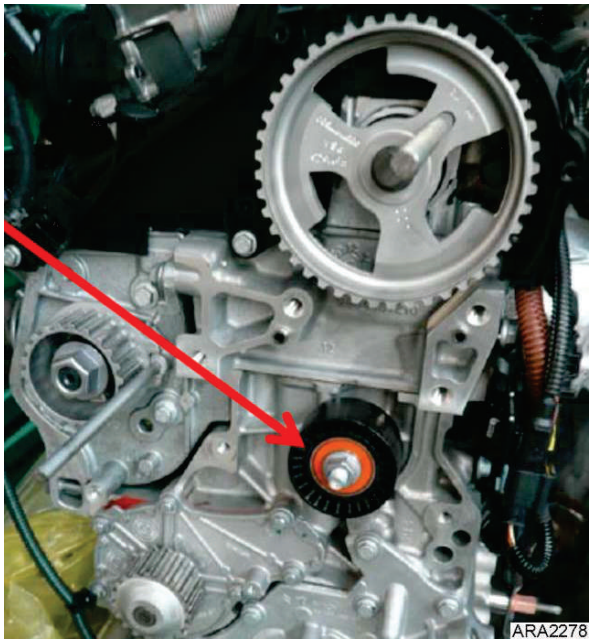


13. Loosen bolt (13) and remove the belt tensioner.

Figure 52. Remove Belt Tensioner

14. Keep the camshaft and injection pump pegs in place and remove the timing belt.
15. Loosen and remove the timing belt guide roller.

Figure 53. Remove Belt Guide Roller

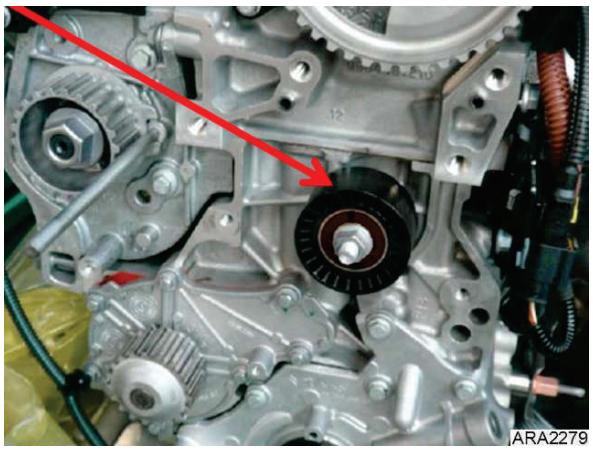


16. Set aside and DO NOT REUSE the following removed parts.
    a. Belt guide roller

b. Tensioner roller
c. Timing belt

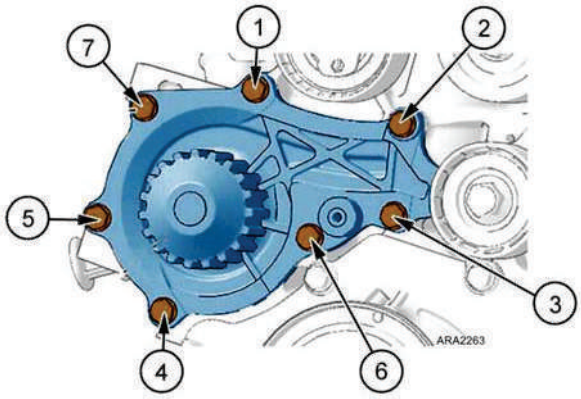
17. Install the new belt guide roller. Torque to 27.3 ft-lb (37 N•m).

Figure 54. Install New Belt Guide Roller



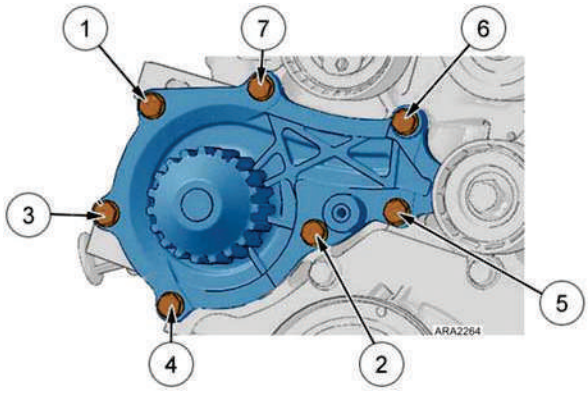
18. Replace the coolant (water) pump.
    a. Remove the seven bolts that fasten the water pump to the engine.

Figure 55. Remove Water Pump Bolts



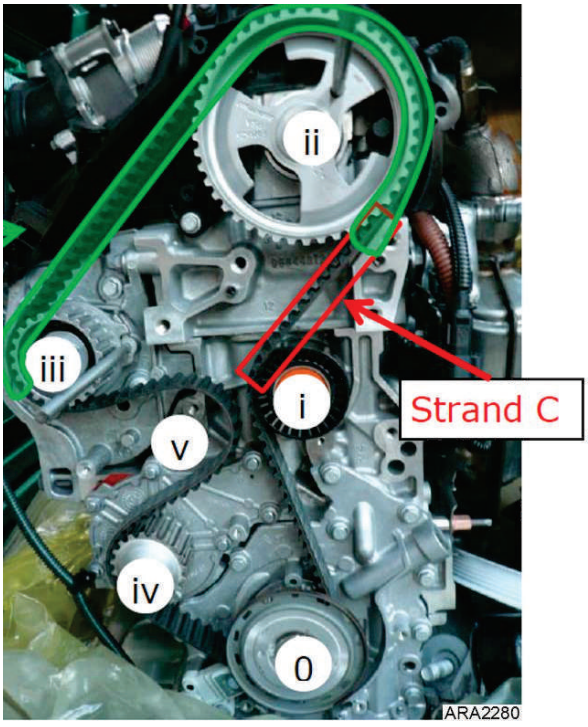
    b. Remove the water pump and gasket.
    c. Install a new gasket and water pump. Torque the bolts in two stages in the order shown below.
       The initial torque should be 3.7 ft-lb (5 N•m).
       The final torque should be 6.6 ft-lb (9 N•m).

Figure 56. Install New Water Pump



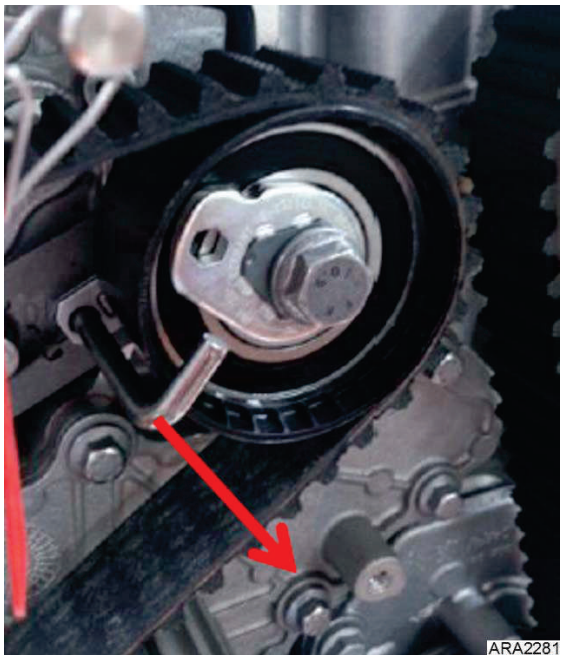
19. Before installing the new timing belt, check for play in the injection pump shaft (high pressure fuel pump). If injection pump shaft has play, replace the injection pump. Refer to the TKDV6 Repair Manual (TK 55810).
20. Install the new timing belt. Position the belt, the reference number on the belt should be between the injection pump pulley (iii) and the camshaft pulley (ii).
    a. Start at the crankshaft pulley (0).
    b. From (0) work the belt up and around pulley (i).
    c. Keep Strand C tight and wrap belt around the camshaft pulley (ii).
    d. Next bring the belt down to the injection pump pulley (iii). Keep all slack in the belt between the injection pump pulley (iii) and the water pump (iv).

Figure 57. Install New Timing Belt



21. Install the new belt tensioner and finger tighten the bolt.
22. Remove the shipping key from the belt tensioner.

Figure 58. Remove Shipping Key from Belt Tensioner

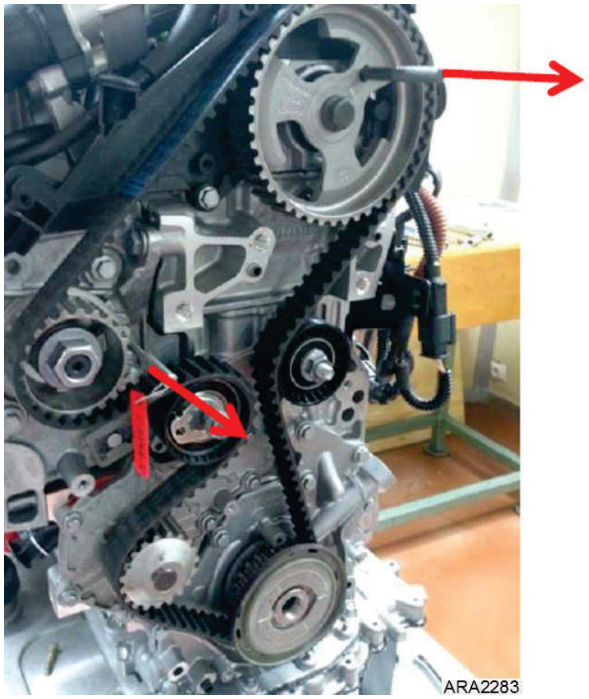


23. Install the engine speed sensor and tighten the bolt to 5.9 ft-lb (8 N•m).

Figure 59. Install Engine Speed Sensor

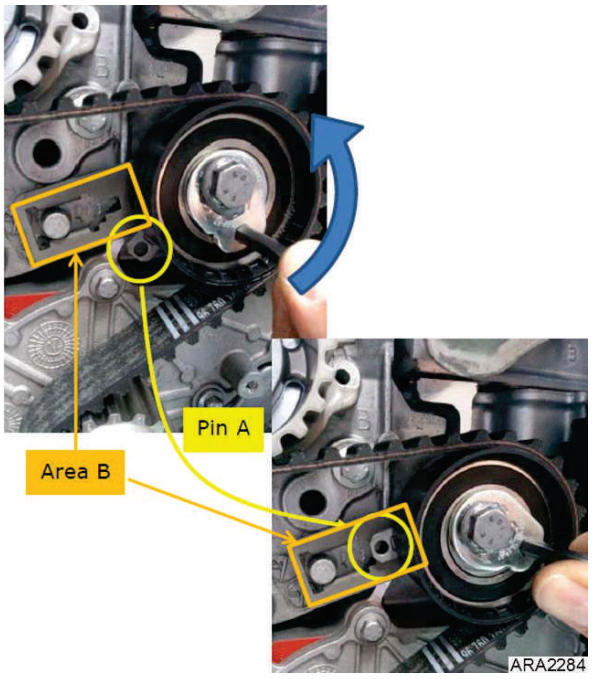
24. Remove the camshaft and injection pump pin tools.

Figure 60. Remove Camshaft and Injection Pump Pin Tools



25. Use an Allen wrench to rotate the tensioner roller counter clockwise until Pin A is centered with Area B.

Figure 61. Rotate Tensioner Roller Counter Clockwise until Pin A Is Centered with Area B



26. While holding Allen wrench with Pin A centered in Area B. Tighten the bolt to secure the tensioner to engine block. Torque the tensioner bolt to 22.1 ft-lb (30 N•m).
27. Place the crankshaft pulley onto the crankshaft.

Note: *Be sure to align the input print on the back of the crankshaft pulley with the key in the crankshaft.*

Figure 62. Input Print on Crankshaft Pulley

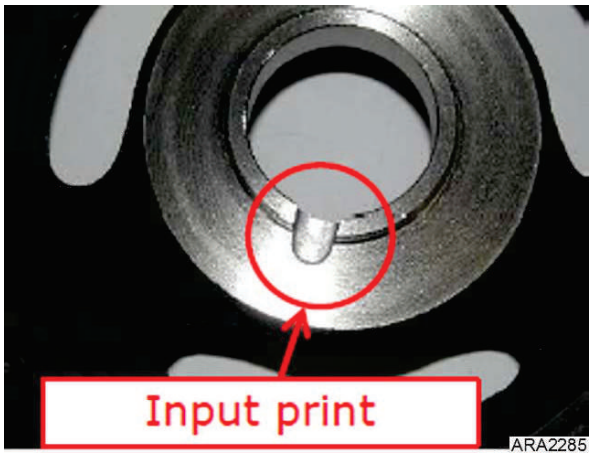
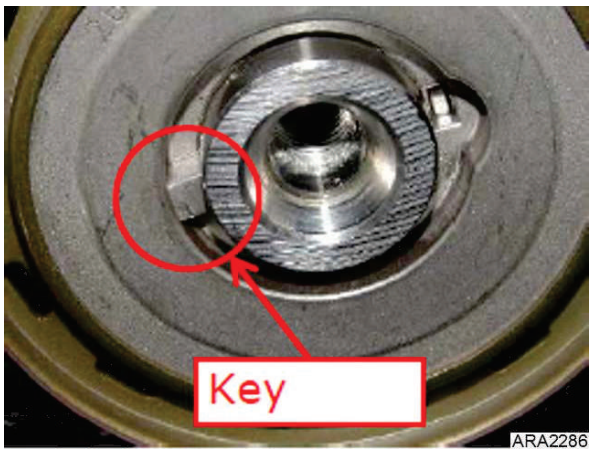
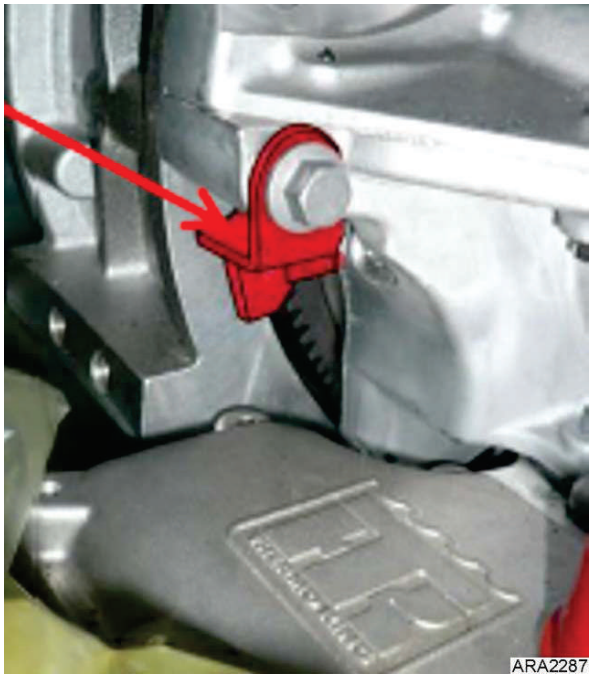


Figure 63. Key in Crankshaft



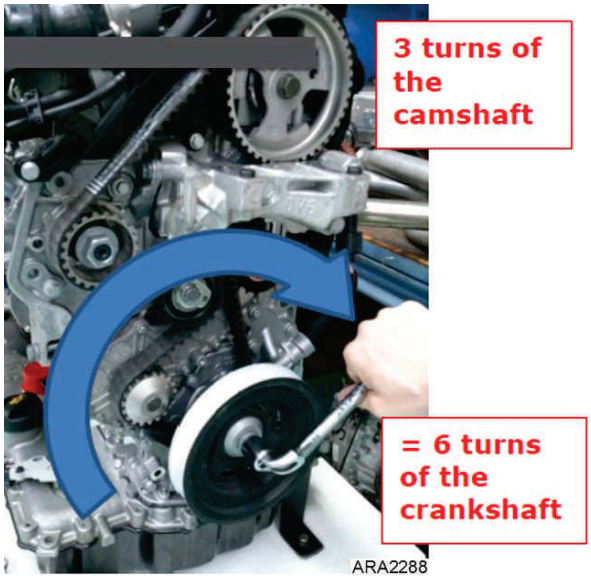
28. Install the old crankshaft bolt. DO NOT tighten at this time.
29. Remove the flywheel locking tool.

