



Maintenance Manual

SGSM 4000, SGCM 4000 & SGCO 4000

TK 61010-4-MM (Rev. 1, 02/16)

SGSM 4000, SGCM 4000 & SGCO 4000

TK 61010-4-MM (Rev. 1, 02/16)

The maintenance information in this manual covers unit models:

SGCO (718208M): Model with SG+ controls and clip-on unit frame

SGUM (718207M): Model with SG+ controls and side-mount or centre mount arms

For further information, refer to:

SGUM 4000 Parts Manual	TK 55682
SGCO 4000 Parts Manual	TK 55683
Electrostatic Discharge (ESD) Training Guide	TK 40282
Tool Catalog	TK 5955
TKDV6 Engine Repair Manual	TK 55810

The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units. The Thermo King family of generator sets includes three models: SGSM, SGCM and SGCO. When maintenance information differs between models, this manual uses the model nomenclature (e.g. SGSM) to indicate that the information applies to specific units only. In addition, the model nomenclature indicates the following:

Model Nomenclature	Unit Feature
SM.....	Side-mount unit frame
CM.....	Center-mount unit frame
CO.....	Clip-on unit frame

Revision History

Rev. 1 – TK 61010-4-MM (Rev. 1, 02/16) Update with 6,000 hour engine timing belt replacement procedure, other latest engine information, new radiator fan motor, and other general updates.

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

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Safety Precautions

Thermo King recommends that all service be performed by a Thermo King dealer. However, you should be aware of several general safety practices:

The  symbol appears next to a point that is particularly important

 **DANGER:** Denotes the possibility of serious injury or death.

 **WARNING:** Denotes the possibility of serious equipment damage or serious personal injury.

 **CAUTION:** Denotes the possibility of minor to severe equipment damage or personal injury.

General Practices

1. Always Wear Goggles Or Safety Glasses. Battery acid can permanently damage the eyes (see First Aid under Battery Hazards).
2. Keep your hands, clothing and tools clear of all fans, pulleys and belts when the unit is running. Be very careful with tools or meters to avoid contacting the rotor, if it is necessary to run the alternator with the end cover removed.
3. Be sure all mounting bolts are tight and the correct length for their particular application.
4. Use extreme caution when drilling holes in the unit. The holes may weaken structural components. Holes drilled into electrical wiring can cause fire, explosion or shock hazard.
5. Use caution when working around exposed coil fins. The fins can cause painful lacerations.
6. Do not work on a generator set in a confined area. Diesel exhaust can become very dangerous under certain conditions.

Battery Hazards

Few people realize just how dangerous a battery can be. The electrolyte in a lead acid battery is dilute sulfuric acid (H_2SO_4). During charge or discharge functions of a battery, a chemical change takes place within the individual cells. This causes the gas bubbling we see through the filler hole. The bubbling gases are hydrogen and oxygen. They are EXPLOSIVE. An explosion could occur if a means of ignition is present during this gassing action. A defective battery may suddenly explode even while standing idle. Added to this danger, is the fall-out of highly corrosive sulfuric acid caused by the explosion. A rubber blanket or other cover can be used to reduce the risk of injury from a possible explosion.

Precautions

1. Always wear eye protection when servicing a battery. If electrolyte is splashed on the skin or in the eyes, flush immediately under running water. Obtain medical help as soon as possible.
2. Do not remove the vent caps when charging a battery.

3. Make sure the On/Off switch is in the OFF position when disconnecting or connecting the generator set battery. This will prevent an electrical arc which could cause the battery to explode. Disconnect the ground cable first, preferably at a point AWAY FROM THE BATTERY. Connect the ground cable last, again away from the battery if possible.
4. Do not check a battery by shorting (sparking) across the battery posts. Eye injury may result from the electrical arc or from an explosion.

First Aid

- **EYES:** Immediately flush eyes with large amounts of water while holding the eyelids open 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.

Electrical Hazards

High Voltage

The possibility of serious or even fatal injury from electrical shock exists, when servicing or repairing a generator set. 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.

Precautions

1. Turn the generator set On/Off switch to OFF before connecting or disconnecting a power plug to the generator set receptacle. Never attempt to stop a refrigeration unit by disconnecting the power plug from an operating generator set.
2. Be certain a unit power plug is clean and dry before connecting it to the generator set receptacle.
3. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.
4. Stand on a solid work platform with rubber mats or dry wood if possible. If you slip, you can instinctively grab for support. This can be lethal when working on a generator set.
5. Do not make any rapid moves when working on high voltage circuits. If a tool or other object falls, do not attempt to grab it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
6. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
7. Never work alone on high voltage circuits on the generator set. Another person should always be standing by in the event of an accident to shut off the generator set and to aid a victim.
8. Have electrically insulated gloves, cable cutters and safety glasses available in the immediate vicinity in the event of an accident.

First Aid

IMMEDIATE action must be initiated after a person has received an electrical shock. Obtain immediate medical assistance if available.

Low Voltage

Control circuits are low voltage (12 Vdc). This voltage potential is not considered dangerous, but the large amount of current available (over 30 amperes) can cause severe burns if shorted to ground.

Disconnect the negative terminal of the battery if possible when working on the generator set. Disconnect the cable end that is away from the battery.

Do not wear jewelry, watches or rings. These items can short out and cause severe burns to the wearer.

The source of shock must be immediately removed by either shutting down the power or removing the victim from the source. If it is not possible to shut off the power, the wire should be cut with either an insulated instrument (e.g., a wooden handled axe or cable cutters with heavy insulated handles) or by a rescuer wearing electrically insulated gloves and safety glasses. Whichever method is used, do not look at the wire while it is being cut. The ensuing flash can cause burns and blindness.

If the victim has to be removed from a live circuit, pull the victim off with a non-conductive material. Use the victim's coat, a rope, wood, or loop your belt around the victim's leg or arm and pull the victim off. DO NOT TOUCH the victim. You can receive a shock from current flowing through the victim's body.

After separating the victim from the power source, check immediately for the presence of a pulse and respiration. If a pulse is not present, start CPR (Cardio Pulmonary Resuscitation) and call for emergency medical assistance. If a pulse is present, respiration may be restored by using mouth-to-mouth resuscitation, but call for emergency medical assistance.

General Safety Precautions for Servicing Units (or Containers) Equipped with a Microprocessor Controller

Precautions must be taken to prevent electrostatic discharge during service of the SG+ 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 are as follows:

- The failure to wear adequate electrostatic discharge preventive equipment when handling and servicing the controller.
- Electric welding on the unit and/or container chassis without taking precautionary steps.

Controller Repair

It's necessary to ensure that electrostatic discharges are avoided when servicing the controller. Potential differences considerably lower than those which produce a small spark from a finger to a door knob can severely damage or destroy solid-state integrated circuit components. The following procedures must be rigidly adhered to when servicing these units to avoid controller damage or destruction.

1. Turn the generator set OFF.
2. Disconnect the negative terminal of the battery. Disconnect the cable end that is away from the battery.
3. Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
4. Wear a static discharge wrist strap (TK P/N 204-622) 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.
5. Avoid contacting the electronic components on the unit circuit boards.

6. Leave the circuit boards in their static proof packing materials until ready for installation.
7. If a defective controller is to be returned for repair, it should be returned in the same static protective packing materials from which the replacement component was removed.
8. After servicing the circuit board and any other circuits, the wiring should be checked for possible errors before restoring power.

Welding of Units or Containers

It is necessary to ensure that welding currents are NOT allowed to flow through the electronic circuits of the unit. This includes whenever electric welding is to be performed on any portion of the generator set, container or container chassis with the generator set attached. These procedures must be rigidly adhered to when servicing these units to avoid damage or destruction.

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

Safety Do's and Don'ts

DO:

- **Do** perform your tasks carefully, without undue haste.
- **Do** provide a fire extinguisher (rated ABC).
- **Do** provide a First Aid kit (for bumps and abrasions). Obtain medical attention.
- **Do** use the correct tools for the job you are doing.
- **Do** make sure that all fasteners are secure.
- **Do** use extreme care while making adjustments on the generator set while it is running.
- **Do** keep your hands away from moving parts.
- **Do** disconnect the battery before starting work on a generator set.
- **Do** use screwdrivers, pliers, diagonal pliers. etc. with insulated handles.
- **Do** obtain CPR (Cardio Pulmonary Resuscitation) and mouth-to-mouth resuscitation knowledge.
- **Do Practice Safety, The Life You Save May Be Your Own.**

DO NOT

- **Don't** allow inexperienced personnel to work on the generator or electrical equipment.
- **Don't** remove guards or protective devices.

- **Don't** wear loose clothing or jewelry in the vicinity of moving parts. These can get in machinery, with disastrous results. Don't wear jewelry while working on electrical equipment. If your hair is long, wear a head covering. Hair caught in a drill press, fan belt or other moving parts can cause serious injury.
- **Don't** stand on a wet floor while working on electrical equipment. Use rubber insulated mats placed on dry wood platforms.
- **Don't** lunge after a dropped tool. To do so may place you in a position of extreme danger.
- **Don't** commence any operation until you have taken all the necessary steps to ensure that you are in complete safety.

Battery Installation and Cable Routing



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



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



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



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



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



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



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

Battery Removal



DANGER: *Disconnect the negative battery terminal (-) first when removing a battery. Connect the positive terminal (+) first when installing a battery.*

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.

Serial Number Locations

Generator: The generator nameplate is attached to the generator housing. The serial number is located on this nameplate.

Engine: The engine serial number is stamped on the back side of the engine block near the flywheel end.

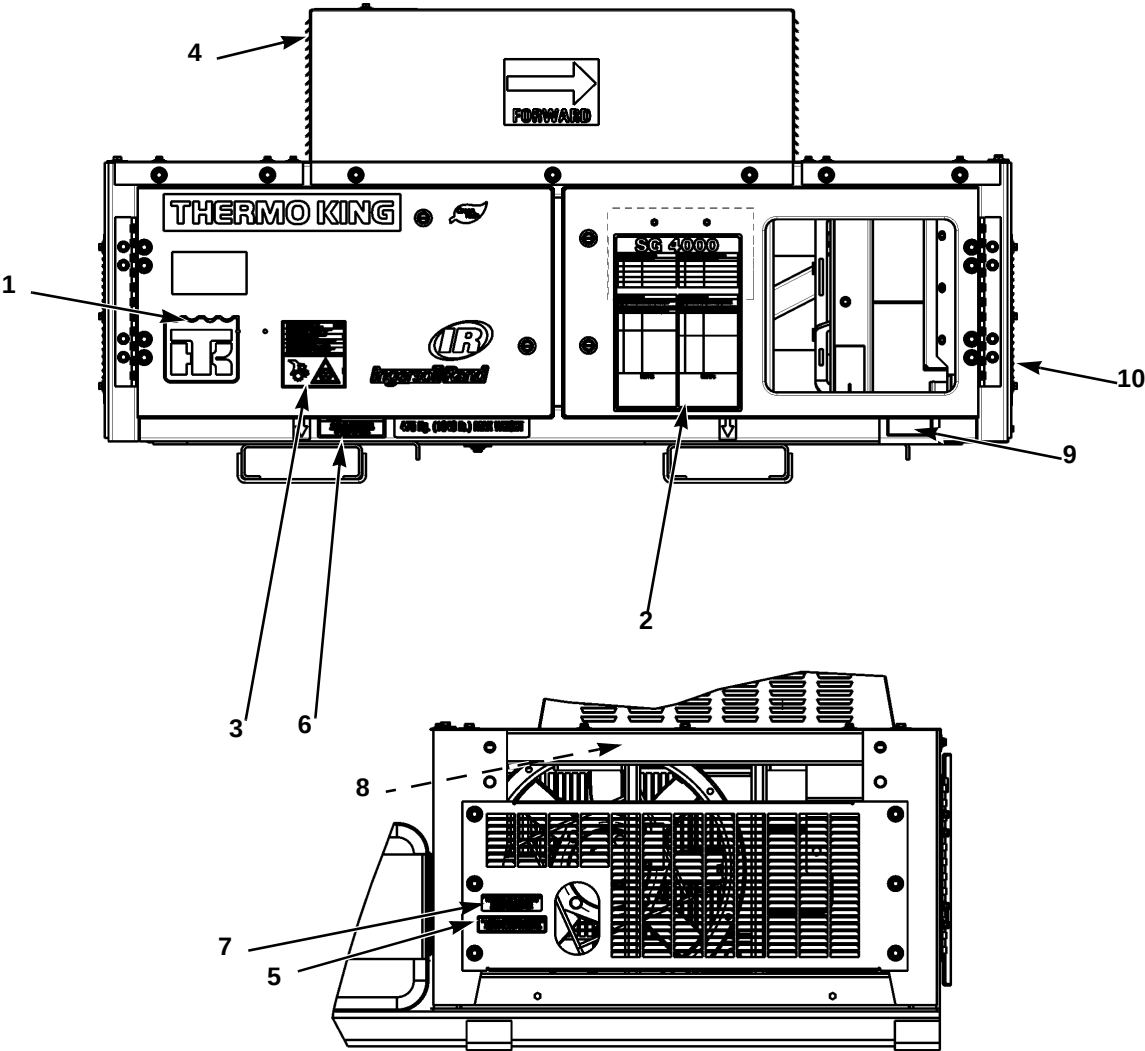
SGUM Units: The unit serial number nameplate is attached to the unit frame near the rear mounting bracket or on the air cleaner bracket.

SGCO Units: The unit serial number nameplate is attached to the unit battery box beside the engine compartment.

SG+ Controller: The controller serial number nameplate is on the end of the controller and on mounting flange of controller.

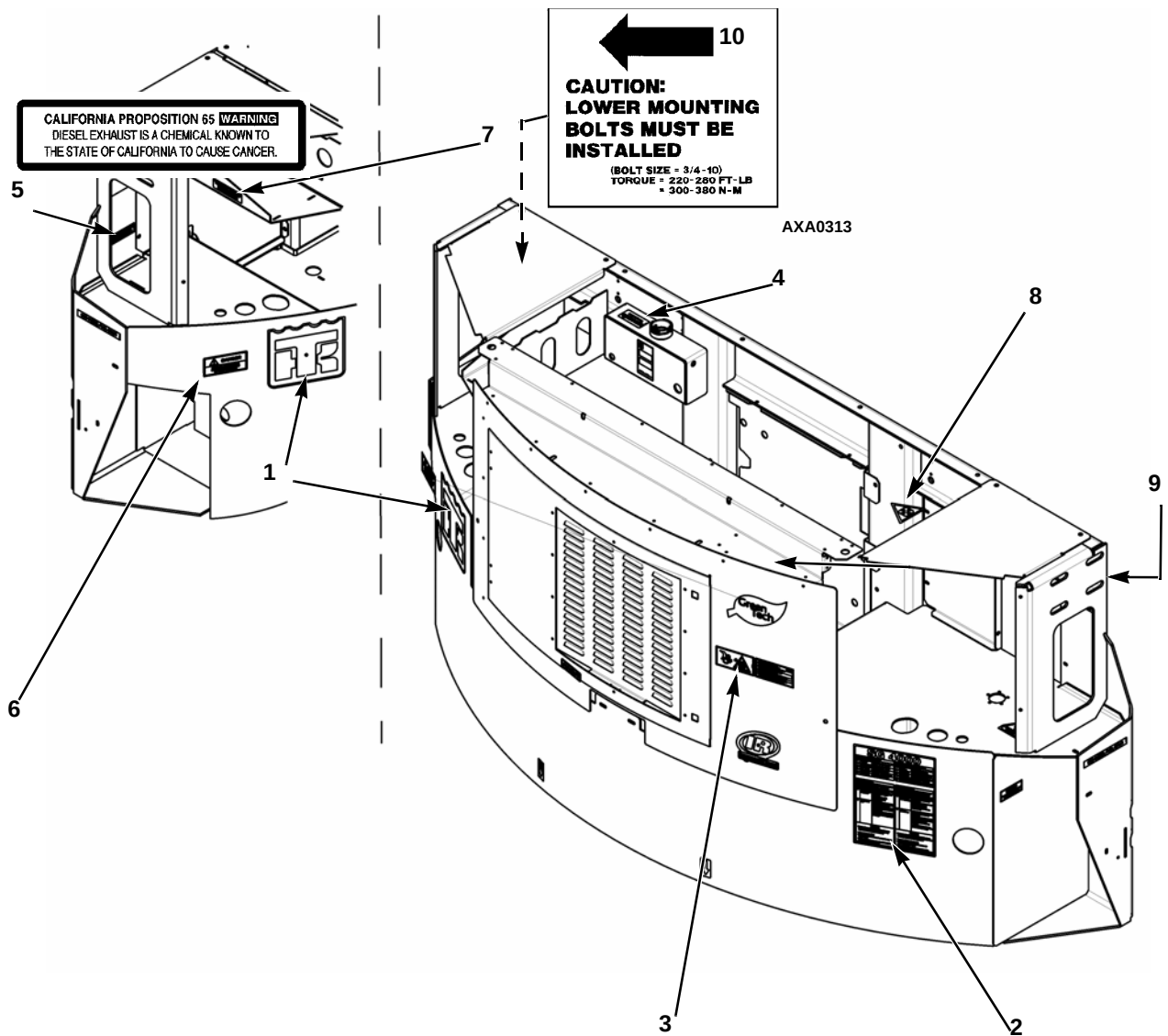
Unit Decals

Serial number decals, installation decals and warning decals appear on all Thermo King generator sets. These decals provide information that may be needed to service or repair the unit. Service technicians should read and follow the instructions on all warning decals.



1.	Thermo King Symbol
2.	Operating Instructions EN/ES
3.	Auto Stop/Start
4.	Radiator Fill
5.	CA Proposition
6.	Warning - Ether Use
7.	Battery 925 CCA
8.	Universal Fan
9.	Decal Unit ID
10.	Caution, 460V

Figure 1: Model SGUM 4000 Decals



1.	Thermo King Symbol
2.	Operating Instructions EN/ES
3.	Auto Stop/Start
4.	Radiator Fill
5.	CA Proposition
6.	Warning - Ether Use
7.	Battery 925 CCA
8.	Universal Fan
9.	Decal Unit ID
10.	Caution, Lowering Bolts must be installed

Figure 2: Model SGC0 4000 Decals

Specifications

Engine

Model	DV6NR (Tier 4)
Number of Cylinders	4
Cylinder Arrangement	In-line vertical, number 1 on flywheel end
Firing Order	1-3-4-2
Direction of Rotation	Counterclockwise viewed from flywheel end
Emissions Compliance	EPA Tier 4 Final - TRU Test Mode ONLY (4 Mode)
Displacement	1.6L
Combustion Chamber	Direct Injection
Speed Control	Electronic Isochronous speed control
Fuel System	Electronically Controlled common rail system multiple injection
Fuel Type	No. 2 diesel fuel under normal conditions No. 1 diesel fuel is acceptable cold weather fuel
Noise	Less than 71 dBA under any condition
Fuel Requirements	Diesel fuel Ultra low sulfur (ULSD) CFR 1065.703; Max 15ppm Sulfur. ASTM D 975 No 2 diesel
ECU	Electronic Control Unit
EGR	Cooled Electric EGR valve
Turbocharger	Fixed geometry type, waste gate
Oil Capacity	12.4 quarts (11.7 liters) crankcase and oil filter Fill to full mark on dipstick
Oil Type	API Classification CJ-4 or better
Oil Viscosity:	Recommended For Other Climates
	10W-30 Delo XLE Syntheblend for -13 to 100 F (-25 C to 38 C) 5W-40 Delo 400LE Full Synthetic for Cold Climates -22 to 122 F (-30 C to 50 C) 14 F to 122 F (-10 C to 50 C): SAE 15W-40 (Synthetic) 5 to 104 F (-15 to 40 C): SAE 15W-40 -13 to 104 F (-25 to 40 C): SAE 10W-40 -13 to 100 F (-25 to 38 C): SAE 10W-30 -22 to 122 F (-30 to 50 C): SAE 5W-40 (Synthetic) Below -22 F (-30 C): SAE 0W-30 (Synthetic)
Engine rpm:	Low Speed Operation High Speed Operation
	1500 ± 25 rpm 1800 ± 25 rpm
Intake Valve Clearance	Hydraulic
Exhaust Valve Clearance	Hydraulic
Engine Coolant Thermostat	160 F (71 C)

Engine (Continued)

Engine Coolant Type	Chevron/Delo XLC - a nitrite-free Extended Life Coolant (ELC) Use a 50/50 concentration CAUTION: Do not add other types of coolant to cooling systems using Chevron/Delo XLC except in an emergency. If another type of coolant is added, the coolant must be changed to Chevron/Delo XLC when available.
Coolant System Capacity	7.5 quarts (7.1 liters)
Radiator Cap Pressure	21 psig (145 kPa)

* SG+ controller uses a sensor to provide engine high coolant temperature protection.

Generator

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

Radiator Fan Motor

One Piece Fan and Motor (Before 6/15)	
Voltage/Phase/Frequency	460 Vac/3 Phase/60 Hz
Amperes	4.5 to 4.6 amps
RPM	2890 to 3430 RPM
Separate Fan and Fan Motor (6/15 and After)	
Voltage/Phase/Frequency	460 Vac/3 Phase/60 Hz
Amperes	1.3 amps
RPM	3499 RPM

Electrical Control System

Controls	SG+ microprocessor controller
Voltage	12.5 Vdc (nominal)
Battery	12 volts, group C31, 925/950 Cold Cranking Amps at -18 C (0 F)
Fuse SI1	30 Amp
Fuse SI2	30 Amp
Fuse SI3	10 Amp

Electrical Components

NOTE: Disconnect components from unit circuit to check resistance.

	Current Draw (Amperes) at 12.5 Vdc	Resistance (Ohms)
Glow Plugs	35 AMP Max	
Starter Motor	400 (cranking) 140 (bench test)	

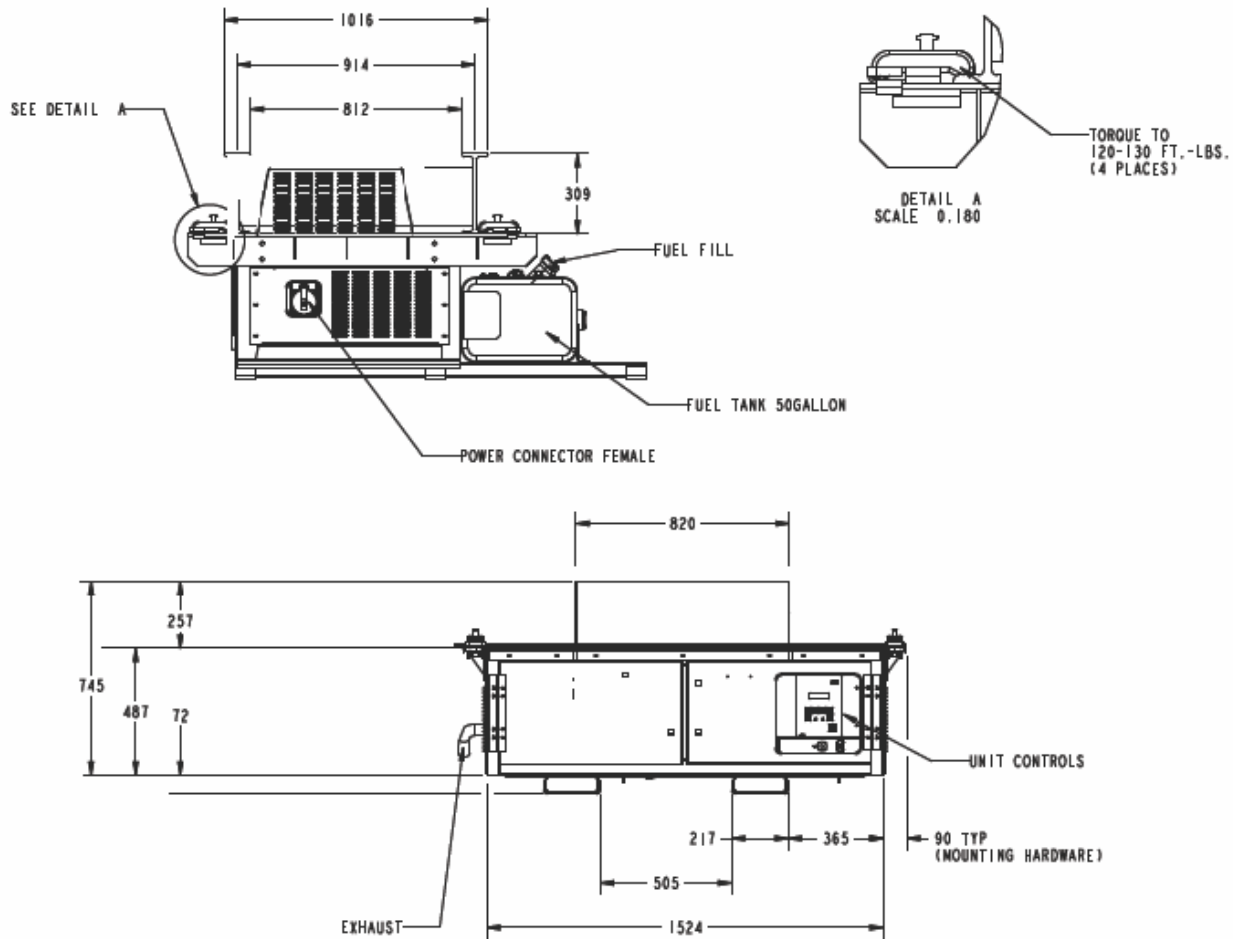
Controller Default Settings

Setting – Menu Location	Default Setting
Tank Size – Commands/System Setup	125
Date/Time – Commands/System Setup	Software Date
ID Number – Commands/System Setup	00000000
C/F Mode – Misc. Functions	F
HM1 (Hour Meter 1) Threshold – Configuration	0
HM2 (Hour Meter 2) Threshold – Configuration	0
ENG (Engine) Off Hours – Configuration	0
Factory Reset – Configuration	Off
APU Connected – Configuration	Off
Output Voltage – Configuration	460
Fuel Sensor – Configuration	Off
Fuel Level – Configuration	0
Crank Restarts – Configuration	3
Telematic – Configuration	Off

Physical Specifications

Weight (net): SGUM 4000 (SGCM and SGSM 4000 - the only difference is an added Bracket)	678 Kg (1495 lbs) including oil, coolant, battery and 195 liter (50 gal.) fuel tank (excluding fuel)
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Unit Dimensions



20

Metric Hardware Torque Charts

Bolt Type and Class*	Bolt Size			
	M6	M8	M10	M12
	N.m (Ft.-lb.)	N.m (Ft.-lb.)	N.m (Ft.-lb.)	N.m (Ft.-lb.)
HH – CL 5.8	6-9 (4-7)	12-16 (9-12)	27-34 (20-25)	48-61 (35-40)
HH – CL 8.8	10-13 (7-10)	20-27 (15-20)	41-47 (30-35)	75-88 (55-65)
HH – CL 10.9	14-17 (10-13)	27-34 (20-25)	54-68 (40-50)	102-122 (75-90)
HH – CL 12.9	17-21 (12-16)	41-47 (30-35)	68-81 (50-60)	122-149 (90-110)
HH – SS (2)	10-13 (7-10)	20-27 (15-20)	41-47 (30-35)	75-88 (55-65)

Bolt Type and Class*	Bolt Size			
	M14	M16	M18	M22
	N.m (Ft.-lb.)	N.m (Ft.-lb.)	N.m (Ft.-lb.)	N.m (Ft.-lb.)
HH – CL 5.8	75-88 (55-65)	115-135 (85-100)	177-216 (130-160)	339-406 (250-300)
HH – CL 8.8	115-135 (85-100)	177-216 (130-160)	271-339 (200-250)	475-610 (350-450)
HH – CL 10.9	136-176 (100-130)	224-298 (180-220)	393-474 (290-350)	678-813 (500-600)
HH – CL 12.9	177-216 (130-160)	285-352 (210-260)	448-542 (330-400)	881-1016 (650-750)
HH – SS (2)	115-135 (85-100)	177-216 (130-160)	271-339 (200-250)	475-610 (350-450)

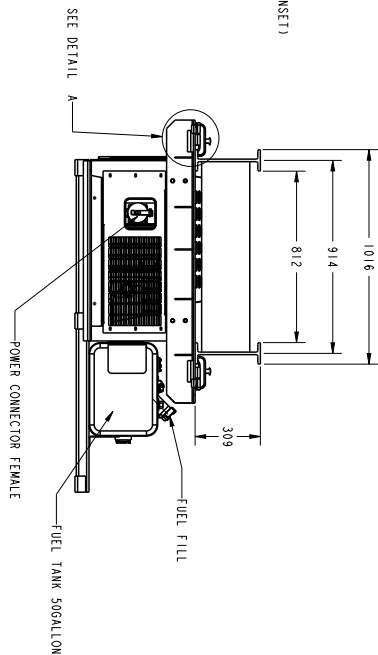
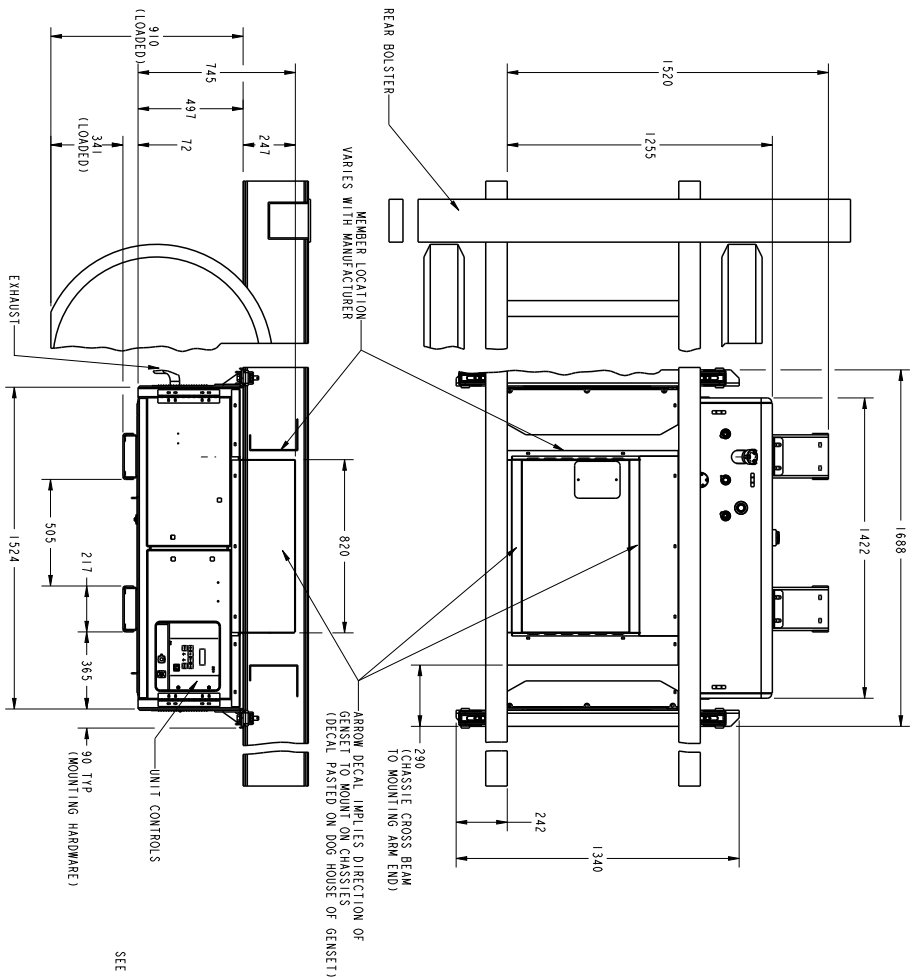
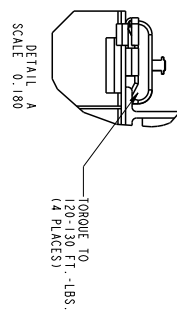
*HH = Hex Head, CL = Class.

Maintenance Inspection Schedule

Pretrip	Every 1,500 Hours	Annual/ 3,000 Hours*	Inspect/Service These Items
			Microprocessor
•			Run Pretrip Test
			Engine
•			Check fuel supply.
•			Check engine oil level.
•	•	•	Listen for unusual noises, vibrations, etc.
•	•	•	Check engine coolant level and antifreeze protection (-30 F [-40 C]).
	•	•	Drain water from fuel tank and check vent.
	•	•	Inspect/clean electric fuel pump filter.
			Check engine mounts for wear.
		•	Replace EMI 3000 air cleaner element (see “EMI 3000 Air Cleaner” on page 123) at 3,000 hours or one year (whichever occurs first).
		•	Replace EMI 3000 fuel filter/water separator.
		•	Change engine oil and oil filter (hot). Requires oil with API Rating CJ-4 or better. NOTE: For high biodiesel use (B20) the engine oil and oil filter should be changed every 1,500 hours.
		—	Change Timing Belt, Water Pump, Belt Tensioner, and Idler Pulley with Timing Belt Kit every 6,000 hours. When replacing the Timing Belt, inspect the High Pressure Fuel Pump and replace as necessary.
		—	Change ELC (red) engine coolant every 5 years or 12,000 hours. Units equipped with ELC have an ELC nameplate on the expansion tank.
			Electrical
	•	•	Inspect battery terminals and electrolyte level.
	•	•	Inspect wire harness for damaged wires or connections.
			Inspect AC generator and alternator wire connections for tightness.
			Inspect electric motors.
			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.

*3,000 hours or one year, whichever occurs first.

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
65314	A	RELEASED	12-Nov-12	R8
704325	B	ADDED NOTES	15-Mar-13	R8
765365	C	UPDATED ARROW DECAL REPRESENTATION	26-Sep-13	R8

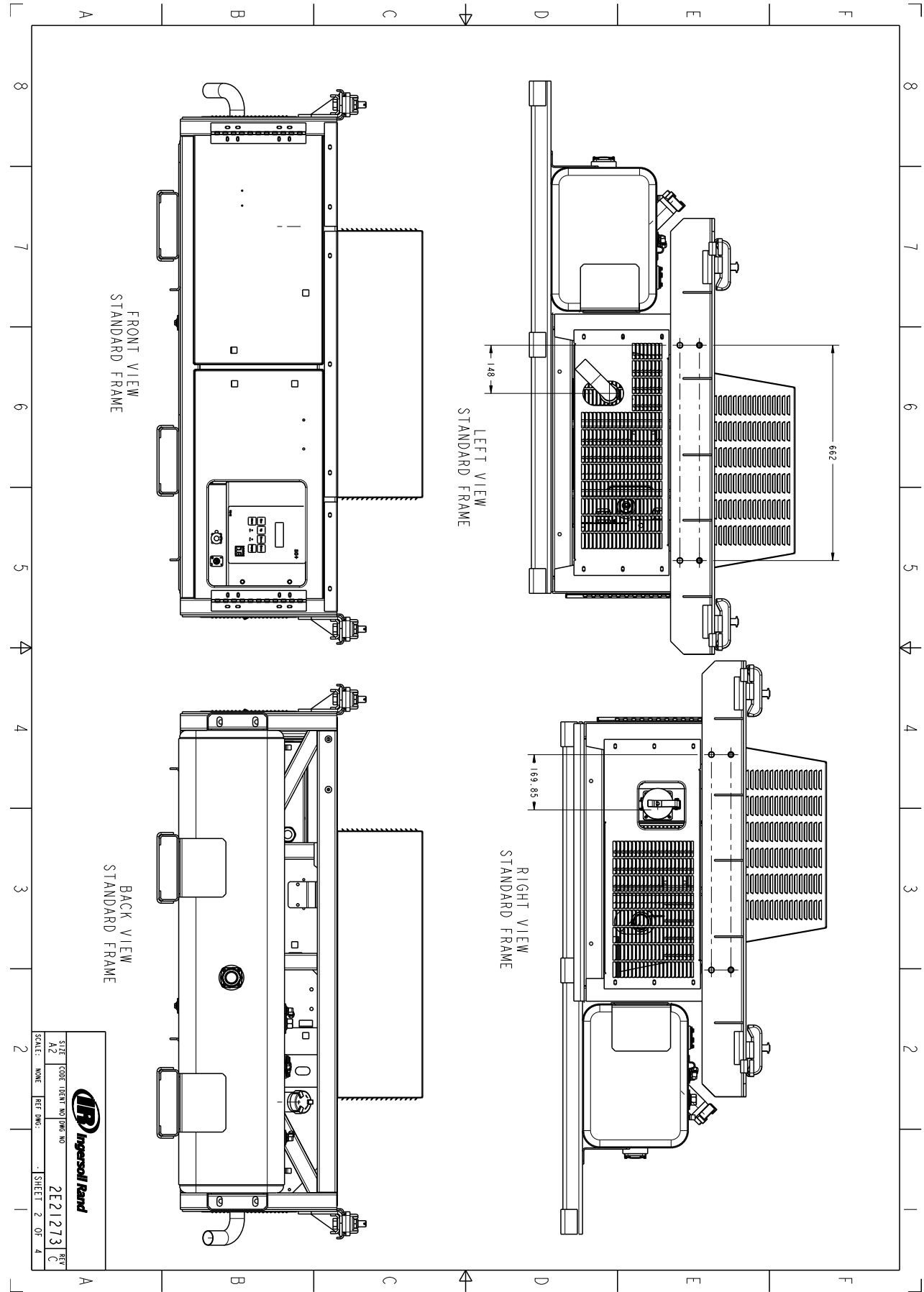


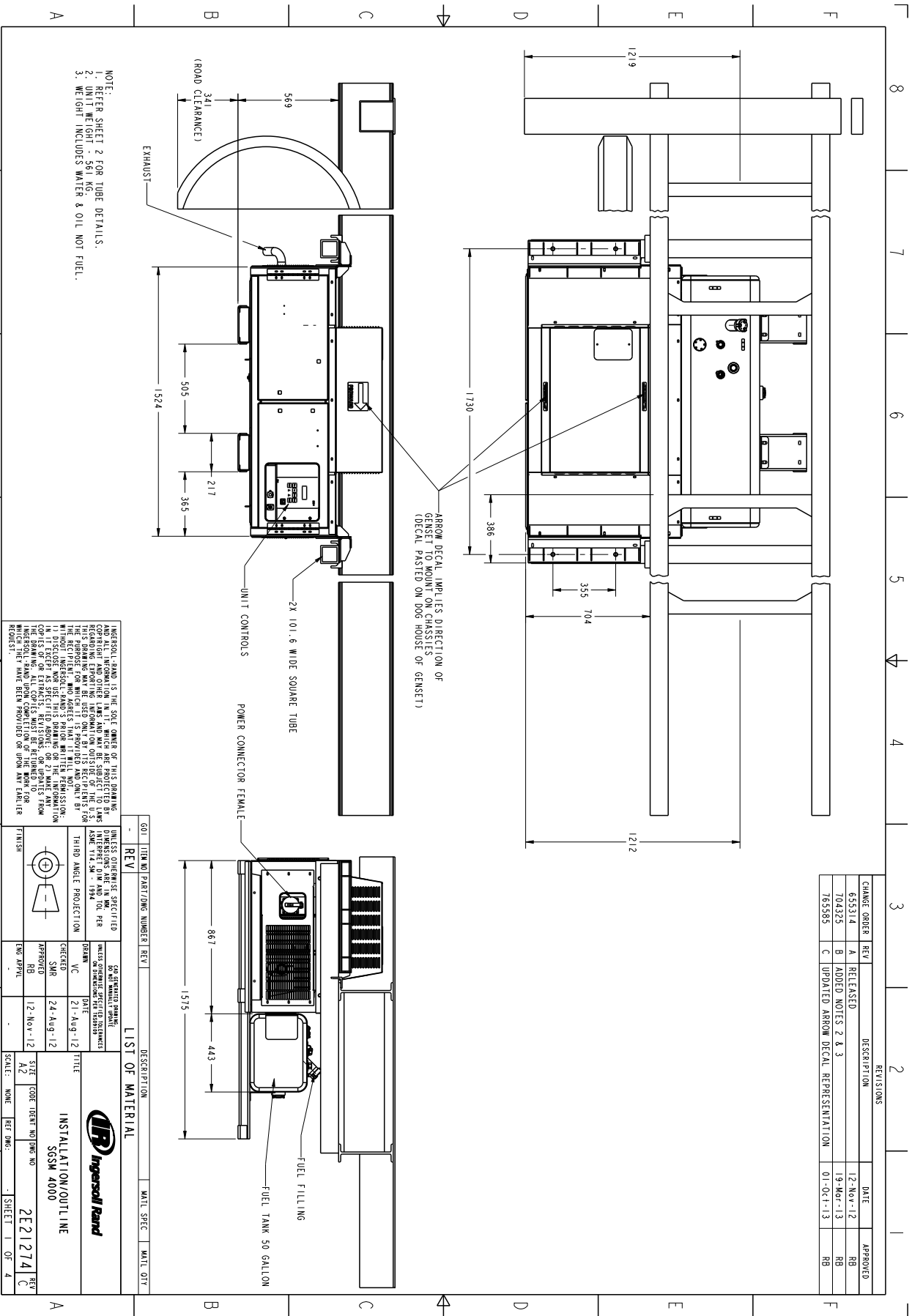
NOTES:
1. UNIT WEIGHT - 494 KG.
2. WEIGHT INCLUDES WATER & OIL NOT FUEL.

