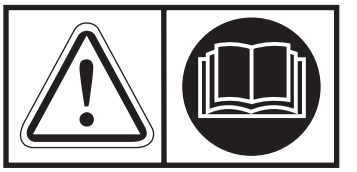
65, 125 & 150 kVA Towable Generator

Service Manual



112504USCN
Rev (A)

Preface

This service manual explains about the cautions for maintenance jobs and is to serve a guide for the electric system, and troubleshooting for service personnel.

In this book the fundamental matters and other things already mentioned in the “Instruction Manual” and the “Parts Catalogue” are omitted to avoid duplication.
Therefore, for the operation and handling of this unit, we request you to refer to the instruction manual and caution plates, and further for the structure and components of the unit, please refer to the “Parts Catalogue” separately to be supplied with the unit.
If you should find any description which does not coincide with the instruction manual and parts catalog, we request you to make sure to start the job after clarifying it.

Service personnel is required to safely take quick and proper countermeasures as well as to use correct technology of maintenance in case of field services and periodical maintenance. It is important that service personnel should have proper and sufficient knowledge about the structure and function of the unit and should be well familiar with such technique mentioned in them.

Regarding the part numbers mentioned in this manual, we request you to refer to the Parts catalogue separately supplied together with the unit, because the parts numbers in this manual are sometimes changed.

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∗:For maintenance of engine parts, see "Engine Workshop manual and Troubleshooting manual" published by engine manufacturer.

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1. Specification

1.1 Specifications

Model			65kVA		
Generator	Exciting system		Brushless		
	Armature connection		Star with Neutral		ZigZag
	Phase number		Three		Single
	Power factor	%	80		100
	Frequency	Hz	60		
	Rated output	kVA	63		36.5
	Rated output	kW	50		36.5
	Voltage	V	240	480	240/120
	Current	A	152	76	152
Engine	Model		ISUZU BJ-4JJ1X		
	Type		4-cycle, water-cooled, direct injection, turbo charged, intercooled		
	Number of cylinders		4		
	Total displacement	cu. in. (L)	183 (2.999)		
	Rated output	hp (kW)	81.8 (61.0)		
	Revolution per minute	rpm (min^{-1})	1,800 (1,800)		
	Lubricating oil capacity	gal. (L)	4.0 (15.0)		
	Coolant capacity (including radiator)	gal. (L)	2.9 (11.0)		
	Battery		95R31R (12V)		
	Fuel tank capacity	gal. (L)	106 (401)		
General Specifications	Overall length	in. (mm)	82 (2,080) (gen) / 141 (3566) (w/trailer)		
	Overall width	in. (mm)	39 (1,000) (gen) / 68 (1715) (w/trailer)		
	Overall height	in. (mm)	61 (1,560) (gen) / 73 (1852) (w/trailer)		
	Net dry mass (weight)	lbs (kg)	2,875 (1,305) (gen) / 3900 (1769) (w/trailer)		
	Operating mass (weight)	lbs (kg)	3,660 (1,660) (gen) / 4680 (2123) (w/trailer)		
Others	The capacity of oil fence	gal. (L)	41 (155)		

1. Specification

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1. Specification

Model			125kVA		
Generator	Exciting system		Brushless		
	Armature connection		Star with Neutral		ZigZag
	Phase number		Three		Single
	Power factor	%	80		100
	Frequency	Hz	60		
	Rated output	kVA	125		72
	Rated output	kW	100		72
	Voltage	V	240	480	240/120
	Current	A	300	150	300
Engine	Model		ISUZU BI-4HK1X		
	Type		4-cycle, water-cooled, direct injection, turbo charged, intercooled		
	Number of cylinders		4		
	Total displacement	cu. in. (L)	317 (5.193)		
	Rated output	hp (kW)	152 (113.6)		
	Revolution per minute	rpm (min^{-1})	1,800 (1,800)		
	Lubricating oil capacity	gal. (L)	5.4 (20.5)		
	Coolant capacity (including radiator)	gal. (L)	5.7 (21.5)		
	Battery		170F51 (12V)		
	Fuel tank capacity	gal. (L)	198 (750)		
General Specifications	Overall length	in. (mm)	96 (2,450) (gen) / 185 (4678) (w/trailer)		
	Overall width	in. (mm)	46 (1,180) (gen) / 77 (1956) (w/trailer)		
	Overall height	in. (mm)	72 (1,830) (gen) / 85 (2163) (w/trailer)		
	Net dry mass (weight)	lbs (kg)	4,729 (2,145) (gen) / 6229 (2825) (w/trailer)		
	Operating mass (weight)	lbs (kg)	6,173 (2,800) (gen) / 7675 (3481) (w/trailer)		
Others	The capacity of oil fence	gal. (L)	38 (145)		

1. Specification

Model			150kVA		
Generator	Exciting system		Brushless		
	Armature connection		Star with Neutral		ZigZag
	Phase number		Three		Single
	Power factor	%	80		100
	Frequency	Hz	60		
	Rated output	kVA	150		87
	Rated output	kW	120		87
	Voltage	V	240	480	240/120
	Current	A	361	180	363
Engine	Model		ISUZU BH- 6HK1X		
	Type		4-cycle, water-cooled, direct injection, turbo charged, intercooled		
	Number of cylinders		6		
	Total displacement	cu. in. (L)	475 (7.790)		
	Rated output	hp (kW)	190.4 (142)		
	Revolution per minute	rpm (min^{-1})	1,800 (1,800)		
	Lubricating oil capacity	gal. (L)	10.0 (38)		
	Coolant capacity (including radiator)	gal. (L)	6.7 (25.5)		
	Battery		95D31×2 (24V)		
	Fuel tank capacity	gal. (L)	215 (814)		
General Specifications	Overall length	in. (mm)	126 (3,190) (gen) / 185 (4678) (w/trailer)		
	Overall width	in. (mm)	46 (1,180) (gen) / 77 (1956) (w/trailer)		
	Overall height	in. (mm)	74 (1,880) (gen) / 87 (2213) (w/trailer)		
	Net dry mass (weight)	lbs (kg)	6,007 (2,725) (gen) / 7510 (3407) (w/trailer)		
	Operating mass (weight)	lbs (kg)	7,628 (3,460) (gen) / 9130 (4142) (w/trailer)		
Others	The capacity of oil fence	gal. (L)	112 (423)		

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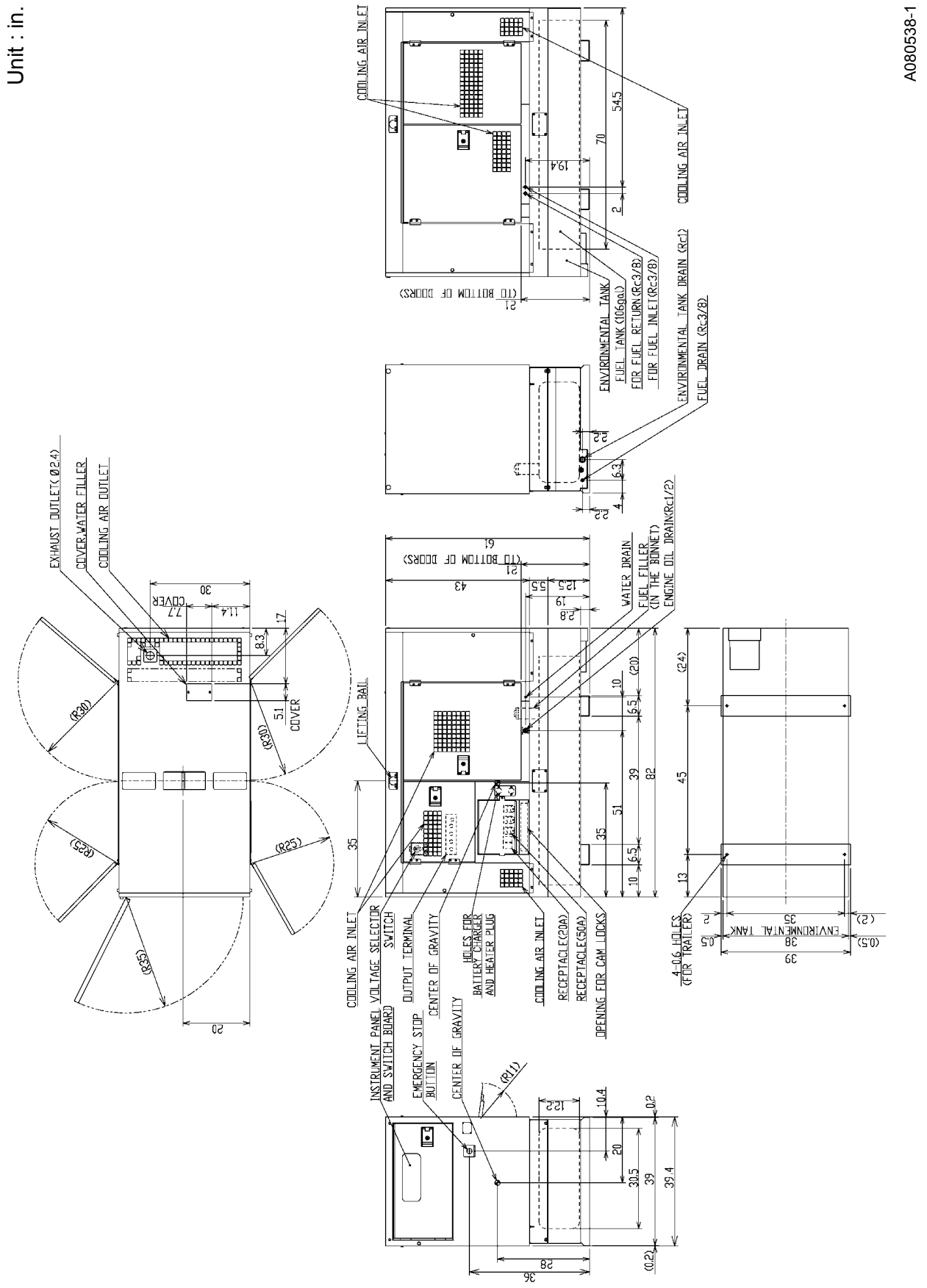
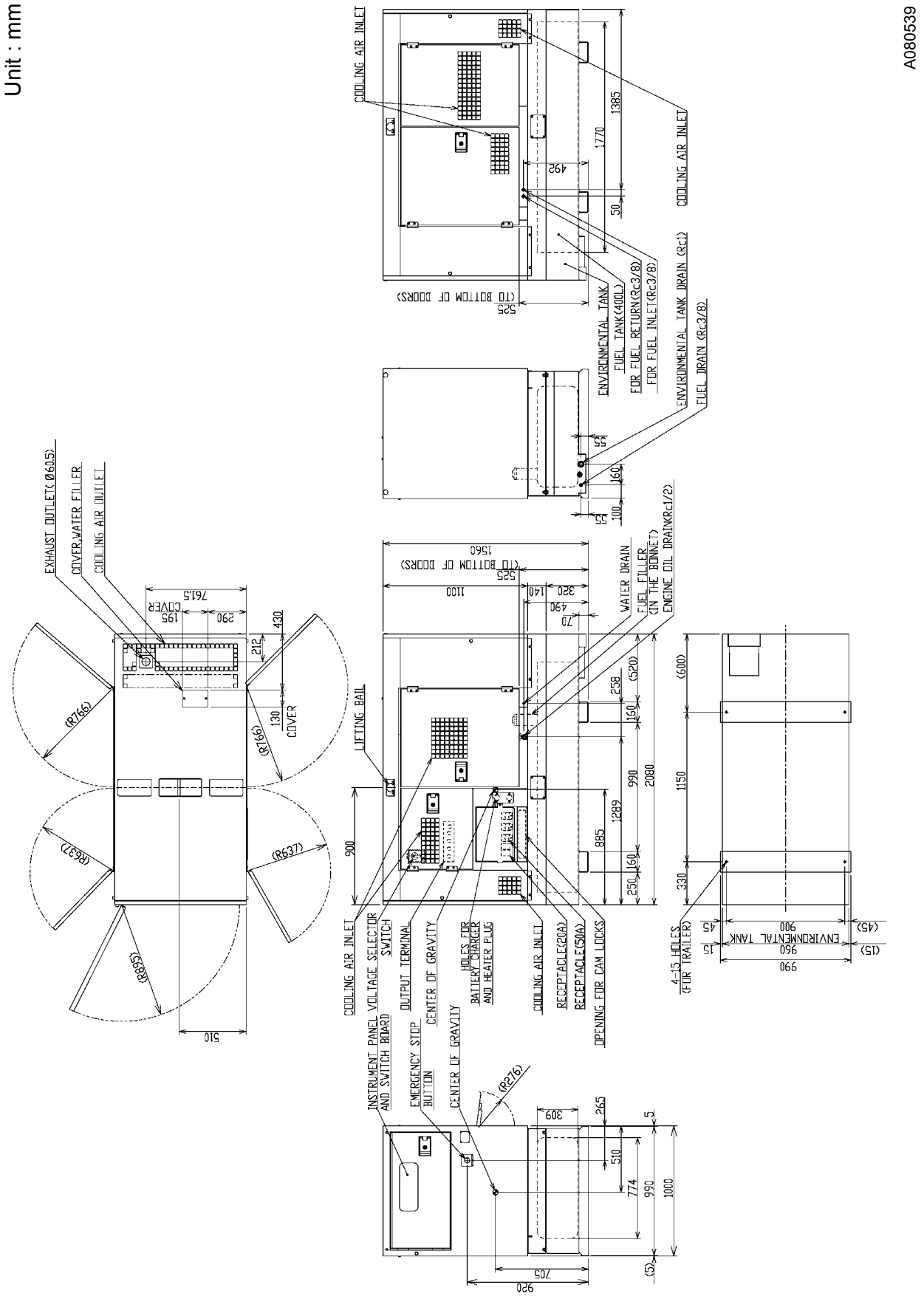
1. Specification

