THERMO KING

Maintenance Manual

Container Edition
SG 3500 Series

Revision B

August 2023

TK 61914-4-MM-EN

TRANE TECHNOLOGIES

THERMO KING

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 3500 System Number	904281M
SGUM 3500 System Number	904282M
SGFM 3500 System Number	905125M
SGCO 3500 System Number - Wujiang	904636M
SGUM 3500 System Number - Wujiang	904637M
For further information, refer to:	
SGCO 3500 Parts Manual	TK 61935
SGUM 3500 Parts Manual	TK 61936
SGFM 3500 Parts Manual	TK 62118
Yanmar TK486VEGS5 Engine Troubleshooting Manual	TK 61757
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	CO: Clip-On unit frame UM: Undermount unit frame FM: Flexi mount unit frame
Tools	
TOOL - ECU Diagnostic, YSAD (Dealer Version)	2041969
TOOL - ECU Diagnostic, YSAD (Customer Version)	2041970

Note: *For Parts Manual TK 61935 go to Eletronic Parts Catalog and search for Grid Number "24U16".*

Note: *For Parts Manual TK 61936 go to Eletronic Parts Catalog and search for Grid Number "24U17".*

Note: *For Parts Manual TK 62118 go to Eletronic Parts Catalog and search for Grid Number "25U44".*

Revision History

Revision A	(04/2022) New Manual.
Revision B	(08/2023) Addition of SGFM 3500.

Customer Satisfaction Survey

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Your feedback will help improve our manuals. The survey is accessible through any internet-connected device with a web browser.

Scan the Quick Response (QR) code or click Technical Publications EMEA Feedback to complete the survey.

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 on curb side of tank by lower mounting bolt area.
- **SGFM Units:** The unit serial number nameplate is on front side of the unit frame, above the front access door.
- **Controller:**The controller serial number nameplate is on the back of the controller.

THERMO KING

Table of Contents

Safety Precautions

Danger, Warning, Caution, and Notice

Thermo King®/ FRIGOBLOCK recommends that all service be performed by a Thermo King/FRIGOBLOCK 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 (PN 2040622 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) or Telematics, 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

Type	460/230 Vac, 3 Phase, 60/50 Hz
Output Power	15 kW
Kilovolt-Amperes	18.75 kVA
RPM	1800 RPM

Electrical Control System

Controls	SG–3500 Controller
Voltage	12.5 Vdc (nominal)
Battery	12 Volts, Group 31, 925 / 950 CCA @ -18 C (0 F)
Fuse FS1 (Located in Control Box)	10 Amp - Battery Post to Main Relay
Fuse FS2 (Located in Control Box)	40 Amp - Battery Post trough ON/OFF switch to SW Post
Fuse FS3 (Located in Control Box)	60 Amp - Starter Fuse
Fuse FS4 (Located in Control Box)	80 Amp - Air Heater Fuse
Fuse FS5 (Located in Control Box)	2 Amp - Battery Post to Telematics
Fuse FS6 (Located in Control Box)	2 Amp - SW Post to Telematics

Electrical Components **NOTE: Disconnect components from unit circuit to check resistance.**		
	Current Draw (Amps) at 12.5 Vdc	**Resistance — Cold (Ohms)**
Starter Motor	350-475*	

* On-the-engine cranking check. Bench test is approximately 140 amps.

Engine

SG 3500

Model		Thermo King TK486VGE1 (EPA Tier IV and 2016/1628 EU regulation (or NRMM Stage V) compliant)
Fuel Type		Diesel fuel must conform to EN590
Oil Capacity		Dry fill: 13.2 liters (14 quart) Wet fill: 12 liters (12.7 quart)
Oil Type		API CK4 grade or better Use multi-weight oils appropriate for the ambient temperature (delivered with 10W30 oil)
Oil Viscosity		-30 °C to +0 °C: SAE 5W-30 -25 °C to +30 °C: SAE 10W-30 -25 °C to +40 °C: SAE 10W-40 -15 °C to +40 °C (or -10 °C to +50 °C): SAE 15W-40
Nominal Engine RPM	SG-3500	High Speed : 1800 RPM Low Speed : 1500 RPM
Engine Oil Pressure		2.1 to 5.5 bar (30 to 80 psi)
Intake Valve Clearance		0.15 to 0.25 mm
Exhaust Valve Clearance		0.15 to 0.25 mm
Valve Setting Temperature		21 °C
Timing Injection Pump		12° +/– 1° BTDC (timed on No. 1 cylinder, flywheel side)
Low Oil Pressure Switch (Normally Closed)		0.55 to 0.83 bar (8 to 12 psi)
High Coolant Temperature Switch		Sensor - 101.7 to 107.2 °C or higher (Shutdown)
Engine Coolant Thermostat		71 °C
Engine Coolant Type		ELC (Extended Life Coolant), which is "RED" Factory filled with Chevron Delo® XLC extended life coolant (ELC), 50/50 glycol/water concentration. Freeze protection of -34°F/ -37°C Compatible coolants: • Chevron Delo® XLC • Havoline Delo® XLC (Europe) • Caltex Delo® XLC (Asia) OR Meets the performance requirements of both ASTM D6210 and ASTM D3306 OAT extended life coolant, nitrite free
Coolant System Capacity		6.7 liters/litres (7.08 quarts)
Radiator Cap Pressure		0.83 bar (12 psi) (88 kPa)

Notice

Equipment Damage!

Do NOT operate the engine in ANY unit more than 100 RPM over the high speed setting shown to avoid damage to the active rectifier.

Notice

System Contamination!

Only OAT extended life coolants (Chevron Delo® XLC or equivalent) should be added to Thermo King systems. Conventional coolants should not be used (Typically identified by green or blue-green color). If a conventional coolant is combined with the Thermo King factory fill up to 25% by volume, the coolant must be changed at the next service opportunity. Above 25%, the coolant must be changed immediately. Conventional coolants dilute/interact with the additive packages of extended life coolant which significantly reduces the service life of the coolant.

Belt Tension

Notes:

1. *All Belt Tension Values indicated are at room temperature*
2. *Belt Tension to be measured at longer span.*

	Use of Frequency Gauge to measure frequency (Hz) is recommended.	**New Belt**	**Field Reset (used belt)**
Water Pump Belt		126 Hz (40 lbs)	118 Hz (32 lbs)

SG 3500 Series Unit Weight

	Max weight	**Tare weight**
SGCO-3500	1234 kg (2719.38 lbs.)	852 kg (1879 lbs.)
SGUM-3500 30Gal	764 kg (1684 lbs.)	669 kg (1474 lbs.)
SGUM-3500 50Gal	846 kg (1864 lbs.)	673 kg (1484 lbs.)
SGUM-3500 80Gal	852 kg (1879 lbs.)	680 kg (1499 lbs.)
SGFM-3500*	600 kg (1323 lbs.)	600 kg (1323 lbs.)

** SGFM units has no factory fit Fuel Tanks, the Fuel Tanks has to be purchased through aftermarket.*

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 belt for condition and proper tension.
•	•	•	Check engine oil pressure hot, on high speed (should display "OK").
•	•	•	Check engine coolant level and antifreeze protection (-30 F [-40 C]).
•	•	•	Drain water from the Primary fuel filter bowl.
	•	•	Drain water from fuel tank and check vent.
	•	•	Inspect/clean screen in banjo fitting on hand fuel pump.
		•	Check engine mounts for wear.
		•	Replace EMI 3000 air cleaner element (see "EMI 3000 Air Cleaner") at 3,000 hours or two years (whichever occurs first). See note.
		•	Replace EMI 3000 fuel filter/water separator. See note.
		•	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.**
		•	Adjust engine valve clearance.
			Change ELC (red) engine coolant every 5 years or 12,000 hours. Units equipped with ELC have an ELC nameplate on the expansion tank (see "Engine Cooling System").
			Electrical:
	•	•	Inspect battery terminals and electrolyte level.
	•	•	Inspect wire harness for damaged wires or connections.
	•	•	Inspect AC generator wire connections for tightness.
			Structural:
•	•	•	Visually inspect unit for fluid leaks.
•	•	•	Visually inspect unit for damaged, loose, or broken parts.
	•	•	Clean entire unit including radiator coil.
	•	•	Check all unit and fuel tank mounting bolts, brackets, lines, hoses, etc.

*3000 hours or one year, whichever occurs first.

Unit Description

General Description

Thermo King generator sets (clip-on, under-mount and flexi 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 TK486VGE1 (EPA Tier IV and 2016/1628 EU regulation (or NRMM Stage V) compliant). This is a 4-cylinder, water cooled, direct injection diesel engine. 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.

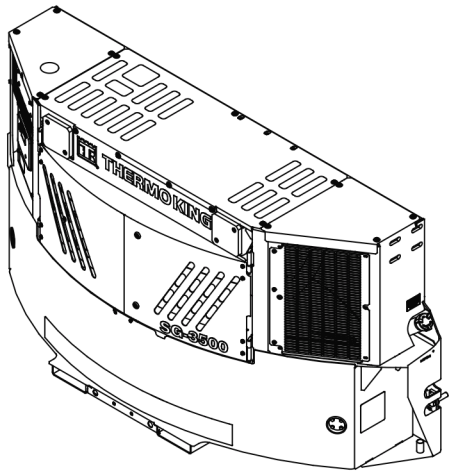
Fuel tanks are provided as an integral part of each unit except SGFM flexi mount models. Fuel capacities are: 454 liter (120 gal.) on SGCO clip-on models; 303 liter (80 gal.), 189 liter (50 gal.) or 114 liter (30 gal.) on SGUM under mount models.

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

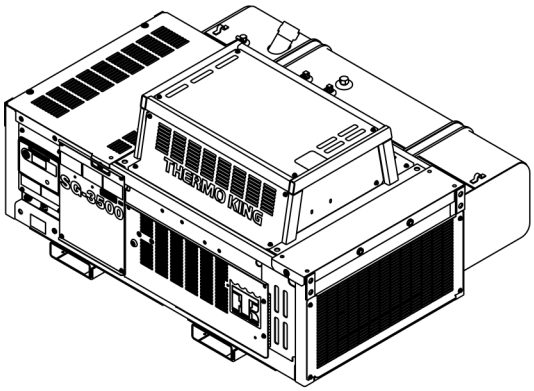
The alternator is a brushless, rotating field ac generator. A rectified exciter armature output provides dc power for the field. The exciter field obtains its power from the full wave rectified output of the main generator. The alternator supplies 230 or 460 Vac, 3 phase, 4 wire, 60 Hz power at 1800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

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

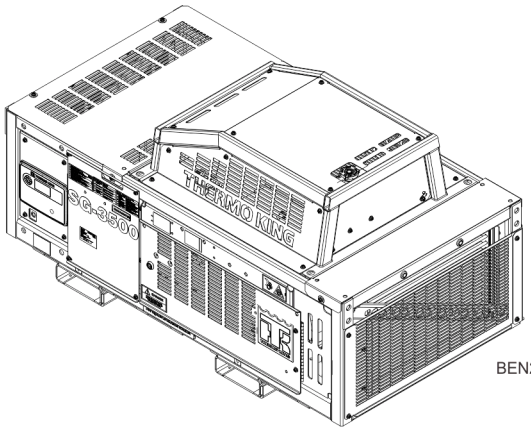
SGCO 3500



SGUM 3500



SGFM 3500



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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.

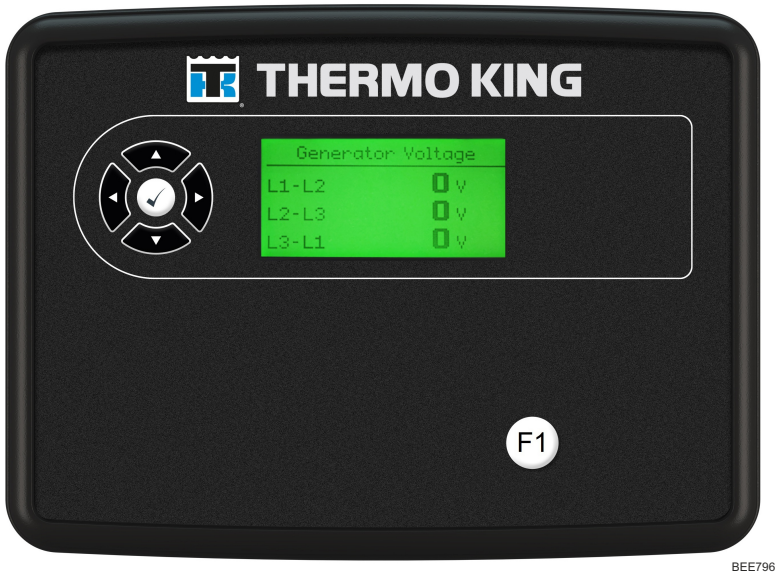
The EMI 3000 package consists of the following key components:

- EMI 3000-Hour Cyclonic Air Cleaner Assembly and Air Cleaner Element
- EMI 3000-Hour 5-Micron Primary Fuel Filter / Water Separator
- EMI 3000-Hour 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).

Microprocessor Controller



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Unit Protection Devices

⚠ Warning

Equipment Damage and Risk of Injury!

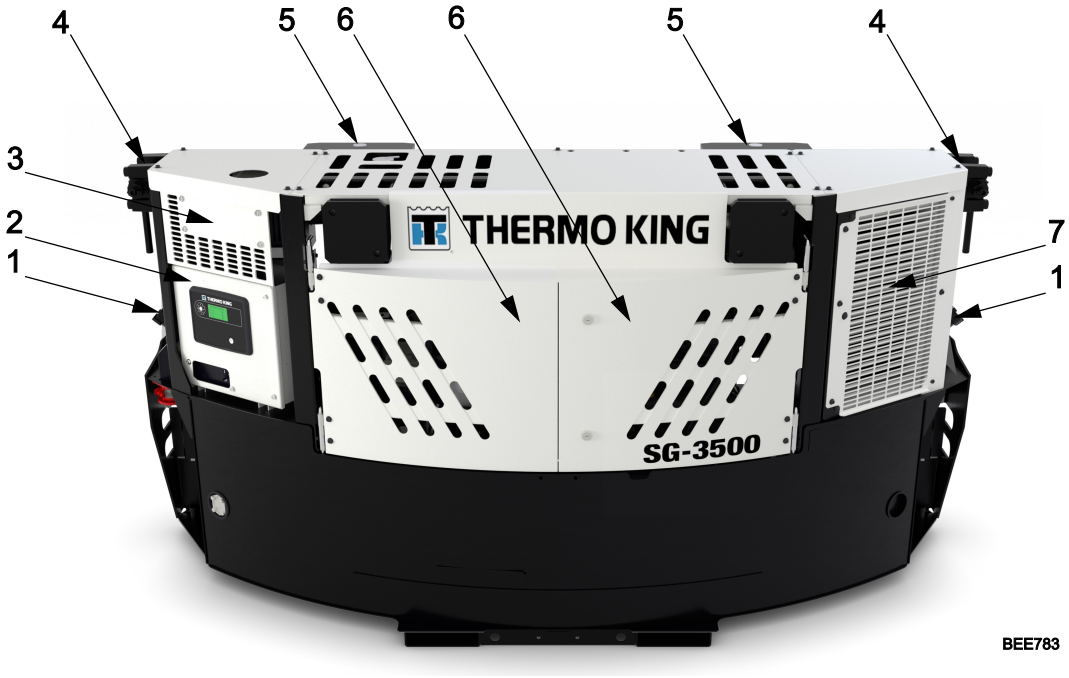
The unit may start at any time without warning when the unit On/Off switch in the On position. Units equipped with a controller feature a Delayed Restart mode. The controller will make up to three (3) attempts every 20 minutes to restart the unit after a Delay Alarm has occurred. The Delayed Restart 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.

Voltage Option

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

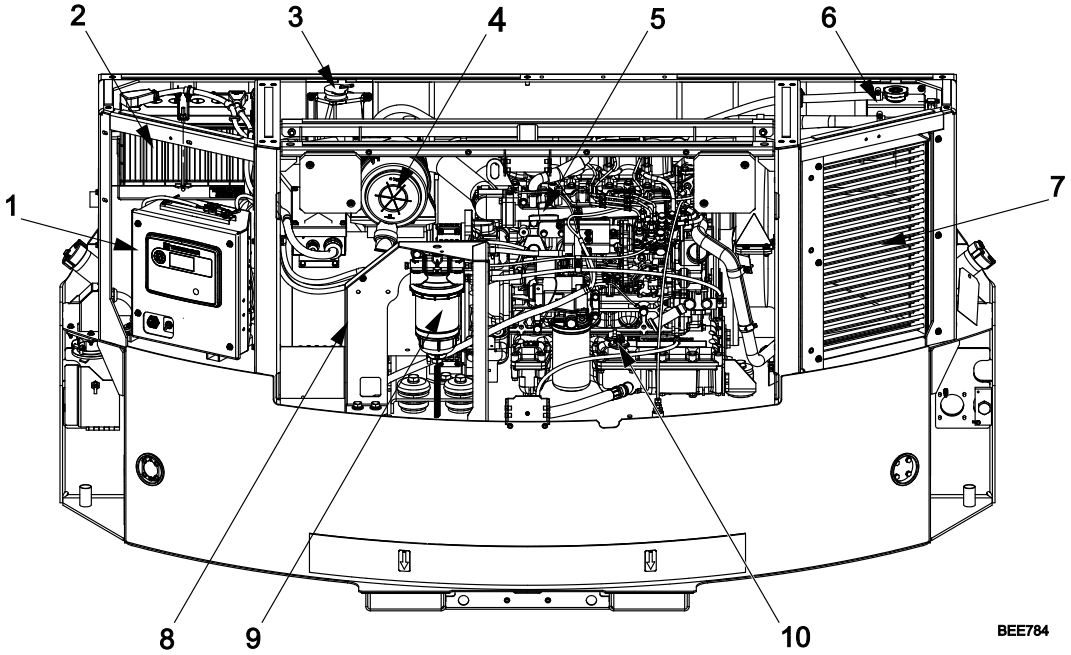
Photos, Illustrations, and Measurements

SGCO 3500 Front View



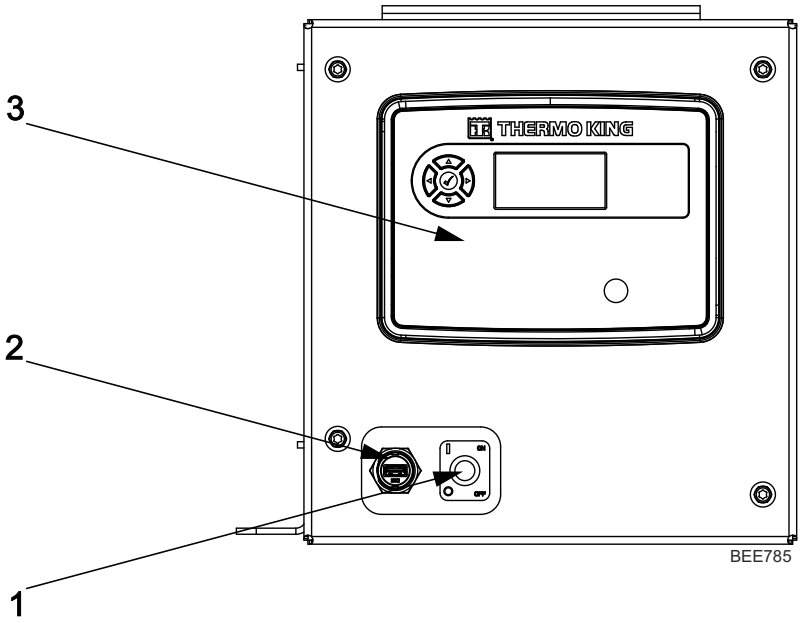
1.	Fuel Tank Cap	5.	Pin mount (option)
2.	Control Box Location	6.	Front Access Doors
3.	Telematics Module	7.	Radiator Location
4.	Corner Casting Mount		

SGCO 3500 Front View (Covers Removed)



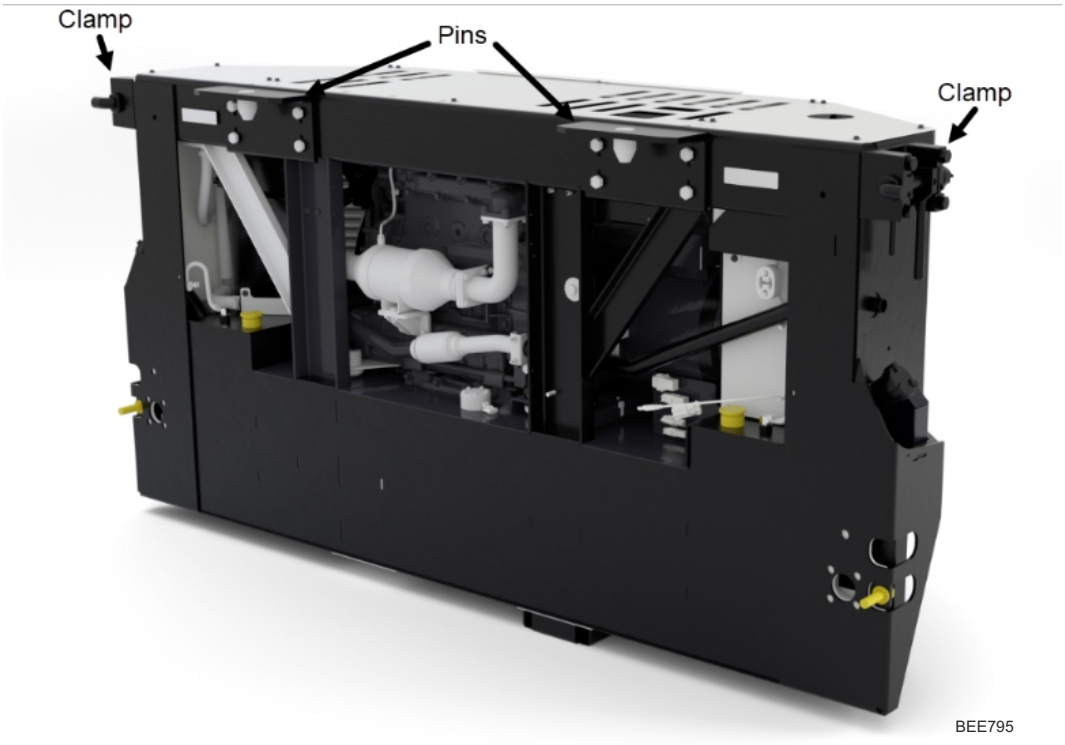
1.	Control Box Location	6.	Cooling System Degas Tank, Pressure Cap, Coolant Level Switch
2.	Battery Location	7.	Radiator
3.	Burp Bottle Tank	8.	Alternator Assembly
4.	Air Filter Assembly	9.	Fuel Filter / Water Separator (Primary)
5.	Engine	10.	Engine Oil Cap / Fill Location

SGCO 3500 Control Box (External)

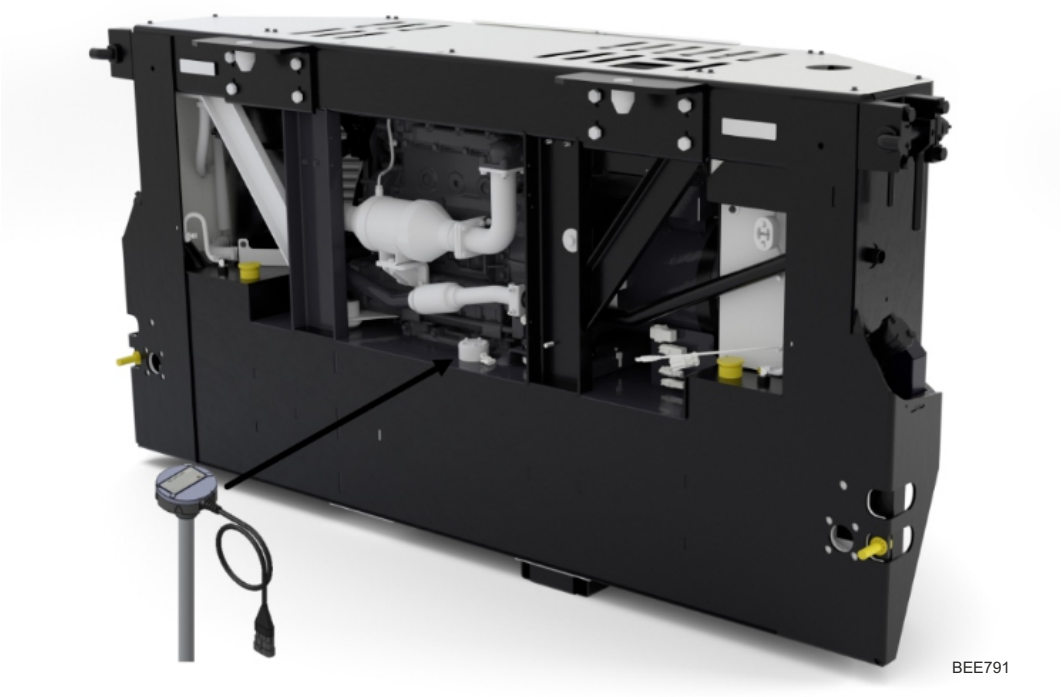


1.	Unit ON / OFF Switch
2.	Flash Drive USB Port
3.	Controller

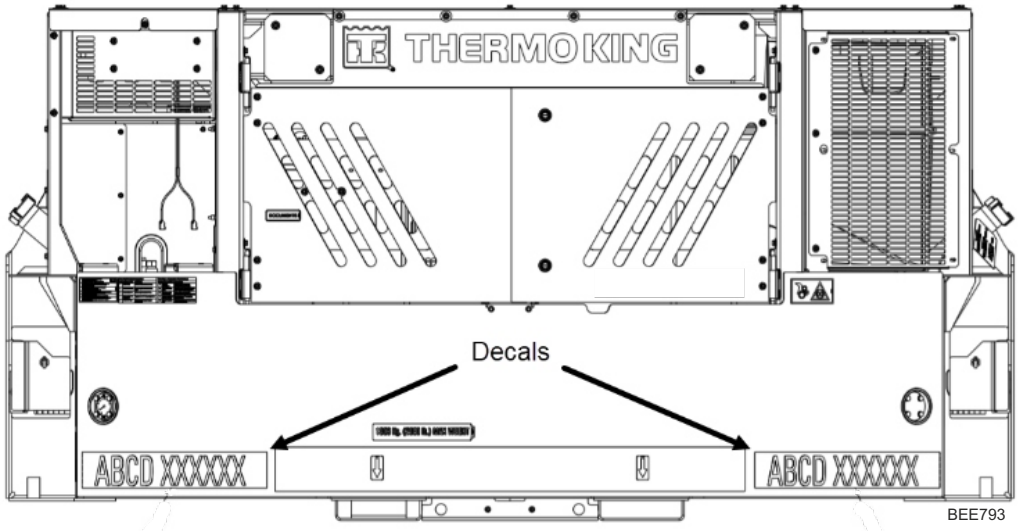
SGCO 3500 Pins and Clamps (Option)



SGCO 3500 Telematics Fuel Sensor

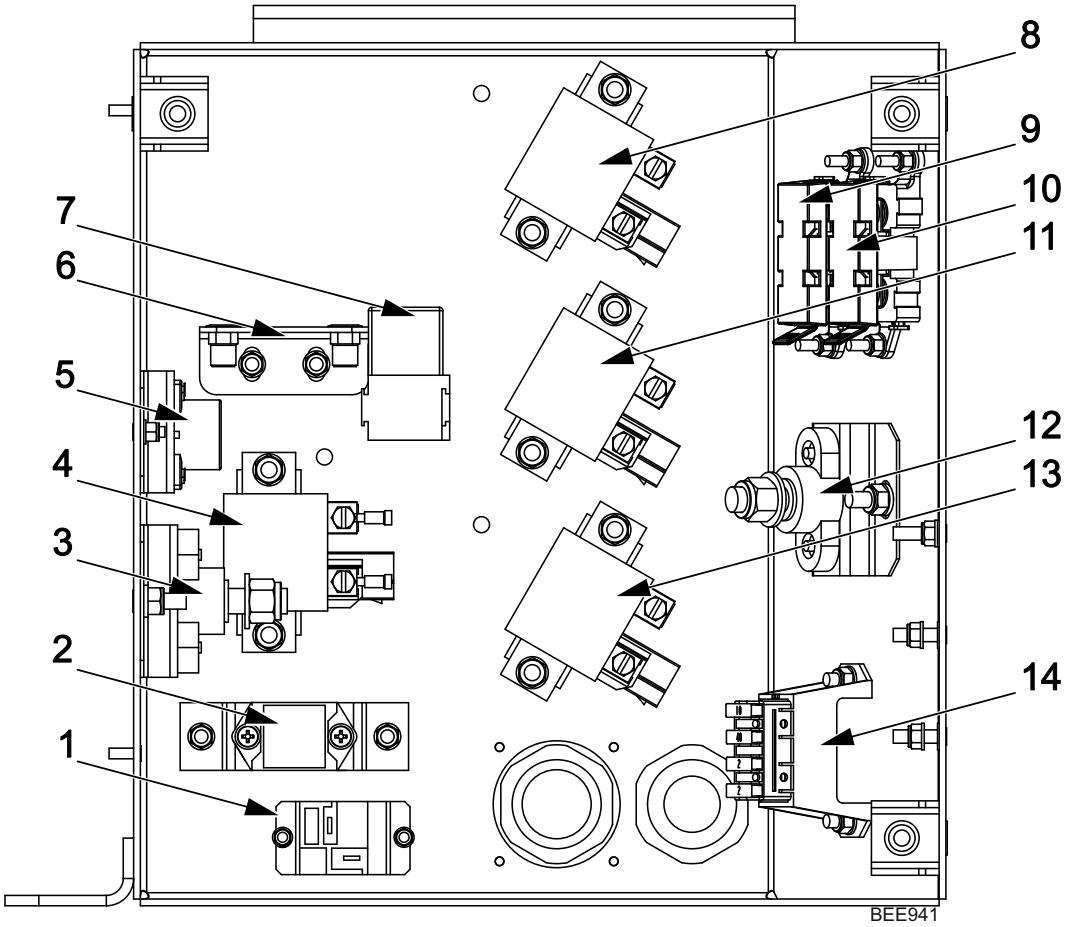


SGCO 3500 Customer asset ID decal



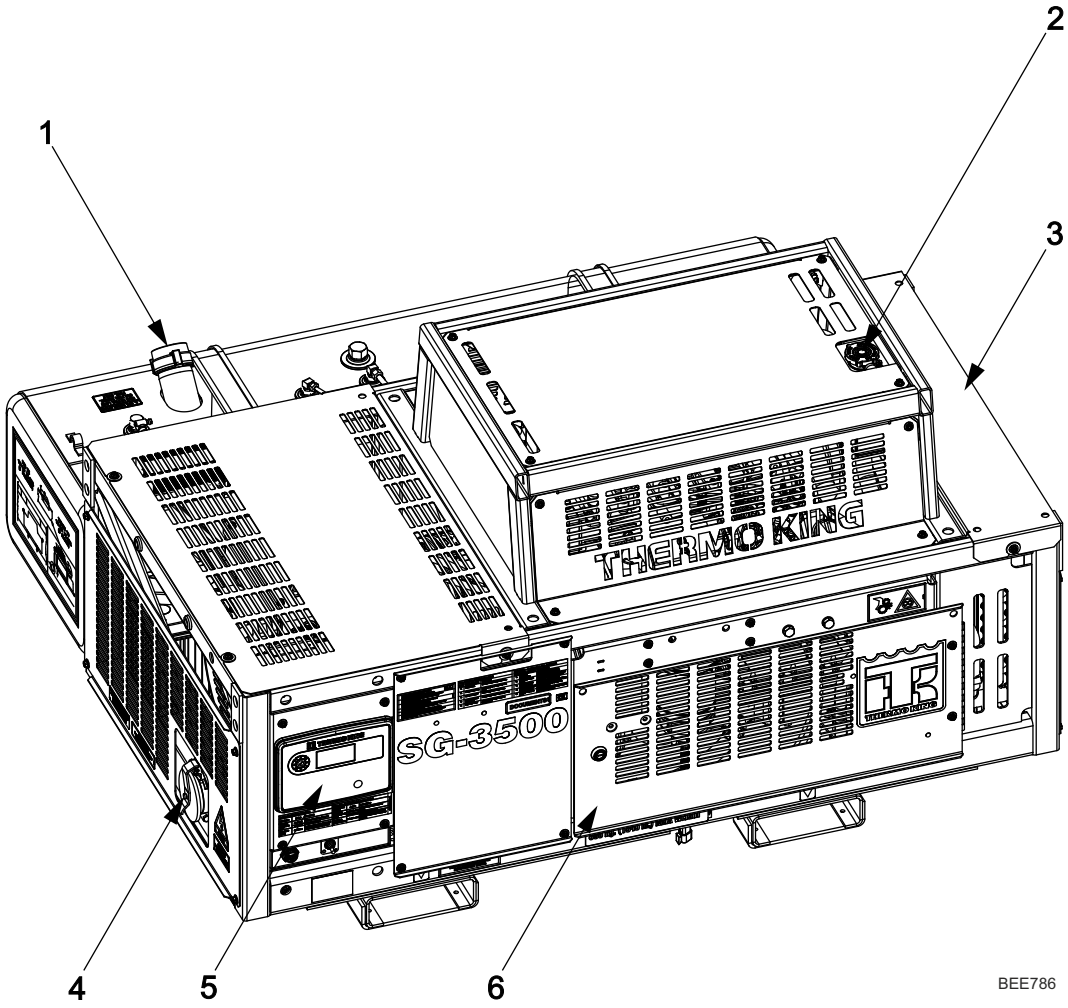
SGCO 3500 Mechanical fuel gauge (Option)

Control Box SGCO Inside view



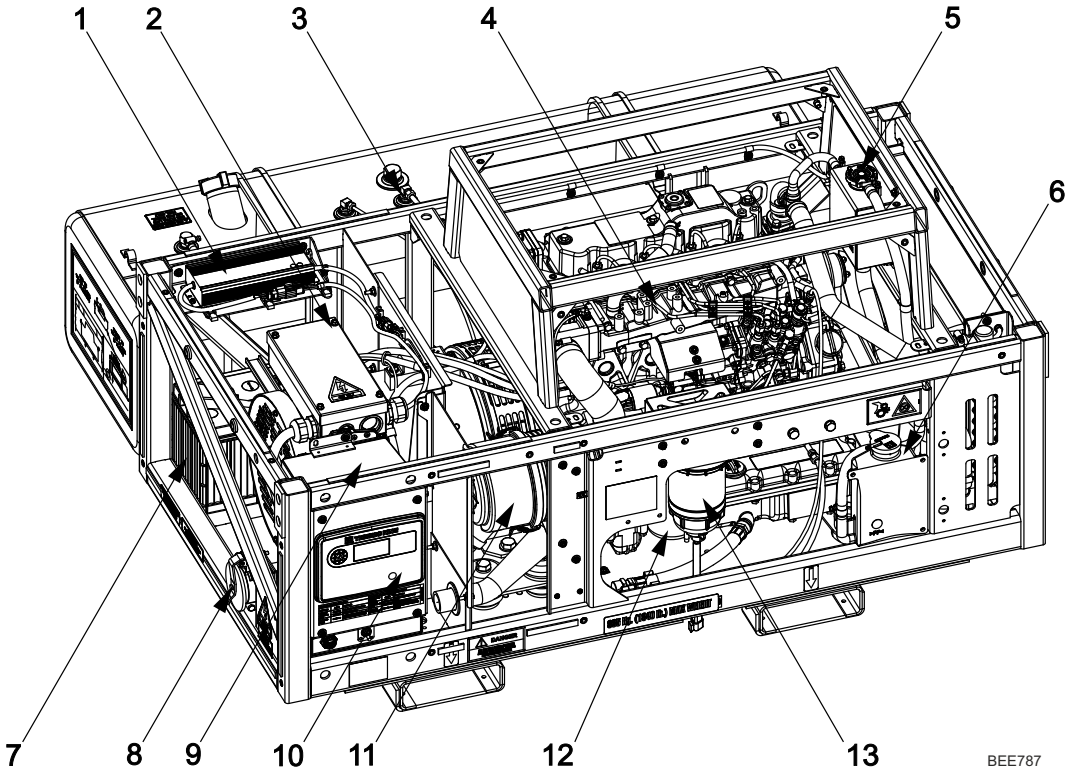
1.	Quad Relay	8.	Air heater Relay
2.	Opto Coupler	9.	FS4 - 80A
3.	Switch battery post 2	10.	FS3 - 60A
4.	ACT Relay	11.	Starter Relay
5.	Buzzer	12.	Battery post
6.	Atmosphere pressure sensor (APS) bracket	13.	Main Relay
7.	Mini Plug 1PDT	14.	Fuse block FS1 -10A FS2 -40A

SGUM 3500 Front View



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

SGUM 3500 Front View (Covers Removed)

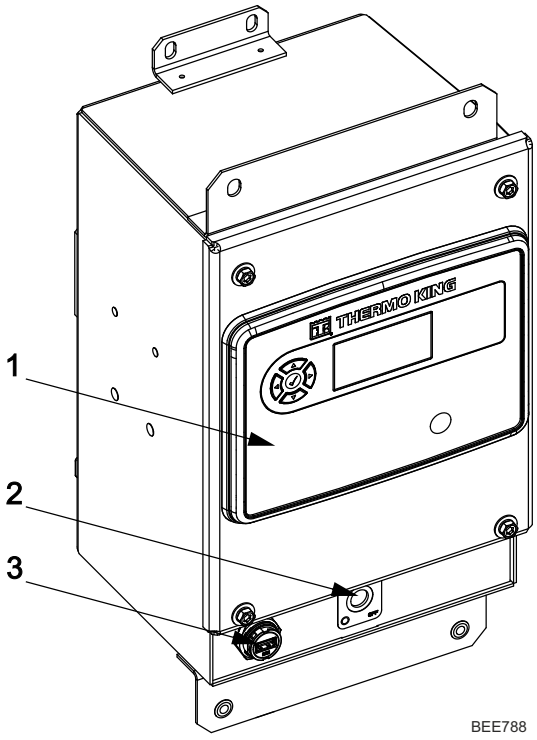


1.	Battery charger	8.	460 or 230 VAC Power Receptacle Location
2.	Alternator Assembly	9.	Telematics location
3.	Telematics antenna	10.	Control Box Location
4.	Engine	11.	Air Filter Assembly
5.	Cooling System Degas Tank and Pressure Cap	12.	Engine Oil Filter
6.	Burp Bottle Tank	13.	Fuel Filter / Water Separator (Primary)
7.	Battery Location		

SGUM 3500 Arms Mounting

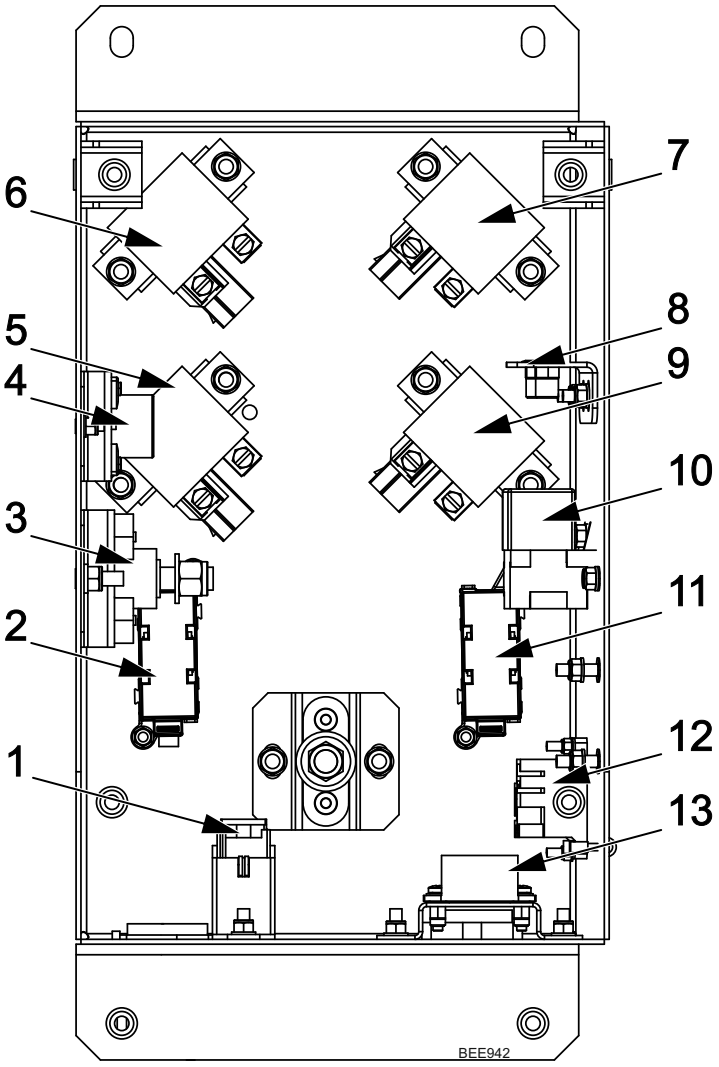
SGUM 3500 Telematics Fuel Sensor

SGCO 3500 Control Box (External)