STANDARD FRAME

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GOI	ITEM NO.	PARTITION NUMBER	REV	DESCRIPTION	MATL SPEC	MATL QTY
-	REV	-	-	LIST OF MATERIAL	-	-
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MM TOLERANCES ARE AS FOLLOWS: FRACTIONS DECIMALS MILLIMETERS ASME Y14.5M 1993 ISO P18 THIRD ANGLE PROJECTION  DO NOT SCALE DRAWING. PROTECT SURFACE FROM DAMAGE. REWORK OR REPAIR TO BE IDENTICAL TO ORIGINAL. DRAWN DATE CHECKED 21-Aug-12 DESIGNED 24-Aug-12 SURF APPROVED RB 12-Nov-12 END AVAL - TITLE Ingersoll Rand INSTALLATION/OUTLINE SCCM 4000 SIZE CODE ITEM NO DWG NO REV A2 2E12173 C REF DWG: SHEET 1 OF 4						

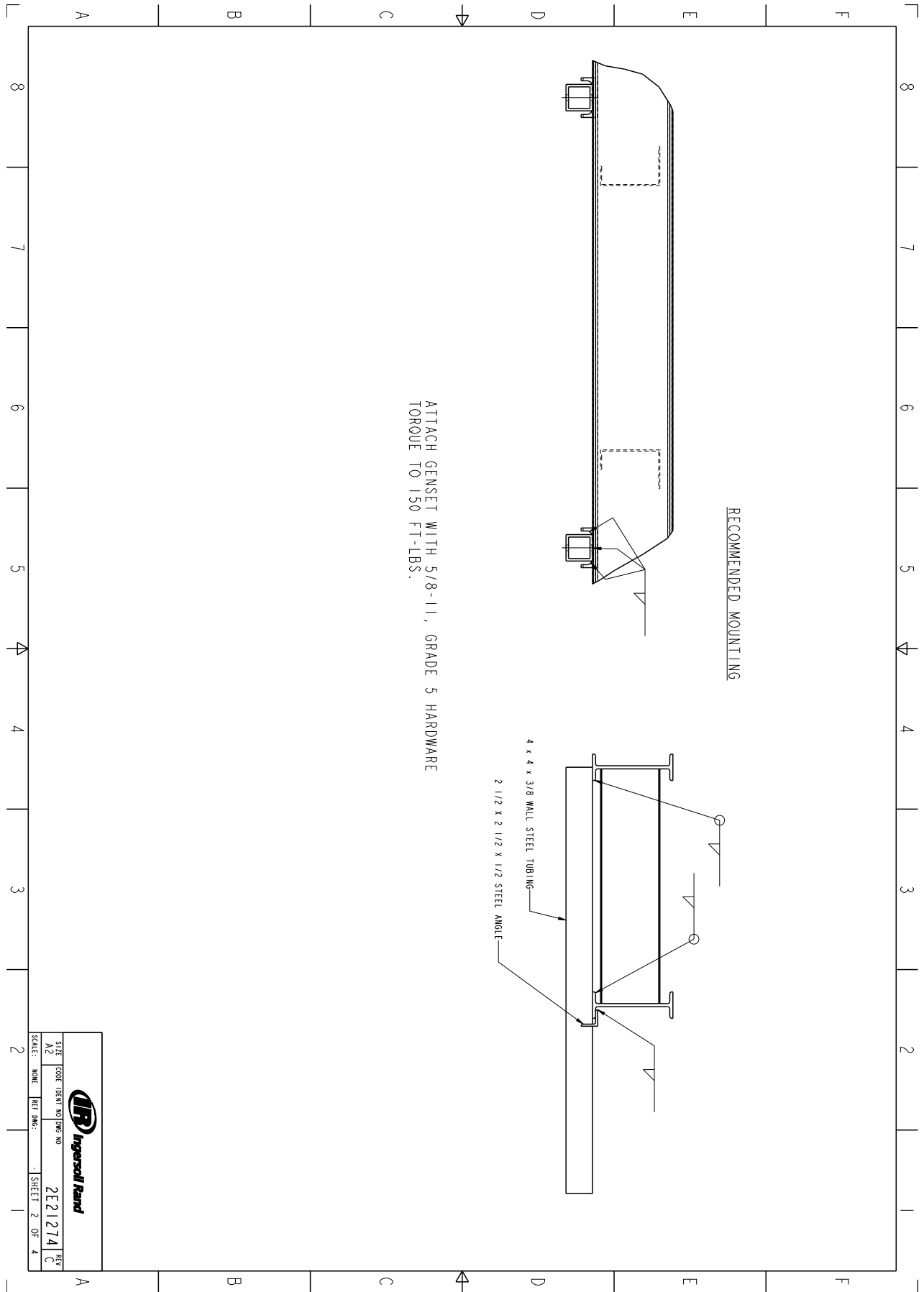




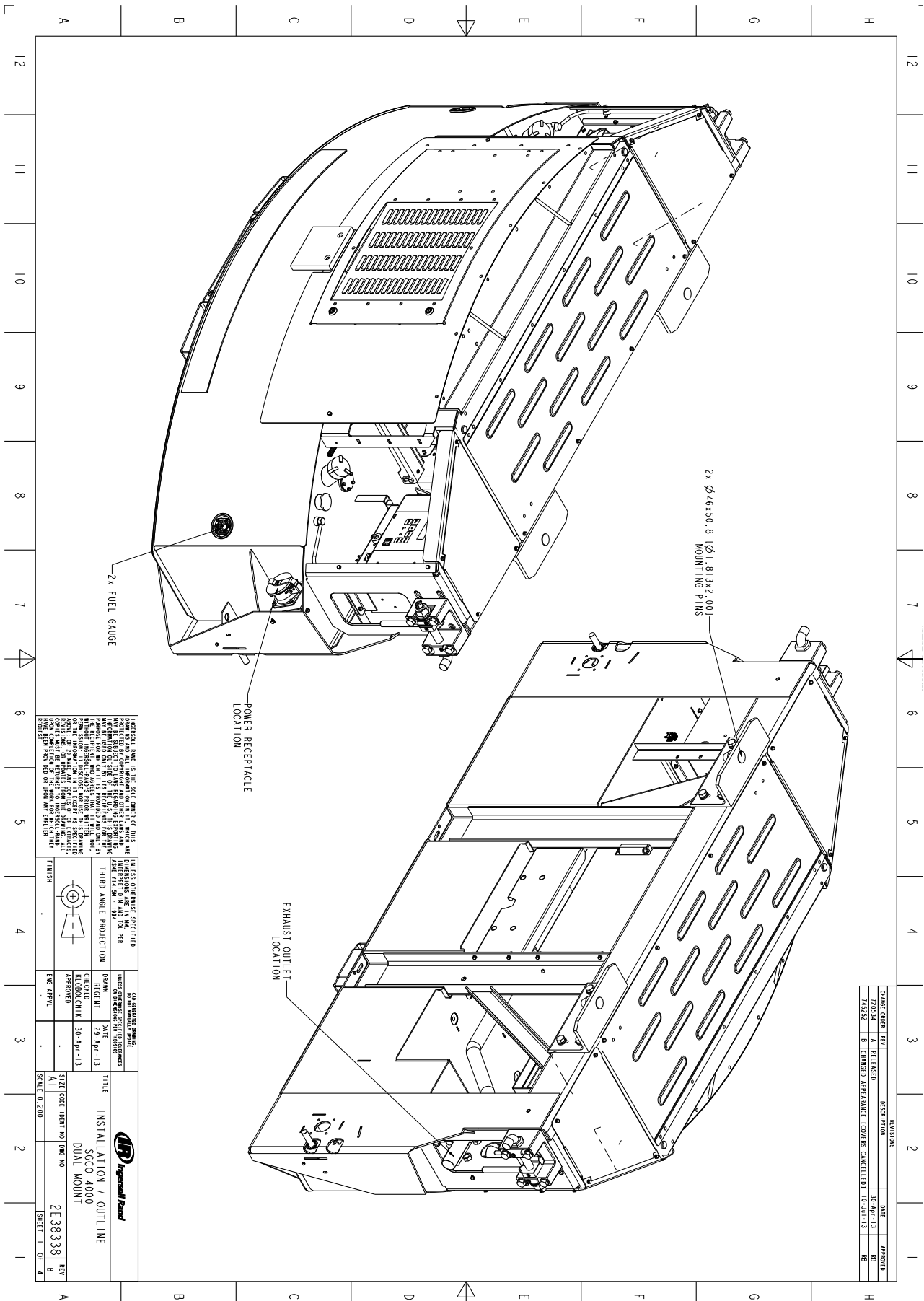
REVISIONS			
CHANGE ORDER	REV	DESCRIPTION	DATE
655314	A	RELEASED	12-Nov-12
104325	B	ADDED NOTES 2 & 3	19-Mar-13
165365	C	UPDATED ARROW DECAL REPRESENTATION	01-Oct-13

GOI	ITEM NO	PART/IMG NUMBER	REV	DESCRIPTION	MATL SPEC	MATL QTY
-	REV	LIST OF MATERIAL				
UNLESS OTHERWISE SPECIFIED		FOR QUANTITIES SHOWN	IN BRACKETING THE TOLERANCES			
DIMENSIONS ARE IN MM		DRAWN BY	CHECKED BY			
TOLERANCES ARE IN MM		DATE	DATE			
ASME Y14.5M - 1994		21-Aug-12	24-Aug-12			
THIRD ANGLE PROJECTION		SMR	SMR			
FINISH		APPROVED	APPROVED			
ENG APPR		12-Nov-12	12-Nov-12			
SCALE: NONE		A2	A2			
REF DWG:		2E21274	2E21274			
SHEET 1 OF 4		C	C			

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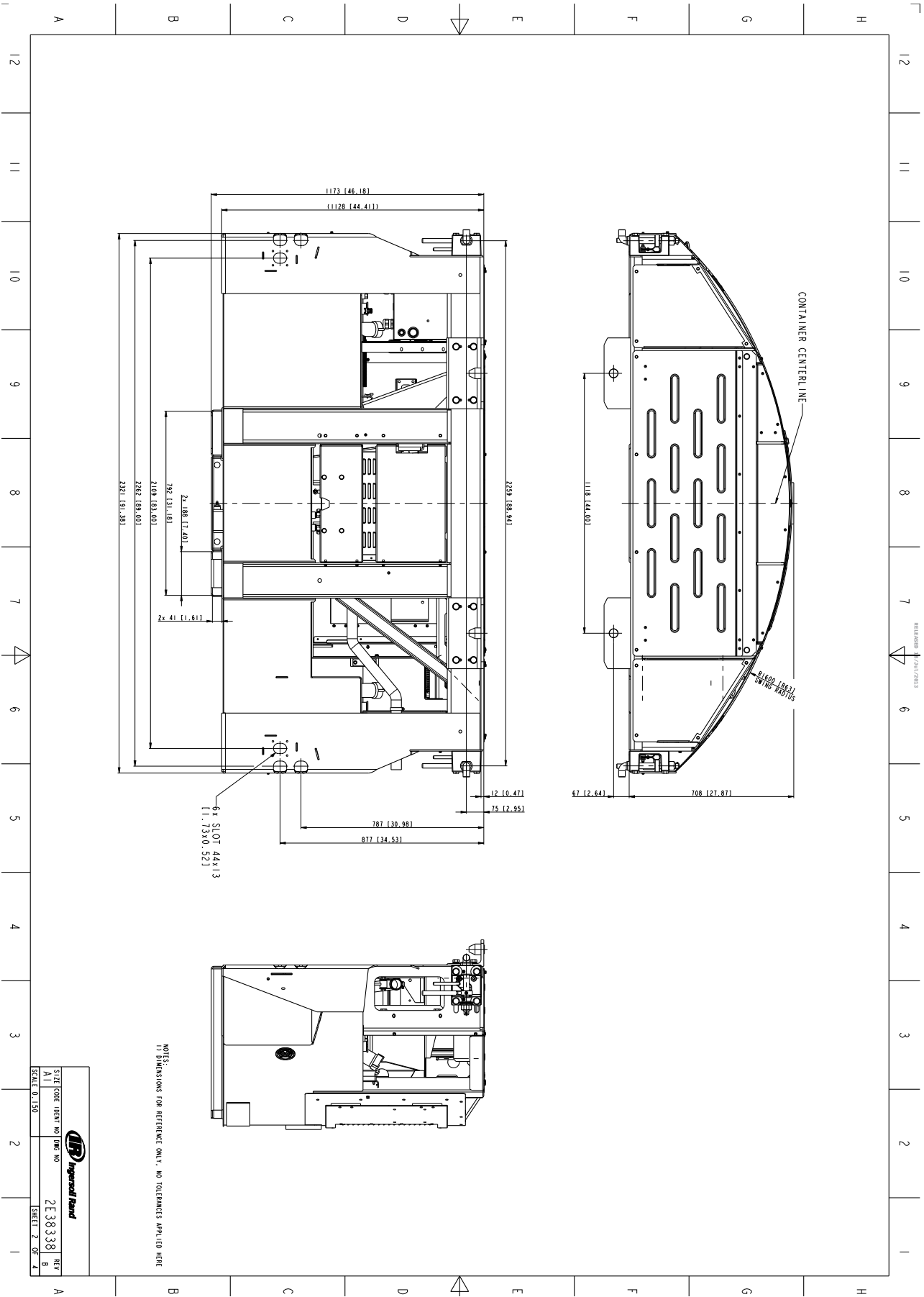


			
SIZE	CODE	TOLERANCE	DWG NO
A2			2E21274
SCALE: NONE	REF DWG:		SHEET 2 OF 4

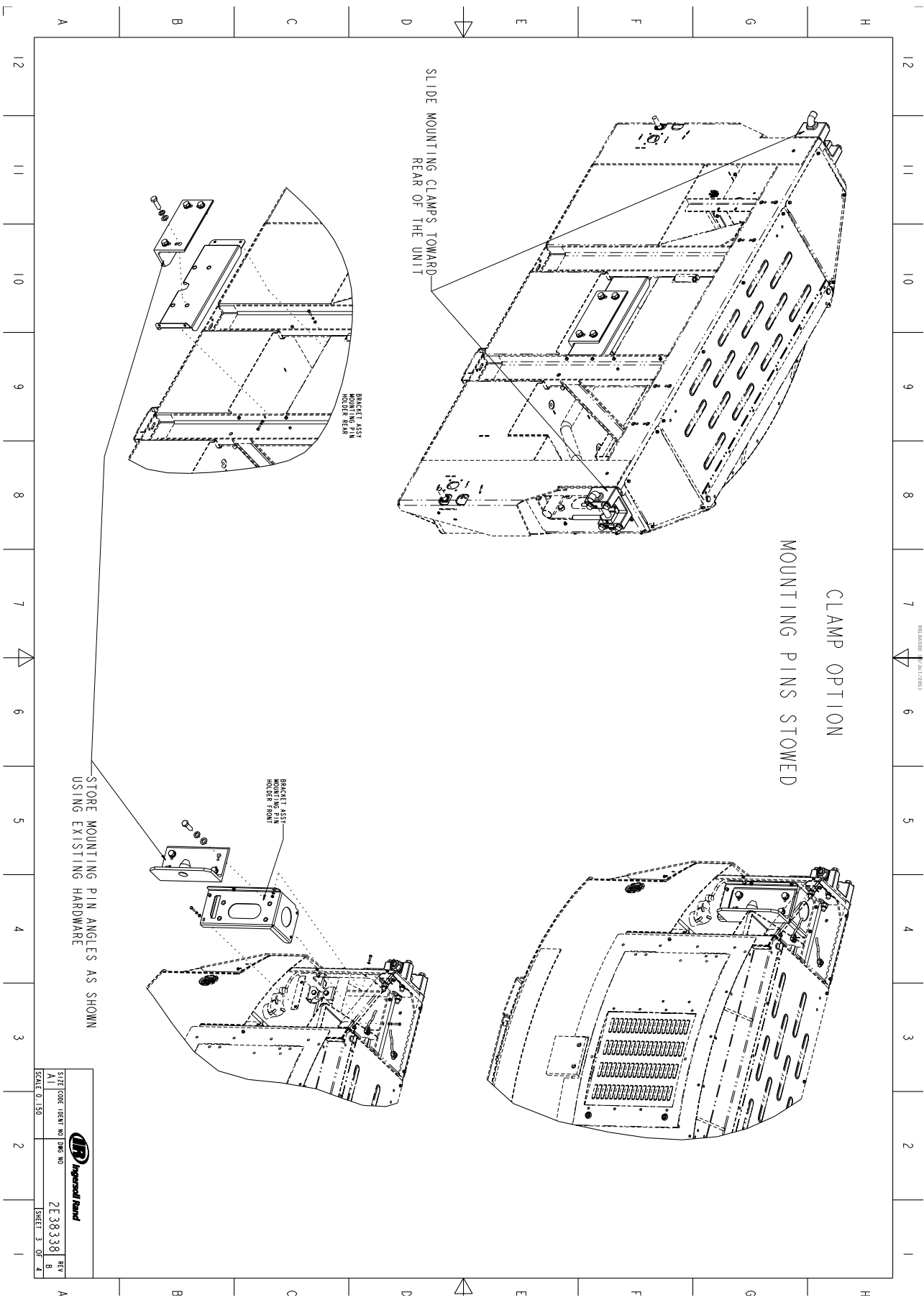


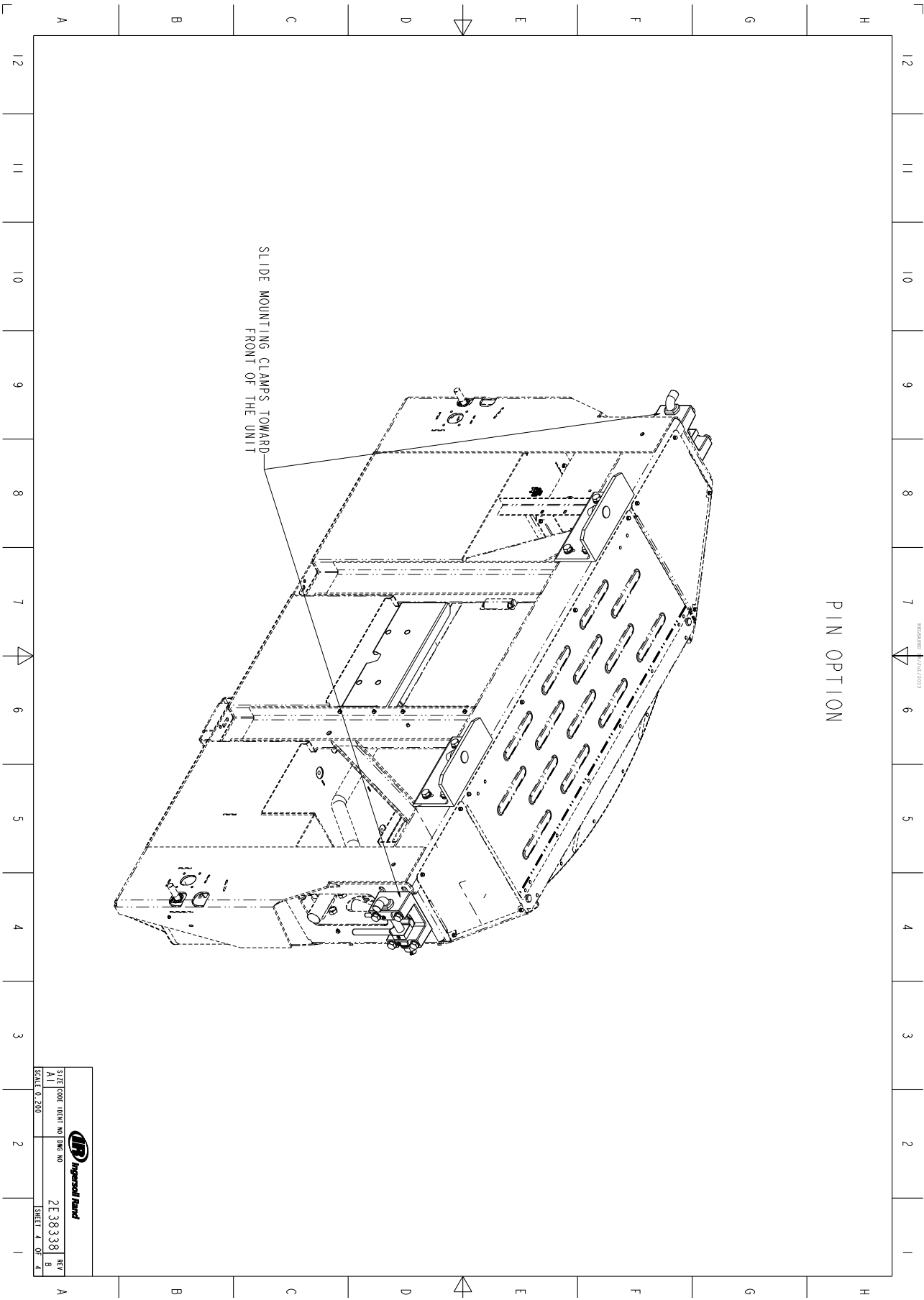
REVISIONS			
CHANGE ORDER	REV	DESCRIPTION	DATE
14532	B	CHANGED APPEARANCE (COVER CANCELLED)	10-24-13

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM. PER ANSI Y14.5M - 1993, 30 PER CENT PRECISION.		DATE 23-Apr-13		TITLE INSTALLATION / OUTLINE	
THIRD ANGLE PROJECTION		SHEET 2E.38338		REV B	
		APPROVED 30-Apr-13		DRAWN 2E.38338	
FINISH		SCALE 0.200		SHEET 1 OF 4	



RELEASED BY 1012033





Unit Description, Features & Options

General Description

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



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

This unit uses a new engine called the DV6NR. Common Rail fuel injection system, which used electronically controlled fuel injectors to reduce emissions. An EGR (Exhaust Gas Recirculation) system and DOC (Diesel Oxidation Catalyst) exhaust after-treatment system also reduce emissions so the engine is EPA Tier 4 compliant. An ECU (Engine Control Unit) monitors and controls engine operation. The unit controller indirectly monitors and controls the engine through the ECU.

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

Fuel tanks are provided as an integral part of each unit. Fuel capacities are: 473 liter (125 gal.) on SGCO clip-on models; 303 liter (80 gal.), or 210L (50 gal.) on SGCM center mount or SGSM side mount models.

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

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



Figure 3: SGUM 4000 Under Mount Generator



Figure 4: SGCO 4000 Clip On Generator

EMI 3000 Package

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 includes:

- 5 Year or 12,000 Hour Extended Life Coolant (ELC)
- EMI 3000 Dual Element Oil Filter, P/N 11-9960 (identified by blue and white colors)
- EMI 3000 API Rating CI-4 Mineral Oil
- EMI 3000 Fuel Filter, P/N 11-9957

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

SG+ Microprocessor Controller

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



Figure 5: SG+ Controller Display

Unit Instruments

INDICATOR LEDs.

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

FUEL GAUGE. A gauge mounted in the fuel tank indicates the level of diesel fuel in the tank.

Unit Protection Devices



WARNING: *the unit may start at any time without warning when the unit On/Off switch is in the On position.*

Units equipped with a SG+ controller feature a Delayed Restart mode. The controller will make up to three (3) attempts every 20 minutes to restart the unit after a Delay Alarm has occurred. The Delayed Restart mode continues until the unit has been successfully restarted, or until a Shutdown Alarm is generated. Protection shutdown devices that cause an Delayed Restart shutdown condition include:

- **Low Oil Pressure**
- **Low Oil Level**
- **High Water Temperature**

Low Oil Pressure Switch: Engine oil pressure should rise immediately on starting. The controller will stop the engine if oil pressure drops below 117 ± 21 kPa, (1.17 ± 0.21 bar), (17 ± 3 psig) for more than 30 seconds, and the oil level drops below 8 qt (7.6 litres) (Also see oil level sensor below). The controller then records an alarm.

Oil Level Sensor: An oil level switch closes if the oil level drops below 8 qts. (7.6 liters) and the oil pressure drops below 117 ± 21 kPa (Also see low oil pressure switch above). The controller will stop the engine if the switch stays closed for more than 30 seconds. The controller then records an alarm.

Water Temperature Sensor: The controller will stop the engine if the engine coolant temperature rises to 107 C (225 F) for more than 30 seconds. The controller also records an alarm. The unit will restart when the coolant temperature drops to 88 C (190 F).

Voltage Option

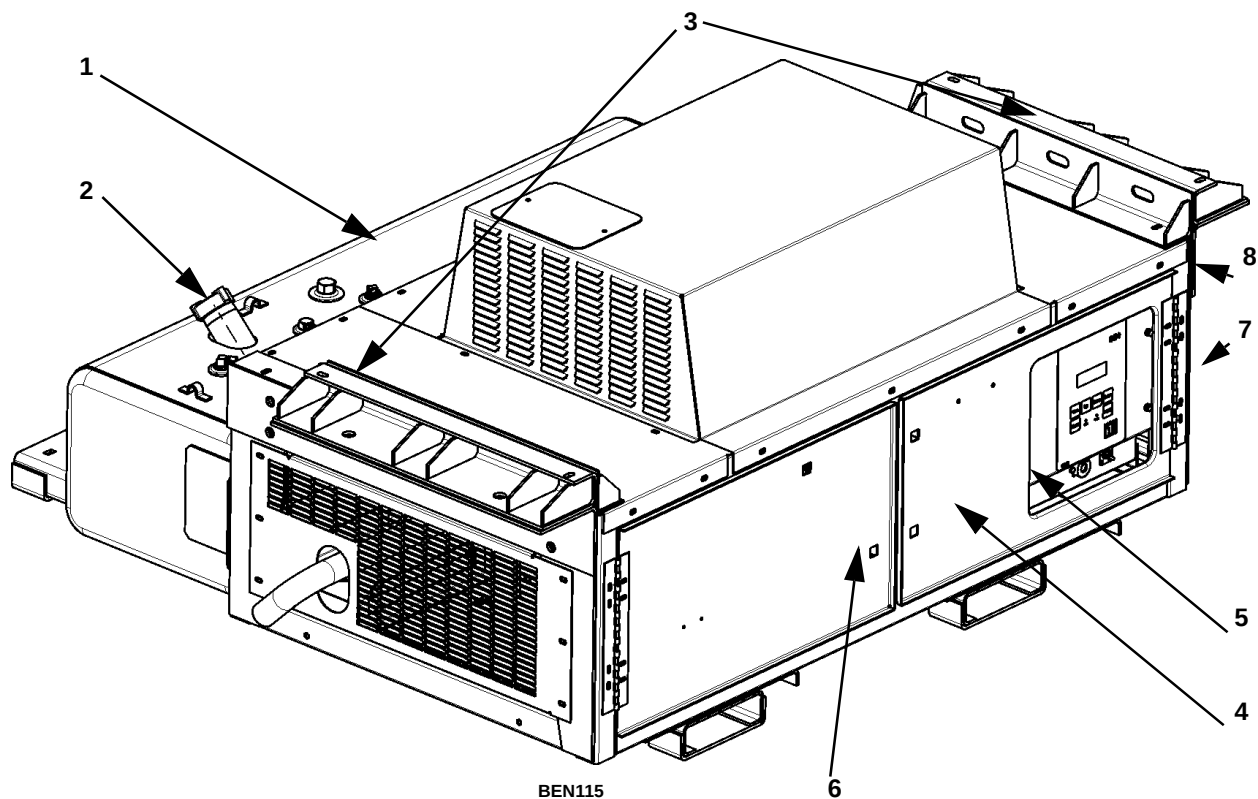
A power cable and receptacle wired for 230 Vac or 460 Vac is supplied as standard equipment with each generator. Genset models can be wired for either receptacles: 230 Vac or 460 Vac.

EcoPower

EcoPower™ is an standard feature on all SG 4000 units - designed to save fuel and meet emissions regulations. The controller monitors the load from the refrigeration unit and determines if the engine should run in high speed (1890 ± 10 RPM), or low speed (1560 ± 5 RPM). The output frequency is 60 Hz in high speed and 50 hz in low speed. The engine runs in high speed for at least fifteen minutes when it is started, and whenever it shifts from low speed to high speed.

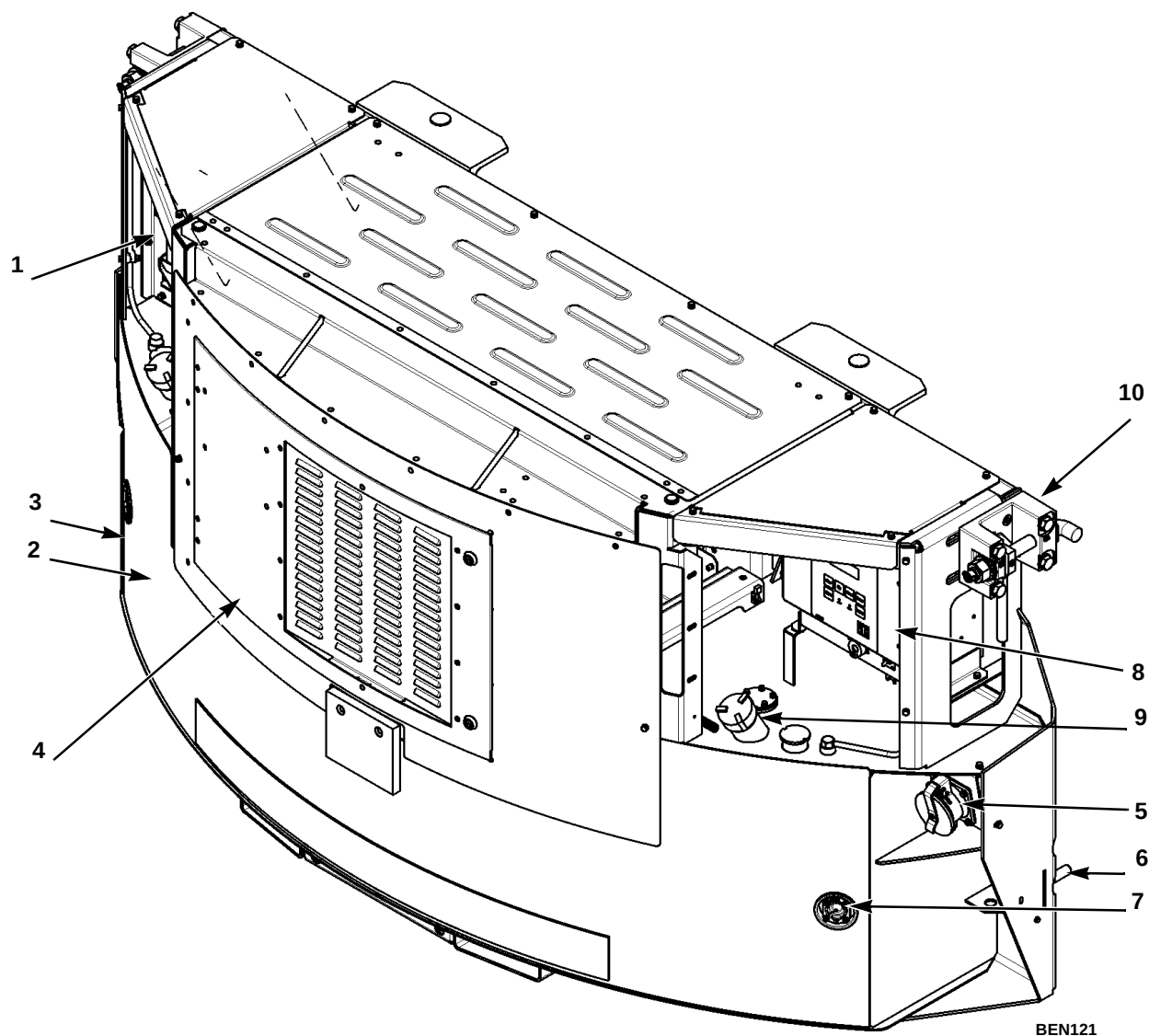
Fuel Level Sensor Option

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



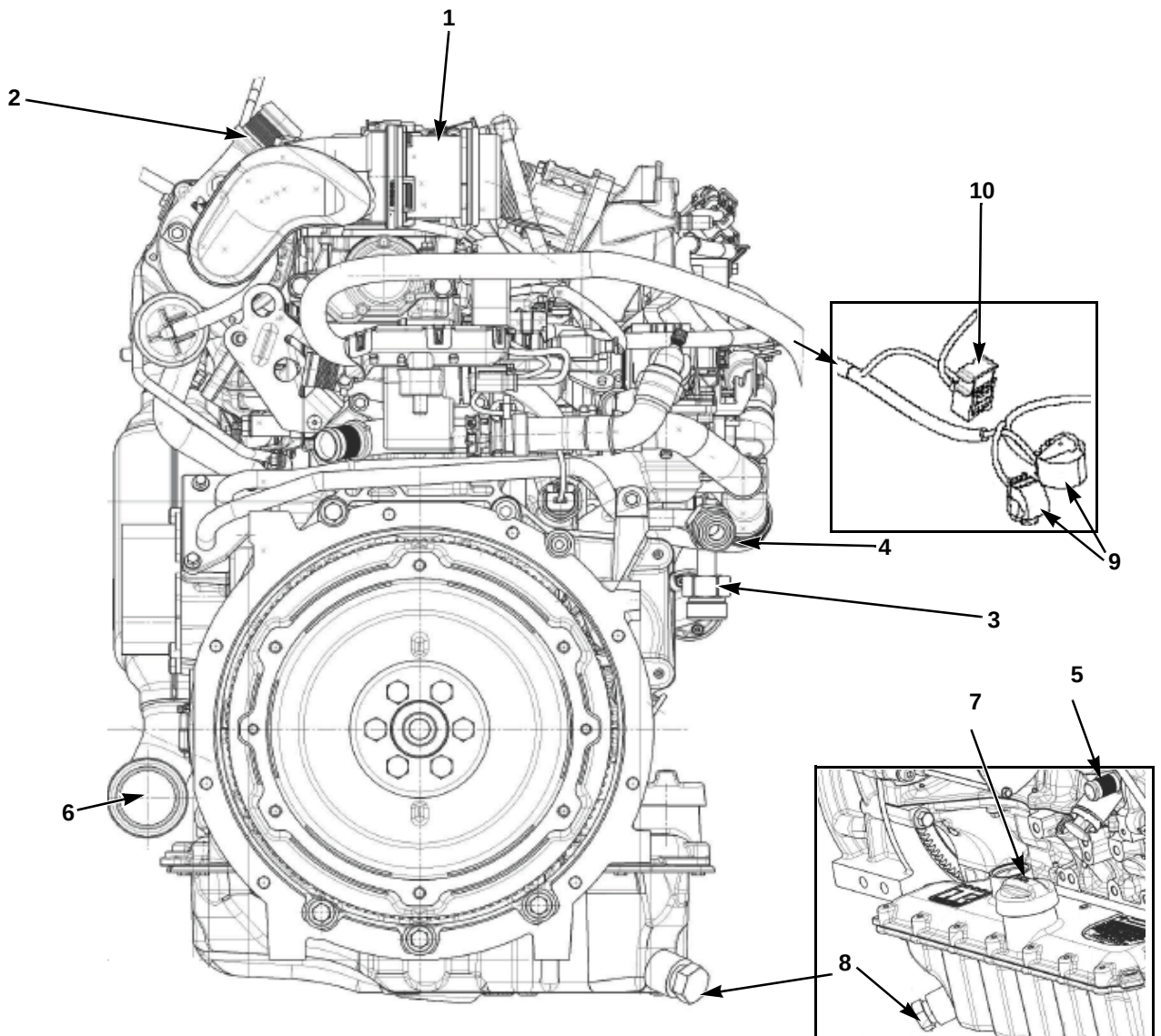
1.	Fuel Tank	5.	Control Box Cover
2.	Fuel Tank Fill Neck and Cap	6.	Engine Compartment Access Door
3.	Unit Mounting Arms	7.	460 or 230 Vac Power Receptacle Location
4.	Alternator and Control Box Compartment Access Door	8.	Radiator Location

Figure 6: SGUM 4000 — Unit Front View



1.	Battery	6.	Lower Mounting Screw and Washer (each side)
2.	Unit Nameplate Location	7.	Fuel Gauge (each side)
3.	Fuel Tank	8.	Control Box Location
4.	Alternator and Engine Compartment Access Door	9.	Fuel Tank Fill Neck and Cap (each side)
5.	460 or 230 Vac Power Receptacle Location	10.	Bracket-Clip on (One each side)

Figure 7: SGC0 4000 — Unit Front View



1.	Mass Air Flow Sensor	6.	Exhaust
2.	Turbocharger	7.	Oil Fill and Electric gauge attachment
3.	Feed Return Oil Assembly	8.	Oil Drain
4.	Oil Filter	9.	ECU Connectors
5.	Water Inlet Assembly	10.	Preheat Relay Socket

Figure 8: Engine (All Models) — Unit Front View

Genset Model Features

Genset Model Features

SGSM	SGCM	SGCO	MODEL
S	S	S	DV6NR Diesel Engine
S	S	S	460 Vac Output for 15 KW, 18.75 KVA, 3 Phase, 60 Hz, 4 Wire Generator
O	O	O	230 Vac Output for 15 KW, 18.75 KVA, 3 Phase, 60 Hz, 4 Wire Generator
S	S	S	SG+ Control System
S	S	S	Battery with Post
S	S	S	Battery Charging System, Solid-state
S	—	—	Side-mount Unit mounting bracket
—	S	—	Center-mount Unit mounting arms
—	—	S	Clip-on Unit Frame
S	S	S	Combination Fuel Filter/Water Separator
S	S	S	Dry Air Cleaner
S	S	S	Stainless Steel Exhaust System
O	O	O	Fuel Heater Electric
—	—	O	Header Pin, Mounting
S	S	S	EMI 3000 Extended Maintenance Interval Package
O	O	—	Integral 80 Gallon (303 Liter) Aluminum Fuel Tank
—	—	S	Integral 125 Gallon (473 Liter) Steel Fuel Tank
S	S	—	Integral 50 Gallon (190 Liter) Aluminum Fuel Tank
O	O	O	Fuel Monitoring - Monitoring and Recording of fuel level events.
O	O	O	Telematic's
S = STD O = Optional — = N/A			

Controller Description

SG+ Controller Description

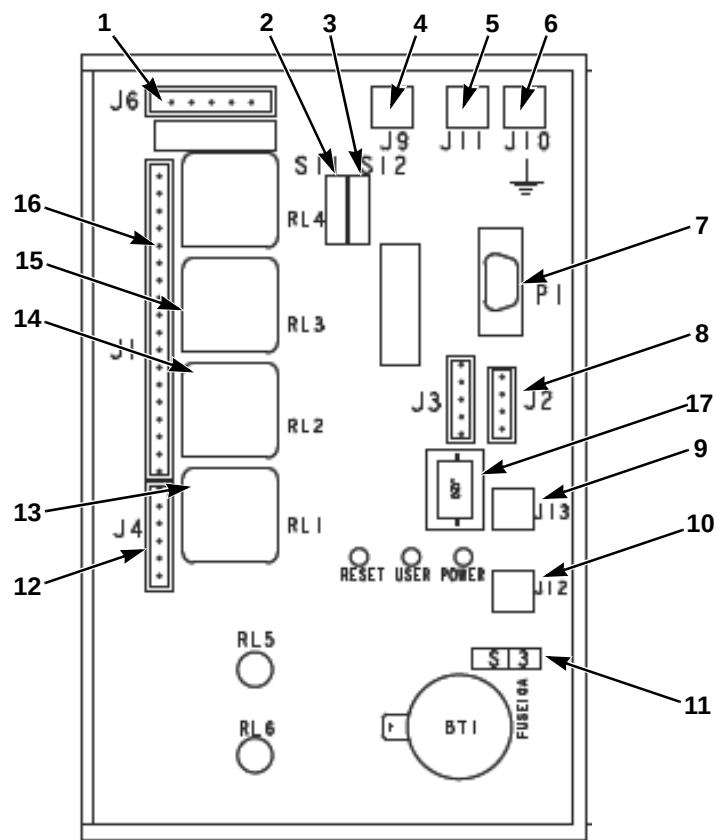
The SG+ controller is a two-piece, self contained microprocessor for diesel generator sets. The SG+ display is mounted on the control box cover. The SG+ microprocessor is mounted inside the control box (see Figure 10 on page 40). Three external relays - two ECU Relays and the Start Relay are also mounted inside the control box near the microprocessor. Another Relay - the Preheat Relay, is located in the Engine Compartment.

This system automatically controls generator operation by providing:

- Automatic unit preheat and engine startup during initial startup or delayed restart
- Variable glow plug preheat time
- Automatic Pretrip Test capability
- Delayed alternator excitation for 2 minutes
- Unit shutdown protection for the engine and alternator. The controller stops the unit due to low engine oil pressure, low engine oil level, high coolant temperature, or alternator overload.
- Automatic unit restart 20 minutes after unit shutdown due to an unknown condition, high engine water temperature, engine failure to start, check fuel alarm, or alternator overload (also low engine oil pressure if enabled). It will attempt three (3) restarts and then stop.



Figure 9: SG+ Controller Display



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

Figure 10: SG+ Microprocessor

Controller Overview

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.

Keypad: Contains the following six keys.

Escape Key: Press this key to escape a new setting or jump to the parent menu.

Up Key: Press this key to scroll UP through the menu display, or increase the value of a setting.

Down Key: Press this key to scroll DOWN through the menu display, or decrease the value of a setting.

Enter Key: Press this key to enter or execute controller menu tasks or commands.

Alarm Key: Press this key to go directly to the Alarm List Menu and view the alarm information in the display.