65kVA (shown without trailer)



1. Specification

65kVA (shown without trailer)



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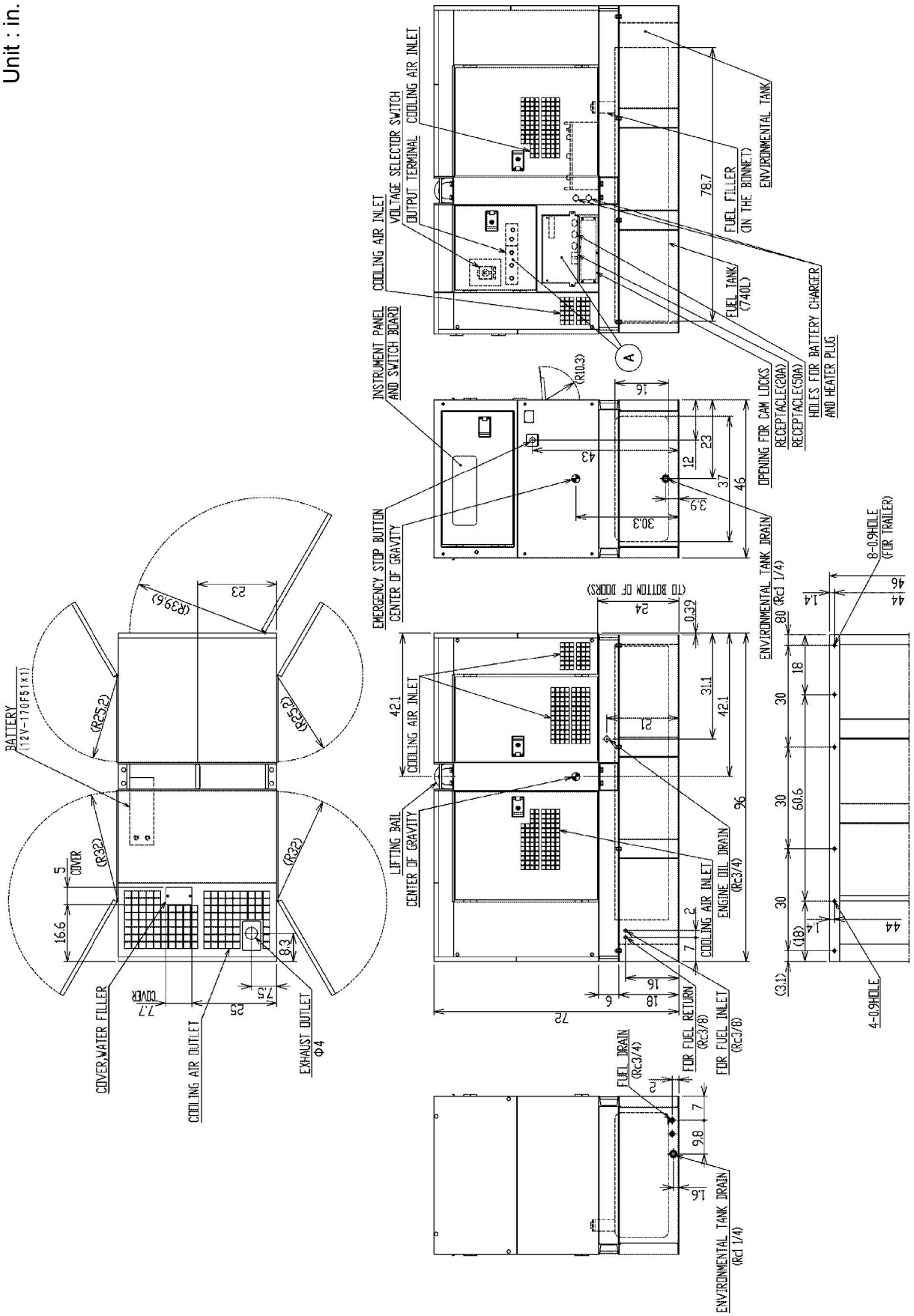
125kVA (shown without trailer)

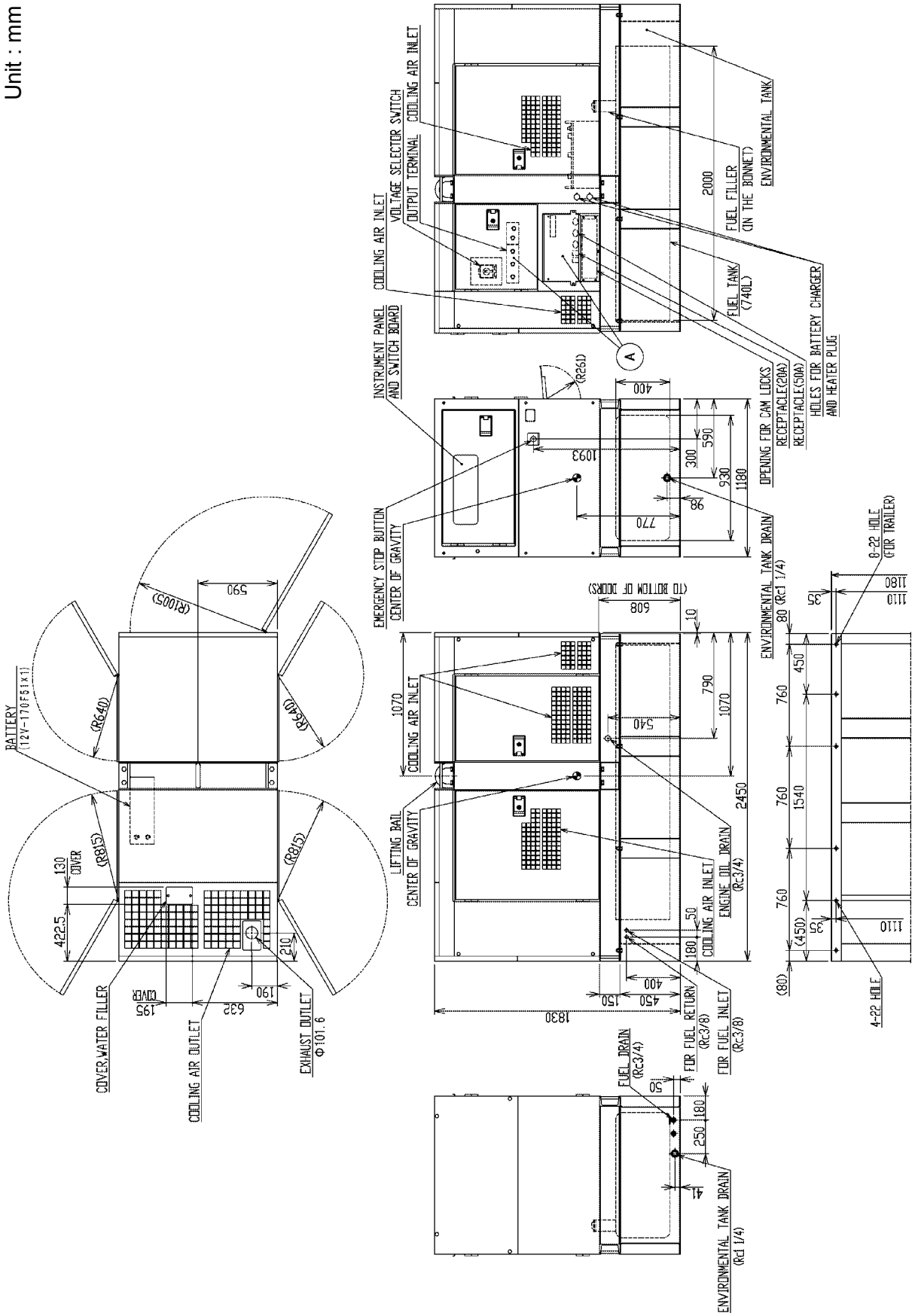
Unit : in.