Figure 64. Remove Flywheel Locking Tool



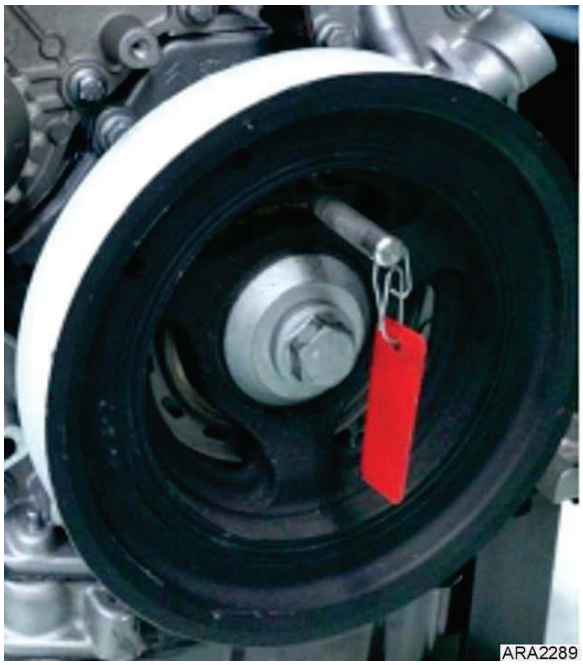
30. Rotate the crankshaft six turns clockwise.

Figure 65. Rotate Crankshaft Six Turns Clockwise



31. Put the engine into the pegging position. Peg the crankshaft with tool P/N 204-2977.

Figure 66. Peg Crankshaft with Tool P/N 204-2977

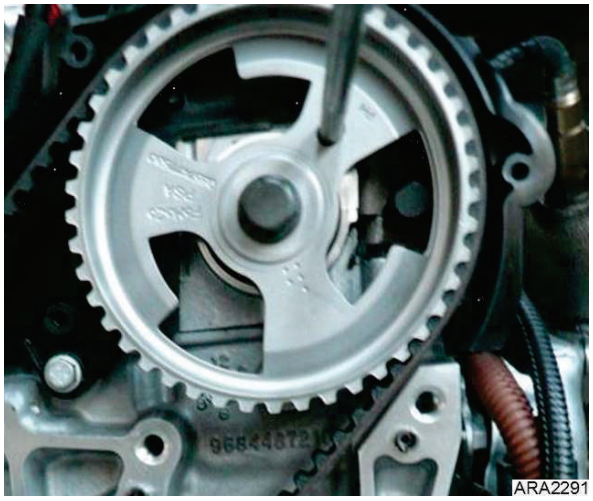


32. Once crankshaft is in pegging position, remove pin P/N 204-2977 and install it at the injection pump pulley. The peg tool should fit into hole in block at the gap in the pulley.

Figure 67. Install Pin P/N 204-2977 at Injection Pump Pulley

33. Use pin tool P/N 204-2978 to check the position of the camshaft pulley.

Figure 68. Use Pin P/N 204-2978 to Check Camshaft Pulley Position

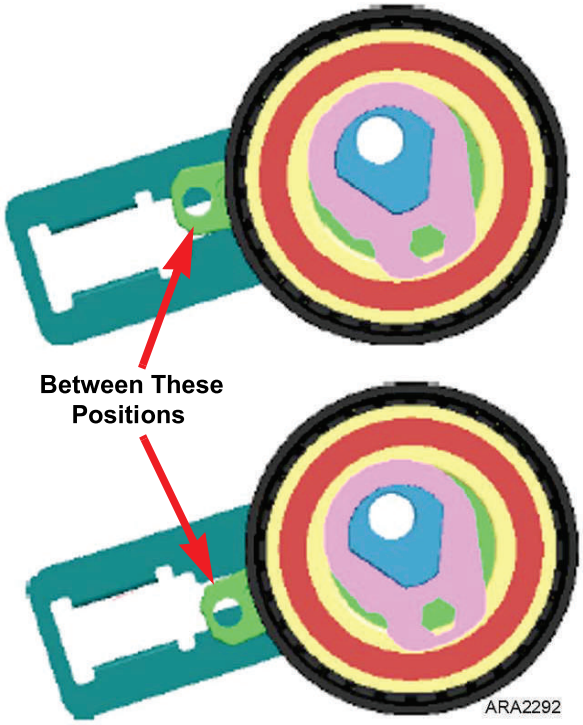


34. If the camshaft peg hole does not line up, check to make sure the pin is not misaligned by more than 0.04 in. (1 mm).

    Note: *If the camshaft or injection pump pins do not fit properly go back to step 6 and repeat timing belt procedure. If the camshaft and injection pump are timed correctly remove all pins and proceed to step 35.*

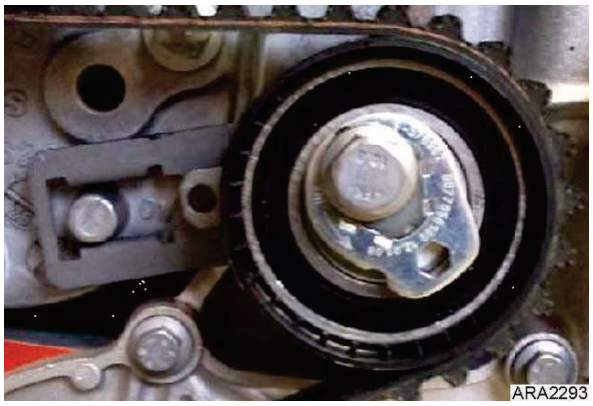
35. Check that the timing belt tension is set correctly. The control pin A must be between these two extreme positions.

Figure 69. Control Pin A Should Be Between These Positions



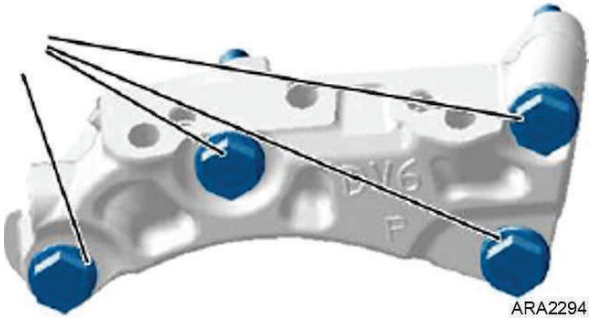
36. If the tensioner needs to be adjusted, place an Allen wrench in the tensioner, loosen the bolt, and adjust it to center control pin A as shown below. Re-torque the tensioner bolt if adjustment was necessary to 22.1 ft-lb (30 N•m).

Figure 70. Control Pin A in Center Position



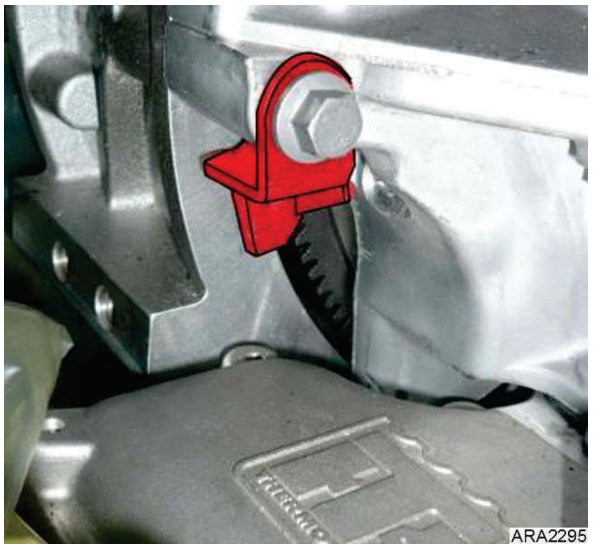
37. Install the engine bracket. Tighten the four bolts to 33.2 ft-lb (45 N•m).

Figure 71. Install Engine Bracket



38. Reinstall the flywheel locking tool.

Figure 72. Reinstall Flywheel Locking Tool

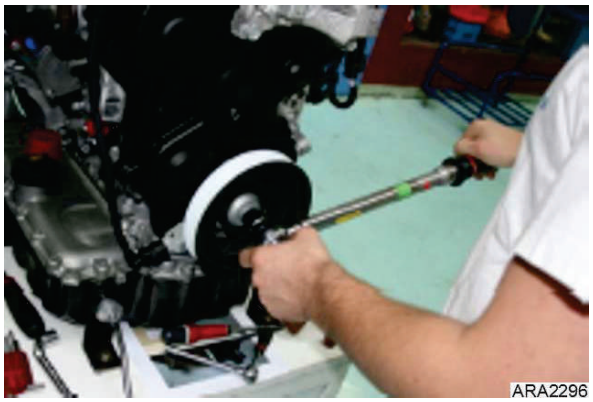


39. Remove the crankshaft bolt and pulley.
40. Install the lower timing cover Torque the bolts to 3 ft-lb (4 N•m).
41. Install the upper timing cover. Torque the bolts to 3 ft-lb (4 N•m).
42. Install the crankshaft pulley. Make sure to align the input print on the back of the crankshaft pulley with the key in

the crankshaft when installing the pulley onto the crankshaft.

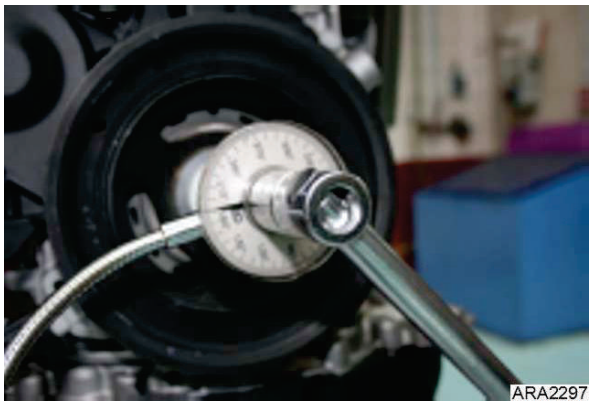
43. Install a NEW crankshaft bolt.
    a. Torque the bolt to 25.8 ft-lb (35 N•m).

Figure 73. Torque to 25.8 ft-lb (35 N•m)



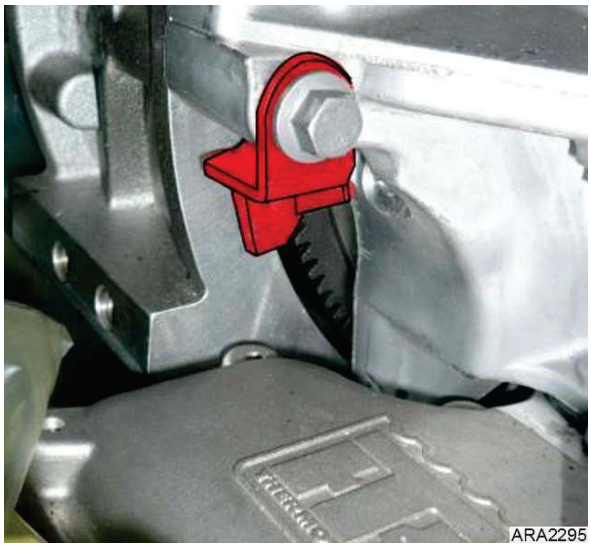
    b. Tighten the bolt an additional 190 degrees.

Figure 74. Tighten Bolt 190 Degrees



44. Remove the flywheel locking tool and reinstall the bolt.

Figure 75. Remove Flywheel Locking Tool



a. Torque the bolt to 40.6 ft-lb (55 N•m).

Figure 76. Torque to 40.6 ft-lb (55 N•m)

45. Plug the harness into the crankshaft position sensor and clip the harness onto the lower timing cover.

Figure 77. Install Crankshaft Position Sensor Harness

46. Reinstall the generator belt and A-frame
47. Refill the engine cooling system.
48. Connect the battery and verify proper unit operation.

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 78. EMI 3000 Air Cleaner Assembly

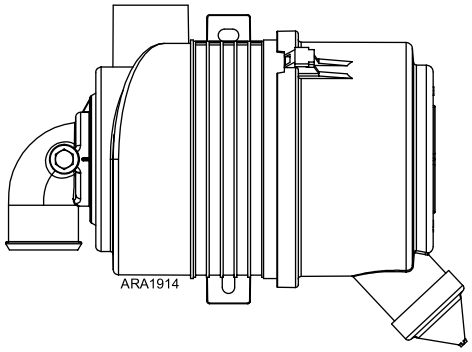
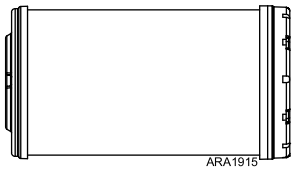


Figure 79. EMI 3000 Air Filter Element



Peugeot EXXODiag Diagnostic Engine Service

The EXXODiag Diagnostic Tool is used to connect the PC Computer USB Port to the ECU. An EXXODiag Diagnostic Tool connector is located in the unit Control Box. Peugeot EXXODiag Diagnostic Software installed on the PC Computer is used to communicate with the ECU. This allows ECU information to be retrieved, DTCs to be read, operational data to be examined and updated, and other diagnostic functions to be performed. The EXXODiag Diagnostic Tool (P/N 2041993 or P/N 2041996) consists of the EXXODiag Interface Module, a standard Micro USB to USB cable, a storage box and instructions.

Refer to the TKDV6 Repair Manual TK 55810 for engine service information not included in this manual. Use the following procedure to connect a PC with the Peugeot EXXODiag Diagnostic Software to the ECU to view the DV6NR engine DTCs (Diagnostic Trouble Codes) and troubleshoot engine problems. Thermo King alarm codes A118 or A121 indicate DTCs are recorded in the ECU.

Connecting and Using the Peugeot EXXODiag Diagnostic Tool

Materials Required:

- EXXODiag Diagnostic Tool
- Peugeot EXXODiag Diagnostic Software installed on a PC

Availability:

The Peugeot EXXODiag Diagnostic Tool is available from Service Parts. Each kit will have a card containing information to obtain and register the EXXODiag Software.

Figure 80. EXXODiag Engine Diagnostic Tool Kit

SAP162

To download the software and activate the tool, send an email to TKServiceTools@irco.com. Use the subject line: Activate PCM Diagnostic Tool, and include the Interface Box Serial Number, Dealership Code, and contact information in the body of the email.