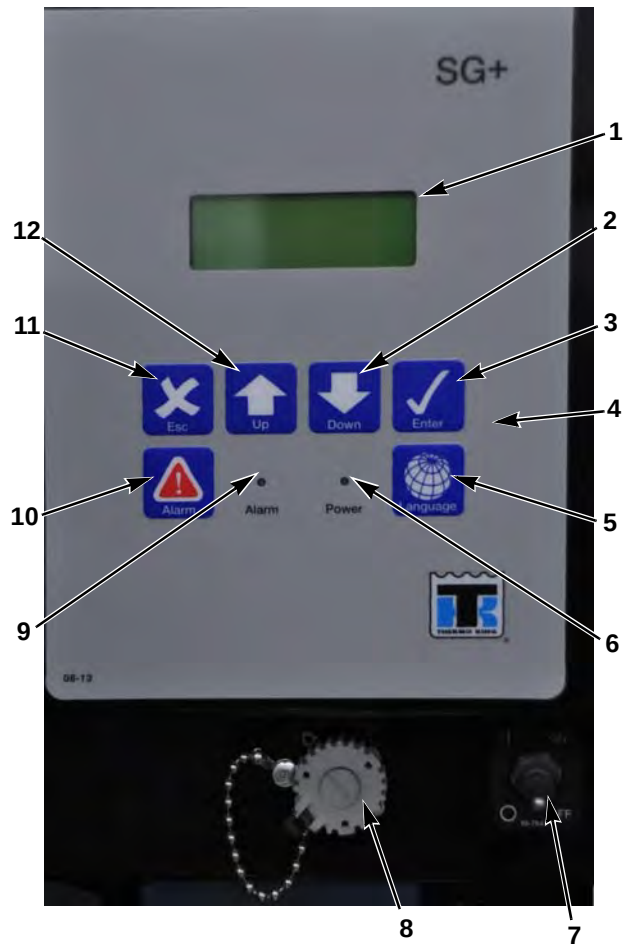
Language Key: Press this key to change the language used on the display. English and Spanish are the languages that are currently available.

Alarm LED: Flashes when the controller has detected an alarm condition. It is off when there are no alarms.

Power LED: Lights up while the Unit On/Off Switch is in the ON position. It is off when the Unit On/Off Switch is in the OFF position.

Unit On/Off Switch: In the ON position, the electrical control system energizes for unit operation. In the OFF position, the electrical control system including the fuel solenoid de-energizes to stop the engine. The unit will not operate.

Download Port: Is used to download the event logger and flash load new software.



1.	Display
2.	Down Key
3.	Enter Key
4.	Keypad
5.	Language Key
6.	Power LED
7.	Unit On/Off Switch
8.	Download Port
9.	Alarm LED
10.	Alarm Key
11.	Escape Key
12.	Up Key

Figure 11: Control Box Cover

Miscellaneous Features

- Internal self-checking/diagnostic capability
- Pretrip test capability (see “PTI” on page 71)
- Hourmeter: The controller has a built-in run hourmeter that can be accessed through the Timers/Counters Submenu under the Misc. Functions Menu.
- The application software version is displayed by selecting the Program Version Submenu under the Misc. Functions Menu.
- Display menus: The SG+ controller contains extensive display menus that can be navigated via the keypad. The display menus are organized into seven Main Menus: Data Menu, Alarm List Menu, Warning List Menu, Commands Menu, Misc. Functions Menu, Configuration Menu, and Event Log Menu.
- Microprocessor Inputs:
 - Alternator Voltage
 - Battery Voltage
 - Coolant Level Sensor
 - Ignition Relay Feedback
 - Run Relay Feedback
 - Fuel Sender (Optional)
- Microprocessor Outputs:
 - Start Relay
 - Ignition Relay
 - Run Relay
 - On Light
 - Alarm Light.
 - Fuel Pump
 - Quad Relay

Navigating the Controller Menus

Controller Display Menus

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

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

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

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

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

An overview of the menu structure is shown in Figure 13 on page 46.

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

Navigating Controller Menus

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



Escape Key: Press the **ESCAPE** key to escape a new setting or jump to the parent menu.



Up Key: Press the **UP** key each time you want to scroll up to view another item in a menu or submenu), or increase the value of a setting.



Down Key: Press the **DOWN** key each time you want to scroll down to view another item in a menu (or submenu), or decrease the value of a setting.



Enter Key: Press the **ENTER** key each time you want to enter or execute controller menu tasks or commands.



Alarm Key: Press the **ALARM** key to go directly to the Alarm List Menu and view the alarm information in the display.



Language Key: Press the **LANGUAGE** key to change the language used on the display.



1.	Down Key
2.	Enter Key
3.	Language Key
4.	Alarm Key
5.	Escape Key
6.	Up Key

Figure 12: Controller Display

Menu Overview

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

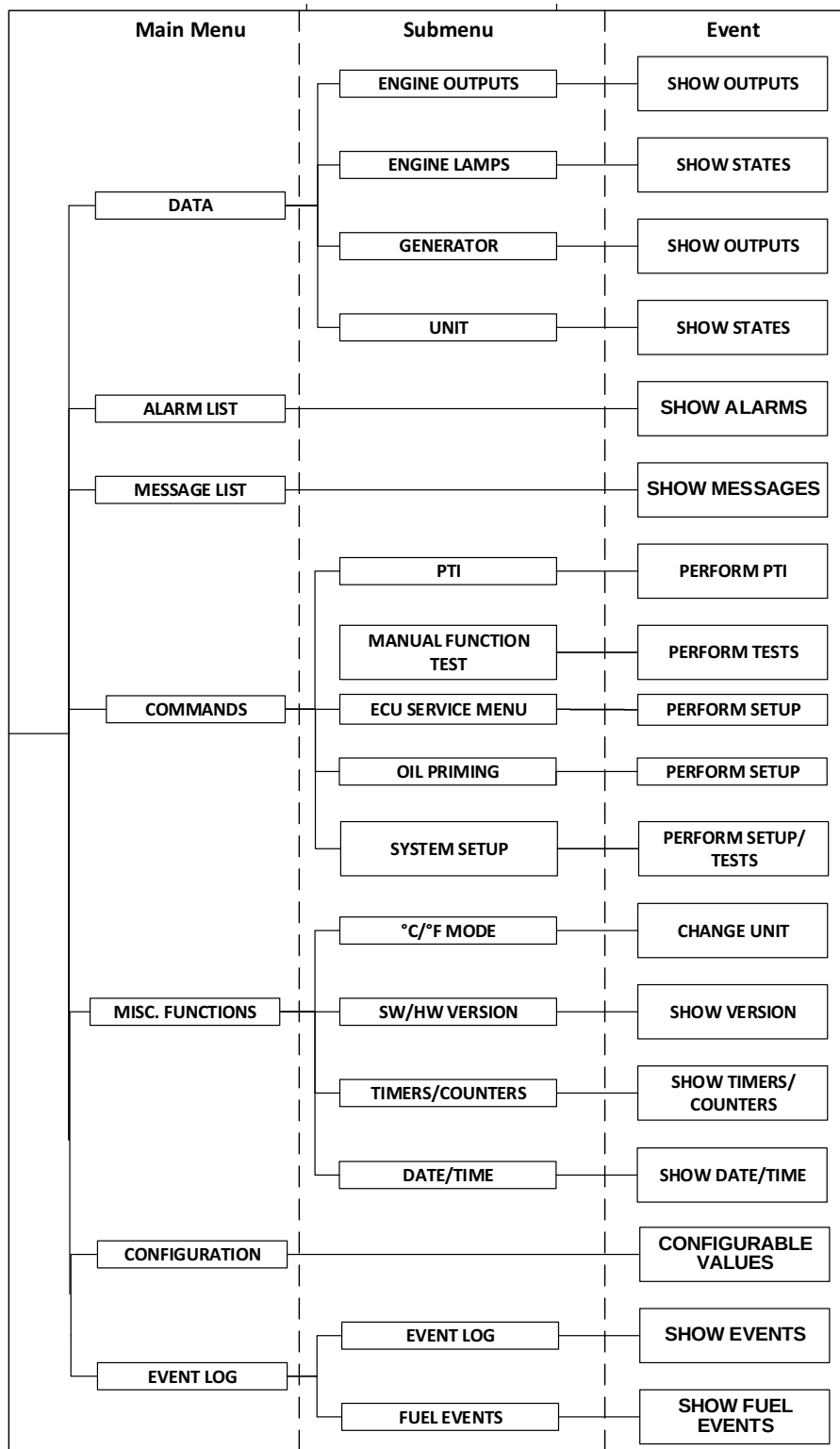


Figure 13: Menu Structure

ARA1103

Data Menu

The Data Menu contains the following submenus. See “Data Menu” on page 55 for more information.

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

Alarm List Menu

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

Message List Menu

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

Commands Menu

The Commands Menu contains the following submenus:

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

Misc. Functions Menu

The Misc. Functions Menu contains the following submenus:

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

Configuration Menu

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

Event Log Menu

The Event Log Menu contains the following submenus:

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

Standard Display

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

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

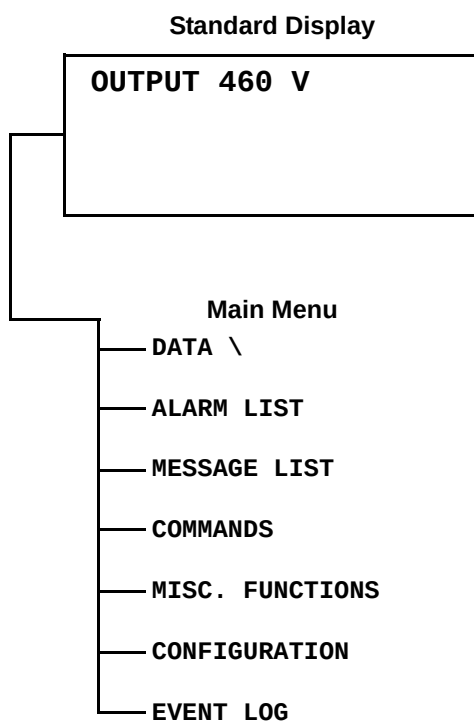


Figure 14: Standard Display and Main Menu

Pause Mode Displays



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

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

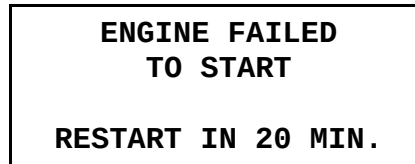


Figure 15: Typical Pause Mode Display

Controller Link Down Display

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

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



Figure 16: Controller Link Down Display

Operating Instructions

Pretrip Inspection

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

Visual Inspection

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

Fuel: The diesel fuel supply must be sufficient to guarantee engine operation to the next check point.

Engine Oil: Engine oil level should be at the FULL mark. Never overfill. The dipstick is attached to the filler cap.

Coolant: Engine coolant must be above the ADD mark with antifreeze protection of -34 C (-30 F). Check and add coolant in the expansion tank.



WARNING: *DO NOT remove the radiator cap from the radiator fill neck when the engine coolant is hot.*



CAUTION: *With both Extended Life Coolant (EMI 3000) and Conventional Coolant (non-EMI 3000) equipped units operating in the field, there are several important rules to remember:*

- *Extended Life Coolant (ELC) is RED in color while conventional coolant is GREEN or BLUE-GREEN.*
- *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.*

Battery: Terminals must be clean. Electrolyte should be at the full mark.

Electrical: Electrical connections should be securely fastened. Check wires and terminals for corrosion, cracks or moisture. Repair or replace if necessary.

Structural: Visually inspect the unit for leaks, loose or broken parts and other damage. The radiator coil should be clean and free of debris. Clean if necessary. Use an air or water spray jet directed against the coil from the air discharge side.



CAUTION: *Air or water spray jet pressure should not be high enough to damage (bend) coil.*

Mounting Bolts: Check the mounting bolts on the unit and engine. Tighten if necessary.

Starting the Unit

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



WARNING: *With the unit On/Off switch in the "ON" position, the unit may start at any time without prior warning.*

1. Turn unit **ON/OFF** switch to On.

2. A series of displays called the Start Sequence appears on the display as follows:

- a. DISPLAY UNIT
REV 1.0.0
- b. SG+
X.X.X.X YYMMDD
HARDWARE REV. X
- c. MAIN MENU
DATA
DELAY 30 (or 30, 29, 28, etc. to 01)
The delay screen counts down from 30 to 01 while the controller performs some self checks.
- d. MAIN MENU
DATA
INIT
The controller energizes the glow plugs for preheat (if necessary). The preheat buzzer is energized during the preheat period. Preheat time ranges from 5 to 120 seconds, depending on the engine temperature. Preheat may continue until after the engine starts.
- e. MAIN MENU
DATA
FUEL RELAY ON
The controller energizes the fuel relay.
- f. MAIN MENU
DATA
GLOW PLUG ON
The glow plugs are energized.
- g. MAIN MENU
DATA
STARTER
The engine begins cranking. The glow plug and pre-heat buzzer may remain energized during the cranking period.
- h. MAIN MENU
DATA
DELAYED OUTPUT
This display appears while the controller delays energizing the alternator output for approximately 2 minutes.



CAUTION: *Never use starting fluid.*

After Start Inspection

After the engine has started:

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

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

Functional Inspection

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

1. Start the unit (see “Starting the Unit” on page 50).
2. Initiate an automatic PTI.

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

- a. Press the **ENTER** key or the **ESCAPE** key to enter the Main Menu, if necessary.
 - b. Press the **UP** or **DOWN** key to scroll up or down through the Main Menu to the Commands Menu.
 - c. Press the **ENTER** key to enter the Commands Menu.
 - d. The PTI submenu will be displayed.
 - e. Press the **ENTER** key to start the PTI.
3. The controller then performs the PTI. Observe the unit for proper operation and functions during the PTI. The display shows which component is being tested, and the test result (PASSED or FAILED).
 - a. “Please Wait”
 - b. The engine stops.
 - c. A display test is performed. Watch the display to verify it is operating properly.
 - d. The controller beeps to test the buzzer.
 - e. The ECU ignition is tested.
 - f. The ECU run relay is tested.
 - g. The ECU fuel relay is tested.
 - h. The ECU CAN connect is tested.
 - i. Engine Start is tested. The engine starts, The display says
“START ENGINE TEST (beep on, then off, then start appears briefly)
(the result of the test - i.e. RUNNING 1491)
RESULT: PASS” if the result is acceptable.
 - j. Low/High speed is tested. (Engine still running - similar results screen and test sequence to point i. above)
 - k. The output voltage is tested, (Engine still running - similar results screen and test sequence to point i. above)

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

4. When the PTI is complete, the test ends automatically and the controller display shows “PTI PASSED (or FAILED) - REBOOT”. Turn the On/Off Switch Off and back On to reboot and return the unit to normal operation.
5. If an operating problem occurs during the PTI, view and correct any alarms or messages. Then acknowledge the alarms or messages and repeat the PTI.

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

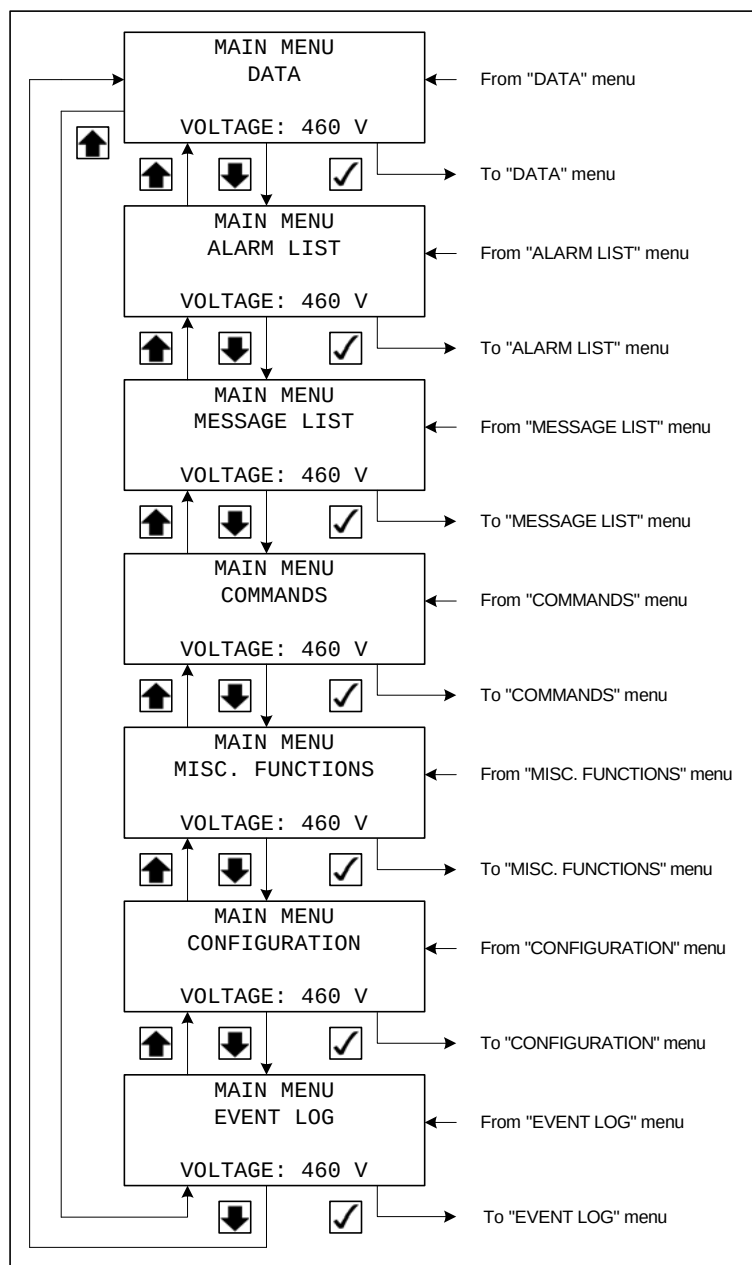
Main Menu

The Main Menu contains the following menus:

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

To enter the Main Menu complete the following steps:

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



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Figure 17: Main Menu

Data Menu

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

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

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

To enter the Data Menu complete the following steps:

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

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

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

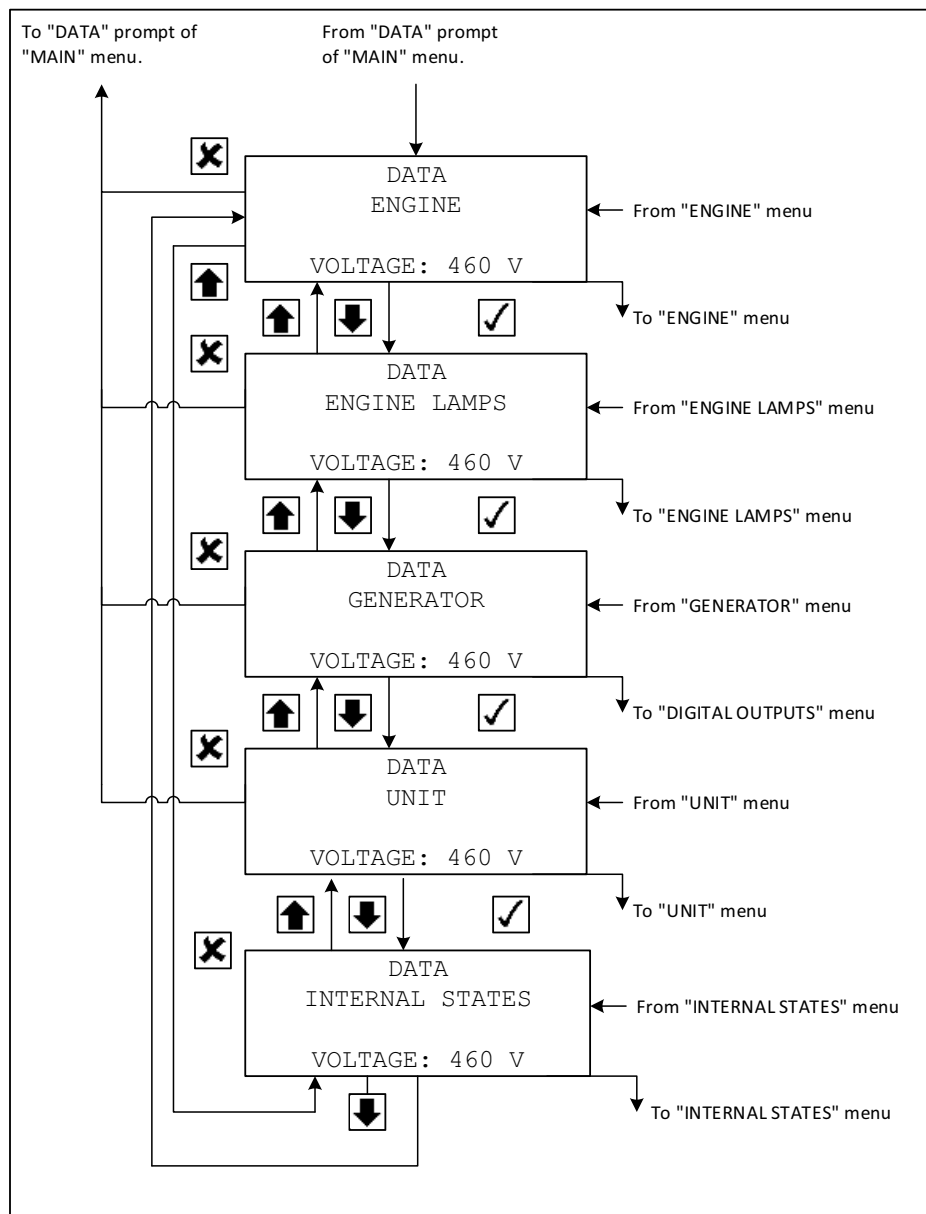


Figure 18: Data Menu

Engine Menu

The Engine display the following unit operating information:

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

To enter the Engine Submenu complete the following steps:

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

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

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

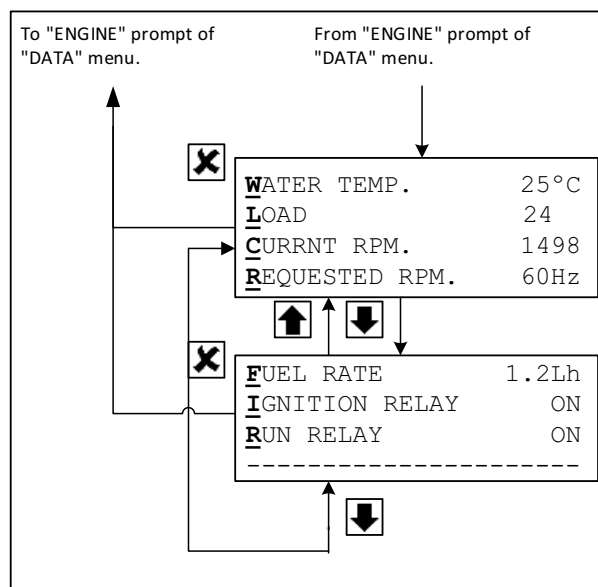


Figure 19: Engine Submenu

Engine Lamps

The Engine Lamps submenu displays the following information:

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

To enter the Engine Lamps submenu complete the following steps:

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

NOTE: Press the UP or DOWN key to scroll up or down through the Main Menu to the Data Menu, if necessary.
4. Press the **ENTER** key to enter the Data Menu.
5. Press the **UP** or **DOWN** key to scroll up or down through the Data Menu to the Engine Lamps submenu.
6. Press the **ENTER** key to enter the Engine Lamps Submenu.
 - Press the **UP** or **DOWN** key to scroll up or down through the Engine Lamps submenu.
 - Press the **ESCAPE** key to return to the Data Menu.

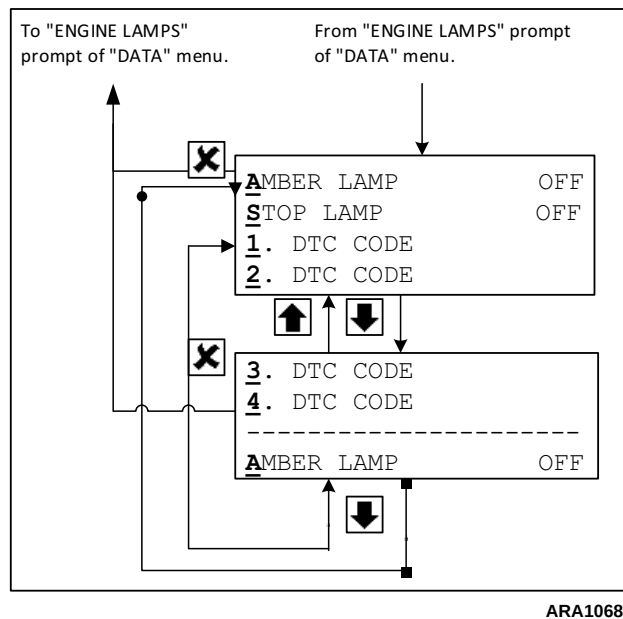


Figure 20: Engine Lamps submenu

Generator

The Generator submenu display the status of the following outputs:

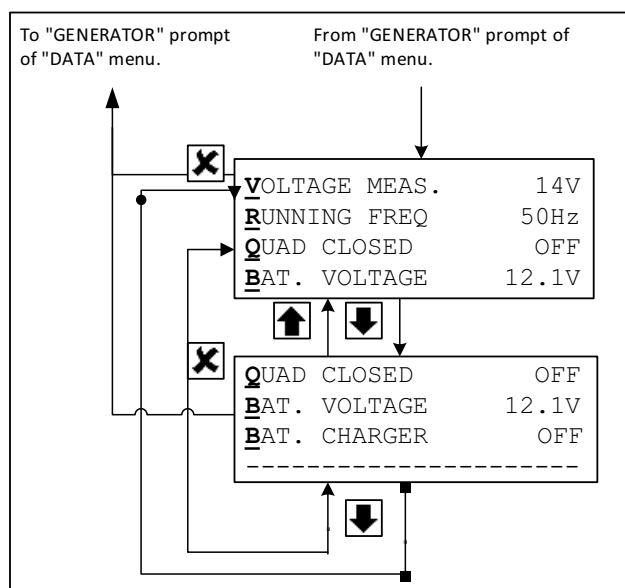
- Voltage Measurement
- Running Frequency
- Quad closed on/off
- Battery Voltage
- Battery Charger on/off

To enter the Generator submenu complete the following steps:

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

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

4. Press the **ENTER** key to enter the Data Menu.
5. Press the **UP** or **DOWN** key to scroll up or down through the Data Menu to the Generator submenu.
6. Press the **ENTER** key to enter the Generator submenu.
 - Press the **UP** or **DOWN** key to scroll up or down through the Generator submenu.
 - Press the **ESCAPE** key to return to the Data Menu.



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Figure 21: Generator submenu

Unit

The Unit submenu display the status of the following outputs:

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

To enter the Unit submenu complete the following steps:

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

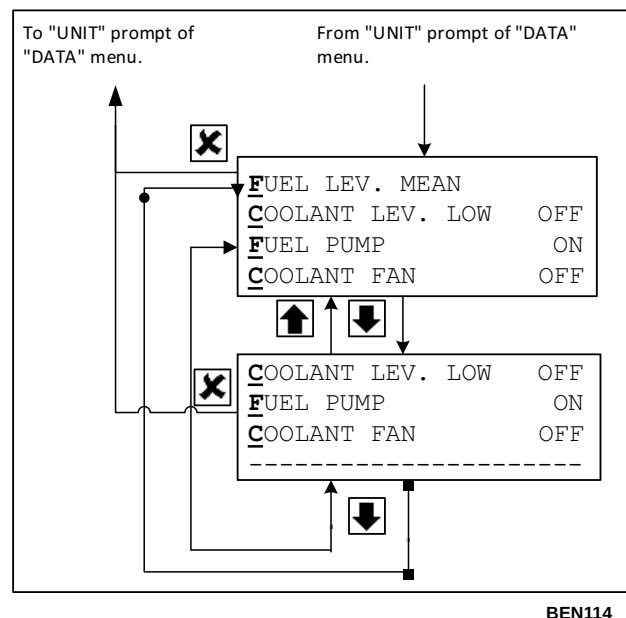


Figure 22: Unit submenu

Internal States

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

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

To enter the Internal States complete the following steps:

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

NOTE: Press the **UP** or **Down** key to scroll up or down through the Main Menu to the Data Menu, if necessary.

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

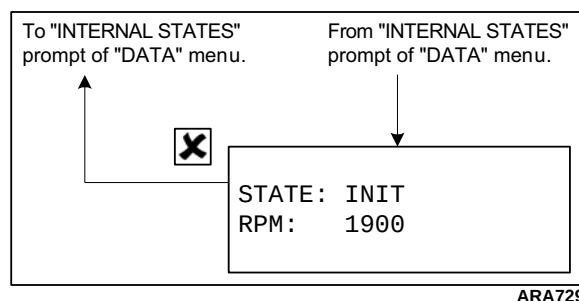


Figure 23: Internal States

Alarm List Menu

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

Alarm Types

There are two types of alarms:

Delayed Restart Alarm: Delayed restart alarms indicate the unit has stopped temporarily because of a problem or to prevent damage to the unit. The unit will attempt to restart in 20 minutes. The display will show information about the unit in the message screen and the time left to the restart attempt. A delayed restart alarm becomes a shutdown alarm after the third failed restart attempt in an hour.

Shutdown Alarm: The Alarm LED flashes and unit stops. Shutdown alarms indicate the unit has been stopped to prevent damage to the unit. The condition must be corrected before restarting the unit.

Displaying and Acknowledging Alarms

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

1. Place the On/Off switch in the “ON” position.
2. Press the **ALARM** key to enter the Alarm List Menu directly.
Or
Enter the Alarm List Menu through the Main Menu as follows:
 - a. Press the **ENTER** key or the **ESCAPE** key to enter the Main Menu, if necessary.
 - b. Press the **UP** or **DOWN** key to scroll up or down through the Main Menu to the Alarm List Menu.
 - c. Press the **ENTER** key to enter the Alarm List Menu.
3. The Alarm List Menu will appear on the display. It shows the most recent alarm and the following information:
 - The alarm code (A101 through A111)
 - The position of the alarm in the list of recorded alarms. For example, 1/2 means alarm one of two.
 - The alarm text
 - The alarm status (Active or Acknowledged).
4. Write down the alarm code and the alarm text.
5. Press the **ENTER** key to acknowledge the alarm. The Alarm LED will continue flashing until the active alarms (and messages) have been acknowledged.
6. Press the **DOWN** key to scroll down to the next alarm, if necessary.
7. Write down the alarm code and the alarm text.
8. Press the **ENTER** key to acknowledge the alarm.
9. Repeat steps 6 through 8 until all active alarms have been written down and acknowledged.
10. Press the **ESCAPE** key to return to the Main Menu.

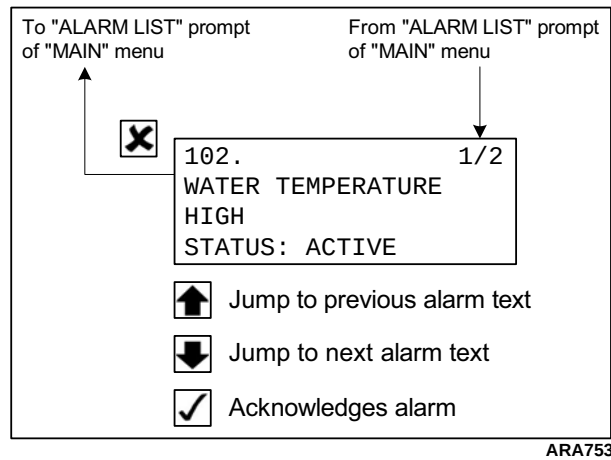


Figure 24: Alarm List Menu

Alarm Diagnosis

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

Alarm List

Alarm Code and Text	Alarm Type–Cause	Diagnostics
A101. WATER TEMPERATURE HIGH	Delayed Restart Alarm—Engine is running and water temperature is above 107 C (225 F) for 5 seconds. Engine then stops and then attempts to restart.	1. Check for cause of engine overheating: - Check engine coolant level. - Check water pump belt. - Check radiator for airflow and coolant flow restrictions. 2. Check for faulty water temperature sensor.
A103. FAILED TO START	Delayed Restart Alarm—Engine failed to crank. Becomes a Shutdown Alarm when number of restart attempts is greater than number of “Crank Restarts” set in Configuration Menu.	1. Check fuel level. 2. Check fuel pump, and fuel system both electrically and mechanically. 3. In cold ambient temperatures check for fuel gelling. 4. Check for restricted air cleaner or air intake system. 5. Check intake air heater.
A104. RL2 (FUEL H) FEEDBACK FAILURE	Shutdown Alarm—No feedback when relay is energized, or feedback when relay is not energized.	1. Check RL2 (Fuel Hold) relay.
A107. EXTERNAL OVERLOAD	Shutdown Alarm—Engine restart if output voltage is short-circuited.	1. Unplug load and attempt restart. 2. Check alternator field circuit. 3. Check alternator output circuit. 4. Check external generator controller electrical system.

Alarm List (Continued)

Alarm Code and Text	Alarm Type–Cause	Diagnostics
A108. ENGINE NOT RUNNING REASON UNKNOWN	Delayed Restart Alarm–Genset stops for restart without any reason with oil pressure but zero RPM when engine should be running. • Engine will attempt to restart in 20 minutes.	1. Check fuel level. 2. Check oil level 3. Check RPM Sensor
A109. LOW OIL LEVEL	If low oil level for 60 seconds.	1. Check oil level. 2. Check Oil Level Switch. 3. Check circuits to Oil Level Switch.
A110. RPM BELOW LIMIT	Shutdown Alarm–Engine stops for restart if speed is below limit i.e, Engine speed is below 1350 RPM.	1. Check engine speed. 2. Check RPM sensor.
A111. FAILED TO START LOW BATTERY	The controller is resetting 3 times during crank caused by low voltage on the battery. The low voltage could be controller not charging the battery, defective battery or cables.	1. Defective battery, load test battery. 2. Check Battery Charger. 3. Check ground connections at block.
A113. COOLANT LEVEL LOW	Coolant level is low.	1. Check coolant level. 2. Check Coolant Level Sensor. 3. Check circuits to Coolant Level Sensor.
A115. EXCITER CONTROL UNIT SHUTDOWN	External controller has not responded within 5 seconds.	1. Check wiring to exciter controller. 2. See “Alternator Diagnosis” on page 147.
A116. ENGINE CONTROL UNIT SHUTDOWN	The engine is restarted if communication has been lost with the engine controller. • External controller has not responded within 5 seconds.	1. Check wiring to engine controller.
A118. ENGINE STOP LAMP	Engine stop lamp activated	1. Connect ECU Test Tool to read codes.
A119. LOW OIL PRESSURE	Low oil pressure message active.	1. Connect ECU Test Tool to read codes.
A120. OUTPUT VOLTAGE HIGH	Output voltage above 500 volts over 15 seconds	1. See “Alternator Diagnosis” on page 147.
A121. ENGINE PROTECT LAMP	Engine degraded mode (speed limitation) or starter relay defect.	1. Connect ECU Test Tool to read codes.
A122. GENERATOR UNIT ERROR	Over excitation or short circuit	1. See “Alternator Diagnosis” on page 147.
A123. COOLANT FAN ERROR	Coolant fan klaxon is open and coolant temperature is above limit.	1. Check coolant fan klaxon. 2. Check circuits to coolant fan klaxon.
A124. FUEL TANK EMPTY	Monitoring the engine P-code for low fuel delivery pressure will activate the alarm when the engine is about to shut down due to out of fuel condition.	1. Check fuel level.

Message List Menu

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

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

Displaying and Acknowledging Messages

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

1. Place the On/Off switch in the “ON” position.
2. Press the **ENTER** key or the **ESCAPE** key to enter the Main Menu, if necessary.
3. Press the **UP** or **DOWN** key to scroll up or down through the Main Menu to the Message List Menu.
4. Press the **ENTER** key to enter the Message List Menu.
5. The Message List Menu will appear on the display. It shows the most recent message and the following information:
 - The message code (M101 through M131)
 - The position of the message in the list of recorded messages. For example, 1/1 means message one of one.
 - The message text
 - The message status (Active or Acknowledged).
6. Write down the message code and the message text.
7. Press the **ENTER** key to acknowledge the message. The Alarm LED will continue flashing until the active messages (and alarms) have been acknowledged.
8. Press the **DOWN** key to scroll down to the next message, if necessary.
9. Write down the message code and the message text.
10. Press the **ENTER** key to acknowledge the message.
11. Repeat steps 8 through 10 until all active messages have been written down and acknowledged.
12. Press the **ESCAPE** key to return to the Main Menu.
13. The unit will then enter the Start Sequence and start the engine.

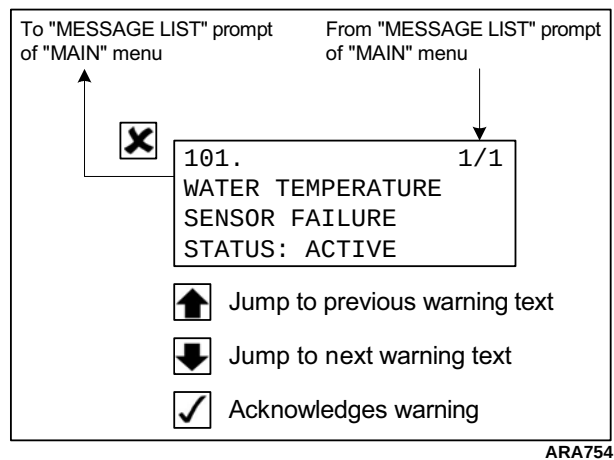


Figure 25: Message List Menu

Message Diagnosis

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

Message List

Message Code and Text	Cause	Diagnostics
M101. BAT. VOLTAGE LOW	The battery voltage is reported to be below 12 voltages for 3 minutes. If the air heater is activated the battery voltage should be below 9 voltage for 3 seconds.	1. Check battery 2. Check battery cables.
M102. DIGITAL INPUT FAILURE	Digital inputs have been changing once a second for the last 100 seconds.	This condition indicates noise on the line, a loose connection, or a bad sensor.
M103. OUTPUT VOLTAGE < 180 V	Exciter field regulation is turned on and voltage measurement is below 360 volts for 30 seconds.	Check alternator for low output.
M104. AIR FILTER BLOCKED	Not used.	
M105. COOLANT LEVEL LOW	Coolant Level Sensor indicates low coolant level for 30 seconds.	1. Check coolant level. 2. Check Coolant Level Sensor. 3. Check circuits to Coolant Level Sensor.
M106. OUTPUT FREQUENCY LOW	Output frequency is below 45 Hz for 30 seconds (engine RPM below 1350).	Check and adjust engine speed.
M107. OUTPUT FREQUENCY HIGH	Output frequency is above 70 Hz for 30 seconds (engine RPM above 2100).	Check and adjust engine speed.
M108. LOW OIL LEVEL	Oil Level Switch indicates low oil level for 3 minutes.	1. Check oil level. 2. Check Oil Level Switch. 3. Check circuits to Oil Level Switch.
M109. HOUR METER 1 HAS EXCEEDED THRESHOLD	Hour Meter 1 (HM1) has exceeded the threshold set in the Configuration Menu.	Acknowledge message to reset timer.

Message List (Continued)

Message Code and Text	Cause	Diagnostics
M110. HOUR METER 2 HAS EXCEEDED THRESHOLD	Hour Meter 2 (HM2) has exceeded the threshold set in the Configuration Menu.	Acknowledge message to reset timer.
M111. FUEL LEVEL LOW	Fuel Level is below "Fuel Level" set in Configuration Menu.	1. Check fuel level. 2. Check Fuel Level Sensor. 3. Check circuits to Fuel Level Sensor.
M114. LOW OIL PRESSURE	No oil pressure.	1. Check oil level. 2. Check oil pressure using the Engine submenu of the Data Menu. 3. Check Oil Pressure Switch. 4. Check Oil Pressure Switch circuit.
M116. COUNTDOWN TIMER HAS EXPIRED	If hour counter exceeds user setup.	1. Acknowledge message and reset timer.
M119. WATER TEMPERATURE HIGH	If water temp. >107 C for 5 sec. - restarting.	1. Check water temperature sensor. 2. Check WTP/WTN circuit.
M121. ENGINE FAILED TO START	No oil pressure and did not reach 800 RPM - restarting.	1. Check fuel level. 2. Check fuel pump, and fuel system both electrically and mechanically. 3. In cold ambient temperatures check for fuel gelling. 4. Check for restricted air cleaner or air intake system. 5. Check glow plugs.
M122. EXTERNAL OVERLOAD	If output is short-circuited - restarting.	1. Unplug load and attempt restart. 2. Check alternator field circuit. 3. Check alternator output circuit.
M123. ENGINE STOPPED REASON UNKNOWN	Oil pressure good and no RPM - restarting.	1. Check fuel level. 2. Check fuel pump, and fuel system both electrically and mechanically. 3. In cold ambient temperatures check for fuel gelling. 4. Check for seized engine or alternator.
M126. FUEL LEVEL SENSOR OUT OF RANGE	Fuel level reading is 90 Gallons above then maximum tank size.	1. Check fuel level sensor. 2. Check FPOS, FNEG, and FOUT circuits. 3. Check fuel tank size setting in System Setup submenu.
M127. FUEL LEVEL CHANGE TO FAST	Fuel level reading decreased faster than normally expected. <i>NOTE: Must use password (0007) to clear this message.</i>	1. Check for leak in fuel tank. 2. Check to see if fuel has been removed from fuel tank.