A080042



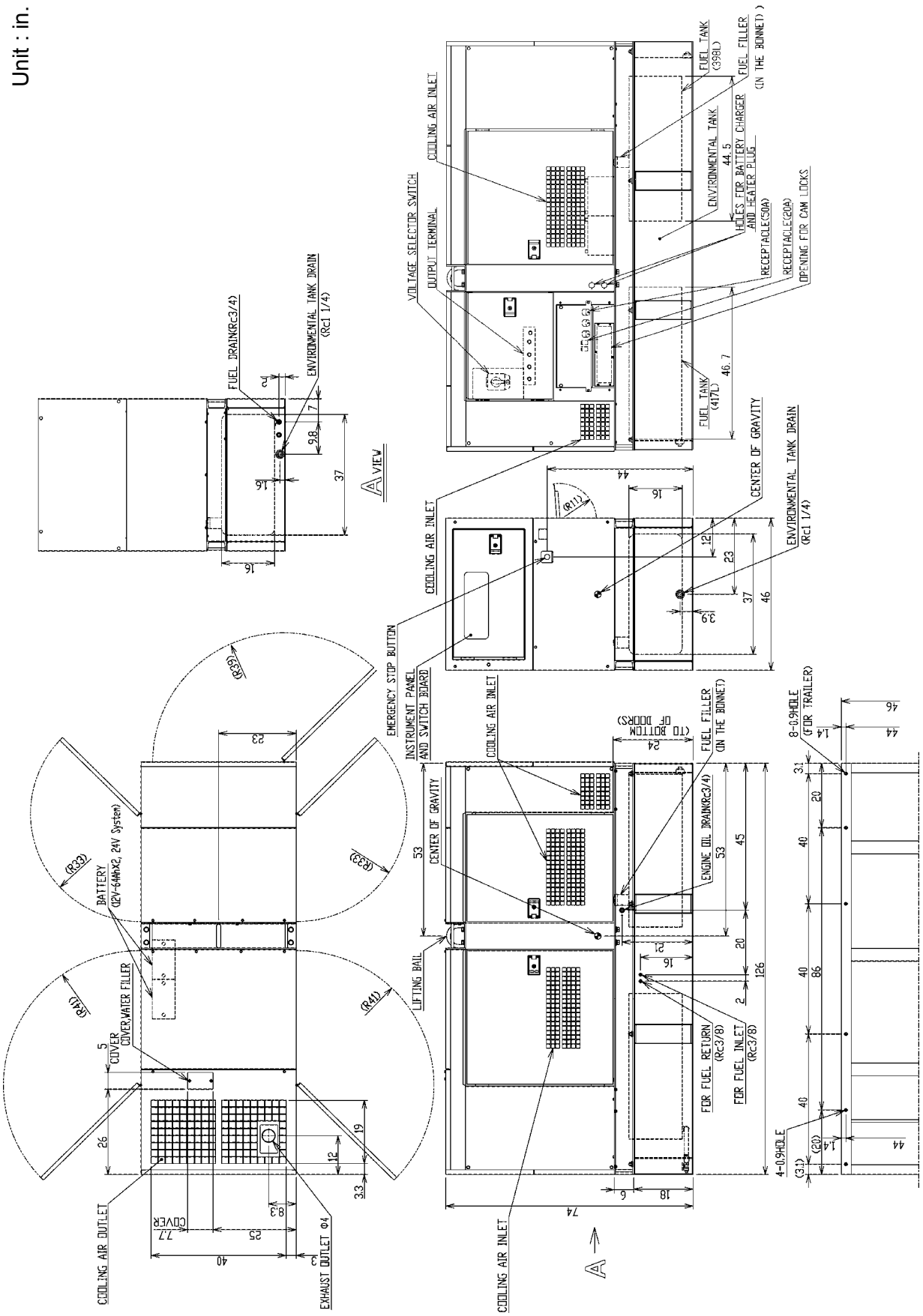
125kVA (shown without trailer)

Unit : mm



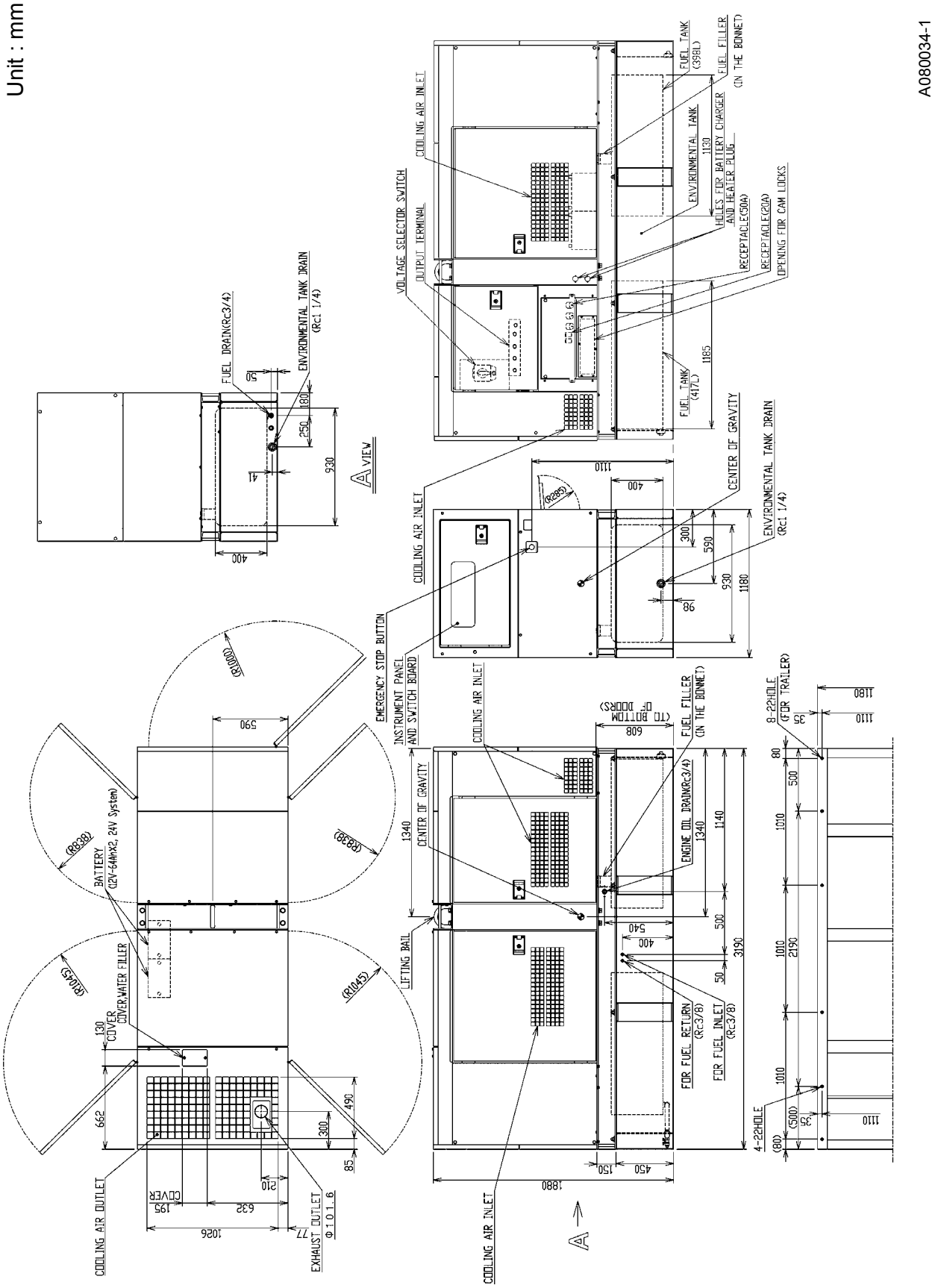
1. Specification

150kVA (shown without trailer)