Table 1. Procedure

Step	Action	Result	Comments
1	The unit battery must be connected and the Microprocessor Power Switch 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)

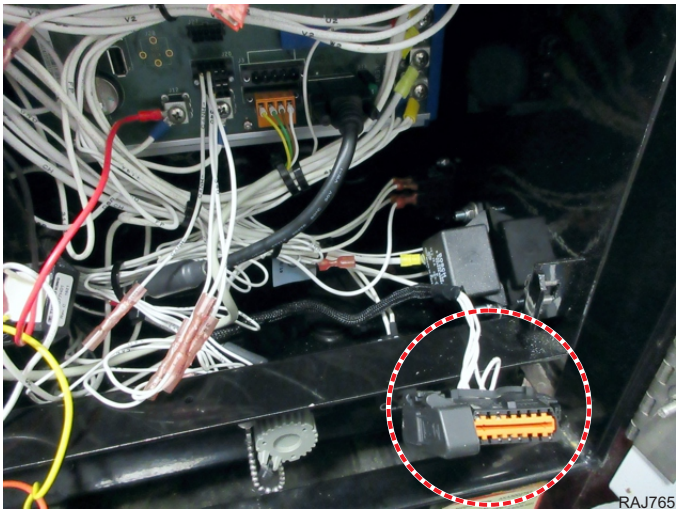
Step	Action	Result	Comments
4	Open the Control Box and locate the Engine Diagnostic Connector.	 RAJ765	
5	Connect the EXXODiag Diagnostic Tool to the Engine Diagnostic Connector in the unit Control Box using the supplied cable.	 SAP163	
6	Connect the EXXODiag Diagnostic Tool to the PC using the supplied cable.		This cable is a standard USB cable. Excessive cable length of the USB cable may affect operation.
7	To start the EXXODiag software, click on the EXXODiag TK icon on the PC desktop.	The Main Menu will appear.  SAP166	
8	To begin, select Diagnostics and follow the prompts. Fill out the required fields.		All fields must be completed.

Table 1. Procedure (continued)

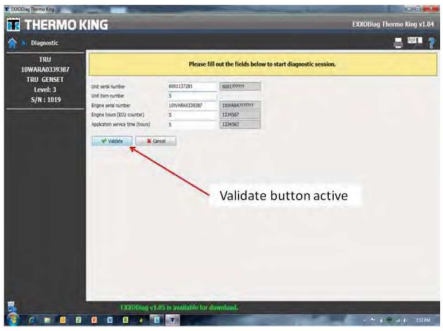
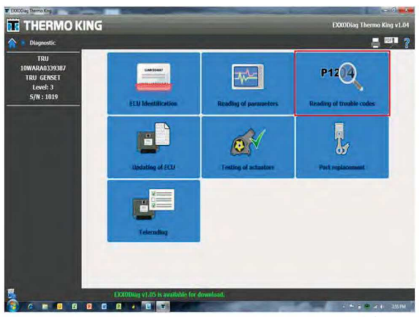
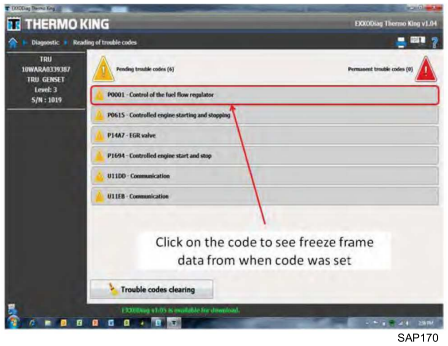
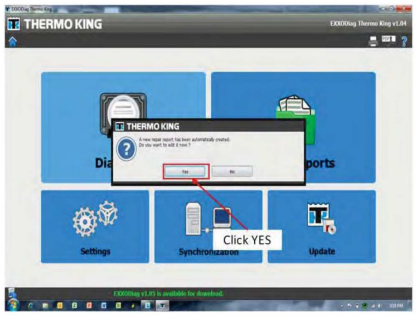
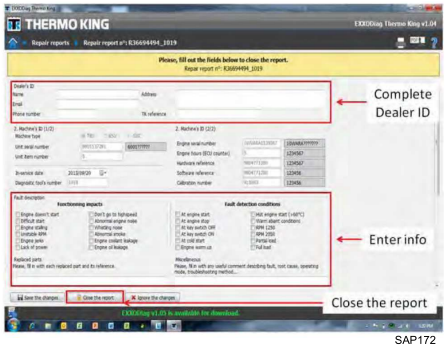
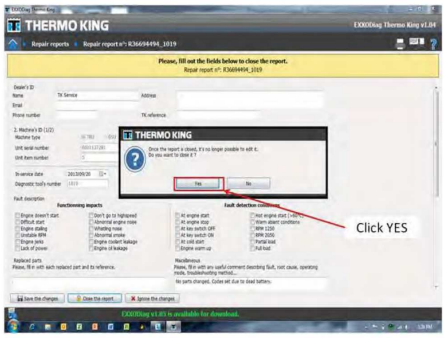
Step	Action	Result	Comments
		 SAP167	
9	When all fields are complete, press "Validate".	 SAP168	
10	In the example shown, Reading of Trouble Codes has been selected. Click the code to see freeze frame data when the code was set. Proceed as required to complete the diagnosis and repair.	 SAP169  SAP170	
11	Complete a Repair Report after parts are replaced.	The report will update the Peugeot database with the new parts installed on the engine.	The Repair Report is created automatically.

Table 1. Procedure (continued)

Step	Action	Result	Comments
		 SAP171  SAP172	
12	Verify the report is complete before closing and sending it. Click Yes to close the report.	 SAP173	Once the report is closed it can no longer be edited.

Alternator Operation and Diagnosis

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.

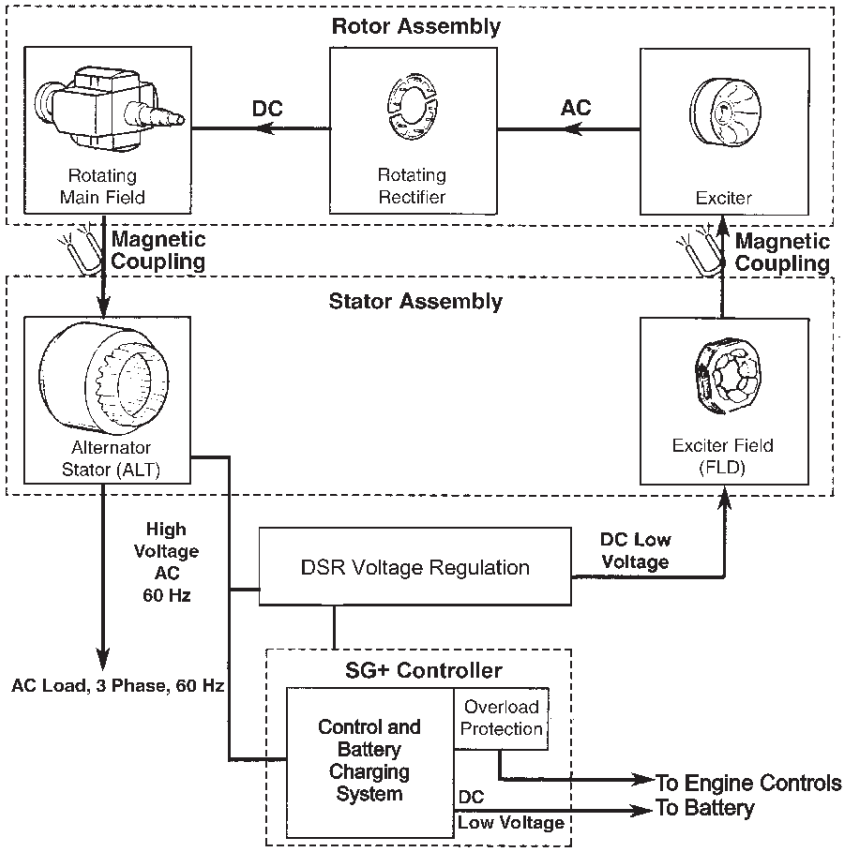
The main alternator may be subdivided into the 4-pole rotating main field and the alternator stator (ALT). The rotating main field, the rotating rectifier and the exciter armature are all mounted on a common shaft. Output of the exciter is rectified by the shaft mounted rotating bridge rectifier to provide 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 81. 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 (± 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

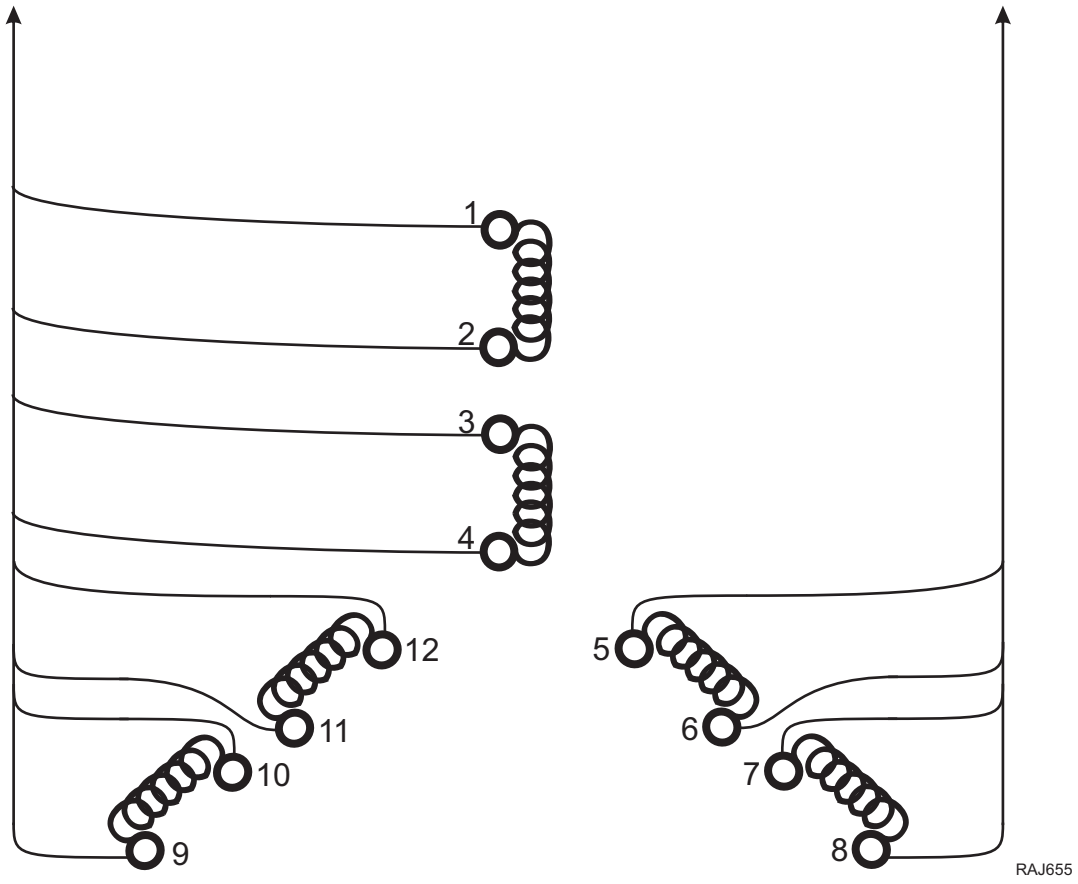
1. Disconnect the Blue and Yellow wires from pin 1 and 2 on the DSR field wire. Measure the resistance of the field circuit (Blue to Yellow). The standard value is 9.7 (±10%) ohms at 77 F (25C). If field is open or resistance value is low replace exciter field.
2. Measure Blue or yellow wires to GND 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 (±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 82. Alternator Stator



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%.**

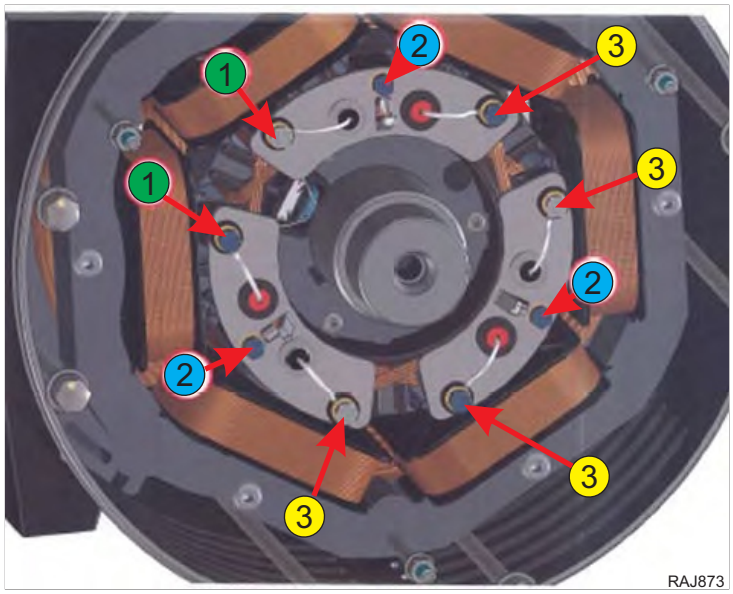
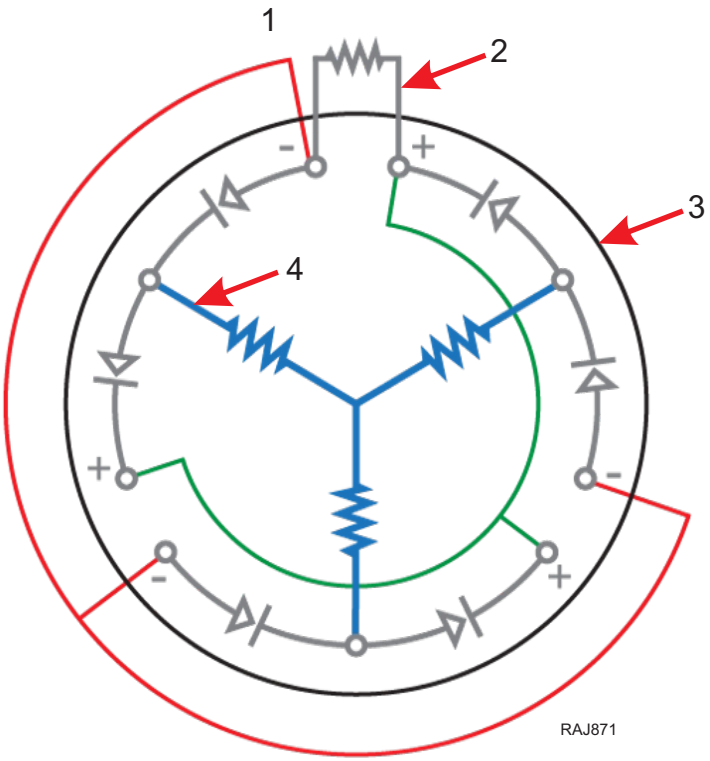
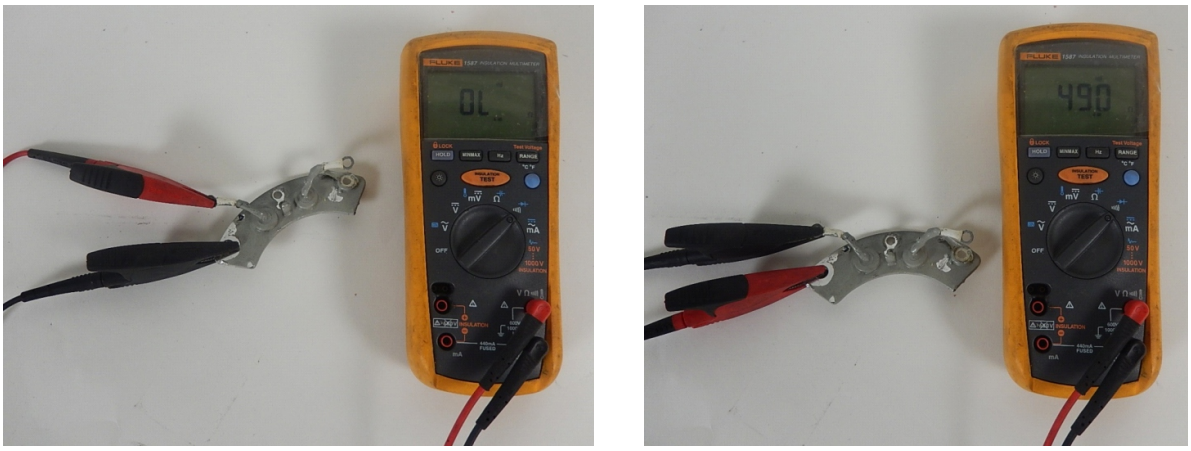


Figure 83. Exciter Rotor Components



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. Check for continuity between the armature leads. The resistance between the leads should be 1.33 (±10%) ohms at 25 C (77 F).
    a. Using a megger meter, check for insulation break down between leads to the rotor shaft. @ 500 Volts must be more than 1 M ohm.
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

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.