Message List (Continued)

Message Code and Text	Cause	Diagnostics
M129. RPM BELOW LIMIT	RPM is below 1350 for 5 sec.	1. Check engine speed. 2. Check RPM sensor.
M130. DELAYED OUTPUT TIMED OUT	Water temperature sensor is below 32 C (90 F) for 5 minutes.	1. Check water temperature sensor. 2. Check WTS circuit.
M133. EXCITER CONTROL SHUTDOWN	External controller has not responded within 5 sec	1. See "Alternator Diagnosis" on page 147.
M135. ENGINE CONTROL UNIT SHUTDOWN	Exciter voltage below 20V.	1. See "Alternator Diagnosis" on page 147.
M137. ENGINE AMBER LAMP	On for defects that could lead to degraded mode (speed limitation), and for Starter relay defect (because impacting safety)	1. Connect ECU Test Tool to read codes.
M138. ENGINE STOP LAMP	On for defects that could lead to engine stop mode.	1. Connect ECU Test Tool to read codes.
M140. DSR CHECKSUM WARNING	Regulator running with default parameters	1. See "Alternator Diagnosis" on page 147.
M141. DSR CHECKSUM WARNING	Output is short-circuited	1. See "Alternator Diagnosis" on page 147.
M142. DSR EXCITATION OVERCURRENT WARNING	Exciter current exceeds the damage threshold	1. See "Alternator Diagnosis" on page 147.
M143. DSR UNDER OR OVER SPEED WARNING	Speed is below or above threshold.	1. See "Alternator Diagnosis" on page 147.
M144. DSR OVER CURRENT AND SPEED WARNING	Current and speed above limits.	1. See "Alternator Diagnosis" on page 147.
M146. OUTPUT VOLTAGE HIGH	Output voltage above 500 volts over 15 seconds	1. See "Alternator Diagnosis" on page 147.
M148. EXCITER PROTECTION ACTIVATED	HRG exciter protection gizmo has been activated	1. See "Alternator Diagnosis" on page 147.
M149. COOLANT FAN FAILURE	Coolant fan klaxon open for 5 seconds	1. Check coolant fan klaxon. 2. Check circuits to coolant fan klaxon.
M150. ENGINE P-CODE INFO	Generated for engine P-codes that do not activate any engine lamps.	1. Connect ECU Test Tool to read codes.

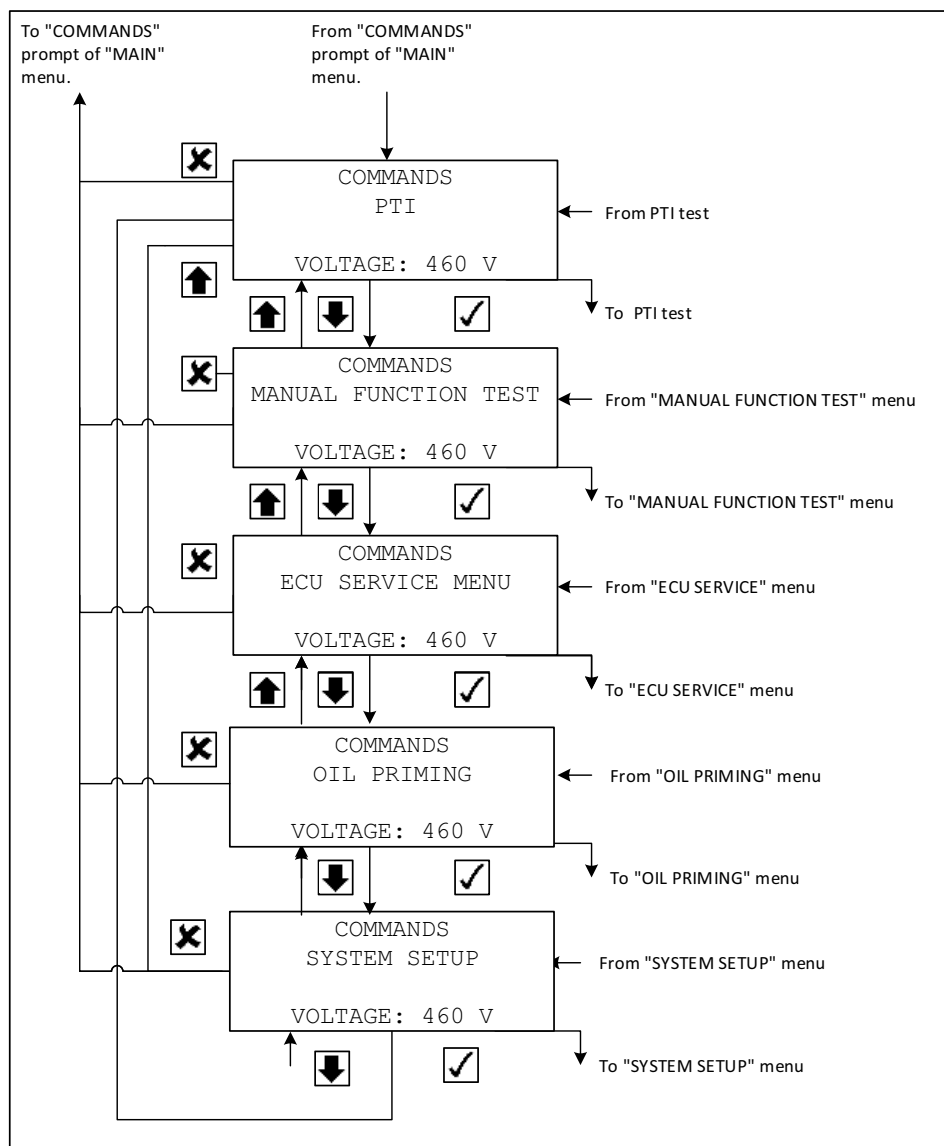
Commands Menu

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

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

To enter the Commands Menu complete the following steps:

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



ARA1070

Figure 26: Commands Menu

PTI

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

NOTE: The unit will not start a PTI until all active messages have been acknowledged. The display will show "ACKNOWLEDGE MESSAGE" if there are messages that have not been acknowledged when trying to perform a PTI. See "Displaying and Acknowledging Messages" on page 65.

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

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

8. When the PTI is complete, the test ends automatically and the controller display shows “PTI PASSED (or FAILED) - REBOOT”. Turn the On/Off Switch Off and back On to reboot and return the unit to normal operation.
9. If an operating problem occurs during the PTI, view and correct any alarms or messages. Then acknowledge the alarms or messages and repeat the PTI.

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

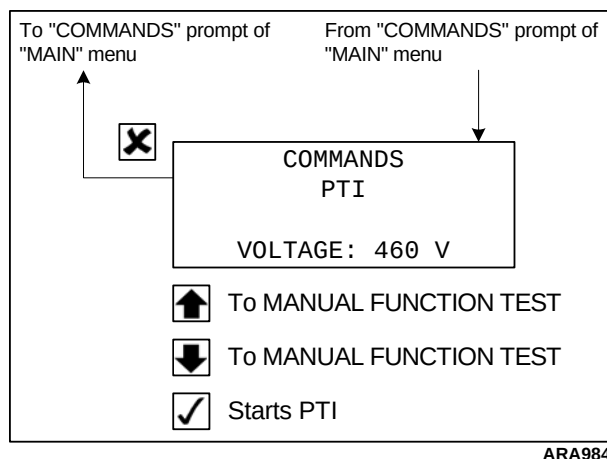


Figure 27: PTI Submenu

Manual Function Test

The Manual Function Test submenu contains the following component tests:

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

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

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

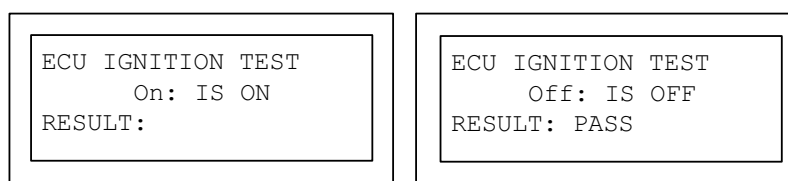
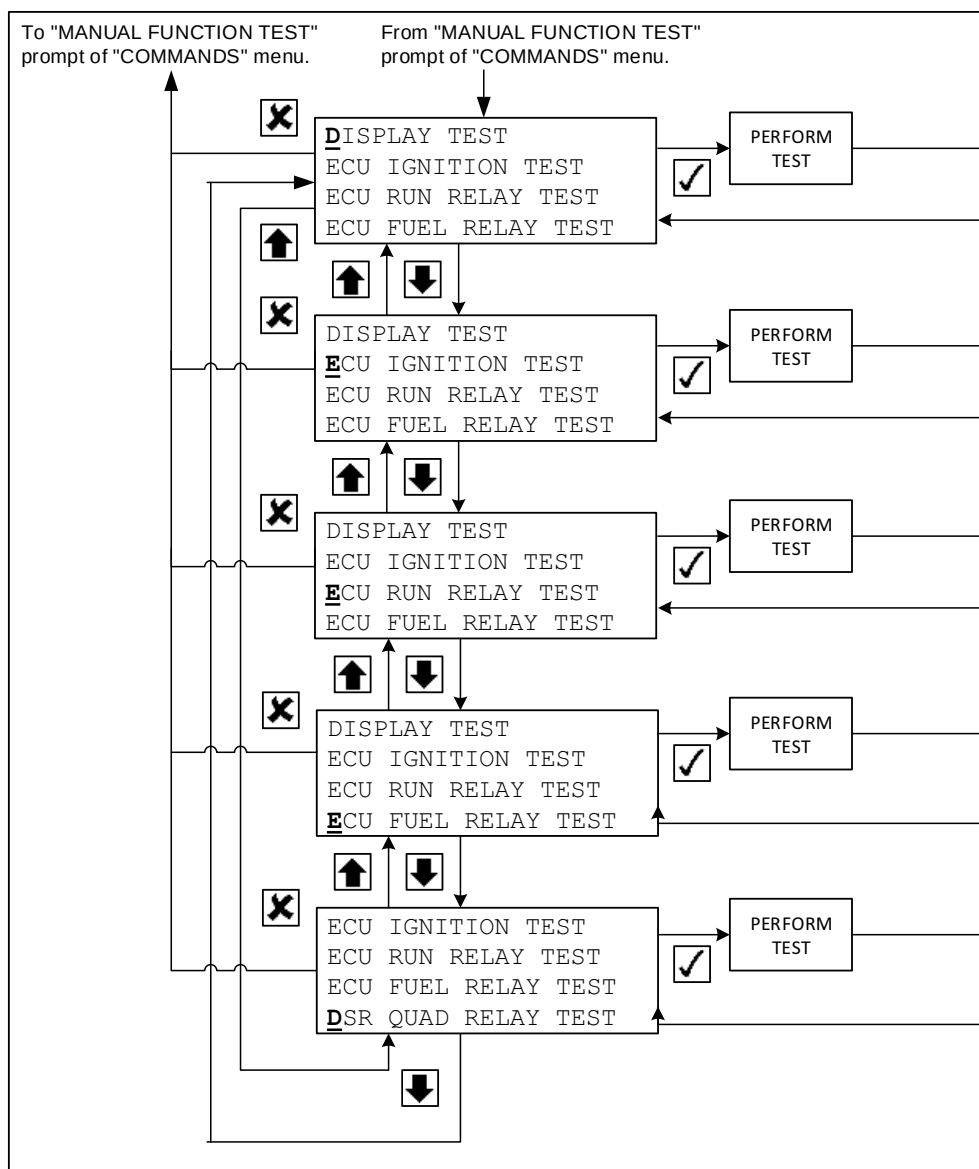


Figure 28: Manual Function Test example



ARA1071

Figure 29: Manual Function Test Submenu

ECU Service Menu

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

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

ECU SERVICE MODE

ENGINE OFF

CONTROLLER ON

ECU ON

The ECU Service Tool is software that is independent of the SG+ Controller and is a program with is opened on your PC. This software tool comes in a Diagnostic kit which is called EXXODiag Diagnostic Tool. See the EXXODiag Diagnostic Tool Manual (which you can find on the help link within the tool itself - see arrow below) on how to install and operate this tool, and “Using EXXODiag to Connect to ECU” on page 102.



Figure 30: EXXODIAG Main Screen

Oil Priming

Oil Priming is used to crank the engine without starting to prime oil galleries. It is typically used when changing the engine oil and oil filter.

System Setup

The System Setup submenu contains the following:

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

To enter the System Setup submenu complete the following steps:

1. Place the On/Off switch in the “ON” position.
2. Press the **ENTER** key or the **ESCAPE** key to enter the Main Menu, if necessary.
3. Press the **UP** or **DOWN** key to scroll up or down through the Main Menu to the Commands Menu.
4. Press the **ENTER** key to enter the Commands Menu.
5. The PTI submenu will be displayed.
6. Press the **UP** or **DOWN** key to scroll up or down through the Commands Menu to the System Setup submenu.
7. Press the **ENTER** key to enter the System Setup submenu.
8. Press the **UP** or **DOWN** key to scroll up or down through the System Setup submenu.
9. Press the **ENTER** key to enter the selected function.

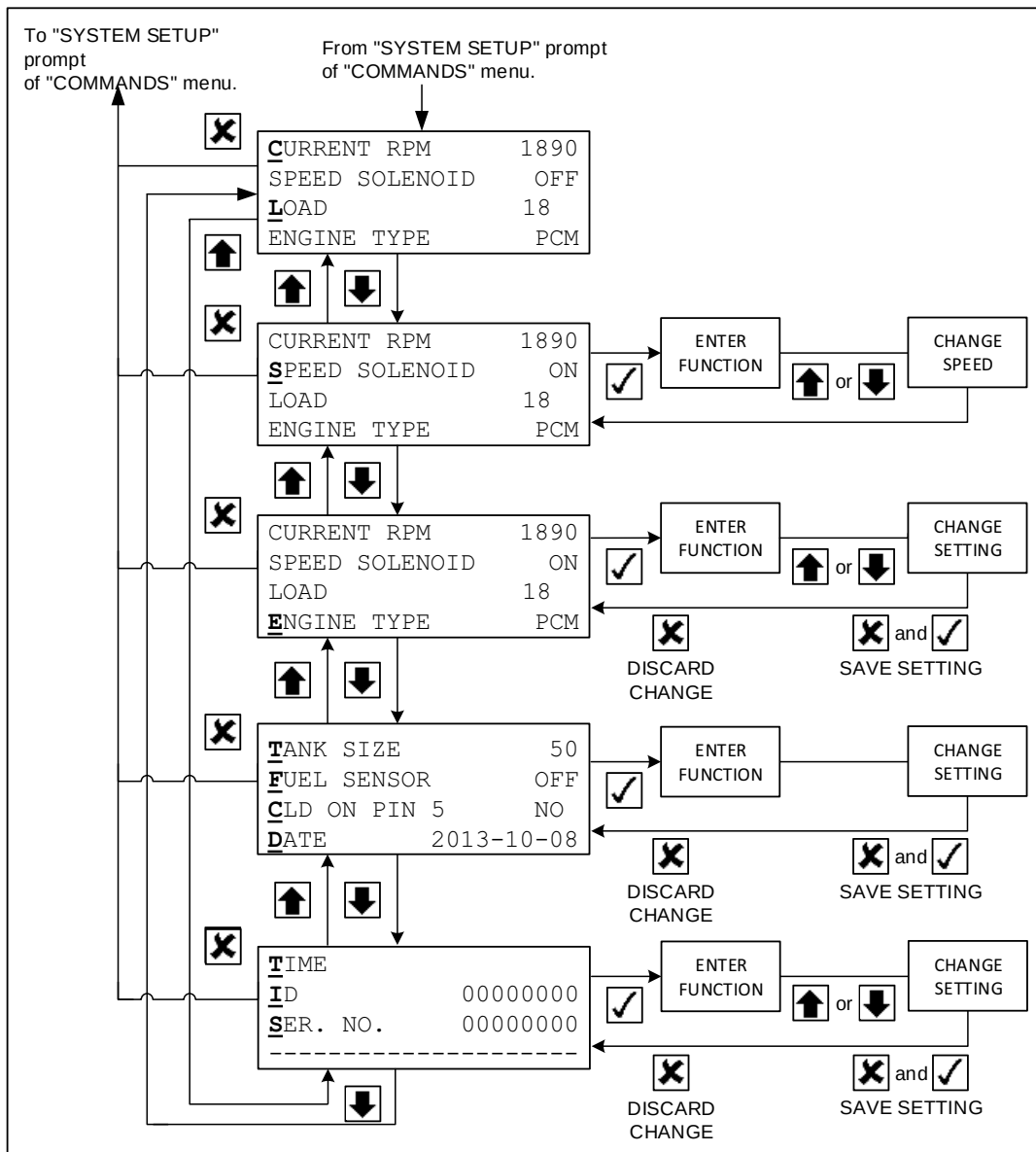
- Press the **UP** or **DOWN** key to change the value of the selected function. See “Misc. Functions Menu” on page 78 for information about setting the date and time.

NOTE: The engine speed will change when the UP or DOWN key is pressed.

- Press the **ESCAPE** key and the **ENTER** key at the same time to save the new Tank Size setting.

NOTE: Press the ESCAPE key to return to the System Setup submenu without saving the new settings.

- Press the **ESCAPE** key to return to the System Setup submenu.



ARA1678

Figure 31: System Setup Submenu

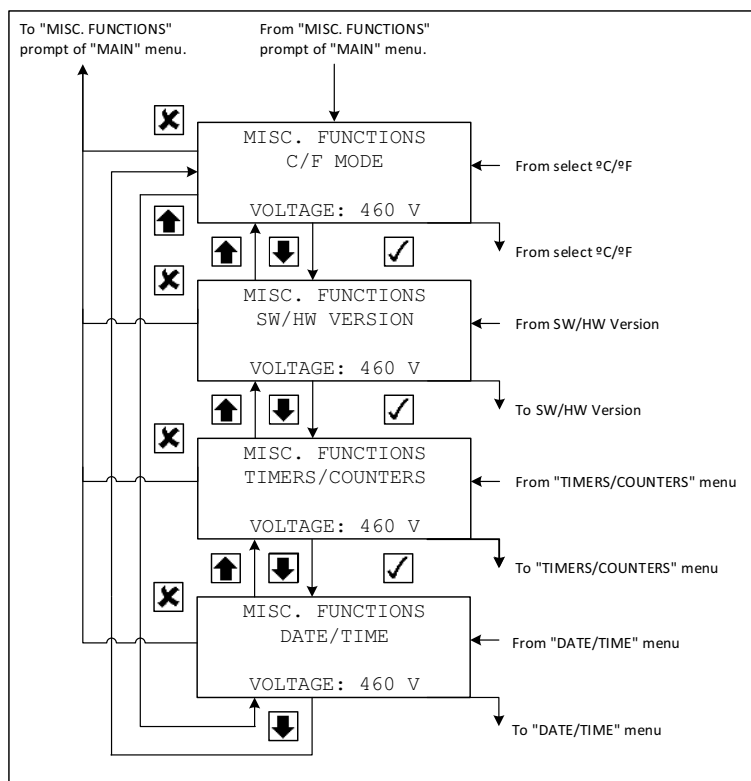
Misc. Functions Menu

The Misc. Functions Menu contains the following submenus:

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

To enter the Misc. Functions complete the following steps:

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



ARA1105

Figure 32: Misc. Functions Menu

C/F Mode

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

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

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

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

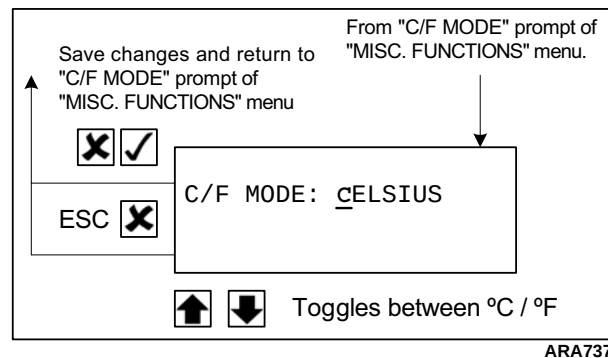


Figure 33: C/F Mode

ARA737

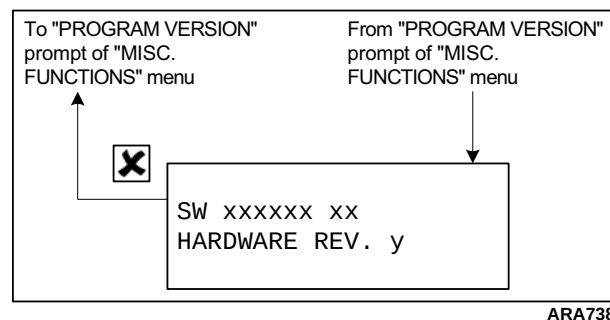
SW/HW Version

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

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

To enter the Program Version submenu complete the following steps:

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



ARA738

Figure 34: SW/HW Version

Timers/Counters

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

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

NOTE: The readings for Run Hours, Run Hours 50 Hz, and Run Hours 60 Hz can be adjusted. See “Setting Hour Meter Thresholds and Resetting Hour Meters” on page 87.

To enter the Timers/Counters submenu complete the following steps:

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



Date/Time

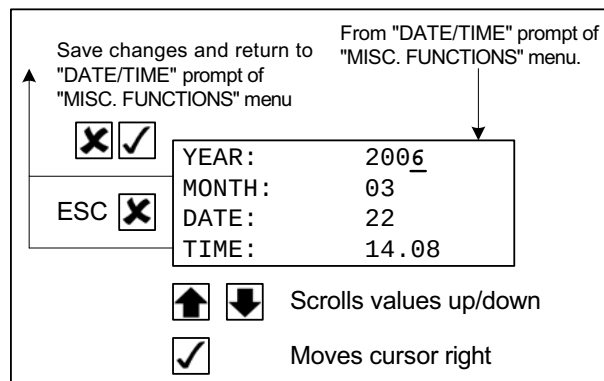
The Date/Time submenu is used to set the clock in the controller. To enter the Date/Time submenu and set the clock complete the following steps:

1. Place the On/Off switch in the "ON" position.
2. Press the **ENTER** key or the **ESCAPE** key to enter the Main Menu, if necessary.
3. Press the **UP** or **DOWN** key to scroll up or down through the Main Menu to the Commands Menu.
4. Press the **ENTER** key to enter the Commands Menu.
5. The PTI submenu will be displayed.
6. Press the **UP** or **DOWN** key to scroll up or down through the Commands Menu to the System Setup submenu.
7. Press the **ENTER** key to enter the System Setup submenu.
8. Press the **UP** or **DOWN** key to scroll up or down through the MISC. FUNCTIONS submenu to the Date/Time submenu.
9. Press the **ENTER** key to enter the Date/Time submenu to set the clock.
10. Press the **ENTER** key to move the cursor (to the right or down at the end of a row) to select the value you want to change.

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

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

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



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Figure 36: Date/Time

Configuration Menu

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

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

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

To enter the Configuration Menu complete the following steps:

1. Place the On/Off switch in the “ON” position.
2. Press the **ENTER** key or the **ESCAPE** key to enter the Main Menu, if necessary.
3. Press the **UP** or **DOWN** key to scroll up or down through the Main Menu to the Configuration Menu.
4. Press the **ENTER** key to enter the Configuration Menu.
5. See “Setting Hour Meter Thresholds and Resetting Hour Meters” on page 87 for an example of how change a setting.

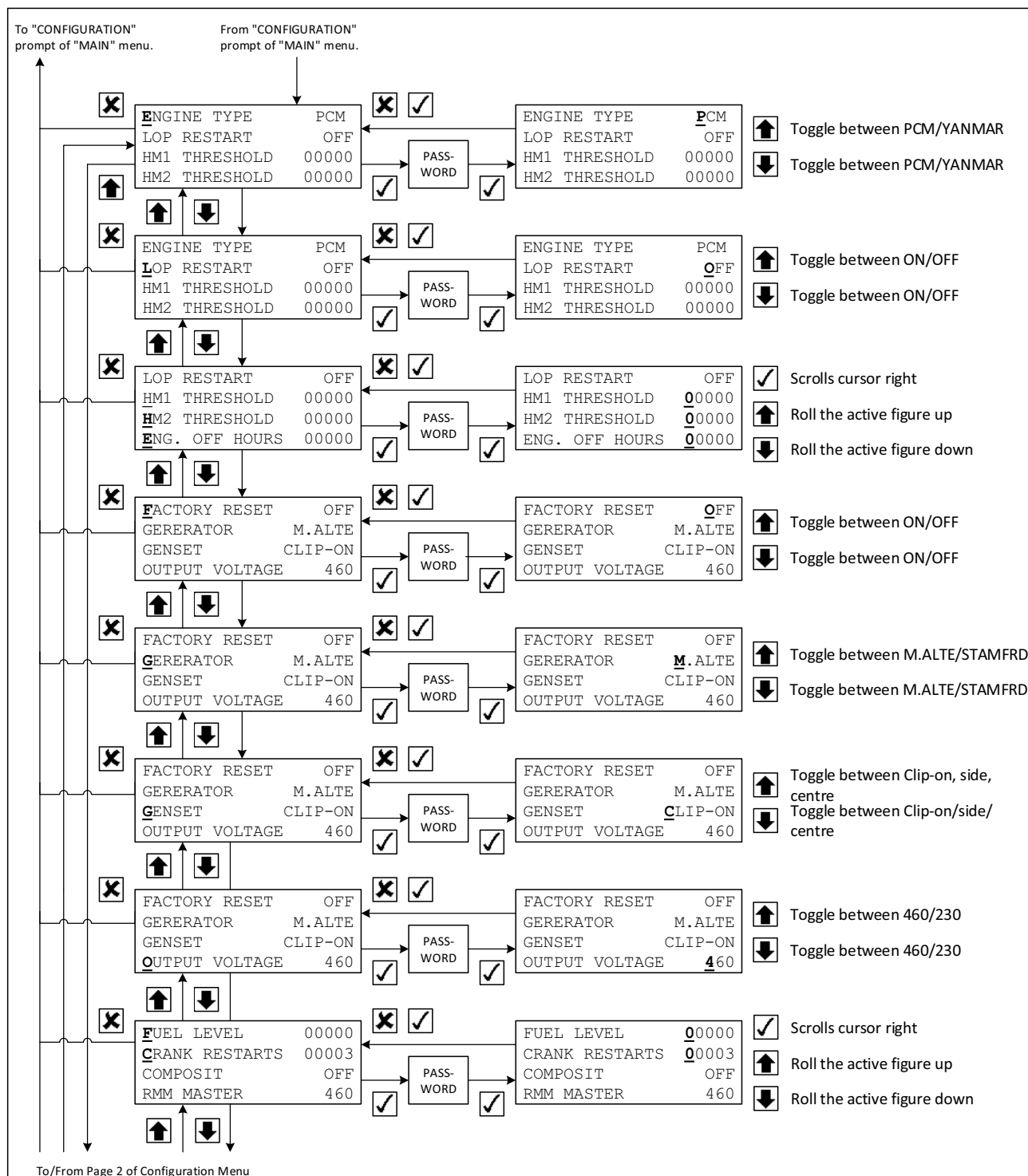
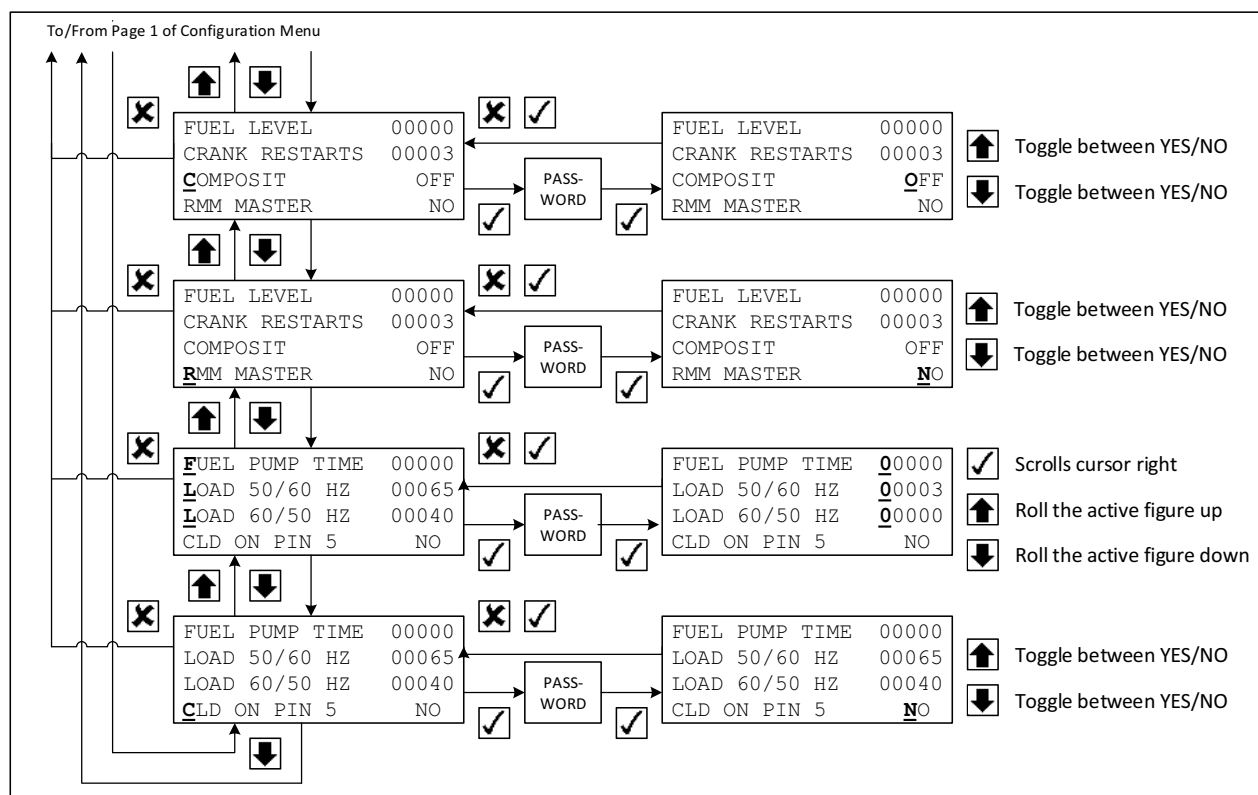


Figure 37: Configuration Menu (Page 1)

ARA1080



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Figure 38: Configuration Menu (Page 2)

Setting Hour Meter Thresholds and Resetting Hour Meters

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

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

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

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

1. Place the On/Off switch in the “ON” position.
2. Press the **ENTER** key or the **ESCAPE** key to enter the Main Menu, if necessary.
3. Press the **UP** or **DOWN** key to scroll up or down through the Main Menu to the Configuration Menu.
4. Press the **ENTER** key to enter the Configuration Menu.
5. The Configuration Menu will be displayed. with the cursor on LOP Restart.
6. Press the **UP** or **DOWN** key to scroll up or down through the Configuration Menu to HM1 Threshold, HM2 Threshold, Run Hours, Run Hours 50 Hz, or Run Hours 60 Hz.
7. Press the **ENTER** key to display the Password screen.
8. Enter the password, which is 0007. To enter the password press the **ENTER** key to move the cursor to the last value and press the **UP** or **DOWN** key to scroll the value to 7. Press the **ESCAPE** key and the **ENTER** key at the same time to enter the password.
9. The cursor will be under the H of the HM1 or HM2 Threshold selection, or under the R of the Run Hours, Run Hours 50 Hz or Run Hours 60 Hz selection.
10. Press the **ENTER** key to move the cursor to select the value you want to change.

NOTE: *For example, to change the setting for the HM1 Threshold to 400 hours, press the **ENTER** key until the cursor is under the third digit from the right. Then press the **UP** key until that value reads 4.*

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

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

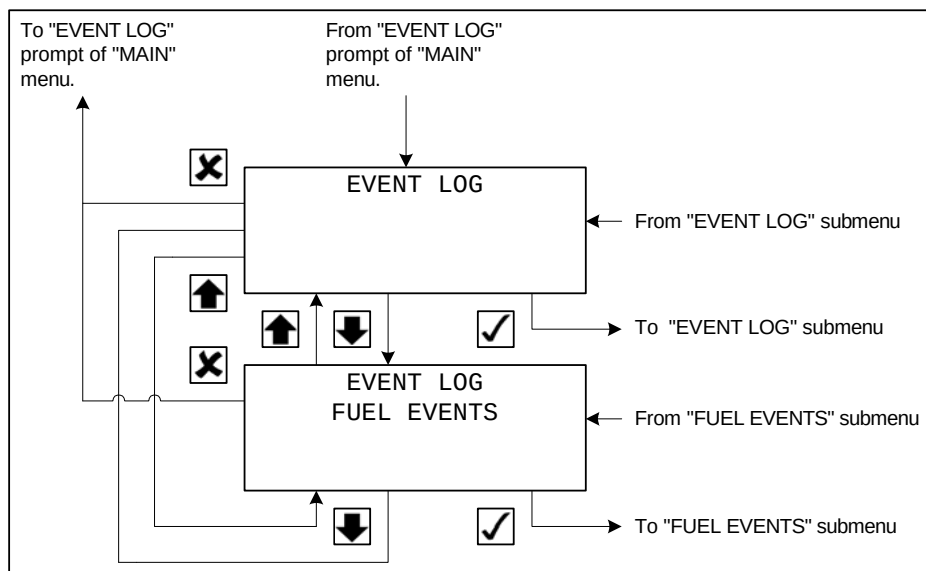
Event Log Menu

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

- Event Log
- Fuel Events

To enter the Event Log Menu complete the following steps:

1. Place the On/Off switch in the “ON” position.
2. Press the **ENTER** key or the **ESCAPE** key to enter the Main Menu, if necessary.
3. Press the **UP** or **DOWN** key to scroll up or down through the Main Menu to the Event Log Menu.
4. Press the **ENTER** key to enter the Event Log Menu.
5. The Event Log submenu will be displayed.
 - Press the **ENTER** key to enter the Event Log submenu.
 - Press the **UP** or **DOWN** key to scroll up or down to the Fuel Events submenu.
 - Press the **ESCAPE** key to return to the Main Menu.



ARA1075

Figure 39: Event Log Menu

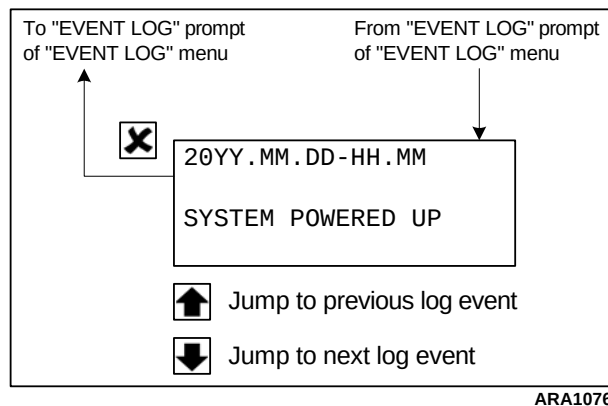
Event Log

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

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

To enter the Event Log submenu complete the following steps:

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



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Figure 40: Event Log Submenu

Fuel Events

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

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

To enter the Fuel Events submenu complete the following steps:

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

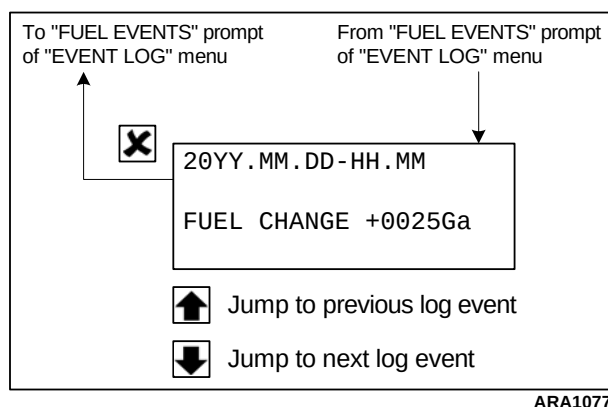


Figure 41: Fuel Events Submenu

ARA1077

LogView and Viewing SG+ Logs

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

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

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

NOTE: Logman II PC Rev. 2.5.0 (or later) is required to flashload software or to download the data logger.

Event Description

Data	ID / Code	Description
Alarm	Alarm Code	An alarm is activated, see "Alarm List" on page 63 for alarm descriptions
Message	Message code	A message is activated, see "Message List" on page 66 for message descriptions
Engine	Shutdown alarm	If an alarm is active and entering shutdown state
	Engine running	The engine is running
	Restart engine	Restart sequence started
Pre trip	PTI started	PTI start event
	PTI failed	PTI failed
	PTI OK	PTI completed
Configuration	Factory reset	Factory reset initiated by user
	Clock set	Time and date adjusted
Power	Power off	Time and date for controller power off
	Power on	Time and date for controller power on
Log retrieved	Log retrieved	The event log is retrieved from the unit
Speed	High to low speed - was XXX RPM	RPM above shift point
	Low to high speed - was XXX RPM	RPM below shift point
	Low to high speed RPM below limit	RPM below 1500 RPM
	High to low speed MAGNUM unit detected	A TK MAGNUM unit is detected
	Low to high speed compressor start detected	Reefer unit controller is resetting
	Low to high speed water temperature to high Water temperature XXX	If water temperature is above 5 C below alarm high limit
	Failed to detect speed solenoid	This event is set in the state "LOAD MEAS" if it fails to detect the speed change
Fuel	Positive change from X.X to X.X Ga Change in level; +X.X Ga	Positive fuel change detected
	Negative change from X.X to X.X Ga Change in level; - X.X Ga	Negative fuel change detected
System	Flashload completed OLD: XXX to NEW: XXX	A new version of the application is loaded

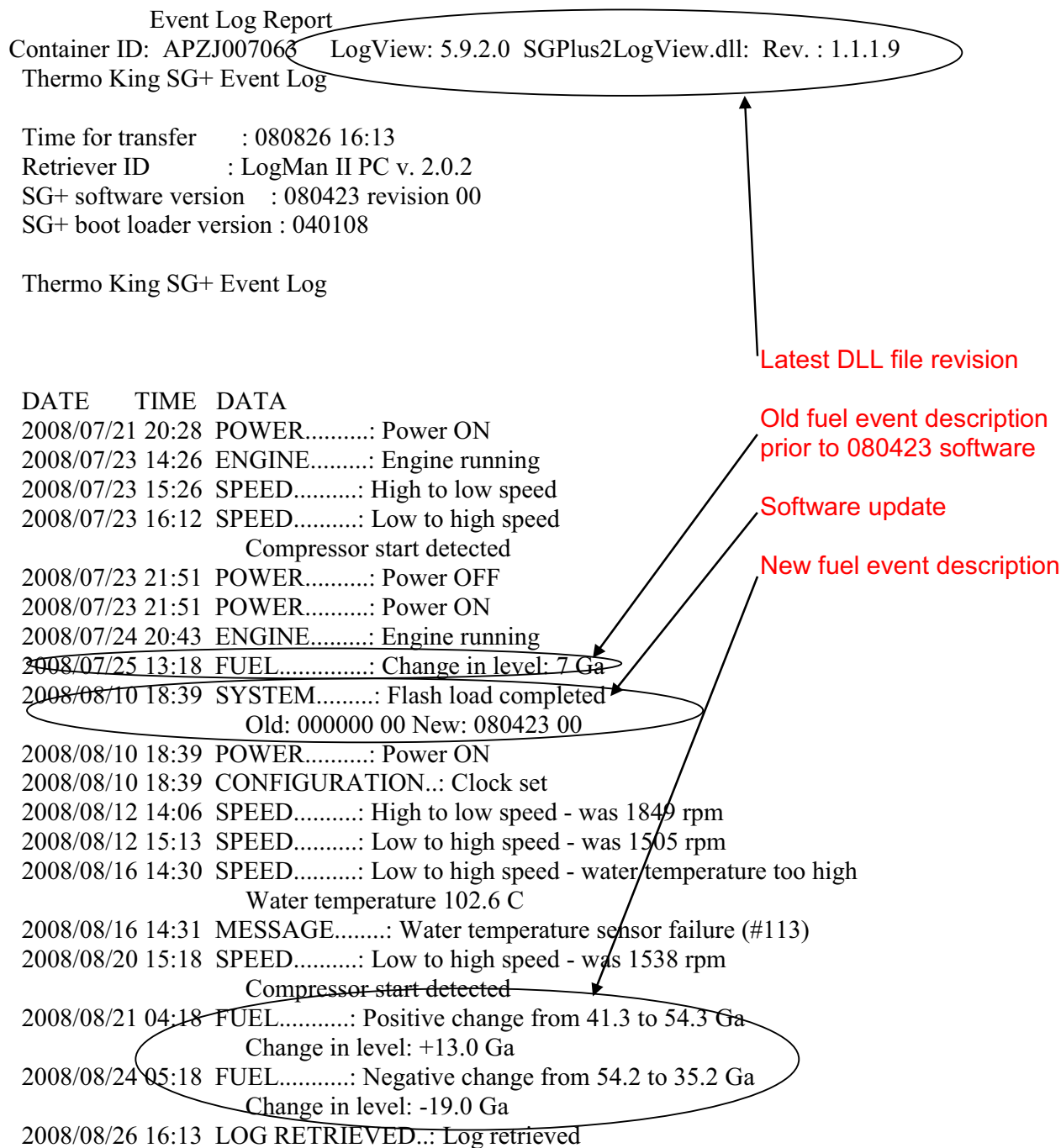


Figure 42: Example of SG+ Log

ARA1663

Electrical Maintenance

Battery

CAUTION: Place the Unit On/Off switch in the “OFF” position, Before connecting or disconnecting the unit battery.