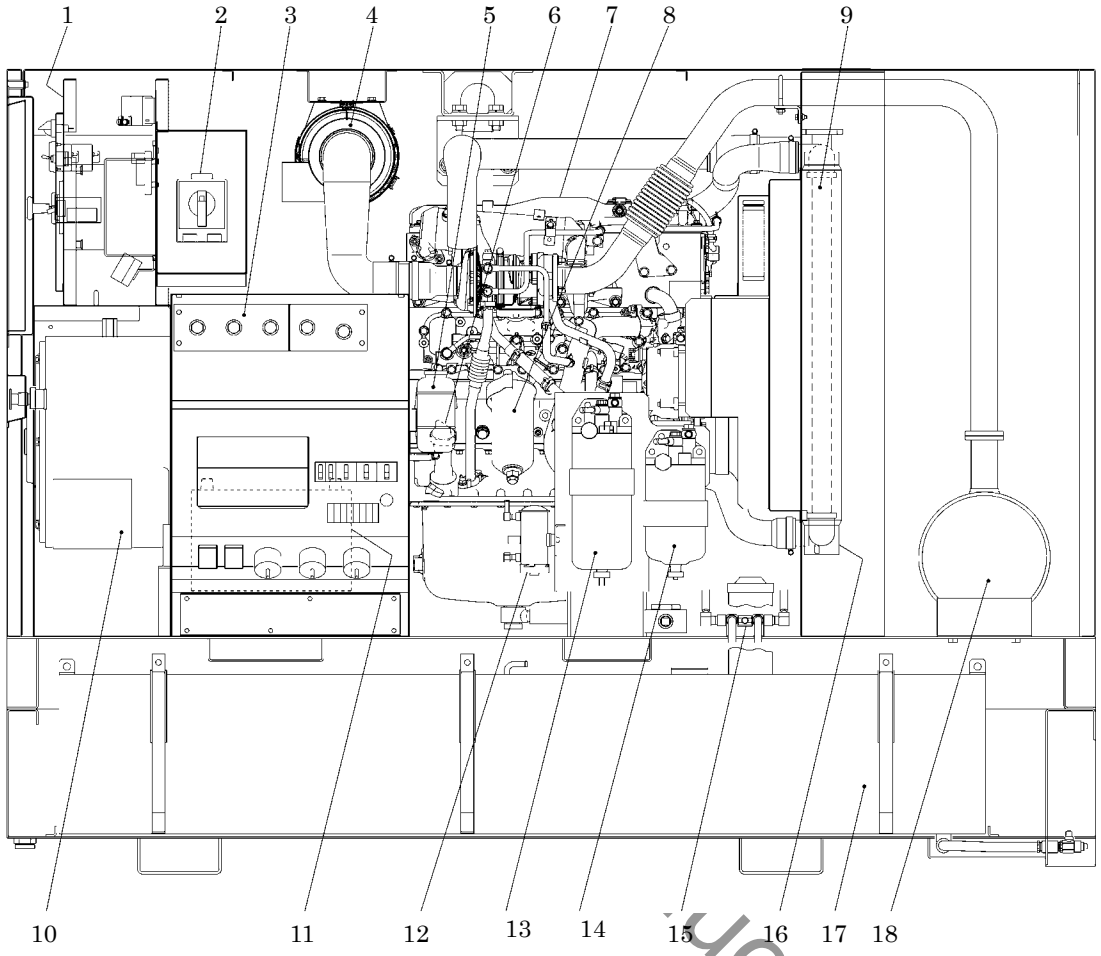
1. Specification

150kVA (shown without trailer)



1.3 Internal Components

65kVA



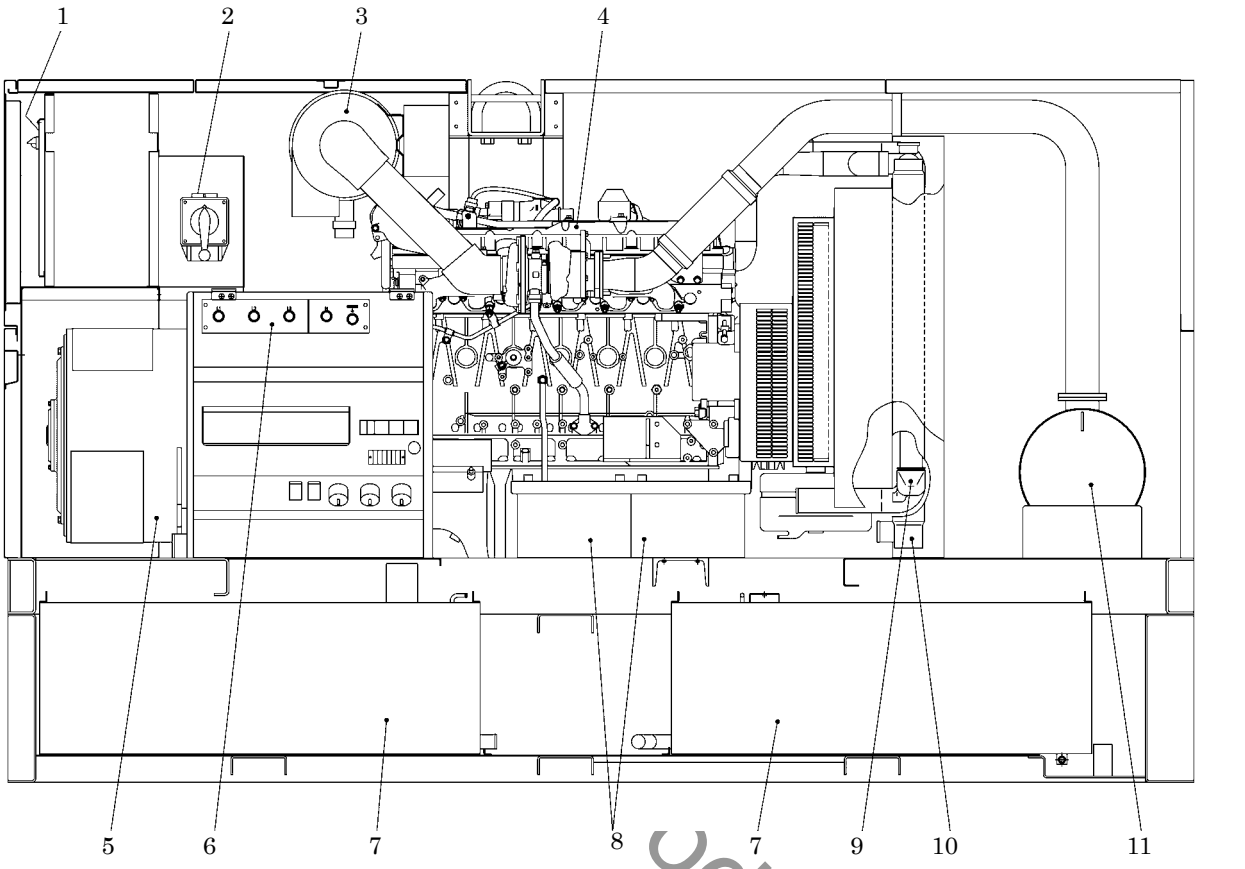
65kVA

1. Control panel
2. Voltage selector switch
3. Output terminals
4. Air filter
5. Reserve tank
6. Engine oil filler port
7. Engine
8. Engine oil filter
9. Radiator
10. Generator main unit
11. Battery ＊
12. Air bleeding electromagnetic pump
13. Fuel pre-filter
14. Fuel filter
15. Selector valve of fuel pipe
16. Intercooler
17. Fuel tank
18. Exhaust muffler

Instrument 11 marked "＊" are provided on the other side.

1. Specification

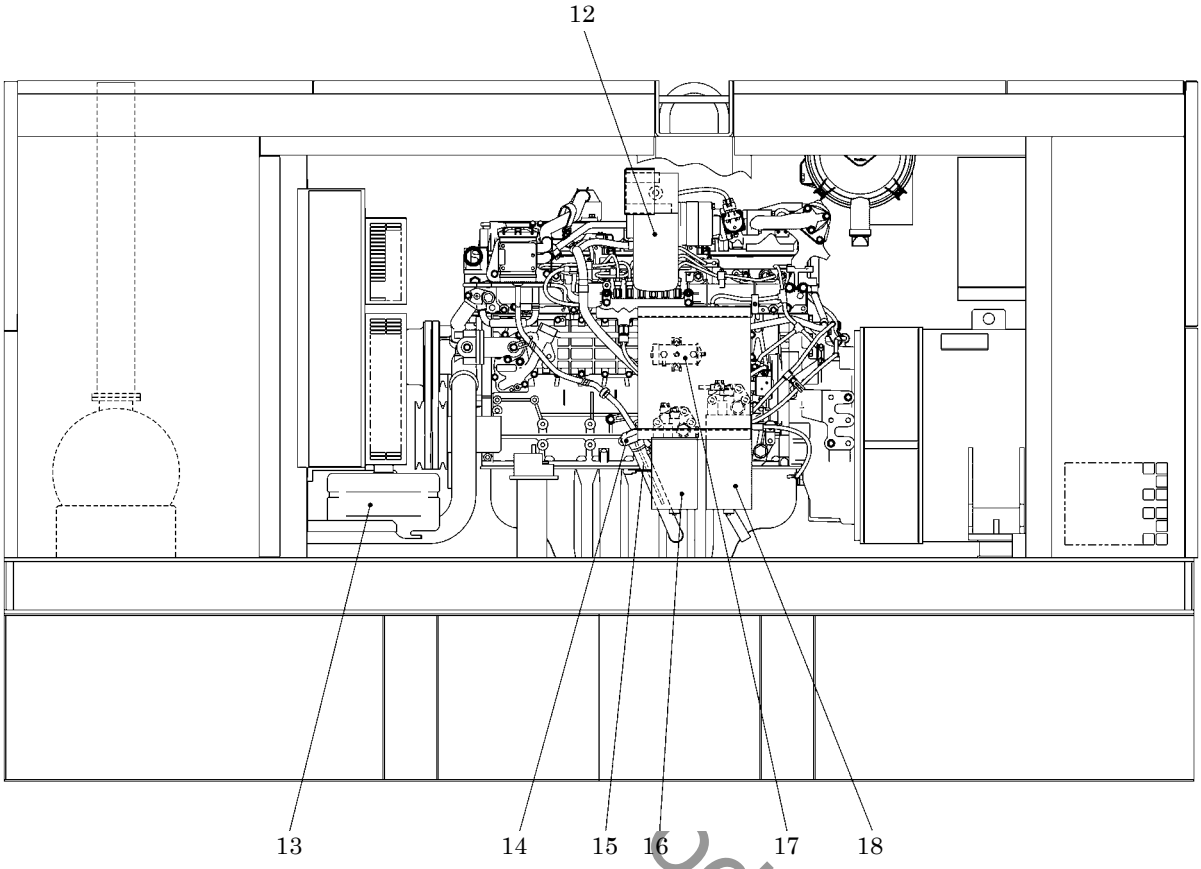
125/150kVA



150kVA

1. Control panel
2. Voltage selector switch
3. Air filter
4. Engine
5. Generator main unit
6. Output terminals
7. Fuel tank
8. Battery
9. Radiator
10. Intercooler
11. Exhaust muffler

1. Specification



150kVA

12. Engine oil filter
13. Reserve tank
14. Engine oil filler port
15. Engine oil level gauge
16. Fuel filter
17. Air bleeding electromagnetic pump
18. Fuel pre-filter

2. Overhauling

2.1 Cautions for Overhauling

2.1.1 Precautions before starting work

(1) Work to be performed

It is very important to always plan in advance what facilities, tools, instruments, materials, oil, etc. you will need to use; the exact locations and methods of performing inspection, adjustment, or disassembly; and the key points of any repair work to be performed.

(2) Care not to spill oil

Use a pan to collect used engine oil when changing the oil or attaching or detaching an oil line. If a large volume of oil is expected to flow out, make sure to drain any accumulated oil from the engine oil pan in advance.

(3) Care when detaching parts

When disassembling a complicated part, put a matching mark to indicate the position of detached parts for future reference. Make sure that the negative(－) cable is detached from the battery terminals before starting repair work.