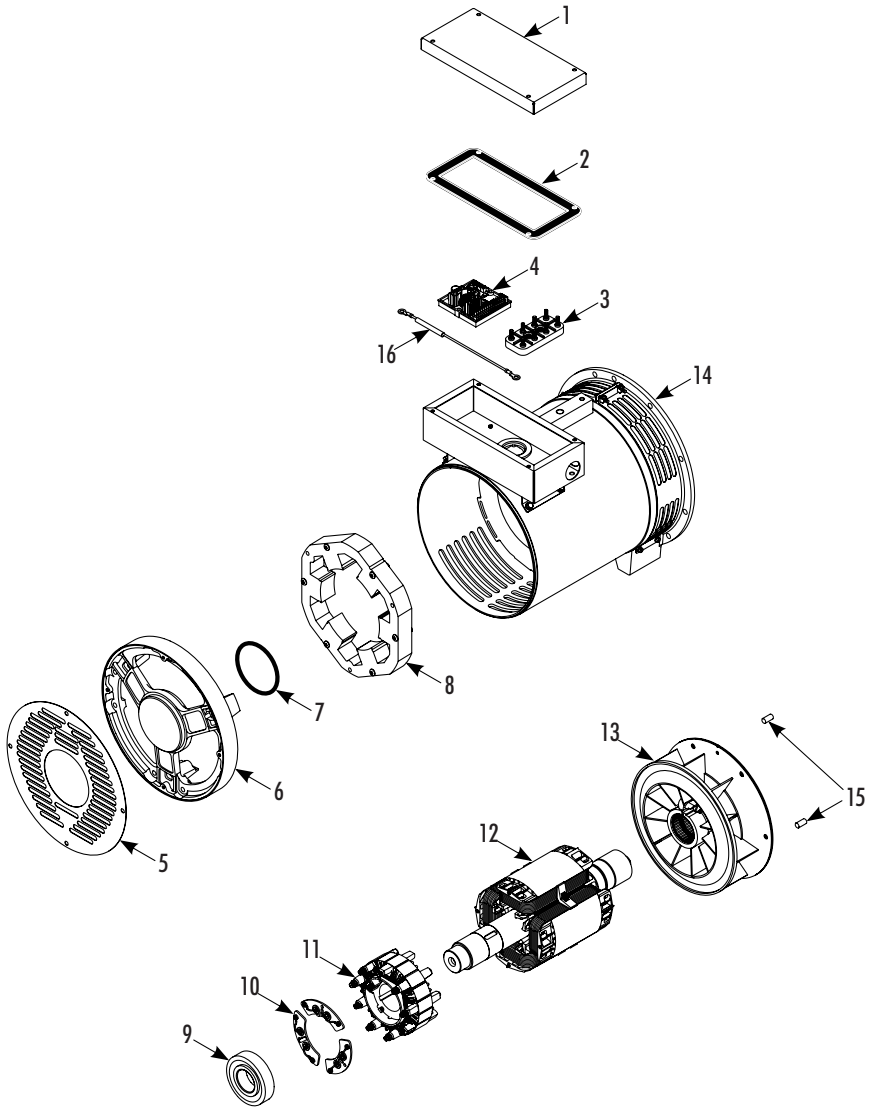
Impeller Fan

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 84. Alternator Assembly



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		

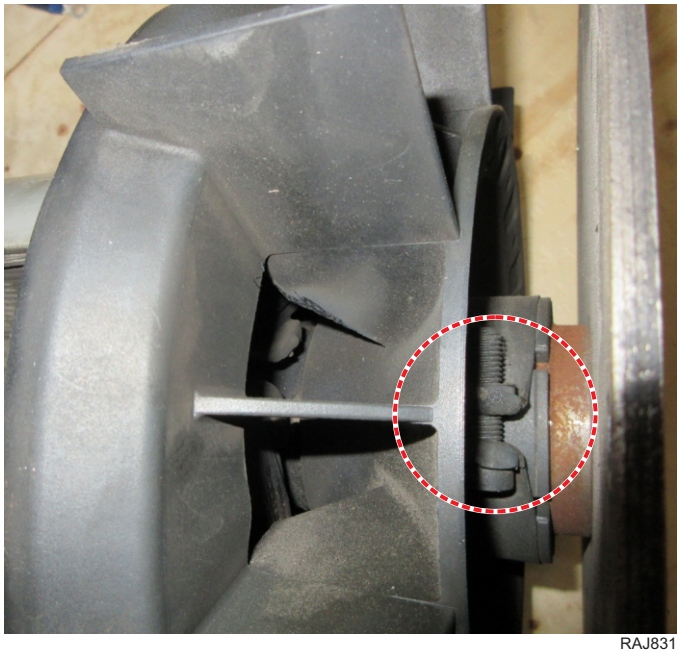
Alternator Replacement

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 85. Fan Clamp



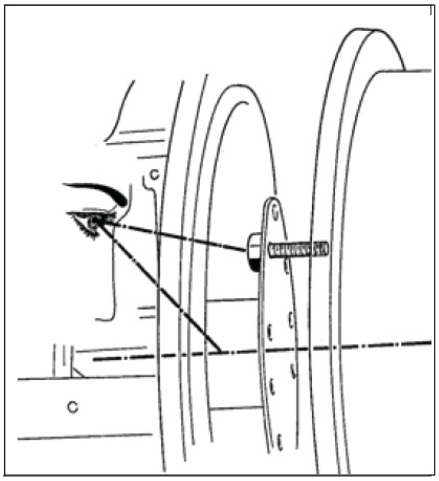
RAJ831

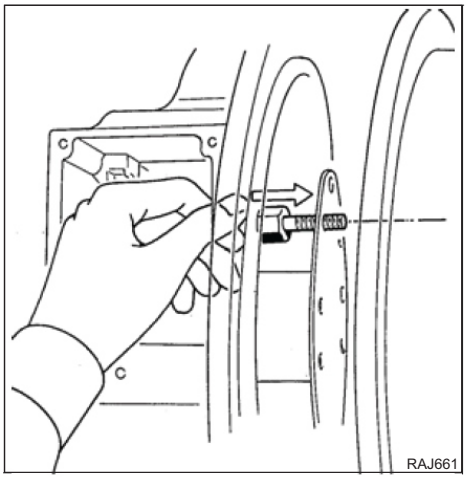
3. Once all flex plate bolts are removed, be sure to support engine and alternator, remove the last bolt holding the alternator to flywheel housing and remove alternator from engine.

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.*

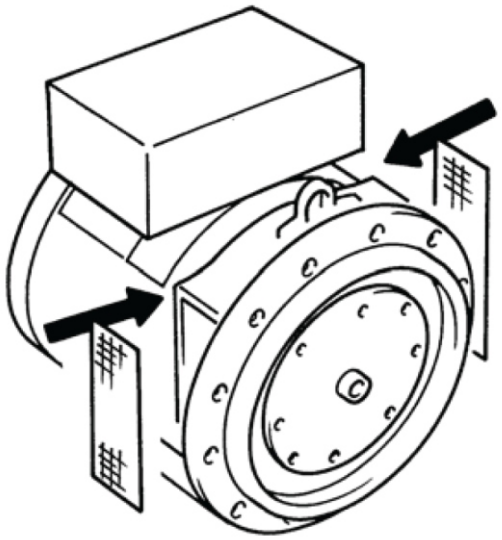
1. Position the alternator assembly up to the flywheel housing. Align the 2 dowel pins in the flywheel to the holes in the flex plate. Start to install the bolt through the alternator outer ring to the flywheel housing. Install bolts at the 10 and 4 o'clock position.





RAJ661

2. 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.
3. Install the alternator to flywheel housing bolt and toque to 45 Nm (33 ft-lbs).
4. 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**
SGSM Units	
Tubular Mounting Arm to Unit Frame	203 Nm (150 ft-lbs)
I-Beal Clamp Screw	203 Nm (150 ft-lbs)
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	203 Nm (150 ft-lbs)
Exciter Control Box	20 to 27 Nm (15–20 ft-lbs)

SGSM Typical Unit Installation

1. Attach the mounting arm assemblies on each end of the unit. Two sets of mounting bolt holes are provided on the mounting arms.

   Note: *The clear insulator pad should be located between the steel mounting arms and the inside of the unit frame members. The stainless steel plate should be placed on the outside of the unit frame members.*

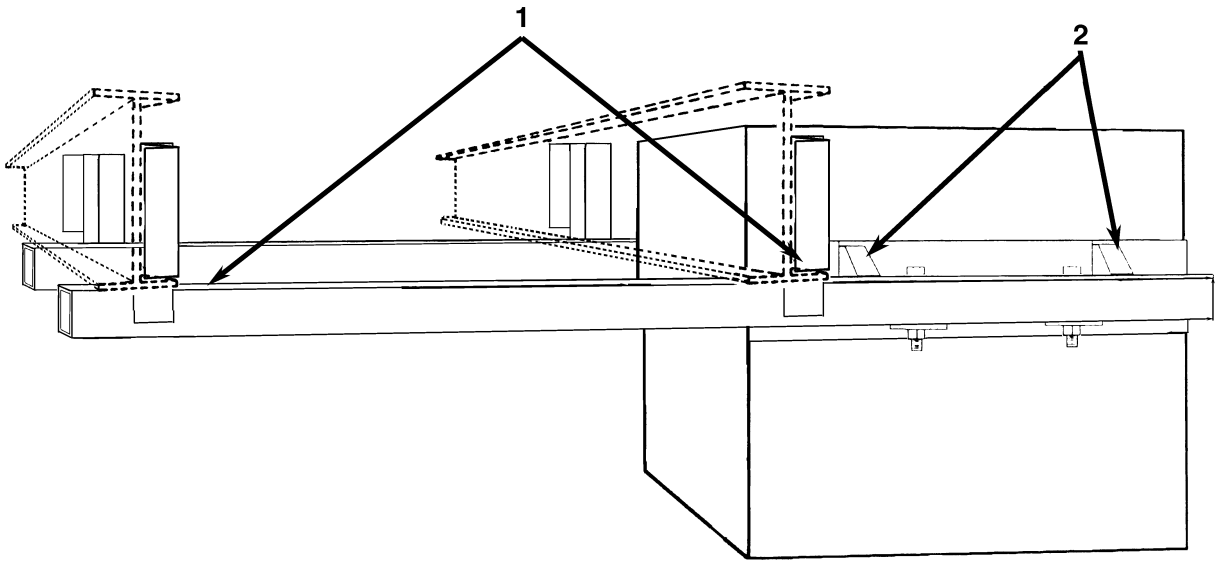
2. Move the unit under container or trailer chassis. Place each mounting channel on top of a chassis frame member. Locate each channel as close to the vertical web of the chassis member as possible.

⚠ Caution

Service Procedures!

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

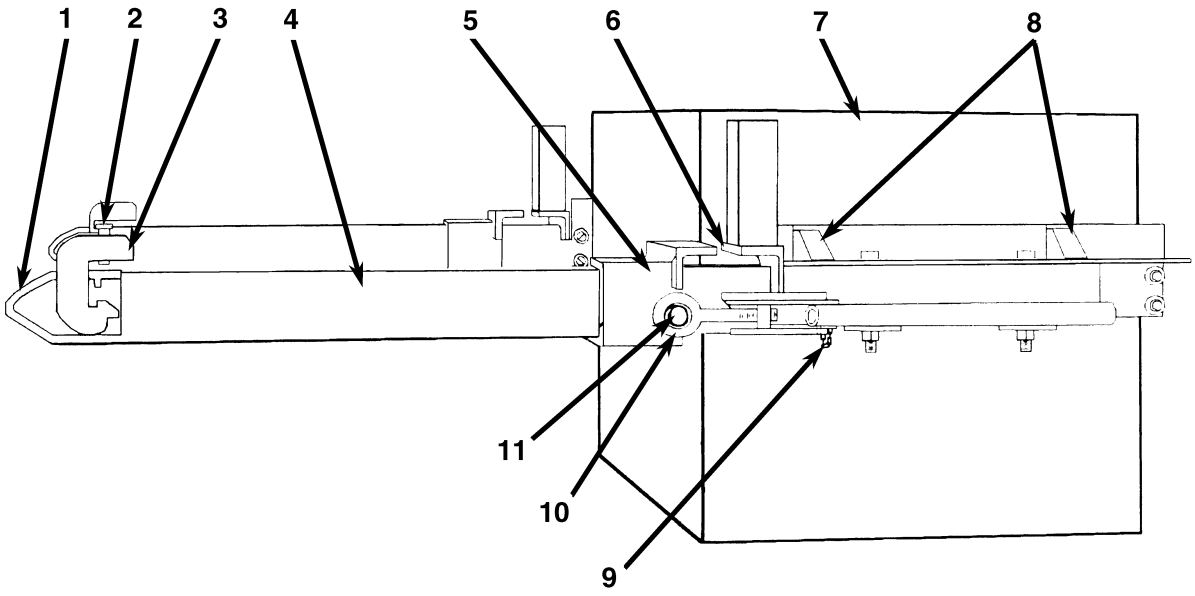
3. Torque the mounting bolts:
   - Mounting Arm to Unit Frame: 203 Nm (150 ft-lb)



1.	Mounting Arm Tube and Channel Assembly
2.	Unit Mounting Bracket Assembly

SGSM Keener Arm Unit Installation

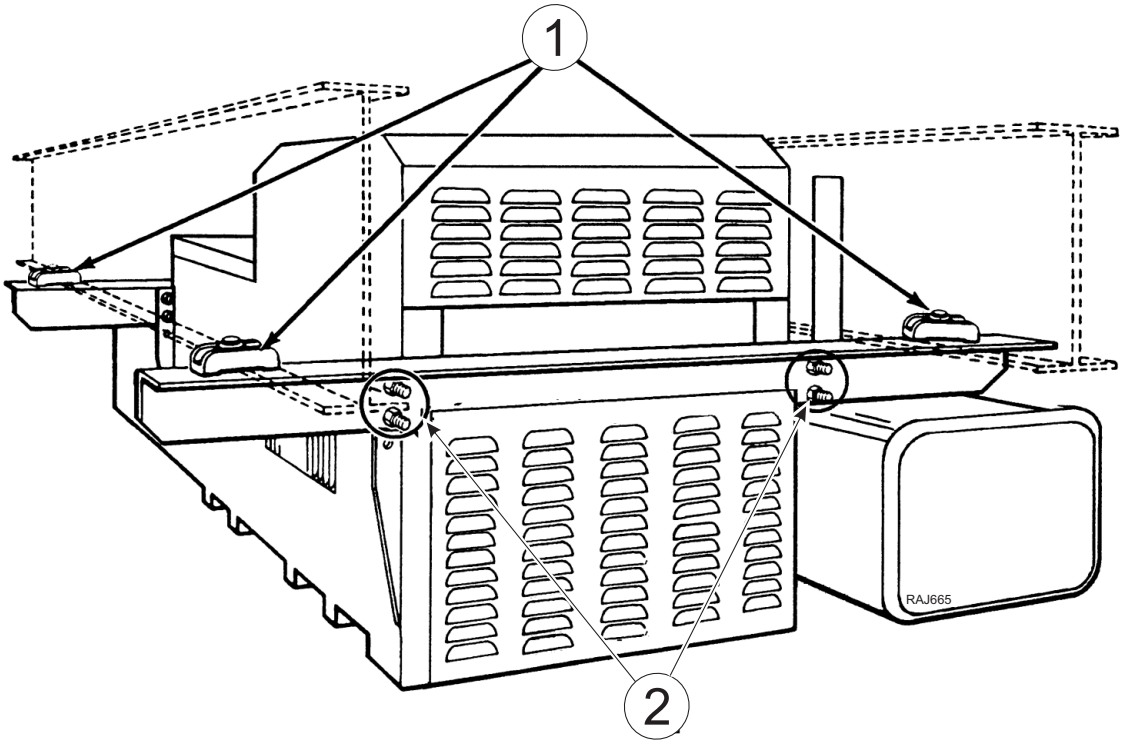
1. Attach mounting arm assemblies to unit with clamp screw end of the channel facing the rear side of the unit. Torque mounting bolts that fasten mounting arms to the unit to 203 Nm (150 ft-lb).
2. Place mounting arm clamp screw assemblies in open (down) position.
3. Open each slider channel at least 200 mm (8 in.).
4. Move the unit under container or trailer chassis. Place fixed gripper channels on unit over edge of chassis I-beam.
5. Seat the chassis I-beam against the back of both fixed gripper channels. Move each slider channel forward over the back edge of the chassis I-beam.
6. Place the eye bolts over the slider pins by adjusting the bolt length as necessary.
7. Insert quick release pins in eye bolt handles to lock the eye bolts in the closed (lock) position.
8. Place the clamp screw assemblies on the rear edge of the second chassis I-beam.
9. Seat each clamp firmly against the edge of the I-beam and tighten clamp screw. Torque each clamp screw to 203 Nm (150 ft-lb).