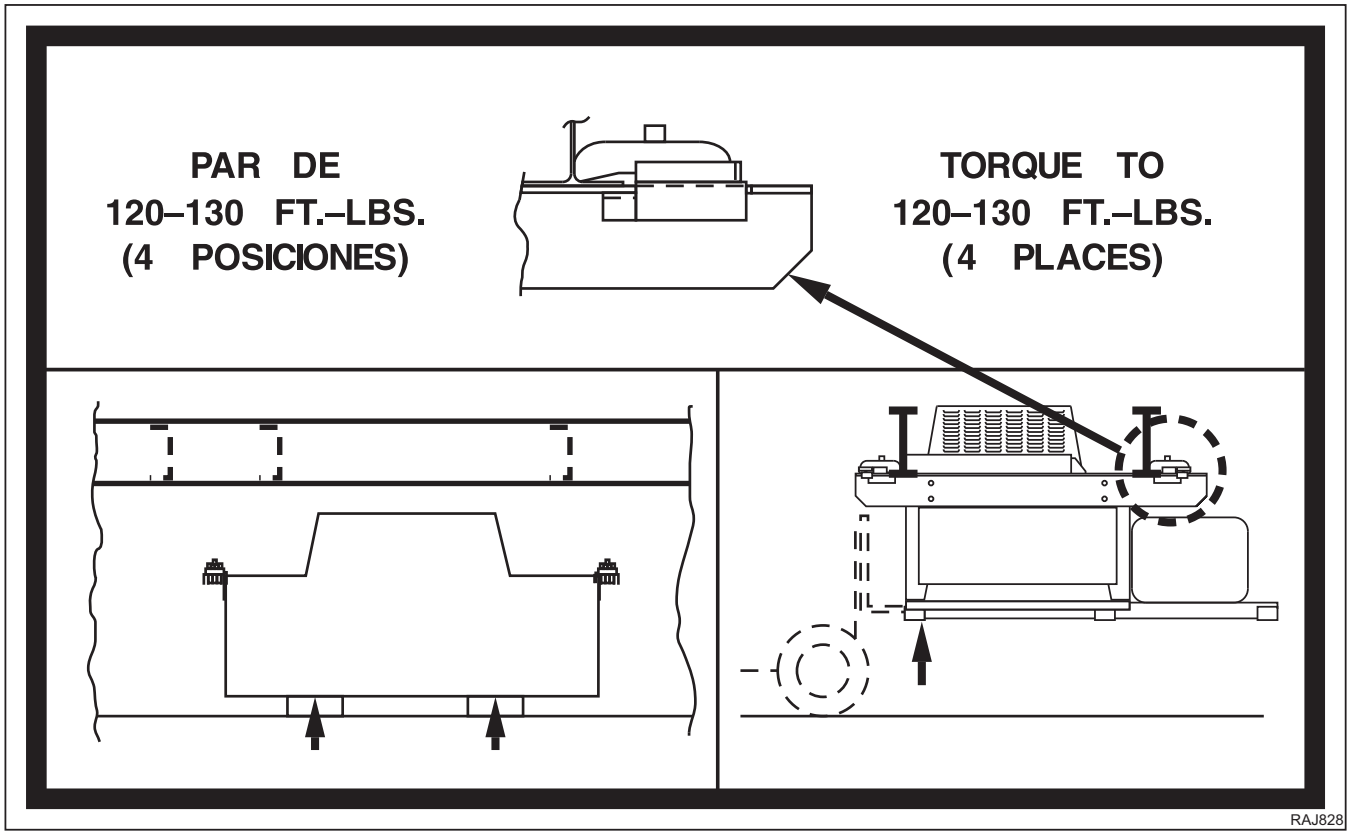
1.	Controller
2.	Unit ON / OFF Switch
3.	USB Port

Control Box SGUM Inside view

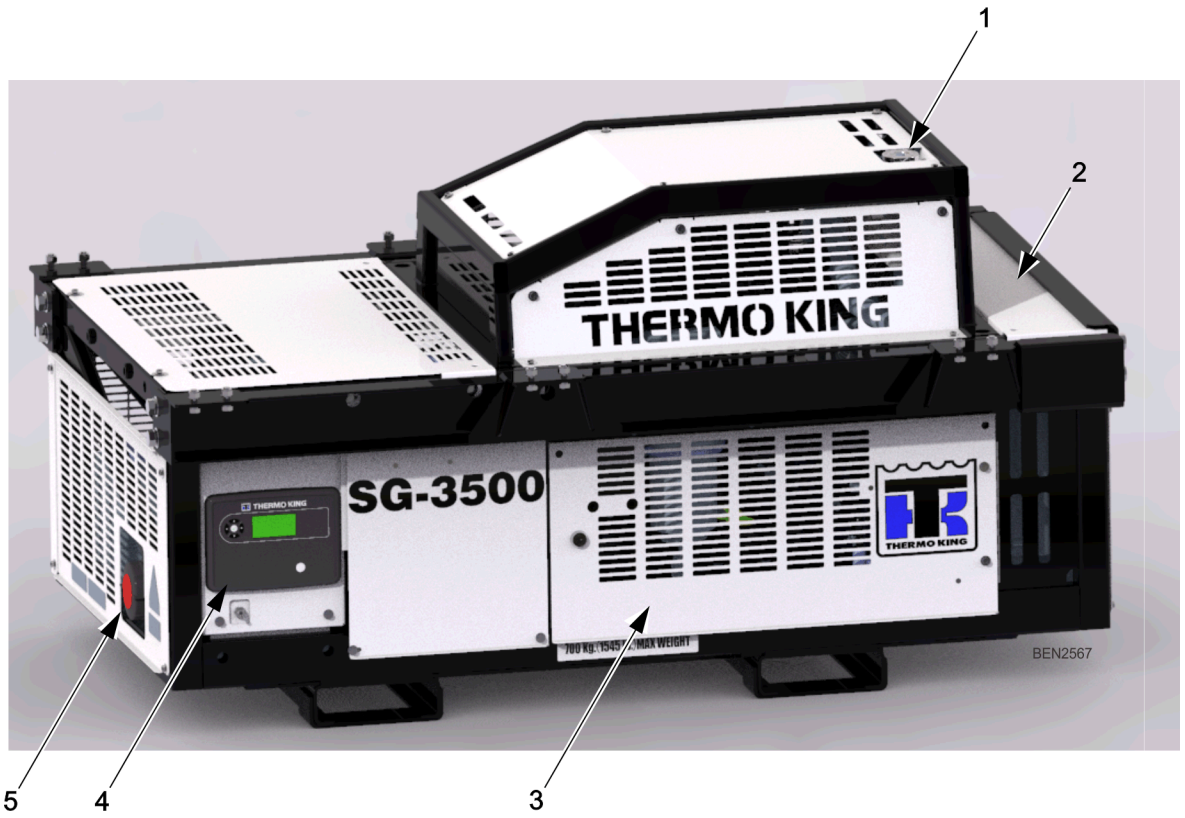


1.	Fuse block FS1 -10A FS2 -40A	7.	Main Relay
2.	FS4 - 80A	8.	Mini Plug 1PDT
3.	Switch battery post 1	9.	Starter Relay
4.	Buzzer	10.	FS3 - 60A
5.	Air heater Relay	11.	Quad Relay
6.	ACT Relay	12.	Opto Coupler

SGUM 3500 Installation Decal

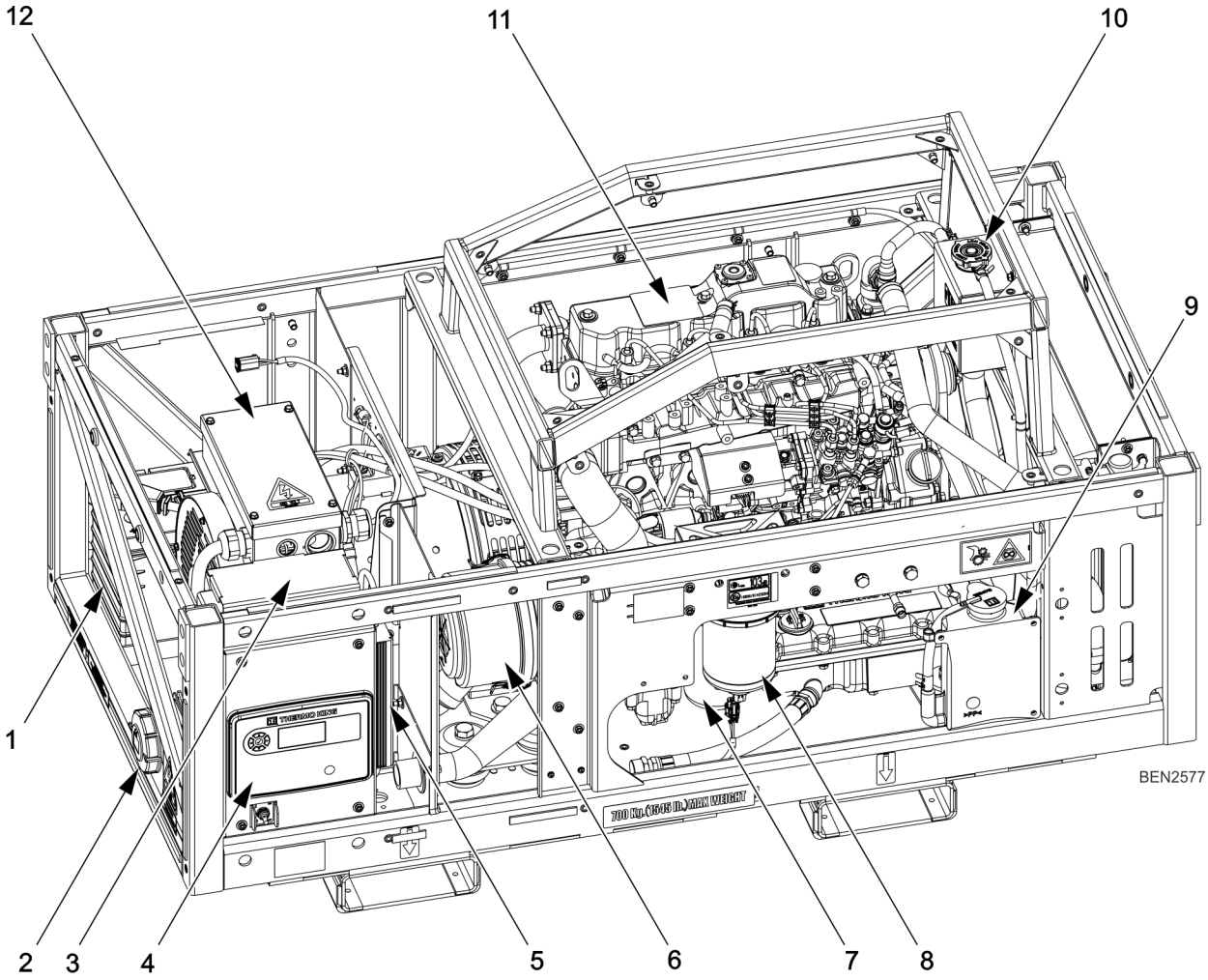


SGFM 3500 Front View



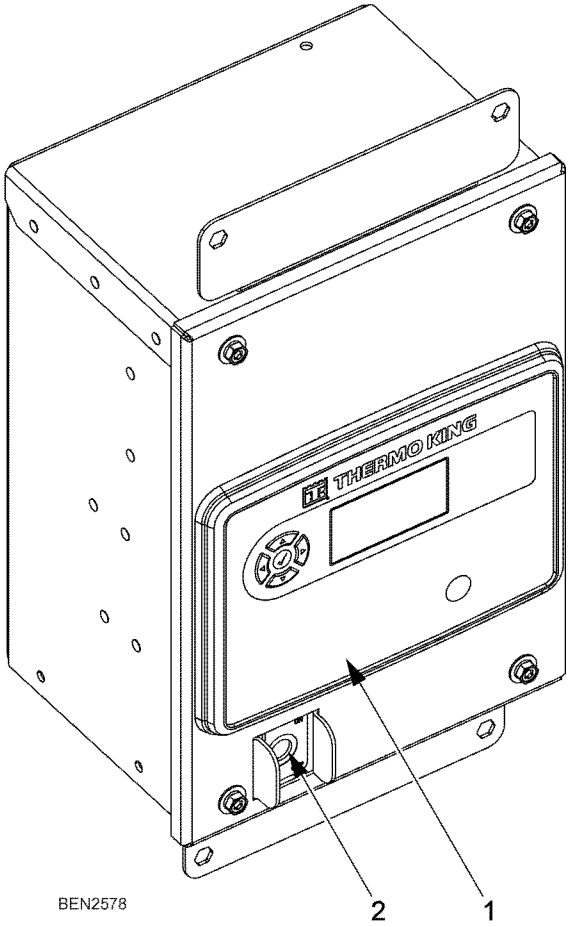
1.	Cooling System Degas Tank and Pressure Cap	4.	Control Box Location
2.	Radiator Location	5.	460 or 230 VAC Power Receptacle Location
3.	Front Access Door		

SGFM 3500 Front View (Covers Removed)



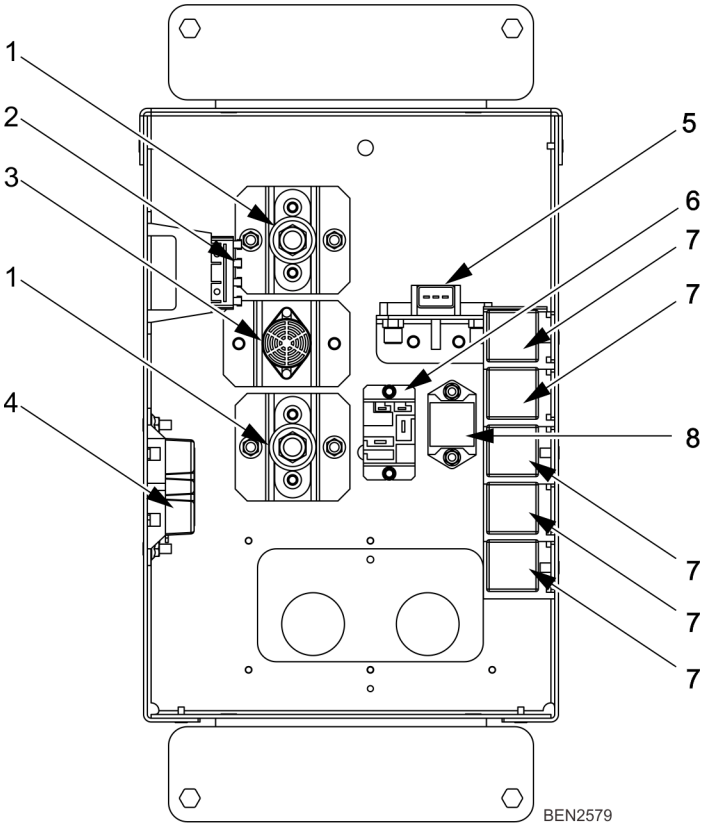
1.	Battery Location	7.	Engine Oil Filter
2.	460 or 230 VAC Power Receptacle Location	8.	Fuel Filter / Water Separator (Primary)
3.	Telematics Antenna	9.	Burp Bottle Tank
4.	Control Box Location	10.	Cooling System Degas Tank and Pressure Cap
5.	Battery charger	11.	Engine
6.	Air Filter Assembly	12.	Alternator Assembly

Figure 1. SGFM 3500 Control Box (External)



1.	Controller
2.	Unit ON / OFF Switch

Figure 2. Control Box SGFM Inside view



1.	Junction Box Studs	5.	Pressure Sensor
2.	Fuse Holder FS1 - 10A FS2 - 40A FS2 - 2A	6.	Relay
3.	Buzzer	7.	Relay
4.	Fuse Holder FS1 - 80A FS2 - 60A	8.	Oppo Isolator

Figure 3. SGFM 3500 Center Mounting Option

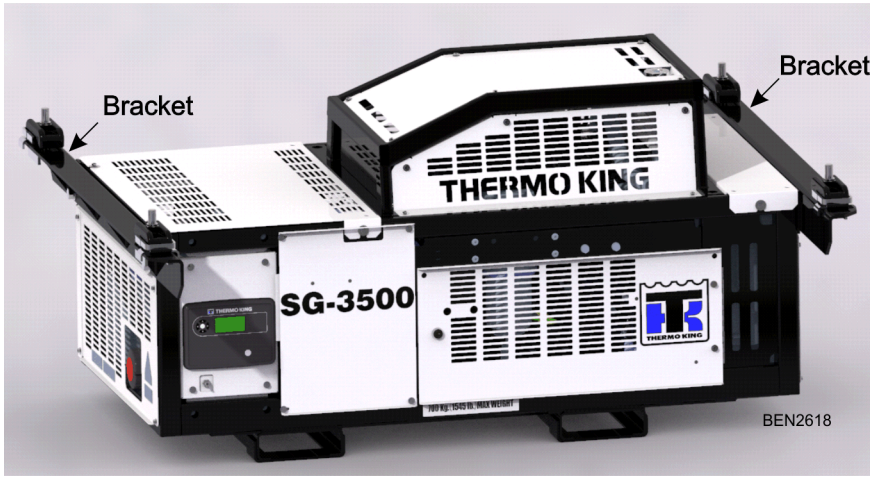


Figure 4. SGFM 3500 Transverse Mounting Option

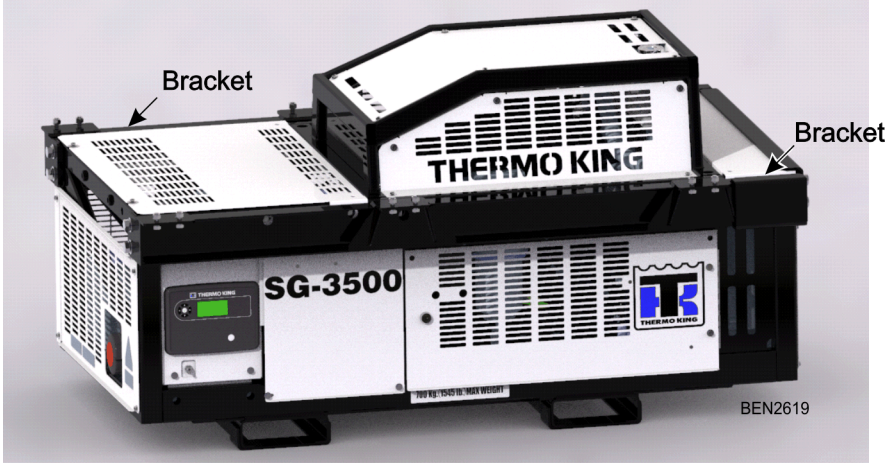


Figure 5. 30 Gallon (90 L) Fuel Tank with Telematics

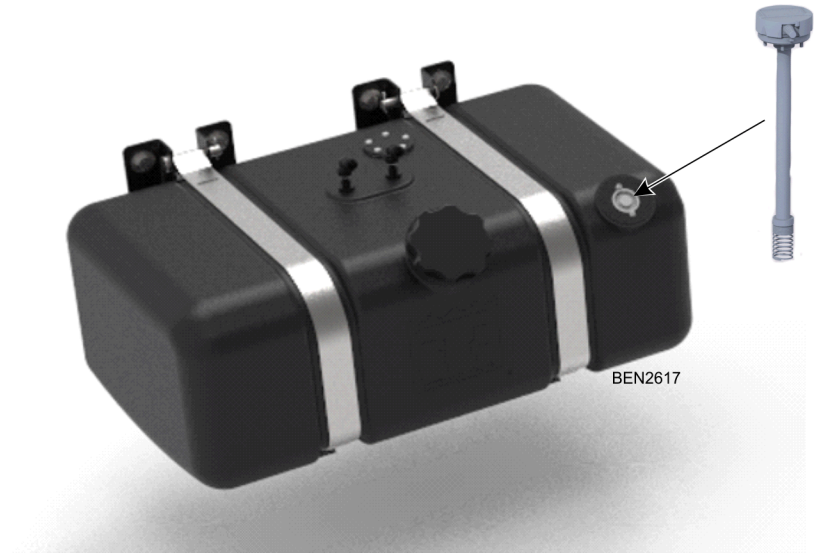
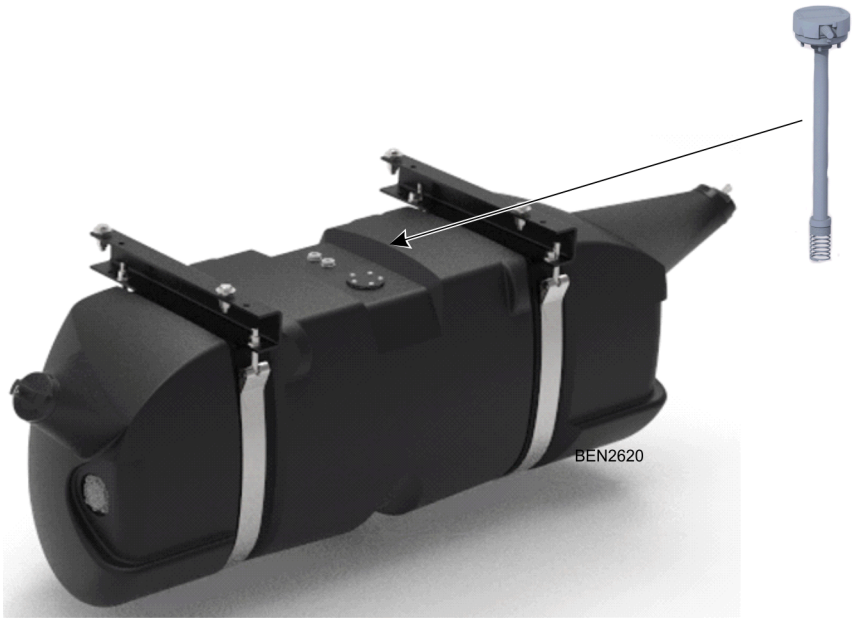


Figure 6. 80 Gallon (230 L) Fuel Tank with Telematics



Genset Model Features

SGUM 3500	SGCO 3500	SGFM 3500	Model
S	S	S	TK486VGE1
S	S	S	460 Vac Output for 15 KW, 18.75 KVA, 3 Phase, 60 Hz, 4 Wire Generator
O	O	O	230 Vac Output for 15 KW, 18.75 KVA, 3 Phase, 60 Hz, 4 Wire Generator
S	S	S	SG 3500 Control System
S	S	S	Battery with Post
S	S	S	Battery Charging System, Solid-state
S	—	S	Center-mount Unit mounting arms
—	O	—	Corner Casting mount
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	—	—	Integral 66 Gallon (250 Liter) Aluminum Fuel Tank
—	S	—	Integral 120 Gallon (454 Liter) Steel Fuel Tank
S	—	—	Integral 41 Gallon (155 Liter) Aluminum Fuel Tank
O	—	—	Integral 26 Gallon (98 Liter) Aluminum Fuel Tank
O	O	O	Fuel Monitoring - Monitoring and Recording of fuel level events.
O	O	O	Telematics
—	O	—	Dual Mount

S = Standard
O = Optional
— = Not Applicable

Controller and Operating Instructions

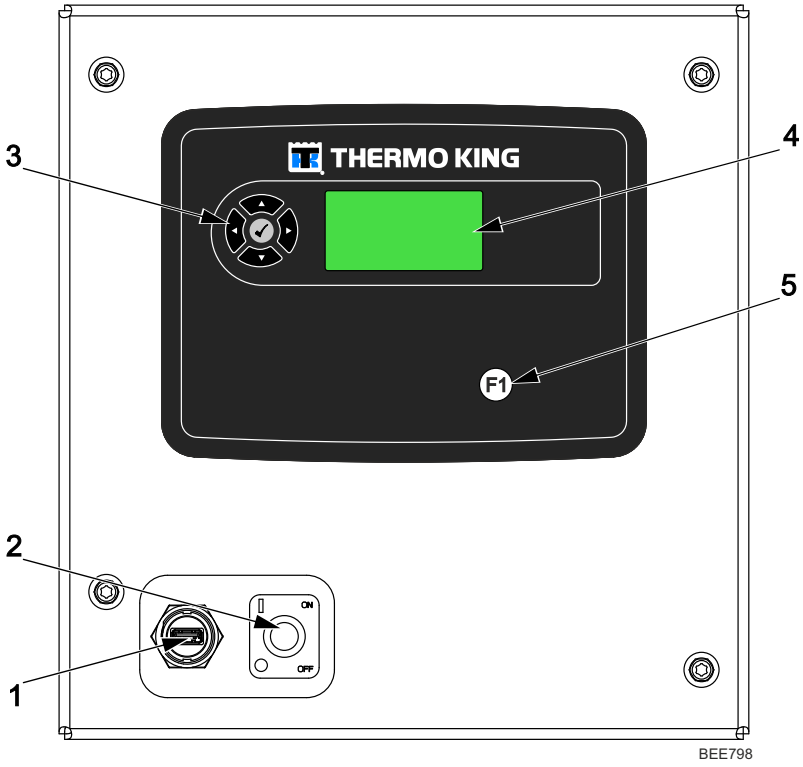
Controller Description

The controller is a one-piece, self contained microprocessor for diesel generator sets. The display and microprocessor is mounted in the cover. Six external relays - Main relay, Starter relay, Air Heater relay, Injector Actuator relay, Charger relay and Quad relay are also mounted inside the control box near the microprocessor.

This system automatically controls generator operation by providing:

- Automatic unit preheat and engine startup during initial startup or delayed restart
- Automatic Pretrip Test capability
- 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. Refer the "Alarms List," p. 54 section for Shut Down Alarm codes.

Controller Overview



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1.	**Download Port**	Is used to download the event logger and flash load new software.
2.	**Unit ON / OFF Switch**	In the ON position, the electrical control system energizes for unit operation. In the OFF position, the electrical control system de-energizes to stop the engine. The unit will not operate.
3.	**Directional keys**	Used to scroll up and down and left and right thru tabs
4.	**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.
5.	**Hot Key**	Is used to initiate pre-test, put the generator into stand-by mode, manual speed control mode.

Miscellaneous Controller Features

- Internal self-checking/diagnostic capability
- Pretrip test capability

- Display menus: The controller contains extensive display menus that can be navigated via the Directional keys.

Navigating the Controller Menus

Hot keys

F1

While Unit Starting

- Short Press: Will stop start sequence and ECU will remain ON
- Long Press: Initiate Pre-trip Test

While Unit Running

- Short Press: Enable manual speed selection. Shifting between high and low speed

Directional and Confirmation Keys

The outer arrow keys provide content navigation and the inner arrow key provides content selection and as well as confirmation of an action.

↑ / ↓Used to cycle through selected Menu Tab as described in Controller Display Menu section

← / →Used to switch between Top-Level Menu Tabs

✓ Used as Enter / Selection or Acknowledgment in select menus

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 :

- **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.
- **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.

Controller Interaction and Display

Unit Power Toggle Switch

There is a separate toggle switch on the Genset that will allow/ disallow battery power to the controller. This switch will be used by the customer to turn the Genset on and off

Genset power on

When the external switch is toggled on, power will be provided to the controller, which will then automatically initiate the genset start-up sequence as defined below

Genset power off

When the external switch is toggled to off, power will be disallowed to the controller will immediately shut off the Genset. This function needs to be hardware based to ensure that it also acts as a safety shutoff.

Controller Display

Splash Screen

Thermo King/Marine logo to be displayed as a splash screen for 10 seconds when the controller is switched on.

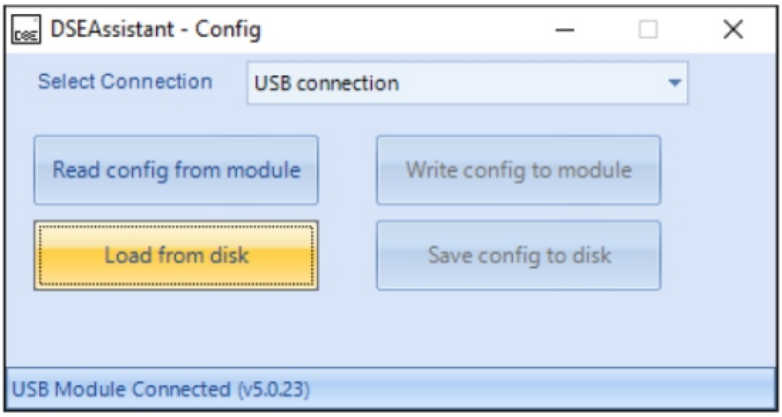
Active Display

The controller screen is to remain illuminated for 10 minutes whenever the unit is powered on. Following that 10 min duration, the back light can be switched off, and will resume whenever a key is pressed.

Flashloading the controller

1. Download the DSE Assistant program and controller firmware from Global Marine Solution Info Central site. Install the DSE Assistant on your PC. Create a DSE Controller Firmware fold under My Document, place the controller firmware in the folder.
2. Connect the module to the PC using a USB to USB cable

   Start the DSE Assistant program and select the Connection to be USB connection from the drop box.
3. Select Load from disk and locate the controller software under DSE Controller Firmware folder



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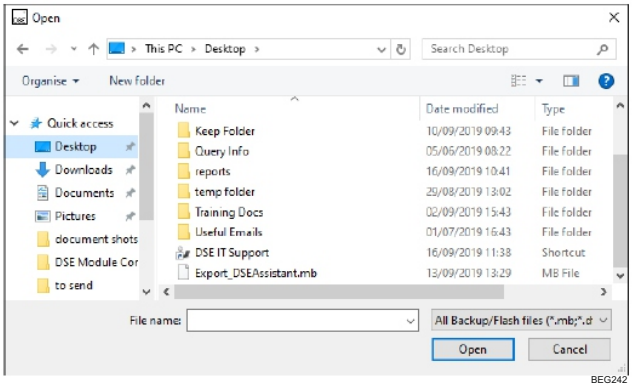
4. Select Open and the Write config to module will show active, click on to start the flashload



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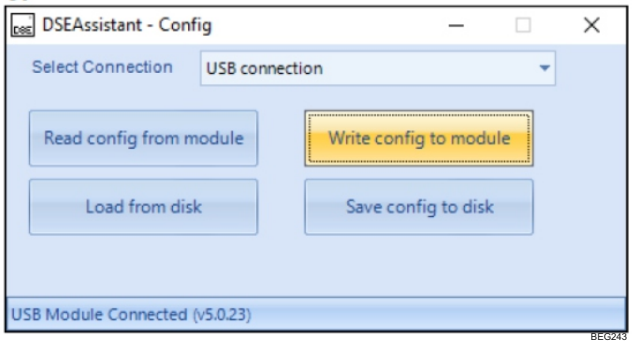
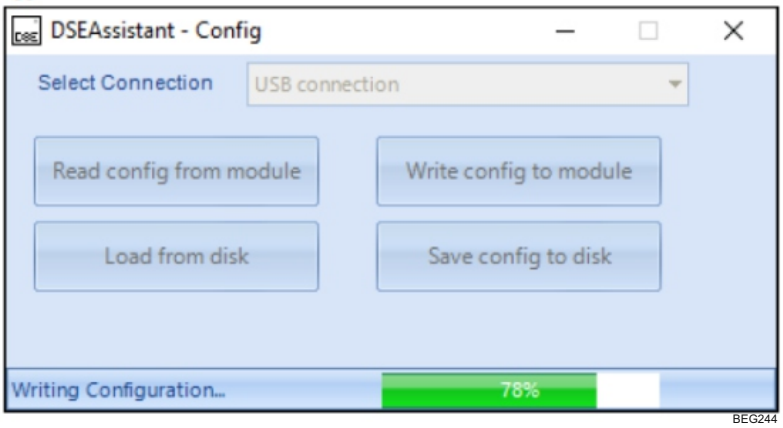


BEG243

5. Program will show Writing Configuration progress



Controller Display Menu

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

User to be able to Cycle through the top-level tab structure using the ←/→ arrows and view the displayed information by using the ↑ / ↓ arrows

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

- Status
- Engine
- Generator
- Alarms
- ECU Current DTC's
- Event Log
- Serial Port
- Genset Information
- PLC instruments
- About

Status

Displays a summary of electrical output

These lines are not 'selectable '. Data is readable only

Status tab submenu information:

- On Load
- Voltage
- Frequency

Engine

Displays Engine and System information and status

User to be able to Cycle through the menu using the ↑ / ↓

These lines are not 'selectable '. Data is readable only

Engine tab submenu information:

- Engine Speed
- Coolant Temperature
- Battery Voltage
- Engine Run Time
- WiF Status
- Engine percentage load
- Engine Link
- Can bus information

Generator

The Generator submenu display the status of the following outputs:

Displays Generator information, status and configuration

User to be able to Cycle through the menu using the ↑ / ↓

These lines are not 'selectable '. Data is readable only

Generator tab submenu information:

- Generator Voltage
- Generator Frequency

- Generator Phase Sequence
- Active Configuration (Volts)

Alarms

Displays a list of the current logged alarms

User to be able to Cycle through the menu using the ↑ / ↓

These lines are not 'selectable '. Data is readable only

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.

Active ECU DTC's Menu

Displays a list of the current logged Engine Diagnostic Trouble Codes

User to be able to Cycle through the menu using the ↑ / ↓

These lines are not 'selectable '. Data is readable only

Event Log

Displays the unit event log

User to be able to Cycle through the menu using the ↑ / ↓

These lines are not 'selectable '. Data is readable only

Serial Port Menu

Displays Serial Port information and condition

User to be able to Cycle through the menu using the ↑ / ↓

These lines are not 'selectable '. Data is readable only

Genset Data Menu and Config Details

Displays System Configuration

User to be able to Cycle through the menu using the ↑ / ↓

Allows the user to specify / modify various system conditions. All data is manually entered

PLC Instrumentation

Displays PLC Settings and condition

User to be able to Cycle through the menu using the ↑ / ↓

These lines are not 'selectable '. Data is readable only

- Restart Timer
  - Timer Countdown
  - Timer Total (Default 20)
- Low Speed Hours
- High Speed Hours
- Restart Attempts
  - Restarts attempted
  - Restart total (Default 3)

About

Displays Software information and revision.

User to be able to Cycle through the menu using the ↑ / ↓

These lines are not 'selectable '. Data is readable only

- Variant Version
- Application Version
- USB ID

- Bootloader Version
- Analogue Version
- Engine Type
- Version

Genset Start-up and Initial Runtime

The startup sequence is initiated by the user applying power to the controller by toggling the external switch to the on position.

Unit Start Sequence

Countdown Timer

A countdown will be displayed on the screen to inform the user that the start-up sequence is about to begin. This countdown is the time allowed for a used to interact with the controller and stop the start sequence

- Display “Start Delay” and the value displayed in seconds.
- Countdown timer is to be 30 seconds regardless of start process or preheat process
- Short press of FI will stop start sequence and ECU will remain ON

Buzzer

During a unit start sequence the controller will activate the buzzer in order to alert the user. This alert will cease at starter engagement.

- Buzzer to cease when starter engages

Engine Start Sequence

At the appropriate point in the Genset power on process, the controller will request an engine start by sending the appropriate message to the Yanmar ECU.

Start attempt:

1. Countdown timer is to be 30 seconds regardless of start process or preheat process
2. Buzzer is to sound for 20 seconds regardless of start process or preheat process
3. Controller to request engine start, and 1500 rpm operation.
4. Yanmar ECU to manage Preheat and Starter engagement.
5. Successful engine start is achieved when the Yanmar ECU broadcasts the appropriate CAN message.

Engine Restart Sequence

Following a start sequence where the engine did not start as defined above., the controller will take the following actions.

Display

- During the first restart attempt, the controller display will follow the process defined above.
- During subsequent restart attempts, the controller is to display “20 minute delay ” and the countdown timer

Restart Rules

- The controller is to count the number of restarts, and to continue attempting to restart the unit until the number specified in the unit configuration menu is reached
- After user defined number of restarts is expired, controller unit is to shut down and take no further action
- The restart counter it to reset to zero after 1 hour of unit running

First restart attempt

- If the engine fails to start on the first attempt, the controller is to repeat the start process immediately, beginning from the countdown timer step.

Subsequent restart attempts

- If the engine fails to start on the second attempt, the controller to initiate a 20-minute countdown timer followed by a 3rd attempt to start again
- Upon completion of the 20 minute countdown, the controller is to repeat the start process immediately, beginning from the 20 second Countdown Timer step.
- The number of restarts is to be user definable via the configuration menu.
- After user defined number of restarts is expired, controller unit is to shut down and take no further action.

Post Start

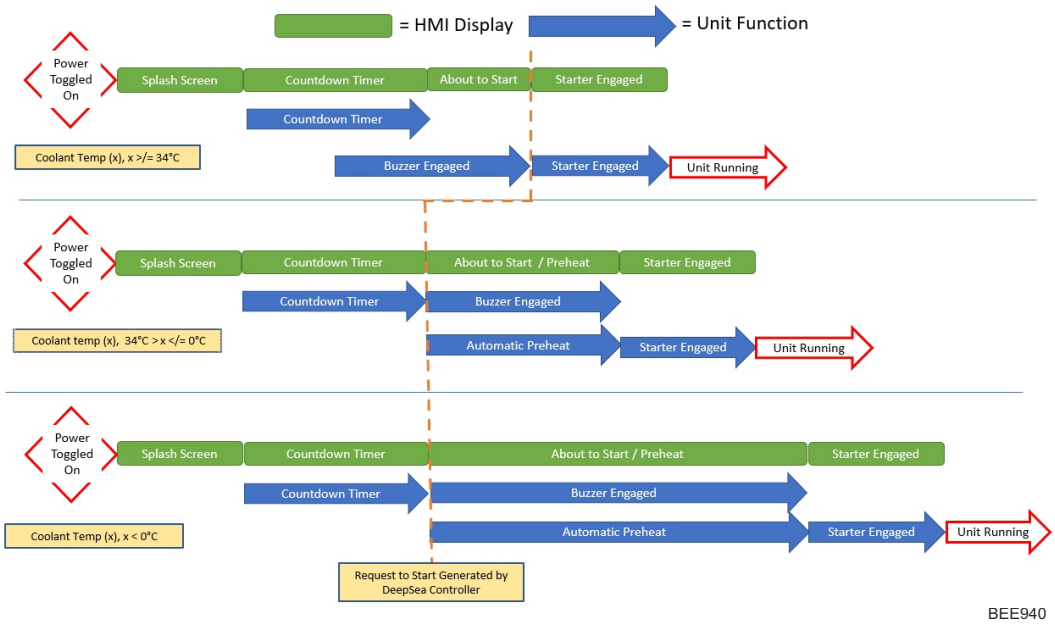
Following a successful start as defined above, and the controller has requested 1500 rpm operation, the controller is to take the following actions:

- Controller is to display “Delay to Output” This is to align with the non-energized state of the Quad Relay
- Engine is to remain at 1500 rpm for 2 minutes, then the controller is to request speed switch to 1800 rpm and remain at that RPM for 15 mins
- When the engine is shifted to 1800 rpm, the controller is to wait 10 seconds and then energize quad relay
- When the Quad Relay is energized the controller display is to revert to normal operation

Pre and Post Heat

- Coolant temperature =/> 34°C
  - No automatic pre-heat, or post-heat required.
- Coolant temperature =/> 20°C, < 34°C
  - 20 seconds of pre-heat, 0 seconds of post-heat
- Coolant temperature =/> 10°C, < 20°C
  - 20 seconds of pre-heat, 1 second of post-heat
- Coolant temperature =/> 0°C, < 10°C
  - 20 seconds of pre-heat, 10 second of post-heat
- Coolant temperature < 0°C
  - 50 seconds of pre-heat, 10 seconds of post-heat

Figure 7. Genset Start Sequence and Display Timing



Engine Operation and Speed Control

- Isochronous speed control to be used at all RPM’s
- The controller must evaluate engine load to select between 1500 or 1800 RPM operation using the logic below.
- The logic below applies only after completion of the Initial Runtime routine defined above
- The Genset is to remain in Low Speed (1500 rpm) at all times regardless of engine load with the following exceptions:
  - During the initial runtime routine, the engine will run in High Speed (1800 rpm) for 15 mins as specified in “Initial Runtime Routine”

– After that 15 minute period of High Speed (1800 RPM) operation. The controller is to shift to Low Speed (1500 RPM) operation if the Engine Load is </= 85% or >/= 97%

Engine Stall

If during normal operation the genset engine stalls and ceases to run, the controller will take the following actions.

- Review alarms for cause of shut down.
- If alarm level permits a restart (as defined in alarm section) then the controller to initiate an engine restart following the process outlined in the Genset Start Sequence above
- Attempted restarts after an engine stall event does not require the 20 minute delay step, the controller should attempt restart immediately.
- Attempted restarts after engine stalls are not to be considered in the count of re-start attempts as defined by the user in the configuration menu.
- Engine stall is defined if the engine is at 100% load, is unable to maintain requested RPM and ceases to run

Unit Alarm Monitoring

During on time, the controller needs to monitor the Genset system function and react as defined in the Alarm Handling and Protection

Genset Service and Pre-trip Testing

Pre-trip Testing

Allows the User to test the genset for ability to perform a self-diagnostic test prior to sending the unit out for operation. The test verifies no operational issues prior to Genset being put into service

•

1. PTI is initiated by pressing and holding the **F1** button while unit is waiting to start.
2. When initiated, the controller will begin the engine start sequence from the beginning of the buzzer alert .
3. Genest is to bypass the 2 mins excitation delay and then test the high and low speed operation of the genset. The controller shall also test generator output voltage at those speeds.
4. **Pass** = Controller to receive appropriate run confirmation from the Yanmar ECU, the generator and any internal DSE specific operations
5. **Fail** = Lack of receipt of appropriate run confirmation from the Yanmar ECU, the generator and any internal DSE specific operations
6. All items in the below Manual function test sub menu shall be validated and logged for “Pass” or “Fail

Manual Speed Control

Allows User to lock the unit temporarily into high or low speed operation.

- For manual speed control the unit must wait to energize quad relay.
- To enable speed override press and Hold the F1 button while the unit is running.
- Cycle speed selection by pressing F1 button while in speed override mode.
- Operating RPM to return to normal after 5 mins of inactivity

Service Mode

Service mode is used for the YSAD tool communication to ECU for part replacement or firmware updates to ECU

Allows the user to prevent engine start, while still providing interaction with all unit menus.

- Service Mode initiated from this level in the menu via the **F1** button
- If initiated during the countdown, the controller is to stop the Genset start sequence
- All menus to be active and accessible for review / modification
- Engine is to remain off. The user will cycle the power switch to reset and begin start sequence as described above

Event logging

All logged events must be logged in non-volatile memory and include a time and date, along with the other specific data called out.

The list below is the event to be captured in the unit event log:

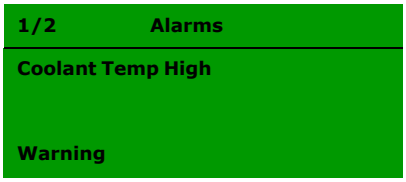
- Power on/off event.
- ECU Lamps
- Engine Starts and Stops
- Shutdown Alarms
- Warning Alarms
- Latched / Unlatched Warnings
- Speed Shift events
- Engine P-codes and alarms.
- PTI Test - Also to log the Pass / Fail

Alarms List

Warning Alarms

Warnings are non-critical alarm conditions and do not affect the operation of the engine system, they serve to draw the operators attention to an undesirable condition.

Example:



In the event of an alarm the LCD jumps to the alarms page, and scroll through all active alarms.

By default, warning alarms are self-resetting when the fault condition is removed.

Shutdown Alarms

Shutdown Alarms are latching and immediately stop the Generator. Once this has occurred, the module shuts the generator set down immediately to prevent further damage. To restart the generator the fault must be cleared and the alarm reset.