(4) Tools to be prepared

① Measuring instruments (e. g. tester, insulation resistance gauge etc.)
② Tools
③ Torque wrenches
④ Jigs and specialized tools
⑤ Solder and soldering iron
⑥ Sealing tape
⑦ Molybdenum sulfide (tube type)
⑧ Lithium-base grease
⑨ Diesel oil (cleaning solvent)
⑩ Cleaning cloths
⑪ Literatures (such as manuals etc.)

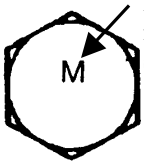
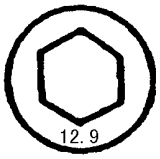
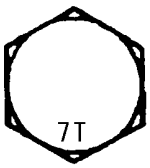
2.1.2 Disassembly and reassembly

① Wash dirt, dust and grime off vinyl tube and fuel hose before removing it, and take necessary steps to cover or tape the openings of vinyl tubes or fuel hoses to prevent any dirt from entering them.
② Perform disassembly work in a dust-free location whenever possible.
③ When disassembling parts, wash their outer surface and place them on a clean sheet of paper or cloth, taking care not to contaminate or damage them.
④ Wash disassembled parts with diesel oil (cleaning solvent) after checking for contamination or discoloration. However, do not wash rubber parts with diesel oil.
⑤ Be careful not to damage disassembled parts, they are precision built.
⑥ Replace consumables such as oil seals, O-rings, filters, oil, etc. with new items when reassembling parts.
⑦ Apply a coating of clean grease to O-rings when installing them in the machine.
⑧ When reassembling parts, place each part in the order of assembly and take care that no parts are missing or misassembled.
⑨ When reassembling an assembled part (set part), be sure to replace it as an assembly.
⑩ Contamination or rusting may occur due to dust or humidity if parts are left in disassembled or partly disassembled condition for a long time. Therefore, be careful to prevent dust or rust from affecting parts if you have to leave the repair incomplete for a long period of time.
⑪ Check tightening torque and clearance when assembling parts.
⑫ Check the direction of rotation, speed, and oil leakage after assembly.
⑬ Before starting the machine after disassembly, run it at low idle to check for unusual noises, etc. to prevent engine or generator damage.

2.2 Tightening Torque

2.2.1 General tightening torque of bolts and nuts

Fasten all the bolts and nuts with the specified tightening torque when assembling.

Type / Strength, classification, and indication example / Torque / Nominal diameter (mm)	Low or medium carbon steel bolt (SS400B, etc.)		High strength steel bolt (SCM435, etc.)	
	4.6－6.8 (4T－6T)  Indication does not appear in some cases. Hexagon headed bolt		8.8－12.9 (7T－12T)  Socket bolt  Hexagon headed bolt	
	lb･ft	N･m (kgf･cm)	lb･ft	N･m (kgf･cm)
6	3.7	5 (51)	7.2	10 (100)
8	9	12 (124)	18	25 (245)
10	18	25 (245)	35	49 (485)
12	31	43 (425)	61	85 (845)
14	49	68 (675)	98	135 (1350)
16	76	106 (1055)	152	210 (2100)
18	105	145 (1450)	210	290 (2900)
20	148	205 (2050)	297	410(4100)
22	203	280 (2800)	405	560 (5600)
24	250	345 (3450)	514	710 (7100)
Applied sections.	For general sections such as bonnet and frame.		For specified sections.	

IMPORTANT

- Each clamping torque listed in the above-mentioned table applies to bolts being used for generators.
- The list shows normal clamping torque. In some sections, special specified torque is required. In such a case, use the specified torque only.
- Make sure to remove rust and dust before tightening.

2.2.2 Tightening torque for terminal plate

IMPORTANT

- When connecting the output terminals of the generator, it is important to tighten the screws, according to the designated torque.
  Since the terminal is so small, it could be burned or damaged without the proper torque.

Bolt size	Tightening torque
	lb·ft [N·m (kgf·cm)]
M3.5	0.7 [1.0 (10)]
M4	1.1 [1.5 (15)]
M5	2.2 [3 (30)]
M6	3.7 [5 (51)]
M8	7.2 [10(100)]
M10	12.7 [18(175)]
M12	25 [35(350)]

2.3 Disassembly/Reassembly of Generator Main Unit and Connection of Generator Main Unit and Engine

2.3.1 Disassembly of generator main unit

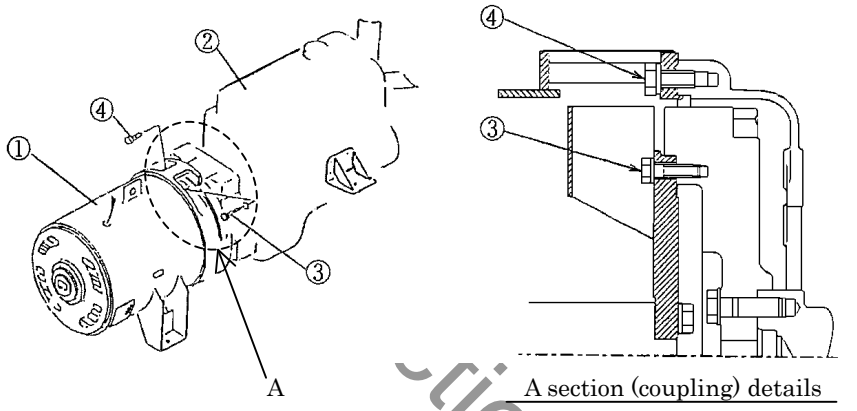
IMPORTANT

- The generator main unit is unilaterally mounted and the clearance is small, so it must be handled with extreme care to avoid the possibility of damage to the rotor or stator.
- Use hoisting equipment of sufficient capacity when it is necessary to lift up the engine and the generator main unit.

Lifting weight Unit : lbs (kg)

	65kVA	125kVA	150kVA
Weight of generator main unit	595 (270)	980 (445)	1,224 (555)
Weight of engine	705 (320)	1,036 (40)	1,373 (623)

① Generator main unit
② Engine
③ Bolts (for coupling of the engine flywheel and the generator coupling)
④ Bolts (for connection of the engine flywheel housing and the generator main unit frame)



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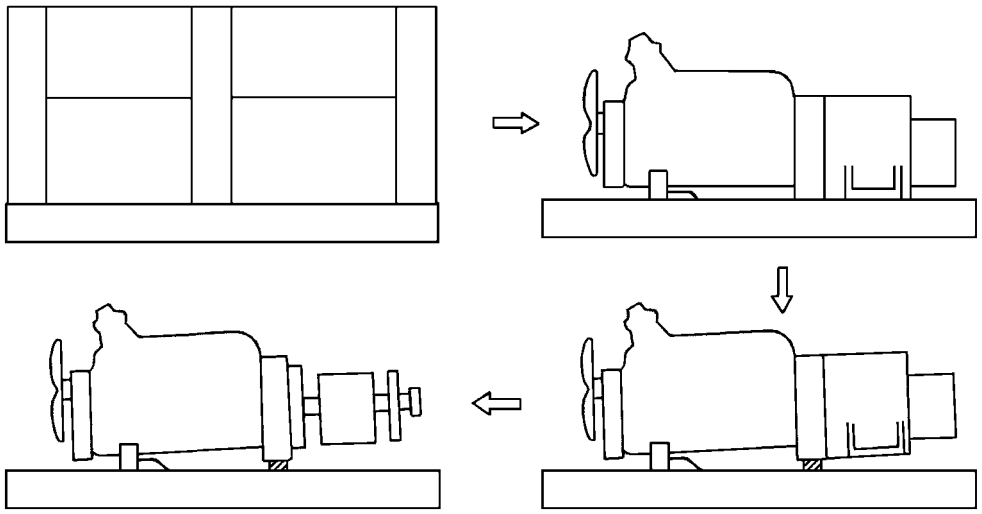
2. Overhauling

(1) Procedures of disassembly

1. Remove cables from battery (-) terminal.
2. Remove brackets (or fittings for muffler, air filter and etc.) equipped on the bonnet.
3. Remove top cover and dismantle such parts on the bonnet so that generator main unit can be pulled out.
4. Remove cables and pipes.
5. Remove mounting bolts of generator main unit and engine.
6. Remove engine cooling fan guard and fan shroud.
7. If necessary, remove radiator, radiator hoses, fuel tank and battery.
8. Insert an angle timber under the engine housing for inclining the engine.
9. Separate engine housing and generator stator.
10. Separate engine flywheel and generator rotor.



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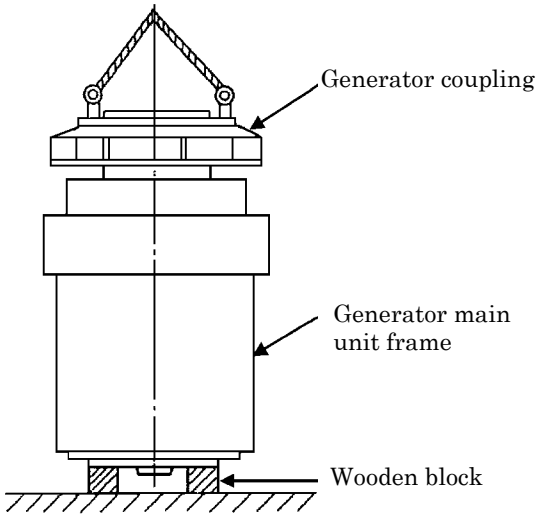
※If insulation film is damaged by contact of stator and rotor during disassembly of generator main unit, perform varnish drying treatment to such portion.

(2) Demounting stator and rotor at the same time from engine

When demounting stator and rotor of generator main unit at the same time from engine, place the generator main unit with the engine coupling face upward, and pull out the rotor.

At this time, stabilize the generator main unit frame padded by wooden block at the bearing side face.

(The generator main unit separated from engine should be kept firm with the rotor in the stator fastened by wire or rope to prevent them from moving. Then start this job.)