1.	Clamp Channel	7.	Unit
2.	Clamp Screw	8.	Unit Mounting Bracket Assembly
3.	Mounting Arm Clamp	9.	Chain and Quick Release Pin
4.	Mounting Arm Tube	10.	Eye Bolt
5.	Slider Channel	11	Slider Pin
6.	Fixed Gripper Channel		

SGCM Unit Installation

1. Attach the mounting arm assemblies on each end of the unit.



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. Place 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:
   - Mounting Arm to Unit Frame: 88 to 115 Nm (65 to 85 ft-lb)
   - Chassis Clip Bolt: 162 to 176 Nm (120 to 130 ft-lb)

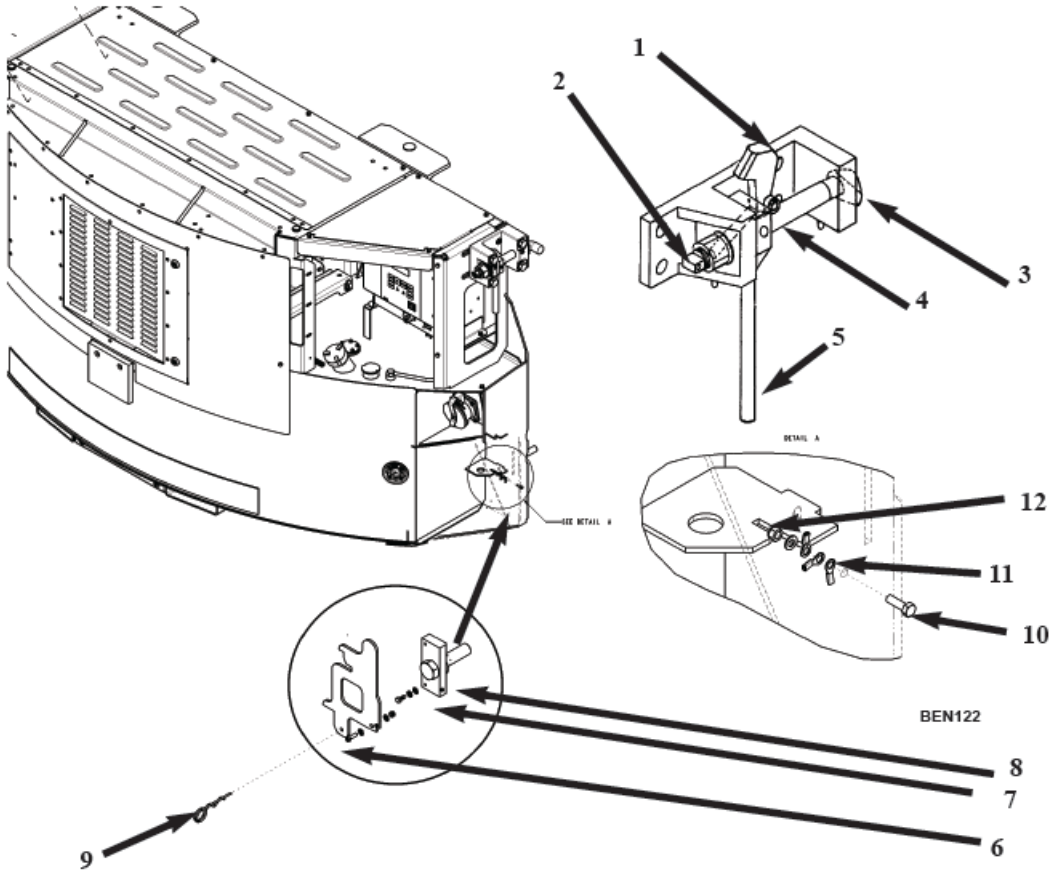
SGCO Clip-on Corner Clamp Unit Installation

1. Pull the lock pawl handle forward. Lift the clamp handle to rotate the clamp shaft 90 Degrees.
2. Lift the unit into mounting position on front wall of the container. The foot of generator set mounting clamp should fit into mounting hole on each side of the container.

⚠ Caution

Risk of Injury!

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



1.	Lock Pawl	7.	Washer Assembly
2.	Mounting Clamp Flat	8.	Lower Mounting Bolt Assembly
3.	Handle	9.	Cotter Hair Spring
4.	Shoulder Screw	10.	Screw
5.	Mounting Clamp Foot	11.	Lanyard (other end mounted onto #9)
6.	Stopper Plate	12.	Nut hexstop

3. Insert the foot of the mounting clamp fully into the container mounting hole. Pull lock pawl handle forward. Pull the clamp handle down to rotate the clamp shaft bolt 90° and clamp generator set to container.

⚠ Caution

Service Procedure!

Watch the clamp flat on threaded end of the mounting shaft when rotating the handle. The clamp flat should turn as the clamp handle rotates. With the mounting clamp in the locked position (handle down), the clamp flat must be horizontal. If the flat is not horizontal, check the clamp handle for a broken shoulder screw.

4. Release the lock pawl to hold the clamp handle in the locked (down) position.

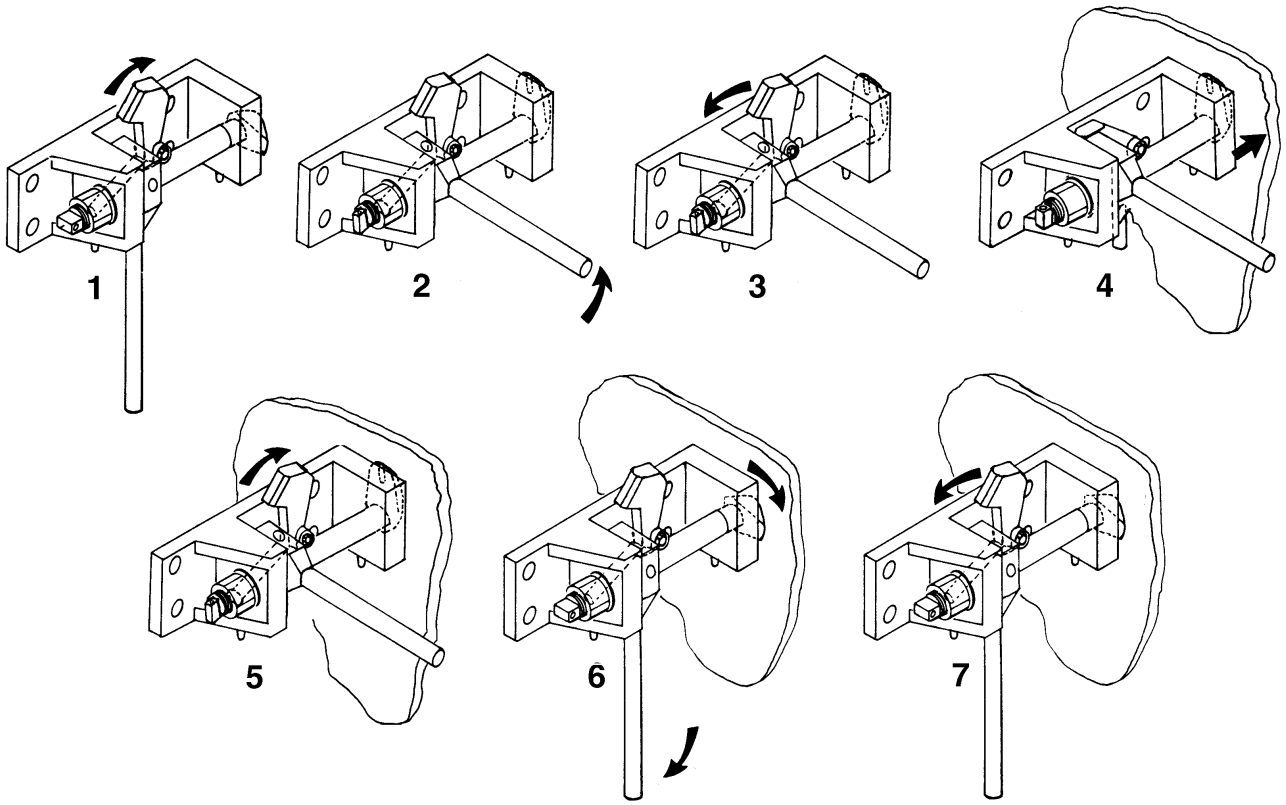
⚠ Caution

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.

5. Check to be sure the generator set frame fits tightly against the container. Turning the mounting clamp handle should pull the generator set frame tight against the container front wall. If necessary, tighten the mounting clamp. The mounting clamp can be tightened or loosened by turning the nut on the head of the clamp shaft.

Figure 86. SGCO 4000 Clip-on Corner Clamp Installation Procedure



1.	Lift (Unlock) Lock Pawl	5.	Lift (Unlock) Lock Pawl
2.	Rotate Clamp Handle Up 90 degrees	6.	Rotate Clamp Handle Down 90 degrees
3.	Release (Lower) Lock Pawl	7.	Release (Lower) Lock Pawl
4.	Insert Mounting Clamp Foot in Container Mounting Hole		

6. Install the lower mounting bolts:
   a. Remove the retaining pin from the lower mounting bracket.

b. Remove the mounting bolt and backup plate from the keeper nut. Put the mounting bolt through the backup plate and install the bolt in the mounting hole.
c. Tighten the lower mounting bolts to 300 to 380 Nm (220 to 280 ft-lb).
d. Install the retaining pin and hair pin key to prevent accidental loss of the mounting bolt and backup plate during unit operation.

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.

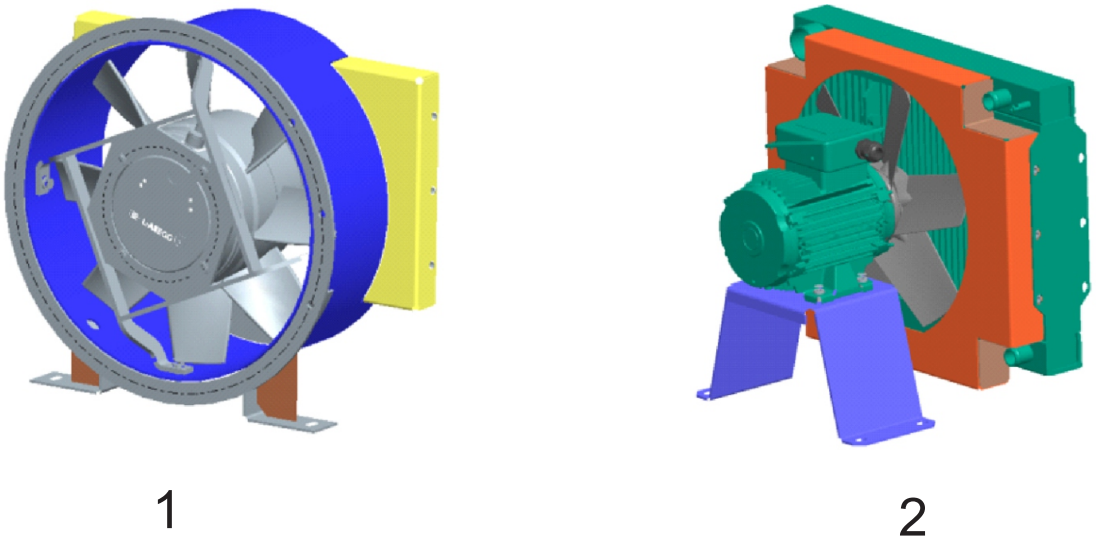
Notice

Equipment Damage!

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

Radiator Fan Motor

Starting in June of 2015 the radiator fan motor changed from a one piece fan and motor to a separate fan and fan motor.