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

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

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

Relays

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

Ignition Relay

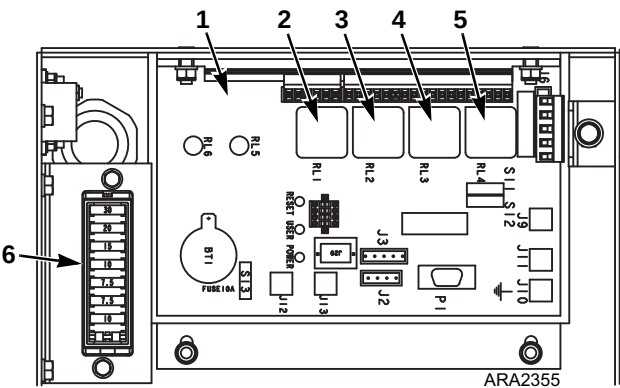
The Ignition relay (RL1) is located on the PC board. It supplies power to the ECU. The RL1 LED on the PC board will light up when the Ignition relay is energized.

Run Relay

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

Fuel Pump Relay

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



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

Figure 43: Components Inside Control Box

Start Relay

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

Preheat Relay

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

ECU Fuses

Several ECU fuses are located inside of the control box. See the unit wiring and schematic diagrams for the size and function of these fuses.

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.

12 Vdc Charging System

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

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

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

Engine Low Oil Pressure Switch

Engine oil pressure should rise immediately on starting. This causes the oil pressure switch to open. If the oil pressure drops below 117 ± 21 kPa (1.17 ± 0.21 bar) (17 ± 3 psi), 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:

1. Remove wire OPS 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.

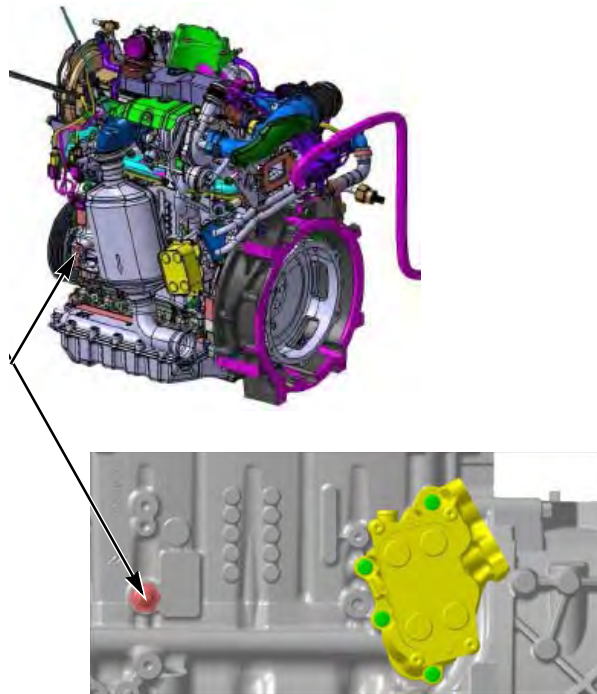


Figure 44: Engine Oil Pressure Switch

Oil Level Sensor

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

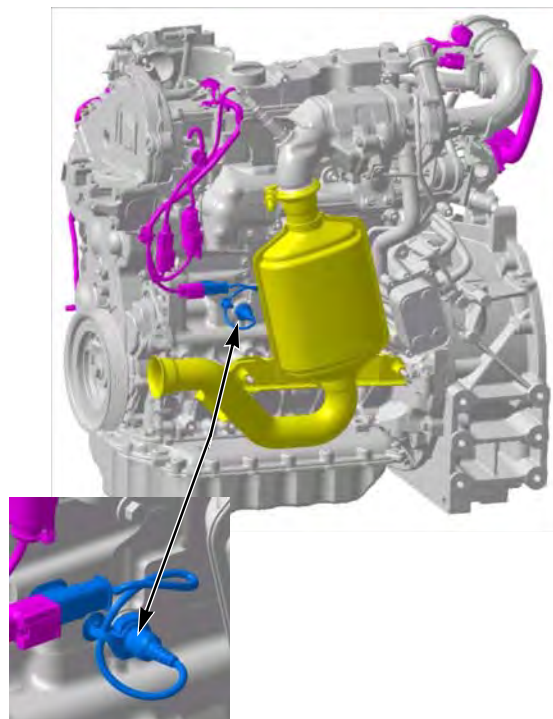


Figure 45: Oil Level Sensor

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 CH wires and there are no short circuits in the wires.

Switch Removal and Installation

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

Bench Test

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

Coolant Temperature Sensor

The coolant temperature sensor is connected to the engine coolant system near the water pump. It uses coolant temperature to present a variable resistance to the ECU. Test the coolant temperature sensor if the controller records Alarm Code 18 or 41 and the coolant temperature appears to be normal.

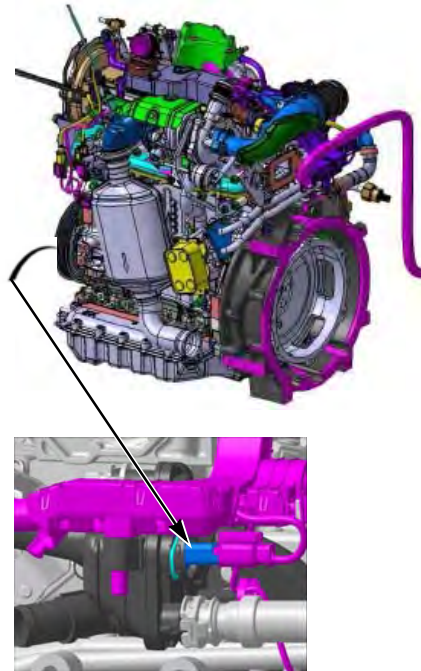


Figure 46: Coolant Temperature Sensor

Sensor Test

1. Turn the unit On/Off switch to the “OFF” position.
2. Disconnect the sensor at the plug next to the sensor.
3. Turn the unit On/Off switch “ON”.

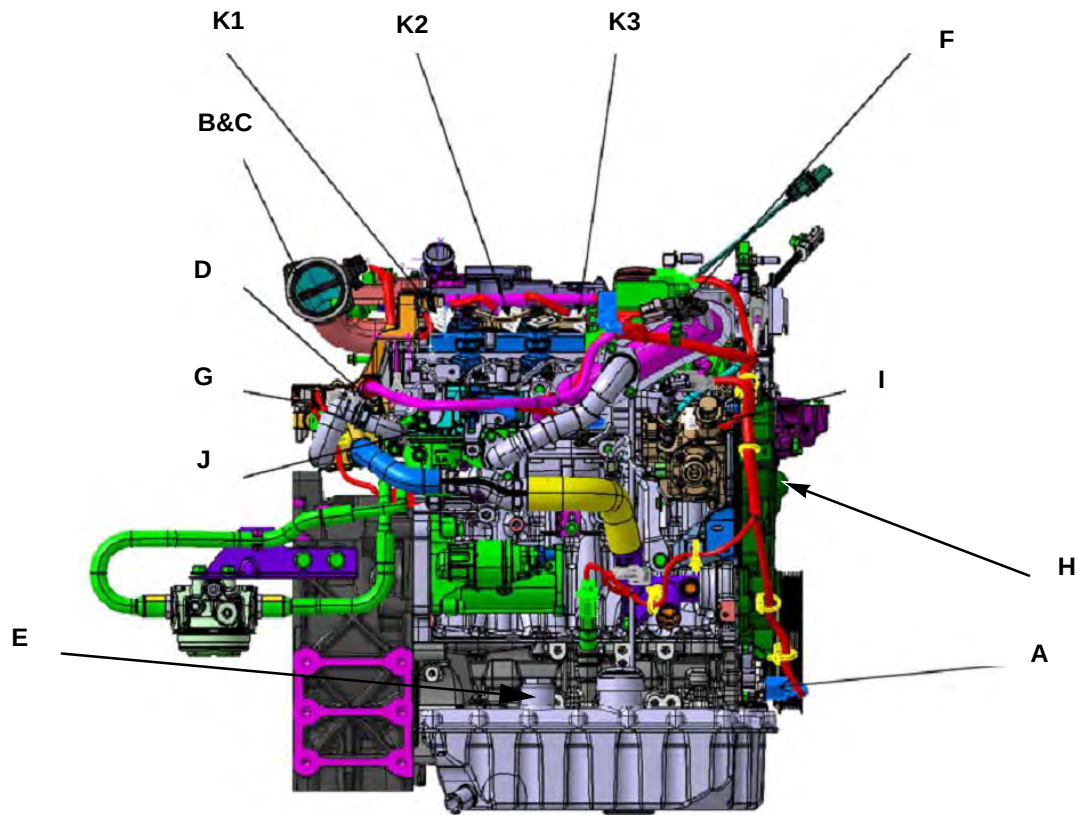
NOTE: *Polarity must be considered when connecting temperature sensors. If a sensor is connected backwards, the display will show a reading below -40 C (-40 F) or above 130 C (266 F) and record Alarm Code 101. Consult the unit wiring diagram or schematic for correct connections.*

4. Enter the Engine submenu of the Data Menu and scroll to the engine temperature screen. If the display shows a reading below -40 C (-40 F) or above 130 C (266 F) check the sensor wiring, the sensor polarity.

Engine Maintenance

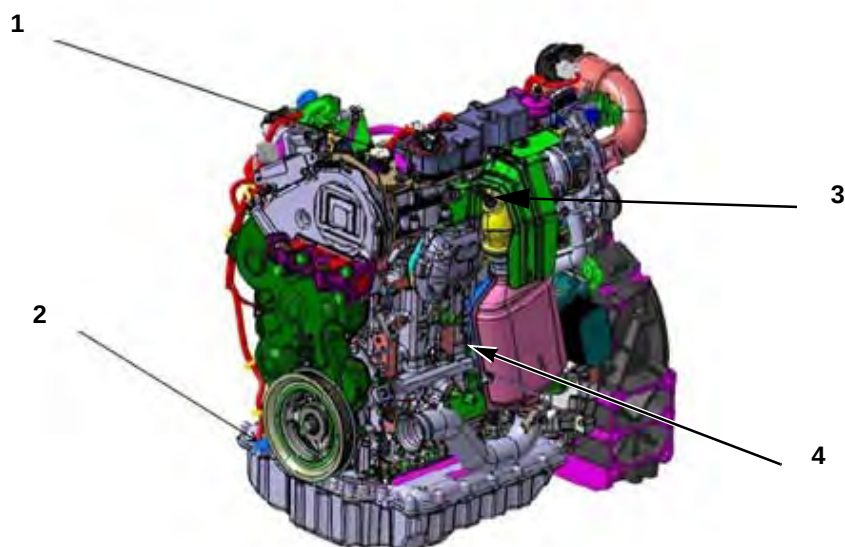
DV6NR Diesel Engine

This unit uses a new engine called the DV6NR. Common Rail fuel injection system, which used electronically controlled fuel injectors to reduce emissions. An EGR (Exhaust Gas Recirculation) system and DOC (Diesel Oxidation Catalyst) exhaust after-treatment system and turbocharger also reduce emissions so the engine is EPA Tier 4 compliant. An ECU (Engine Control Unit) monitors and controls engine operation. The unit controller indirectly monitors and controls the engine through the ECU.



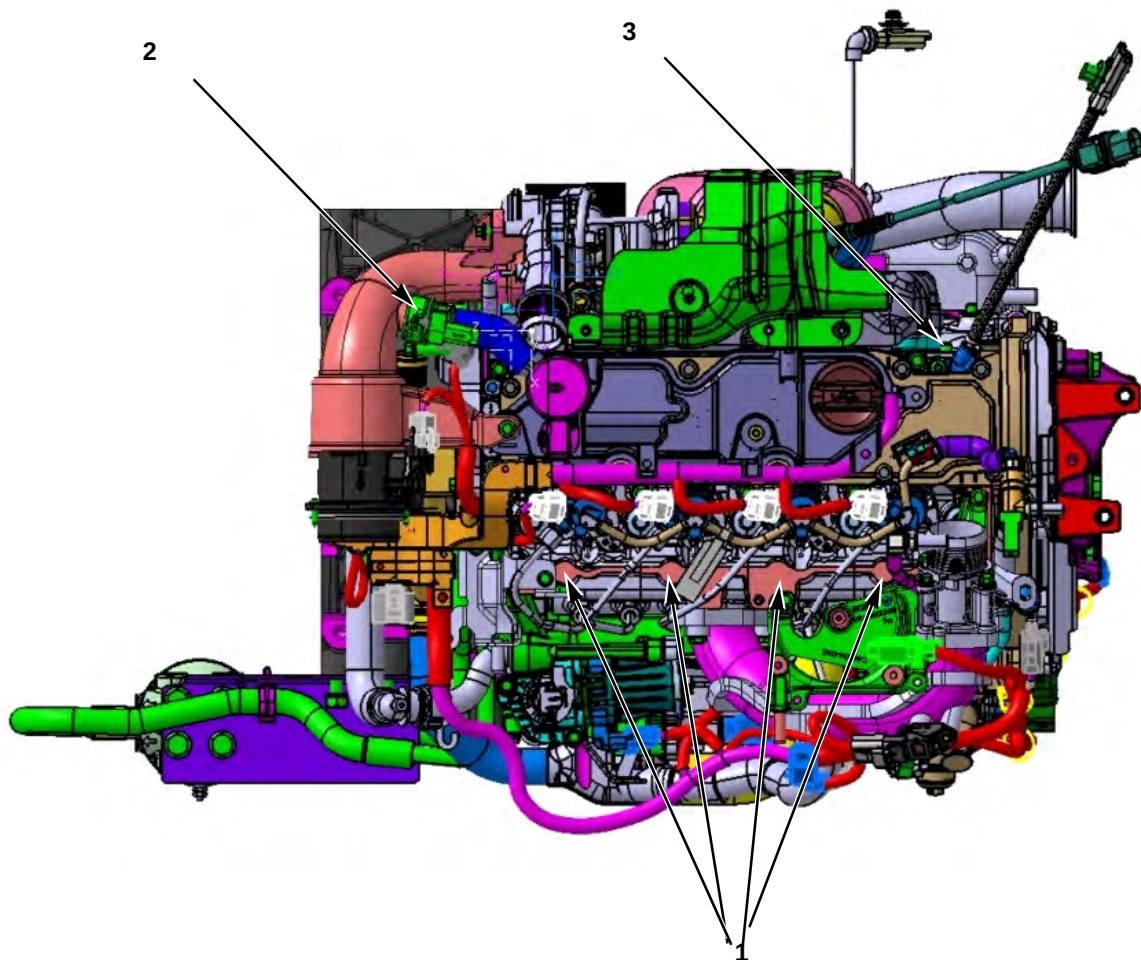
A.	Crankshaft Speed Sensor
B&C	Ambient Air Temperature Sensor & Flowmeter
D	Fuel rail pressure sensor
E	Oil Level Sensor
F	Air Boost Temperature Sensor
G	Coolant Temperature Sensor
H	Fuel Temperature Sensor
I	Fuel Metering Unit
J	EGR Valve actuator
K	Injector Cylinders 1, 2 & 3

Figure 47: DV6NR Sensors and Actuators



1.	Injector Cylinder 4
2.	Crankshaft Speed Sensor
3.	Oxygen Sensor
4.	Oil Pressure Switch

Figure 48: DV6NR Sensors & Actuators for the non-service view, or exhaust side



1.	Glow Plugs
2.	Oil Breather Heater
3.	Camshaft Position Sensor

Figure 49: DV6NR Sensors & Actuators Rear View

CAUTION: Anytime engine power pack is removed from the frame, **DO NOT** sit engine on ground without supporting engine on green highlight areas. If engine is sat on the ground without support, damage will occur to the pan and oil pump.

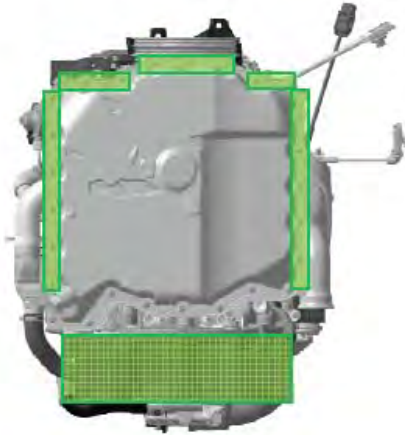


Figure 50: DV6NR Under Engine View

DV6NR Engine Service

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

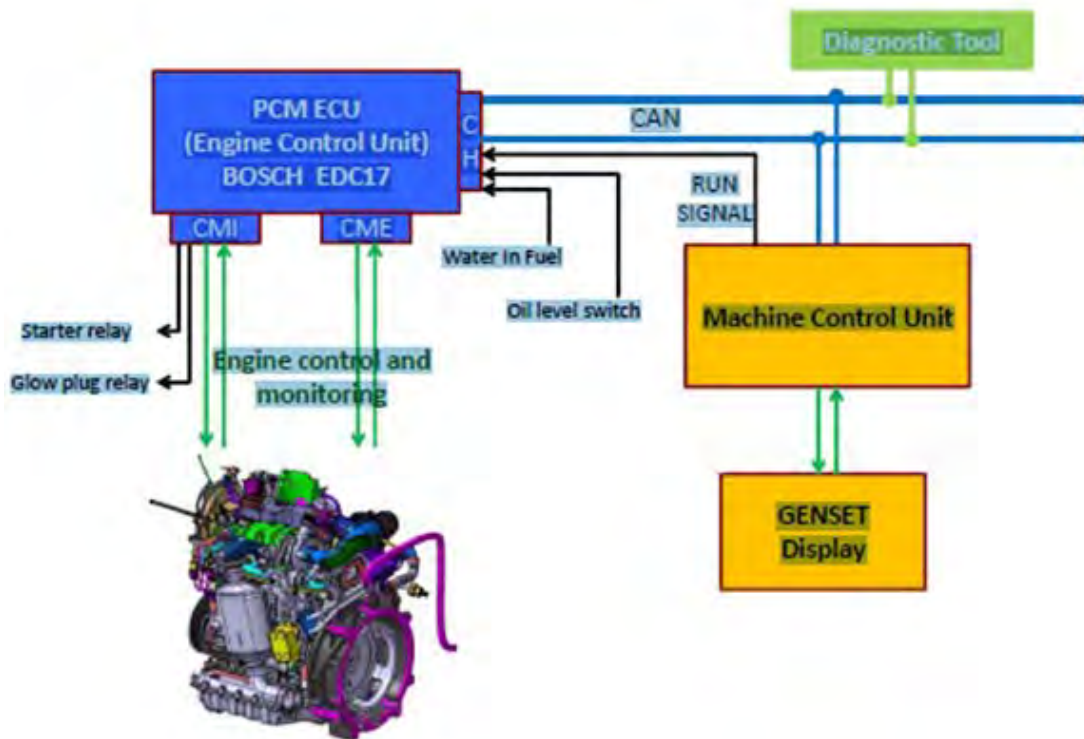


Figure 51: ECU Interfaces (except Power)

Using EXXODiag to Connect to ECU

The EXXODiag Diagnostic Tool is used to connect the PC Computer USB Port to the ECU. An EXXODiag Diagnostic Tool connector is located in the unit Control Box. Peugeot EXXODiag Diagnostic Software installed on the PC Computer is used to communicate with the ECU. This allows ECU information to be retrieved, DTCs to be read, operational data to be examined and updated, and other diagnostic functions to be performed. The EXXODiag Diagnostic Tool (P/N 204-1993 or P/N 204-1996) consists of the EXXODiag Interface Module, a standard Micro USB to USB cable, a storage box and instructions.



Figure 52: EXXODiag Diagnostic Tool (P/N 204-1993 or P/N 204-1996)

Procedure

1. The unit battery must be connected and the Unit On/Off Switch must be turned on.
2. Turn the unit on and enter the Commands Menu.
3. In the Maintenance Menu, scroll down to and enter the ECU Service Menu.



Figure 53: EXXODiag Diagnostic Tool Interface Module and Micro USB to USB Cable

4. Open the control box and locate the EXXODiag Diagnostic Harness and Connector (OBD Port). It is an open 16-pin connector on the ECU harness, which is black.



Figure 54: EXXODiag Connector

5. Remove the connector dust cover and connect the EXXODiag Diagnostic Tool Interface Module to the EXXODiag Connector in the unit Control Box as shown below.



Figure 55: Connect EXXODiag Diagnostic Tool Interface Module to EXXODiag Connector

6. Connect the EXXODiag Diagnostic Tool Interface Module to the PC Computer using the supplied standard Micro USB to USB cable.
7. Start the EXXODiag software.
8. The EXXODiag Main Menu will appear. Click on DIAGNOSTIC as shown below.

NOTE: *If an update version of EXXODiag software is available a notification will be shown at the bottom of the display as shown below.*



Figure 56: EXXODiag Main Menu

9. The Diagnostic Validation screen will appear. Complete the required fields. When all fields have been completed, the VALIDATE Button will become active. Click VALIDATE to continue.

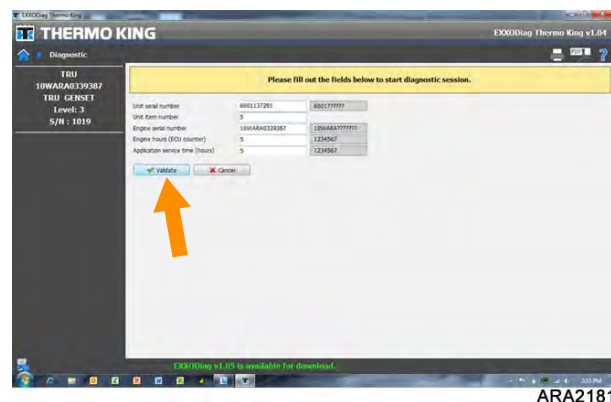


Figure 57: EXXODiag Diagnostic Validation Screen

10. The Diagnostic Menu will appear. To display the DTCs, click READING OF TROUBLE CODES.

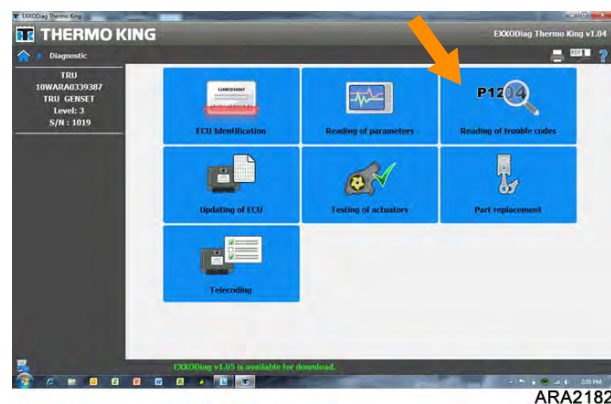


Figure 58: EXXODiag Diagnostic Menu

11. You can now use the EXXODiag to view the DTCs and diagnose the problem.

Creating and Sending Repair Reports

Use the following procedure to create and send a repair report whenever new DTCs are recorded.

1. Use the above procedure to connect EXXODiag to the unit and enter the Diagnostic Menu.
2. Click READING OF TROUBLE CODES on the Diagnostic Menu.

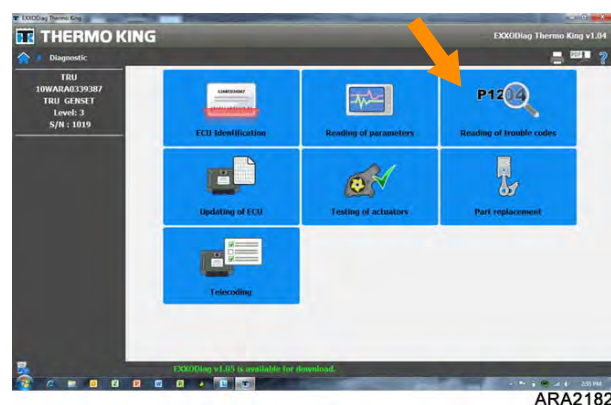


Figure 59: Click Reading of Trouble Codes

3. The screen will display the DTCs in the memory (if any).
4. Click HOME.

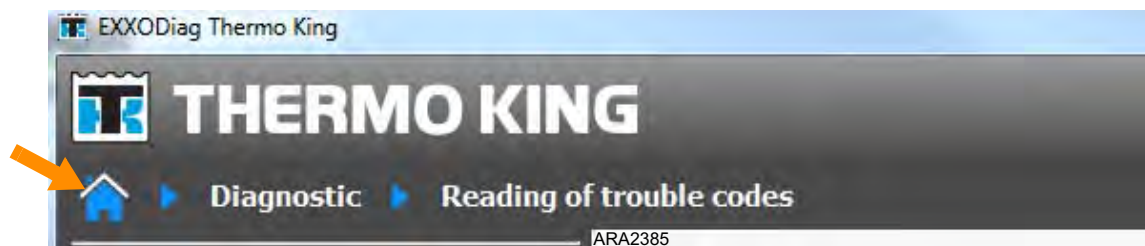


Figure 60: Click Home

5. The following pop-up screen will appear. Click YES.

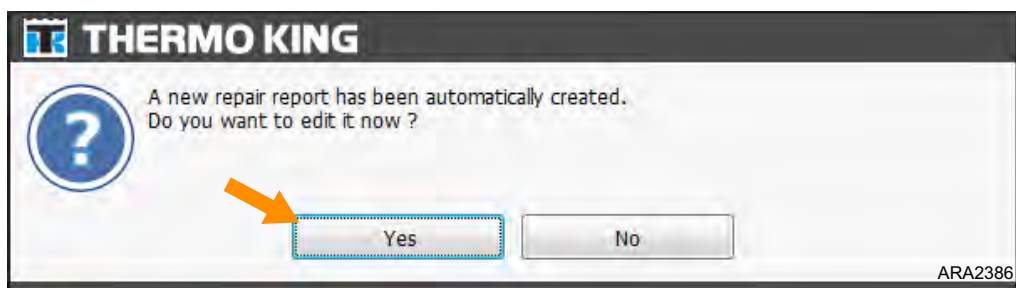


Figure 61: Click Yes

6. The following screen will appear. Fill out the form and click CLOSE THE REPORT.

Repair report n°: R38B54D73_1057

Please, fill out the fields below to close the report.

Repair report n°: R38B54D73_1057

Dealer's ID
 Name: Address:
 Email:
 Phone number: TK reference:

2. Machine's ID (1/2)
 Machine type: ☒ TRU ☐ GSU ☐ GSC
 Unit serial number:
 Unit item number:
 In-service date:
 Diagnostic tool's number:

2. Machine's ID (2/2)
 Engine serial number:
 Engine hours (ECU counter):
 Hardware reference:
 Software reference:
 Calibration number:

Fault description

Functioning impacts

☐ Engine doesn't start ☐ Don't go to highspeed
☐ Difficult start ☐ Abnormal engine noise
☐ Engine stalling ☐ Whistling noise
☐ Unstable RPM ☐ Abnormal smoke
☐ Engine jerks ☐ Engine coolant leakage
☐ Lack of power ☐ Engine oil leakage

Fault detection conditions

☐ At engine start ☐ Hot engine start (>60°C)
☐ At engine stop ☐ Warm ambient conditions
☐ At key switch OFF ☐ RPM 1250
☐ At key switch ON ☐ RPM 2050
☐ At cold start ☐ Partial load
☐ Engine warm up ☐ Full load

Replaced parts
 Please, fill in with each replaced part and its reference.

Miscellaneous
 Please, fill in with any useful comment describing fault, root cause, operating mode, troubleshooting method...

Figure 62: Fill Out Form and Click Close the Report

7. The following pop-up screen will appear. Click YES.

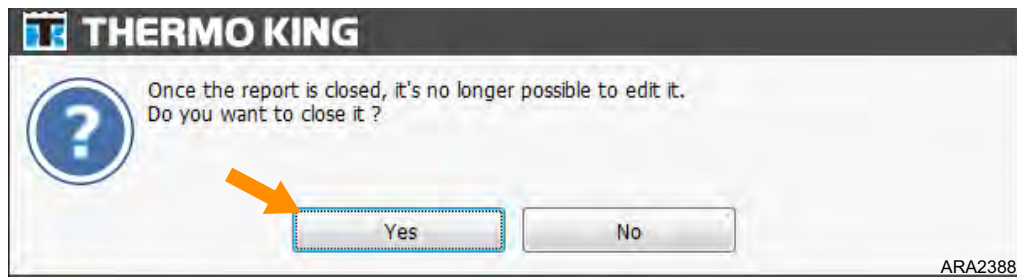


Figure 63: Click Yes

8. If the lap top is connected to the web, it will automatically send the report.

Otherwise, once the lap top is connected to the web; (no need to be connected to the unit anymore) click SYNCHRONIZATION from the Main Menu.



Figure 64: Click Synchronization

9. The following screen will appear. Click SYNCHRONIZE.

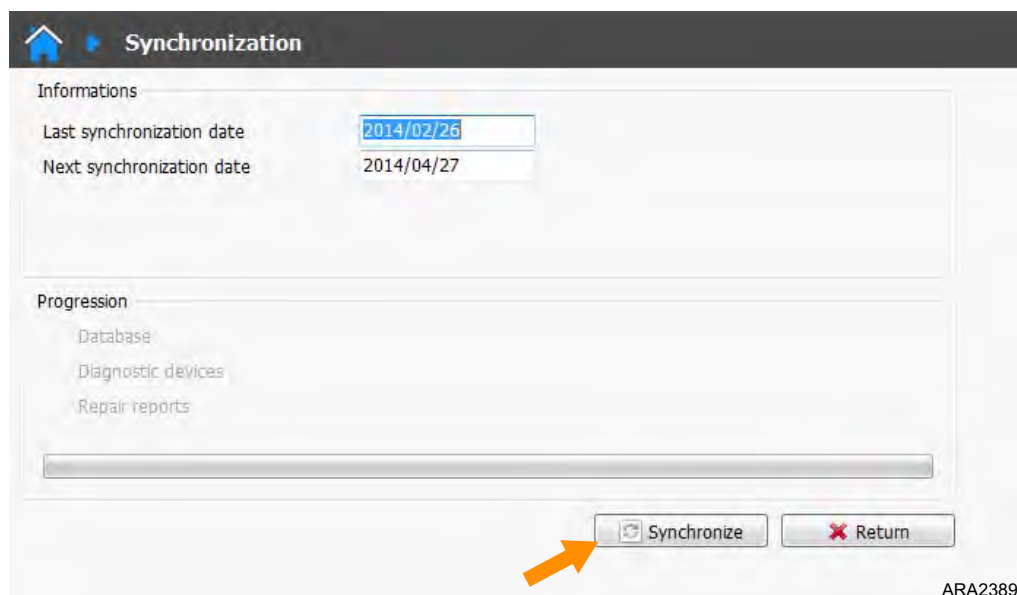


Figure 65: Click Synchronize

10. Check that the Synchronization is successful. If not, check the connection and the tools settings.

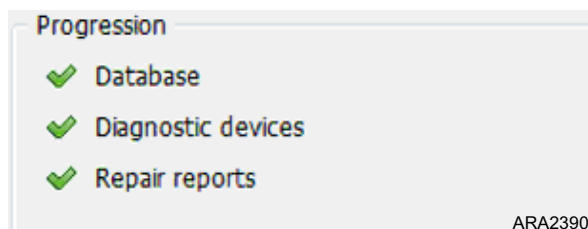


Figure 66: Synchronization Successful

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 Rating CJ-4 Mineral Oil.
- Five Year or 12,000 Hour ELC (Extended Life Coolant).

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 Genset units.

Engine Lubrication System

The DV6NR engine use a pressure lubrication system.

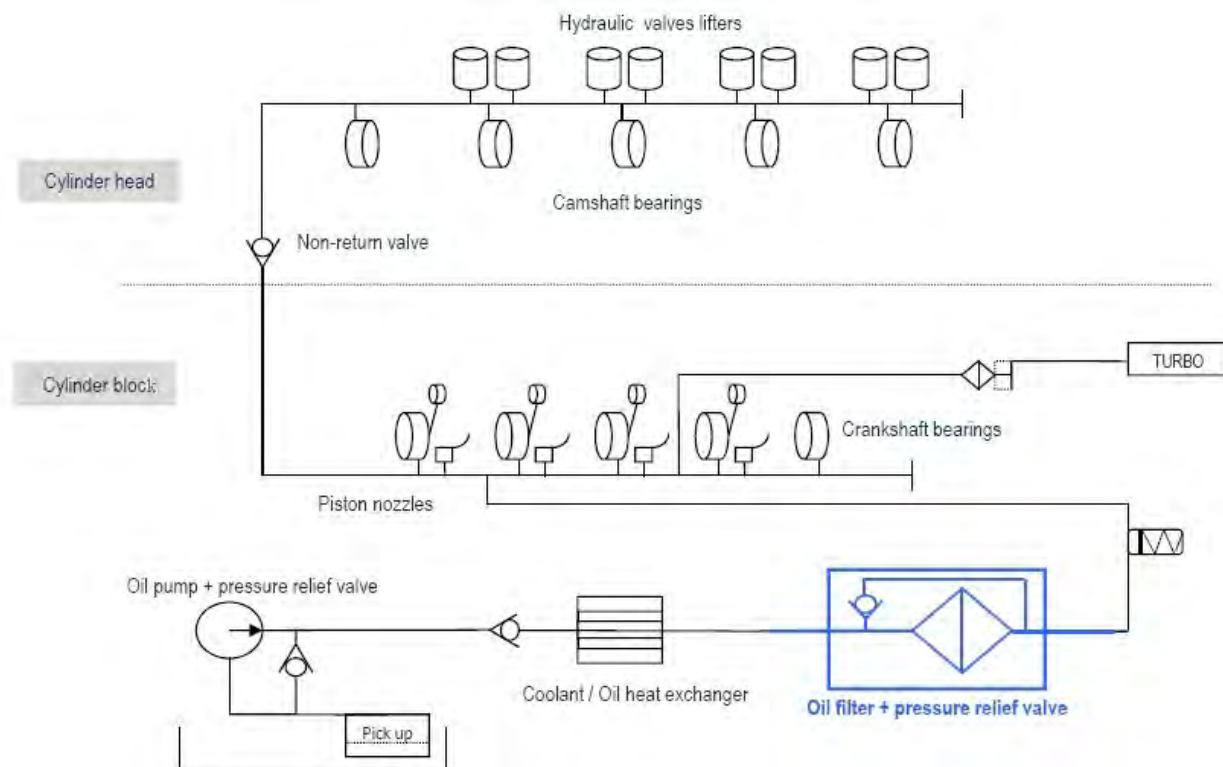


Figure 67: Oil Circuit Diagram

Engine Oil Change

The engine oil should be changed according to the Maintenance Inspection Schedule. Drain the oil only when the engine is hot to ensure that all the oil drains out. When changing oil, keep unit and Genset level so all the oil can flow from the oil pan. It is important to get as much of the oil out as possible because most of the dirt particles are contained in the last few quarts of oil that drain out of the pan. Refill the pan with oil and check the dipstick level. Because the new oil filter must also be filled with oil before it is installed, use a total of approximately 12.4 quarts (11.7 liters) to fill the oil filter and refill the pan. Run the unit, and then recheck the oil level. The engine oil level should be at the FULL mark with the dipstick turned (threaded) into the oil pan. Never overfill.

NOTE: If filling or adding oil from the valve cover, allow time for oil to migrate down to pan before checking level. See Specifications Chapter for correct type of oil.

Oil Filter Change

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

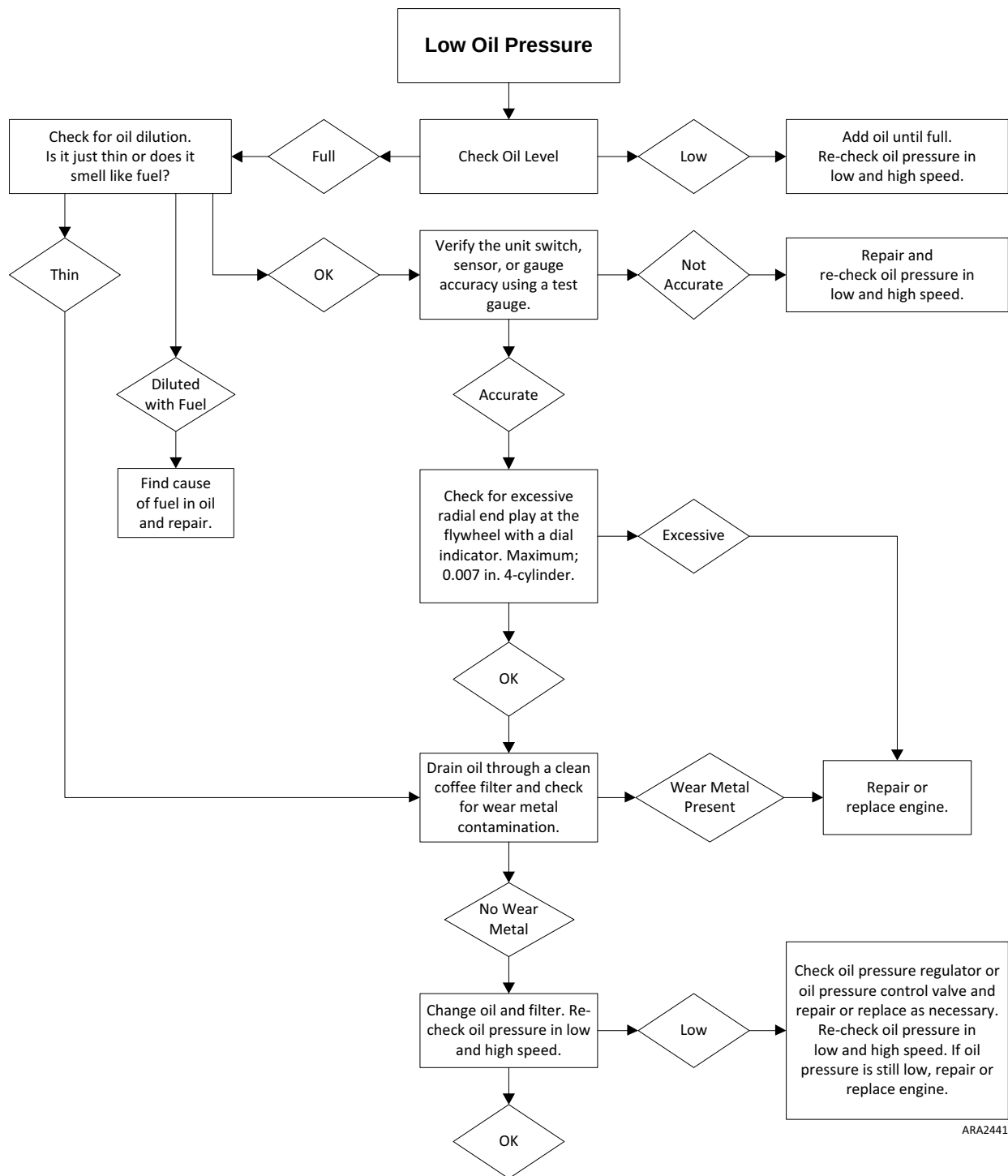
1. Remove the filter.
2. Apply oil to the two inner O-rings of the new filter
3. Fill filter with clean engine oil before installing filter.
4. Install the filter.

5. Hand tighten the filter until it seats firmly. The exposed dust seal ring, if equipped, does not need to be compressed.
6. Turn on the controller and go the Commands Menu and perform OIL PRIMING. Start genset 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” on the following page to help diagnose low oil pressure.

Low Oil Pressure Flow Chart



ARA2441

Engine Cooling System

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

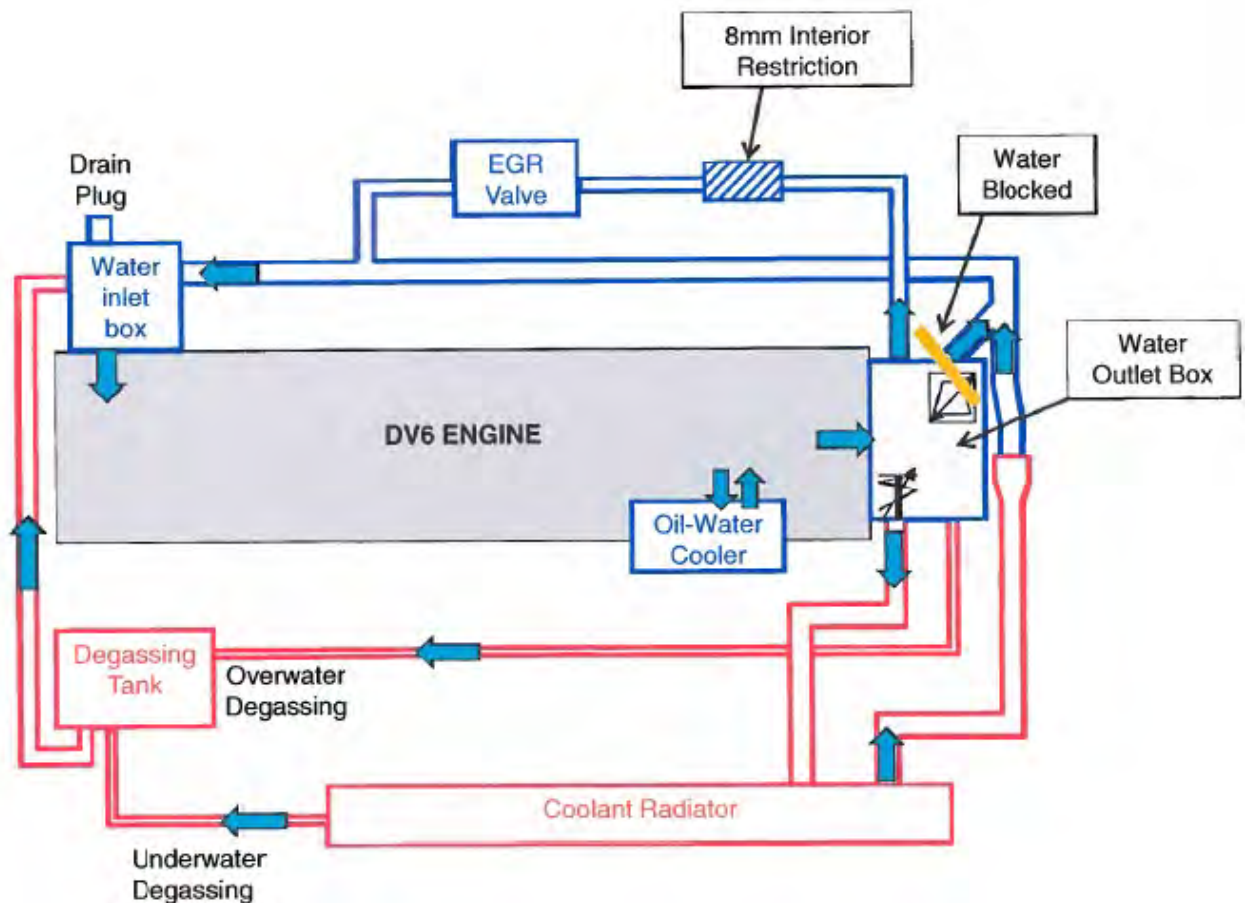


Figure 68: Cooling Circuit Diagram

ELC (Extended Life Coolant)

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



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

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

Antifreeze Maintenance Procedure

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

Do not mix green or blue-green engine coolant with ELC (red) engine coolant. See “ELC (Extended Life Coolant)” on page 112 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.
2. Open the engine block drain (located off water intake tube) and completely drain the coolant. Observe the coolant color. If the coolant is dirty, proceed with a, b, and c. Otherwise go to 3.