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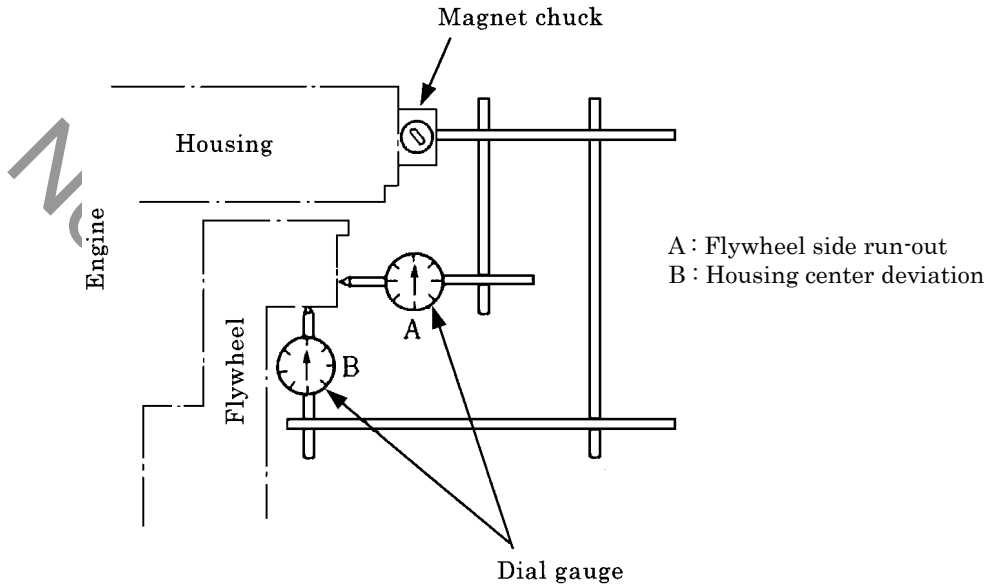
2.3.2 Measuring center deviation and surface deviation

Measure them with a dial gauge pressed to the flywheel.

(1) Measuring the center deviation, turn the rotor with the dial gauge pressed to the circumference of the coupling flange. If the biggest value measured on the same circumference exceeds 0.008in. (0.2mm), it is necessary to repair it.

(2) Measuring the side run-out, turn the rotor with the dial gauge pressed vertically to the coupling flange. If the biggest value measured on the same diameter exceeds 0.008in. (0.2mm), it is necessary to repair it.



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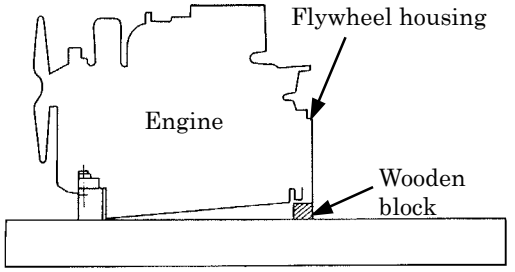
2.3.3 Assembly of engine flywheel and generator coupling (rotor)

IMPORTANT

- The mounting holes are not equally spaced along the circumference. Therefore, position the holes in advance so as to match the coupling counterpart by turning and adjusting the engine flywheel.
- Use guide bolts while centering to mount the assembly.
- Tighten the bolts to the specified torque.

(1) Mounting engine

Mount the engine on the vibration isolator rubbers at the frame side of engine. Put angle wooden block under the engine housing and incline the engine a little.



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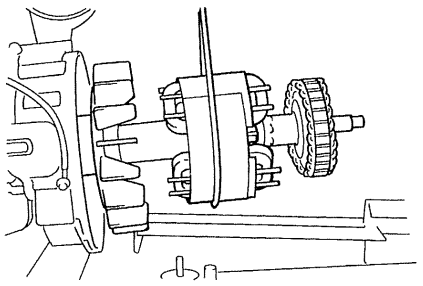
(2) Install rotor

1. Hang the center of the rotor with jute rope and bring it near to the flywheel.
2. Match the rotor coupling plate to the engine flywheel and then combine them, tightening the coupling connecting bolts.
   The coupling connecting bolts shall be high tensile bolts 7T or more. (Use 2 guide bolts for this job.)



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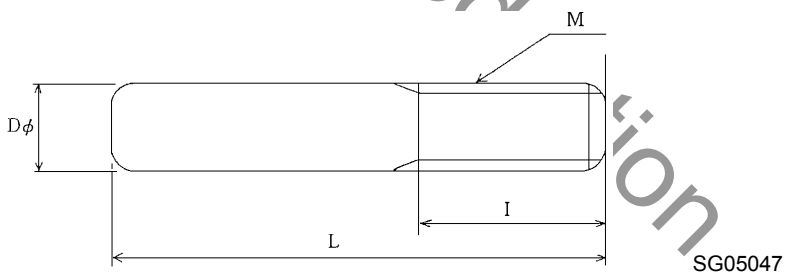
Size of guide bolt



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Unit : in. (mm)

	65kVA	125kVA	150kVA
D ϕ	0.37 (9.5)	←	←
L	1.97 (50)	2.95 (75)	←
I	0.98 (25)	←	←
M	(M10×1.5)	←	←

Tightening torque of generator coupling (rotor) (See ③ of 2.3.1 bolts)

		65kVA	125kVA	150kVA
Bolt size	(mm)	(M10×1.5-30)	(M10×1.5-20)	←
Quantity		8	←	←
Tightening torque	lb·ft [N·m] (kgf·cm)	46.3 [62.8] (640)	←	←

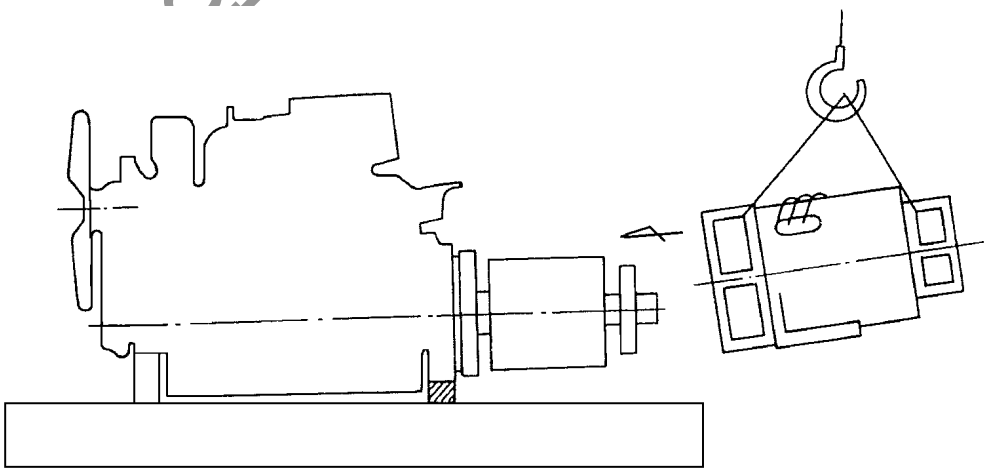
2.3.4 Assembly of flywheel housing and generator main unit frame (stator)

IMPORTANT

- Handle the stator with care after fastening the engine flywheel and generator coupling, to avoid damage to either the rotor or stator.
- Tighten the connections to the specified torque.
- For connection of flywheel housing and generator main unit frame (stator), coat anti-corrosion agent " METAL CLEAR" on the connecting faces to prevent rust and corrosion.

Install the stator

1. Carefully push into the stator, preventing the stator and rotor from rubbing each other.
2. Install the flywheel housing and the stator, tightening the connecting bolts.
   The bolts should be high tensile 7T or more.
3. Remove the angle wooden block from under the flywheel housing, and place the generator main unit and engine horizontally.



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Tightening torque of generator main unit frame (stator) connecting bolts. (See ④ of 2.3.1 Bolts)

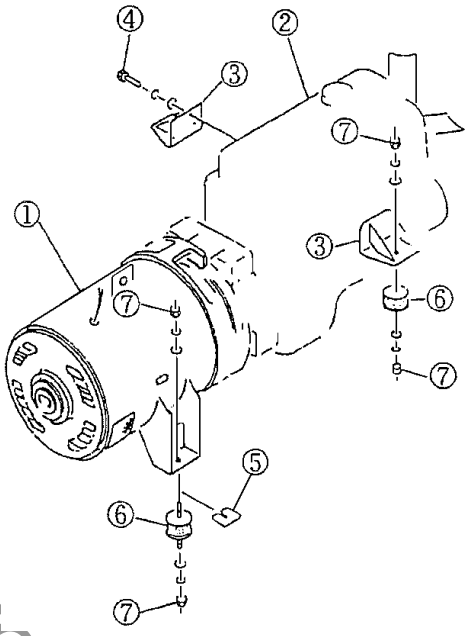
		65kVA	125kVA	150kVA
Bolt size	(mm)	(M10×1.5-30)	←	←
Quantity		12	←	←
Tightening torque	lb·ft [N·m] (kgf·cm)	17.7 [24.0] (245)	←	←

2.3.5 Mounting of generator main unit and engine on frame

IMPORTANT

- Perform centering carefully, to avoid deviation in the horizontal leveling caused by distortion of the frame or inaccurate mounting of the generator main unit and engine.
- Running the machine without accurate centering may cause abnormal vibrations.

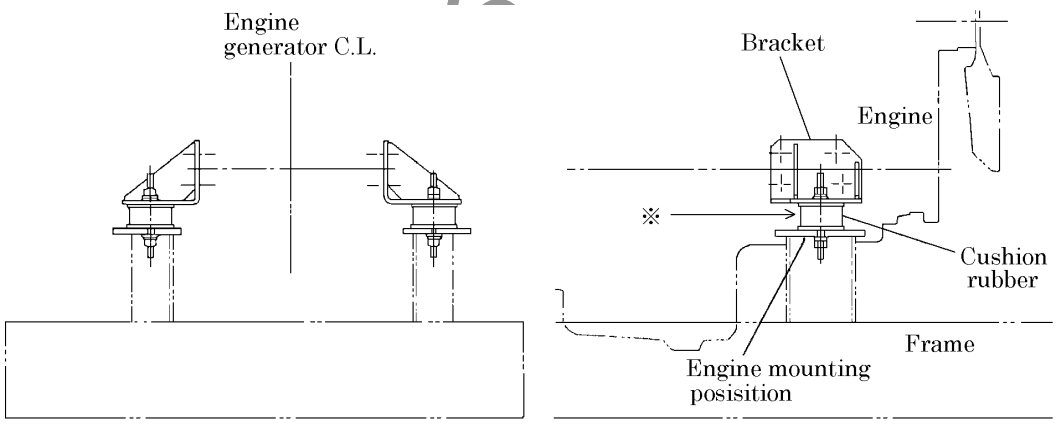
① Generator main unit
② Engine
③ Bracket
④ Bolt
⑤ Shim
⑥ Cushion rubber
⑦ Nut



SG05048

(1) Centering method

1. Mount the brackets on the engine secured to the generator main unit.
   (Use only genuine fastening bolts.)
2. Place four assembly level plates ※ on the points for mounting the engine and the generator main unit onto the frame.
3. Place the generator main unit with the engine mounted onto it on the assembly level plates on the frame.
4. Use shims for adjustment if joint gaps are found at any of the four places where the brackets and assembly level plates are to be fixed.
5. Lift the engine mounted onto the generator main unit, leaving the shims in the four places after adjustment.
6. Remove the assembly level plates and place the cushion rubbers in their respective places on the frame.
   (Insert or place adjusting shims on the vibration isolator rubbers of both engine and generator main unit.)
7. Place the engine with the generator main unit on the cushion rubbers and fasten it with nuts.
   (Placing vibration isolator rubbers for 65kVA, make sure to put plain washers on the rubbers. If not, the vibration isolator rubbers are left loose. So vibration could damage vibration isolator rubbers and machine.)
8. Make sure to coat the bolts with anti-corrosion agent " Metal Clear" which are tightened for vibration isolators. (8 points consisting of upper side 4 pieces and under side 4 pieces.)