Alarm Codes

Level	Alarm Code	Alarms	DTC code	ECU current DTCs	Description
Shut Down	101	Crank Attempts Expired			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.
Warning	102	Failed to Start			The generator had failed to start as it did not meet the required Crank Disconnect criteria during the configured number of Crank Attempts.
Warning	103	Failed to Stop			Module detected that the generator is running when the DSE module has instructed it to stop.
Shut Down	105	Low Oil Level			If low oil level for 60 seconds.
Warning	108	Coolant Level Low			Low Coolant Level detected. - Initiates 20 min restart delay
Shut Down	109	Water in Fuel			Water in the fuel had been detected.
Warning	302	ECU amber	P1192 S= 100 F=4	Oil Press Switch	The circuit to the engine oil pressure sensor had become open
					The low oil pressure switch had activated after the Safety On Delay timer had expired.
					Engine oil pressure had fallen below the Low Oil Pressure Shutdown Trip level after the Safety On Delay timer had expired.
Warning	302	ECU amber	P0219 S= 190 F=0	Engine Speed High - most severe	The engine speed had risen above the Run Away Trip level.
					The engine speed had risen above the Over Speed Alarm Trip level for the configured delay timer.
					The engine speed had risen above the Over Speed Overshoot Trip level
Warning	302	ECU amber	P0118 S= 110 F=3	Coolant Temperature High voltage, or short	The coolant temperature sensor has become open circuit.
					The high engine coolant temperature switch had activated after the Safety On Delay timer had expired.
					The engine coolant temperature had risen above the High Coolant Temperature Shutdown Trip level after the Safety On Delay timer had expired.
Shut Down	116	Calibration Fault		Calibration Fault	Controller internal calibration has failed. The unit must be sent back to DSE to be investigated and repaired.
Warning	117	PTI passed			
Warning	118	PTI activated			
Warning	119	20 Minute Crank Lockout			
Shut Down	120	Pre Trip Test Fail			
Warning	121	Speed Override Mode Enabled			If Manual Speed Switching is Enabled and toggle button is inactive for 5 minutes, go back to Auto Mode

Level	Alarm Code	Alarms	DTC code	ECU current DTCs	Description
Warning	122	Shift to High Speed			When the genset shifts from low to high speed (HS set at 1800rpm)
Warning	123	Shift to Low Speed			When the genset shifts from high to low speed (LS set at 1500rpm)
Shut Down	301a	ECU Protect			The module received a protect fault condition from the engine ECU. Connect ECU Test Tool to read codes.
Shut Down	301b	ECU Red			The module received a red fault condition from the engine ECU. Connect ECU Test Tool to read codes.
Warning	302	ECU Amber			The module received an amber fault condition from the engine ECU. Connect ECU Test Tool to read codes.
Shut Down	410	Gen Over Voltage			The generator output voltage had risen above the Over Voltage Alarm Trip level for the configured delay timer. See "Alternator Diagnosis"
Shut Down	411	Gen Below Voltage			The generator output voltage had fallen below the Under Voltage Alarm Trip level for the configured delay timer after the Safety On Delay timer had expired. See "Alternator Diagnosis"
Shut Down	422a	Gen Under Frequency			The generator output frequency had fallen below the Under Frequency Alarm Trip level for the configured delay timer after the Safety On Delay timer had expired. See "Alternator Diagnosis"
Shut Down	423a	Gen Over Frequency			The generator output frequency had risen above the Run Away Trip level. See "Alternator Diagnosis"
Shut Down	423b	Gen Over Frequency Overshoot			The generator output frequency had risen above the specified trip. See "Alternator Diagnosis"
Shut Down	423c	Gen Over Frequency			The generator output frequency had risen above the Over Frequency Alarm Trip level for the configured delay timer. See "Alternator Diagnosis"
Shut Down	800	ECU Malfunction			The module received a malfunction fault condition from the engine ECU. Connect ECU Test Tool to read codes.
Shut Down	801	ECU Data Fail			The module is configured for CAN operation but has not detected data being sent from the engine's ECU.
Shut Down	—	Generator Locked Out			The generator has cranked 3 times without success. Check the fuel level and the battery voltage.

Electrical Maintenance

Battery

⚠ Caution

Risk of Injury!

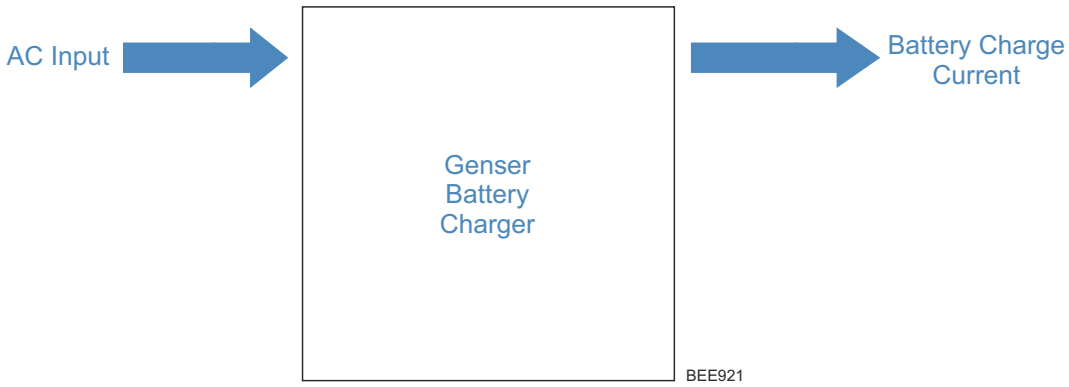
Place the unit On/Off switch in the "OFF" position, Before connecting or disconnecting the unit battery.

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.*

Genset Battery Charger Specification



I/O Descriptions

AC Input

Voltage supplied to the charger will be:

AC Frequency will change depending on load demand on the engine. At low load, it will be 50Hz. At High load it will be 60Hz

Will operate in the voltage range of 200 VAC 50 Hz/ 230 VAC 60 Hz.

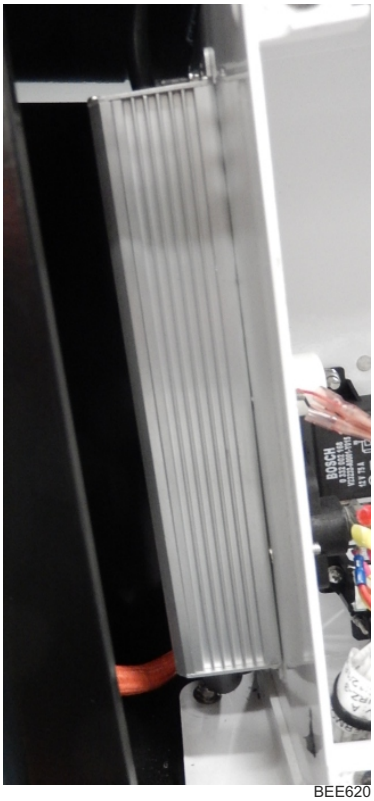
Battery Charge Current

The charger will be capable of bulk charging the battery at 19 Amps

Battery Charge Voltage

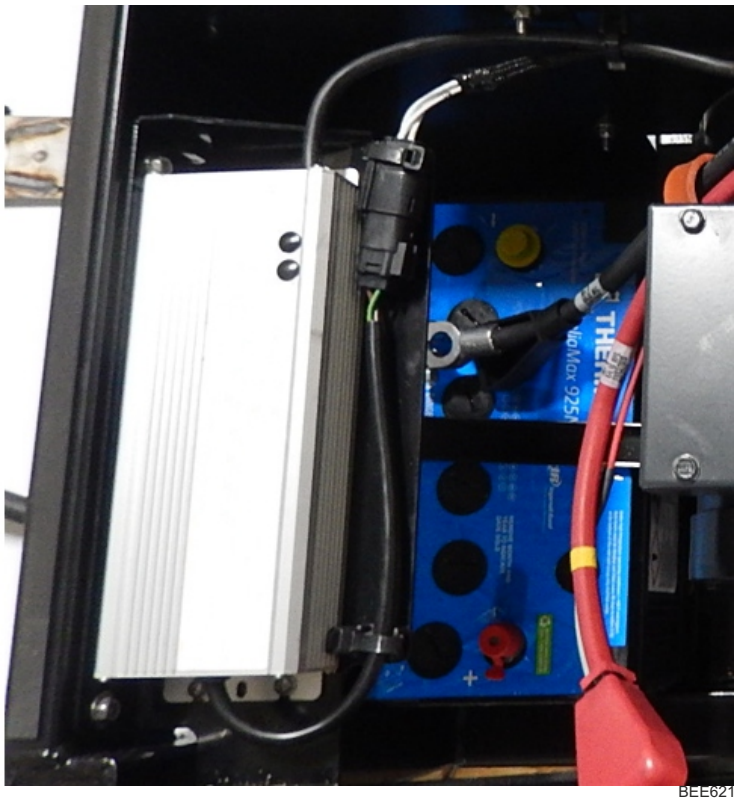
The charger will be used with lead acid batteries with a nominal operating voltage of 14.1 volts. The charger will be capable of charging nearly discharged batteries.

Battery charger



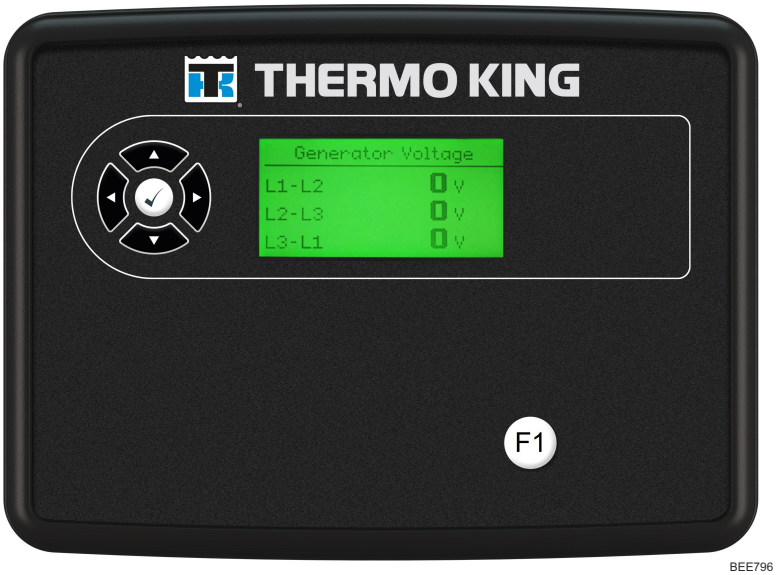
BEE620

Battery charge



BEE621

Microprocessor Controller



BEE796

Fuses

Fuse FS1 (Located in Control Box)	10 Amp - Battery Post to Main Relay
Fuse FS2 (Located in Control Box)	40 Amp - Battery Post through ON/OFF switch to SW Post
Fuse FS3 (Located in Control Box)	60 Amp - Starter Fuse
Fuse FS4 (Located in Control Box)	80 Amp - Air Heater Fuse
Fuse FS5 (Located in Control Box)	2 Amp - Battery Post to Telematics
Fuse FS6 (Located in Control Box)	2 Amp - SW Post to Telematics

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.

Engine Oil Sensors

Engine Low Oil Pressure Switch

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

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

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

Engine Oil Level Sensor

Switch Test:

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

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

Switch Removal and Installation:

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

Bench Test:

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

Engine Maintenance

EMI 3000

EMI 3000 is an extended maintenance interval package. 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 Fuel Filter
- 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.

Note: *Units equipped with the EMI 3000 package do require regular inspection in accordance with Thermo King's maintenance recommendations.*

Note: *The new EMI 3000 oil filters and new EMI 3000 air cleaners are NOT interchangeable with the oil filters and air cleaners previously used in trailer units.*

Engine Lubrication System

The TK486 family of engines use a pressure lubrication system. Refer to the TK482 and TK486 Engine Overhaul Manual (TK 50136-2-OM) for a detailed description of the engine lubrication system.

Engine Model / Oil Pump Type

- TK486V25 - Parachoid Oil Pump
- TK486V25L - Parachoid Oil Pump
- TK486V25X - Parachoid Oil Pump
- TK486V25L1 - Trochoid Oil Pump (the upper oil sump, gear case, gear case cover, and crankshaft are different to accommodate the trochoid style oil pump)
- TK486V25X1 - Trochoid Oil Pump (the upper oil sump, gear case, gear case cover, and crankshaft are different to accommodate the trochoid style oil pump)

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.

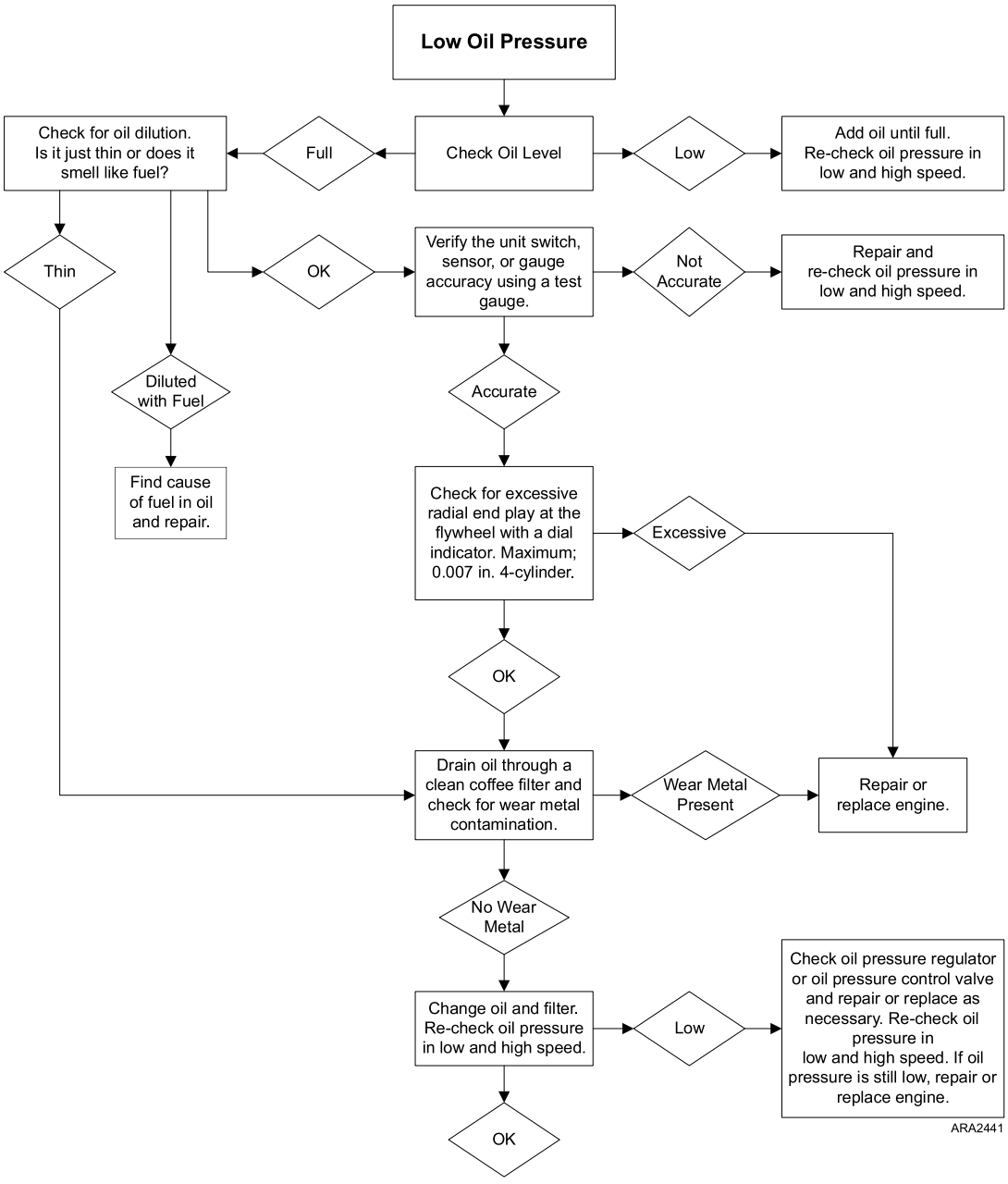
1. Remove the filter.
2. Fill the new oil filter with clean engine oil.
3. Apply oil to the two inner O-rings of the new filter and install the filter.
4. Hand tighten the filter until it seats firmly. The exposed dust seal ring, if equipped, does not need to be compressed.
5. Start the unit and check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

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 8, p. 64) to help diagnose low oil pressure.

Figure 8. 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 a belt driven centrifugal pump. The pump draws the coolant from the side of the radiator, circulates it through the cylinder block and head and returns it to the radiator. A thermostat mounted in the coolant outlet line from the cylinder head to the radiator automatically maintains coolant temperature within the specified temperature range.

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

This provides the following:

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

Extended Life Coolant (ELC)

ELC is used in this unit. A nameplate near the coolant expansion tank identifies units with ELC.

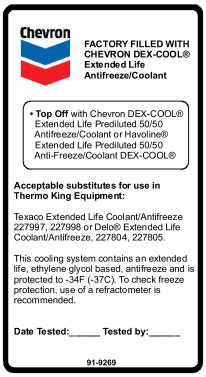
Notice

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.

Note: *The new engine coolant, Chevron Extended Life Coolant, is RED in color instead of the current GREEN or BLUE-GREEN colored coolants.*

Figure 9. ELC Nameplate Located Near Expansion Tank



The following are the Extended Life Coolants currently approved by Thermo King for use in ELC units for five years or 12,000 hours:

- Chevron Dex-Cool
- Texaco ELC (nitrite free)
- Havoline Dex-Cool (with nitrates)
- Havoline Dex-Cool (nitrite free)
- Shell Dexcool
- Shell Rotella
- Havoline XLC (Europe)
- Saturn/General Motors Dex-Cool
- Caterpillar ELC

- Detroit Diesel POWERCOOL Plus

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

Antifreeze Maintenance Procedure

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

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

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

Checking the Antifreeze

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

Changing the Antifreeze

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

⚠ Caution

Risk of Injury!

Avoid direct contact with hot coolant.

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

⚠ Caution

Risk of Injury!

Avoid direct contact with hot coolant.

   c. Open the engine block drain to drain the water and flushing solution.
3. Inspect all hoses for deterioration and hose clamp tightness. Replace if necessary.
4. Loosen the water pump belt. Check the water pump bearing for looseness.
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

Notice

Equipment Damage!

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

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

1. Remove the plug (1) from the front end of the water pump below the thermostat housing as shown ().
2. Slowly pour the coolant into the system until you see coolant at the plug fitting.
3. Reinstall the plug.
4. Pour coolant into the system until it appears to be full.
5. Verify that the amount of coolant that goes back into the system is approximately equal to the amount of coolant that came out of the system.
6. Start the engine and monitor the coolant temperature with the unit engine coolant temperature gauge, or by using a non-contact thermometer pointed at the thermostat housing in the location of the high water temperature switch or sensor.
   a. When the temperature reaches 150 F (66 C), shut the engine off for two minutes.

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

Engine Thermostat

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

Coolant Level Switch

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

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

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

Engine Fuel System

The components of the fuel system are:

- Fuel tank
- Fuel filter
- Hand fuel pump
- Transfer pump
- Injection pump
- Injection nozzles

Operation

The injection pump forces the fuel, at a very high pressure, through the injection nozzles. The injection nozzles atomize the fuel as it is injected directly into the combustion chambers.

Injection pump leakage, injection nozzle overflow and excess fuel from the fuel filter orifice are then all sent back to the fuel tank through the return line.

Fuel Line Routing

The fuel lines from the fuel tank connect to the fittings on the fuel filter. Do not change the factory routing of the fuel lines from the fuel filter to the injection 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

The injection pump and fuel transfer pump are relatively trouble-free and if properly maintained will usually not require major service repairs between engine overhauls.

Contamination is the most common cause of fuel system problems. Therefore, to ensure best operating results, the fuel must be clean and fuel tanks must be free of contaminants. Change the fuel filter/water separator regularly, inspect/clean the fuel pre-strainer, and clean the inlet strainer on the inlet side of the fuel transfer pump.

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

Note: *The injection nozzles must be cleaned and tested (and repaired if necessary) at least every 9,000 hours. Normal conditions are considered to be the use of clean high quality fuel, blended oils are not recommended, and regular maintenance of the fuel system according to the Maintenance Inspection Schedule. Refer to the Engine Overhaul Manual TK 50136 for injection nozzle testing and repair procedures.*

Note: *Use only diesel fuel that conforms to EN590 standard.*

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.

Any major injection pump or nozzle repairs should be done by a quality diesel injection service shop. The necessary service equipment and facilities are not found in most engine rebuild shops because of the large investment required.

The following procedures can be accomplished under field conditions:

- Bleeding air from the fuel system.

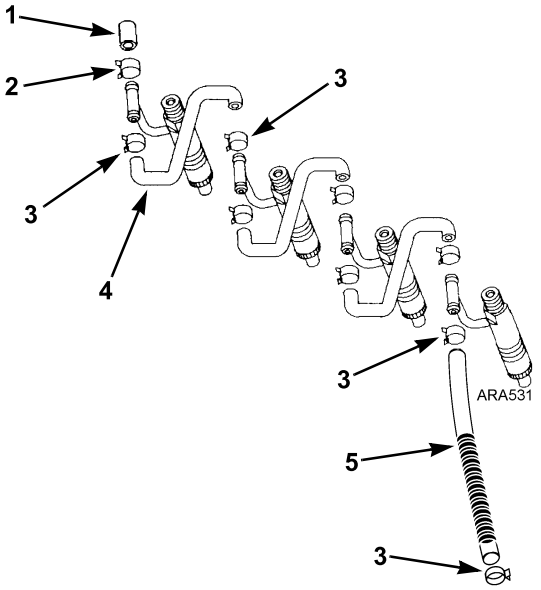
- Fuel tank and filter system maintenance.
- Priming pump (hand) replacement or repair.
- Fuel transfer pump replacement or repair.
- Injection line replacement.
- Engine speed adjustments.
- Injection pump timing.
- Nozzle spray pattern testing and adjustment.
- Injection nozzle testing, adjustment, and minor repair.
- Trochoid feed pump replacement.

Fuel Return Line Replacement

Use the following procedure to replace the fuel return lines and end cap.

1. Remove the clamps, the end cap, the short fuel return lines between the injection nozzles, and the long fuel return line from the injection nozzle to the banjo fitting on the injection pump.

Figure 10. Fuel Return Line Replacement



1.	End Cap	4.	Short Fuel Return Lines
2.	Larger Clamp	5.	Long Fuel Return Lines
3.	Smaller Clamps		

2. Discard the old clamps, end cap, and fuel return lines.
3. Install the end cap and clamp. Note that the end cap has a larger OD than the other hoses and requires the larger clamp.
4. Install the fuel return lines and clamps. It may be necessary to adjust the banjo fitting slightly to obtain the straightest routing for the long return line.
5. Be sure all the fittings are tight and check for leaks.
6. Write the date and engine hours on the decal.

Bleeding the Fuel System

SG 3500 Series

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

To bleed air from the fuel system:

1. Reconnect the battery.
2. Place a proper fuel catch pan under the fuel filter location.
3. Turn the unit on. **Do not allow the engine to start.**
4. When pumping fuel, open the bleed screws on the top of the fuel filter heads.
5. Air from the fuel system will escape through the open bleed screws. When all the air has escaped, and a constant flow of fuel is existing the open bleed screws:
   - 1 - Tighten the primary fuel filter bleed screw first.
6. Turn the unit OFF and clean any spilled fuel. Dispose of fuel and filter according to local regulations.
7. 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.

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

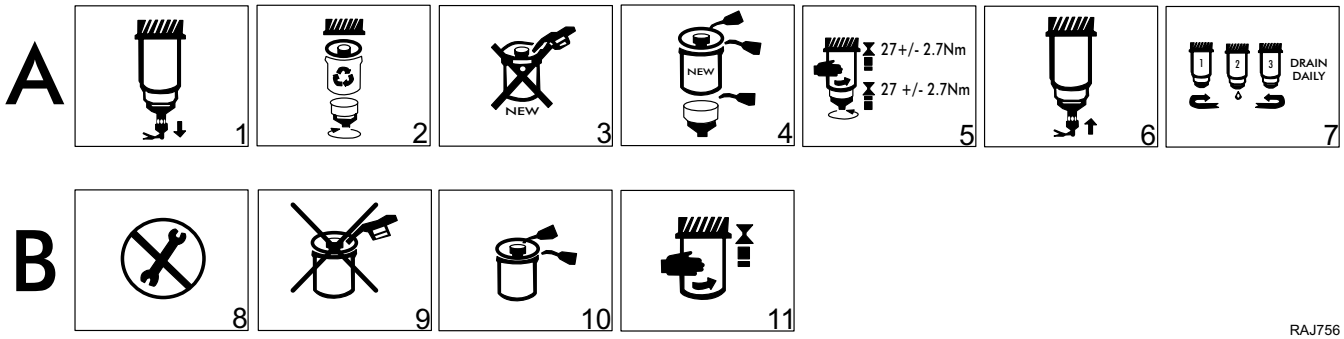
Fuel Filter and Water Separator Service

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

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

Filter Icon Identification

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



RAJ756

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

Injection Pump and Engine Speed Control

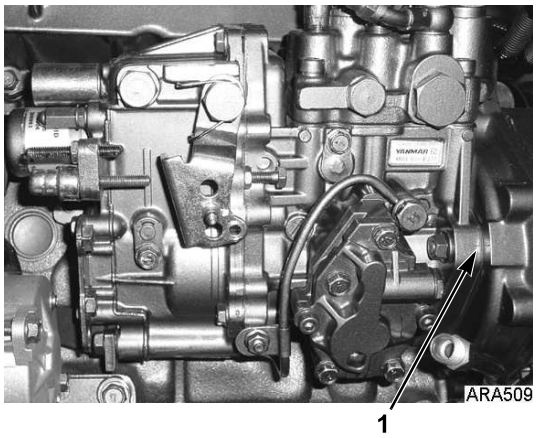
The Eco-governor engine has an electronic governor which controls the fuel supplied to the injection pump. It uses a proportional solenoid to control the amount of fuel. There is an ECU which controls the position of the proportional solenoid. The ECU and proportional solenoid controls the engine speed within +/-30 RPM and allows for up to 4 engine speeds to be selected depending on the unit model. For more Information see Yanmar TK486VEGS5 Engine Troubleshooting Manual.

Injection Pump Removal

The injection pump drive gear will not fit through the gear housing when removing the pump, the gear must be separated from the pump. Using tool P/N 204-1011, it will not be necessary to remove the belts, crankshaft pulley, crankshaft seal or front plate. See Figure 13, p. 74.

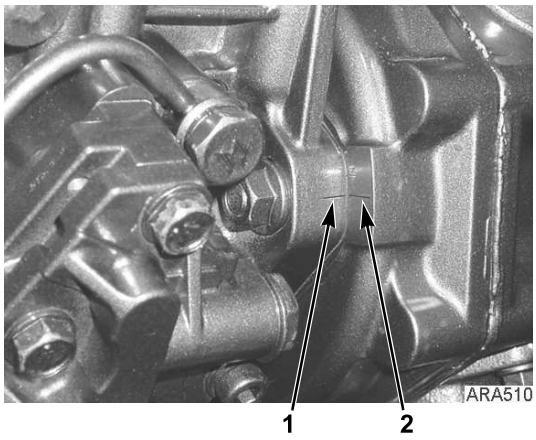
1. Note the alignment of the index marks on the injection pump and the gear case. The index mark on the injection pump is usually aligned with the single index mark on the gear case. If not, mark it so the injection pump can be returned to the same position when it is reinstalled.

Figure 11. Index Mark Location



1.	Index Marks

Figure 12. Index Mark Alignment



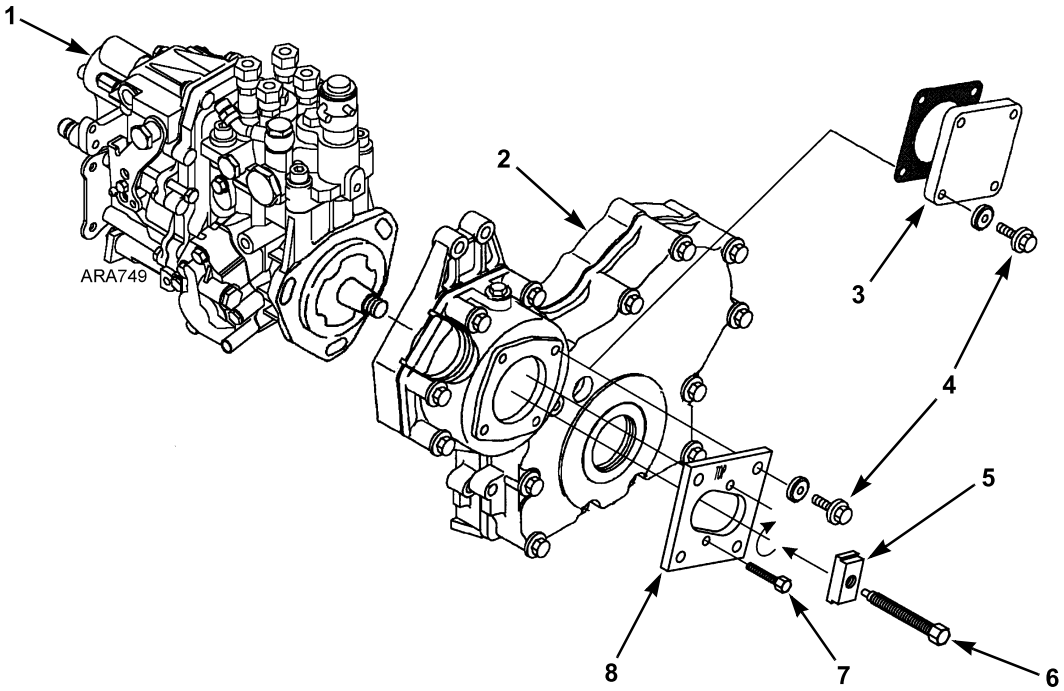
1.	Index Mark on Injection Pump
2.	Index Mark on Gear Case

2. Remove the starter for clearance, remove throttle linkage, fuel lines, harness and mounting hardware from injection pump.
3. Remove the cover plate from the gear case. Remove the nut and lock washer which secure the gear to the injection pump shaft. Use a shop rag to prevent the lock washer or nut from falling into the gear case.

   Note: *The injection pump gear assembly is made of three pieces; the flange, the gear, and the transfer pump cam. Do not loosen or remove the four bolts that fasten the gear to the flange because that changes the timing.*
4. Use the hardware from the cover plate to attach the tool plate (with the marked side pointing up and out) to the gear case.

5. Align the threaded holes in the injection pump gear with the two holes in the tool plate by rotating the engine crankshaft. Attach the gear to the tool plate with the screws provided with the tool plate.
6. Thread the long screw supplied with the tool plate into the small end of the adapter, also supplied with the tool plate. Insert the adapter into the tool plate and rotate to provide a solid position to force the injection pump shaft from the gear. Caution should be made to align the screw over the center of the injection pump shaft.
7. Remove the screw and adapter leaving the tool plate in place. This holds the gear in proper tooth alignment until the injection pump is re-installed.

Figure 13. Injection Pump Gear Tool



1.	Injection Pump	5.	Adapter (Tool)
2.	Gear Case	6.	Tool Long Screw (Tool)
3.	Cover Plate	7.	Tool Short Screw (Tool)
4.	Cover Plate Bolt	8.	Tool Plate (Tool)

Injection Pump Reinstallation

1. Position injection pump shaft into gear, rotating shaft to mate key with keyway in gear. Take care to make sure the key mates with the keyway.
2. Secure injection pump to gear case with previously removed hardware. Make sure to align the index marks on the injection pump and the gear case like they were in step 1 of "Injection Pump Removal," p. 73.

   Note: *If a different injection pump is being installed, see "," to set the timing.*
3. Remove hardware holding gear to tool plate, then remove tool plate.
4. Secure the gear to the injection pump shaft with the lock washer and nut. Use a shop rag, as before, to prevent the lock washer or nut from falling into the gear case. Torque the nut to 78 to 88 N•m (58 to 65 ft-lb).
5. Fasten cover plate to gear case and reinstall all components removed previously to facilitate injection pump removal.

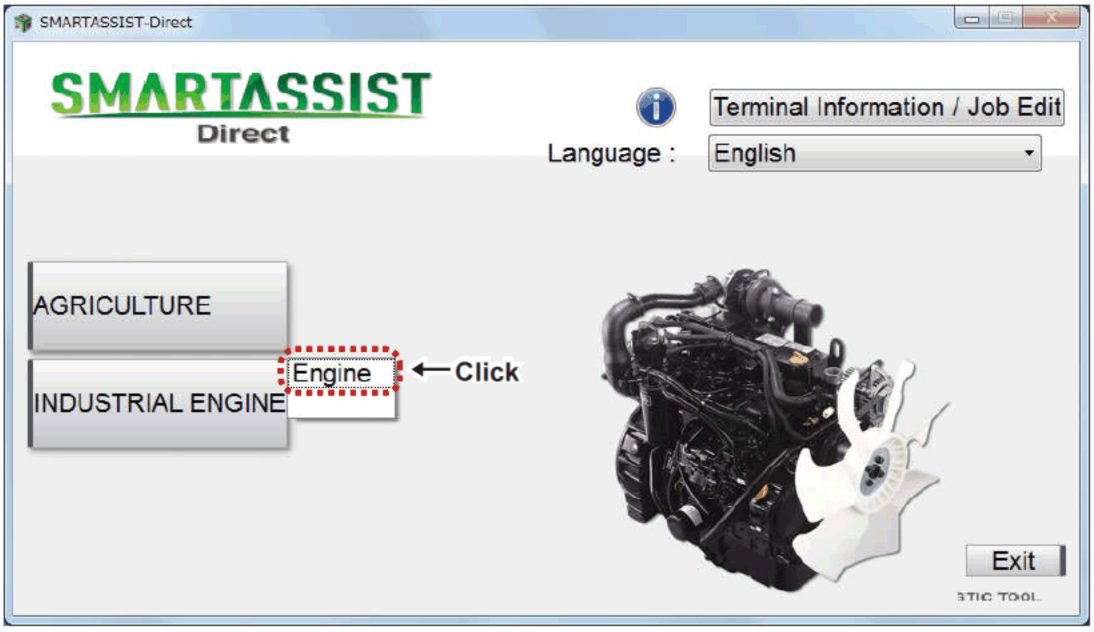
Download Procedure for Injection Pump Replacement

This Procedure is carried out using the Yanmar Diagnostic Tool. The SmartAssist tool Service Parts number is 2041969 and can be order from Aftermarket Service Parts.

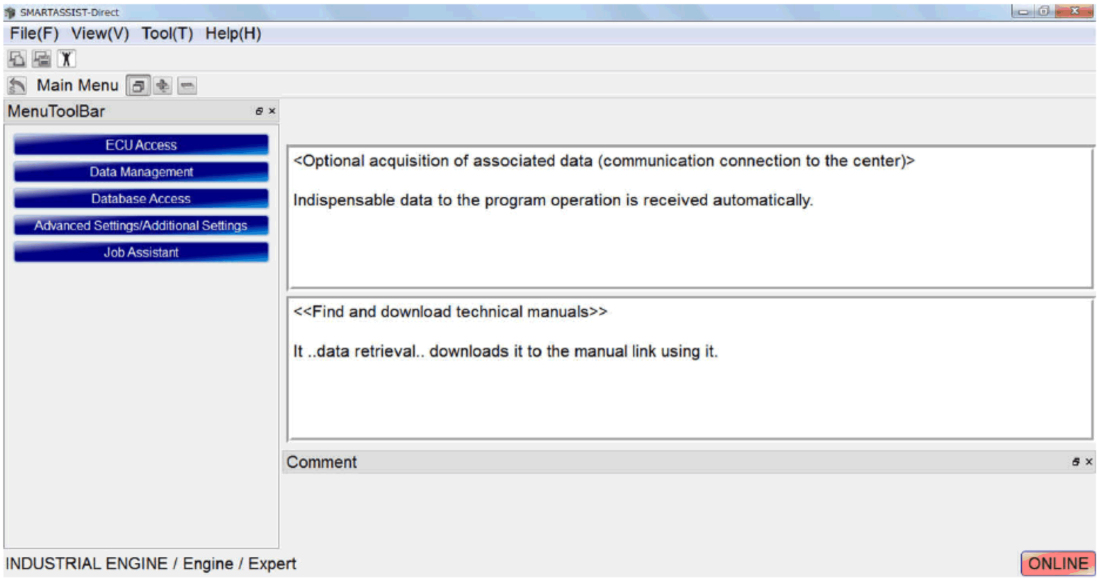
Injection Pump Replacement (Download)

1. Log in with your Username and Password.
2. Select INDUSTRIAL ENGINE from the Start Menu.

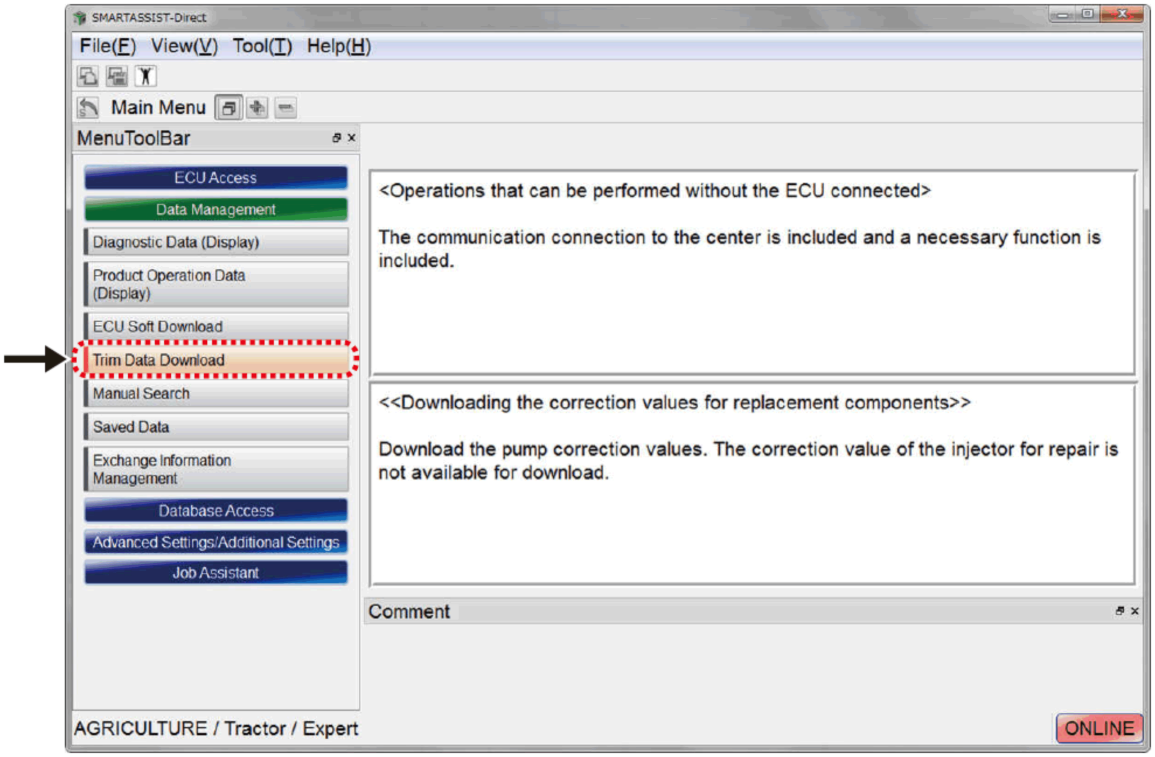
3. Select “Engine”



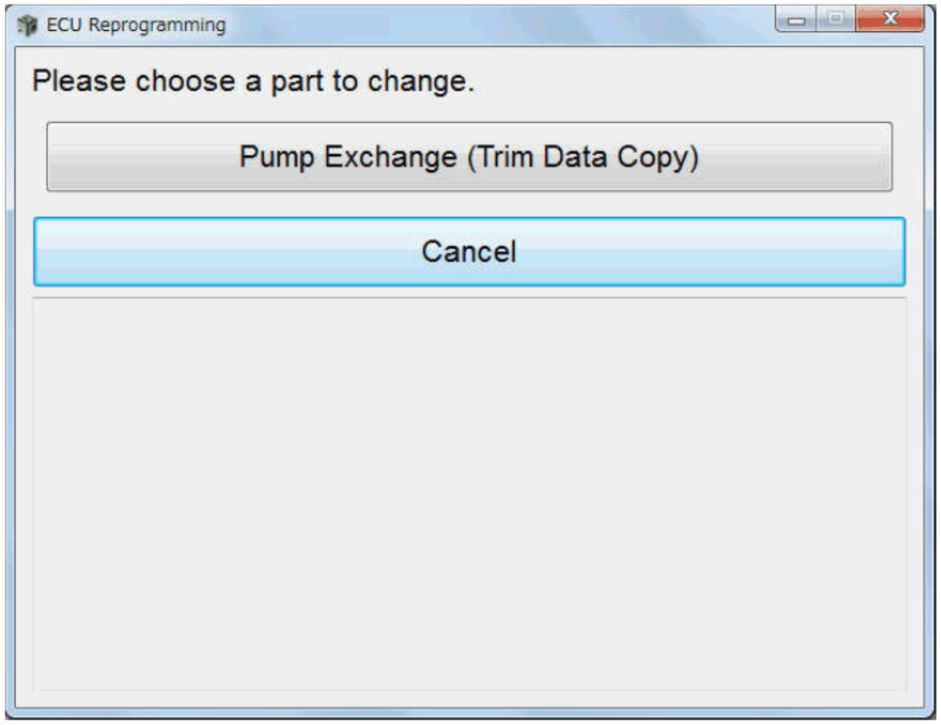
4. The Main Menu Screen is displayed.