CAUTION: Avoid direct contact with hot coolant.

- 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.
- c. Open the engine block drain to drain the water and flushing solution.



CAUTION: Avoid direct contact with hot coolant.

3. Run clear water into the radiator, and allow it to drain out of the block until it is clear.
4. Inspect all hoses for deterioration and hose clamp tightness. Replace if necessary.
5. Inspect the radiator cap. Replace the cap if the gasket shows any signs of deterioration.
6. If using ELC concentrate, mix one gallon of ELC concentrate and one gallon of de-ionized or distilled water in a container to make a 50/50 mixture. (Do not add antifreeze and then add 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 make sure to bleed the air from the cooling system as needed.

Bleeding Air from the Cooling System

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



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

NOTE: 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. Slowly pour the coolant into the expansion tank until it appears to be full.
2. Make sure 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.
3. Start the engine. Monitor the coolant temperature with the unit engine coolant temperature gauge, or by using a non-contact thermometer pointed at the thermostat housing in the location of the high water temperature switch or sensor. When the temperature reaches 150 F (66 C), shut the engine off for 2 minutes. This allows time for the thermostat to heat soak and open fully, ensuring that any remaining air will be purged out of the engine block when the engine is restarted.
4. Restart the engine and run it in low speed. Remove the cap from the expansion tank and slowly pour coolant into expansion tank until it is full, then reinstall the expansion tank cap.
5. Repeat steps 3 and 4 until the coolant level stabilizes.

Engine Thermostat

Thermostat is molded in the water outlet box.

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.

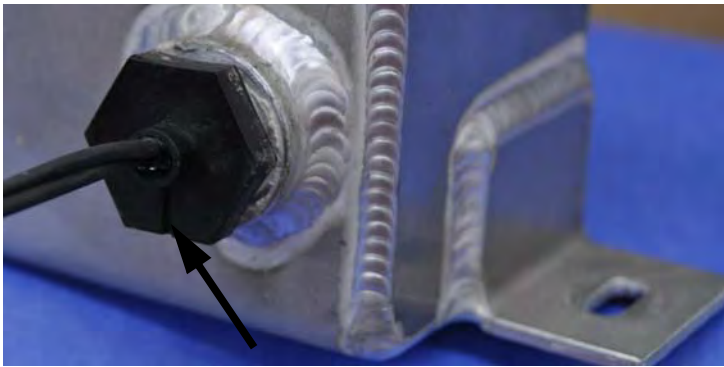
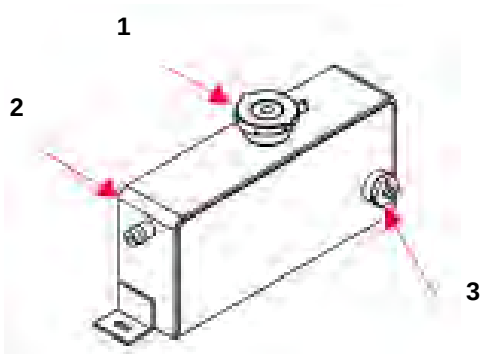


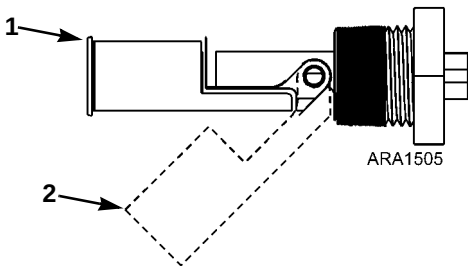
Figure 69: Notch Position

The expansion tank uses a magnetic float type coolant level switch. The coolant level switch senses the position of the magnetic float inside the expansion 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.



1.	Cap-Rad
2.	Expansion Tank
3.	Coolant Level Switch

Figure 70: Expansion Tank



1.	Float in Upper Position - Switch Closed
2.	Float in Lower Position - Switch Open

Figure 71: Coolant Level Switch

Testing the Coolant Level Switch

You can test the switch in the unit by adjusting the coolant level. You can also remove the coolant level switch from the expansion tank and test the switch by moving the float up and down.

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. Make sure the coolant level is above the switch and check the continuity of the switch. The switch should be closed. If you removed the switch from the tank, do this check with the float in the upper position.
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 you removed the switch from the tank, do this check with the float in the lower position.
5. Replace the switch if it does not close in step 3 and does not open in step 4.

Replacing the Coolant Level Switch

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

NOTE: For checking the remaining components of the PCM Engine - i.e. RPM sensor, oil sensor, air flow meter, etc. Refer to the EXXODiag Diagnostic Tool or check continuity of the harness.

Engine Fuel System

DV6NR engine uses a common rail fuel injection system.

The components of the fuel system are:

- Fuel tank
- Electric fuel pump
- Fuel filter/water separator
- High pressure fuel pump
- Common (high pressure fuel) rail
- Electronic injection nozzles

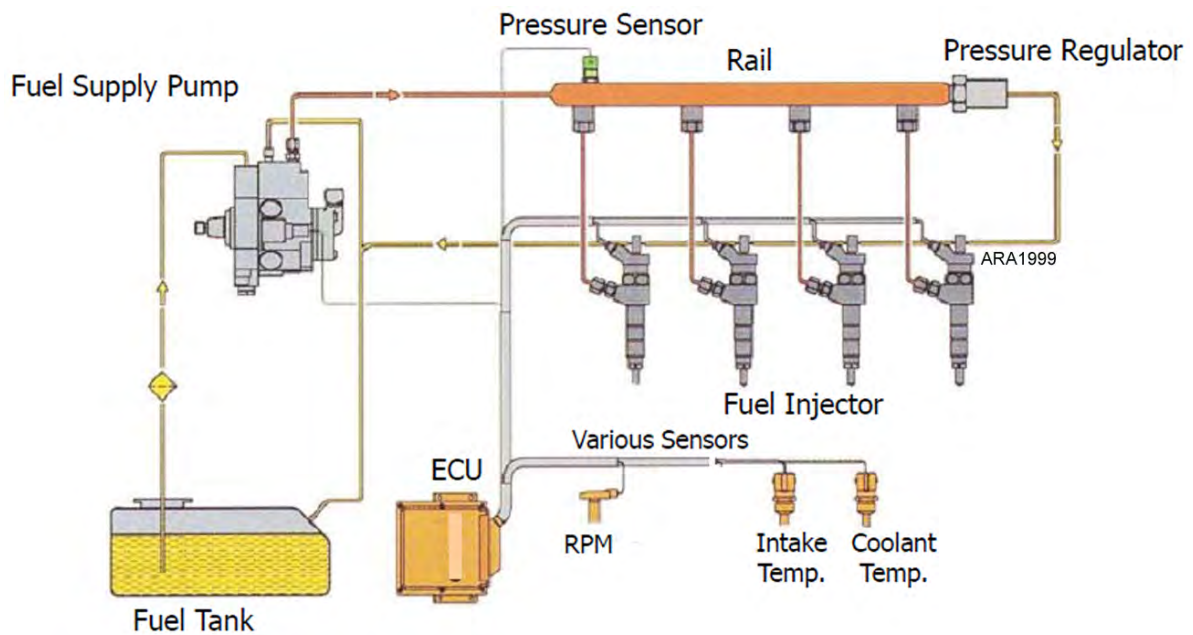
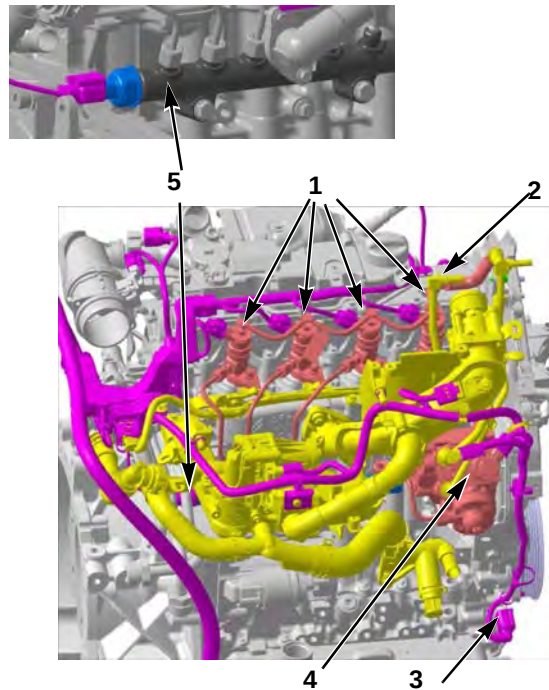


Figure 72: Fuel System

Operation

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

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



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

Figure 73: Fuel Injection Components on Engine

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 high pressure fuel pump.

Fuel System Fittings

IMPORTANT: Using the wrong fuel system fittings may void your engine warranty! All Thermo King supplied fuel line fittings (except fuel line connector) are nickel plated brass for Gensets with Common Rail Engines.

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 on the fuel fittings in a Precedent unit. PTFE tape may allow strands into the fuel system that could plug up the tight clearance fuel injectors causing failures.

Maintenance

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 and inspect/clean the electric fuel pump filter.

IMPORTANT: Do not open the fuel system unless required.

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

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

The following procedures can be done under field conditions:

1. Bleeding air from the fuel system.
2. Fuel tank and filter system maintenance.
3. Electric fuel pump replacement or repair.
4. High pressure fuel pump replacement or repair.
5. Injection line replacement.
6. Common (high pressure fuel) rail replacement.
7. Electronic injection nozzles replacement.

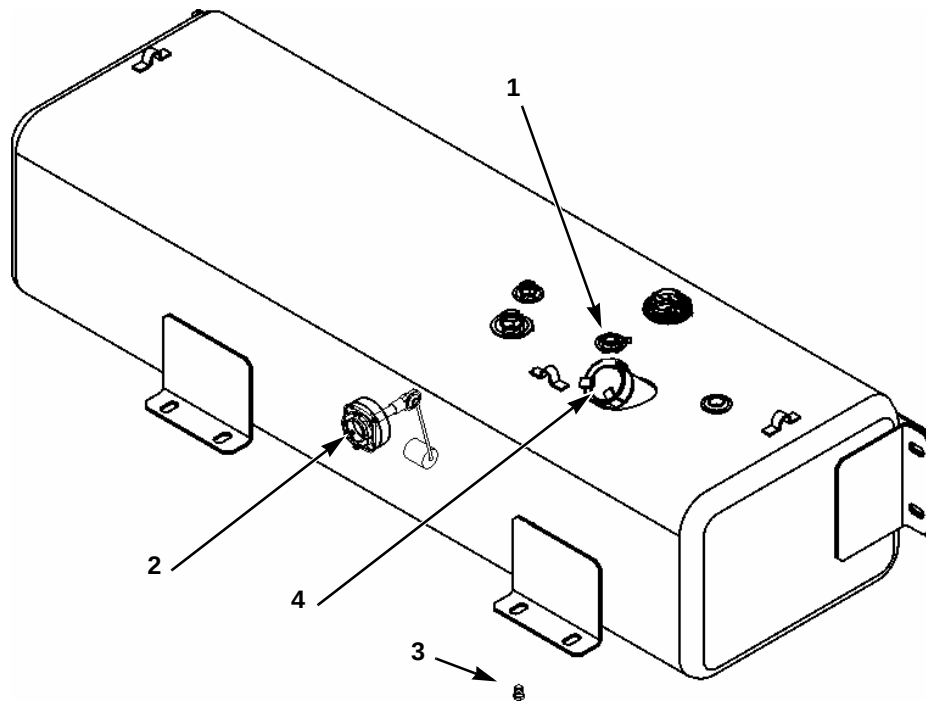
Bleeding the Fuel System

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

To bleed air from the fuel system:

1. Turn the unit on and go to Manual Function Test and select ECU Fuel Relay Test. Run the fuel pump for 1-2 minutes.
2. Start the engine and observe the engine run for a few minutes. If the engine fails to start, or starts but stops in a few minutes, repeat the procedure.

NOTE: MAKE SURE the fuel tank vent is kept open. If the vent becomes clogged, a partial vacuum develops in the tank, and this increases the tendency for air to enter the system.



1.	Vent
2.	Fuel Gauge
3.	Drain Plug
4.	Cap Tank

Figure 74: Fuel Tank

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 off during scheduled maintenance inspections to prevent breakdowns. Drain the water off 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 screw driver 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. 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.

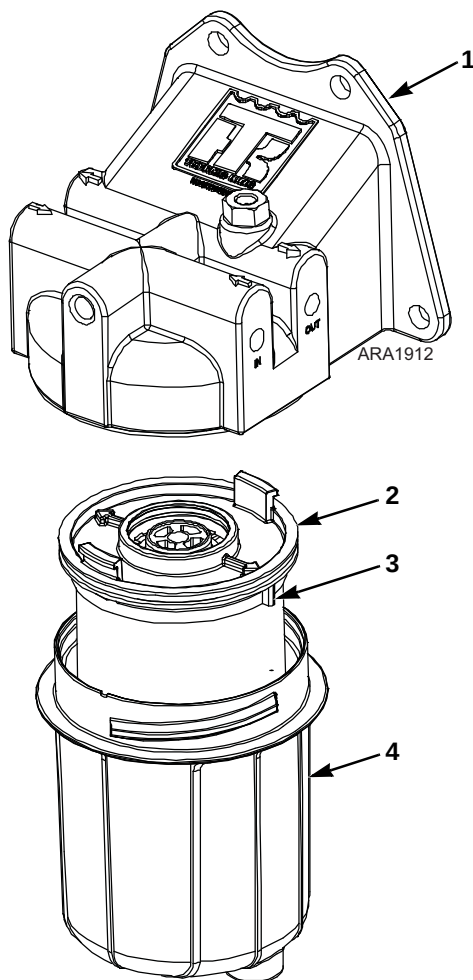
Fuel Filter/Water Separator

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

Fuel Filter/Water Separator Replacement

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

1. Unscrew the filter bowl 1/4 turn and remove it and the filter element. Drain the fuel from the filter bowl and dispose of the filter element properly.
2. Clean the filter bowl and the filter head.
3. Lubricate the top inside edge of the filter bowl with oil.
4. Lubricate the O-ring in the top of the filter element with oil.



1.	Filter Head	3.	Filter Element
2.	Filter Element Tab	4.	Filter Bowl

Figure 75: Fuel Filter/Water Separator Assembly

5. Place the filter element in the filter head with the tabs (and the arrows) on the filter element aligned with the slots (and the arrows) in the filter bowl. Make sure that filter element is fully seated in the filter bowl.
6. Install and tighten the filter bowl about 1/4 turn until you hear and/or feel it click.
NOTE: Do not fill the filter bowl with fuel before installing it.
7. Loosen the bleed screw on the filter head about one turn.
8. Turn the unit on and go to Manual Function Test and select ECU Fuel Relay Test.

9. Run the electric fuel pump until air bubbles are no longer visible in the fuel coming out of the bleed screw.
10. Tighten the bleed screw and check to make sure there are no leaks.
11. Exit the ECU Fuel Relay Test to de-energize the electric fuel pump.
12. Start the engine and observe the engine run for a few minutes. If the engine fails to start, or starts but stops in a few minutes, repeat the procedure steps 7 through 12.

Electric Fuel Pump

Operation

The electric fuel pump must be mounted in the engine compartment. This pump is designed to push fuel rather than pull fuel.

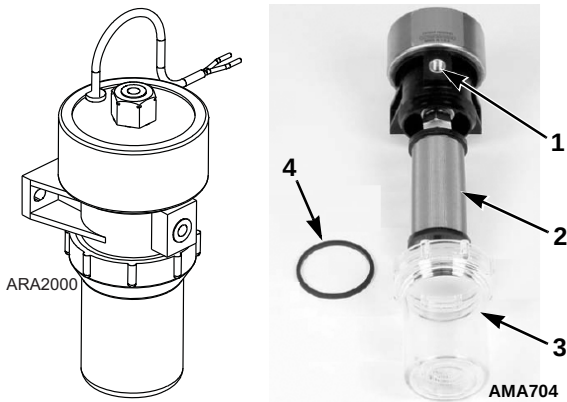
Make sure the GND wire completes a good ground with the battery. Check the voltage at the FP wire in the harness. The pump will not operate at less than 9 Vdc. The pump is self priming.

Maintenance

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

Disassembly

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



1.	Fuel Inlet
2.	Fuel Filter
3.	Fuel Filter Bowl
4.	Fuel Filter Bowl Gasket

Figure 76: Electric Fuel Pump

Assembly

1. Screw the fuel filter back into the pump housing (finger tight).
2. Place the fuel filter bowl gasket in place and hand tighten (or 100 in-lb [11.3 N•m]) the fuel filter bowl.

If the pump does not operate, check for:

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

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

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

Air Supply System

Air is supplied to the engine through the air filter to the Air flow meter to the turbocharger to the Intercooler to the intake manifold. It is then exhausted through the manifold to the turbocharger to the DOC. Some exhaust gas is recirculated through the EGR valve to engine intake.

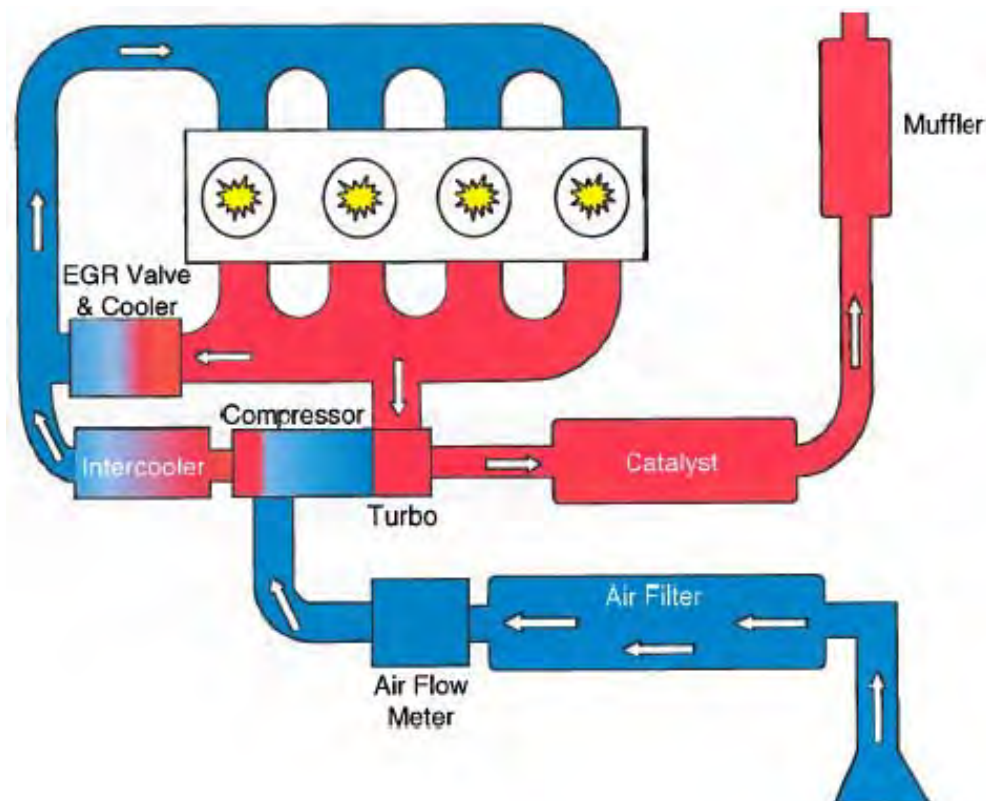


Figure 77: Air Circuit Diagram

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.

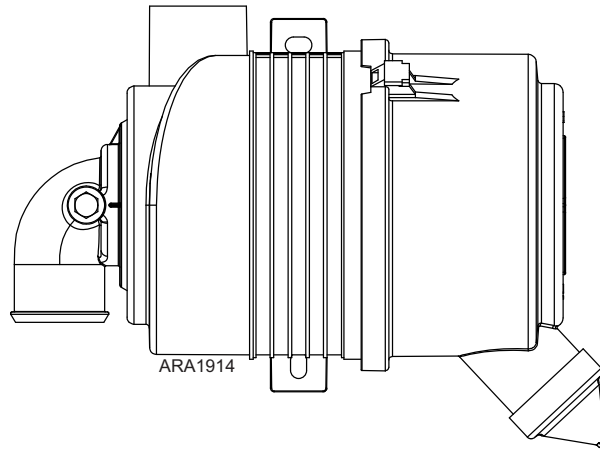


Figure 78: EMI 3000 Air Cleaner Assembly



Figure 79: EMI 3000 Air Filter Element

Air Flow Meter

Measures air supplied to the engine and communicate the reading to the ECU.

Turbocharger

Delivers improved fuel economy, more power and fewer particulate emissions.

Intercooler

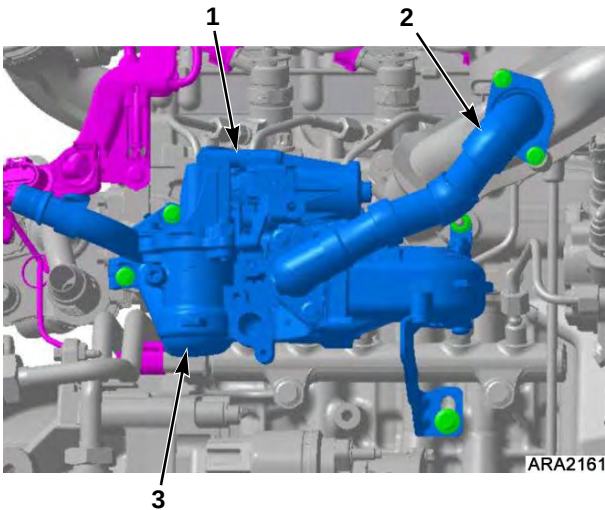
The air after the turbocharger is cooled by the intercooler. It is mounted above the radiator.

EGR (Exhaust Gas Recirculation) System

The EGR (Exhaust Gas Recirculation) system recirculates cooled exhaust gas to engine intake to reduce NOx emissions.

The EGR tube can be removed and replaced if it is dirty. Do not try to clean the EGR tube.

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

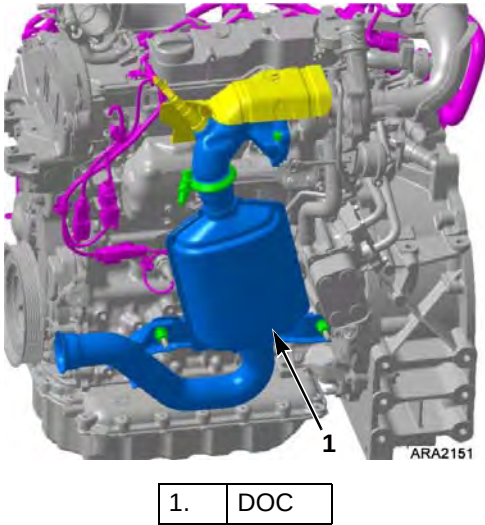


1.	EGR Valve	3.	EGR Cooler
2.	EGR Tube		

Figure 80: EGR Components

DOC (Diesel Oxidation Catalyst) System

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



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

Figure 81: Back View of Engine

Timing Belt Replacement

The timing belt, water pump, belt tensioner, and idler pulley should be replaced every 6,000 hours. These components are all included in the Timing Belt Kit. The first 6,000 hour timing belt replacement is typically covered under the unit's basic warranty. See the following procedure to replace the timing belt and related components. The procedure requires the use of the following tools:

- Flywheel Locking Tool P/N 204-2971
 - Timing Belt Tool Kit P/N 204-2979 (includes the following)
 - Locator Pin 5 mm P/N 204-2977
 - Locator Pin 8 mm P/N 204-2978
1. Disconnect the battery from the unit.
 2. Drain the engine cooling system.
 3. Support the engine and remove the front engine mount bracket and other components as necessary to access the timing covers on the front of the engine.
 4. Remove the top timing cover (four bolts).

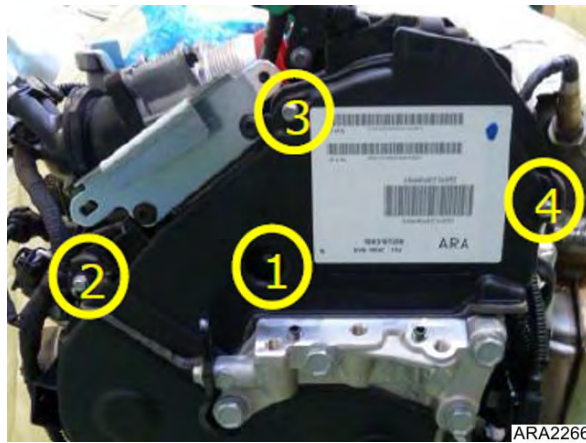


Figure 82: Remove Top Timing Cover

5. Mark the old crankshaft bolt so it does not get mistaken for the new crankshaft bolt.



Figure 83: Mark Old Crankshaft Bolt

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

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

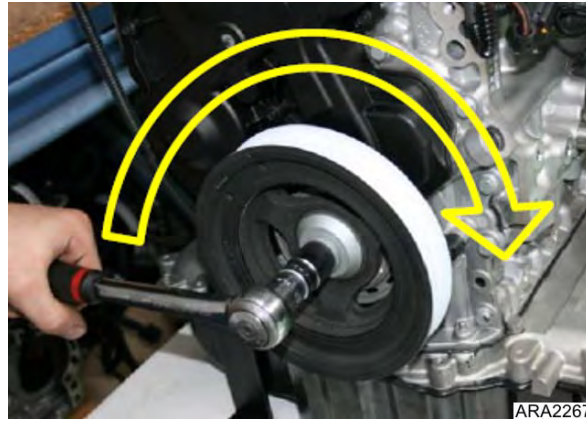


Figure 84: Rotate Crankshaft Clockwise

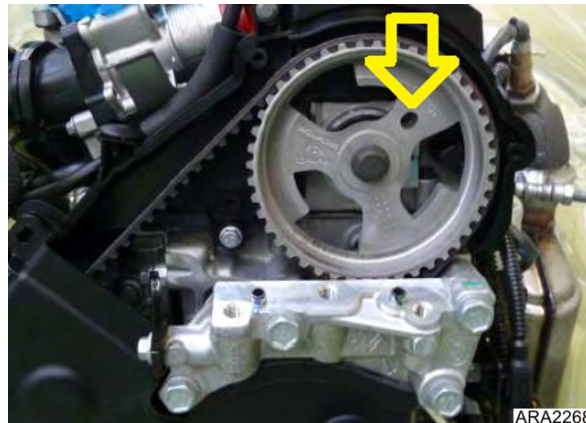


Figure 85: Align Hole in Camshaft Pulley with Corresponding Hole in Cylinder Head

7. Peg the camshaft pulley using an 8 mm Locator Pin from Timing Belt Tool Kit P/N 204-2979.



Figure 86: Place Peg in Camshaft and Cylinder Head

NOTE: The 8 mm Locator Pin from Timing Belt Tool Kit P/N 204-2979 may need to be trimmed so it will fit between the unit frame and the engine. See the picture below. If needed, trim the knurled end of peg.



Figure 87: Trim Knurled End if Necessary

8. Peg the crankshaft pulley using a 5 mm Locator Pin from Timing Belt Tool Kit P/N 204-2979.



Figure 88: Place Peg in Crankshaft Pulley

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



Figure 89: Flywheel Locking Tool

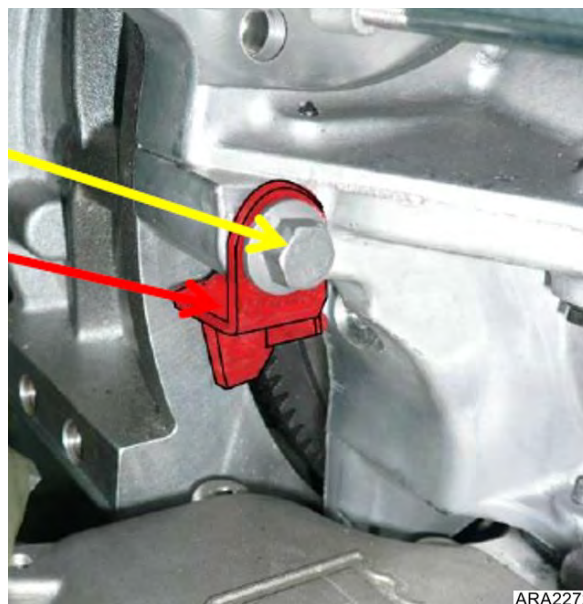


Figure 90: Install Flywheel Locking Tool

10. Remove peg from the crankshaft pulley.

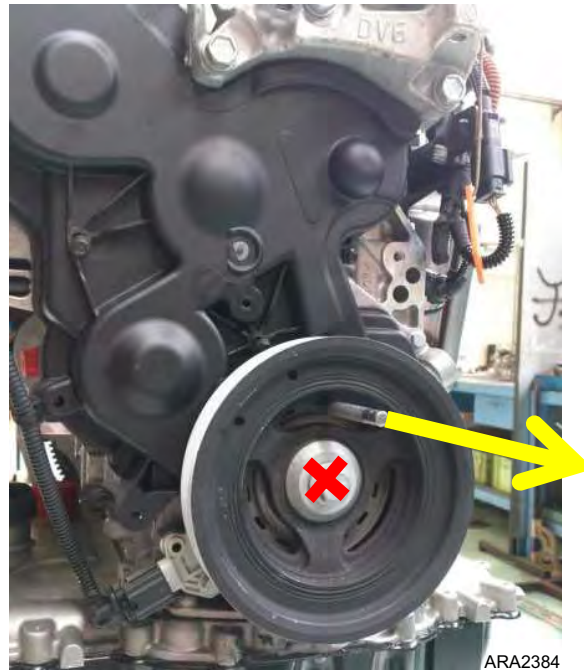


Figure 91: Remove Peg from Crankshaft Pulley

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

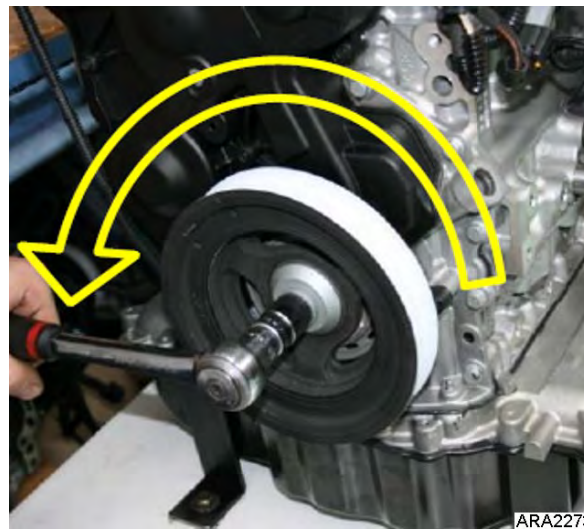


Figure 92: Remove Crankshaft Bolt

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

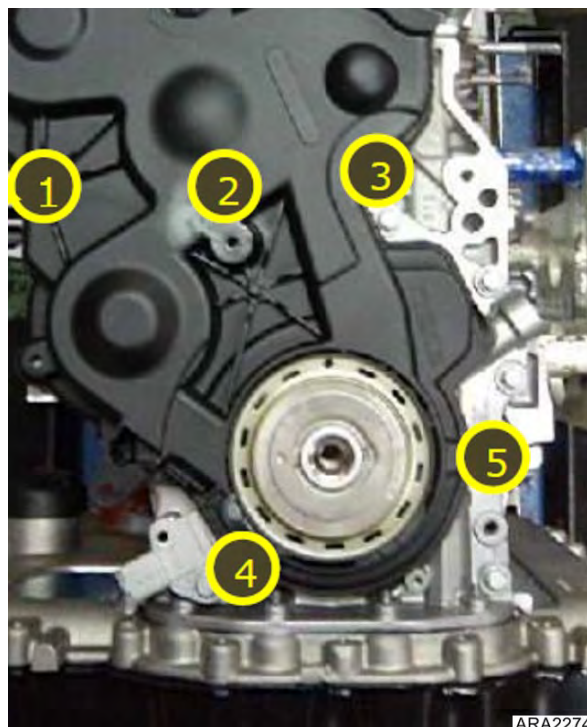


Figure 93: Remove The Lower Timing Cover

13. Peg the injection pump gear using a 5 mm Locator Pin from Timing Belt Tool Kit P/N 204-2979.

14. Remove bolt (8) and the engine speed sensor.

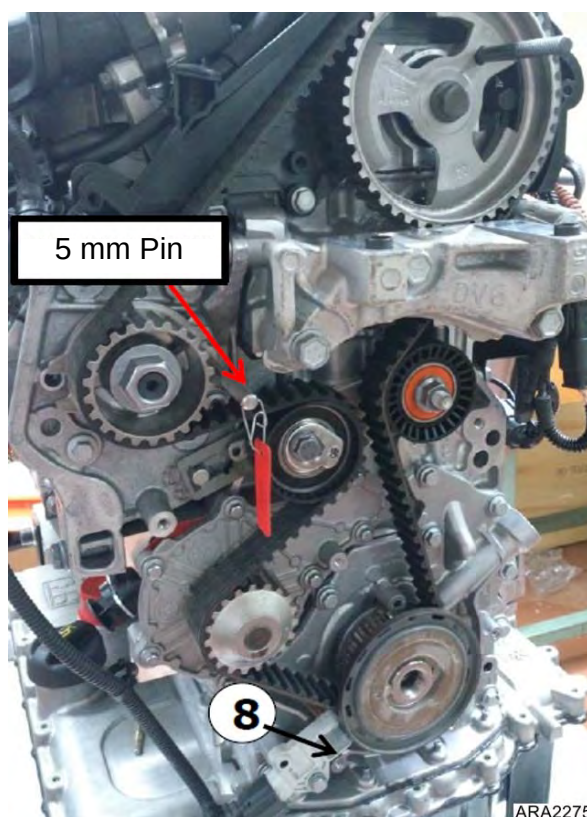


Figure 94: Peg Injection Pump Gear and Remove Engine Speed Sensor

15. Remove the top engine bracket.

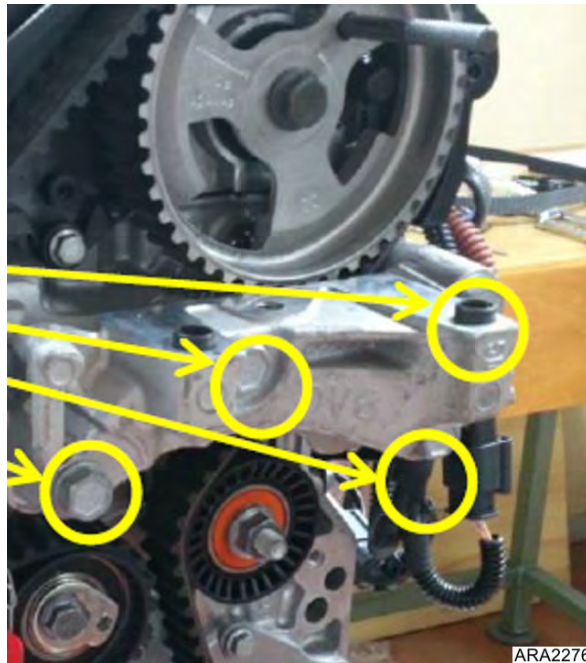


Figure 95: Remove Top Engine Bracket

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

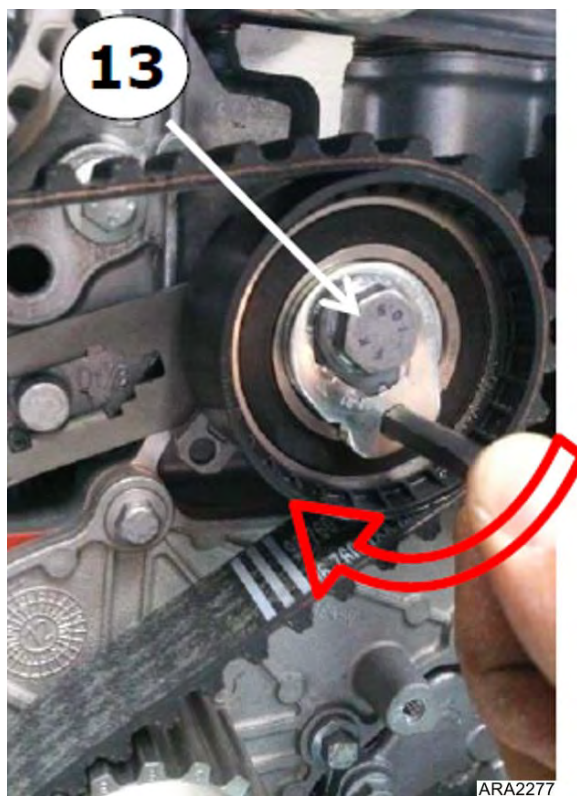


Figure 96: Remove Belt Tensioner

17. Keep the camshaft and injection pump pegs in place and remove the timing belt.

18. Loosen and remove the timing belt guide roller.

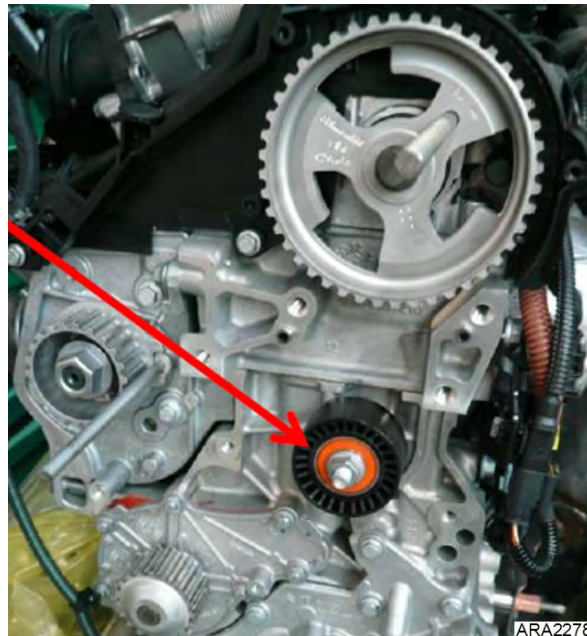


Figure 97: Remove Belt Guide Roller

19. Set aside and DO NOT REUSE the following removed parts.

- a. Belt guide roller
- b. Tensioner roller
- c. Timing belt

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

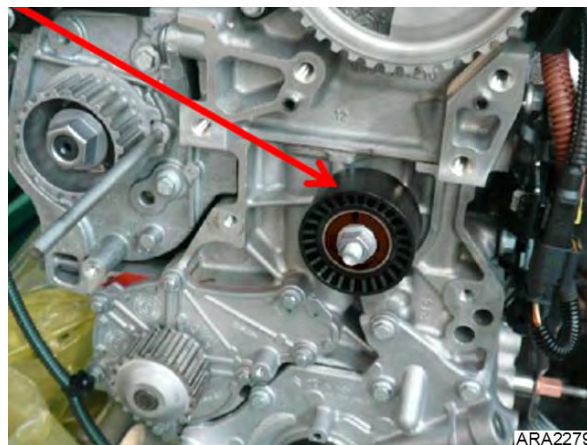


Figure 98: Install New Belt Guide Roller

21. Replace the coolant (water) pump.

- a. Remove the seven bolts that fasten the water pump to the engine.