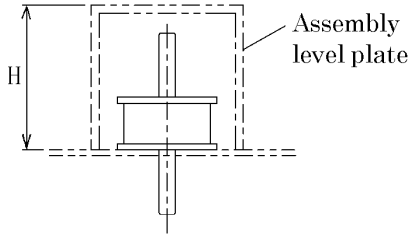


SG05049E

※ Before installing vibration isolators, place assembly level plate on the position of generator main unit and engine connection and then adjust the clearance between engine mounting bracket and assembly level plate.

Assembling level plates size Unit : in. (mm)

	65kVA	125kVA	150kVA
Generator side	4.10 (104)	4.04 (102.5)	3.23 (82)
Engine side	3.78 (96)	4.41 (112)	3.58 (91)

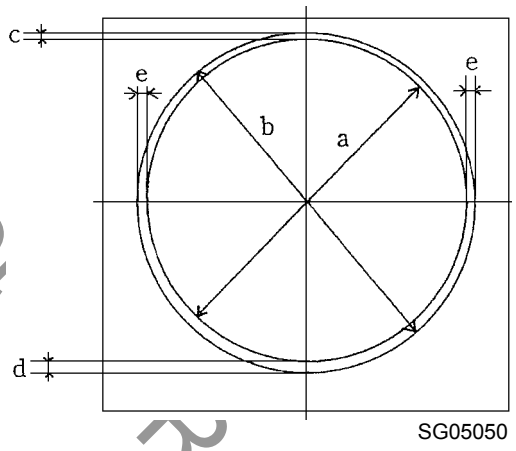


SG09001E

(2) Check the gap between the cooling fan and fan shroud

IMPORTANT

- Maintain an adequate gap in both the vertical and horizontal directions.
- If the fan is mounted incorrectly so that it leans toward one side wall of the shroud, leading to a smaller gap in one direction, the fan may produce abnormal noise due to rubbing against the shroud during starting or stopping and may also overheat.



Gap size Unit : in. (mm)

		65kVA	125kVA	150kVA
Fan outer diameter	(a)	21.7 (550)	22.8 (580)	25.6 (650)
Shroud inner diameter	(b)	22.8 (580)	24.0 (610)	26.8 (680)
Top gap	(c)	0.47 (12)	←	←
Bottom gap	(d)	0.71 (18)	←	←
Side gap	(e)	0.59 (15)	←	←

2.3.6 Changing the bearings in the generator main unit

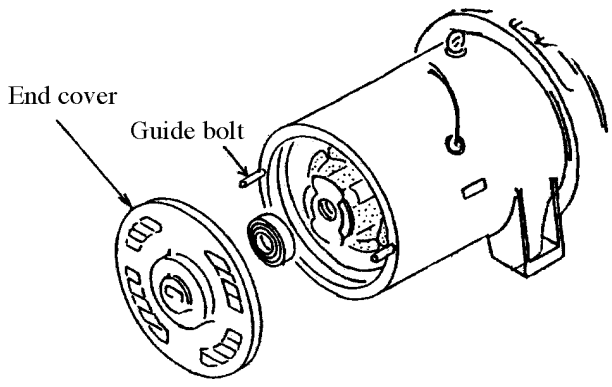
IMPORTANT

- Use guide bolts to avoid the danger of dropping the bearing shield and to prevent the rotor and stator from rubbing against each other. (Use the guide bolts used to mount the generator main unit.)
- Do not hit the bearing outer race when installing or the bearing may be damaged.

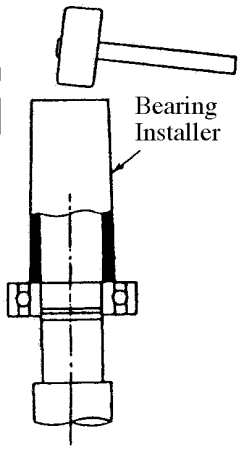
The generator main unit is equipped with fully sealed bearing. It is not necessary to supply grease. But the machine life (4 years or 15,000 ~ 20,000 hours of operation) may change, depending upon the conditions such as vibration, ambient temperature and humidity. So always make sure to check for any abnormal noise of the bearings and also to check for any abnormal rise of temperature. Should it become necessary to replace the bearings, follow the under mentioned procedures.

Replacement of bearings

1. Remove bearing shield (end cover).
2. Pull out the bearing from the shaft, using bearing removing tools (gear puller).
3. Clean the surface of the shaft and check for any damages.
4. Prepare a new bearing, and check it by turning it by hand before installing it.
5. Heat the bearing in the oil bath at average 100 to 118℃ (Never heat it over 120℃ or partially.) and then install the bearing using a bearing installer (Heated bearing can be installed to the shaft.)
6. Set guide bolts to the generator main unit frame.
7. Push in the bearing shield (end cover), hitting it with a plastic hammer evenly.



SG06061



SG06062

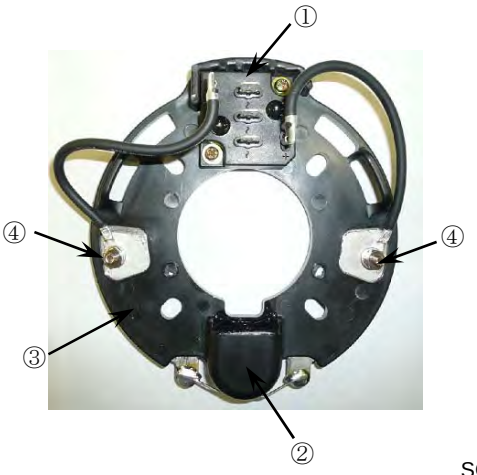
2.3.7 Replacement of rotary rectifier

IMPORTANT

- When installing diode module (silicon rectifier), it is necessary to be careful not to damage it due to over-tightening.
- Shorten time to keep soldering iron touch on diode module (silicon rectifier).
- Degrease such surfaces where thread looseness is prevented by thread locking fluid.

65kVA

① Diode module
② Surge absorber
③ Insulating plate
④ Lead wire (alternator)

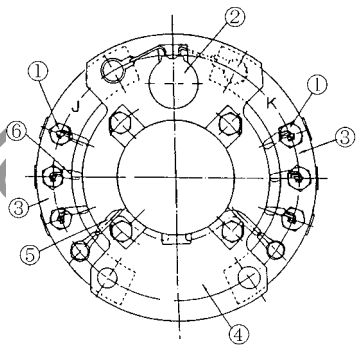


SG09106

May differ from shown

125kVA /
150kVA (−0898)

① Silicon rectifier
② Surge absorber
③ Conductive plate
④ Insulating plate
⑤ Lead wire (alternator)
⑥ Lead wire (exciter)

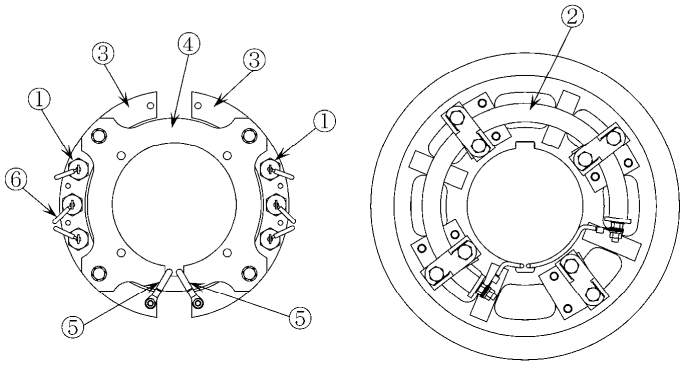


AS-016

Above shows rotary rectifier fitted to 125kVA

150kVA (0899−)

① Silicon rectifier
② Surge absorber
③ Conductive plate
④ Insulating plate
⑤ Lead wire (alternator)
⑥ Lead wire (exciter)



SG10126

Tightening torque

			65kVA	125kVA	150kVA
Rotary rectifier	Thread size		M6 (Nut)	M6-20	←
	Tightening torque	lb・in [N・m] (kgf・cm)	36.5 [4.1] (42)	←	←
	Thread locking fluid		Three Bond 1402B	←	←
Conductive plate	Thread size		M4-10 (Brass)	M6-25,16	M6-20
	Tightening torque	lb・in [N・m] (kgf・cm)	8.7 [1.0] (10)	36.5 [4.1] (42)	←
	Thread locking fluid		Three Bond 1402B	←	←
※Diode module (Silicon rectifier)	Model		S30VT80 (M3 Screw)	SKN26(K) SKR26(J)	←
	Tightening torque	lb・in [N・m] (kgf・cm)	7.8 [0.9] (9.0)	17.7 [2.0] (20.4)	←
	Thread locking fluid		Three Bond 1402B	←	—

※:In the above table 65kVA is equipped with diode module and 125－150kVA with silicon rectifier. Accordingly, tightening torque and thread locking fluid are based on 65kVA with diode module and 125－150kVA with silicon rectifier.

Replacement procedures of rotary rectifier

① Remove rotor according to 2.3.1 “Disassembly of generator main unit”.
② Pull out bearings from the shaft, using bearing puller.
③ Record positions of cable connection of the rotary rectifier.
④ Remove rotary rectifier, disconnecting cables fitted to the rotary rectifier.
⑤ Remove diode module (silicon rectifier).
⑥ Install new diode module (silicon rectifier).
[Silicon rectifier of 125 /150kVA has forward direction polarization to K side, and reverse direction polarization to J side. So be careful not to make mistake in polarization. (For the details, see 3.2.1 “Rotary rectifier” and 4.5 D “Checking Rotary Rectifier and Surge absorber“.
⑦ Diode module (silicon rectifier) should be tightened according to tightening torque mentioned in above table, using torque wrench.
⑧ Diode module (silicon rectifier) should be connected by soldering iron.
⑨ Rotary rectifier should be removed in reverse order to installation procedures.