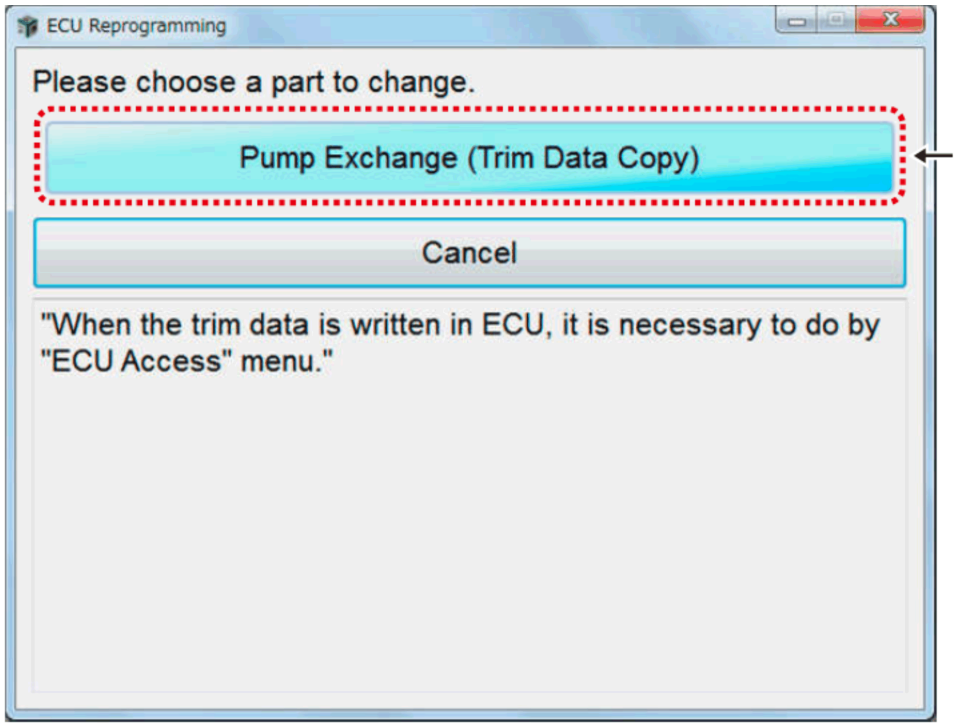
5. Click “Part replacement (download)” on the tab “Operations with ECU Disconnected”



6. The Parts Replacement/Adjustment Screen is displayed.

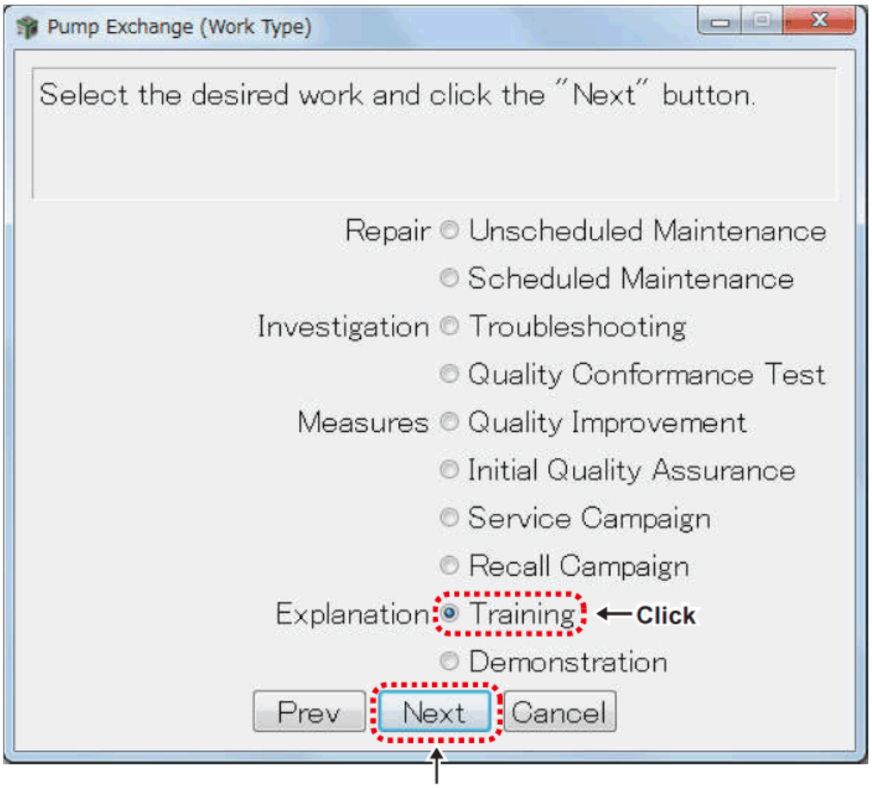


7. Move the cursor over “Pump Replacement (Trim Data Copy)” It will turn blue. Then Click it.

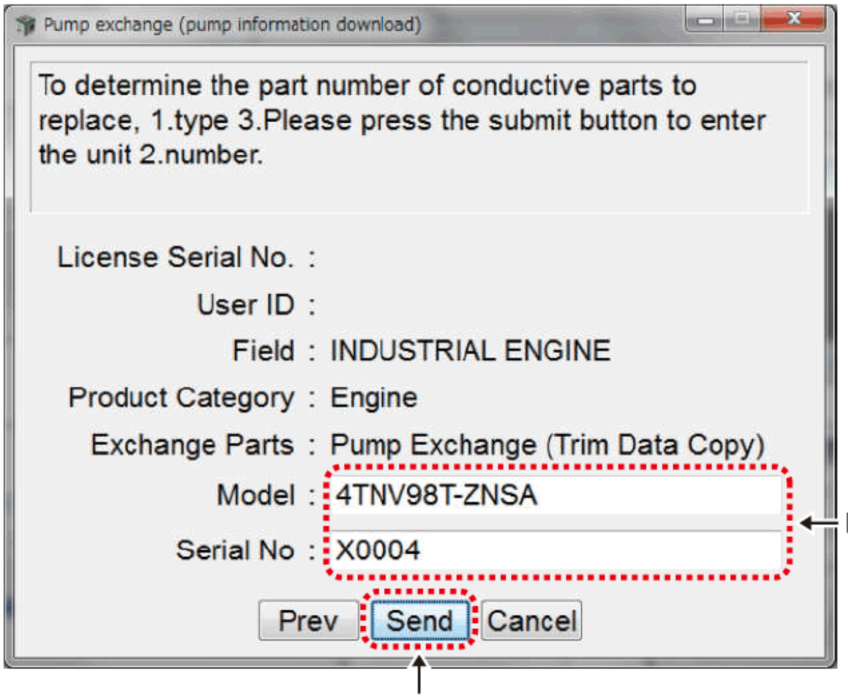


8. The selection screen for the pump replacement type is displayed. Click the type of work, and click “Next”.

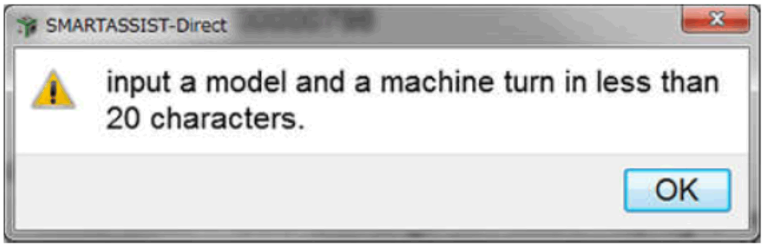
   Note: *This is s data gathering screen for market analysis. The screen shot shows “Training”, but you need to pick what pertains to your specific situation.*



9. The pump replacement (pump data download) screen is displayed. Enter the model and Serial No., and click "Send".

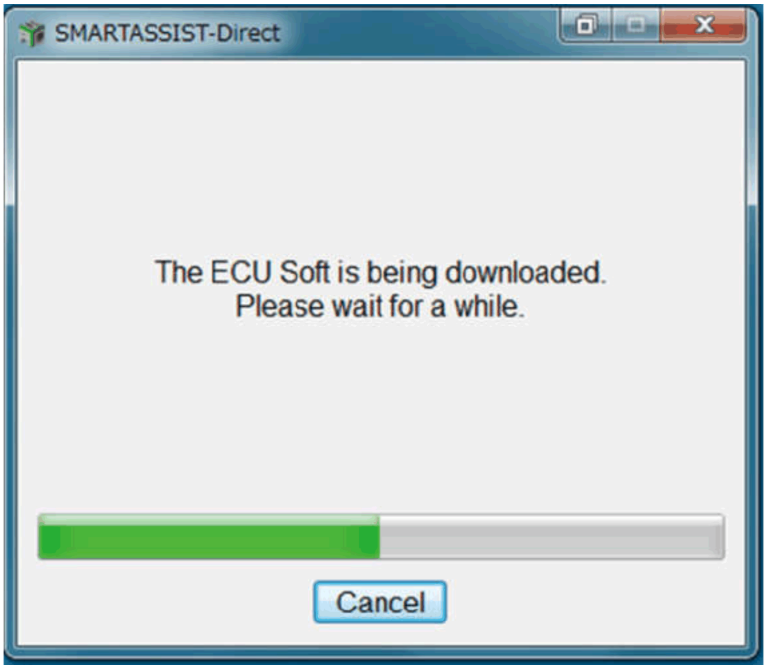


Note: *If you do not enter either the model or unit serial number, the below prompt is displayed.*

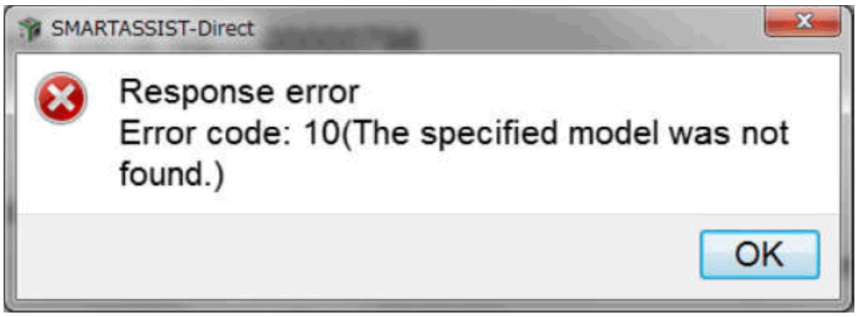


Note: *Make sure that the Internet connection is active. Confirm that the replacement process for the ECU is complete before you write the correction values.*

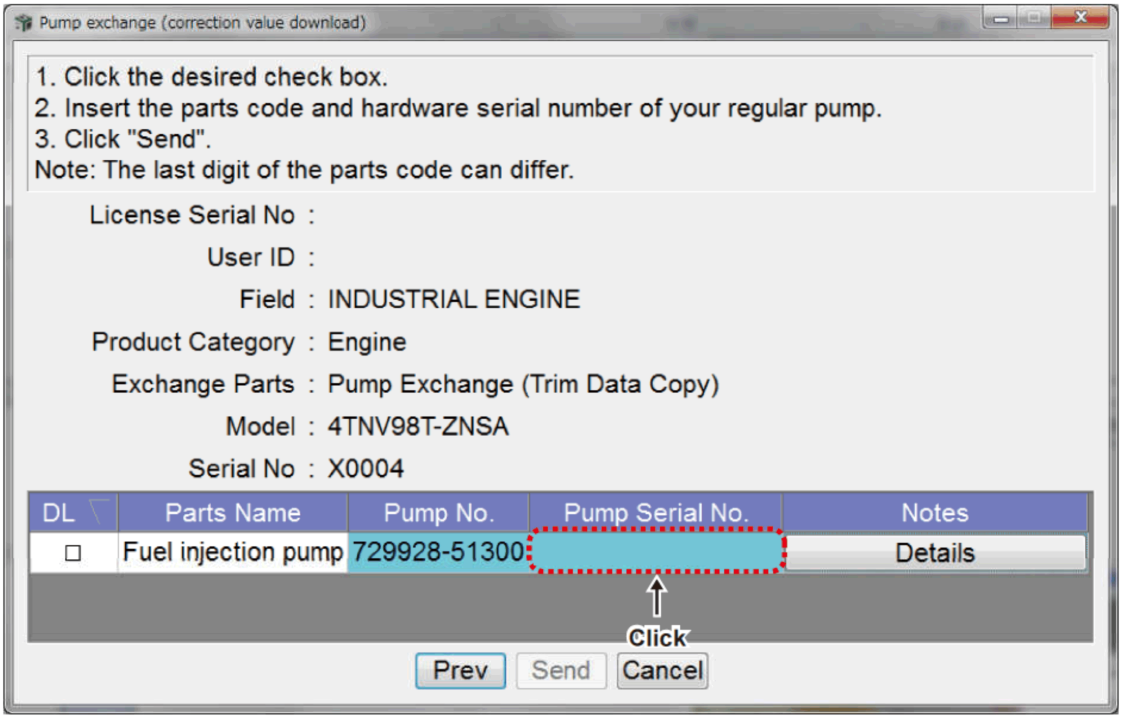
10. The pump replacement (correction value download) process starts.



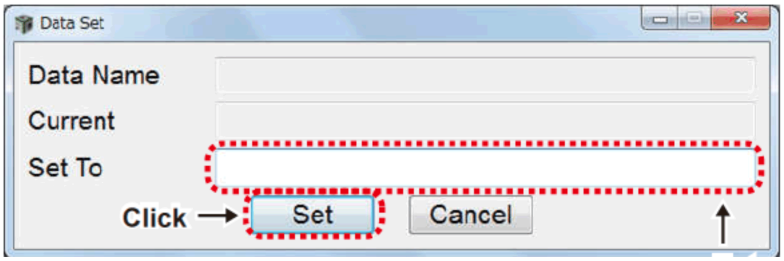
Note: *If no data is found on the center that corresponds to the entered model and Serial No, the below message is displayed. Click "OK", and enter the model and Serial No. again.*



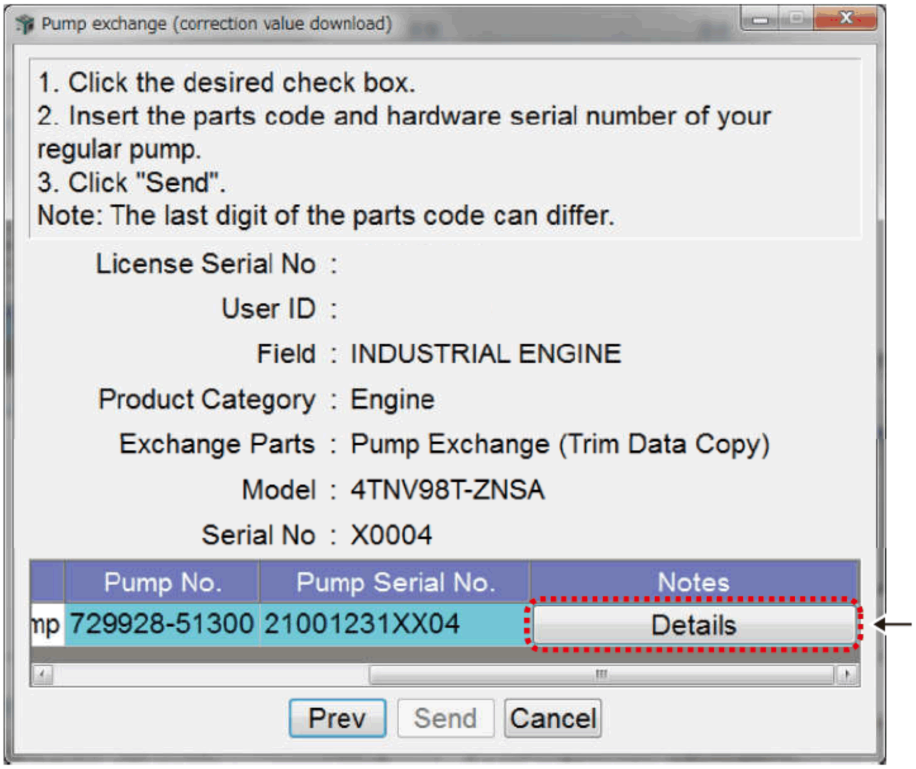
11. A Screen is displayed that lists the downloaded pump replacements (corrected value download). Click the Serial number box.



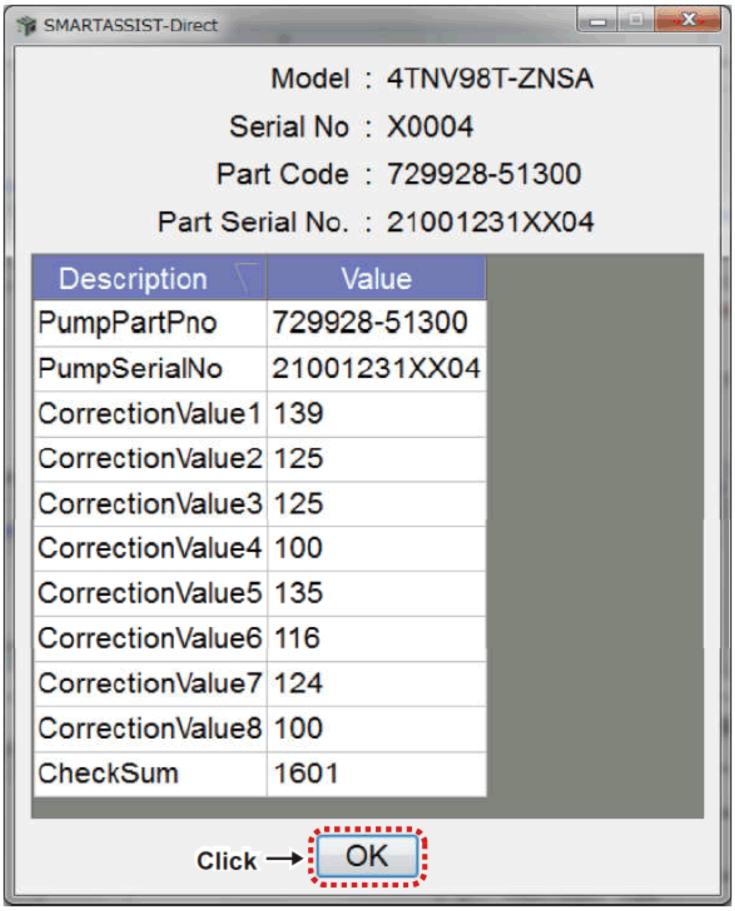
12. The Data Setting Screen is displayed. Enter the serial number of the fuel injection pump, and click “Set”



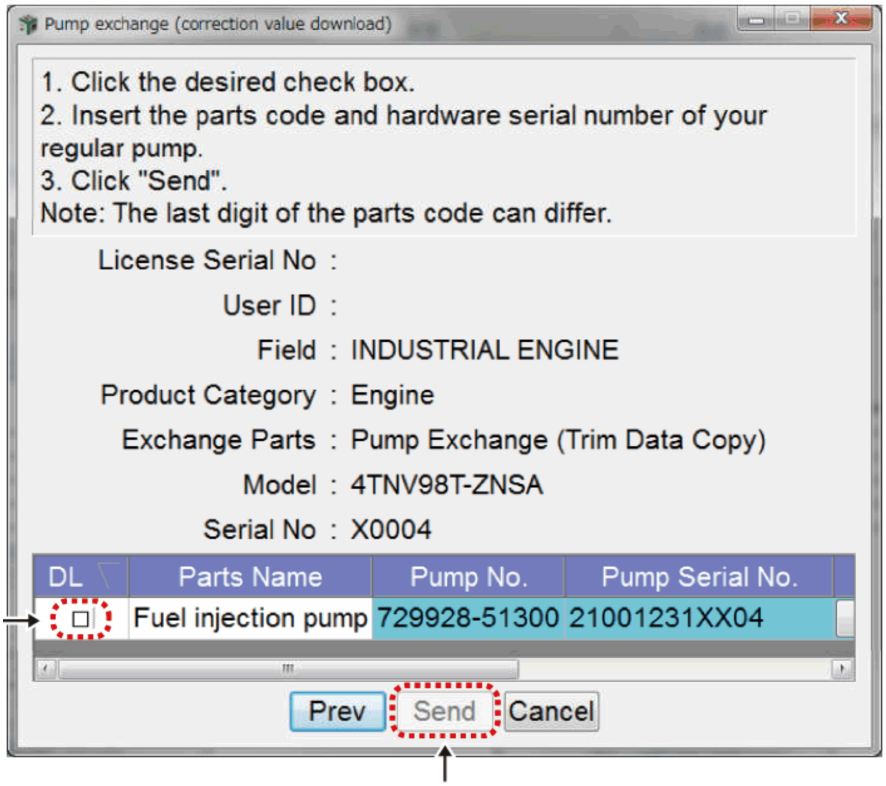
13. Click “Details” on the pump replacement (correction value download) screen.



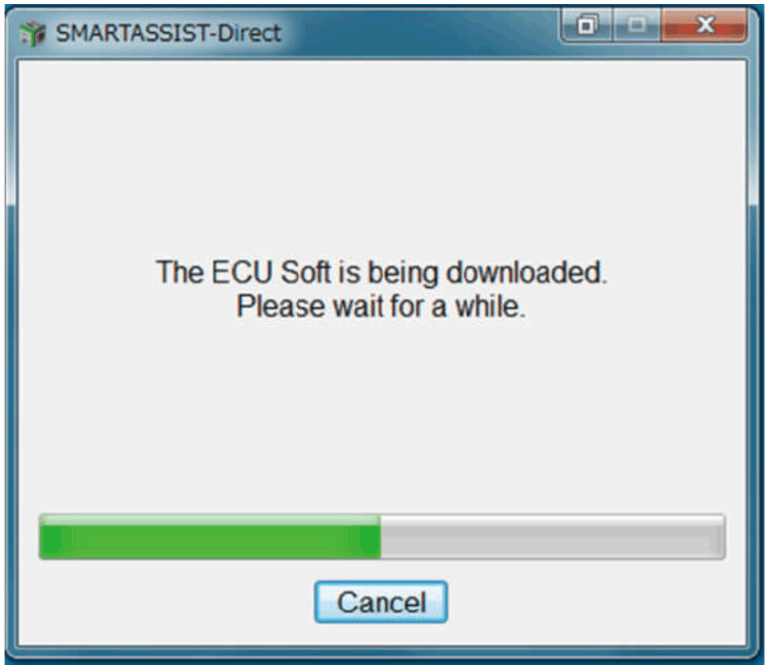
14. The pump replacement information for download is displayed.



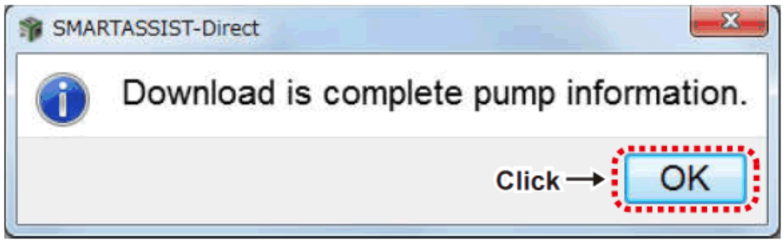
15. On the Pump Replacement (correction value download) List screen, select “DL” next to the Part Name that you wish to download data for.



16. The Pump Replacement (correction value download) process starts.

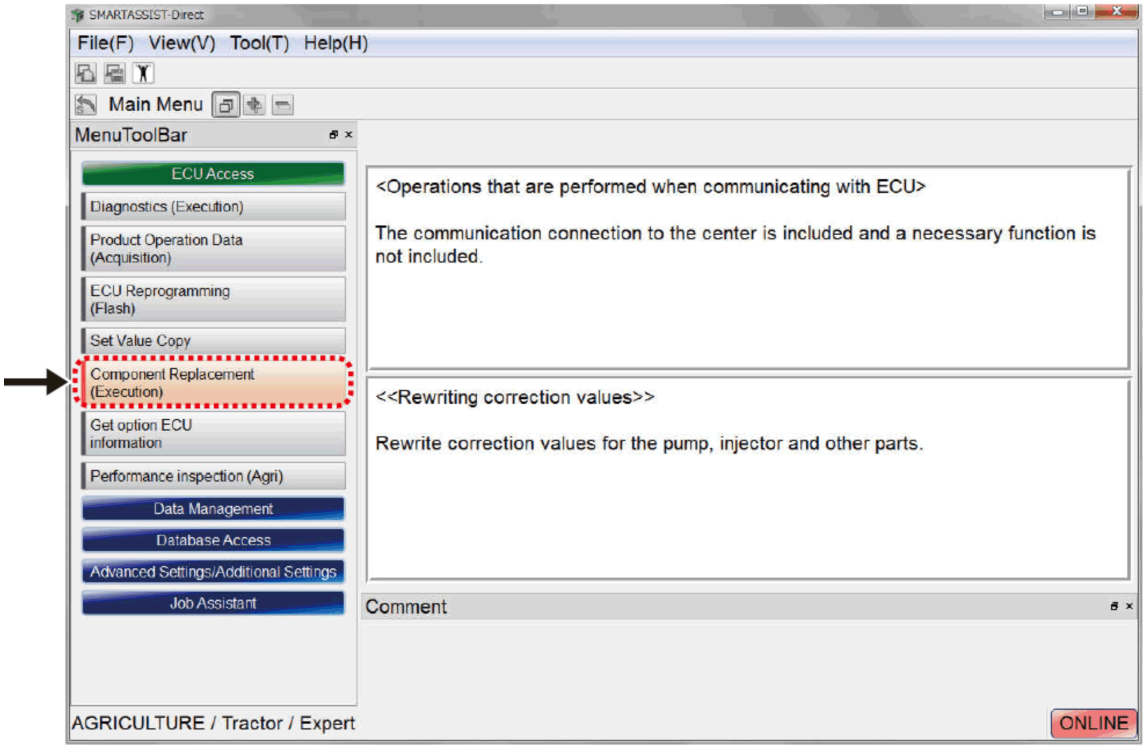


17. A message box notifies you when the Pump Replacement (correction value download) process has finished. Click "OK"



Injection Pump Replacement (Execution)

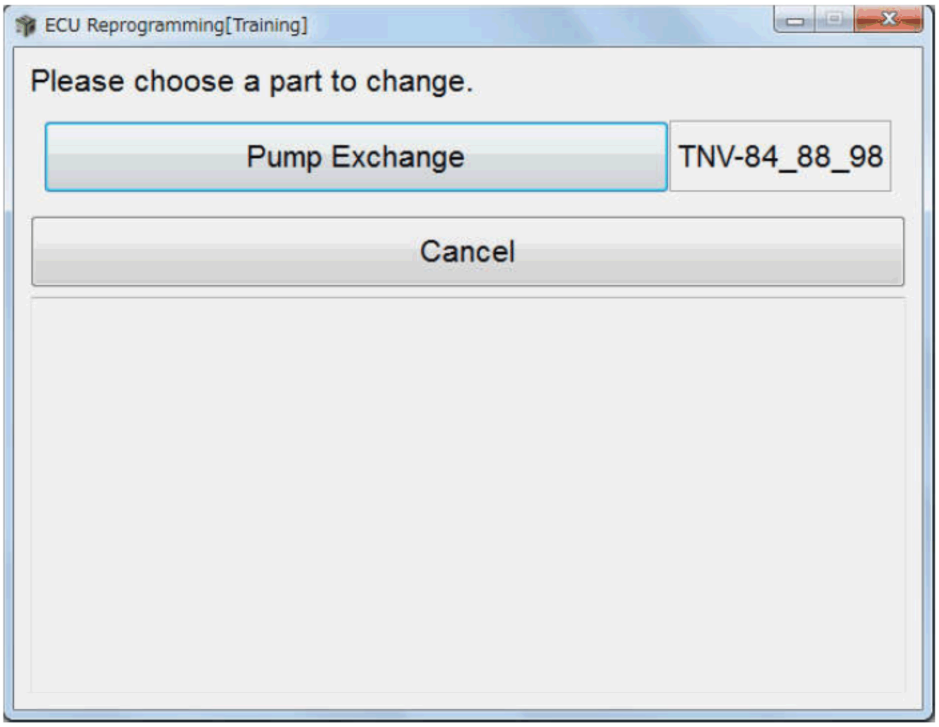
1. Click “FIE Replacement (Execution)” on the tab “ECU Access”.



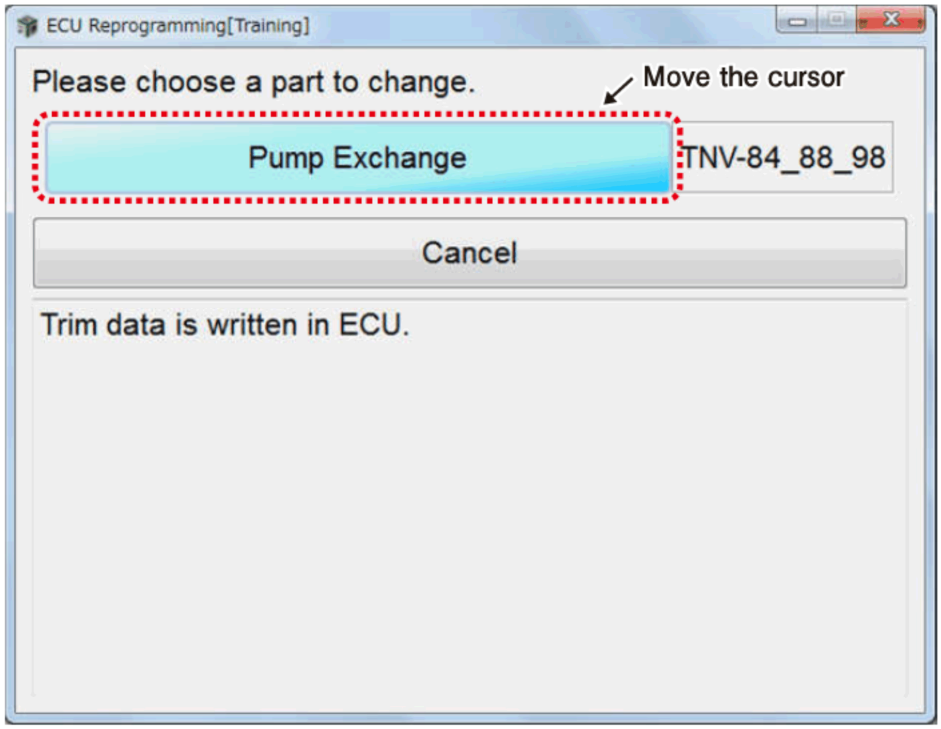
2. After displaying the ECU Search In Process Screen, the ECU Access Screen is displayed. Click “OK”.

3. The Standby Information Screen is displayed.

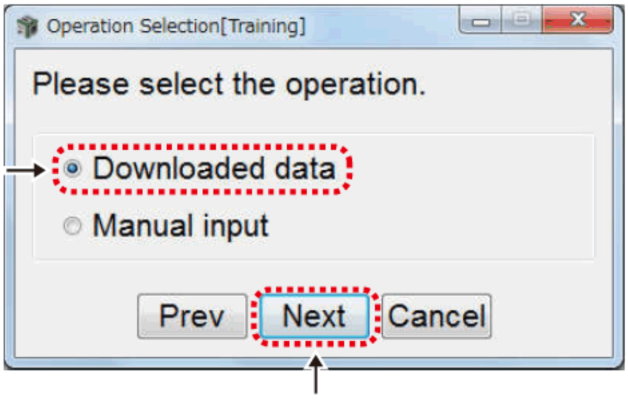
4. The ECU Write Screen is displayed. Move the cursor over “Pump Replacement (Trim data write)”.



5. Move the cursor over “Pump Replacement (Trim data write)”. It will turn blue. Then click it.

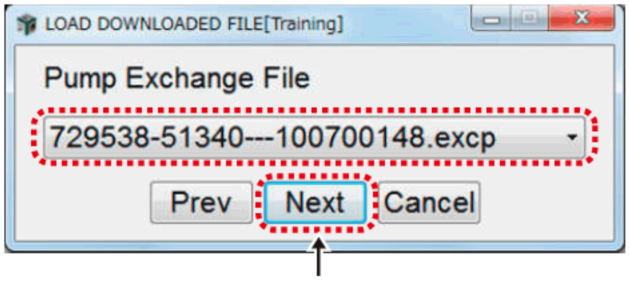


6. The Operation Selection Screen is Displayed. Select “Download data”. Click Next.

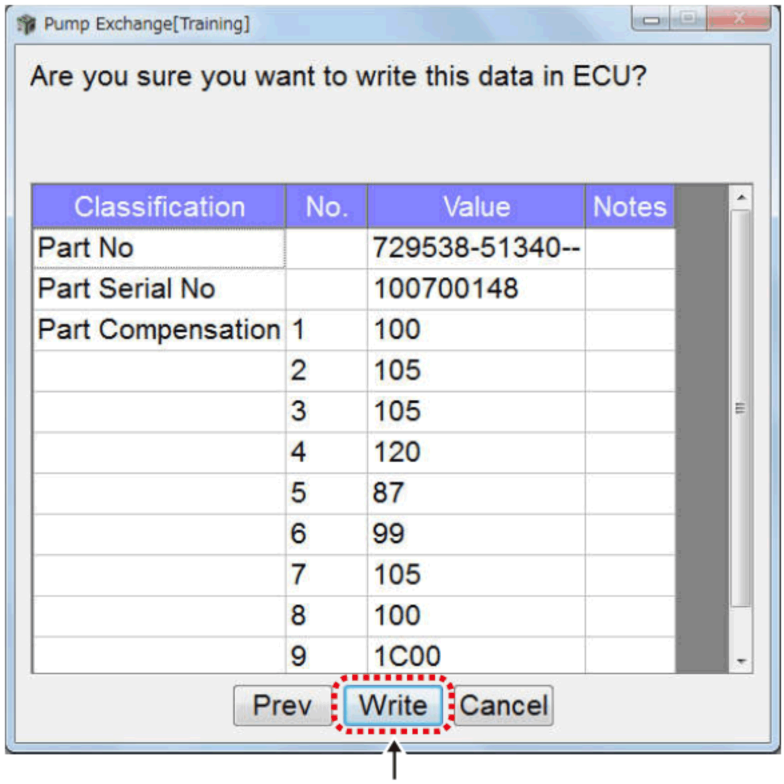


Note: *In the case of “Manual Input” selection, move to step 10.*

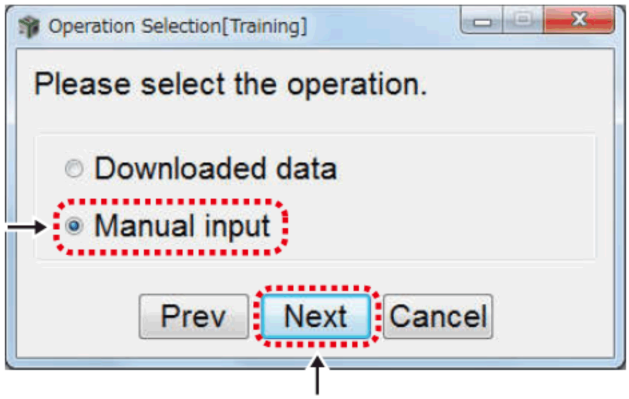
7. The Download File Reading Screen is displayed. Select the applicable file, and click “Next”.



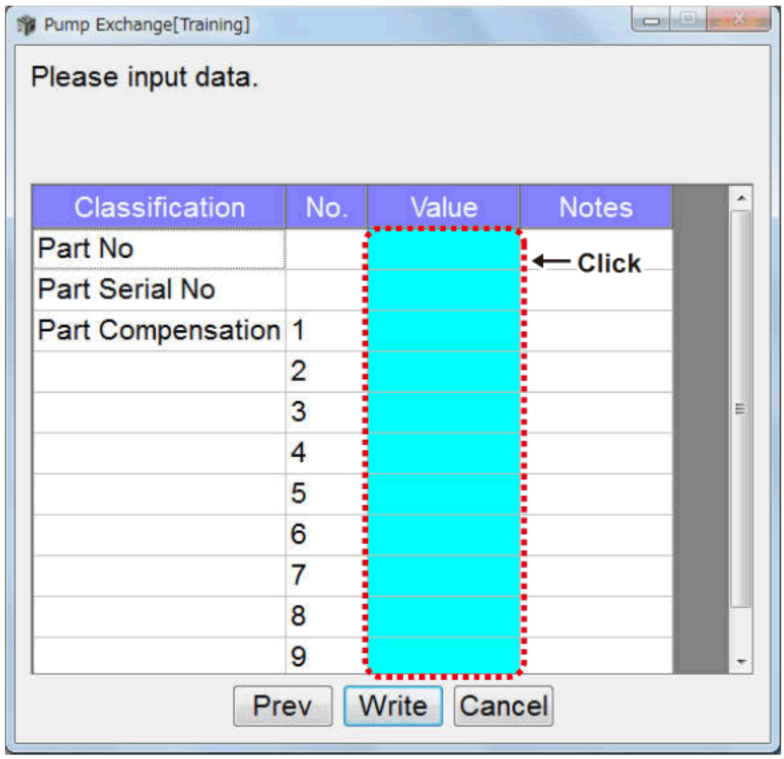
8. The selection screen for the “Pump Replacement (Trim data write)” file is displayed. Confirm the contents, and click “Write”.



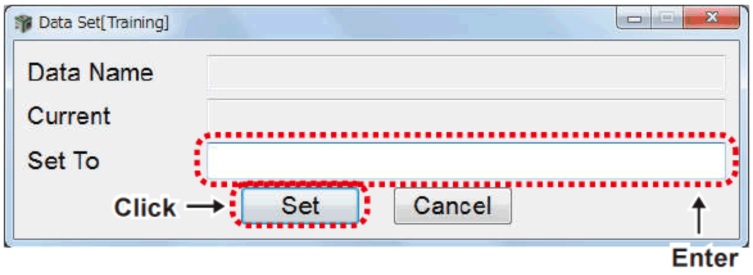
9. The Operation Selection Screen is displayed. Select “Manual Input”, and click “Next.

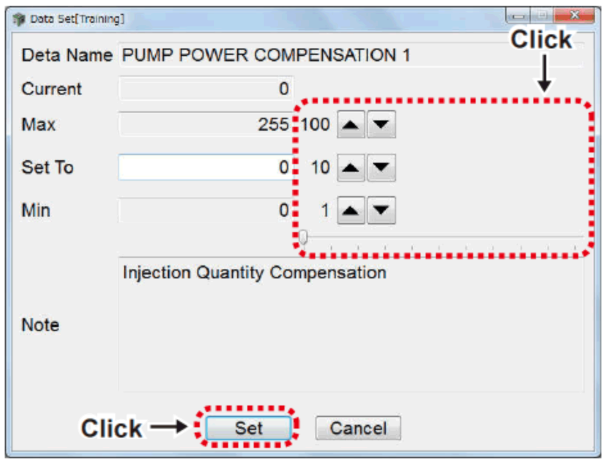


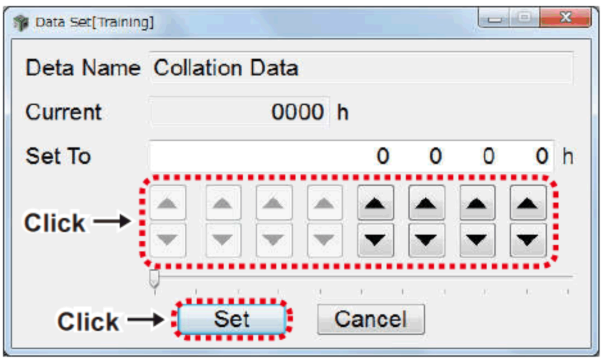
10. The selection screen for the “Pump Replacement (Trim data write)” file is displayed. Click the value box. The entry screen is displayed and you can manually enter the correction values.



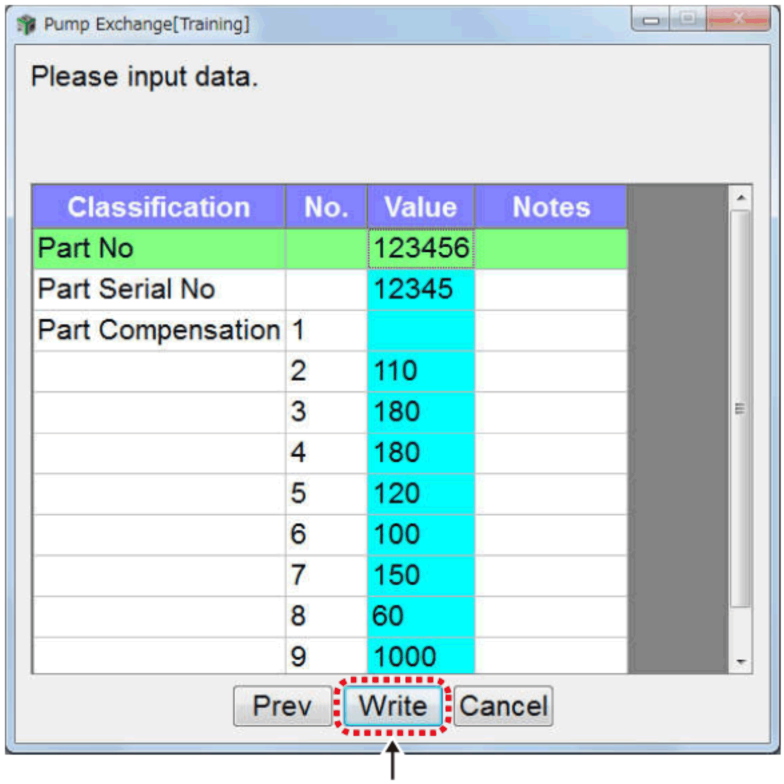
11. The Data Setting Screen is displayed. Manually enter the correction values.