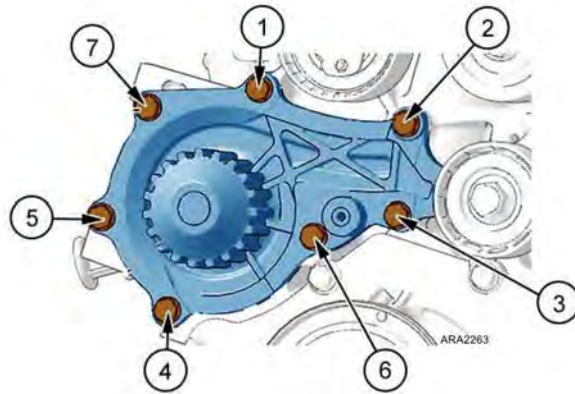


Figure 99: Remove Water Pump Bolts

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

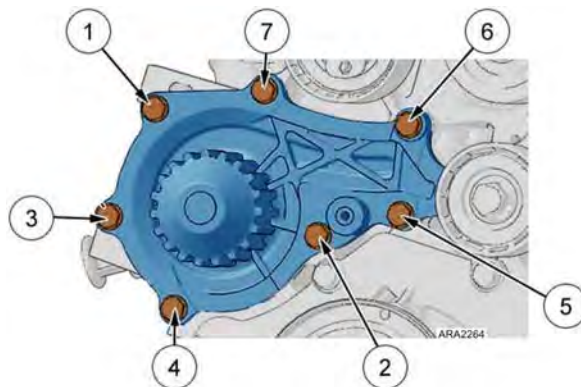


Figure 100: Install New Water Pump

22. Before installing the new timing belt, check for play in the injection pump shaft (high pressure fuel pump). If injection pump shaft has play, replace the injection pump. Refer to the TKDV6 Repair Manual TK 55810.

23. Install the new timing belt. Position the belt, the reference number on the belt should be between the injection pump pulley (iii) and the camshaft pulley (ii).
- Start at the crankshaft pulley (0).
 - From (0) work the belt up and around pulley (i).
 - Keep Strand C tight and wrap belt around the camshaft pulley (ii).
 - Next bring the belt down to the injection pump pulley (iii). Keep all slack in the belt between the injection pump pulley (iii) and the water pump (iv).

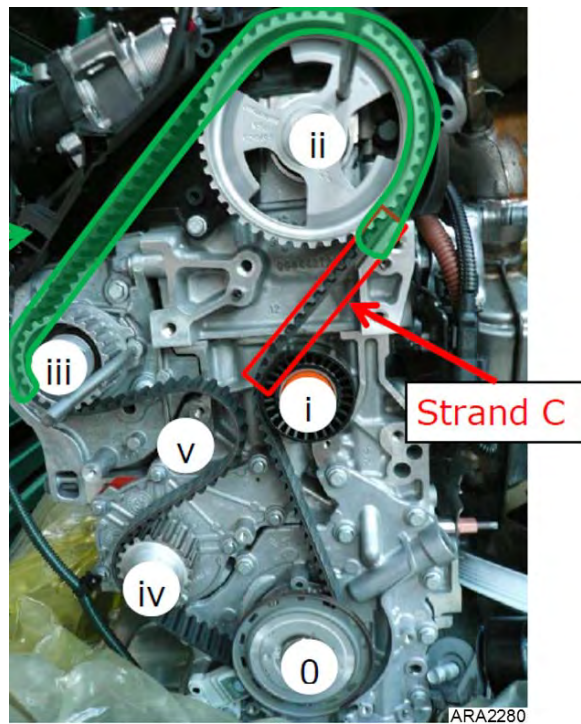


Figure 101: Install New Timing Belt

24. Install the new belt tensioner and finger tighten the bolt.
25. Remove the shipping key from the belt tensioner.



Figure 102: Remove Shipping Key from Belt Tensioner

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



Figure 103: Install Engine Speed Sensor

27. Remove the camshaft and injection pump pin tools.



Figure 104: Remove Camshaft and Injection Pump Pin Tools

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

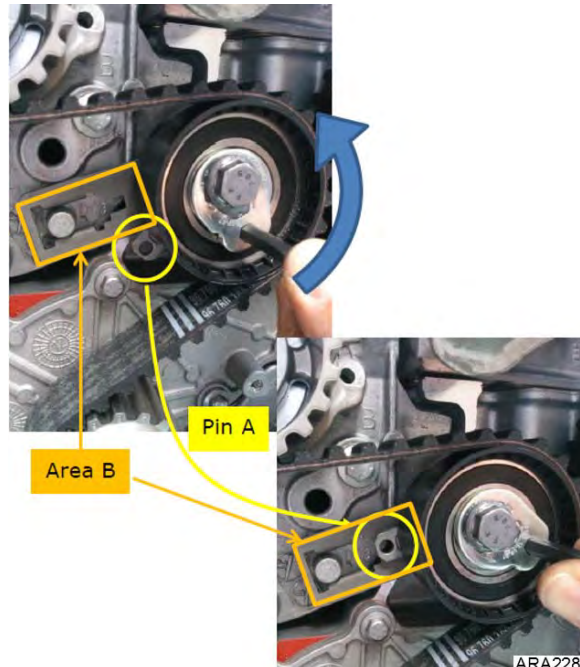


Figure 105: Rotate Tensioner Roller Counter Clockwise until Pin A Is Centered with Area B

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

30. Place the crankshaft pulley onto the crankshaft.

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

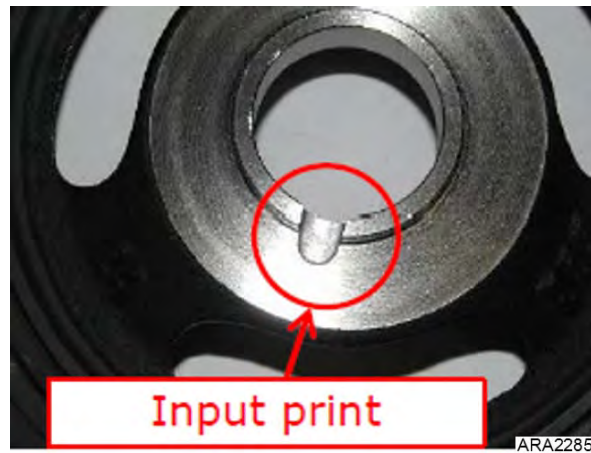


Figure 106: Input Print on Crankshaft Pulley

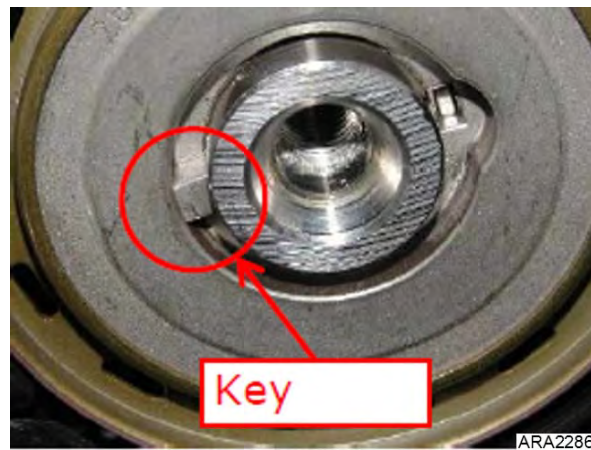


Figure 107: Key in Crankshaft

31. Install the old crankshaft bolt. DO NOT tighten at this time.

32. Remove the flywheel locking tool.

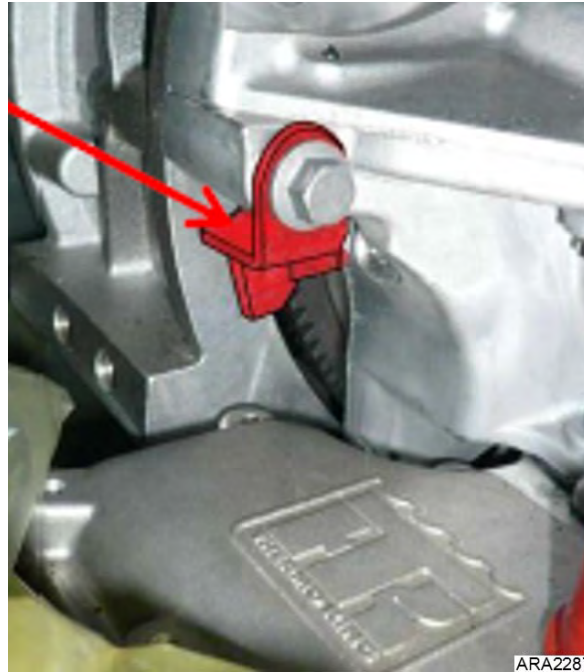


Figure 108: Remove Flywheel Locking Tool

33. Rotate the crankshaft six turns clockwise.

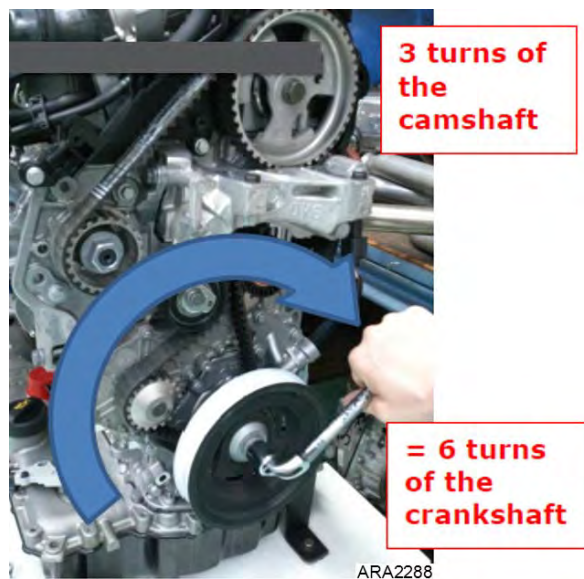


Figure 109: Rotate Crankshaft Six Turns Clockwise

34. Put the engine into the pegging position. Peg the crankshaft with a 5 mm Locator Pin from Timing Belt Tool Kit P/N 204-2979.



Figure 110: Peg Crankshaft with 5 mm Locator Pin from Timing Belt Tool Kit P/N 204-2979

35. Once crankshaft is in pegging position, remove the 5 mm Locator Pin from Timing Belt Tool Kit P/N 204-2979 and install the at the injection pump pulley. The peg tool should fit into hole in block at the gap in the pulley.



Figure 111: Install 5 mm Locator Pin from Timing Belt Tool Kit P/N 204-2979 at Injection Pump Pulley

36. Use the 8 mm Locator Pin from Timing Belt Tool Kit P/N 204-2979 to check the position of the camshaft pulley.



Figure 112: Use 8 mm Locator Pin from Timing Belt Tool Kit P/N 204-2979 to Check Camshaft Pulley Position

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

NOTE: *If the camshaft or injection pump pins do not fit properly go back to step 7 and repeat timing belt procedure. If the camshaft and injection pump are timed correctly remove all pins and proceed to step 38.*

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

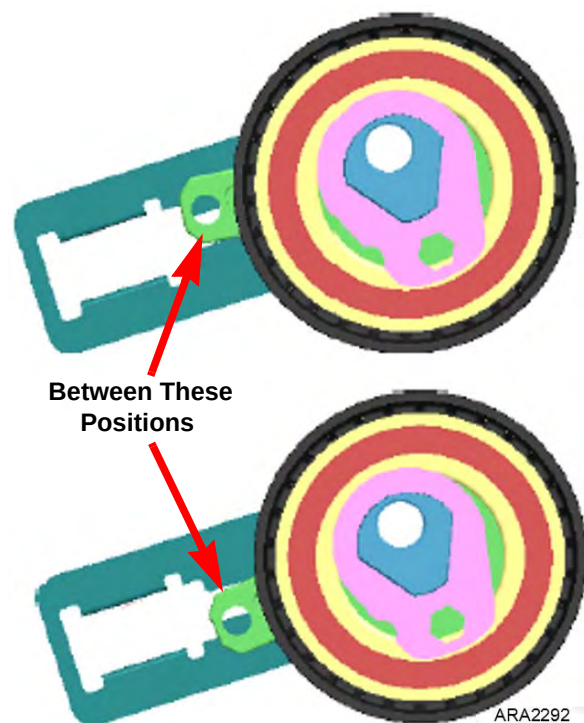


Figure 113: Control Pin A Should Be Between These Positions

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



Figure 114: Control Pin A in Center Position

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

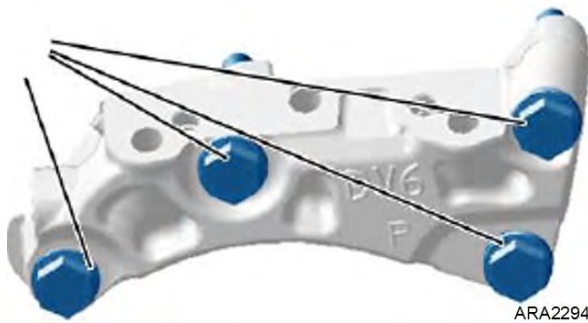


Figure 115: Install Engine Bracket

41. Reinstall the flywheel locking tool.



Figure 116: Reinstall Flywheel Locking Tool

42. Remove the crankshaft bolt and pulley.
43. Install the lower timing cover Torque the bolts to 3 ft-lb (4 N•m).
44. Install the upper timing cover. Torque the bolts to 3 ft-lb (4 N•m).
45. Install the crankshaft pulley. Make sure to align the input print on the back of the crankshaft pulley with the key in the crankshaft when installing the pulley onto the crankshaft.
46. Install a NEW crankshaft bolt.
 - a. Torque the bolt to 25.8 ft-lb (35 N•m).



Figure 117: Torque to 25.8 ft-lb (35 N•m)

- b. Tighten the bolt an additional 190 degrees.



Figure 118: Tighten Bolt 190 Degrees

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



Figure 119: Remove Flywheel Locking Tool

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



Figure 120: Torque to 40.6 ft-lb (55 N•m)

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

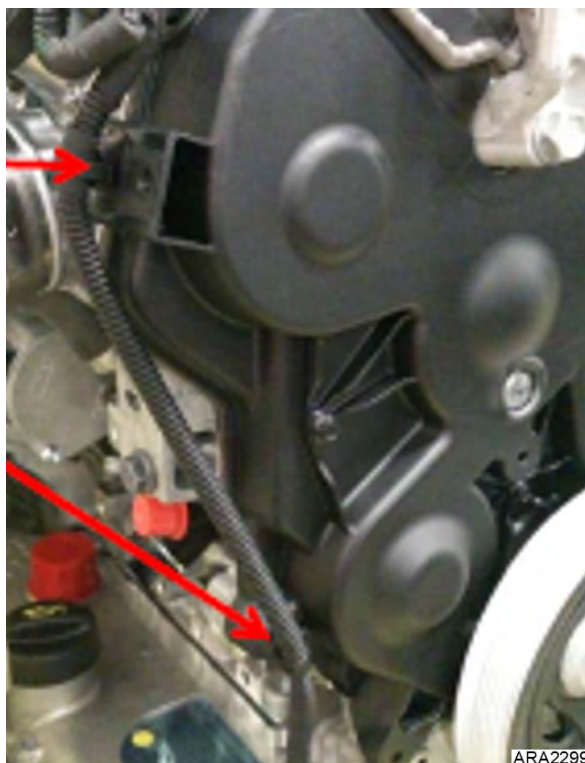


Figure 121: Install Crankshaft Position Sensor Harness

49. Reinstall the front engine mount bracket and other components that were removed to access the timing covers on the front of the engine.

50. Refill the engine cooling system.

51. Connect the battery and verify proper unit operation.

Alternator Operation and Diagnosis

General Description

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

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

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

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

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

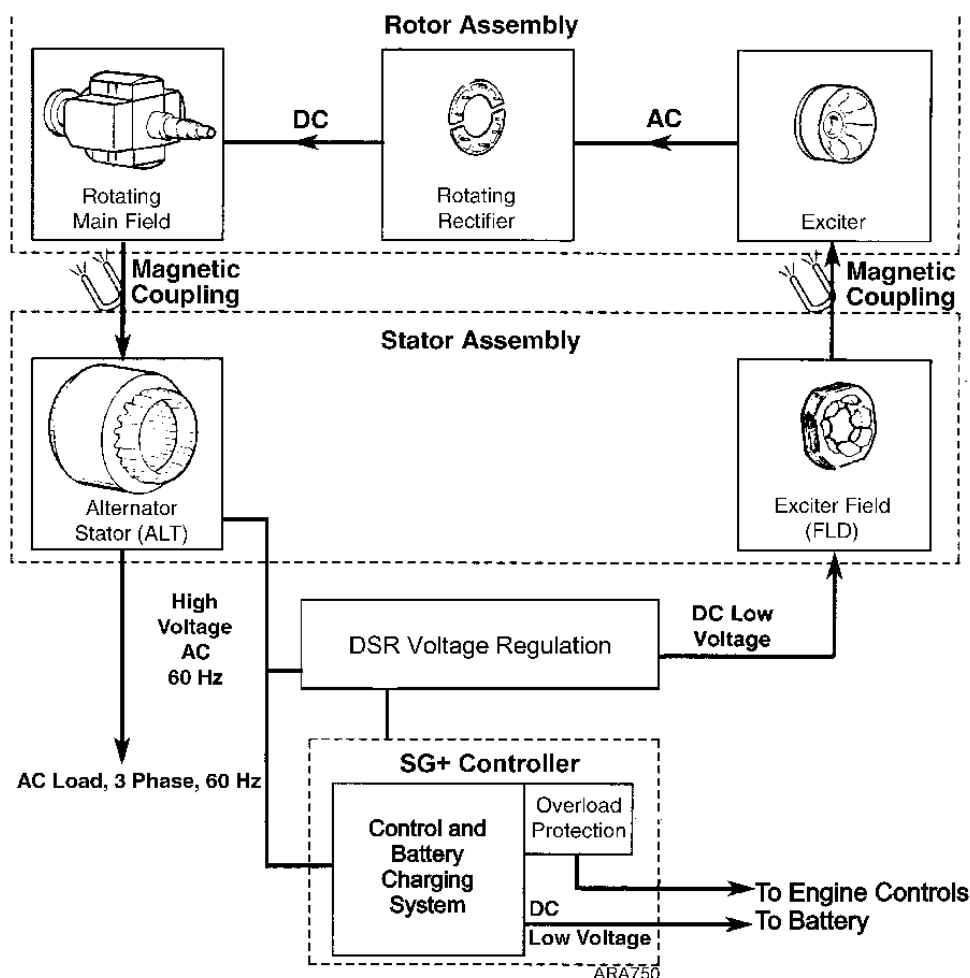


Figure 122: 460/230 Vac Alternator Component Function

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 winding. The SG+ 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 by the DSR induces voltage in the exciter rotating winding. This 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, and therefore, the main 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: *Extreme care must be used when working with an operating generator set. Lethal voltage potentials exist inside the control box, at terminals on the DSR and at the power receptacle.*

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

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

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

Test Instruments

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

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

The test instruments required:

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

Alternator Troubleshooting

WARNING: *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 disconnect fan and replace fuse 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. Disconnect the radiator fan at the connector. This connector is found in the harness or at the terminal block located in the junction box on the alternator (L1, L2, L3).
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 to the Yellow wire. Connect another jumper wire to the Blue wire.

NOTE: Do not connect 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 ground 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 turns relay ON and OFF. If relay is working replace DSR.

Test 2- Alternator Exciter Field Testing

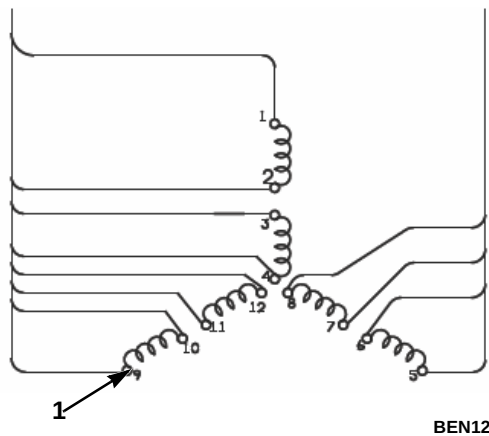
1. Disconnect the Blue and Yellow wires from pin 1 and 2 on the DSR field wire. Measure the resistance of the field circuit (Blue to Yellow). The standard value is 9.7 ($\pm 10\%$) ohms at 77 F (25C). If field is open or resistance value is low replace exciter field.
2. Measure Blue or yellow wires to GND for possible shorted to ground coils. Megger F1 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 ground stud in the terminal box. Check for continuity between the following pairs. 1-2, 3-4, 5-6, 7-8, 9-10, 11-12. The resistance between any of the pairs should be 0.239 ($\pm 10\%$) ohms at 25 C (77 F).
- b. Using a megger meter, check for insulation break down between each pair of leads to the stator case. @ 500 Volts must be more than 1 M ohm.
- c. Remove the end bell for the remaining checks

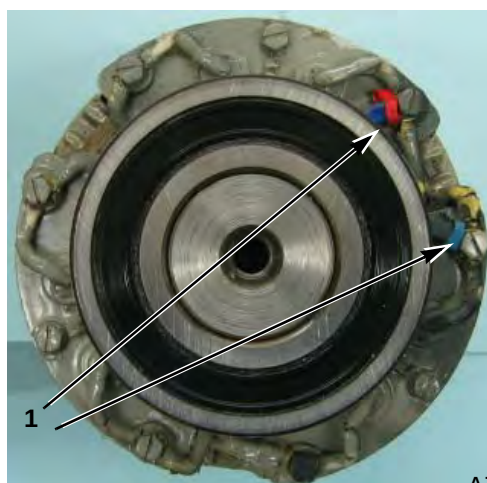


1.	Disconnect all 12 stator leads to test the stator.
----	--

Figure 123: Alternator Stator

2. Rotating Rectifier

Each plate one positive and one negative diode mounted to it.



1.	Disconnect the main alternator field leads to test the diodes.
----	--

Figure 124: Rectifying Diodes

- a. Unbolt each of the exciter armature leads.
 - b. 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.
 - c. Check each diode in the forward and reverse direction. Good diode will have a high resistance reading in one direction and no reading when ohmmeter leads are reversed.
3. Rotating Exciter Armature
- a. Disconnect wires from diode blocks to check ohms and diodes.
 - b. Measure ohms from A to A on the main field. Should be 1.3 ohms $\pm 10\%$.
 - c. Measure ohms from B to B, B to B, and B to B. Should be 0.420 ohms $\pm 10\%$.

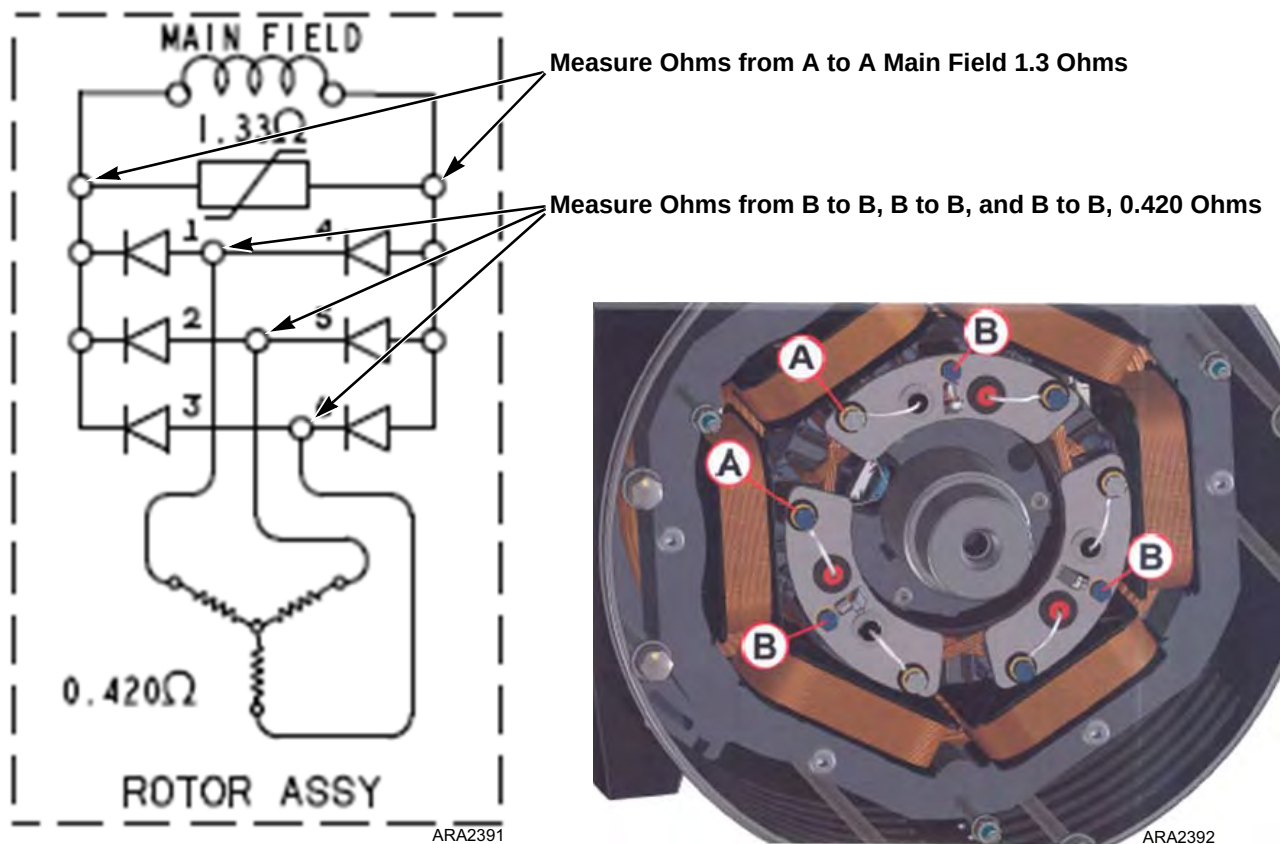
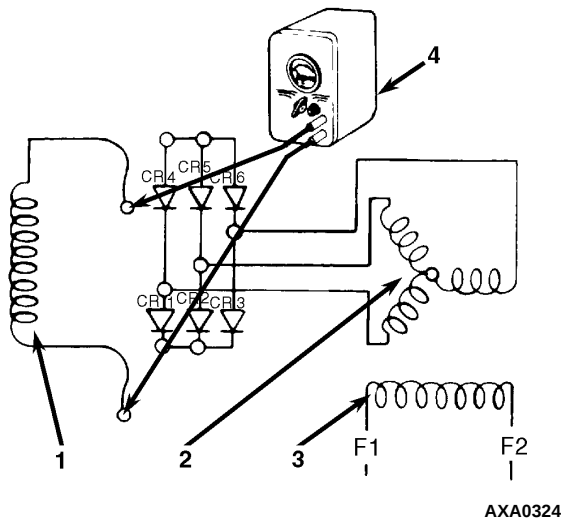


Figure 125: Exciter Rotor

4. Rotating Field Armature
- a. Measure the resistance of the main field armature leads. The resistance should be 1.33 ($\pm 10\%$) ohms.
 - b. Using a megger meter, check for insulation break down between the leads to the rotor shaft. @ 500 Volts must be more than 1 M ohm.



1.	Main Field
2.	Exciter Rotor
3.	Exciter Field
4.	Ohmmeter

Figure 126: Main Field Winding

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: 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

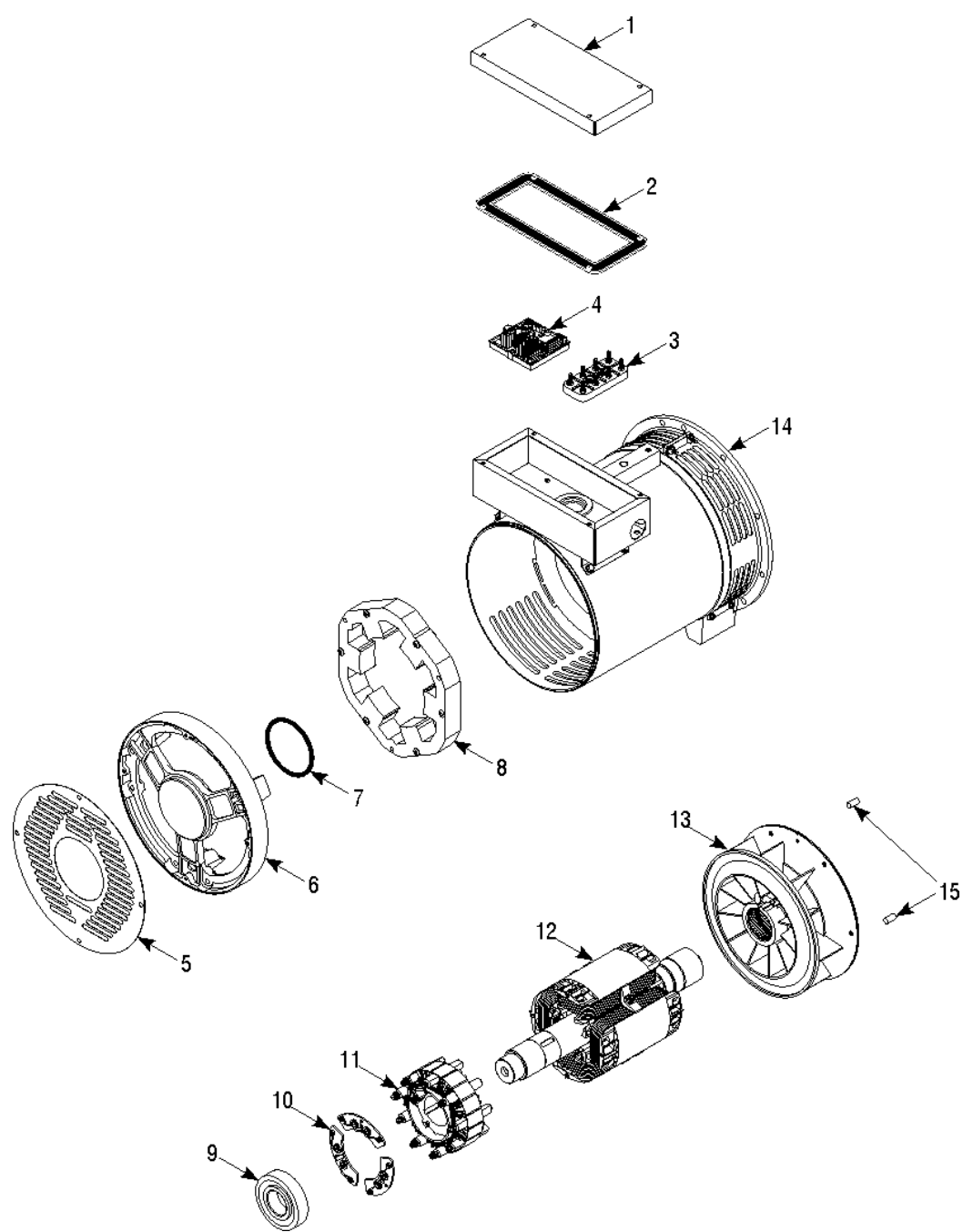
All alternators covered in this manual are fitted with a permanently lubricated bearing which requires no maintenance in normal service.

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.



BEN126

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		

Figure 127: Alternator Assembly

Alternator Replacement

Alternator Removal

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

NOTE: *If powerpack is removed from the frame, be sure to support the engine at the block area and do not sit it up on the oil pan(1).*

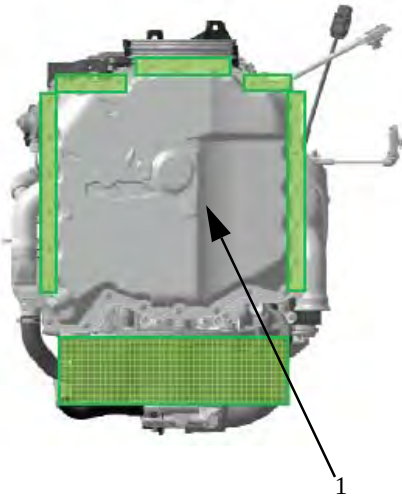
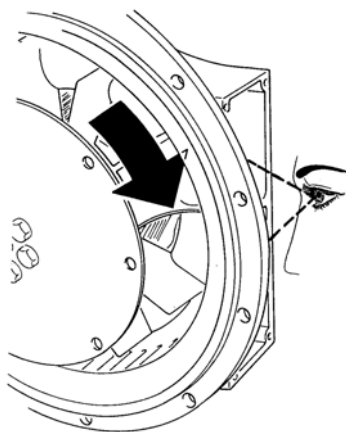


Figure 128: Under View of Engine Showing Oil Pan

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. Notice that one of the vanes of the blower fan is cut away and can be used to remove a bolt if it aligned with a vane. Using a 6 mm Allen wrench loosen the fan and rotate. Be sure to retighten fan bolt.

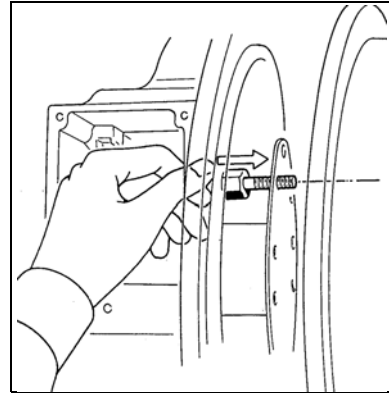
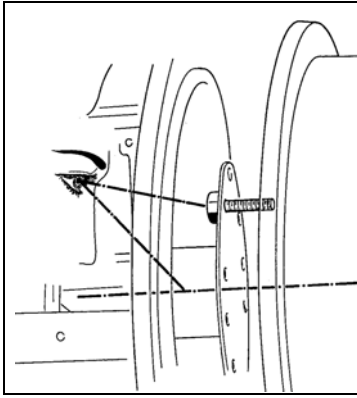


3. Once all flex plate bolts are removed, be sure to support engine and alternator, remove the last bolt holding the alternator to flywheel housing and remove alternator from engine.

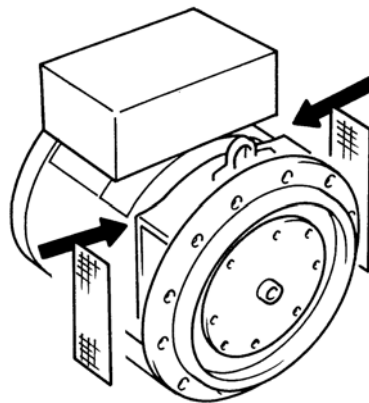
Alternator Installation

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

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



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 2—27 nm (15-20).
3. Install the outer ring bolt and torque to 41047 nm (30-35).
4. Install grills.



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
SGSM Units:	
Tubular Mounting Arm to Unit Frame	203 N.m (150 ft-lb)
I-Beam Clamp Screw	203 N.m (150 ft-lb)
SGCM Units:	
Mounting Arm to Unit Frame	88 to 115 N.m (65 to 85 ft-lb)
Chassis Clip Bolt	162 to 176 N.m (120 to 130 ft-lb)
SGCO Units:	
Upper Clamp	Lock clamp with lock pawl
Lower Mounting Bolts	300 to 380 N.m (220 to 280 ft-lb)
All Units:	
PCM Engine	203 N.m (150 ft-lb)
Exciter Control Box	20 to 27 N.m (15 to 20 ft-lb)

SGSM 4000 Typical Unit Installation

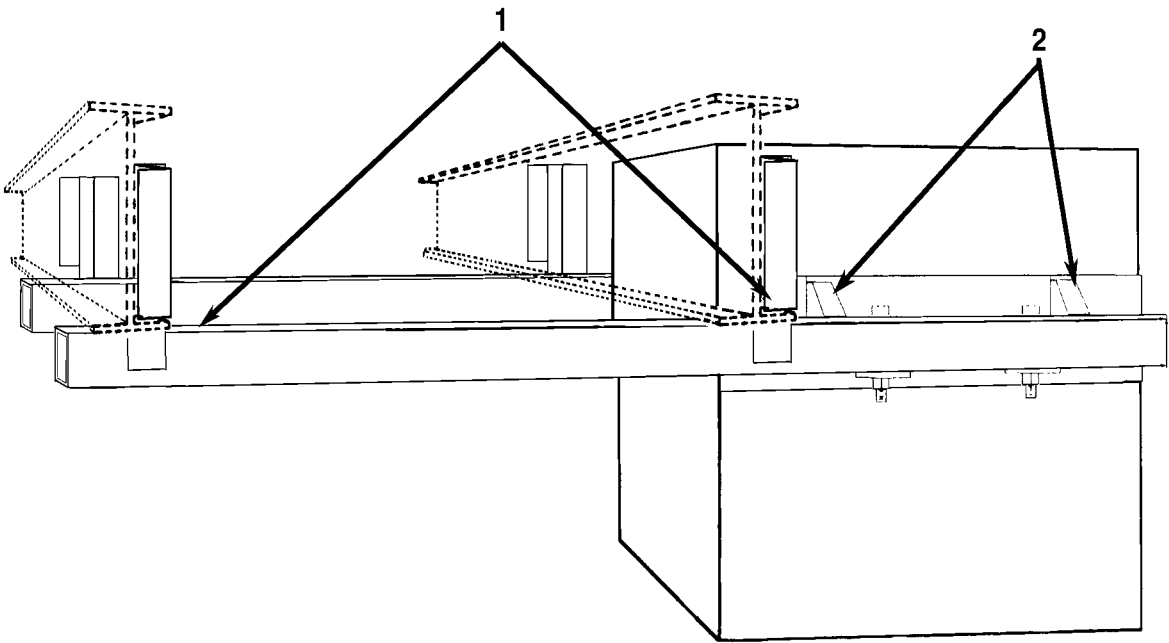
1. Attach the mounting arm assemblies on each end of the unit. Two sets of mounting bolt holes are provided on the mounting arms.