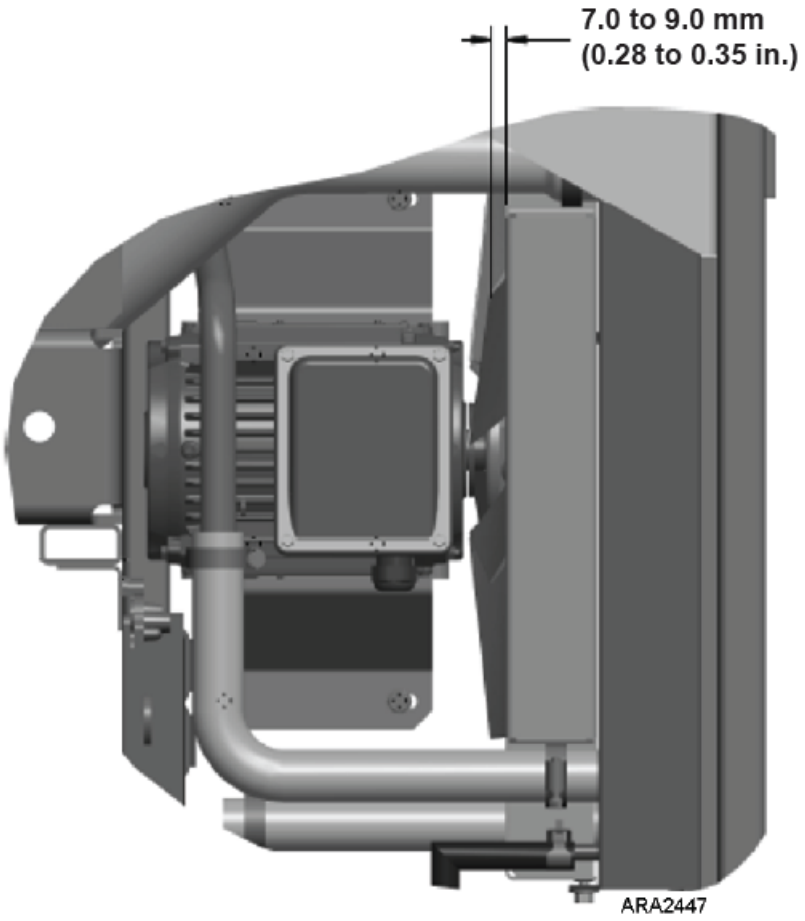


1.	One Piece Fan Motor
2.	Separate Fan and Fan Motor

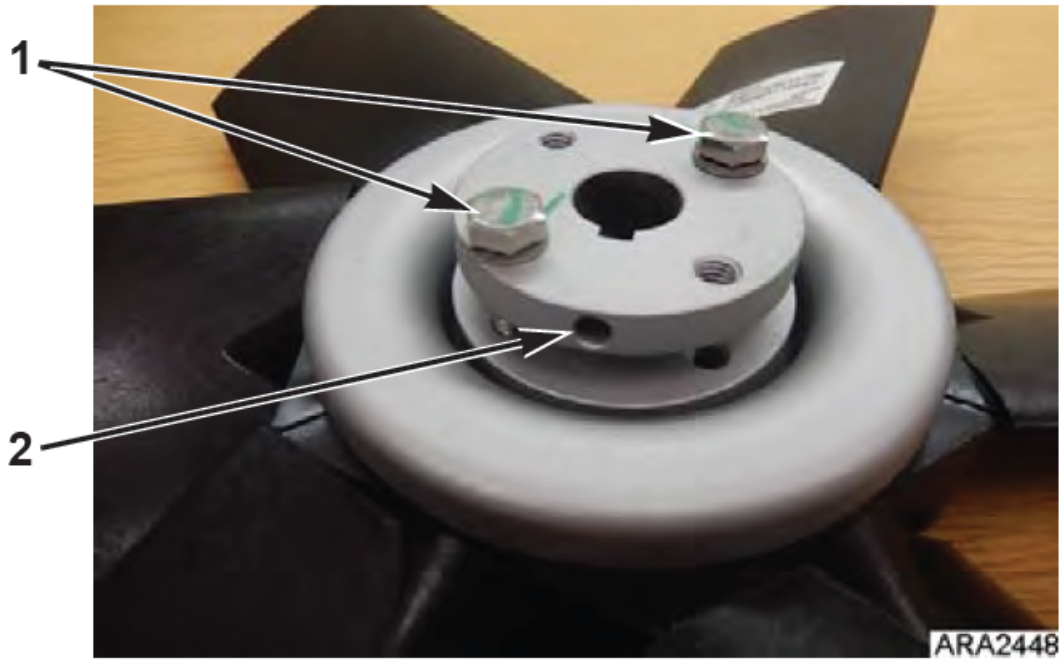
Fan Installation for Separate Fan and Fan Motor

When installing the fan on the fan motor, the fan and fan shroud must be properly aligned for proper air flow.

1. Place the fan assembly on the fan motor shaft so and position it so the inside fan blade tip is 7.0 to 9.0 mm (0.28 to 0.35 in.) from the fan shroud as shown below.



2. Finger tighten the hub bolts till the bolt heads are flush with the hub face.
3. Using a wrench, do a full turn on each bolt alternatively. Repeat this step until some torque builds.
4. Use a torque wrench set at 7.0 to 9.0 N.m (5.2 to 6.6 ft-lb) to complete the tightening sequence on each hub bolt alternatively.
5. Tighten the set screw to a torque of 2.5 to 2.9 N.m (1.8 to 2.1 ft-lb).



1.	Hub Bolts
2.	Set Screw

Mechanical Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Unit Switch ON; Controller display does not come on	Corroded battery terminals / cable Battery discharged Fuse S13 open Defective ON / OFF Switch Open Circuit	Clean and tighten Charge or replace battery Check circuit and replace fuse Check switch Check 2, 2B, 2C, and 8 circuit
Unit Switch ON; Controller display ON, but engine does not crank	Battery discharged Corroded battery terminals / cable Defective starter relay or open circuit Defective starter solenoid Defective starter Water in cylinders	Charge or replace battery Clean and tighten Replace relay; check 2A, 8S, SR, and PSR circuits Replace solenoid Repair starter Check for hydrostatic lock. Remove injectors and manually turn engine slowly.
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 EXXODiag diagnostic tool to diagnose problem
	Electric fuel pump not energized	Check FP+ and GND 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	Alarm LED Flashing	Check alarm code and repair fault
	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

CONDITION	POSSIBLE CAUSE	REMEDY
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 EXXODiag diagnostic tool to diagnose problem
	Compression low or unbalanced	Overhaul engine
Engine speed too high	Problem with ECU controlled engine function	Use EXXODiag diagnostic tool to diagnose problem
Engine fails to stop when unit is OFF	Problem with ECU controlled engine function	Use EXXODiag diagnostic tool to diagnose problem
Engine knocks heavily	Air in system	Bleed fuel system
	Wrong fuel	Change fuel
	Compression too low	Overhaul engine
	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
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

White Smoke	Black Smoke	Blue Smoke
Fuel is not burning	Excessive Fuel to Air Ratio	Oil Consumption
• Air or water in fuel • Incorrect timing • Poor compression • Faulty injectors	• Type of fuel used • Cold engine • Excessive load • Clogged air intake system • Faulty nozzles • Poor compression • Restricted exhaust • Air leak in intercooler or piping	• Poor compression • Defective valve seals

Diagram Index

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

Drawing No.	Drawing Title
2E20735 (Rev. K)	Wiring Diagram - Genset SG+ Units with Separate Fan and Fan Motor (6/15 and After)
2E20735 (Rev. G)	Wiring Diagram - Genset SG+ Units with One Piece Fan and Motor (Before 6/15)
2E20736 (Rev. L)	Schematic Diagram - Genset SG+ Units with Separate Fan and Fan Motor (6/15 and After)
2E20736 (Rev. G)	Schematic Diagram Genset SG+ Units with One Piece Fan and Motor (Before 6/15)

Figure 87. 2E20735 (Rev. K) - Wiring Diagram - Genset SG+ Units with Separate Fan and Fan Motor (6/15 and After)

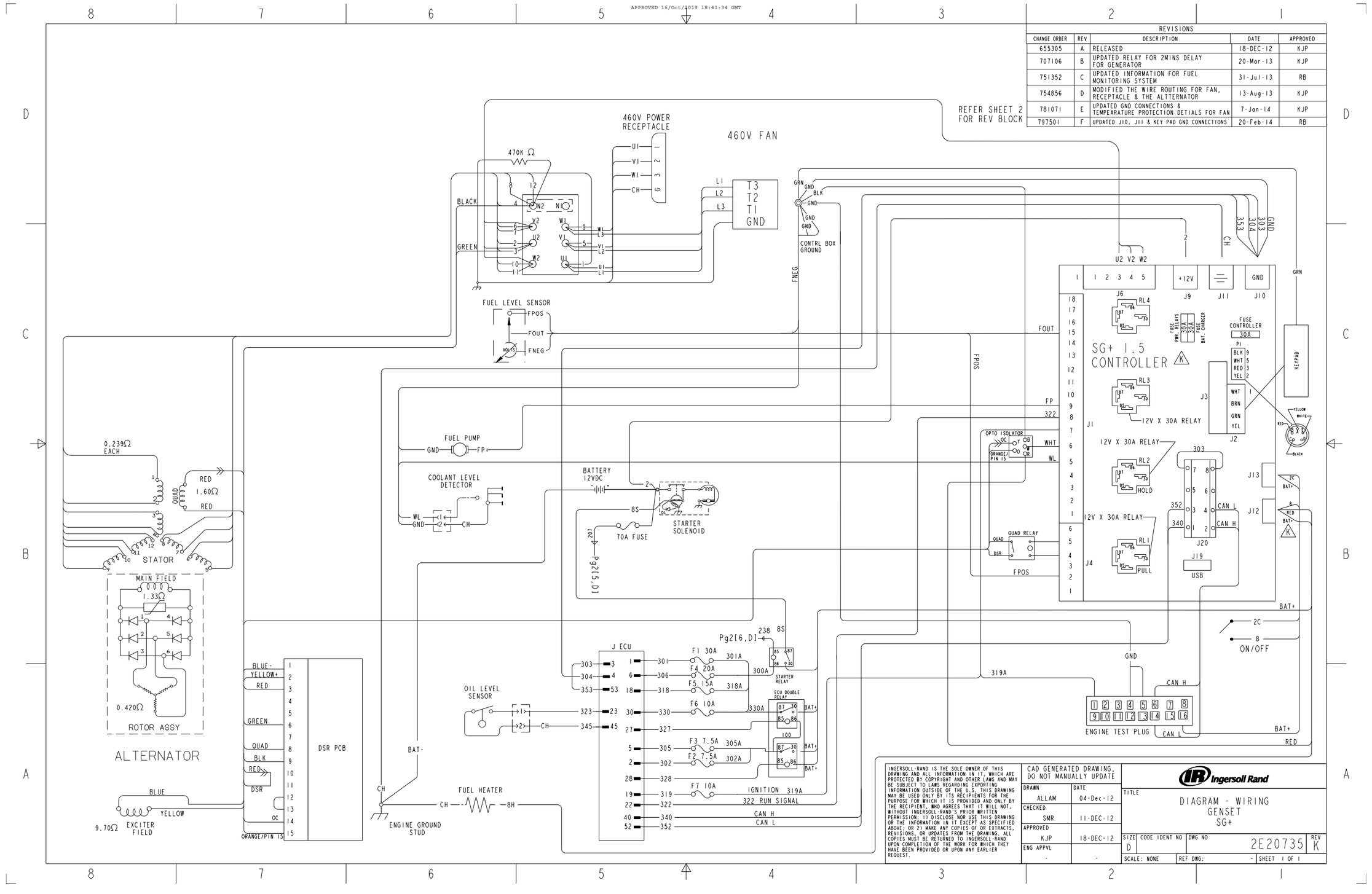


Figure 88. 2E20735 (Rev. K) - Wiring Diagram - Genset SG+ Units with Separate Fan and Fan Motor (6/15 and After)

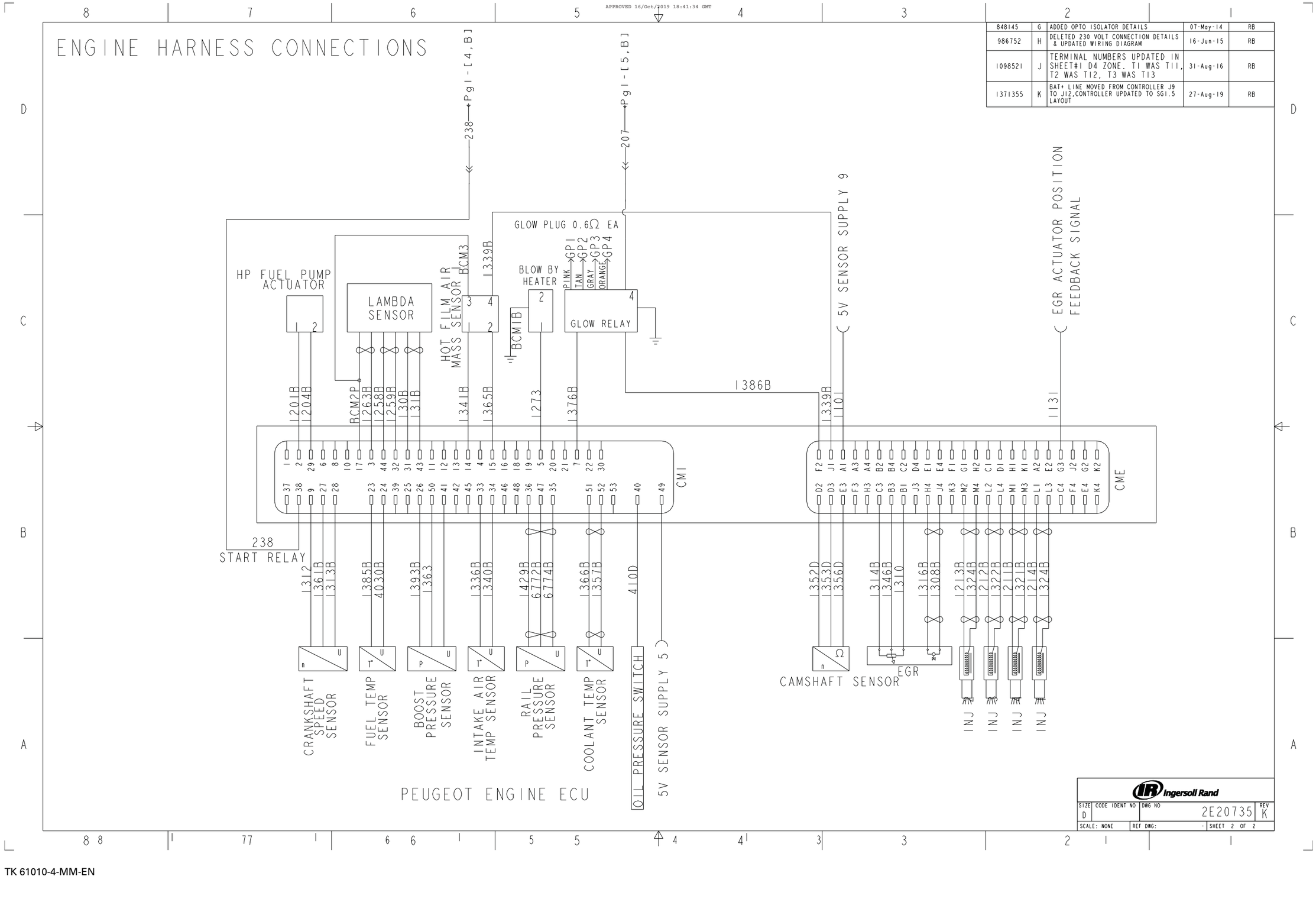
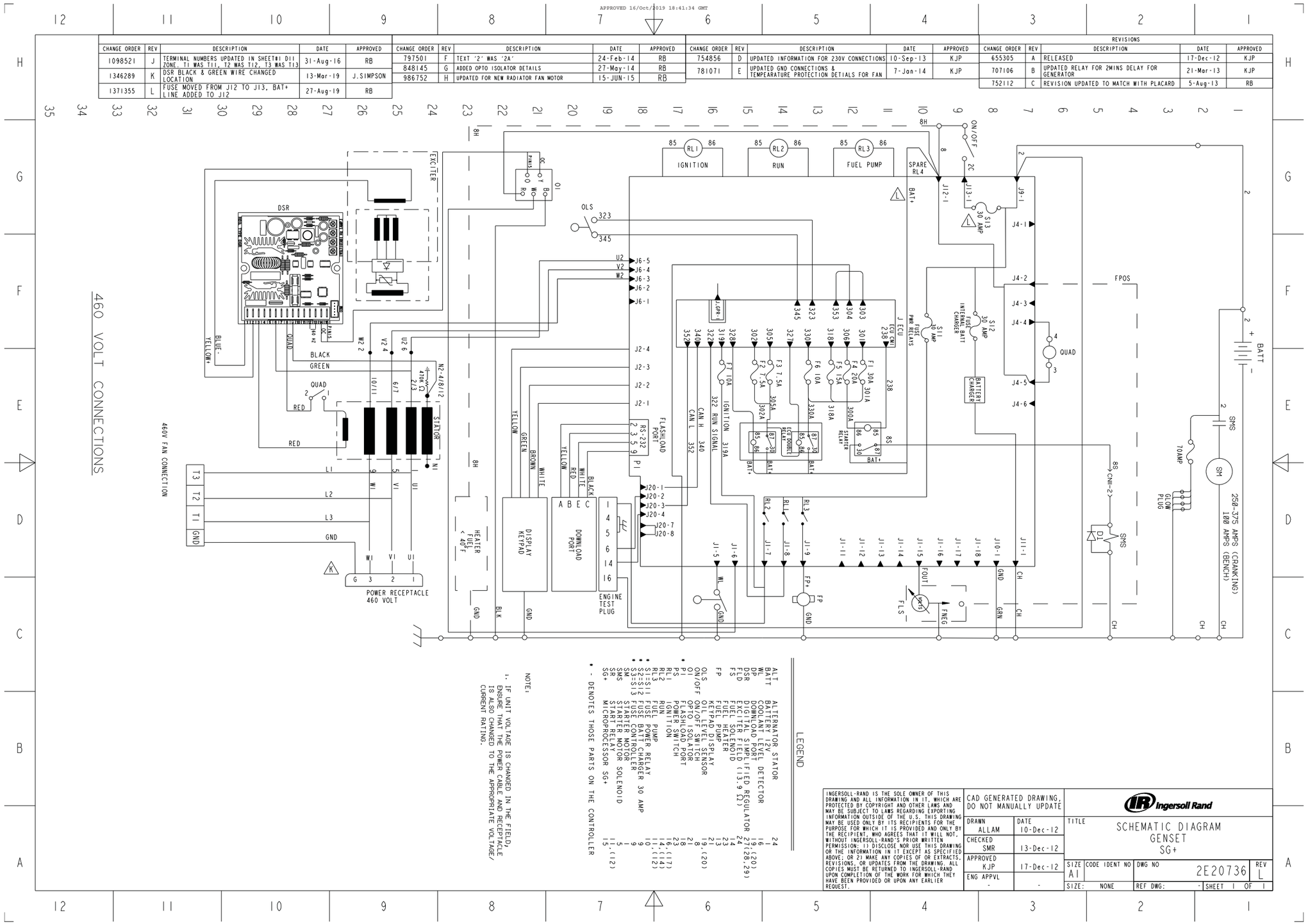