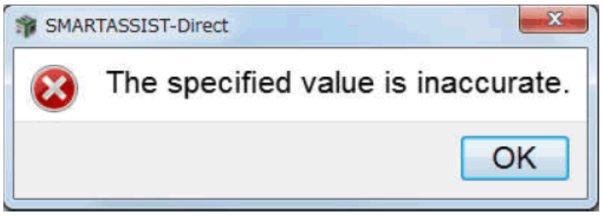


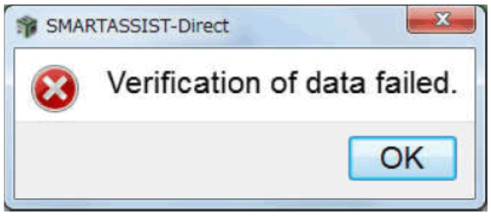


12. When you have finished the manual entry of the pump replacement correction values, check them and then click "Write"

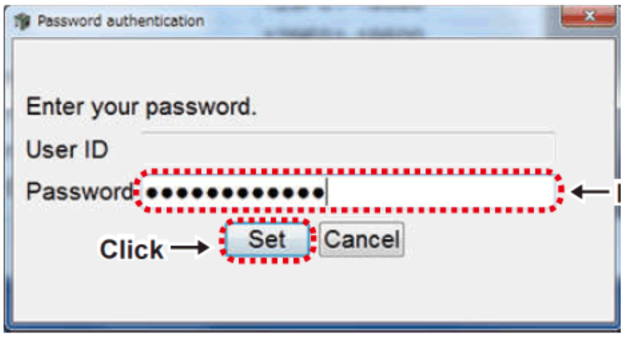


Note: *If a value has not been entered or if the check data is incorrect, the below error screen is displayed.*

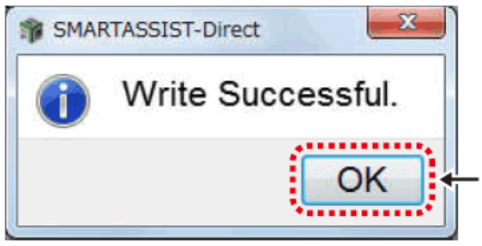




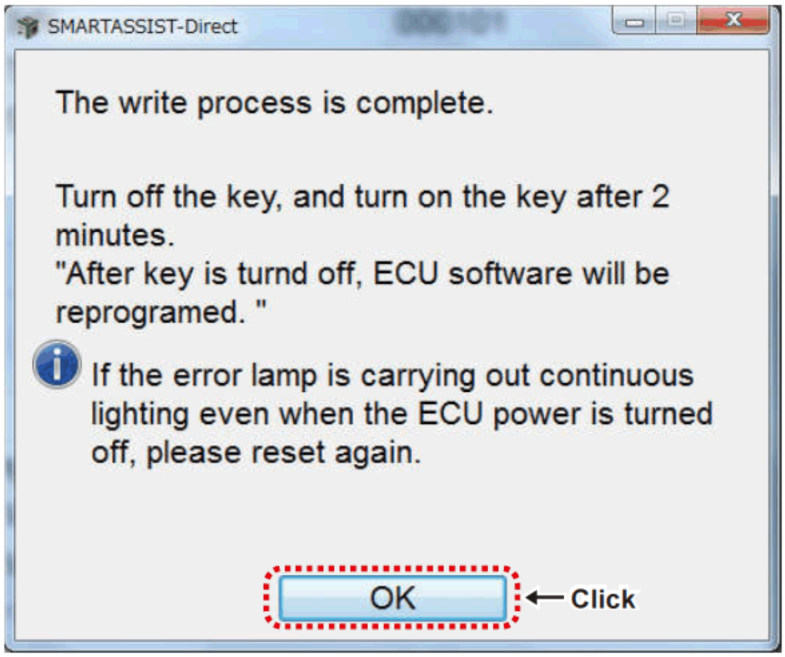
13. The Password Check Screen is displayed. Enter the password, and click set.



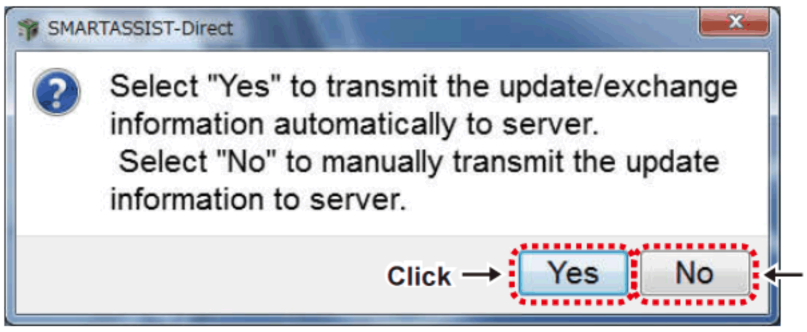
14. A message box notifies you when the writing process has finished. Click “OK”



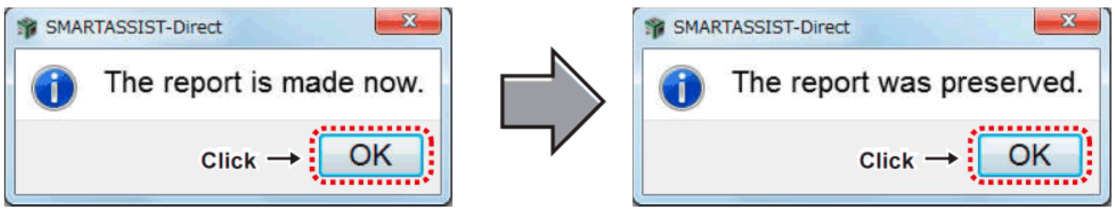
15. A screen with the necessary procedures after the ECU writing process is displayed. When the confirmation screen is displayed, click “OK”. Turn ON/OFF the ECU by the following on-screen instructions.



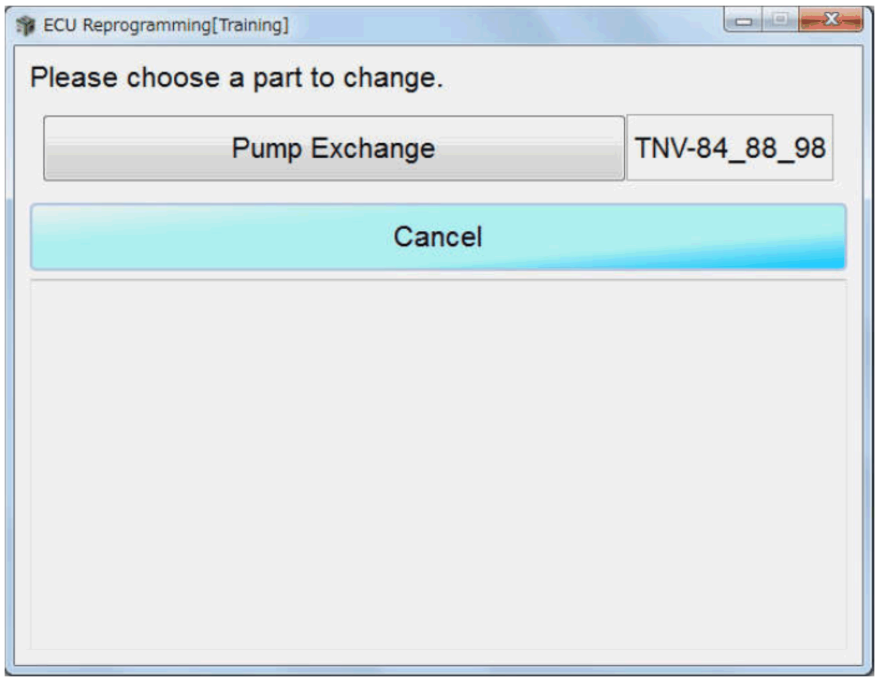
16. Confirm the content and click “Yes” to automatically send the replacement completion data to the management server. Click “No” to send it manually at a later time. Click “OK”.



17. A message box informing you that a report was created will appear. Click “OK”



18. Click “OK” on the message box for the report creation notification to return to the below screen. Click “Cancel” to return to the main menu.



Engine Valve Clearance Adjustment

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

1. Remove the rocker arm cover.
2. Remove the round cover (plug) from the timing mark access hole on the front of the bell housing.

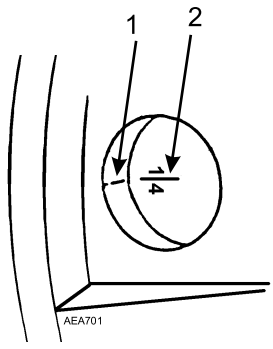
⚠ Warning

Risk of Injury!

Loosen all of the injection lines at the injection nozzles to prevent the possibility of the engine firing while it is being rotated.

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

Figure 14. Top Dead Center One and Four



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

b. Check the rocker arms on the number one cylinder to see if they are loose.

c. If the rocker arms are loose, the engine is at top dead center of the compression stroke for the number one cylinder.

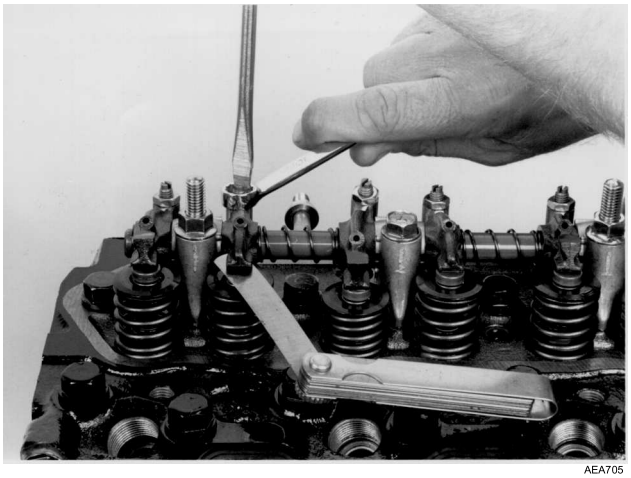
d. If the rocker arms are tight, the engine is at top dead center of the exhaust stroke for the number one cylinder. Rotate the engine 360 degrees to place the engine at top dead center of the compression stroke for the number one cylinder.

4. Use a feeler gauge to check the valve clearance on both valves for the number one cylinder, the intake valve for the number two cylinder, and the exhaust valve for the number three cylinder. The valve clearance for both the intake valve and the exhaust valve should be 0.15 to 0.25 mm (0.006 to 0.010 in.).

   a. Check to verify that the valve stem cap is in good condition and is positioned squarely on the top of the valve stem. Replace the valve stem cap if it shows significant wear.

5. Adjust the valves if necessary by loosening the locknut and turning the adjustment screw until the valve clearance is correct.

Figure 15. Adjusting the Valve Clearance



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

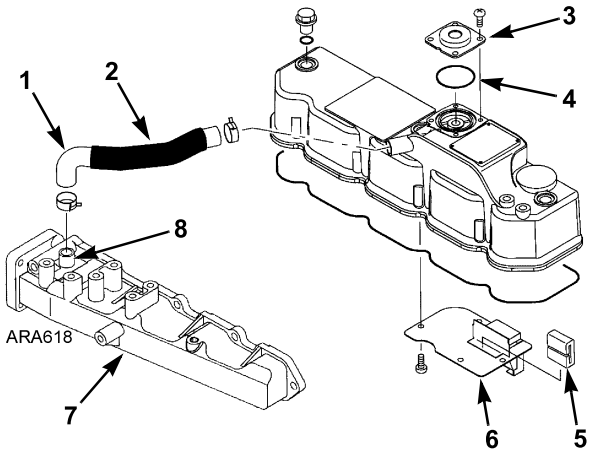
Valve Adjustments and Cylinder Configurations								
	Rear Flywheel End						Front Pulley End	
Cylinder Number	**1**		**2**		**3**		**4**	
Valve arrangement	E	I	E	I	E	I	E	I
Piston in No. 1 cylinder is at TDC on compression stroke	◯	◯		◯	◯			
Piston in No. 4 cylinder is at TDC on compression stroke	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

Crankcase Breather

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

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

Figure 16. Crankcase Breather



1.	Breather Hose	5.	Baffle Breather
2.	Insulation	6.	Baffle Plate
3.	Breather Cover	7.	Intake Manifold
4.	O-Ring	8.	Restrictor Location

Normal crankcase pressures with a new air cleaner are 0 to 300 mm (0 to 12 in.) H_2O of vacuum. The vacuum will increase as the air cleaner gets dirty and becomes more restrictive. Check the air restriction indicator before checking the crankcase pressure. Replace the air cleaner if the reading on the air restriction indicator exceeds 508 mm (20 in.) H_2O of vacuum. A dirty air cleaner may cause excessive vacuum, leading to oil carry over and high oil consumption.

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

The following items can affect the crankcase pressure readings:

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

EMI 3000 Air Cleaner

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

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

Figure 17. EMI 3000 Air Cleaner Assembly

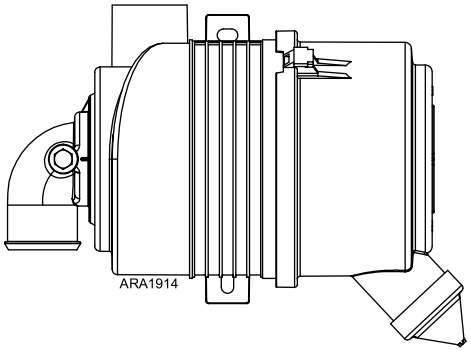


Figure 18. EMI 3000 Air Filter Element

Belts

⚠ Caution

Risk of Injury!

The unit can start and run automatically any time the unit is turned on. Units start automatically in both Cycle Sentry mode and Continuous mode. Turn the unit On/Off switch Off and disconnect the battery before doing inspections or working on any part of the unit.

⚠ Warning

Risk of Injury!

DO NOT jump belts on by cranking the engine.

Belts should be regularly inspected during unit pretrip inspections for wear, scuffing, or cracking. Belt tension should also be checked during scheduled maintenance inspections. Correct belt tension is critical for correct unit operation. Belts that are too loose will whip and belts that are too tight put too much strain on the belt fibers and bearings.

New belts should be tensioned cold and re-tensioned cold after 10 hours of unit operation.

Note: *Do not attempt to remove or install belts without loosening adjustments. Belts that are installed by prying over pulleys will fail prematurely due to internal cord damage.*

Water Pump Belt Service

The water pump pulley is a split type. Adjust the tension by adding or removing shims between the pulley sheaves. See the specification chapter for the correct water pump belt tension settings.“,”

⚠ Warning

Risk of Injury!

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

⚠ Caution

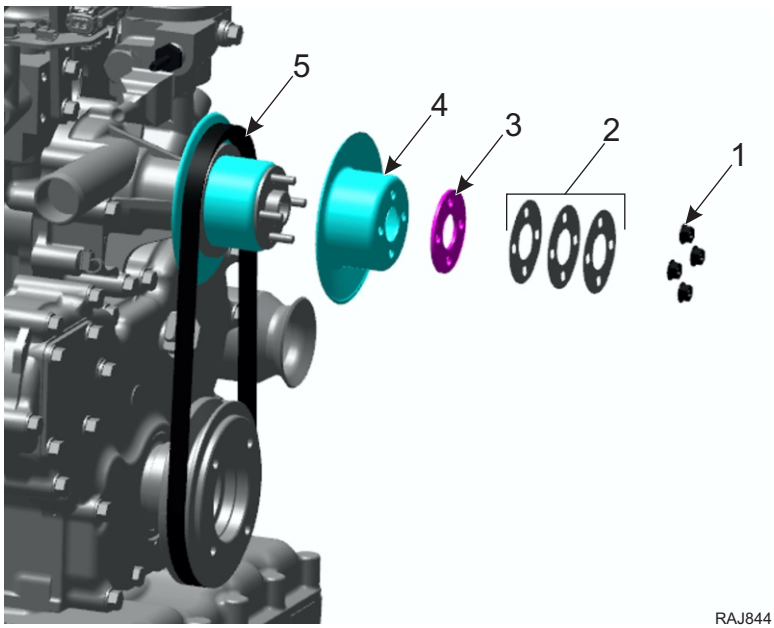
Risk of Injury!

Do not attempt to adjust belts with the unit running.

Belt Removal

1. Turn the unit OFF and disconnect the negative battery terminal to ensure unit cannot be operated.
2. Access the front of the engine.
3. Remove the (4) nuts from the water pump pulley.
4. Remove the pulley shims, washer, and outer pulley sheave.

   Note: *Make note of the shim location for reassembly.*



RAJ844

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

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

Belt Installation and Tension Setting

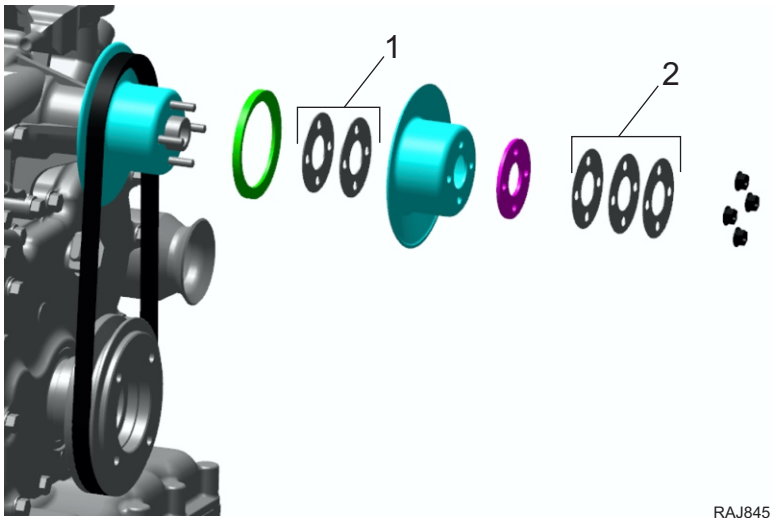
6. Install the belt around the crankshaft pulley and water pump inner sheave hub.
7. Install the outer pulley sheave, washer, extra shims, and (4) pulley nuts. Torque the nuts to specification: 6.6 ft-lbs (9 Nm).

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

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

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

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



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

10. After belt tension is set correctly, ensure the (4) pulley nuts are torqued to specification: 6.6 ft-lbs (9 Nm).

Important: *Rotating the engine allows the belt to seat properly in the sheaves and ensures the (4) pulley nuts can be properly tightened.*

11. Manually rotate the engine four revolutions or connect the unit battery and run the unit for 1–2 minutes.
12. Verify belt tension and re-tighten the (4) pulley nuts to specification: 6.6 ft-lbs (9 Nm).
13. Connect battery terminals and verify unit function.

Radiator and Fan Service

Radiator

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

Notice

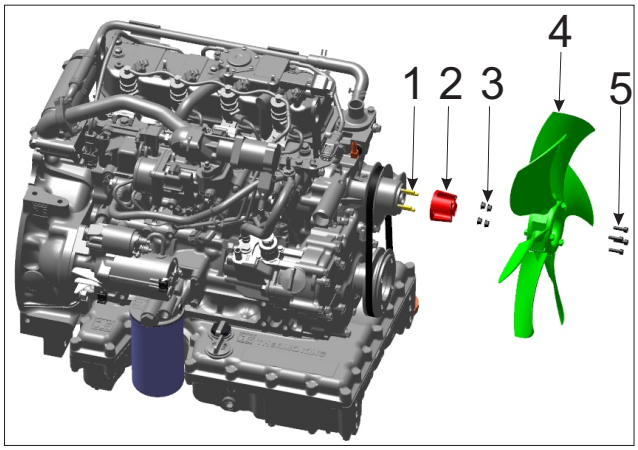
Equipment Damage!

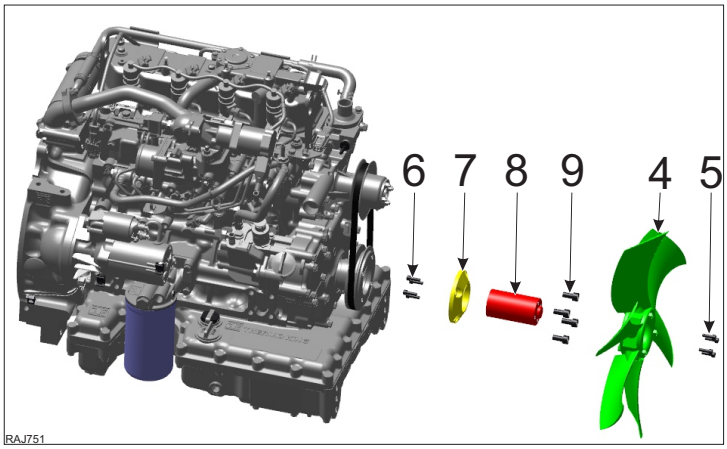
The air pressure should not be high enough to damage coil fins.

Radiator Cooling Fan

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

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





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

Fan and Shroud Adjustment

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

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

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

Yanmar YSAD Diagnostic Engine Service

Part Number 2041969 - Tool Kit, YSAD Expert

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

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

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

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

When a Yanmar DTC Code is set, a corresponding 300 Series Thermo King Alarm Code is also set. The 300 Series Alarm Code is a general indication of what issues may exist. Always connect the Yanmar Service Tool and read all existing DTC codes. Use this information to diagnose the problem using the Yanmar Service documentation.

Clearing Yanmar DTC Codes and Associated Thermo King Alarm Codes

Yanmar DTC Codes are cleared using the Yanmar Service tool. When the Yanmar Fault Codes are cleared, the associated Thermo King Alarm Code is also cleared. The codes are still available by view the event log from the controller.

Connecting and Using the Yanmar Engine Diagnostic Tool

Short press F1 to enter ECU Service Mode feature allows the unit to be powered down but maintains power to the Engine Control Unit (ECU) for diagnostic purposes. This allows the Yanmar Smart Assist Direct (YSAD) Diagnostic Tool to be connected to the Yanmar Engine Control Unit without having the rest of the unit powered up.

Purpose:

To connect and use the Yanmar Diagnostic Tool.

Materials Required:

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

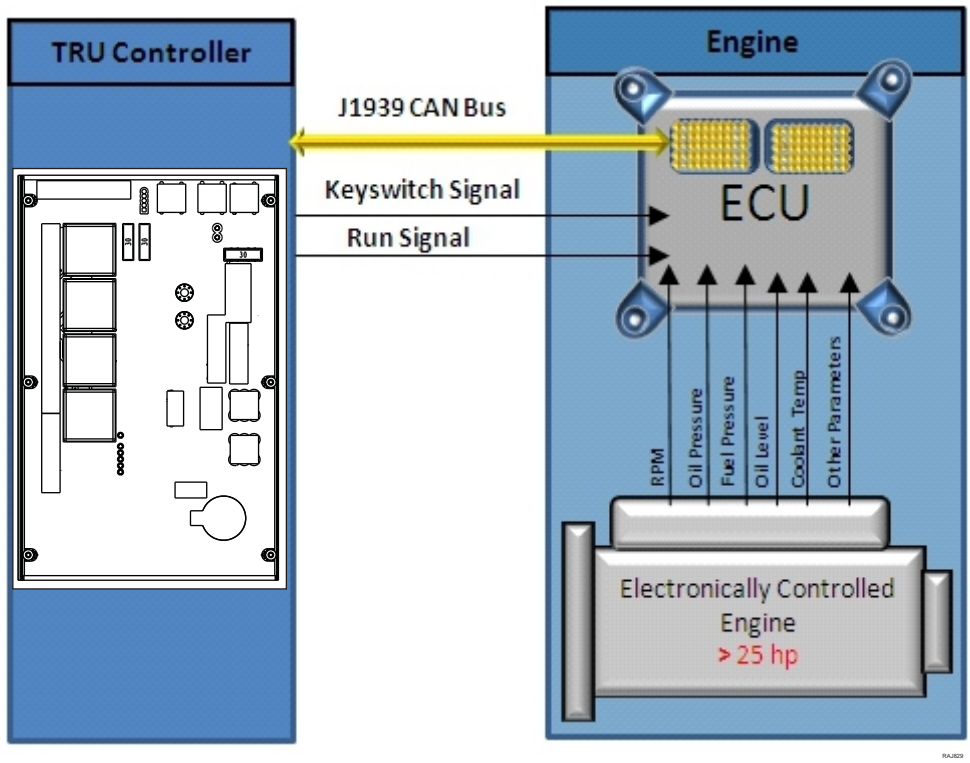
Operation:

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

Connection:

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

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



Diagnostic Process:

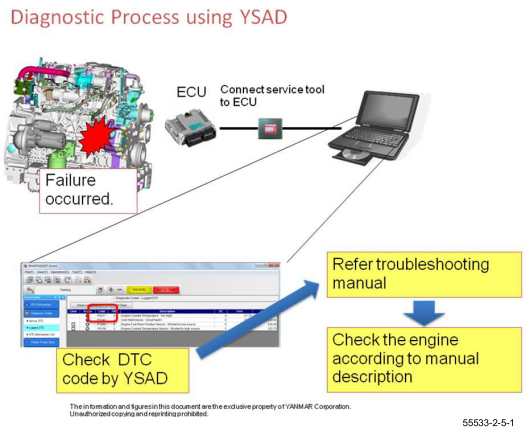


Table 1. Procedure

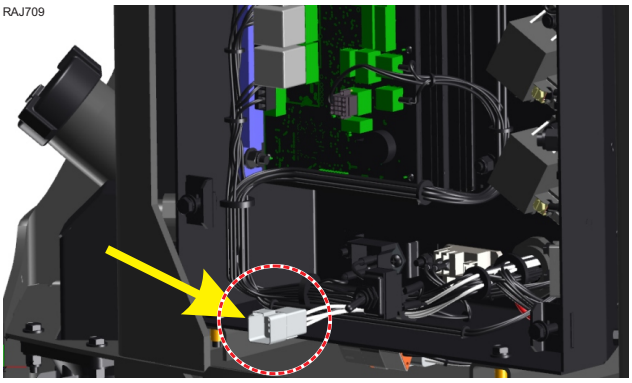
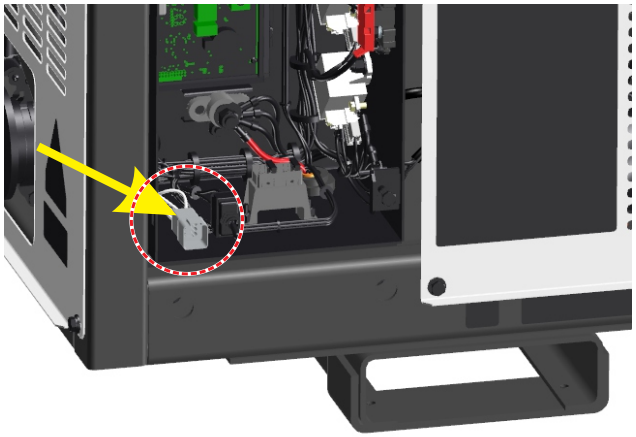
Step	Action	Result	Comments
1	The unit battery must be connected and the Microprocessor Power Switch must be turned on.		
2	Turn the unit on and enter the Maintenance Menu.		
3	In the Maintenance Menu, scroll to and select Connect Engine Service Tool.		Connect Engine Service Tool is the last item in the Maintenance Menu.
4	Open the Control Box and locate the Yanmar Diagnostic Connector near the fuse panel. ***Note:*** *Some early build SGUM units (before November 2020) have the YSAD connector located under the alternator near the power receptacle - NOT in the control box.*	**Figure 19. SGCO**  RAJ709 **Figure 20. SGUM**  RAJ710	
5	Connect the Yanmar Diagnostic Tool to the Yanmar Diagnostic Connector in the unit Control Box using the supplied cable.	 55533-2-6-3	
6	Connect the Yanmar Diagnostic Tool to the PC using the supplied cable.		This cable is a standard USB cable. Excessive cable length of the USB cable may affect operation.

Table 1. Procedure (continued)

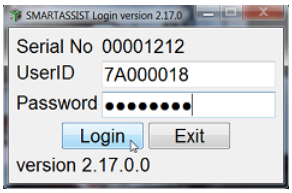
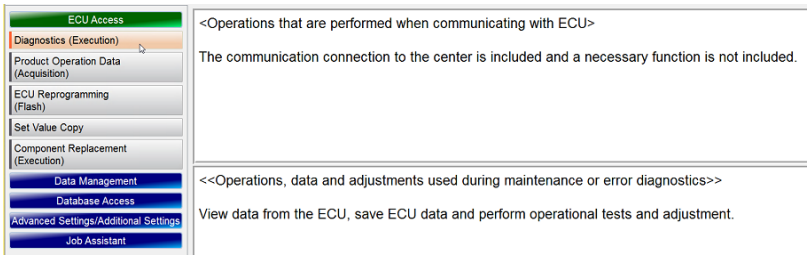
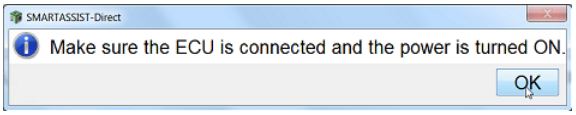
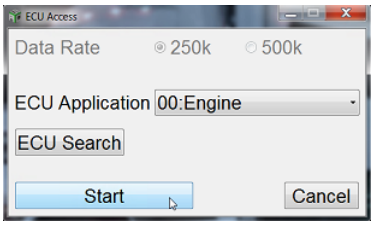
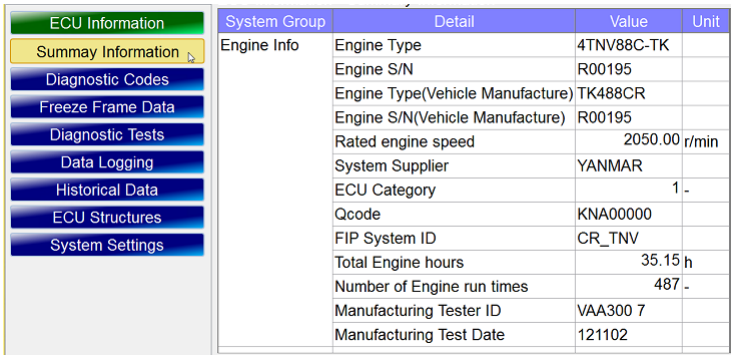
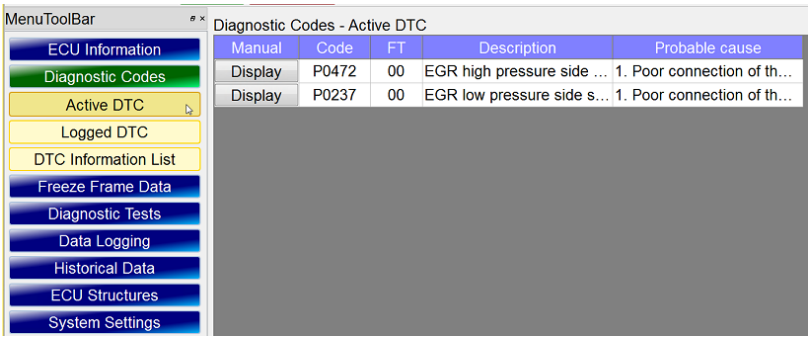
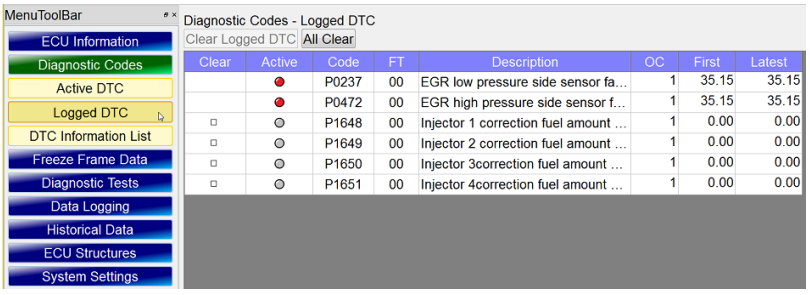
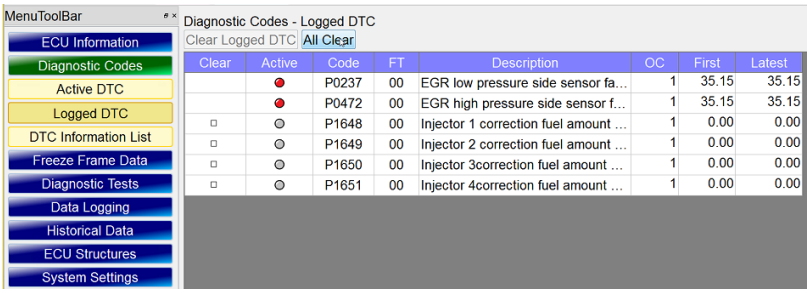
Step	Action	Result	Comments
7	Start the Yanmar SA-Direct (YSAD) software.	To maintain current status, the Yanmar SmartAssist Direct (YSAD) software must be started every 90 days while the PC is connected to the internet.	This verifies the YSAD software and extends the license for another 90 days.
8	Complete the login information as shown.		
9	Select ECU Access, then select Diagnostics (Execution).		
10	Click OK.		
11	Click Start.		
12	Select ECU Information - Summary Information.	 System Group / Detail / Value / Unit Engine Info: Engine Type 4TNV88C-TK; Engine S/N R00195; Engine Type(Vehicle Manufacture) TK488CR; Engine S/N(Vehicle Manufacture) R00195; Rated engine speed 2050.00 r/min; System Supplier YANMAR; ECU Category 1 -; Qcode KNA00000; FIP System ID CR_TNV; Total Engine hours 35.15 h; Number of Engine run times 487 -; Manufacturing Tester ID VAA300 7; Manufacturing Test Date 121102	This displays engine information, such as the engine serial number, run hours, and start cycles.

Table 1. Procedure (continued)

Step	Action	Result	Comments
13	Select Diagnostic Codes – Active DTC.		
14	Select Diagnostic Codes – Logged DTC.		Any logged fault codes will be added to the list.
15	To clear all fault codes, click the All Clear button. Enter your password in the popup window when prompted.	All fault codes in the ECU will be cleared.  For additional information, refer to the Yanmar Diagnostic Documentation.	Operation must be performed in Connect Engine Service Tool mode. YSAD will not allow codes to be cleared while engine is operating.

Software Download for Flash to Replacement ECU

Purpose:

Preparing ECU for Replacement.

Materials Required:

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

Operation:

The Yanmar Diagnostic Tool is used to connect the computer USB Port to the Yanmar Engine Control Unit data connector located in the Unit Control Box. Yanmar SmartAssist Direct (YSAD) Software installed on the computer is

used to communicate with the Yanmar Engine Control Unit (ECU). This allows ECU information to be retrieved, Yanmar Fault Codes to be read, operational data to be examined and updated, and other diagnostic functions to be performed.

Table 2. Procedure

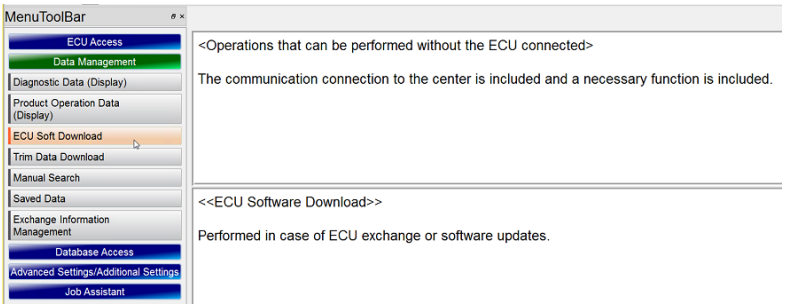
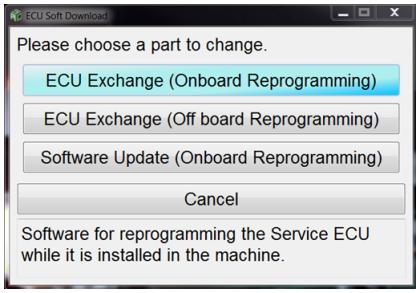
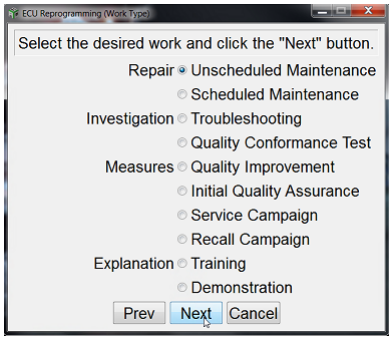
Step	Action	Result	Comments
1	With an internet connection, open YSAD, select Data Management tab, and click on ECU Soft Download.		
2	Select ECU Exchange (Onboard Reprogramming)		Onboard programming is currently not supported.
3	Choose the reason for reprogramming the ECU and click Next.		This information is only used for data collection purposes, and does not affect the version of software downloaded.
4	Locate engine model number, serial number, and enter the values into data fields. Click Send when finished. ***Note:*** *Use upper case letters when entering values.*		This information is used to compare ECU and engine serial number data against Yanmar's database.

Table 2. Procedure (continued)

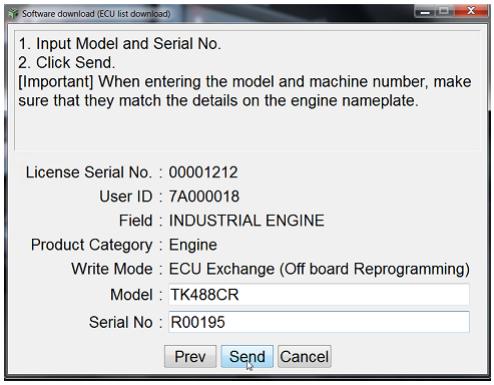
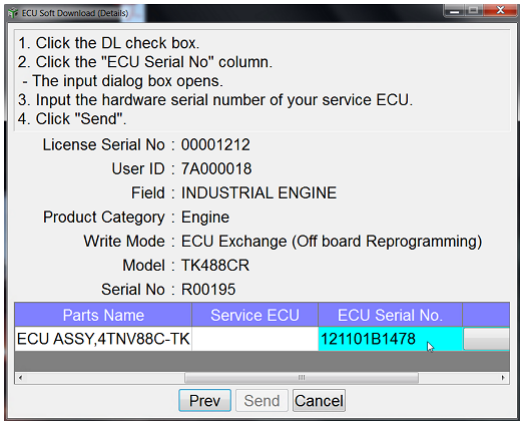
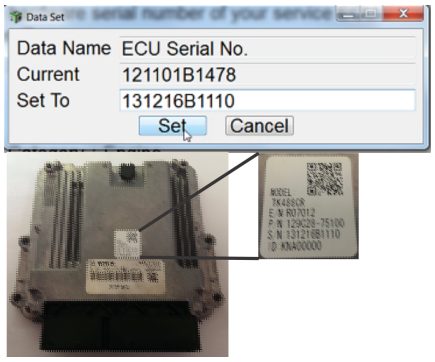
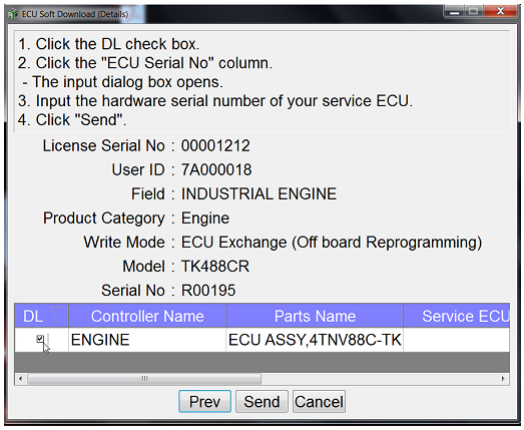
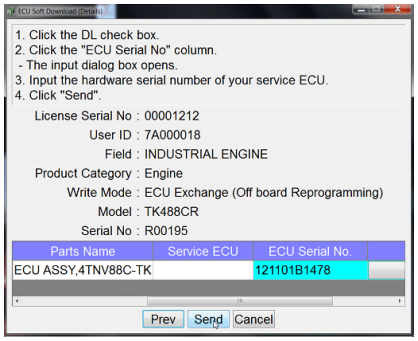
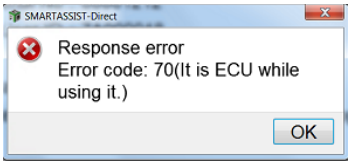
Step	Action	Result	Comments
			
5	Click the ECU Serial No field. ***Note:*** *Use scroll bar located at bottom of screen if required.*		
6	Enter the serial number of the new ECU and click Set.		

Table 2. Procedure (continued)

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

Uploading Information to Yanmar

Purpose:

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

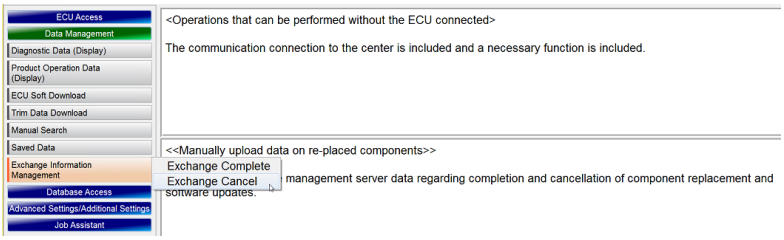
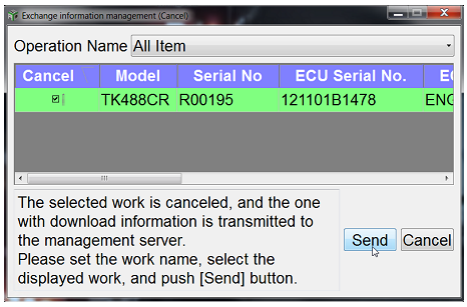
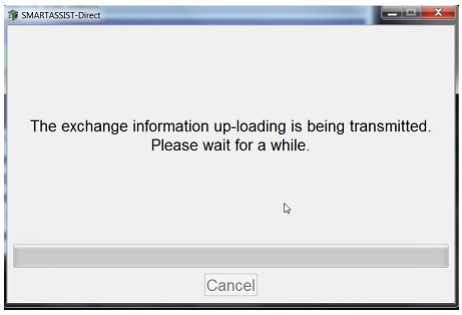
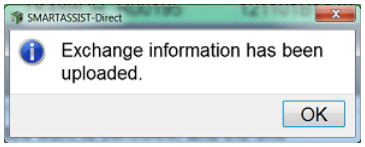
Materials Required:

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

Operation:

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

Table 3. Procedure

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

Updating ECU Software From Yanmar Core Database

Purpose:

To reprogram ECU / Required Data Exchange.

Materials Required:

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

Operation:

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

Table 4. Procedure

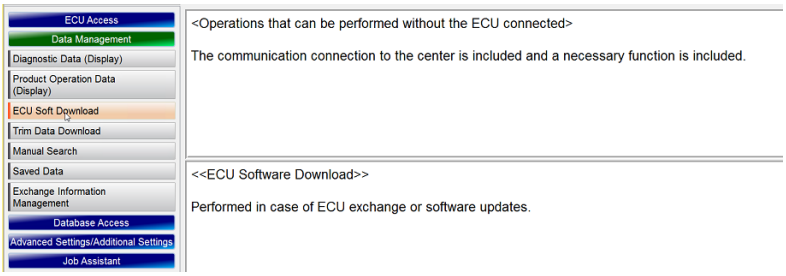
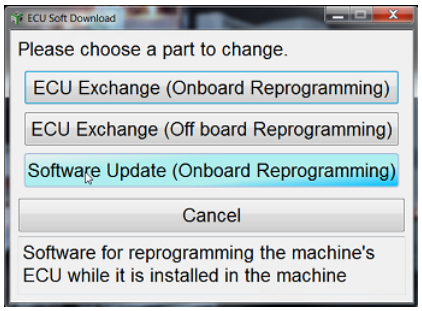
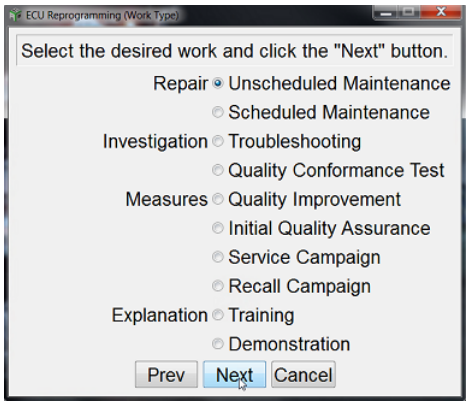
Step	Action	Result	Comments
1	With an internet connection, open YSAD, select Data Management, and click on ECU Soft Download.		
2	Choose Software Update (Onboard Reprogramming) and click Select.		
3	Choose reason for ECU Reprogramming (Quality Improvement) and click Next.		