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

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

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

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



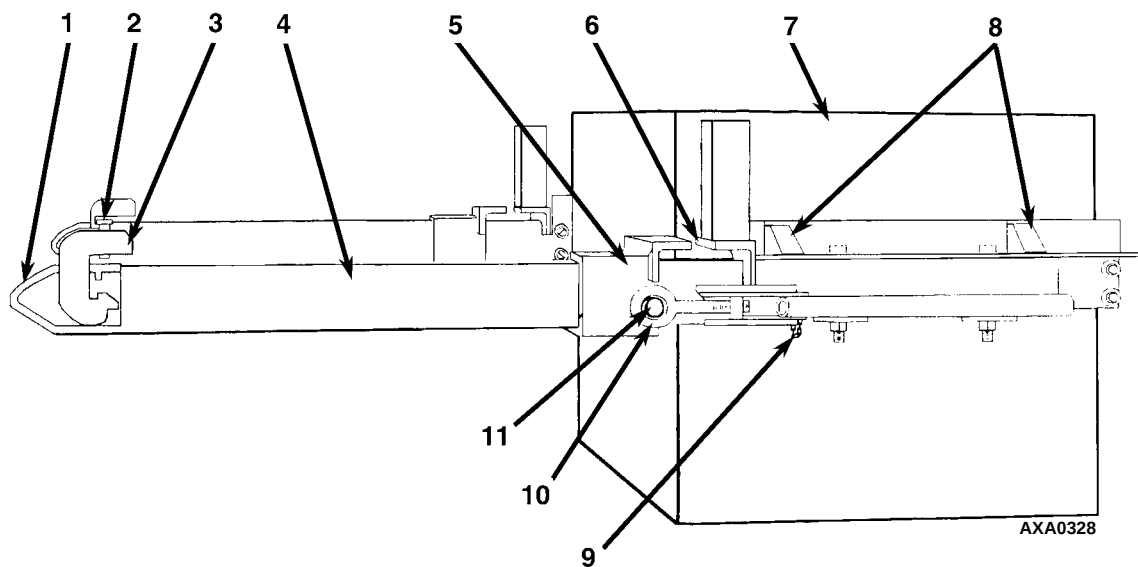
AXA0327

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

Figure 129: SGSM 4000 Side Mount Installation — Typical

SGSM 4000 Keener Arm Unit Installation

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

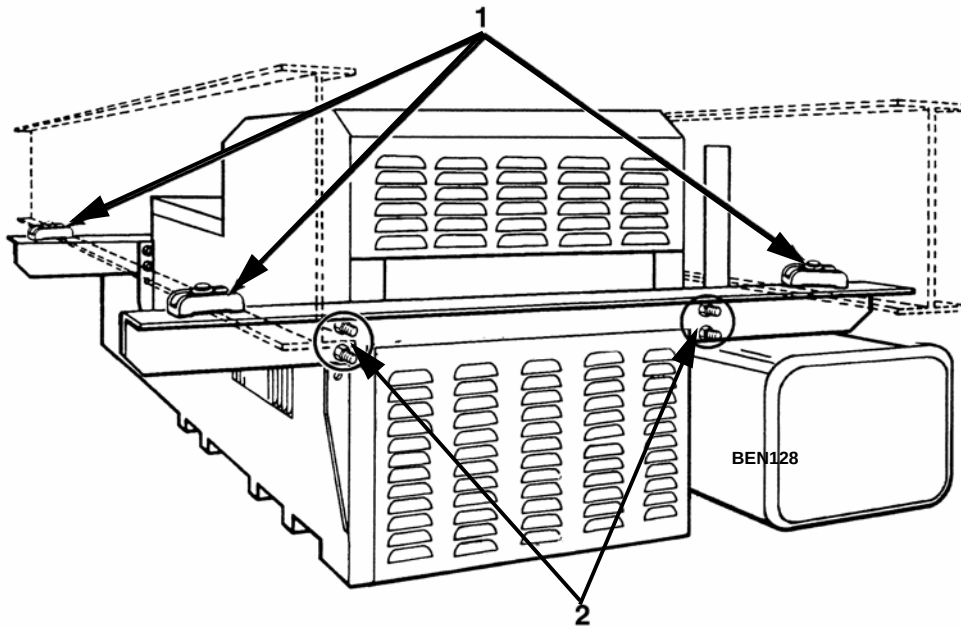


1.	Clamp Channel	7.	Unit
2.	Clamp Screw	8.	Unit Mounting Bracket Assembly
3.	Mounting Arm Clamp	9.	Chain and Quick Release Pin
4.	Mounting Arm Tube	10.	Eye Bolt
5.	Slider Channel	11.	Slider Pin
6.	Fixed Gripper Channel		

Figure 130: SGSM 4000 Side Mount Installation — Keener Arm

SGCM 4000 Unit Installation

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



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

Figure 131: SGUM 4000 I-Beam Centermount Installation

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



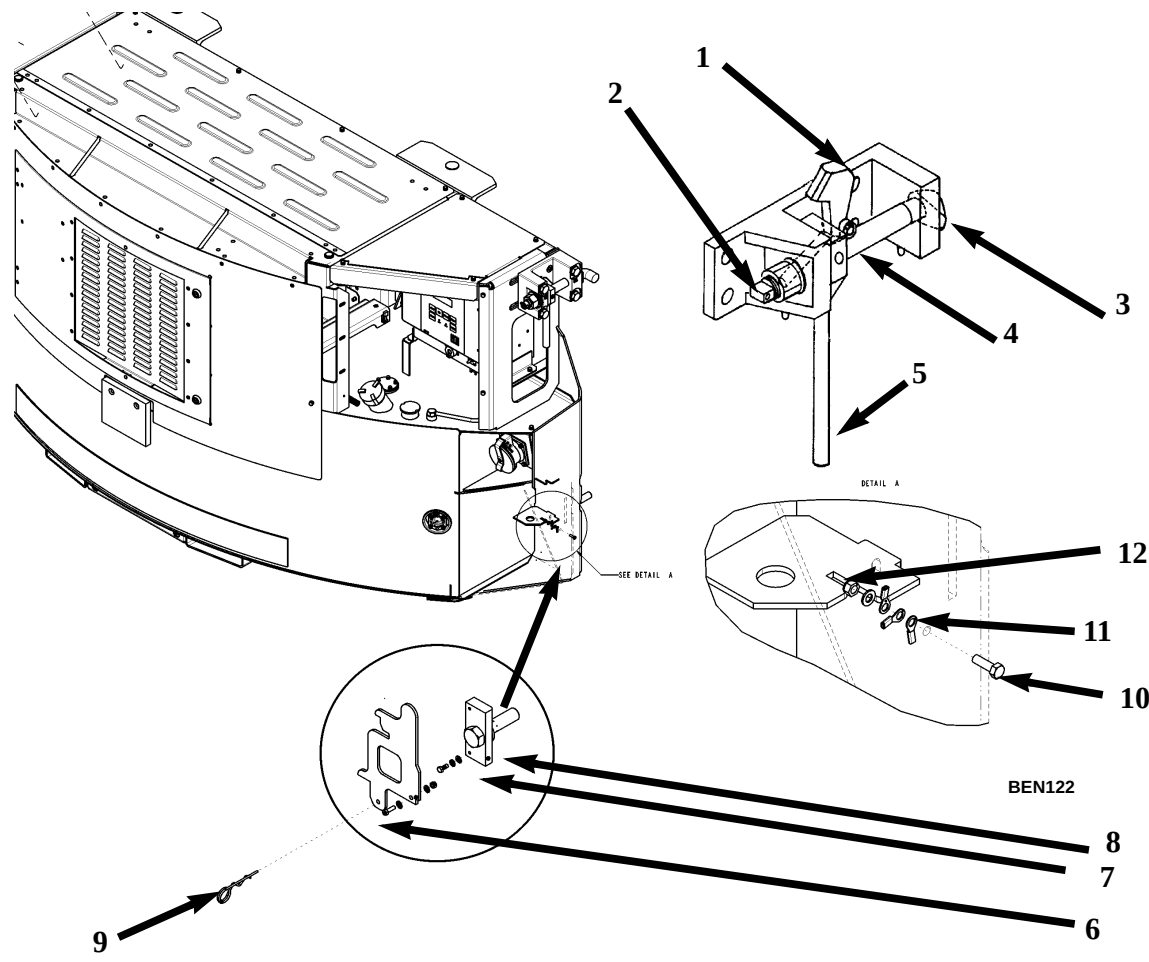
CAUTION: Keep all container or trailer electrical lines and air lines away from the clips to prevent damage during unit installation and operation.

3. Torque the mounting bolts:
 - Mounting Arm to Unit Frame: 88 to 115 N.m (65 to 85 ft-lb)
 - Chassis Clip Bolt: 162 to 176 N.m (120 to 130 ft-lb)

SGCO 4000 Clip-on Corner Clamp Unit Installation

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

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



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

Figure 132: SGCO 4000 Clip-on Corner Clamp Installation

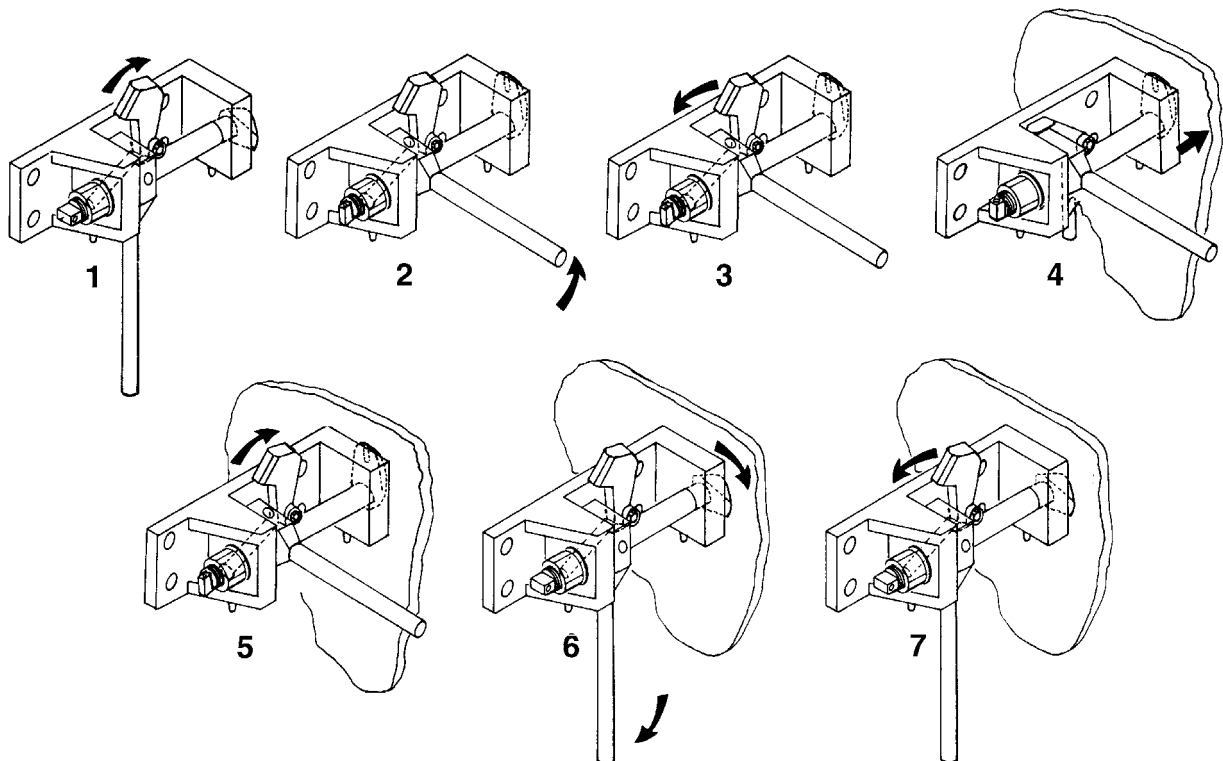
3. Insert the foot of the mounting clamp fully into the container mounting hole. Pull lock pawl handle forward. Pull the clamp handle down to rotate the clamp shaft bolt 90° and clamp generator set to container.

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

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

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

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



AXA0332

1.	Lift (Unlock) Lock Pawl	5.	Lift (Unlock) Lock Pawl
2.	Rotate Clamp Handle Up 90 degrees	6.	Rotate Clamp Handle Down 90 degrees
3.	Release (Lower) Lock Pawl	7.	Release (Lower) Lock Pawl
4.	Insert Mounting Clamp Foot in Container Mounting Hole	8.	

Figure 133: SGC0 4000 Clip-on Corner Clamp Installation Procedure

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

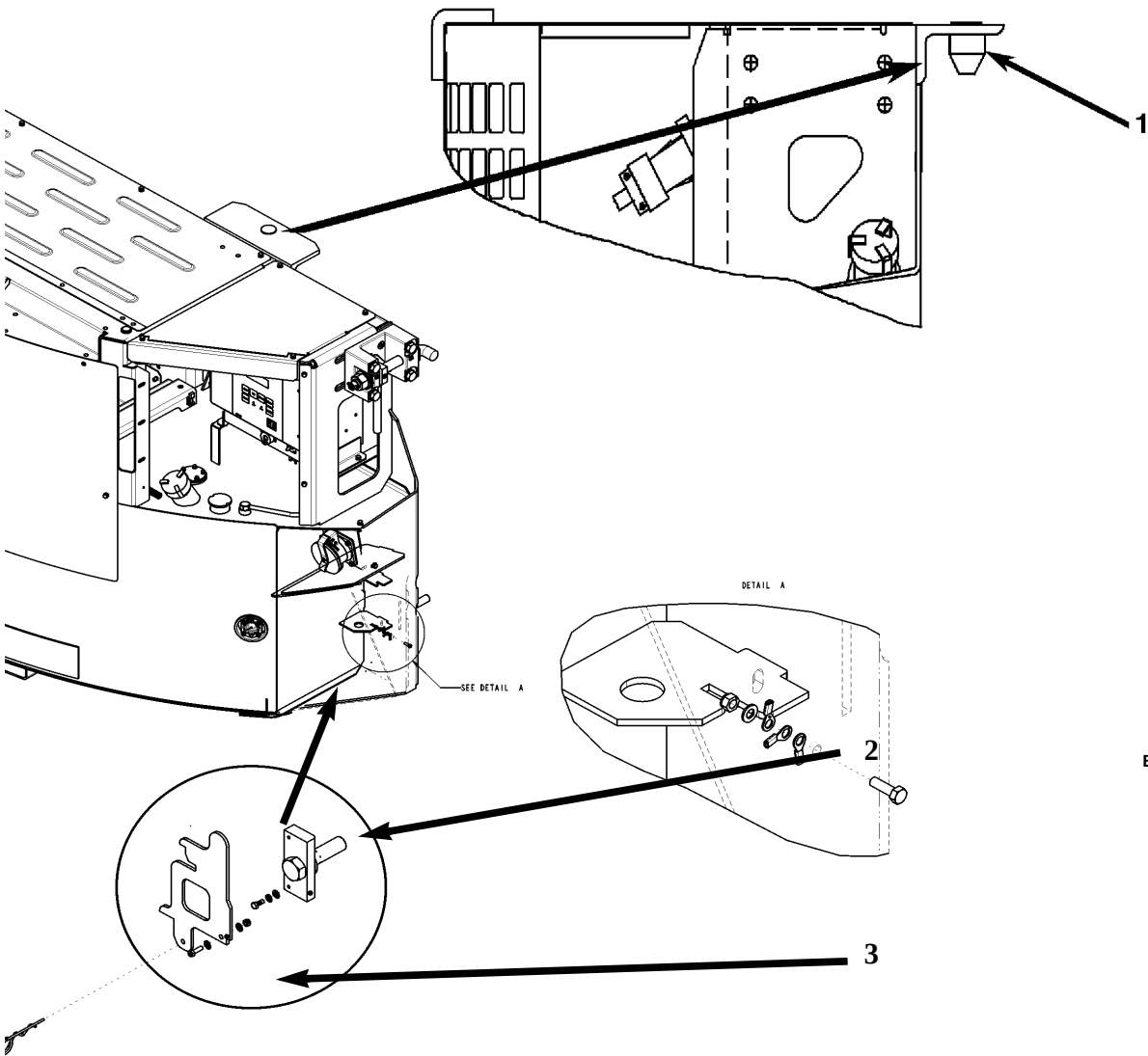
SGCO 4000 Clip-on Header Pin Unit Installation

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



BEN123

1.	Header Pin	3.	Lower Mounting Bolt Assembly
2.	Stopper Plate		

Figure 134: SGCO Clip-on Header Pin Mounting Installation

3. Install the lower mounting bolts:

- a. Remove the retaining pin from the lower mounting bracket.
- b. Remove the mounting bolt and backup plate from the keeper nut. Put the mounting bolt through the backup plate and install the bolt in the mounting hole.
- c. Tighten the lower mounting bolts to 203 N.m (150 ft-lb).
- d. Install the retaining pin and hair pin key to prevent accidental loss of the mounting bolt and backup plate during unit operation.

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.

Radiator and Intercooler

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



CAUTION: Air pressure should not be high enough to damage coil.

Radiator Fan Motor

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

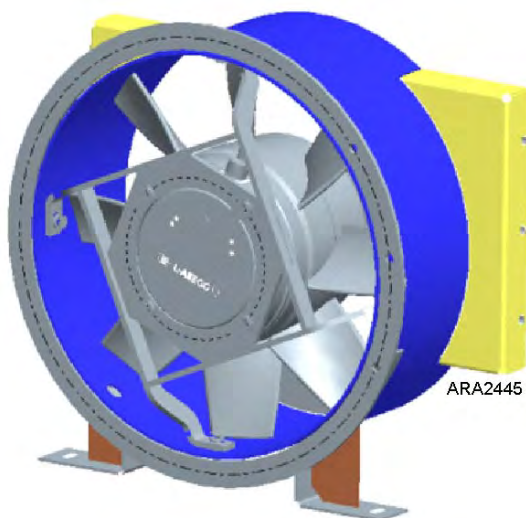


Figure 135: One Piece Fan and Motor

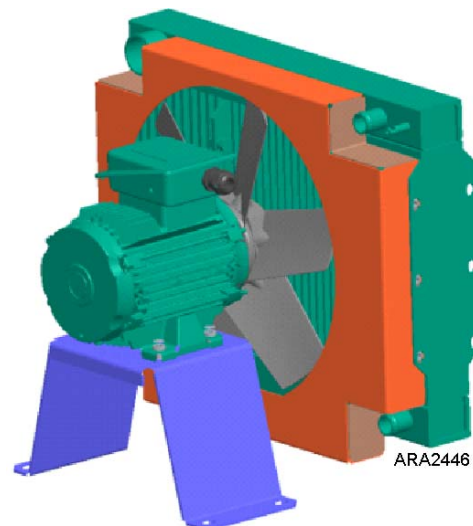


Figure 136: Separate Fan and Fan Motor

Fan Installation for Separate Fan and Fan Motor

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

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

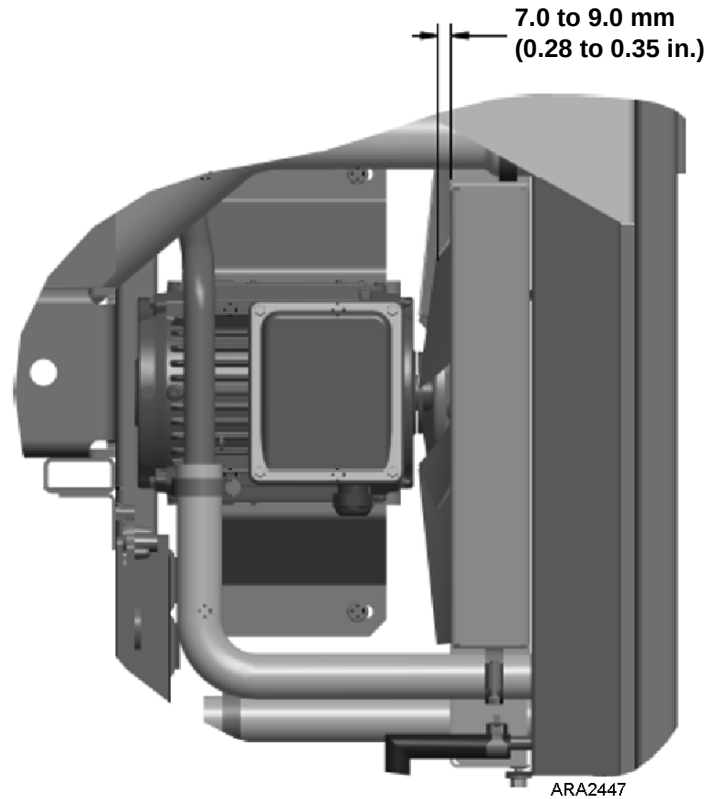
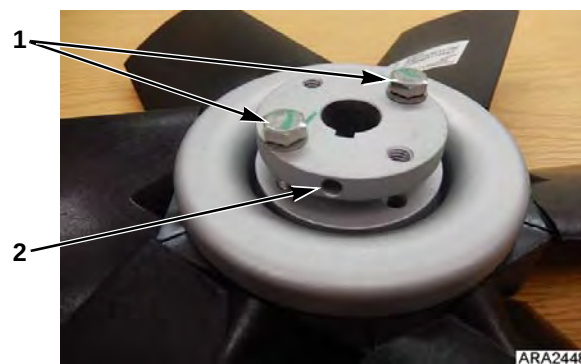


Figure 137: Fan Position

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



1.	Hub Bolts	2.	Set Screw
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Figure 138: Fan Hub Bolts and Set Screw

Mechanical Diagnosis

Diagnosing Unit Conditions

Condition	Possible Cause	Remedy
Unit switch On; controller display does not come on	Corroded battery cable connections Batteries discharged Fuse S13 open (blown) Defective On/Off switch Open circuit	Clean and tighten Charge or replace batteries Check for short circuit and replace fuse Check switch Check 2, 2B, 2C and 8 circuits
Unit switch On (controller display is On) but engine does not crank	Batteries discharged Corroded battery connections Defective starter relay or open circuit Defective starter solenoid Defective starter Water in cylinders	Charge or replace battery Clean and tighten Replace relay; check 2A, 8S, SR and PSR circuits Replace solenoid Repair starter Check for hydrostatic lock. Remove injectors and turn engine slowly
Starter motor turns but engine does not crank	Starter clutch defective	Replace
Engine cranks but fails to start	No fuel or wrong fuel Air cleaner clogged Exhaust plugged Glow Plug defective Air in fuel system Electric fuel pump not energized Electric Fuel pump defective Voltage falls below 6 Vdc at ECU while starter cranking Problem with ECU controlled engine function Compression low	Fill with proper fuel Replace dry air cleaner filter Clear exhaust system Replace defective air heater Bleed air Check FP+ and GND circuits Replace pump Repair cause of low voltage at ECU while starter cranking Use EXXODiag diagnostic tool to diagnose problem Overhaul engine
Engine stops after starting	Alarm LED flashing Vent of fuel tank obstructed Fuel filter obstructed Clogged fuel tank or fuel lines Air in injection pump	Check alarm code and repair fault Unclog vent Replace filter element Clean fuel tank and fuel lines Bleed fuel system

Diagnosing Unit Conditions (Continued)

Condition	Possible Cause	Remedy
Engine does not develop full power	Air cleaner or intake system clogged Fuel tank vent clogged Clogged fuel tank or fuel lines Insufficient fuel volume leaving filter(s) Air cleaner clogged Delivery of electric fuel pump insufficient Problem with ECU controlled engine function Compression low or unbalanced	Clean air intake system, or replace dry air cleaner filter Unclog vent Clean fuel tank and fuel lines Check for dirty filter or air in system Replace air filter Repair pump Use EXXODiag diagnostic tool to diagnose problem Overhaul engine
Engine speed too high	Problem with ECU controlled engine function	Use EXXODiag diagnostic tool to diagnose problem
Engine fails to stop when unit is OFF	Problem with ECU controlled engine function	Use EXXODiag diagnostic tool to diagnose problem
Engine knocks heavily	Wrong fuel Air in system Fuel return line plugged Valve out of adjustment Compression too low Rod or main bearing worn	Change fuel Bleed fuel system Remove return line restriction Adjust valves Overhaul engine Replace rod or main bearings
Engine runs hot	Coolant level is low Generator overloaded Dirty radiator Defective thermostat Cooling system heavily scaled Cylinder head gasket leaks	Add coolant Check load Wash radiator Check or replace thermostat Clean cooling system Replace cylinder head gasket. Use correct gasket
Oil pressure too low or drops suddenly. Minimum oil pressure for a hot engine is 117 kPa, 1.17 bar, 17 psi (low oil pressure switch setting)	Insufficient oil in pan Defective oil pressure switch Oil pressure control valve defective Worn oil pump, camshaft, main or connecting rod bearings, loose oil gallery plug	Add oil Check oil pressure switch. Replace if necessary Check oil pressure control valve Repair engine

Diagnosing Unit Conditions (Continued)

Condition	Possible Cause	Remedy
High oil consumption	10 hour engine break in running was not successfully completed Oil leakage Clogged air cleaner system Damaged valve seals Worn valve stem Broken piston rings or cylinder bore worn or scored	Run unit continuously for 10 hours in high speed with varying load Check and eliminate possible causes at cylinder head cover, oil lines, oil filter, front timing cover or crankshaft seals Clean air intake system, or replace dry air cleaner filter Replace seals on valve stem Replace valves Have engine repaired and re-bored. Replace broken piston rings
Battery is not recharging system charging system	Loose connections in electrical system Battery defective Controller defective	Check all electrical connections and charging system Replace battery Replace controller
White Smoke (fuel is not burning)	Cold engine Air or water in fuel Insufficient preheat Low compression	Allow engine to warm up Bleed system. Replace filters, clean fuel system, drain and clean tank and check supply tank for water. Use known good fuel Check glow plugs Check and eliminate possible causes. Repair as necessary
Blue Smoke (oil consumption)	Excessive oil consumption	Refer to High Oil Consumption. Repair as necessary
Black Smoke (excessive fuel to air ratio) • Engine is sooting heavily, emits thick black clouds of smoke	Cold engine Wrong fuel Clogged air intake system Restricted exhaust system Excessive load Poor compression Air leak in intercooler or piping	Allow engine to warm up Drain and refill with correct fuel Clean or replace air cleaner Clean or replace Check drive system and engine oil pressure Check and eliminate possible causes. Repair as necessary Repair or replace

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REVISIONS

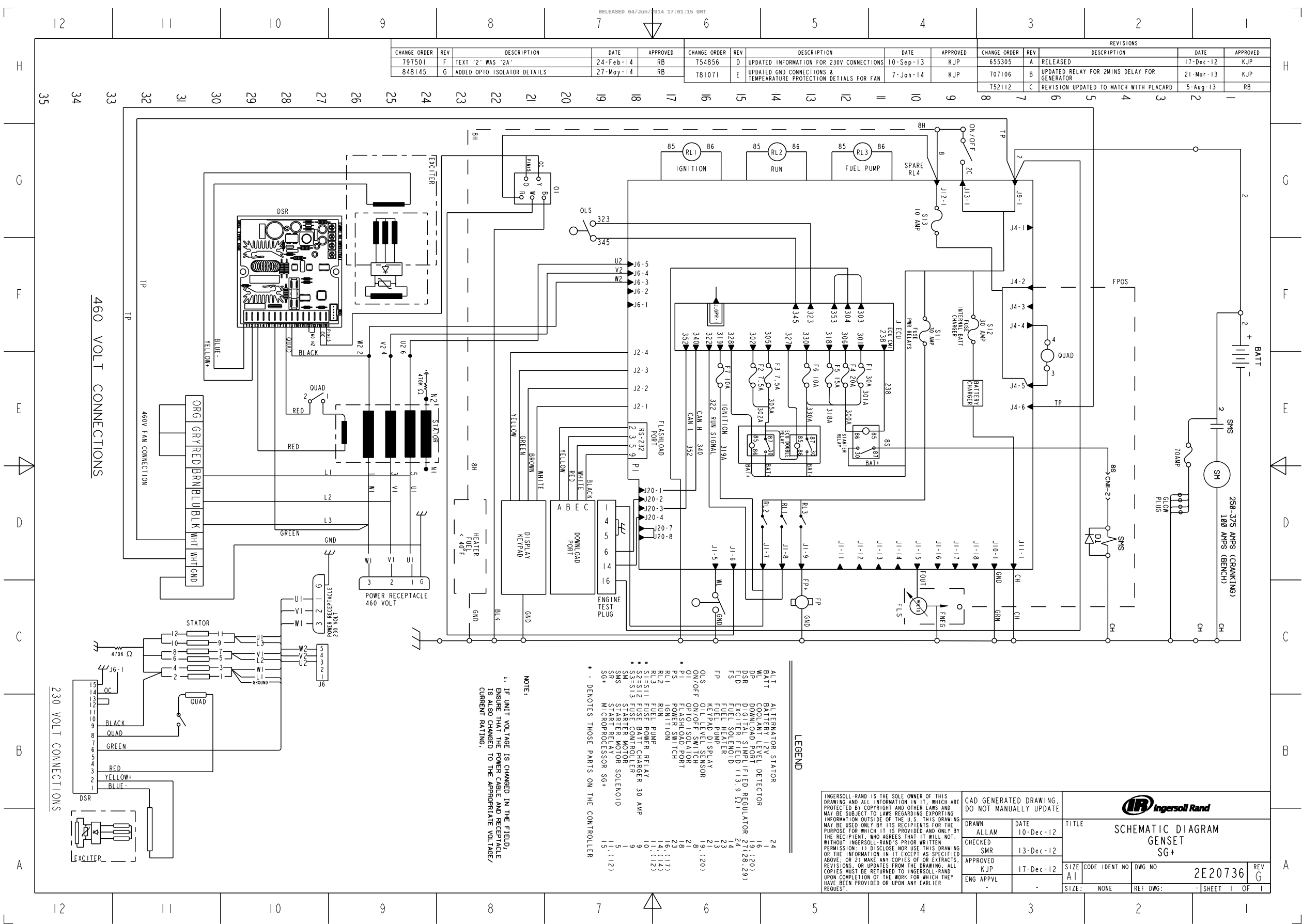
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655305	A	RELEASED	18-DEC-12	KJP
707106	B	UPDATED RELAY FOR 2MINS DELAY FOR GENERATOR	20-Mar-13	KJP
751352	C	UPDATED INFORMATION FOR FUEL MONITORING SYSTEM	31-Jul-13	RB
754856	D	MODIFIED THE WIRE ROUTING FOR FAN, RECEPTACLE & THE ALTERNATOR	13-Aug-13	KJP
781071	E	UPDATED GND CONNECTIONS & TEMPERATURE PROTECTION DETAILS FOR FAN	7-Jan-14	KJP
797501	F	UPDATED J10, J11 & KEY PAD GND CONNECTIONS	20-Feb-14	RB

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APPROVED	KJP	DATE	18-DEC-12	SIZE	D
ENG APPVL	-	CODE IDENT NO	DWG NO	2E20735	REV
		SCALE: NONE	REF DWG:	SHEET 1 OF 1	G



Schematic Diagram SG+ Units with One Piece Fan and Motor (Before 6/15) — Page 1 of 1



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REVISIONS				
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The diagram illustrates the electrical architecture of an Ingersoll-Rand SG+ genset. Key components include:

- Alternator:** Features a stator with four windings (each 0.239Ω) and a rotor assembly with a main field (1.33Ω) and exciter field (9.70Ω).
- Engine Control:** Includes an ECU (J1) managing the starter solenoid (via a 70A fuse), fuel pump, and fuel heater.
- Sensors:** Fuel level sensor, coolant level detector, oil level sensor, and temperature protection details.
- Relays and Switches:** Multiple 12V x 30A relays (RL1-RL4) and switches for battery charging and engine test plug.
- Grounding:** Comprehensive grounding scheme for chassis, engine ground stud, and various functional grounds (FNEG, FP, FPOS).

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CHECKED		
SMR	11-DEC-12	
APPROVED		
KJP	18-DEC-12	
ENG APPVL		
-	-	

SIZE	CODE	IDENT NO	DWG NO	REV
D			2E20735	H

SCALE: NONE REF DWG: SHEET 1 OF 1

ENGINE HARNESS CONNECTIONS

8 7 6 5 4 3 2 1

8 8 1 77 1 6 6 1 5 5 4 4 3 3 2 1 1 1

PEUGEOT ENGINE ECU

START RELAY 238

CRANKSHAFT SPEED SENSOR

FUEL TEMP SENSOR

BOOST PRESSURE SENSOR

INTAKE AIR TEMP SENSOR

RAIL PRESSURE SENSOR

COOLANT TEMP SENSOR

OIL PRESSURE SWITCH

5V SENSOR SUPPLY 5

HP FUEL PUMP ACTUATOR

LAMBDA SENSOR

HOT FILM AIR MASS SENSOR BCM3

GLOW PLUG 0.6Ω EA

BLOW BY HEATER

GLOW RELAY

CAMSHAFT SENSOR

EGR

5V SENSOR SUPPLY 9

EGR ACTUATOR POSITION FEEDBACK SIGNAL

CMI

CME

Wiring connections and components are detailed throughout the diagram.

SIZE	CODE	IDENT NO	DWG NO	REV
D			2E20735	H

SCALE: NONE REF DWG: - SHEET 2 OF 2

INGERSOLL RAND

848145 G ADDED OPTO. ISOLATOR DETAILS 07-May-14 RB

986752 H DELETED 230 VOLT CONNECTION DETAILS & UPDATED WIRING DIAGRAM 16-Jun-15 RB

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DRAWN ALLAM	DATE 10-Dec-12	TITLE SCHEMATIC DIAGRAM GENSET SG+	SIZE A1	REV H
CHECKED SMR	DATE 13-Dec-12	CODE IDENT NO DWG NO 2E20736	REF DWG:	SHEET 1 OF 1
APPROVED KJP	DATE 17-Dec-12	SIZE: NONE		
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RL2	RELAY	14,(14)
RL3	RELAY	10,(11)
RL4	RELAY	10,(12)
SS12	STARTER MOTOR	9
SS13	STARTER MOTOR	1
SS	STARTER MOTOR	1,(12)
SG+	MICROPROCESSOR SG+	15

NOTE:

- IF UNIT VOLTAGE IS CHANGED IN THE FIELD, BROKEN DOWN POWER CABLE AND REPAIR PLACE SHOULD BE CHANGED TO THE APPROPRIATE VOLTAGE/CURRENT RATING.

460 VOLT CONNECTIONS



ARA979

Keypad Operating Tips

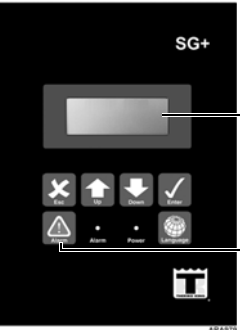
- Text Input:
- To enter a number: Press the **Up** or **Down** key to increase or decrease the value of a digit in the display.
 - Press the **ENTER** key to scroll the cursor to the right.
- To Enter a Controller Menu or Submenu:
- Press **ALARM** key to directly enter the Alarm List Menu.
 - Press the **ENTER** key or the **ESCAPE** key to enter the Main Menu.
 - Press **ENTER** key to enter a menu from the Main Menu, or a submenu from its parent menu.
 - Press **ESCAPE** key to return to the Main Menu from a menu, or a menu from a submenu.
- To Scroll in a menu:
- Press **Up** key to scroll up.
 - Press **Down** key to scroll down.
- To Enter a Command or execute a task:
- Press **ENTER** key.
- To Enter a New Value in a Screen:
- Press **ENTER** key and **ESCAPE** key at the same time.
- To change language
- Press **LANGUAGE** key.

Footnotes:

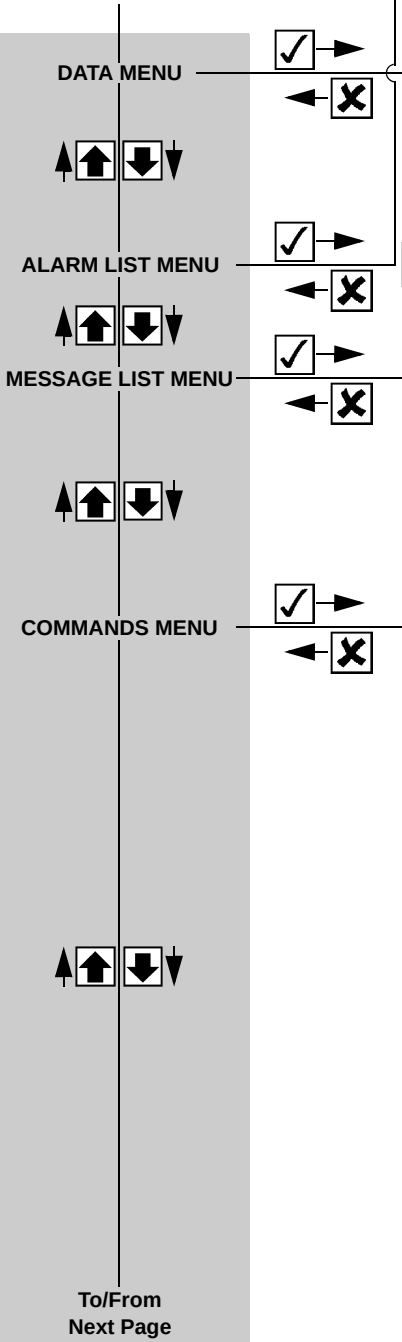
¹“dELAY/ AC.” screen indicates controller has a 2 minute delay.

²“RESTART IN XX MIN.” screen indicates controller has stopped unit operation due to an alarm. Controller will attempt to restart unit in the time shown.

STANDARD DISPLAY



MAIN MENU

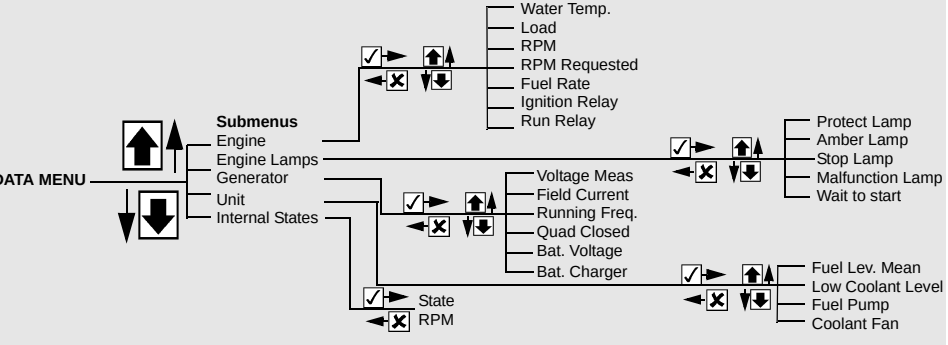


To/From
Next Page

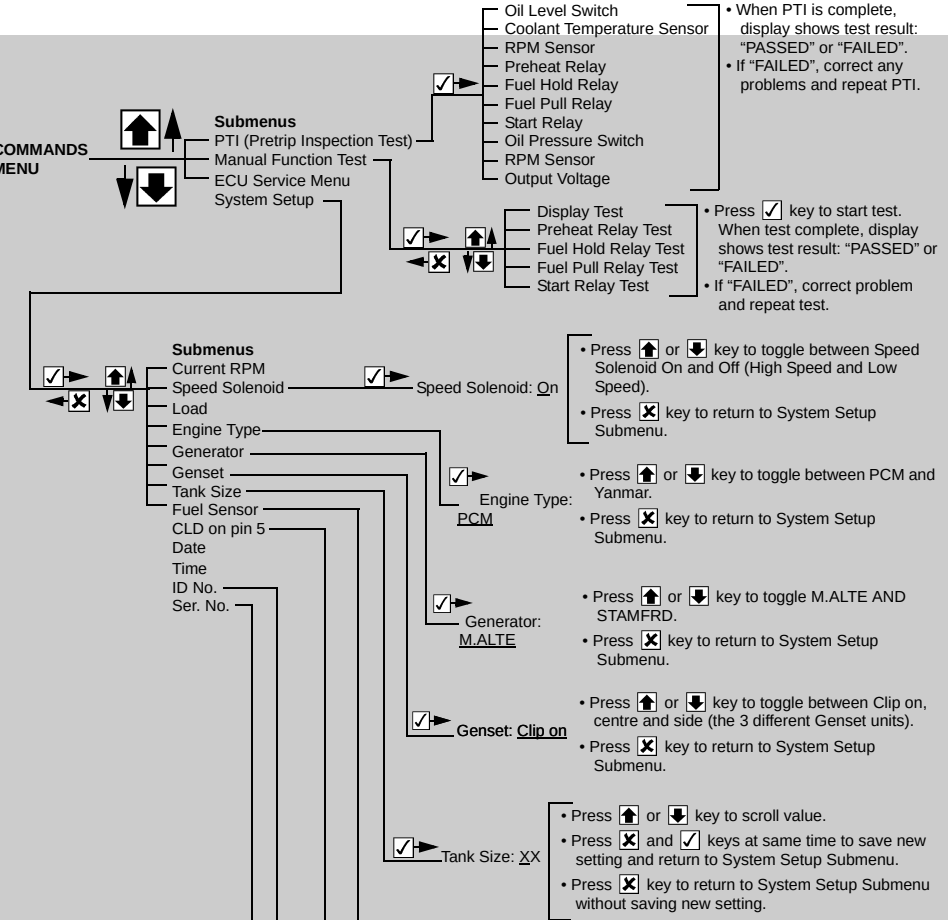
CONTROLLER MENU GUIDE

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

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

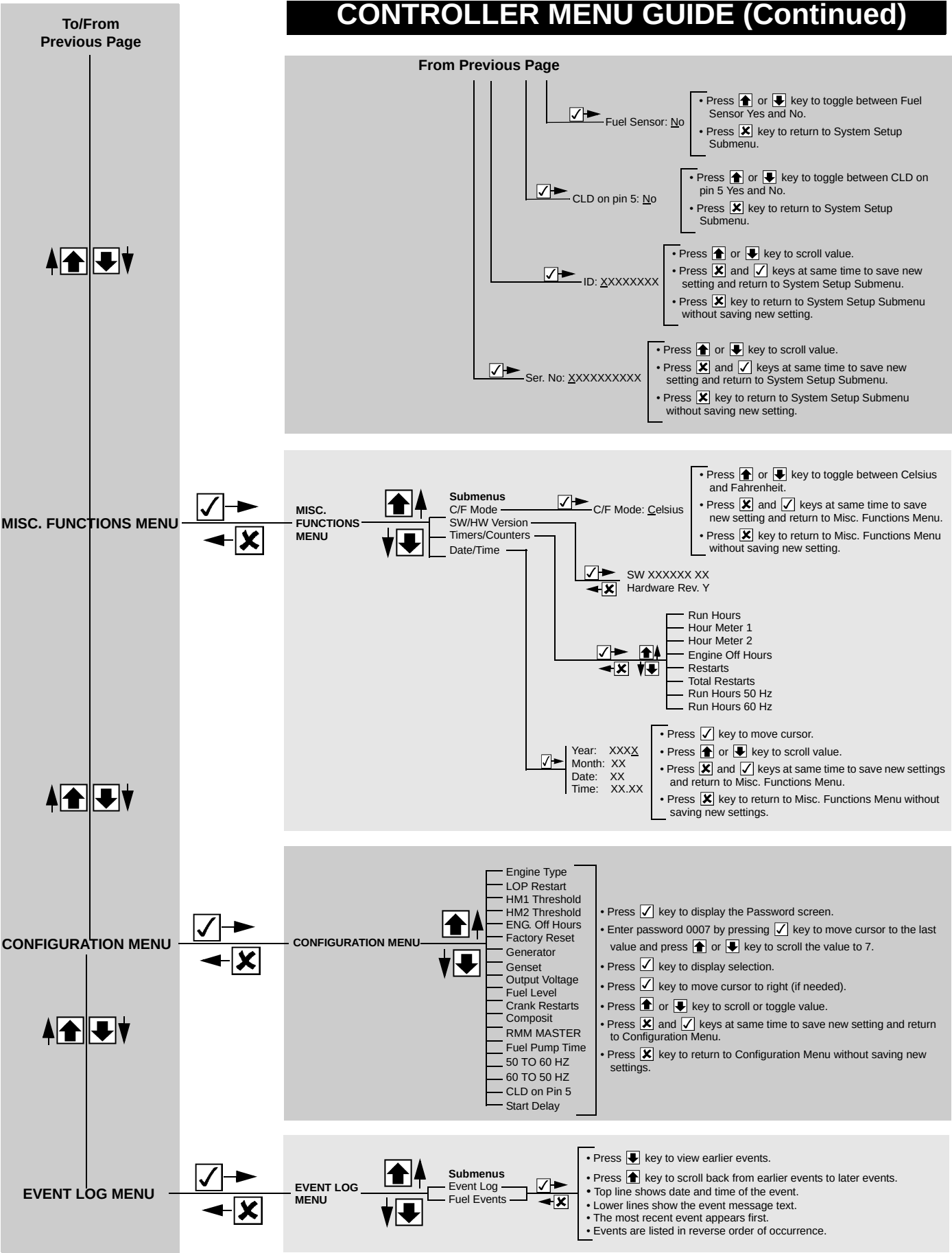


- MESSAGE LIST MENU**
- Top line shows Message Code, and the position of the message and number of messages stored in memory (e.g. “1/2”).
 - Middle lines show message text.
 - Bottom line shows message status.
 - View and write down all messages before acknowledging.
- Press key to view additional messages.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



To Next Page

CONTROLLER MENU GUIDE (Continued)





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