Figure 89. 2E20736 (Rev. L) - Schematic Diagram - Genset SG+ Units with Separate Fan and Fan Motor (6/15 and After)



CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
1098521	J	TERMINAL NUMBERS UPDATED IN SHEET#1 DII ZONE. T1 WAS T11, T2 WAS T12, T3 WAS T13	31-Aug-16	RB
1346289	K	DSR BLACK & GREEN WIRE CHANGED LOCATION	13-Mar-19	J.SIMPSON
1371355	L	FUSE MOVED FROM J12 TO J13, BAT+ LINE ADDED TO J12	27-Aug-19	RB

CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
797501	F	TEXT '2' WAS '2A'	24-Feb-14	RB
848145	G	ADDED OPTO ISOLATOR DETAILS	27-May-14	RB
986752	H	UPDATED FOR NEW RADIATOR FAN MOTOR	15-JUN-15	RB

CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
754856	D	UPDATED INFORMATION FOR 230V CONNECTIONS	10-Sep-13	KJP
781071	E	UPDATED GND CONNECTIONS & TEMPEARATURE PROTECTION DETIALS FOR FAN	7-Jan-14	KJP

REVISIONS

CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
655305	A	RELEASED	17-Dec-12	KJP
707106	B	UPDATED RELAY FOR 2MINS DELAY FOR GENERATOR	21-Mar-13	KJP
752112	C	REVISION UPDATED TO MATCH WITH PLACARD	5-Aug-13	RB

Figure 90. 2E20735 (Rev. G) - Wiring Diagram - Genset SG+ Units with One Piece Fan and Motor (Before 6/15)

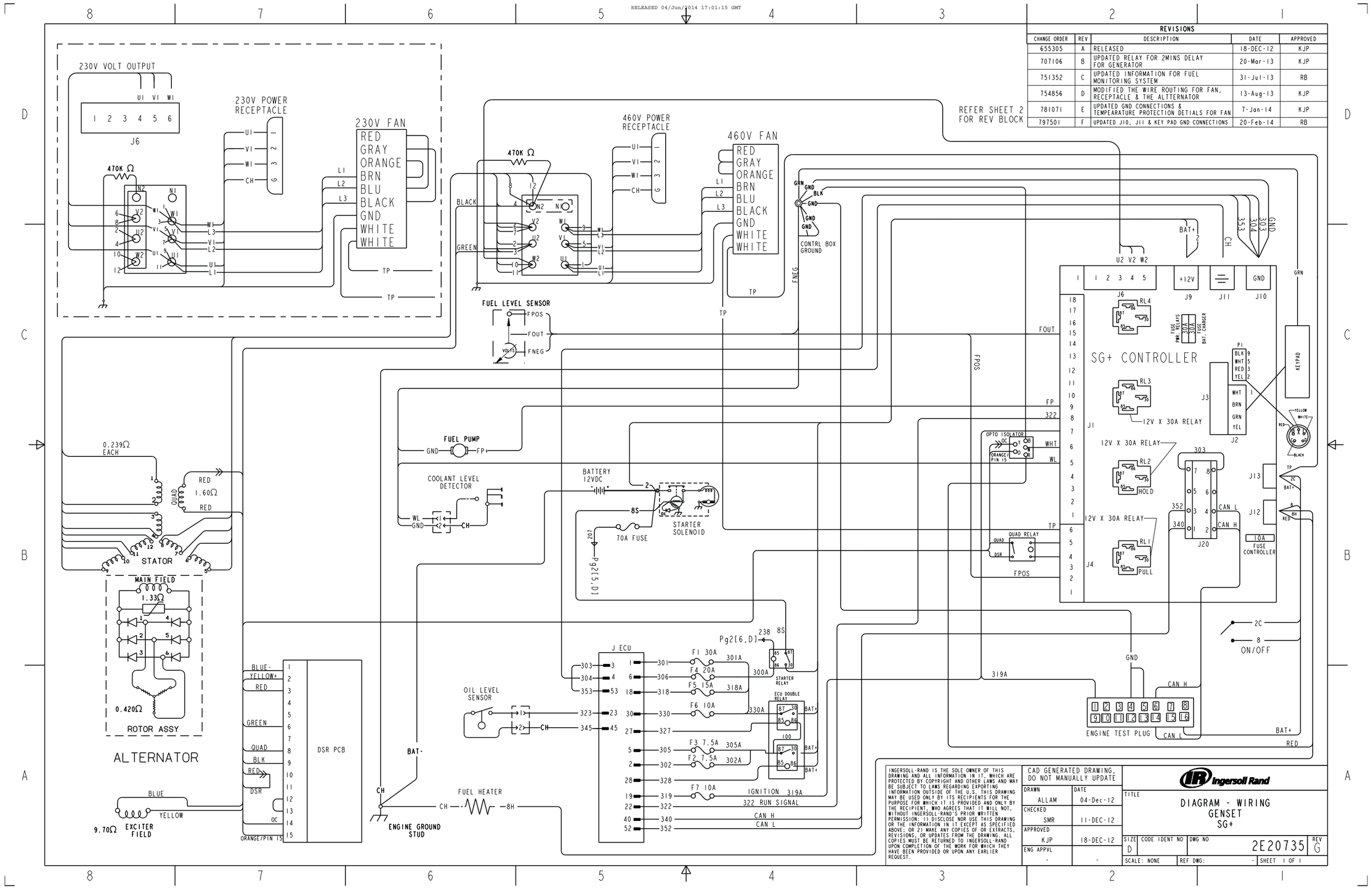


Figure 91. 2E20735 (Rev. G) - Wiring Diagram - Genset SG+ Units with One Piece Fan and Motor (Before 6/15)

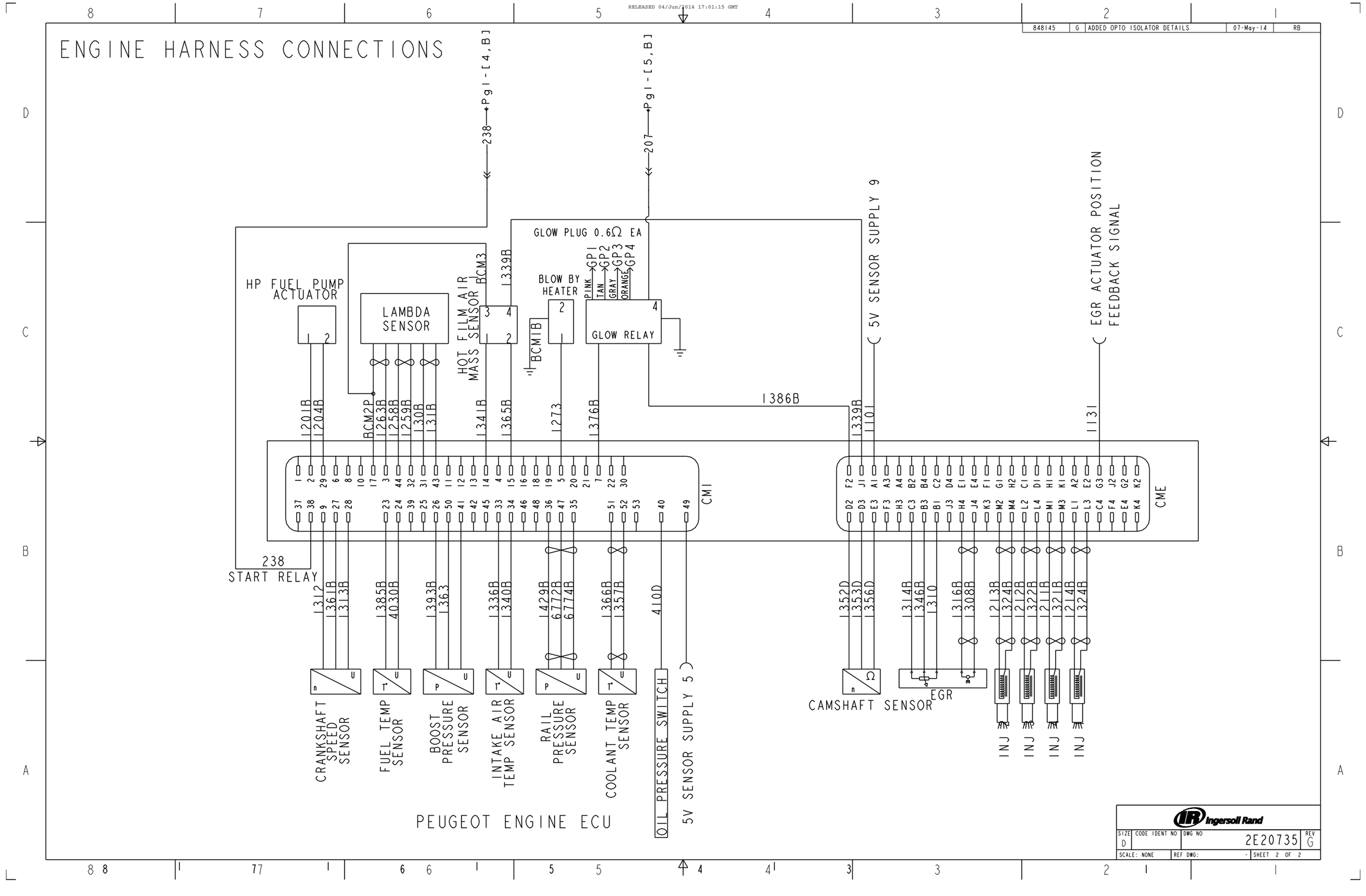
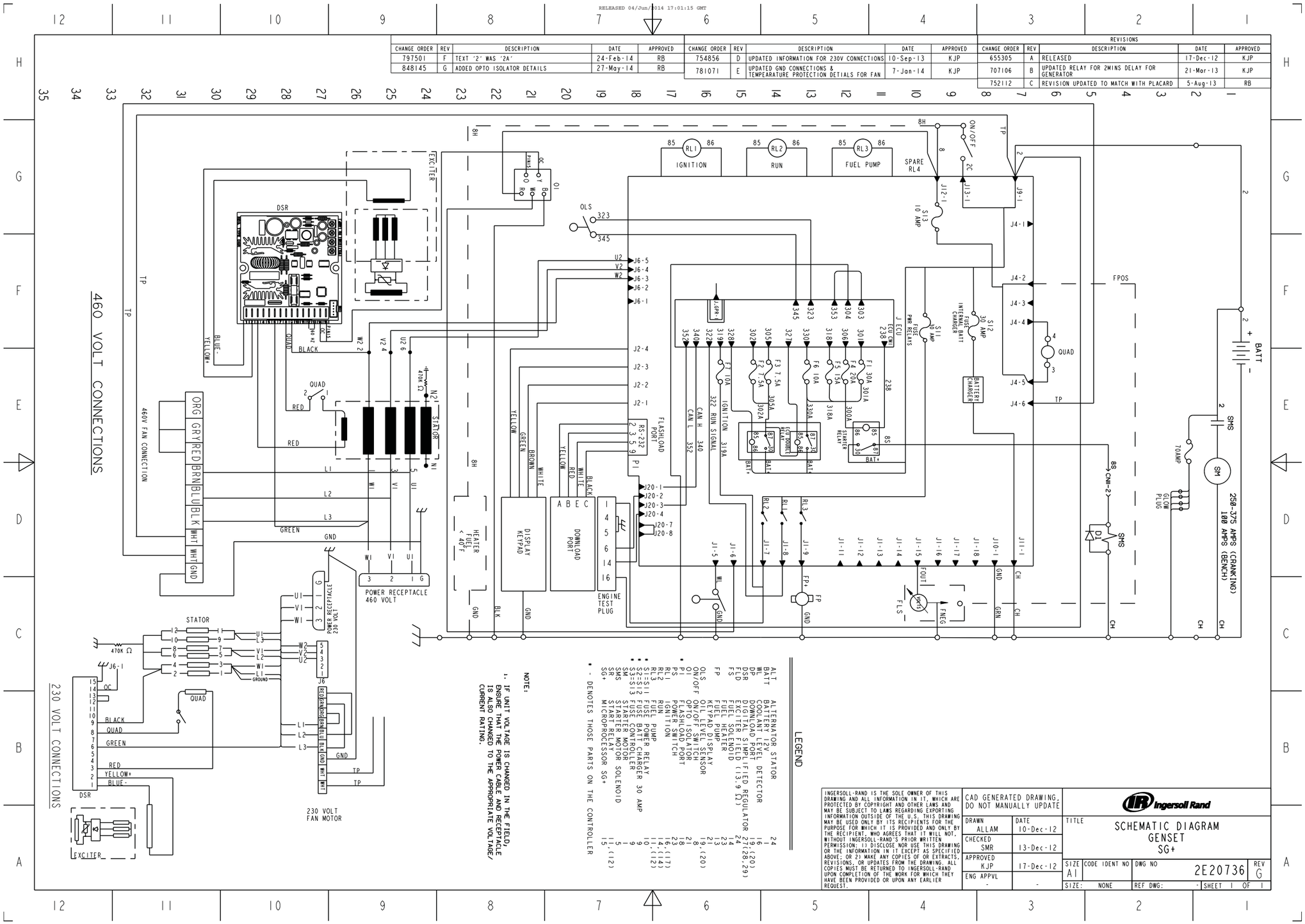


Figure 92. 2E20736 (Rev. G) - Schematic Diagram - Genset SG+ Units with One Piece Fan and Motor (Before 6/15)



THERMO KING

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.