Table 4. Procedure (continued)

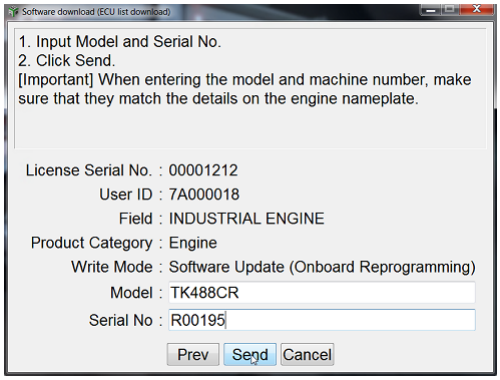
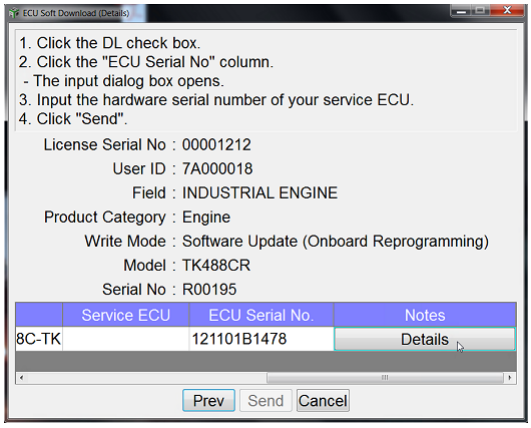
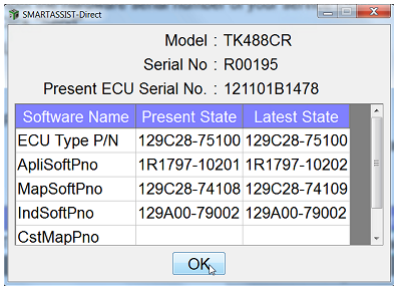
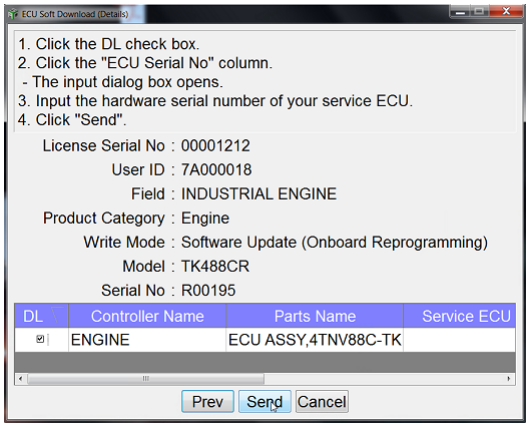
Step	Action	Result	Comments
4	Enter Engine Model Number and Serial Number into data boxes and click Send. ***Note:*** *Use upper case letters when entering values.*		
5	Click on the Details button underneath the Notes heading. ***Note:*** *Use scroll bar located at bottom of screen if required.*		
6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

Table 4. Procedure (continued)

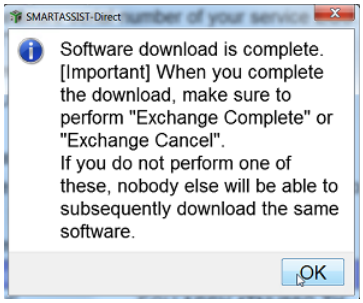
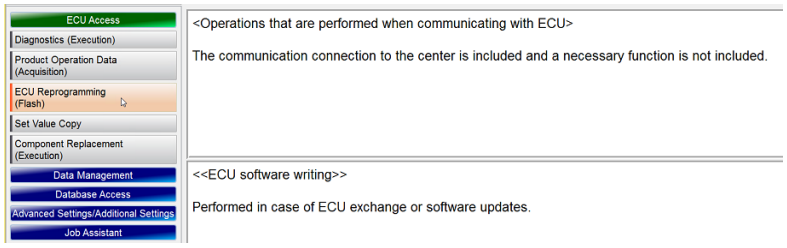
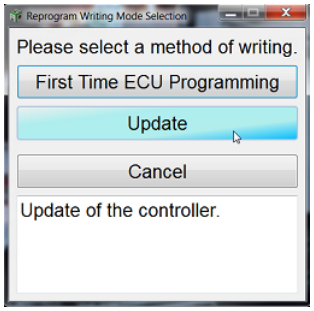
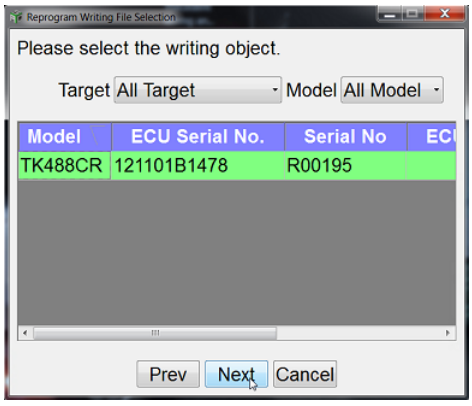
Step	Action	Result	Comments
8	Software update has been downloaded. Click OK.		Begin to write software to ECU using YSAD.
9	Connect YSAD to unit. ***Important:*** *Unit must be in Connect Engine Service Tool mode.*		Use Service Procedure A60A steps 1 to 8.
10	From the YSAD Main Menu, click the ECU Access tab and click ECU Programming.		
11	If ECU replacement, select First Time ECU Programming. If software update only, select Update.		
12	Click on correct engine serial number and click Next.		

Table 4. Procedure (continued)

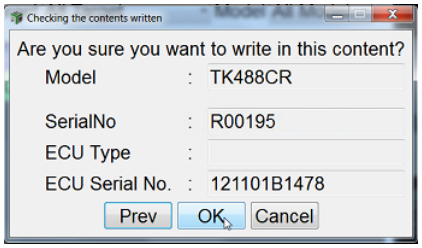
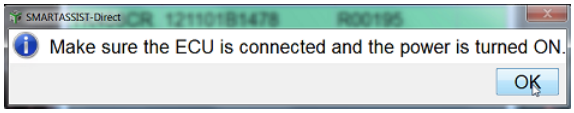
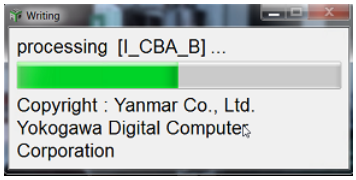
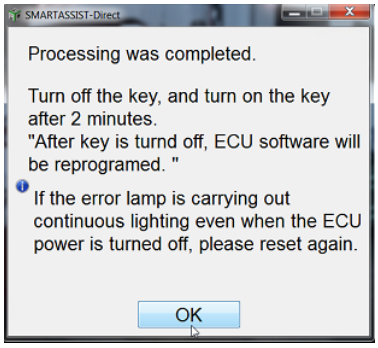
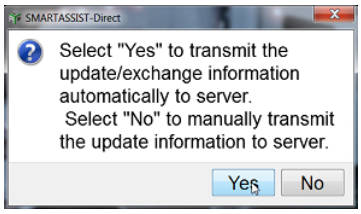
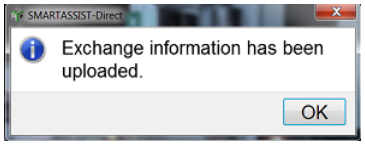
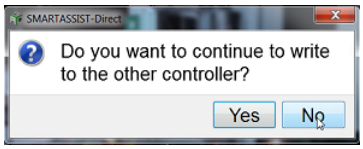
Step	Action	Result	Comments
13	Click OK.		
14	Click OK.		
15	Progress bar is shown as ECU is being flashed. This may take over 10 minutes.		Programming will not initiate if YSAD is not properly connected.
16	Processing completed. Turn the unit off for a minimum of two minutes. Click OK.		
17	Click Yes.		

Table 4. Procedure (continued)

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

ECU Recovery/Failures During Flash Load Procedures

Purpose:

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

Materials Required:

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

Operation:

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

Important Notes:

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

ECU Programming or ECU Updating of Software Failure During Flash

Table 5. Procedure

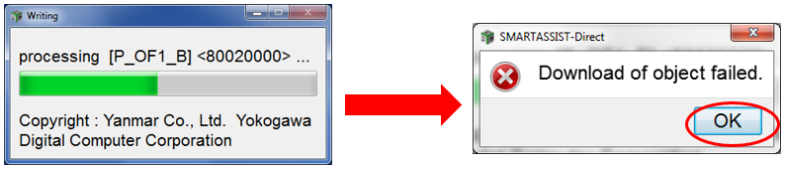
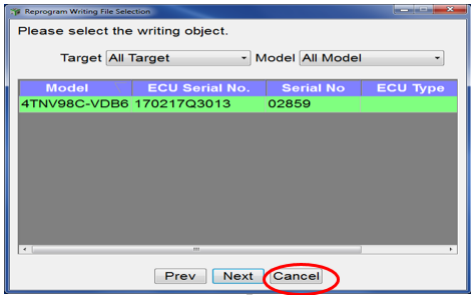
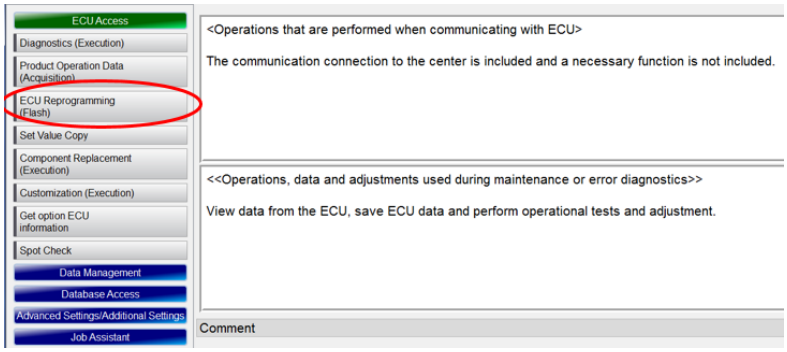
Step	Action	Result	Comments
1	Download of object failed during ECU update/ flash. Click OK.		
2	Click Cancel.		
3	From ECU Access, select ECU Reprogramming (Flash).		

Table 5. Procedure (continued)

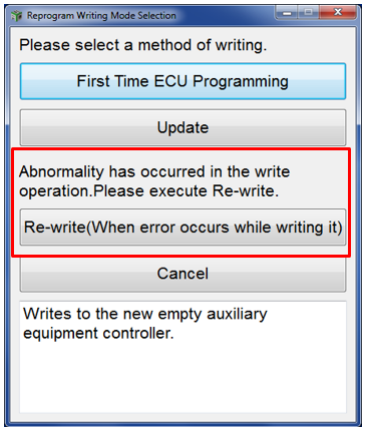
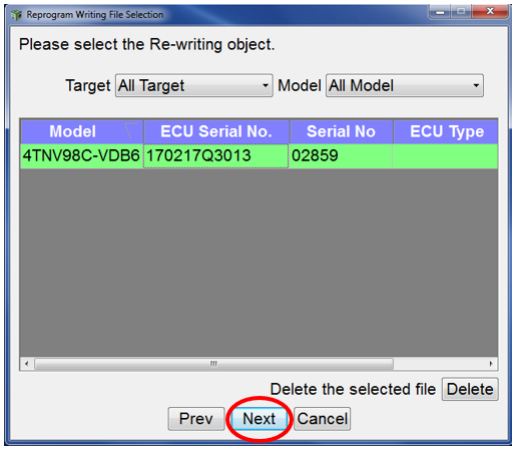
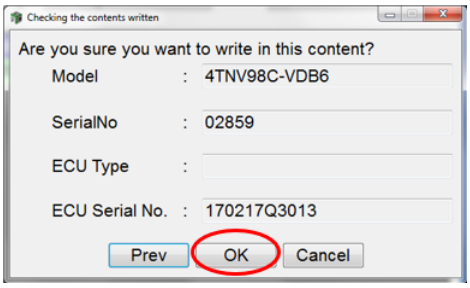
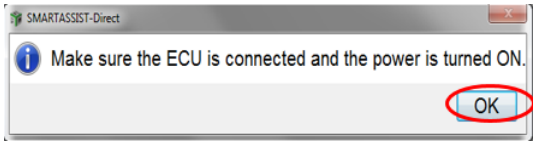
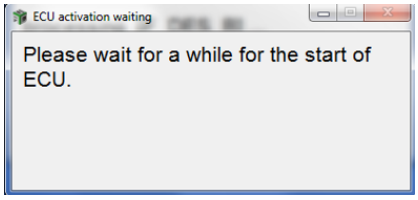
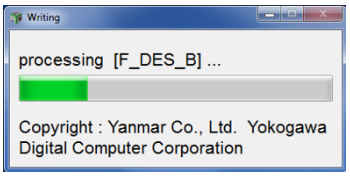
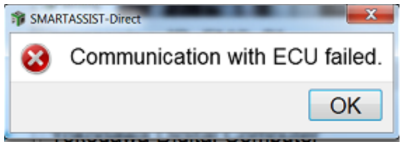
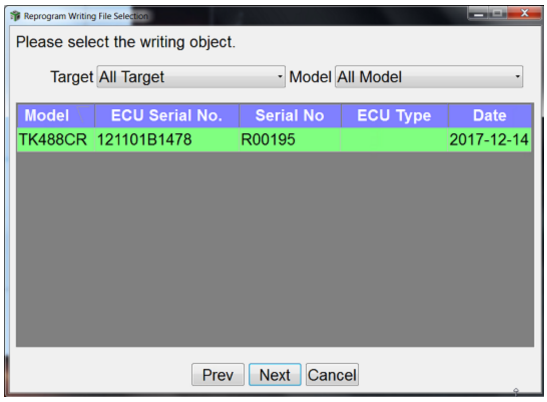
Step	Action	Result	Comments
4	Select Re-write (When error occurs while writing it).		
5	Select engine model to begin re-write and click Next.		
6	Verify engine model and serial number and click OK.		

Table 5. Procedure (continued)

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

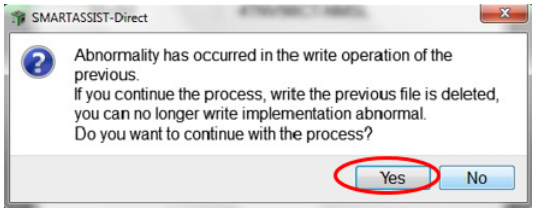
Communication Interruption During Flashing Process

Table 6. Procedure

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

Abnormality Occurrence During Flashing Process

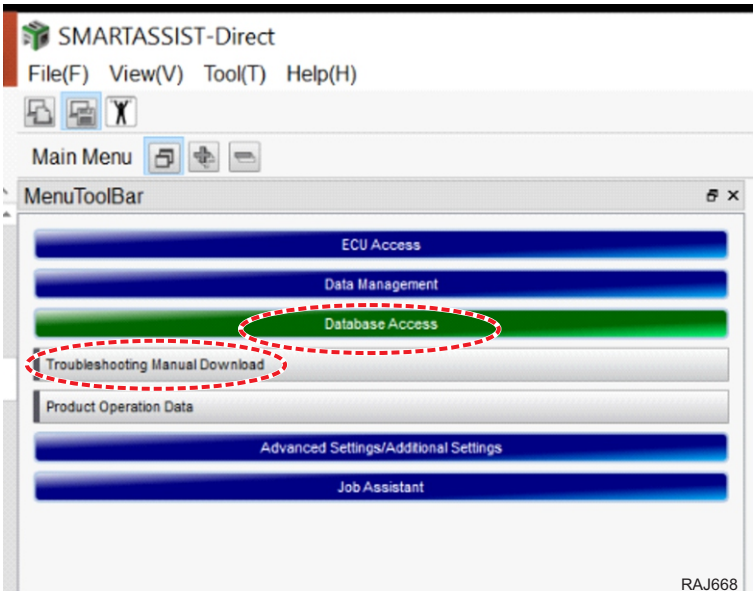
Table 7. Procedure

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

Accessing and Downloading YSAD Troubleshooting Manual

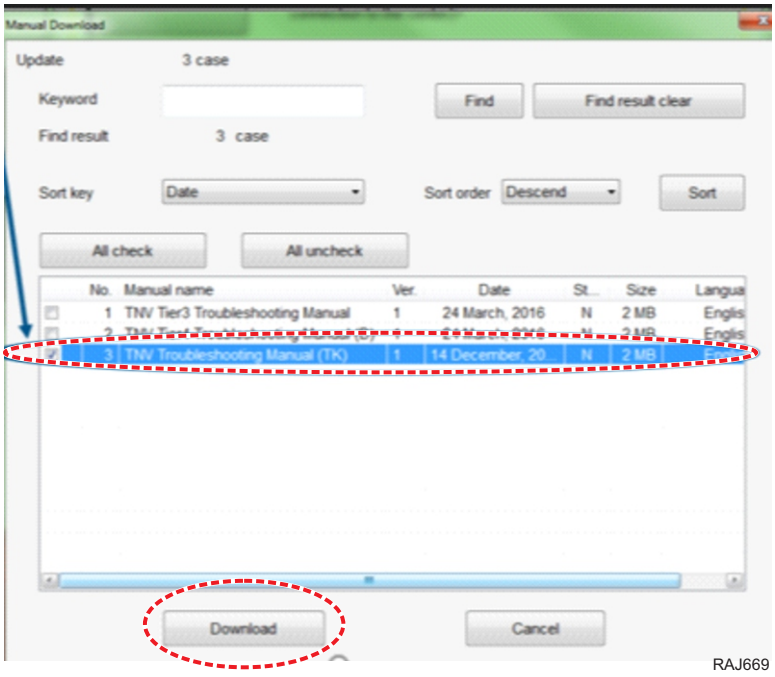
Downloading this manual will allow the technician to access much more information while diagnosing engine trouble codes.

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

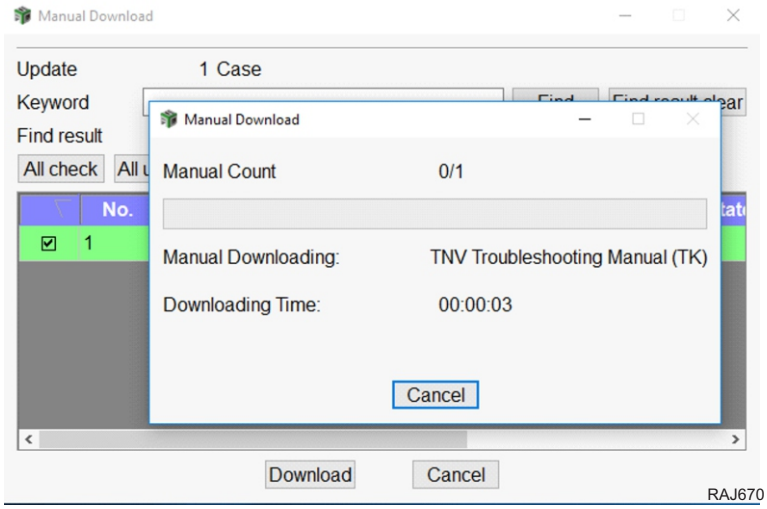


3. Check the box for “TNV Troubleshooting Manual (TK)”, then click download.

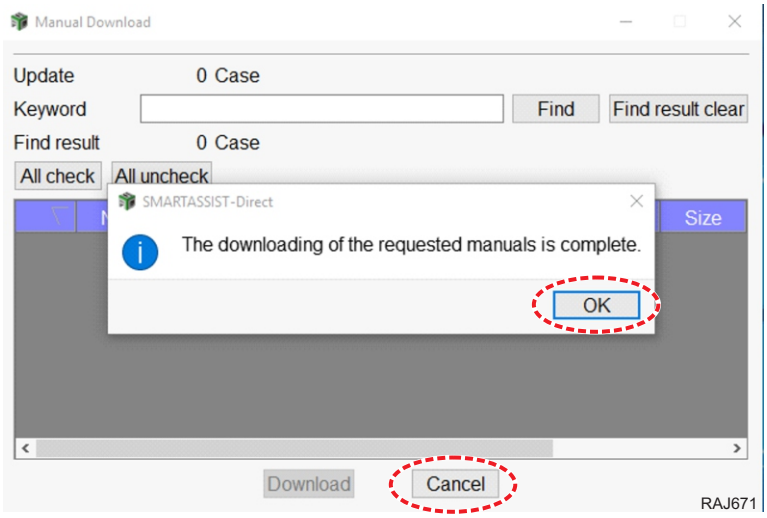
   Note: *If the manual was previously downloaded the manual will not show up here, skip to step 6 for manual viewing instructions.*



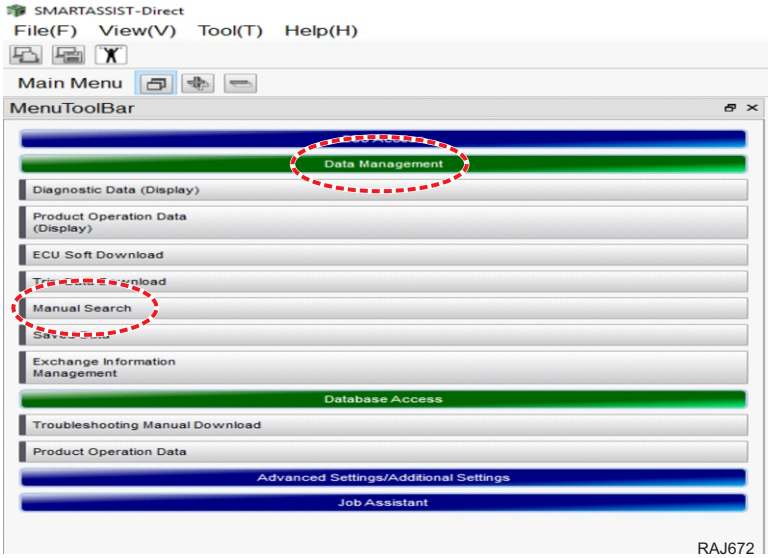
4. A pop-up will appear and show status of the download.



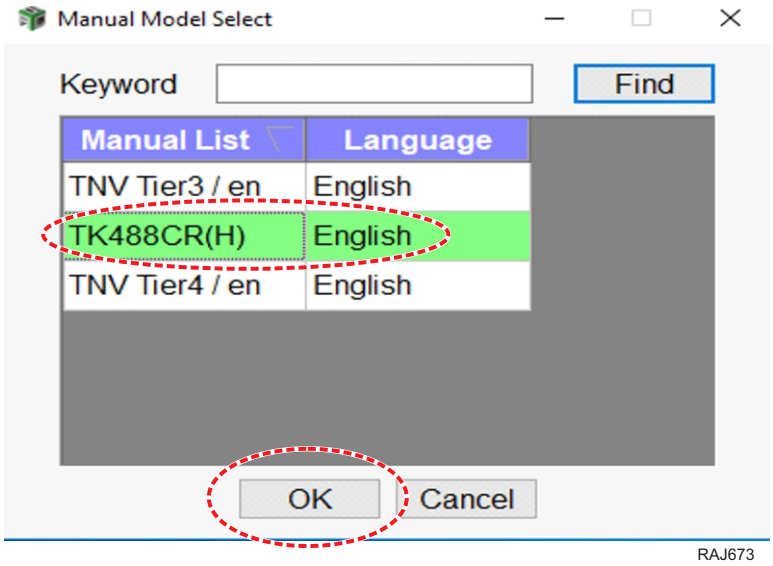
5. When Download is complete, click “OK”, then click “Cancel”.



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



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



8. The manual will open within the web browser.

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

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

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

Alternator Operation and Diagnosis

Megohmmeter

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

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

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

Maintenance Procedures

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

⚠ Warning

Risk of Injury!

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

General Inspection

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

Insulation

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

Field Coils, Stator Windings

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

Generator Housing

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

Generator Bearing

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

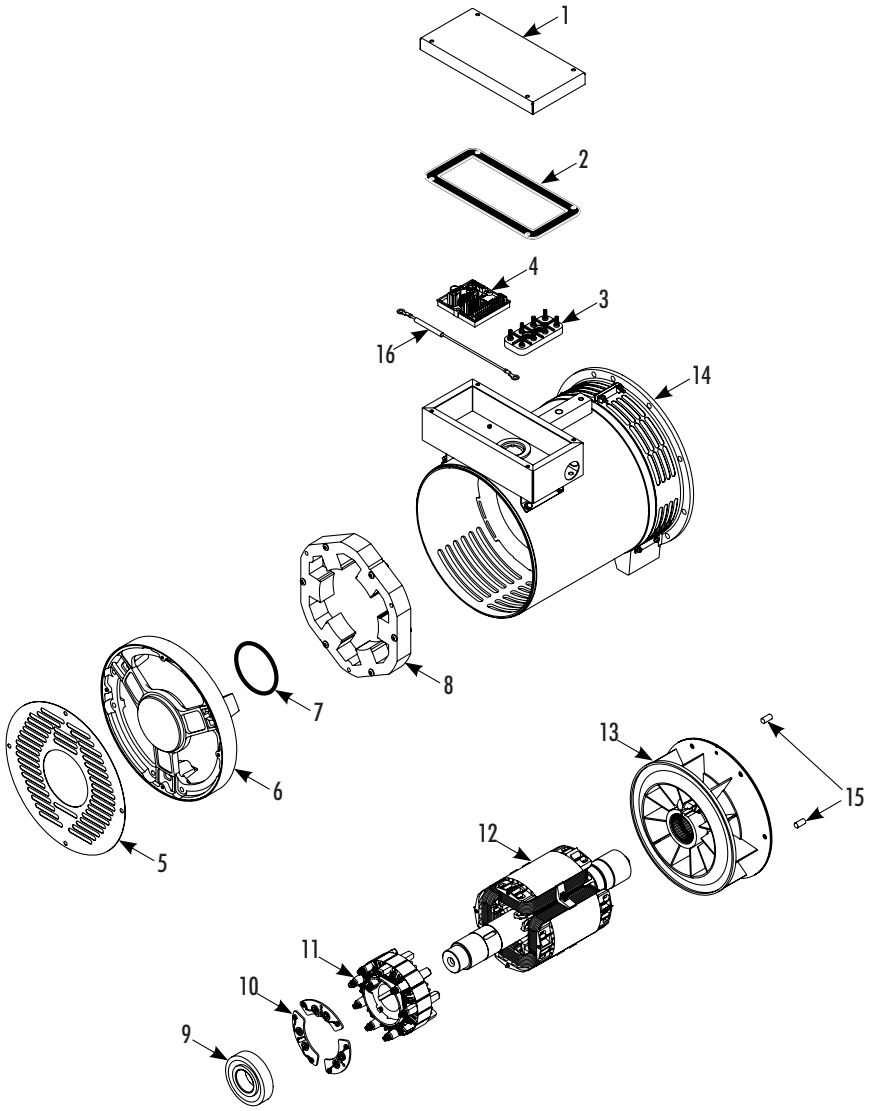
Impeller Fan

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

Coupling

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

Figure 21. 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		

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.

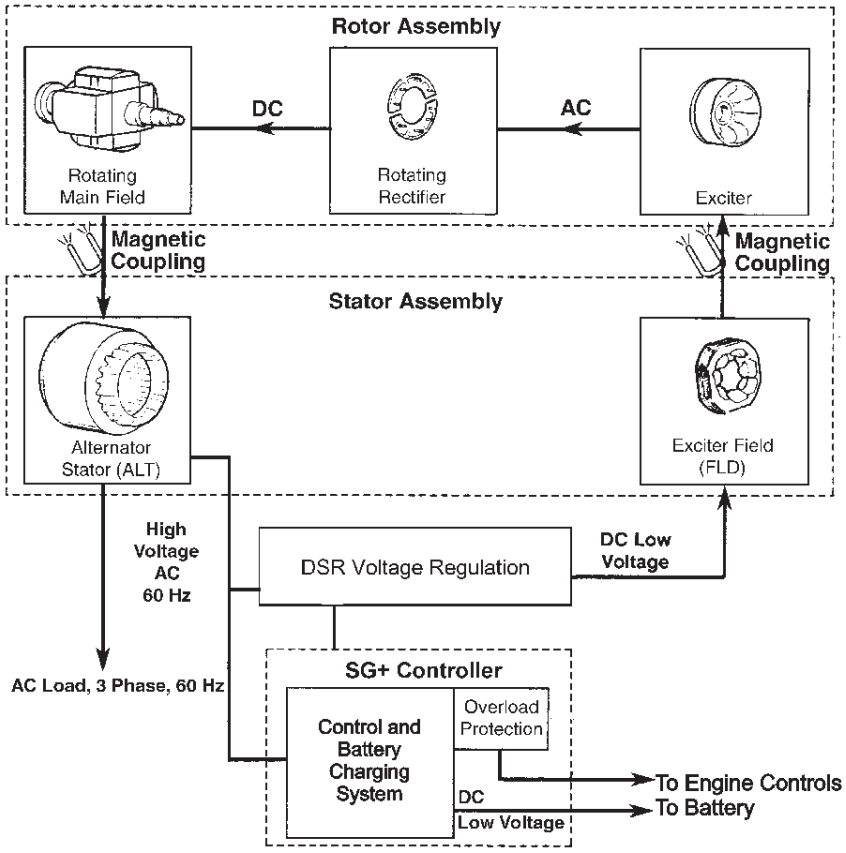
The main alternator may be subdivided into the 4-pole rotating main field and the alternator stator (ALT). The rotating main field, the rotating rectifier and the exciter armature are all mounted on a common shaft. Output of the exciter is rectified by the shaft mounted rotating bridge rectifier to provide 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 22. 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

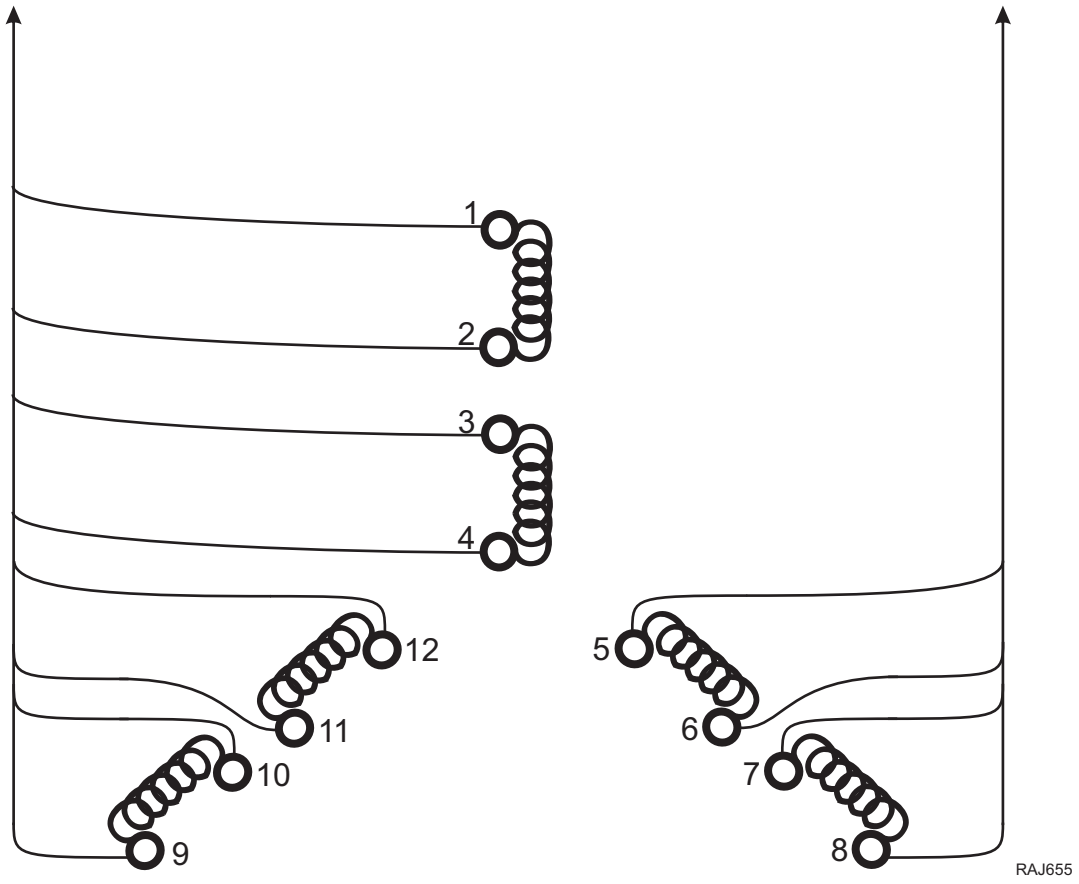
1. Disconnect the Blue and Yellow wires from pin 1 and 2 on the DSR field wire. Measure the resistance of the field circuit (Blue to Yellow). The standard value is 9.7 (±10%) ohms at 77 F (25C). If field is open or resistance value is low replace exciter field.
2. Measure Blue or yellow wires to GND 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 23. 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%.**

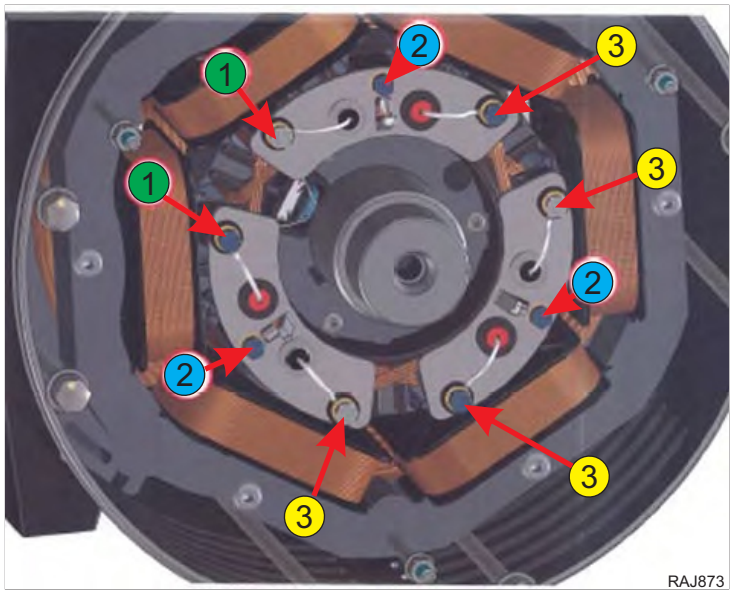
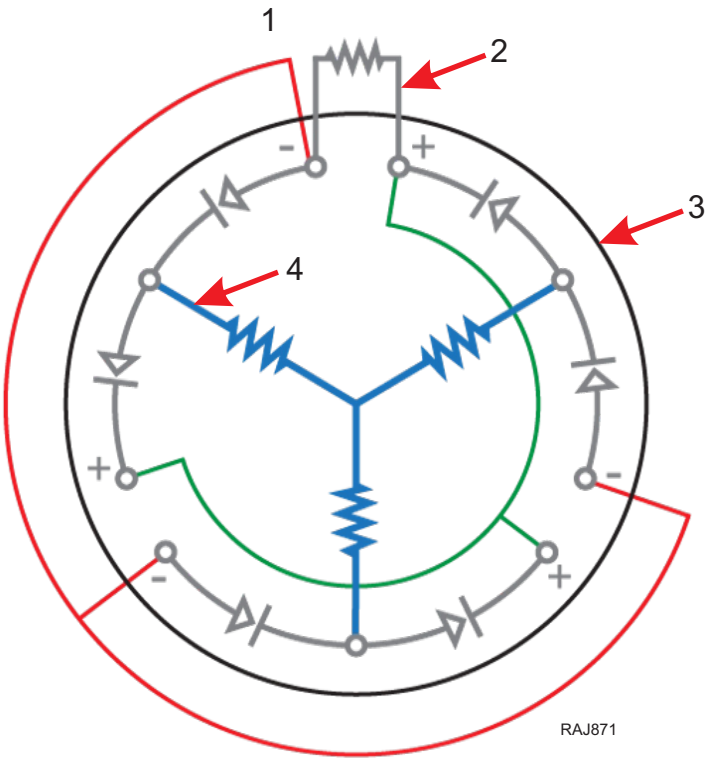
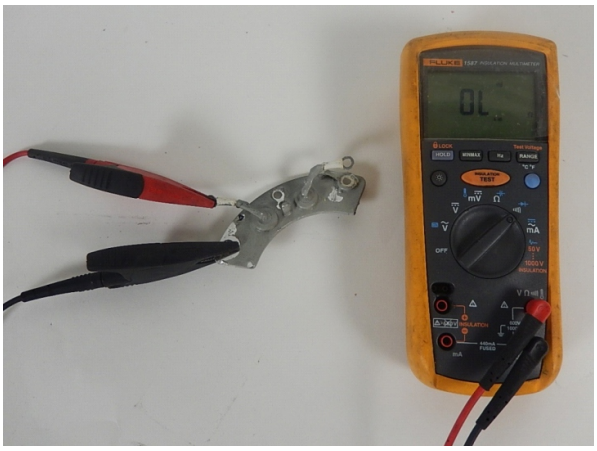


Figure 24. Exciter Rotor Components



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.


FLUKE 1587 INSULATION MULTIMETER
OL
HOLD
MIN MAX
RANGE
INSULATION TEST
mV
Ω
V
mA
OFF
50 V
1000 V INSULATION
INSULATION
FUSED


FLUKE 1587 INSULATION MULTIMETER
49.0
HOLD
MIN MAX
RANGE
INSULATION TEST
mV
Ω
V
mA
OFF
50 V
1000 V INSULATION
INSULATION
FUSED

RAJ872

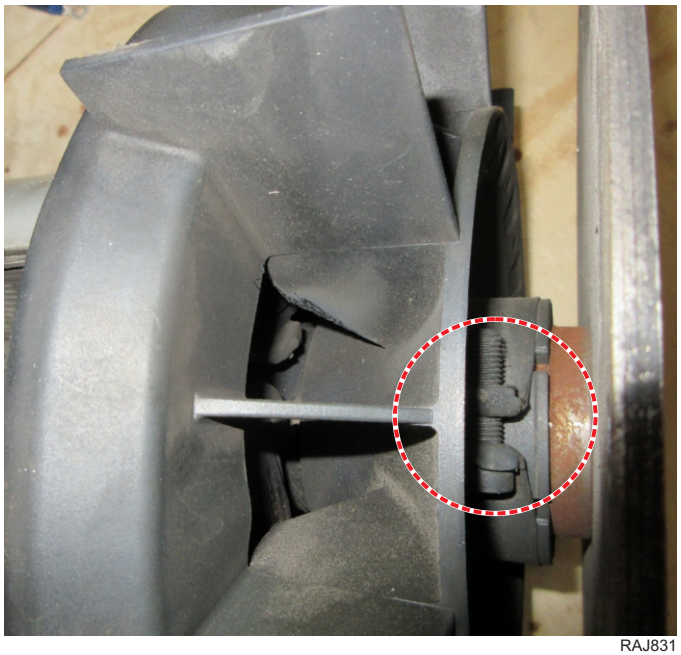
Alternator Replacement

Alternator Removal

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

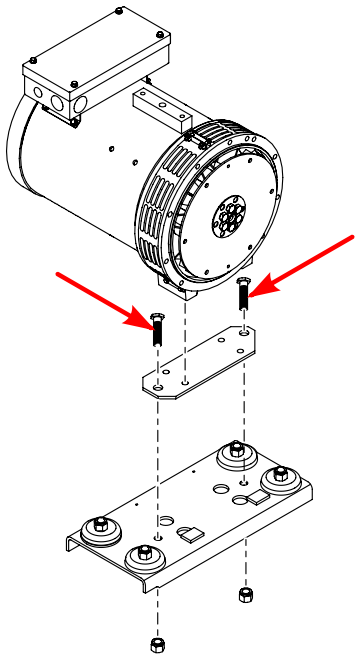
1. Remove the grill from around the alternator. Remove all but one of the bolts holding the alternator to the flywheel housing.
2. Remove the bolts holding the flex plate to the flywheel. If fan blade is blocking access to bolts, loosen fan blade clamp and rotate fan to gain access. Remember to re-tighten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

Figure 25. Fan Clamp



RAJ831

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



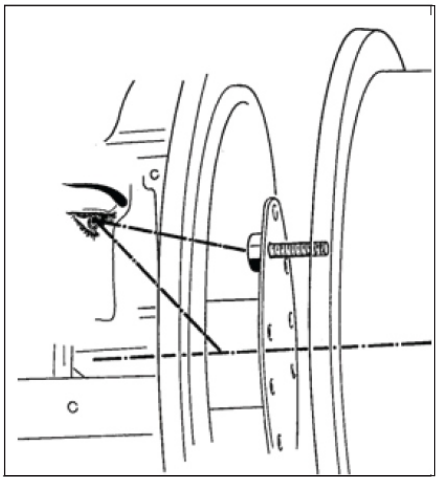
RAJ937

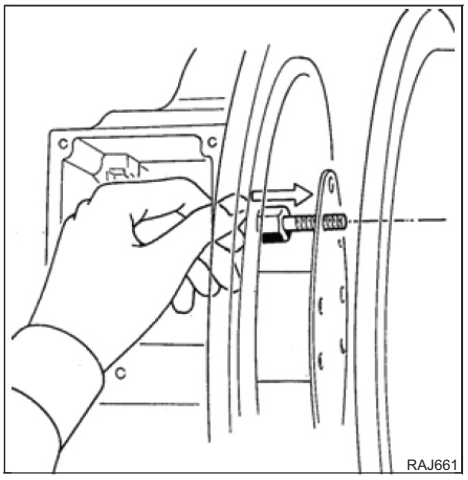
4. Once all flex plate bolts are removed, be sure to support engine and alternator, remove the last bolt holding the alternator to flywheel housing and remove alternator from engine.

Alternator Installation

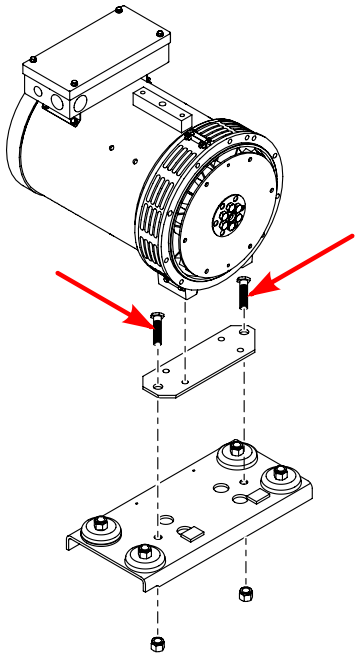
Note: *A bad alignment may cause vibrations and bearing damage. It is advisable to verify the compatibility of the generator torsional characteristic's and the Engine.*

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.



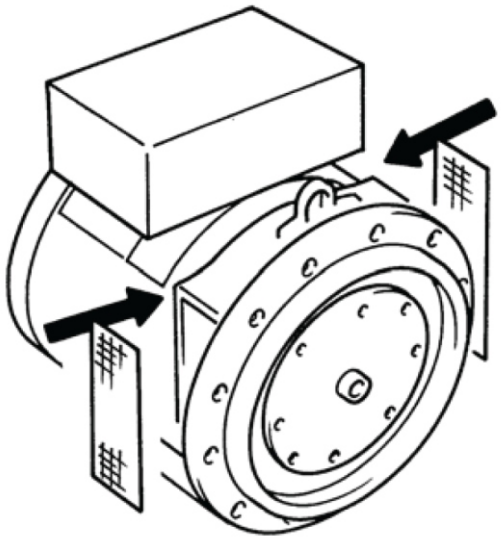


2. Start to install the bolts through the flex plate to the flywheel. Rotate engine to install all the bolts. Loosen fan and rotate if needed. Torque bolts to 16 Nm (12 ft-lbs). If fan blade is blocking access to bolts, loosen fan blade clamp and rotate fan to gain access. Re-tighten fan clamp if loosened.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



RAJ937

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



RAJ662

Structural/Accessory Maintenance

Unit Inspection

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

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

Mounting Bolts

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

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

SGCO Clip-on Corner Clamp Unit Installation

⚠ Caution

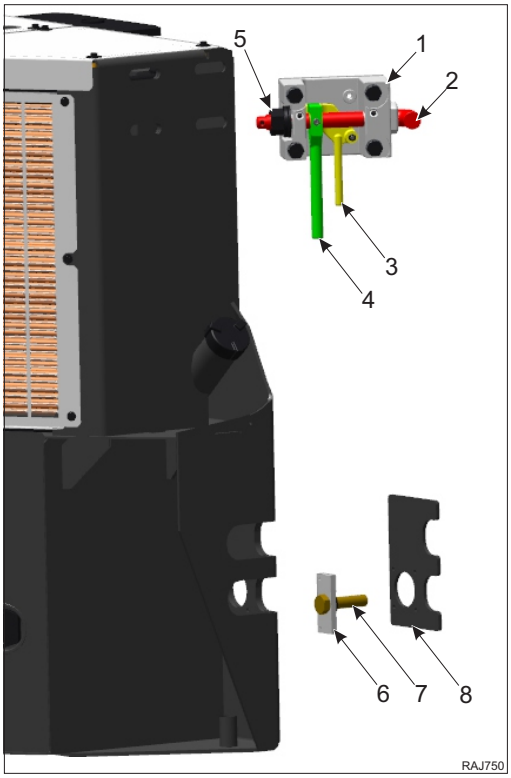
Risk of Injury!

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

⚠ Caution

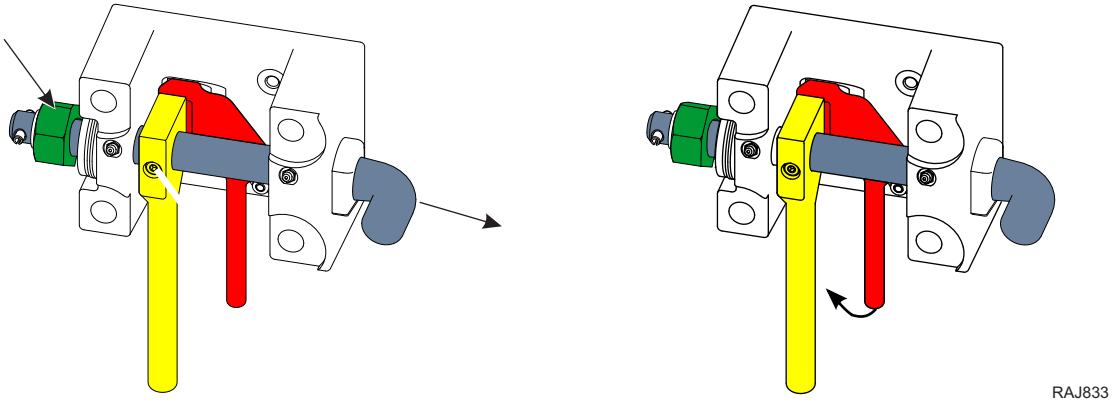
Service Procedure!

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



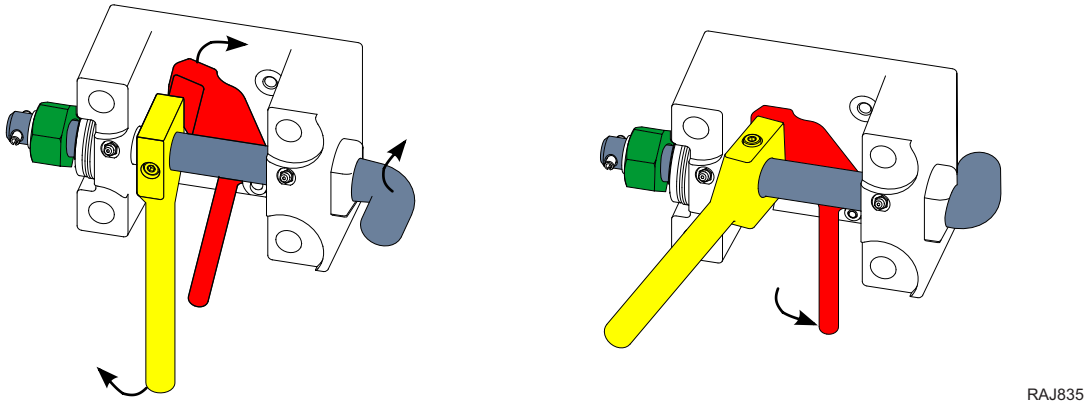
1.	Unit Mounting Bracket Assembly (one per side)	5.	Lock Nut
2.	Clamp Shaft	6.	Washer
3.	Clamp Paw	7.	Lower Mounting Bolt
4.	Clamp Handle	8.	Door

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



RAJ833

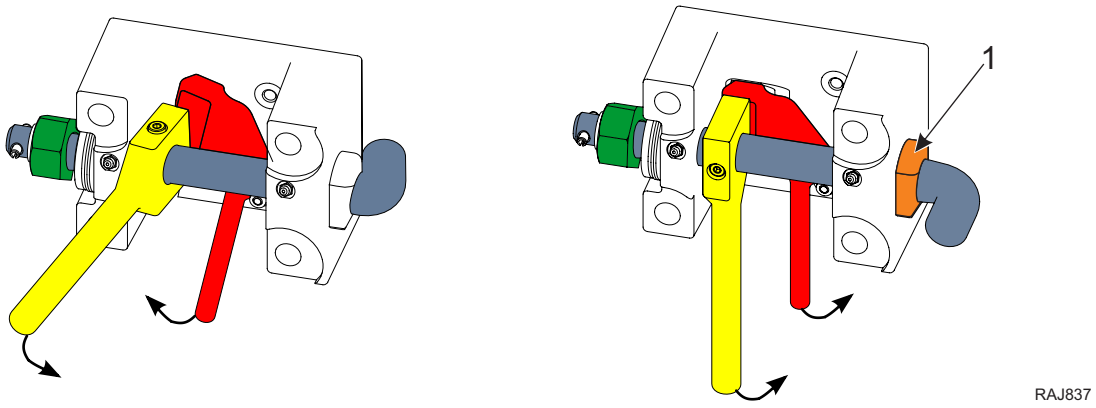
3. Lift the clamp handle (4) upwards to rotate the clamp shaft foot (2) 90 degrees upwards.
4. Let the clamp pawl (3) drop down to hold the clamp handle (4) in position.



RAJ835

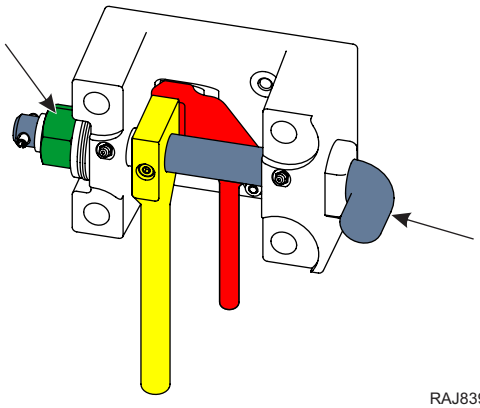
5. Use appropriate heavy equipment to lift the unit into mounting position on front wall of the container. The foot of the mount clamp (5) should fit into corner casting on each side of the container.
6. Ensure the angled foot of the clamp shaft (5) fits properly into the container corner casting on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

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



1.	Clamp Boss

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



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

SGCO Clip-on Corner Header Pin Unit Installation

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

> **⚠ Caution**
>
> **Risk of Injury!**
>
> **Take adequate precautions when lifting and mounting the generator set to prevent personal injury or unit damage.**

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

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

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

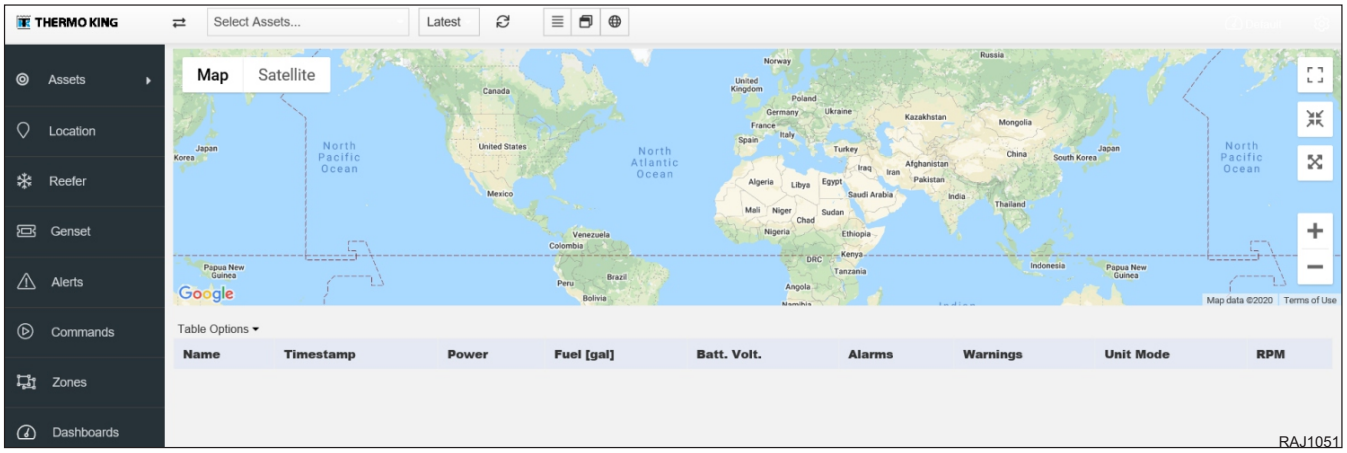
Telematics Information

Telematics General Description

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

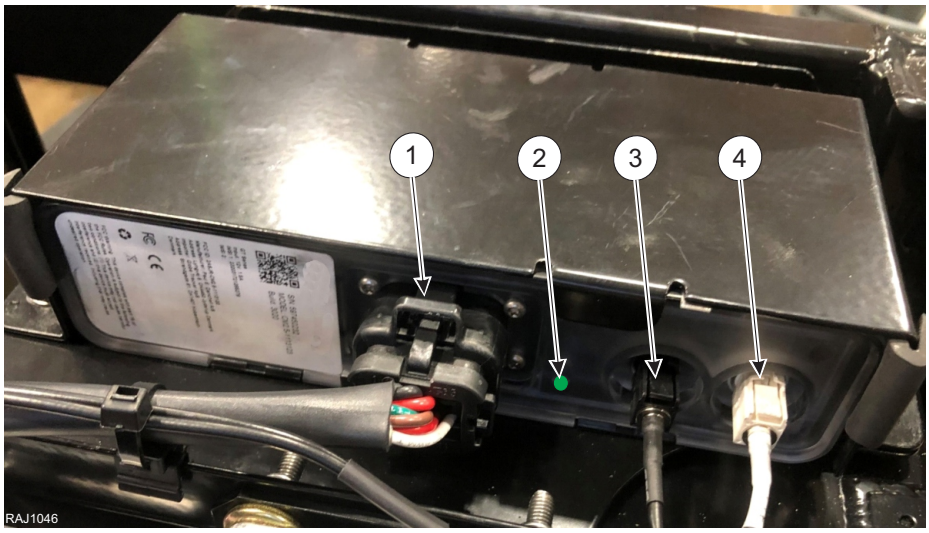
- Asset Name
- Unit Location (GPS Tracking)
- Genset Status (ON/OFF)
- Battery Voltage
- Fuel Level
- Engine RPM
- Engine Load %
- Engine Temperature
- Generator Voltage
- Generator Hz
- Total Hours

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



Telematics Component Locations

Figure 26. Telematics Module



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

Telematics Module Cycle Identification (LED Flash)

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

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

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

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

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

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

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

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

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

RAJ1052

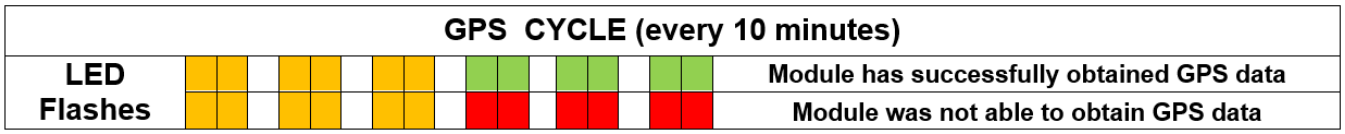
Important: *The ability of the device to call in depends on the availability and strength of the GSM / CELL signal. A missing or bad signal can result in 3 red flashes. This does not mean that there is a problem with the telematics module. Allow the module to go through several call cycles before continuing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

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

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

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

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



RAJ1053

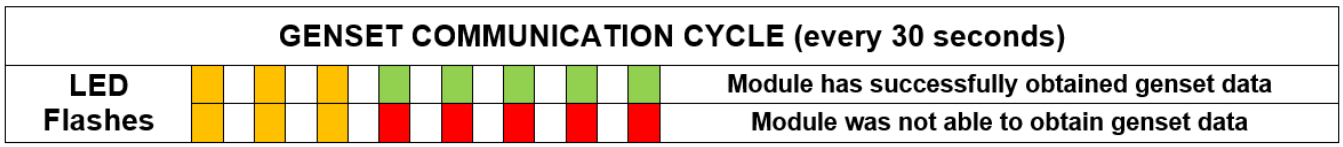
Important: *The ability of the device to obtain GPS data depends on the availability and strength of the GPS signal. A missing or bad signal can result in 2 red flashes. This does not mean that there is a problem with the telematics module. Allow the module to go through several GPS cycles before continuing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

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

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

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

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



RAJ1054

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

Telematics Diagnostic Information

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

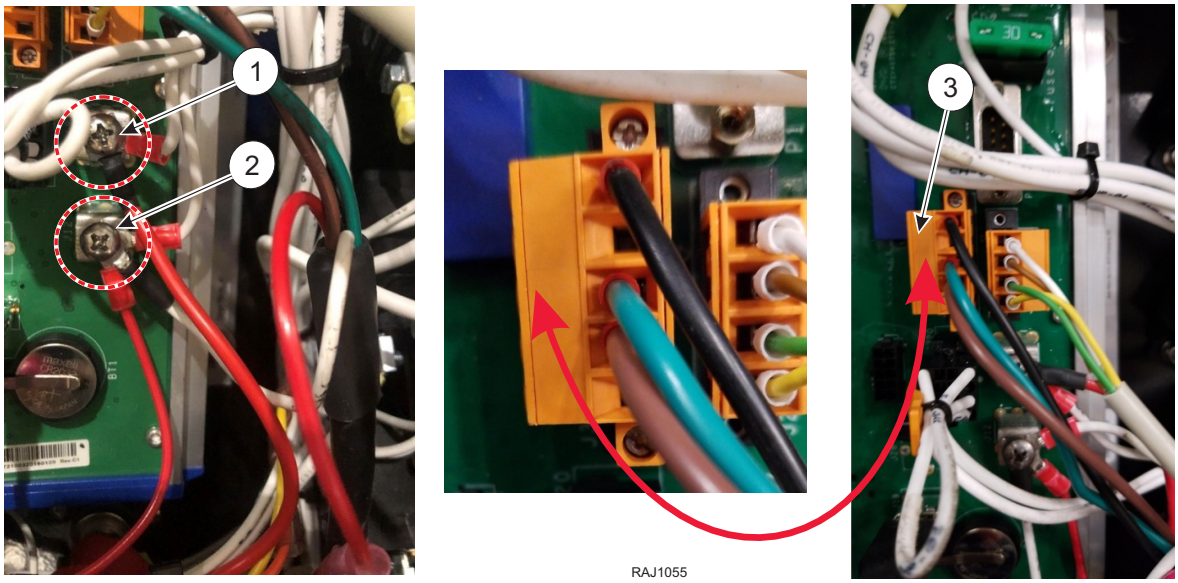
Important: *Each unit is uniquely paired to a telematics module on the assembly line:*

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

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

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

   Putting the SG unit into ECU SERVICE MODE allows the telematics system to operate normally, and will prevent the engine from starting.
2. Verify the SG unit is supplying battery voltage to the telematics system on connections J12 (switched B+ with unit ON/OFF switch) and J13 (B+) on the controller. If battery voltage is not present, diagnose the issue with the SG unit.
3. Verify all other telematics connections are correct and tight at the controller:



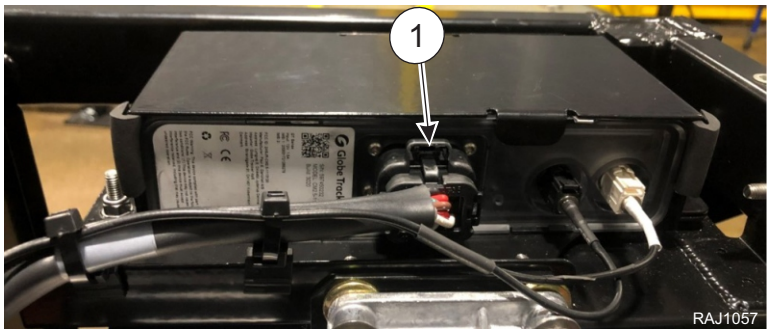
1.	J13 Connection - Red Power Supply Wire Connection for Telematics System with Fuse (B+)
2.	J12 Connection - White Power Supply Wire Connection for Telematics System (B+ switched by unit On / Off switch)
3.	J3 Connection - Telematics Connector Location

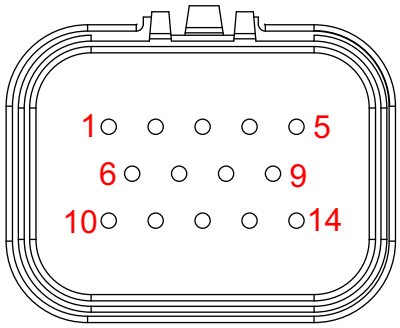
4. Check the telematics system 2A fuse located on the telematics J13 connection in an individual fuse holder near the control module and replace if necessary:

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

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

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





Back of Connector

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

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

   Putting the SG unit into ECU SERVICE MODE allows the telematics system to operate normally, and will prevent the engine from starting.
10. Observe the telematics module LED flash sequence:
    - If the LED is NOT flashing a sequence and the connections, harness, power and ground supply are all verified good, replace the telematics module.
    - If the LED is flashing RED in any of the three sequences (CELL, GPS, GENSET), allow the system to go through a few communications cycles. Ensure the unit is outside and has access to CELL and GPS signal.

      Note: *Verify CELL signal by viewing your mobile phone signal level. This check will give an estimate on CELL signal strength level, but can be inaccurate due to the many telecom providers.*
    - If LED RED flashes continue for the GPS and CELL, verify the antenna pod and harness are not damaged. Verify the antenna connections at the telematics module are tight. Replace the antenna if necessary.
    - If LED RED flashes continue for the GENSET cycle and all connections and harness have been verified good, the telematics module may need replacement.

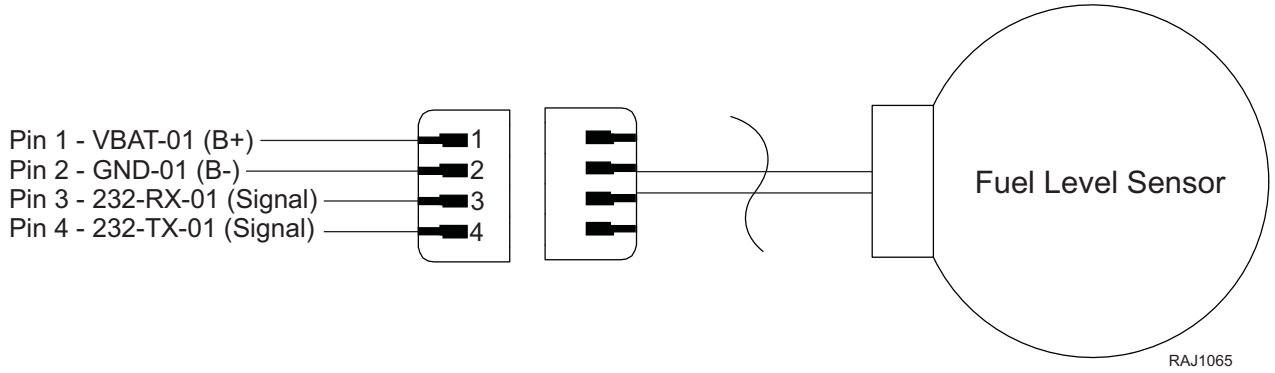
Note: *The SG controller will show a communication error on the screen of the microprocessor is not communicating. In that case, the microprocessor must be replaced. If the SG controller is working normally, but GENSET LED RED flashes persist, the issue is with the telematics module.*

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

Telematics Fuel Level Sensor (optional)

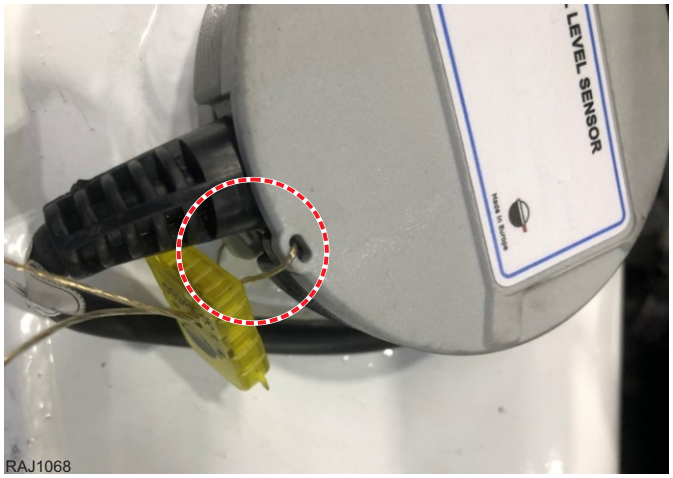
The fuel level sensor is a captive type sensor that transmits a signal to the telematics module. If the unit owner reports fuel level information faults, first perform these electrical checks on the system:

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



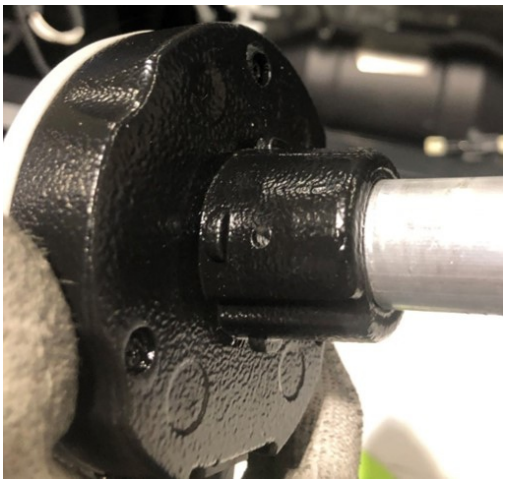
After the electrical side of the fuel level sensor is verified as working properly, there could be debris and sludge causing issues that need to be inspected.

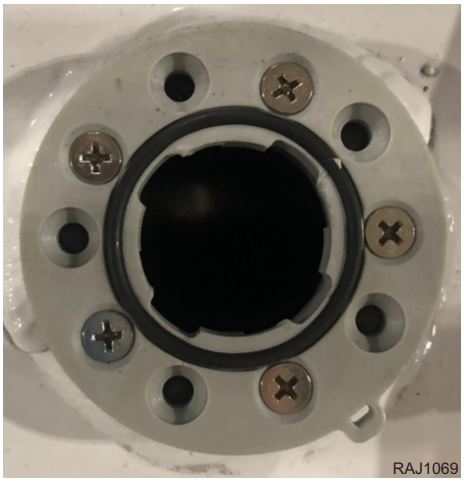
6. Cut the fuel level sensor anti-tamper device to allow sensor removal.



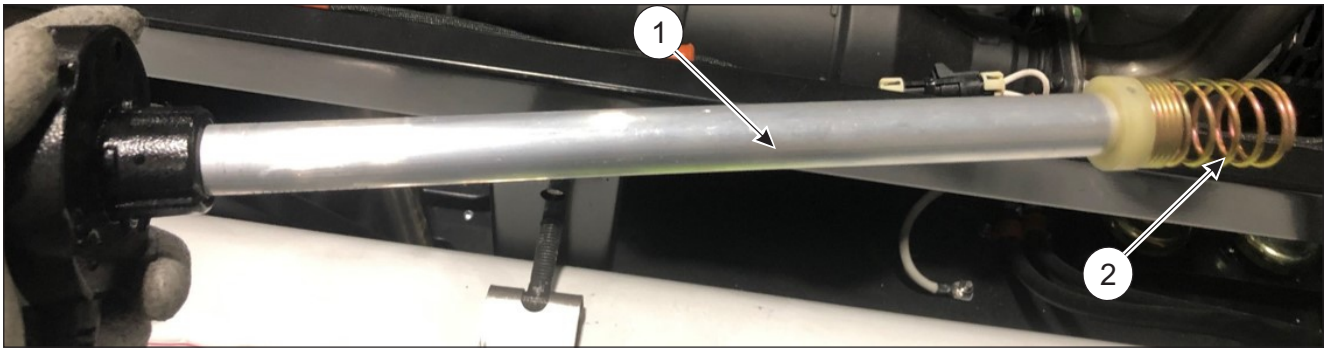
7. Cut the bandwraps securing the sensor harness. Unplug the sensor from the unit wiring.

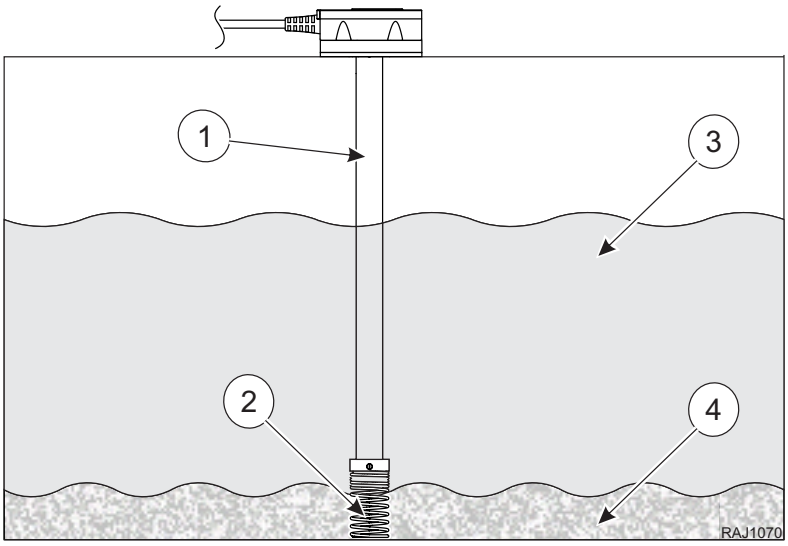
8. Turn the sensor 30 degrees counter clock wise to disengage the retaining lugs. Remove the sensor by lifting it upward out of the tank.





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





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

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

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

Telematics Antenna

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

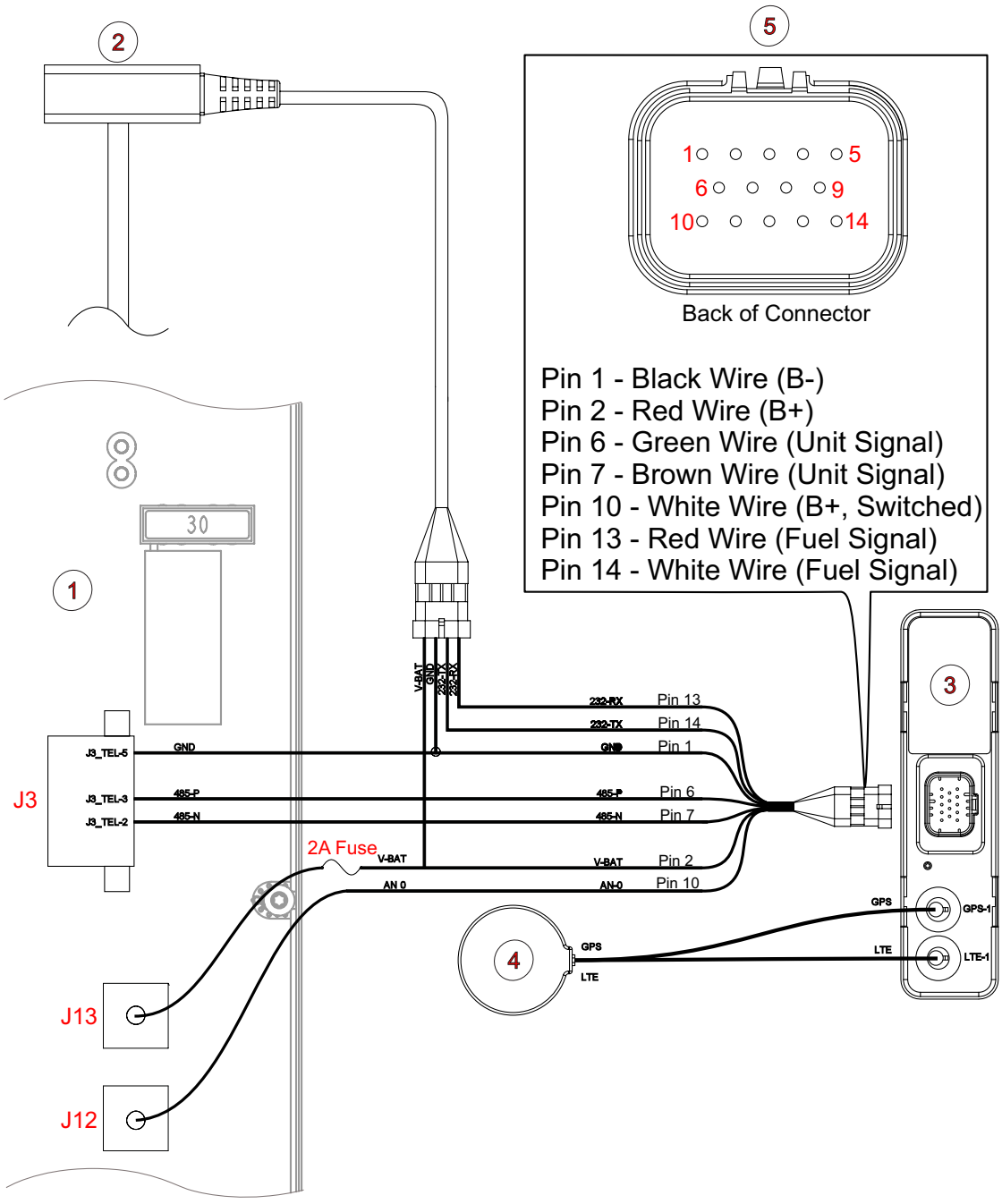
- Verify the SG unit is supplying battery voltage and ground to the telematics system. If battery voltage and ground are not present, diagnose the issue with the SG unit or harness.
- Check the telematics 2A fuse.
- View the LED flash sequence.
- Check the connections at the telematics module.
- Verify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

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

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

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

Figure 27. Telematics Simplified Circuit View



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

Pairing Telematics Module to SG Unit

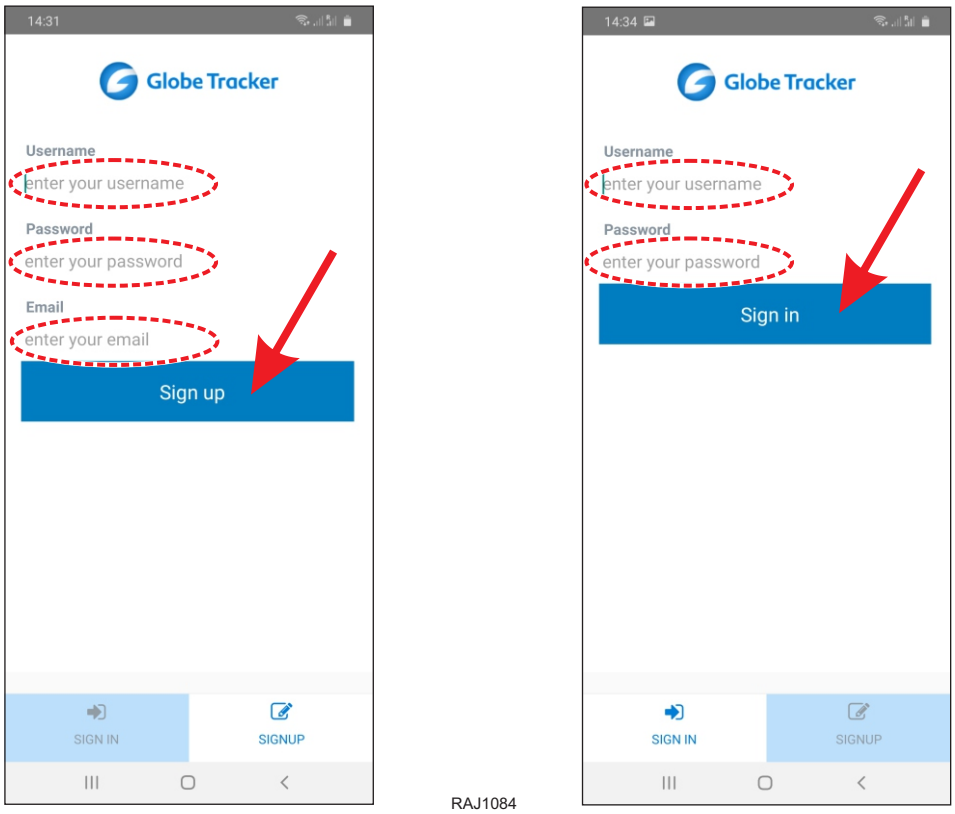
Important: *Each SG unit is uniquely paired to a telematics module on the assembly line:*

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

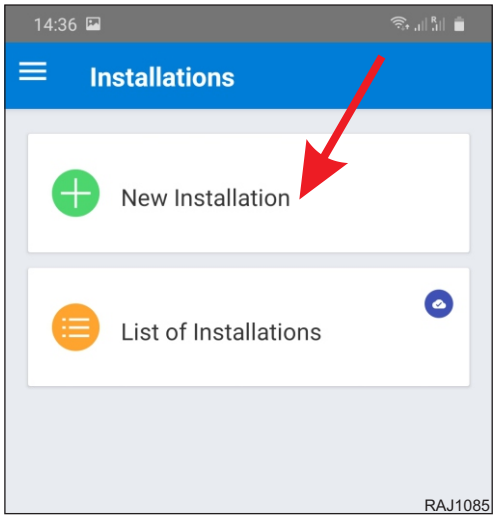
Before a new telematics module will activate, it must be paired with the SG unit.

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

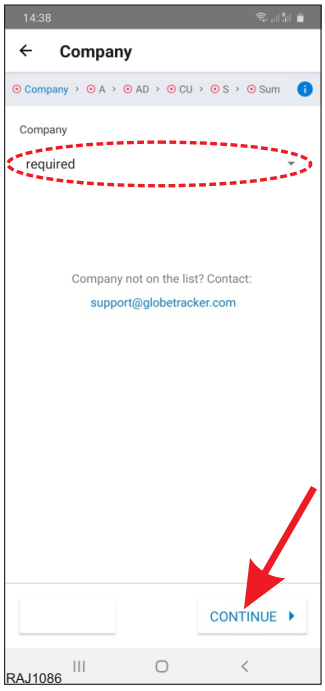
2. Open the app. Create an account (new users) or sign in (existing users):
   - First time users will need to create an account. Enter username, password, email address and tap the **SIGNUP** button.
   - DO NOT enter TOTP Code if shown, this is not used.



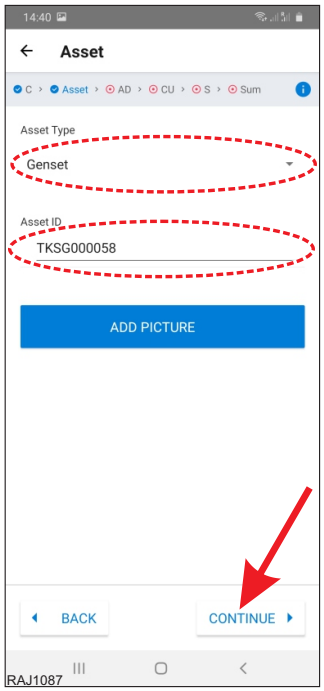
3. Select **New Installation**.



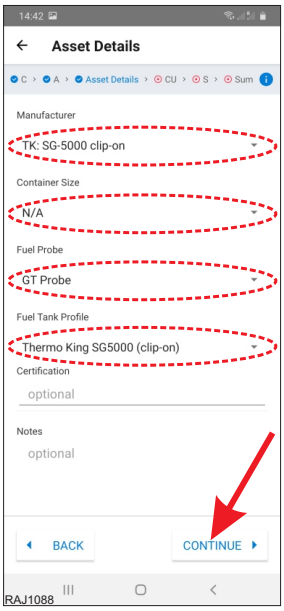
4. Tap **Company** and choose the customer / unit owner from the list. If the unit owners company is not listed, contact: **support@globetracker.com**.
5. Tap **Continue**.



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

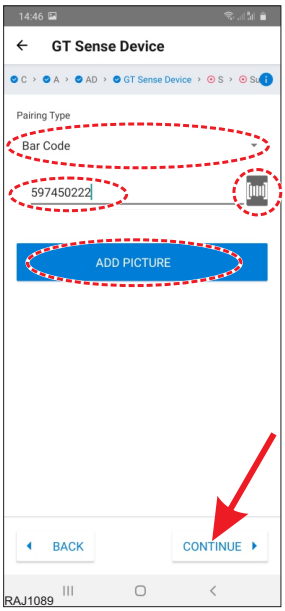


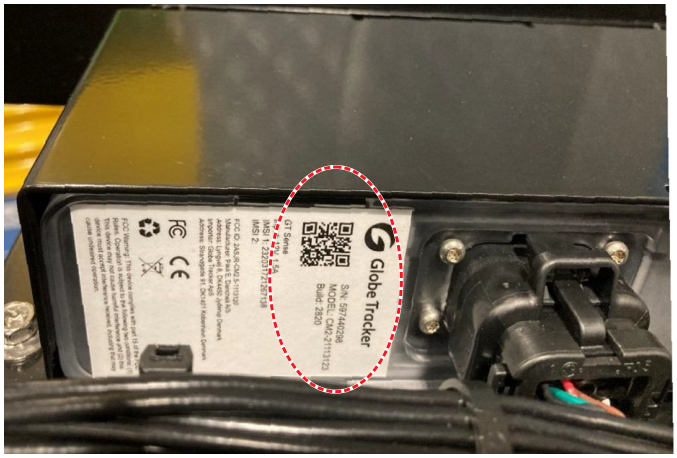
9. Tap **Manufacturer** and choose the correct SG genset type**: TK: SG clip-on** or **TK: SG under-mount**.
10. Tap **Container Size** and select **Container Size Not Applicable**.
11. Scroll down and tap **Fuel Probe** and select **GT Probe** if the unit is equipped with the **optional** fuel level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



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

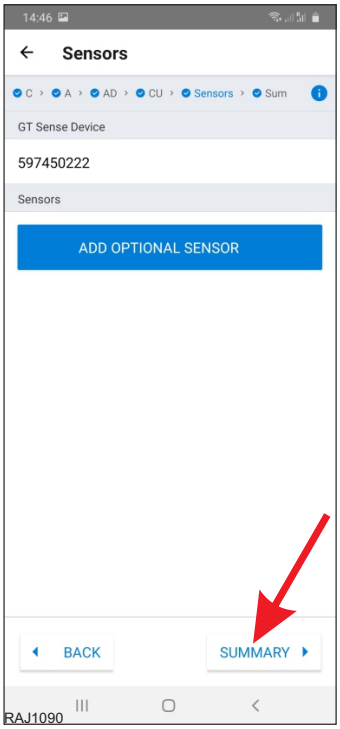
    Important: *This installation can be done remotely once all information is available.*



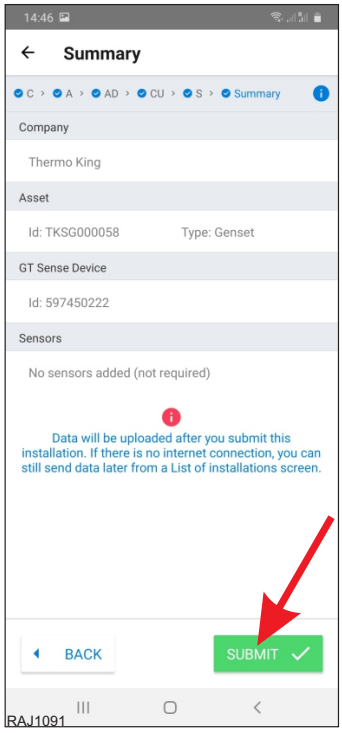


18. DO NOT choose any optional sensor. Leave this blank.

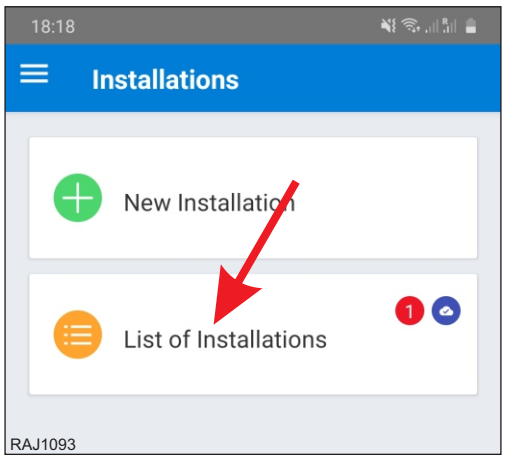
19. Tap **Summary**.