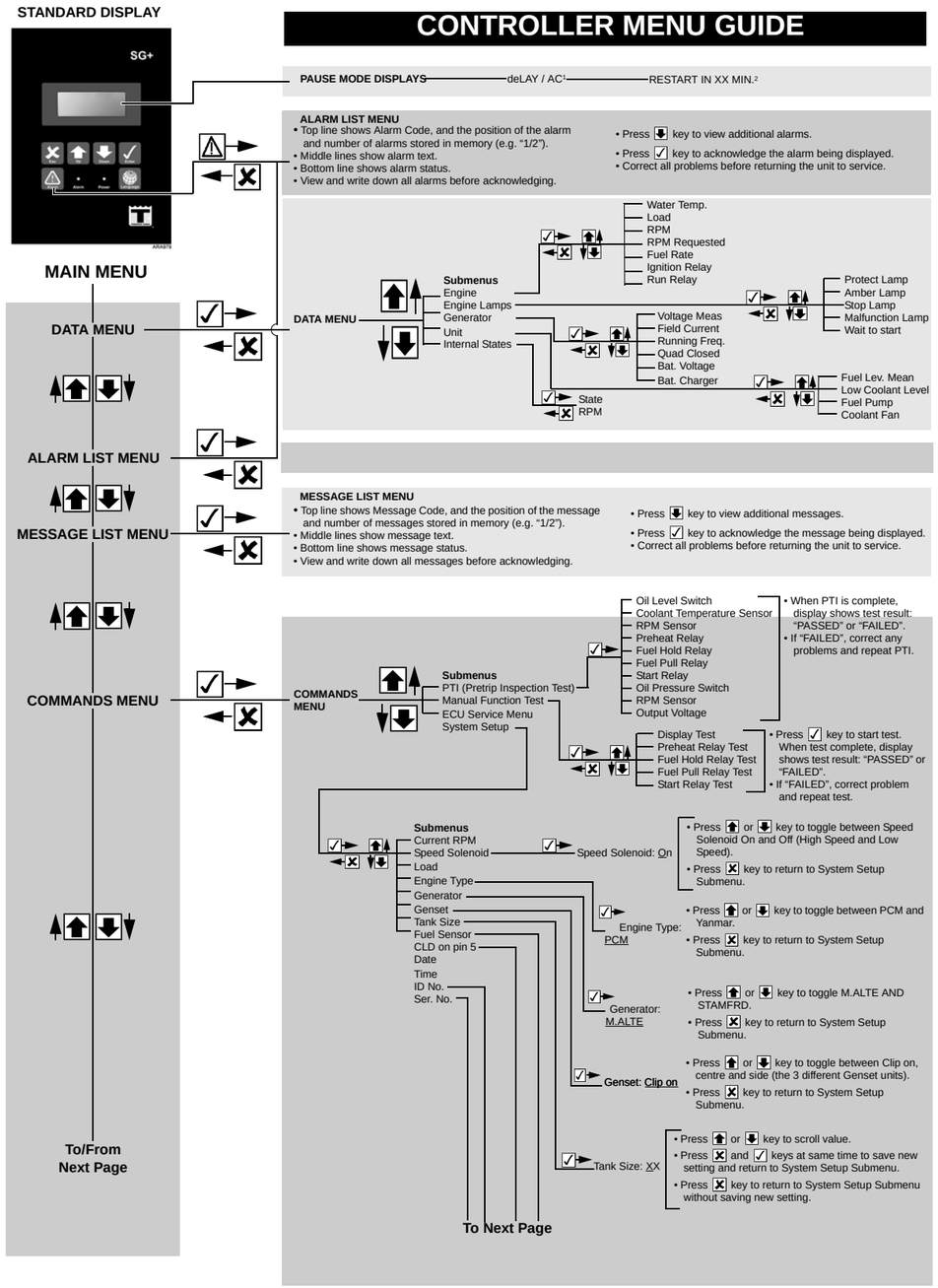
To Enter a Command or execute a task:
- Press **ENTER** key.

To Enter a New Value in a Screen:
- Press **ENTER** key and **ESCAPE** key at the same time.

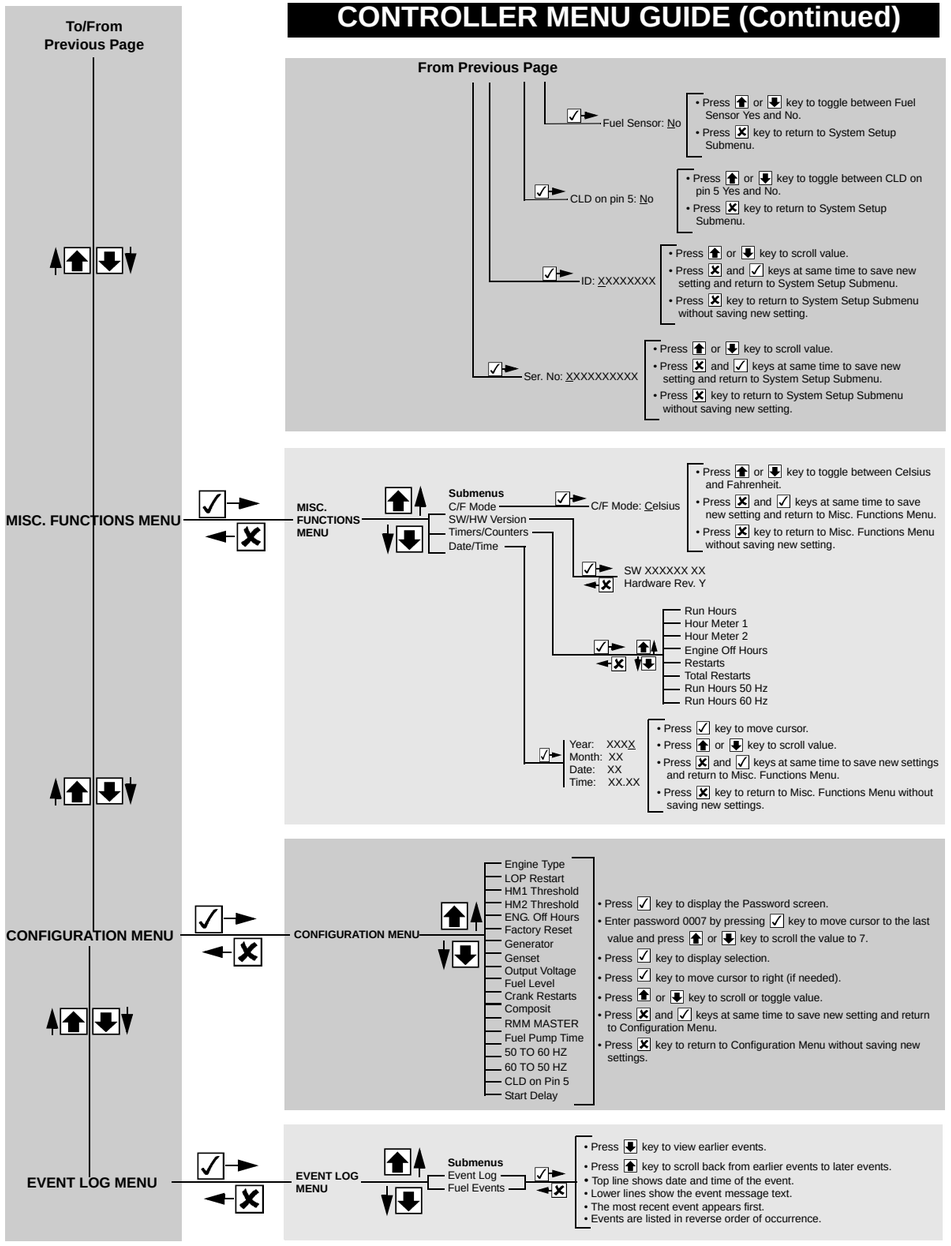
To change language
- Press **LANGUAGE** key.

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.



CONTROLLER MENU GUIDE (Continued)



THERMO KING

Controller Menu Guide

Keypad Operating Tips

Text Input:
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Footnotes:

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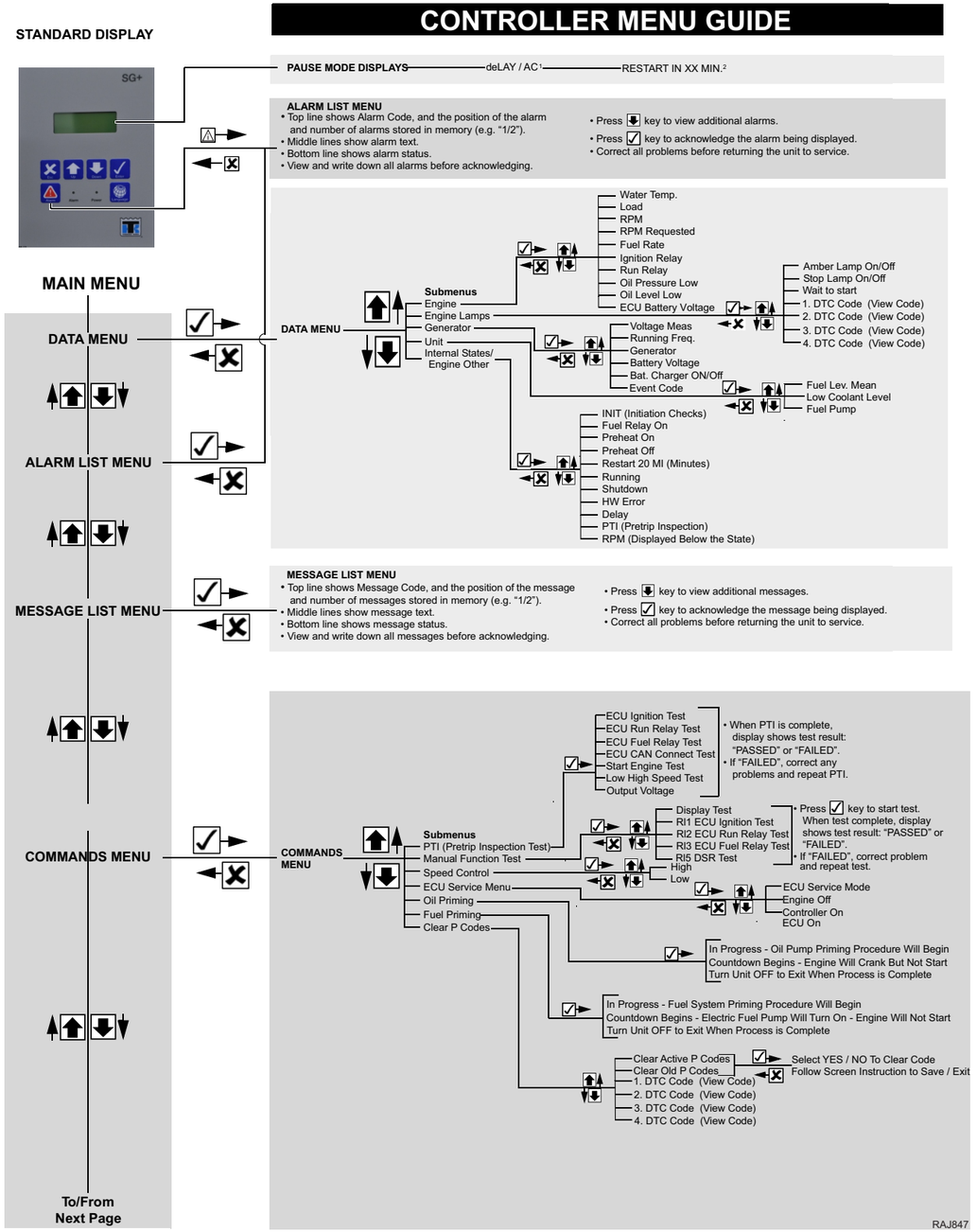
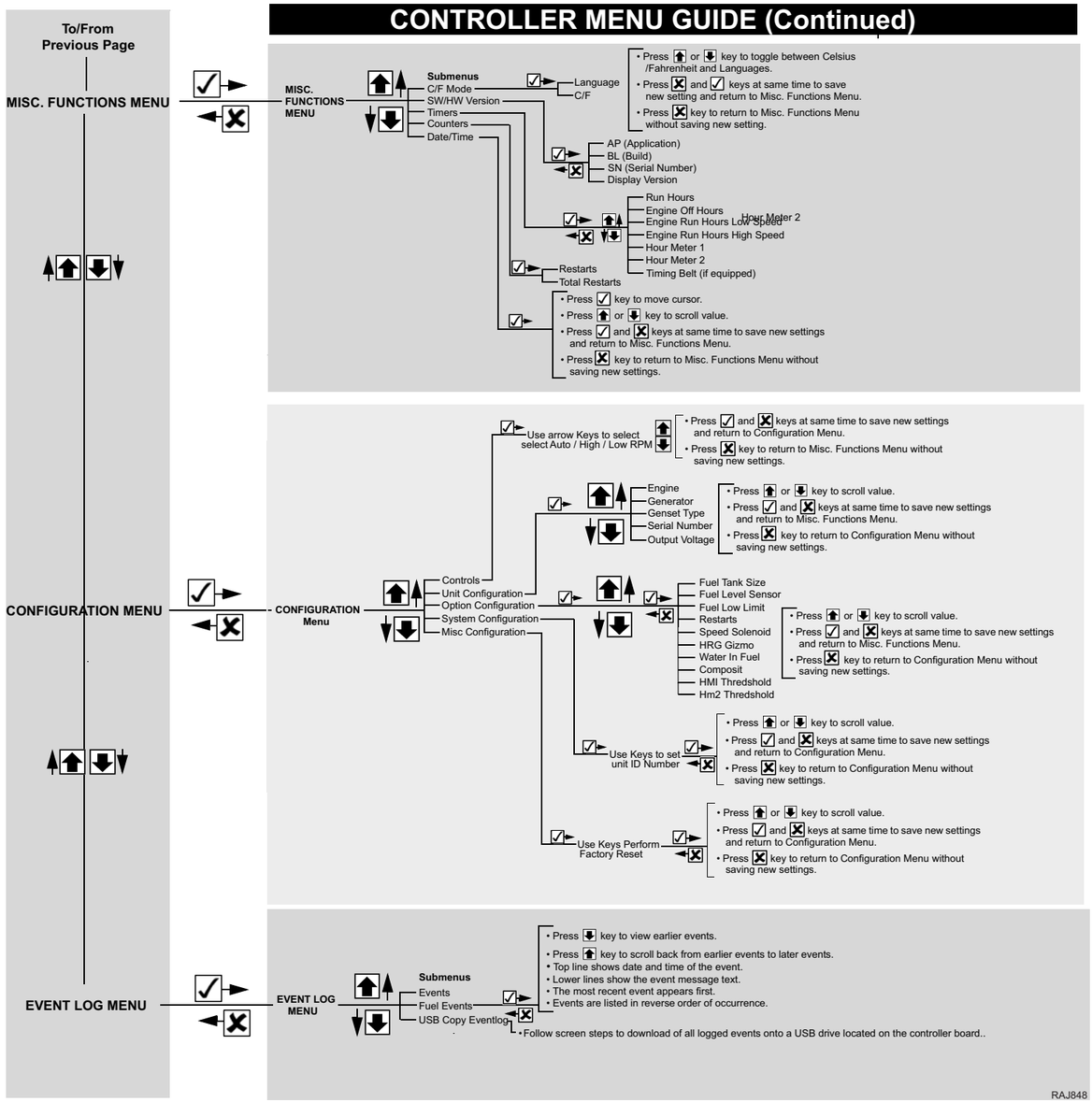


CONTROLLER MENU GUIDE (Continued)



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