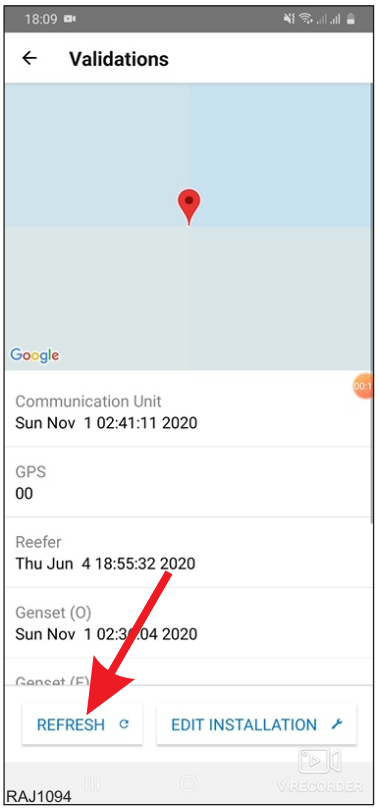
20. Verify all information is correct, then tap **Submit**.



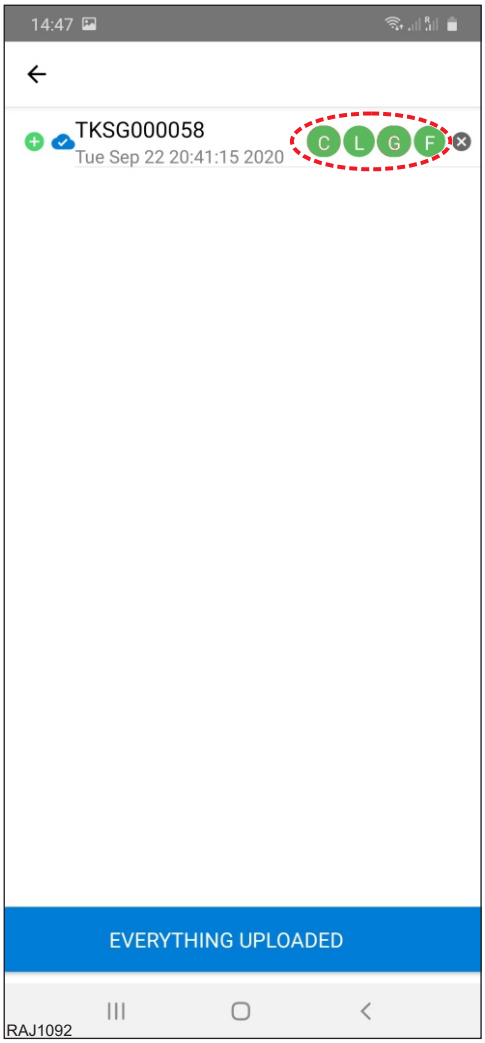
21. Leave the app running.
22. Install the new telematics module. Verify all electrical connections are secure, check the telematics fuse, and wire harnesses.
23. Go back to the home screen and tap **List of Installations**.



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



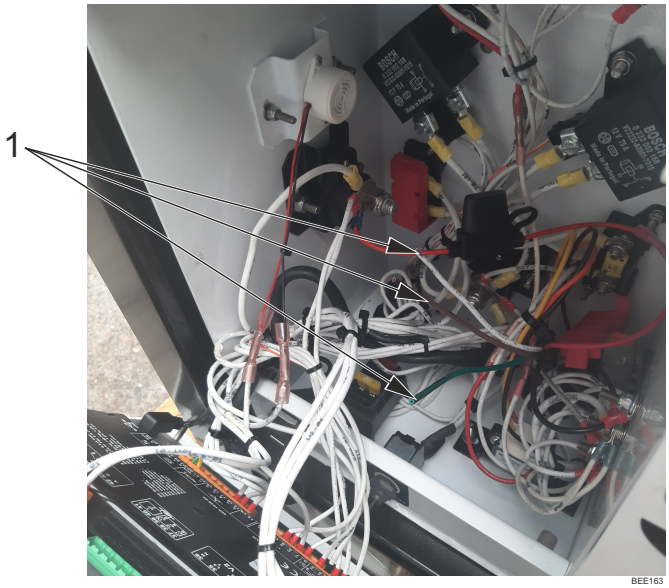
25. Start the SG unit and let it run until all four indicators have turned green in the app.



26. Verify the flash codes on the module indicate normal operation.
27. Pairing is now complete.

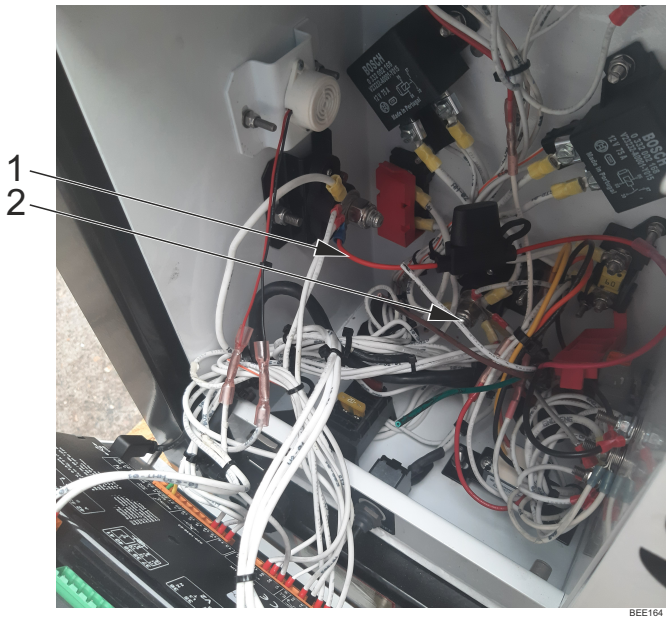
Install of Telematics in the SGUM-3500

1. There are 4 wires in the black telematics, 3 will need to be extended as needed.



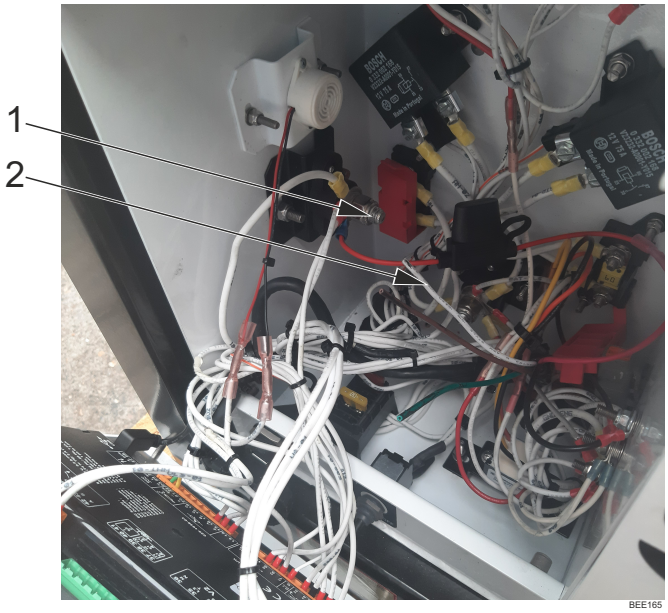
1.	Extendable cables		

2. Connect the Red wire at connect point.



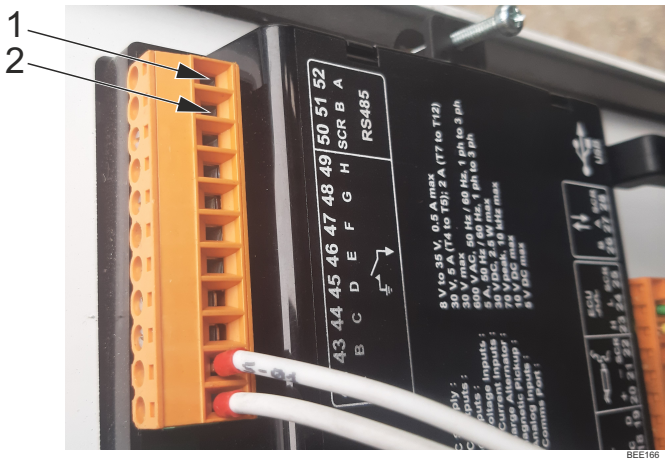
1.	Red cable	2.	Connect point

3. The White wire needs to be connected at connect point



1.	Connect point	2.	White wire

4. Connect the Brown and Green wires in sockets.



1.	Brown wire's socket	2.	Green wire's socket

Mechanical Diagnosis

Table 8. Diagnosing Unit Conditions

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

Table 8. Diagnosing Unit Conditions (continued)

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

Diagram Index

Drawing No.	Drawing Title
3E97558	DIAGRAM WIRING, GENSET SG3500 (4 pages)
3E97559	DIAGRAM SCHEMATIC, GENSET SG3500 (3 pages)

Figure 28. 3E97558 (Page 1 of 4)

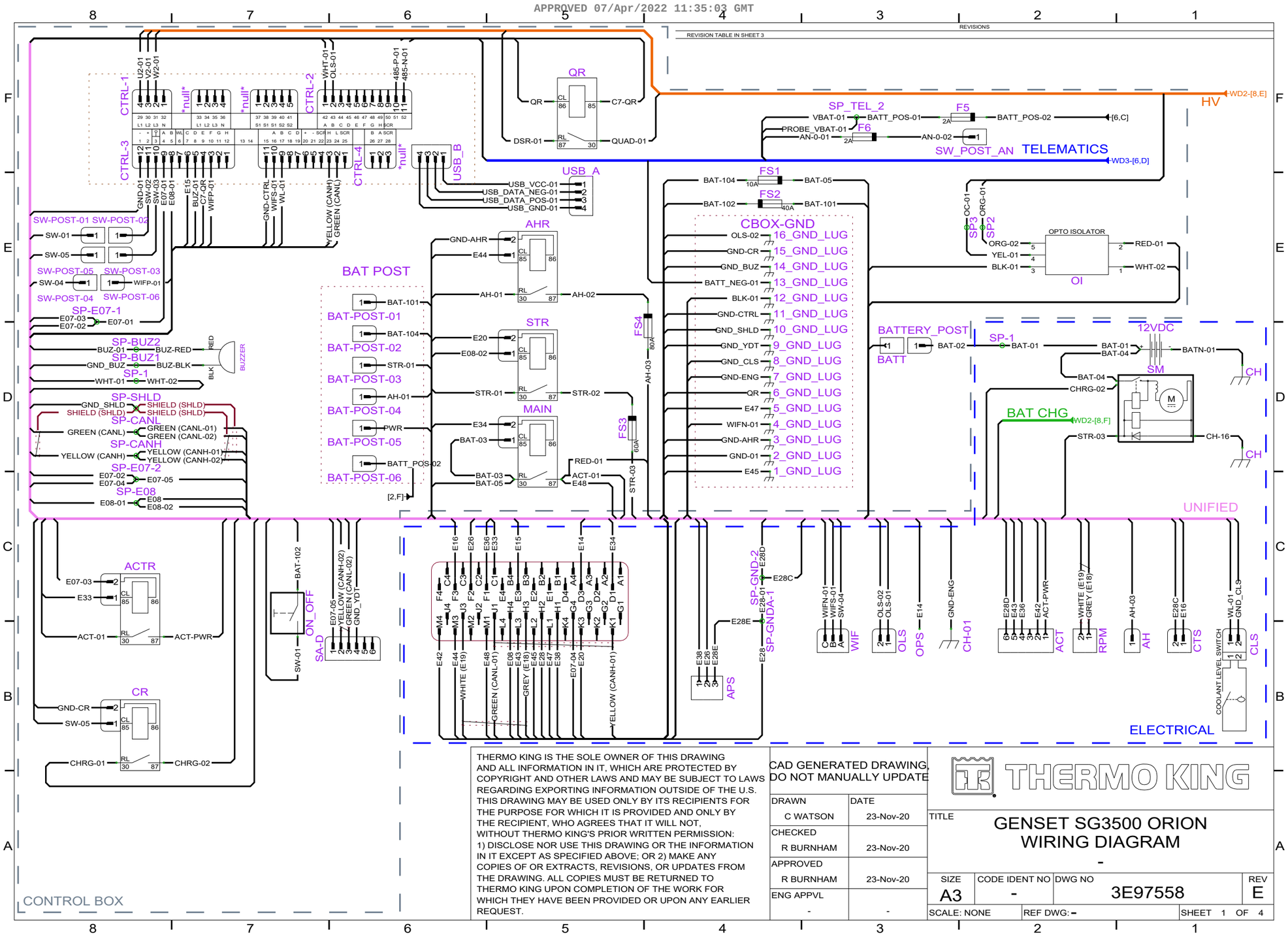


Figure 29. 3E97558 (Page 2 of 4)

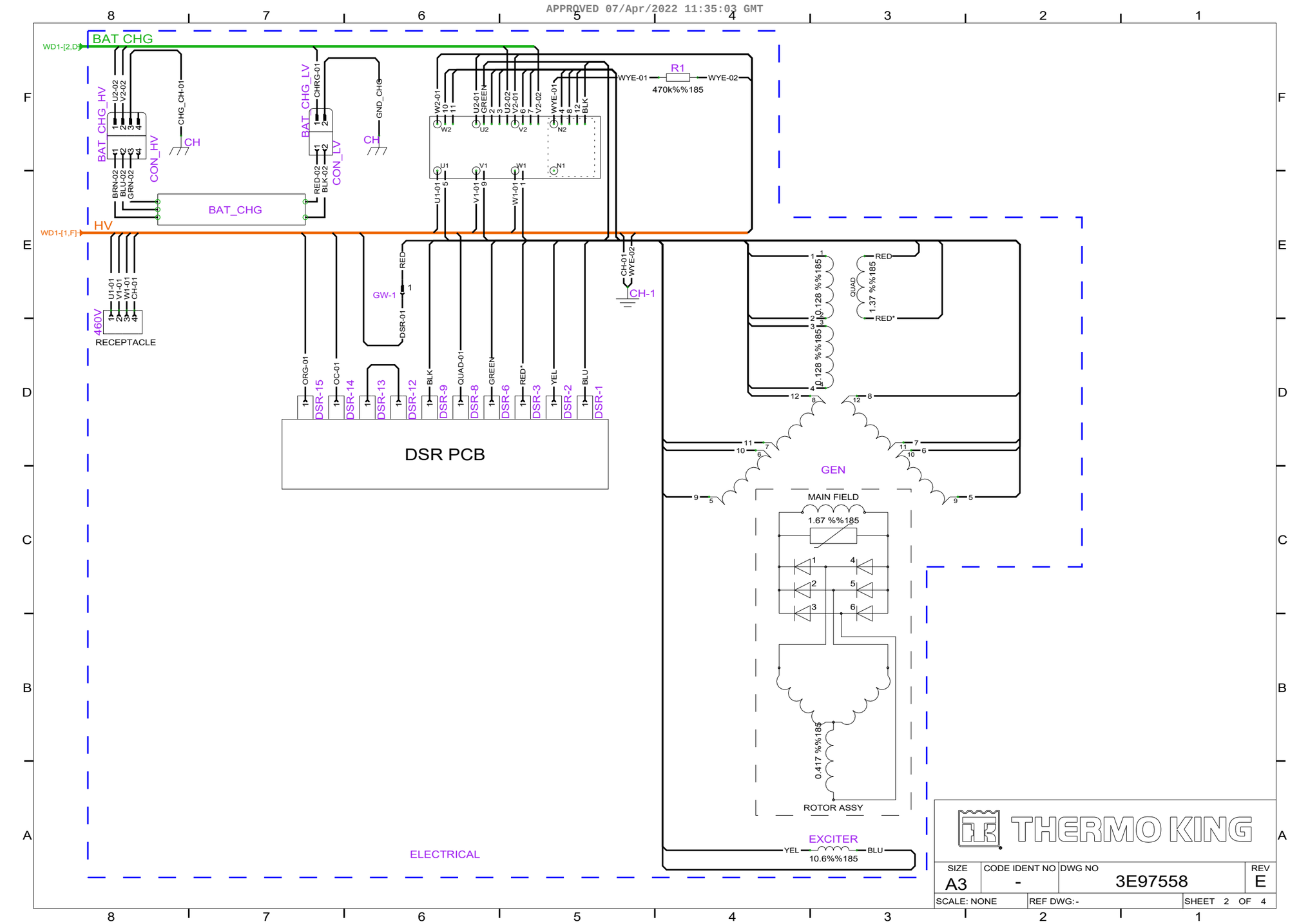
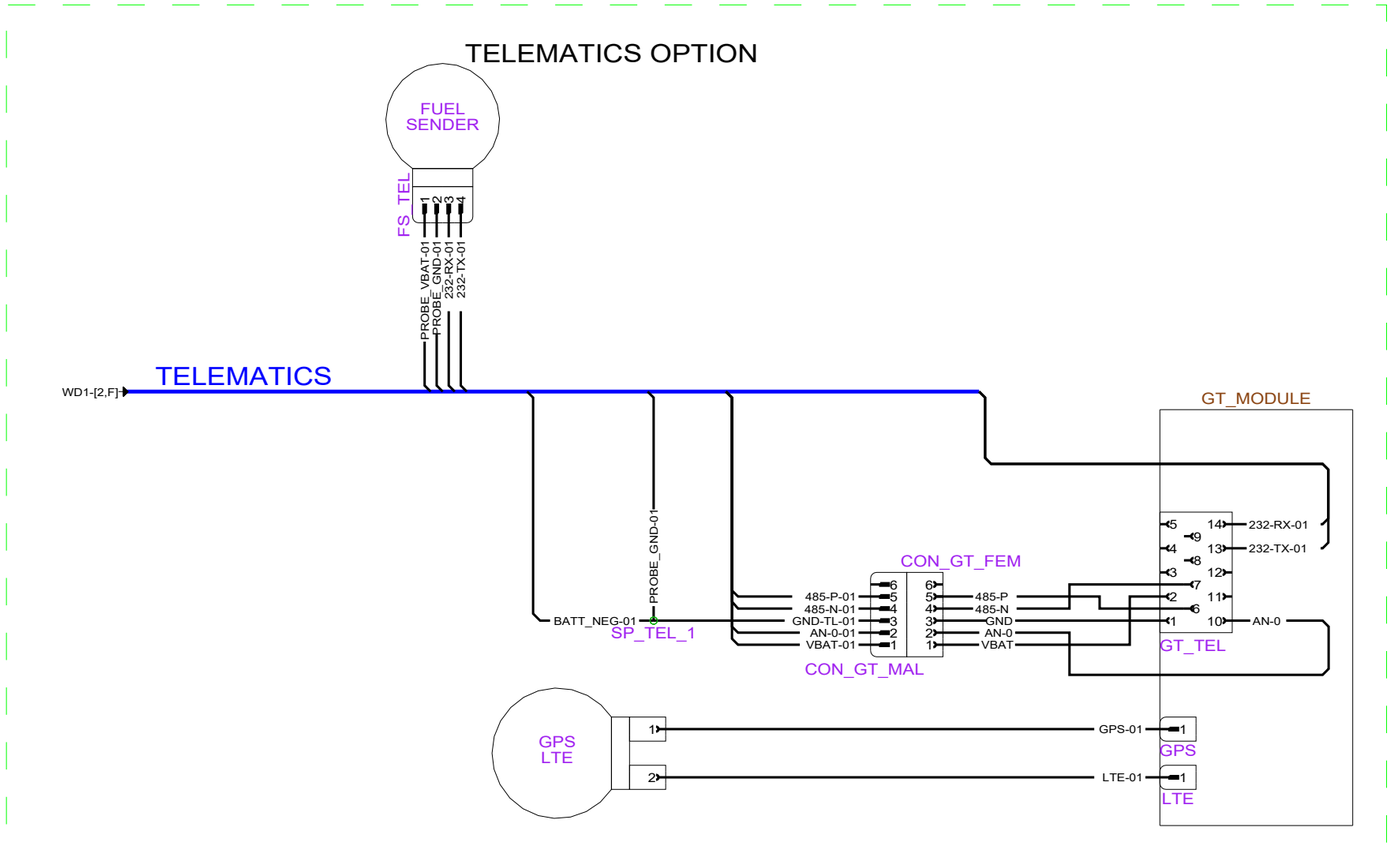


Figure 30. 3E97558 (Page 3 of 4)

APPROVED 07/Apr/2022 11:35:03 GMT

REVISIONS				
CHANGE NOTICE	REV	DESCRIPTION	DATE	APPROVED
1477136	A	INITIAL RELEASE	22/12/20	R.BURNHAM
1509916	B	CHANGE RED-01 FROM STR 87 TO MAIN 87	17/09/21	J.FERREIRA
1515519	C	CHANGE 485-N-01 FROM CTRL-2-10 TO CTRL-2-11,485-P-01 FROM CTRL-2-11 TO CTRL-2-10 REPLACE GND_OLS WITH OLS_2 AND CONNECT TO BAT-POST-06,ADD WIFP-01 FROM CTRL-3-3 TO SW-POST-06, ADD SW-POST-05, ADD CHARGER RELAY,TELEMATICS CONNECTOR,WIRE PWR	11/11/21	R.CAMELL
1523195	E	CHANGE OLS-02 FROM BAT-POST-06 TO 16_GND_LUG, DELETE BAT_CHG_LV CONNECTORS & UPDATE ITS WIRING. CHANGE BATT_POS-02 FROM SW_POST_BAT TO BAT-POST-06	06/04/22	R.CAMELL



SIZE A3	CODE IDENT NO -	DWG NO 3E97558	REV E
SCALE: NONE	REF DWG: -	SHEET 3 OF 4	

Figure 31. 3E97558 (Page 4 of 4)

APPROVED 07/Apr/2022 11:35:03 GMT

WIRE CODE	COMPONENT NAME FROM	CONNECTOR FROM	FROM PORT	COMPONENT NAME TO	CONNECTOR TO	TO PORT
485-N-01	CON_GT_MAL	3A86279H15	4	CTRL-2	3A87415H11	11
485-P-01	CON_GT_MAL	3A86279H15	5	CTRL-2	3A87415H11	10
ACT-01	MAIN-87_2	1080A60G17	1	ACT-30	1081A83G17	1
ACT-PWR	ACT	3E60608G01	1	ACT-87	1081A83G17	1
AH-01	BAT-POST-04	1082A47G06	1	AHR-30	1082A47G03	1
AH-02	FS4-1	1082A47G03	1	AHR-87	1082A47G03	1
AH-03	FS4-2	1082A47G03	1	AH	3E68591G21	1
BAT-01	BAT+	1H71779003	1	SP-1	1081A92G32	1
BAT-03	MAIN-30_2	1080A60G17	1	MAIN	1188A79H12	1
BAT-05	FS1-1	3A87756H04	1	MAIN-30	1080A60G95	1
BAT-101	FS2-1	3A87756H04	1	BAT-POST-01	1080A60G23	1
BAT-102	ON_OFF	3B16833G01	1	FS2-2	3A87756H04	1
BAT-104	FS1-2	3A87756H04	1	BAT-POST-02	1080A60G23	1
BLK-01	OI	2E64577G01	3	12_GND_LUG	1081A83G17	1
BUZ-01	CTRL-3	3A87415H12	5	SP-BUZ2	1081A92G17	2
C7-QR	CTRL-3	3A87415H12	4	QR-85	1190A32H05	1
c-01	ECU	2H24374042	J1	SP-CANL	1081A92G30	1
c-01	SA-D	6A10643H02	3	SP-CANL	1081A92G30	1
c-01	CTRL-4	3A87415H11	2	SP-CANL	1081A92G30	2
c-01	RPM	2H24369014	2	ECU	2H24374042	J3
c-02	ECU	2H24374042	K1	SP-CANH	1081A92G30	1
c-02	SA-D	6A10643H02	2	SP-CANH	1081A92G30	1
c-02	CTRL-4	3A87415H11	3	SP-CANH	1081A92G30	2
c-02	RPM	2H24369014	1	ECU	2H24374042	H3
CH-01	CH-2	1190A94G09	1	CH-1	1082A47G04	1
CHRG-01	CR-30	1082A47G03	1	BAT_CHG_LV	2H24369005	1
CHRG-02	CR-87	1082A47G03	1	STR	1080A60G35	1
DSR-01	QR-87	1190A32H24	1	GW-1	1190A32H21	1
E07-01	CTRL-3	3A87415H12	9	SP-E07-1	1081A92G30	2
E07-02	SP-E07-2	1081A92G30	2	SP-E07-1	1081A92G30	1
E07-03	ACTR	1188A79H12	2	SP-E07-1	1081A92G30	1
E07-04	ECU	2H24374042	G4	SP-E07-2	1081A92G30	2
E07-05	SA-D	6A10643H02	1	SP-E07-2	1081A92G30	1
E08-01	CTRL-3	3A87415H12	8	SP-E08	1081A92G30	2
E08-02	STR	1188A79H12	1	SP-E08	1081A92G30	1
E08	ECU	2H24374042	H4	SP-E08	1081A92G30	1
E14	ECU	2H24374042	D3	OPS	1190A32H24	1
E15	CTRL-3	3A87415H12	6	ECU	2H24374042	E3
E16	ECU	2H24374042	F3	CTS	3E61567G01	1
E20	ECU	2H24374042	K3	STR	1188A79H12	2
E26	ECU	2H24374042	F2	APS	4E01334H01	2
E28-01	SP-GNDA-1	1081A92G30	1	SP-GND-2	1081A92G30	2
E28C	CTS	3E61567G01	2	SP-GND-2	1081A92G30	3
E28D	ACT	3E60608G01	6	SP-GND-2	1081A92G30	1
E28	ECU	2H24374042	H2	SP-GNDA-1	1081A92G30	2
E28E	APS	4E01334H01	3	SP-GNDA-1	1081A92G30	3
E33	ECU	2H24374042	C1	ACTR	1188A79H12	1
E34	ECU	2H24374042	D1	MAIN	1188A79H12	2
E36	ECU	2H24374042	F1	ACT	3E60608G01	4
E38	ECU	2H24374042	H1	APS	4E01334H01	1
E42	ECU	2H24374042	M4	ACT	3E60608G01	2
E43	ECU	2H24374042	L3	ACT	3E60608G01	5
E44	ECU	2H24374042	M3	AHR	1188A79H12	1
E45	ECU	2H24374042	L2	1_GND_LUG	1080A60G95	1
E47	ECU	2H24374042	L1	5_GND_LUG	1080A60G95	1
E48	ECU	2H24374042	M1	MAIN-87	1080A60G95	1
GND_BUZ	14_GND_LUG	1081A83G17	1	SP-BUZ1	1081A92G17	2
GND_CLS	CLS	1E12412H03	2	8_GND_LUG	1081A83G17	1
GND_SHLD	10_GND_LUG	1081A83G17	1	SP-SHLD	1081A92G30	2
GND_YDT	SA-D	6A10643H02	4	9_GND_LUG	1081A83G17	1
GND-01	CTRL-3	3A87415H12	12	2_GND_LUG	1081A83G17	1
GND-AHR	AHR	1188A79H12	2	3_GND_LUG	1081A83G17	1
GND-CR	CR	1188A79H12	2	15_GND_LUG	1081A83G17	1
GND-CTRL	CTRL-4	3A87415H11	11	11_GND_LUG	1081A83G17	1
GND-ENG	7_GND_LUG	1082A47G03	1	CH-01	1080A60G32	1
OC-01	DSR-14	1190A32H24	1	SP3	1081A92G17	2
OLS-01	CTRL-2	3A87415H11	2	OLS	1E12412H03	1

WIRE CODE	COMPONENT NAME FROM	CONNECTOR FROM	FROM PORT	COMPONENT NAME TO	CONNECTOR TO	TO PORT
OLS-02	16_GND_LUG	1081A83G17	1	OLS	1E12412H03	2
ORG-01	DSR-15	1190A32H24	1	SP2	1081A92G17	2
ORG-02	OI	2E64577G01	5	SP2	1081A92G17	1
PWR	BATT	3A86279H45	1	BAT-POST-05	1082A47G06	1
QR	QR-86	1190A32H05	1	6_GND_LUG	1081A83G17	1
QUAD-01	QR-30	1190A32H24	1	DSR-8	1190A32H24	1
RED-01	OI	2E64577G01	2	MAIN-87	1080A60G95	1
SHIELD	NC	NC		SP-SHLD	1081A92G30	1
SHIELD	NC	NC		SP-SHLD	1081A92G30	1
SHIELD	NC	NC		SP-SHLD	1081A92G30	2
STR-01	BAT-POST-03	1082A47G06	1	STR-30	1082A47G03	1
STR-02	FS3-1	1082A47G03	1	STR-87	1082A47G03	1
STR-03	FS3-2	1082A47G03	1	8S	1080A60G33	1
SW-01	ON_OFF	3B16833G01	2	SW-POST-01	1080A60G17	1
SW-02	CTRL-3	3A87415H12	11	SW-POST-02	1080A60G17	1
SW-03	CTRL-3	3A87415H12	10	SW-POST-03	1080A60G17	1
SW-04	SW-POST-04	1080A60G17	1	WIF	1E12412H07	A
SW-05	SW-POST-05	1080A60G17	1	CR	1188A79H12	1
U1-01	U1-2	1190A94G09	1	U1-1	1082A47G04	1
U2-01	U2	1080A60G21	1	CTRL-1	1E35094G03	4
U2-02	BAT_CHG_HV	2H24369018	1	U2	1080A60G15	1
V1-01	V1-2	1190A94G09	1	V1-1	1082A47G04	1
V2-01	V2	1080A60G21	1	CTRL-1	1E35094G03	3
V2-02	BAT_CHG_HV	2H24369018	2	U2	1080A60G15	1
W1-01	W1-2	1190A94G09	1	W1-1	1082A47G04	1
W2-01	W2	1080A60G21	1	CTRL-1	1E35094G03	2
WHT-01	CTRL-2	3A87415H11	1	SP-1	1081A92G17	2
WHT-02	OI	2E64577G01	1	SP-1	1081A92G17	1
WIFN-01	WIF	1E12412H07	C	4_GND_LUG	1081A83G17	1
WIFP-01	CTRL-3	3A87415H12	3	SW-POST-06	1080A60G17	1
WIFS-01	CTRL-4	3A87415H11	10	WIF	1E12412H07	B
WL-01	CTRL-4	3A87415H11	9	CLS	1E12412H03	1
YEL-01	OI	2E64577G01	4	SP3	1081A92G17	1

THERMO KING

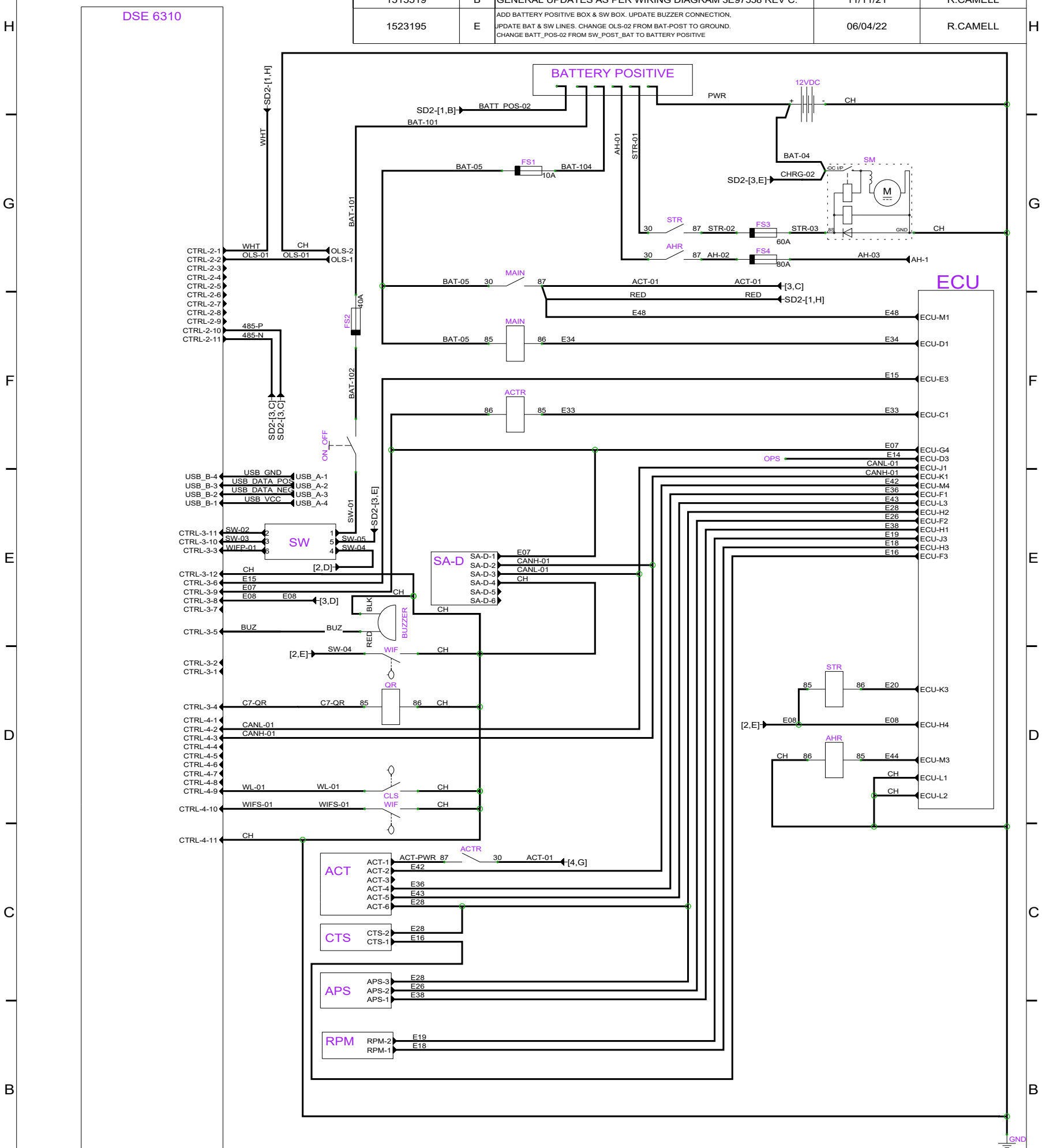
SIZE	CODE IDENT NO	DWG NO	REV
A3	-	3E97558	E

SCALE: NONE | REF DWG:- | SHEET 4 OF 4

Figure 32. 3E97559 (Page 1 of 3)

APPROVED 07/Apr/2022 11:35:13 GMT

REVISION				
CHANGE NOTICE	REV	DESCRIPTION	DATE	APPROVED
1477136	A	INITIAL RELEASE	22/12/20	R.BURNHAM
1515519	B	GENERAL UPDATES AS PER WIRING DIAGRAM 3E97558 REV C.	11/11/21	R.CAMELL
1523195	E	ADD BATTERY POSITIVE BOX & SW BOX. UPDATE BUZZER CONNECTION, JPDATE BAT & SW LINES. CHANGE OLS-02 FROM BAT-POST TO GROUND. CHANGE BATT_POS-02 FROM SW_POST_BAT TO BATTERY POSITIVE	06/04/22	R.CAMELL



CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

DRAWN	C WATSON	23-Nov-20
CHECKED	R BURNHAM	23-Nov-20
APPROVED	R BURNHAM	23-Nov-20
ENG APPVL	-	-

THERMO KING

TITLE: GENSET SG3500 SCHEMATIC DIAGRAM -

SIZE	CODE IDENT NO	DWG NO	REV
A3	-	3E97559	E

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

Figure 33. 3E97559 (Page 2 of 3)

APPROVED 07/Apr/2022 11:35:13 GMT

DSE 6310

SD1-[4,F]
SD1-[1,H]
RED
WHT

WHT W OI B CH
RED R Y OC
O ORG
OPTO ISOLATOR

DSR-14-1
DSR-15-1

DSR-8-1 QUAD
DSR-3-1 RED
DSR-6-1 U2
DSR-9-1 BLK
DSR-1-1 BLU
DSR-2-1 YLW

DSR QR-87 QR QR-30
RED
RED
1.37%%185

U1
0.128%%185
U2
0.128%%185
N1
470k%%185
CH
BLK
EXCITER
10.6%%185

CTRL-1-1 W2
CTRL-1-2 V2
CTRL-1-3 V2
CTRL-1-4 U2

GEN
V2
W2
V1
W1

460V-1 U1
460V-2 V1
460V-3 W1
GRD-4 CH
RECEPTACLE

SD1-[2,E] SW-05 SW-05 85 CR 86 CH
GND

U2 BAT_CHG_HV-1
V2 BAT_CHG_HV-2
CHG_CH BAT_CHG_HV-3
BAT_CHG_HV-4
BAT_CHG_LV-1
BAT_CHG_LV-2
BATTERY CHARGER
CHRG-01 30 CR 87 CHRG-02 SD1-[3,G]
GND_ENG
GND
GND

TELEMATICS OPTION

FS_TEL-1
FS_TEL-2
FS_TEL-3
FS_TEL-4
V-BAT
GND
232-TX
232-RX
GND

SD1-[2,H]
BATT_POS-02 F5 2A V-BAT
SW_POST_AN-1 AN-0-02 F6 2A AN-0-01

SD1-[2,F] 485-P
SD1-[2,F] 485-N
GND
AN-0-01
V-BAT
CON_GT-6
CON_GT-5
CON_GT-4
CON_GT-3
CON_GT-2
CON_GT-1
CON_GT

GT_MODULE
232-RX GT_TEL-14
232-TX GT_TEL-13
GT_TEL-11
485-P GT_TEL-12
485-N GT_TEL-6
GND GT_TEL-7
AN-0 GT_TEL-1
V-BAT GT_TEL-10
GT_TEL-2
GT_TEL-9
GT_TEL-8
GT_TEL-5
GT_TEL-4
GT_TEL-3

GPS-1 GPS GPS GPS-1
LTE-2 LTE LTE LTE-1

THERMO KING

SIZE	CODE IDENT NO	DWG NO	REV
A3	-	3E97559	E
SCALE: NONE	REF DWG: -	SHEET 2 OF 2	

Figure 34. 3E97559 (Page 3 of 3)

APPROVED 07/Apr/2022 11:35:13 GMT

SCHEMATIC LEGEND

REF_DES	DESCRIPTION	LOCATION
12VDC	BATTERY	TK_Circuit/SD1-[4,H]
ACT	INJECTION PUMP ACTUATOR	TK_Circuit/SD1-[2,C]
ACTR	ACTUATOR RELAY	TK_Circuit/SD1-[2,F]
AHR	AIR HEATER RELAY	TK_Circuit/SD1-[4,D]
APS	ATMOSPHER PRESSURE SWITCH	TK_Circuit/SD1-[2,C]
BAT_CHG	BATTERY CHARGER	TK_Circuit/SD2-[2,E]
CLS	COOLANT LEVEL SWITCH	TK_Circuit/SD1-[2,H]
CON_GT	CONNECTOR GT	TK_Circuit/SD2-[3,C]
CR	CHARGER RELAY	TK_Circuit/SD2-[3,E]
CTS	COOLANT TEMPERATURE SWITCH	TK_Circuit/SD1-[2,C]
F5	F5-2A	TK_Circuit/SD2-[2,C]
F6	F6-2A	TK_Circuit/SD2-[2,B]
FS1	FS1-10A	TK_Circuit/SD1-[2,G]
FS2	FS2-40A	TK_Circuit/SD1-[2,F]
FS3	FS3-60A	TK_Circuit/SD1-[3,G]
FS3	FS3-60A	TK_Circuit/SD1-[3,G]
FS4	FS4-80A	TK_Circuit/SD1-[3,G]
GEN	GENERATOR	TK_Circuit/SD2-[4,G]
GND	GROUND	TK_Circuit/SD2-[3,E]
MAIN	MAIN RELAY	TK_Circuit/SD1-[2,F]
OI	OPTO ISOLATOR	TK_Circuit/SD2-[2,G]
OLS	OIL LEVEL SWITCH	TK_Circuit/SD1-[2,G]
ON_OFF	UNIT ON/OFF SWITCH	TK_Circuit/SD1-[2,F]
QR	QUAD RELAY	TK_Circuit/SD1-[2,D]
RPM	BOTTOM OF INJECTION PUMP	TK_Circuit/SD1-[2,B]
SA-D	ENGINE TEST PLUG	TK_Circuit/SD1-[2,E]
SM	STARTER MOTOR	TK_Circuit/SD1-[4,G]
STR	STARTER RELAY	TK_Circuit/SD1-[4,D]
USB_A	USB-A	TK_Circuit/SD1-[1,F]
USB_B	USB_B	TK_Circuit/SD1-[2,E]
WIF	WATER IN FUEL	TK_Circuit/SD1-[2,E]

THERMO KING

SIZE	CODE IDENT NO	DWG NO	REV
A3	-	3E97559	E

SCALE: NONE | REF DWG: - | SHEET 3 OF 3

Thermo King – by Trane Technologies (NYSE: TT), a global climate innovator – is a worldwide leader in sustainable transport temperature control solutions. Thermo King has been providing transport temperature control solutions for a variety of applications, including trailers, truck bodies, buses, air, shipboard containers and railway cars since 1938. For more information, visit www.thermoking.com or www.tranetechnologies.com.

TK 61914-4-MM-EN 18 Aug 2023
Supersedes (New)