2.4 Engine Maintenance Standards

			65kVA
Engine model			ISUZU BJ-4JJ1XYGD-04
Tightening torque of head bolts		lb･ft [N･m(kgf･cm)]	51.7 [70.1 (715)]
Valve clearance	Air intake	in. (mm)	0.006 (0.15) [normal temperature]
	Discharge	in. (mm)	0.006 (0.15) [normal temperature]
Firing order			1-3-4-2
Injection timing (BTDC)		°	Electronic control
Nozzle injection pressure		psi (MPa)	—
Compression		psi (MPa)	435 (3.0) [Rotation speed 200rpm (200min^{-1})]
Thermostat	Temperature for start of release	°F (°C)	185 (85)
	Full open temperature	°F (°C)	198 (92)
	Valve lift	in. (mm)	0.39 (10)

2. Overhauling

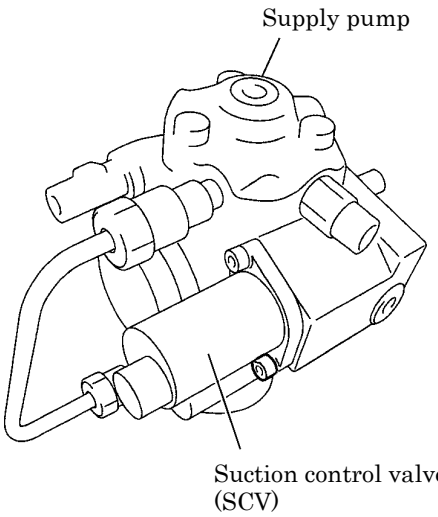
			125kVA
Engine model			ISUZU　BI-4HK1XYGD-02
Tightening torque of head bolts		lb･ft [N･m(kgf･cm)]	13.3　[18.0 (183.5)]
Valve clearance	Air intake	in. (mm)	0.016 (0.4)　[normal temperature]
	Discharge	in. (mm)	0.016 (0.4)　[normal temperature]
Firing order			1-3-4-2
Injection timing (BTDC)		°	Electronic control
Nozzle injection pressure		psi (MPa)	—
Compression		psi (MPa)	441 (3.04)　[Rotation speed 220rpm (220min^{-1})]
Thermostat	Temperature for start of release	°F (°C)	180 (82)
	Full open temperature	°F (°C)	203 (95)
	Valve lift	in. (mm)	0.39 (10)

			150kVA
Engine model			ISUZU　BH- 6HK1XYGD-02
Tightening torque of head bolts		lb･ft [N･m(kgf･cm)]	9.6　[13.0 (132.5)]
Valve clearance	Air intake	in. (mm)	0.016 (0.4)
	Discharge	in. (mm)	0.016 (0.4)
Firing order			1-5-3-6-2-4
Injection timing (BTDC)		°	Electronic control
Nozzle injection pressure		psi (MPa)	—
Compression		psi (MPa)	441 (3.04)　[Rotation speed 200rpm (200min^{-1})]
Thermostat	Temperature for start of release	°F (°C)	180 (82)
	Full open temperature	°F (°C)	203 (95)
	Valve lift	in. (mm)	0.39 (10)

2.5 Suction Control Valve (SCV) Replacement Procedure

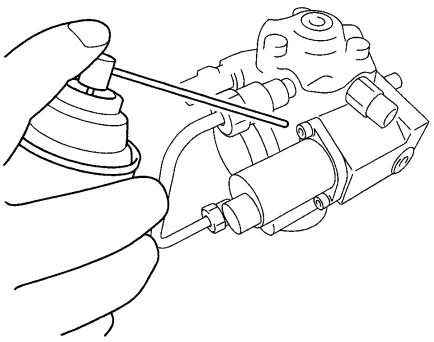
Note:
The illustration indicates the supply pump unit only in order to explain easily.

① Disconnect the suction control valve (SCV) connector.



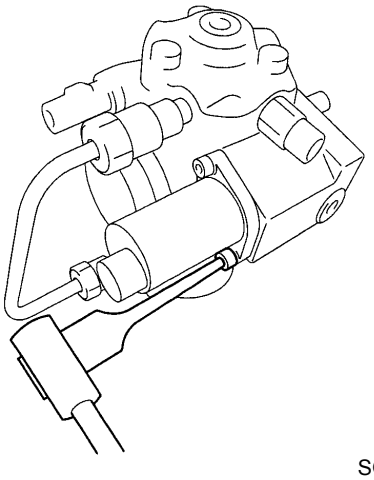
SG09043

② Wash the outside of the suction control valve (SCV) using a cleaning spray.

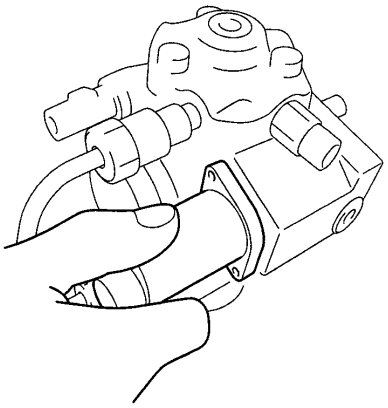

SG09044

Note:
- Wash the suction control valve (SCV) to remove dust or foreign matter in the pump housing or on the installation surface when replacing it.
- Do not allow cleaning solvent of the spray to enter inside of the suction control valve (SCV) connector.

③ Remove the two bolts which tighten the suction control valve (SCV).


SG09045

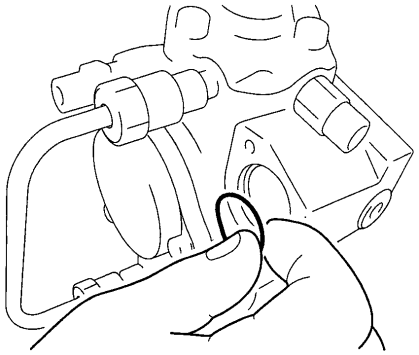
④ Pull out the suction control valve (SCV).



SG09046

Note:
- If it is hard to pull it out due to the resistance on the O-ring, pull it out while rotating it from side to side.
- To prevent foreign matter from entering, do not put gloves on from the next work.

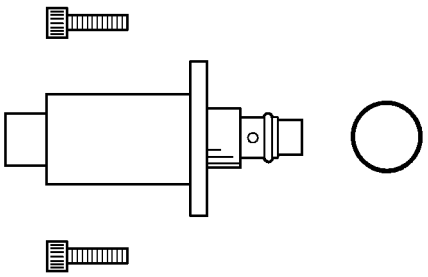
⑤ Remove the O-ring of the suction control valve (SCV).



SG09047

Note:
Be careful not to let foreign matter enter the pump housing at removal.

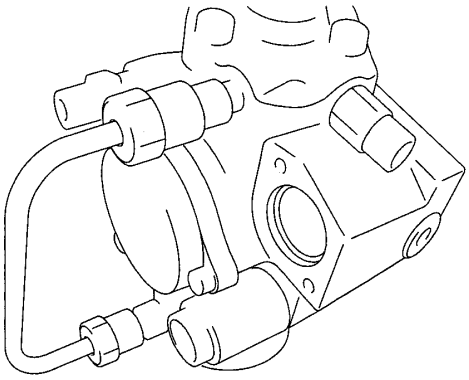
⑥ Check the replacement part.



SG09048

Note:
Make sure that you have got all parts indicated in the illustration.

⑦ Place the new O-ring in the O-ring groove.



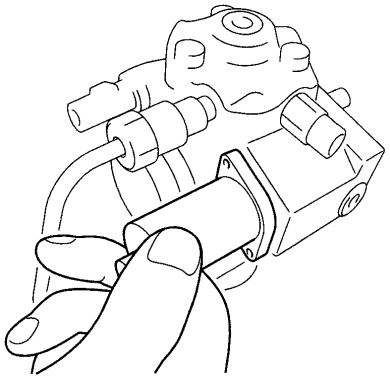
SG09049

Note:
- Do not touch the O-ring with dirty hands.
- Perform this work after making sure there is no foreign matter in the O-ring groove.

⑧ After placing the O-ring, apply oil to it.

Note:
- Use clean oil such as new engine oil.
- Do not let foreign matter on the O-ring.

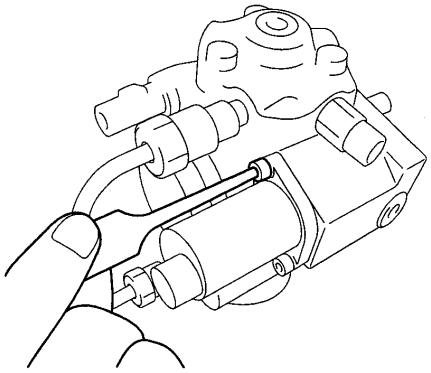
⑨ Insert the suction control valve (SCV) into the pump housing.



SG09050

Note:
Insert the suction control valve (SCV) by hand until it contacts the housing.
If it is hard to insert the suction control valve (SCV), insert it while rotating it from side to side slightly.

⑩ Temporarily tighten the two suction control valve (SCV) installing bolts.

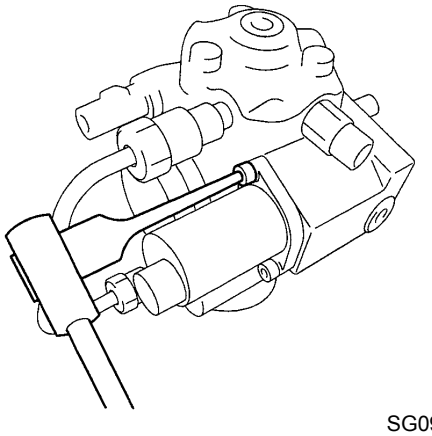


SG09052

Note:
Temporarily tighten the two bolts evenly by hand until the suction control valve (SCV) contacts the pump housing completely.

⑪ Fully tighten the suction control valve (SCV) installing bolts to the specified torque.

: 5.1～8.0lb･ft [6.9～10.8N･m (70～110kgf･cm)]



SG09053

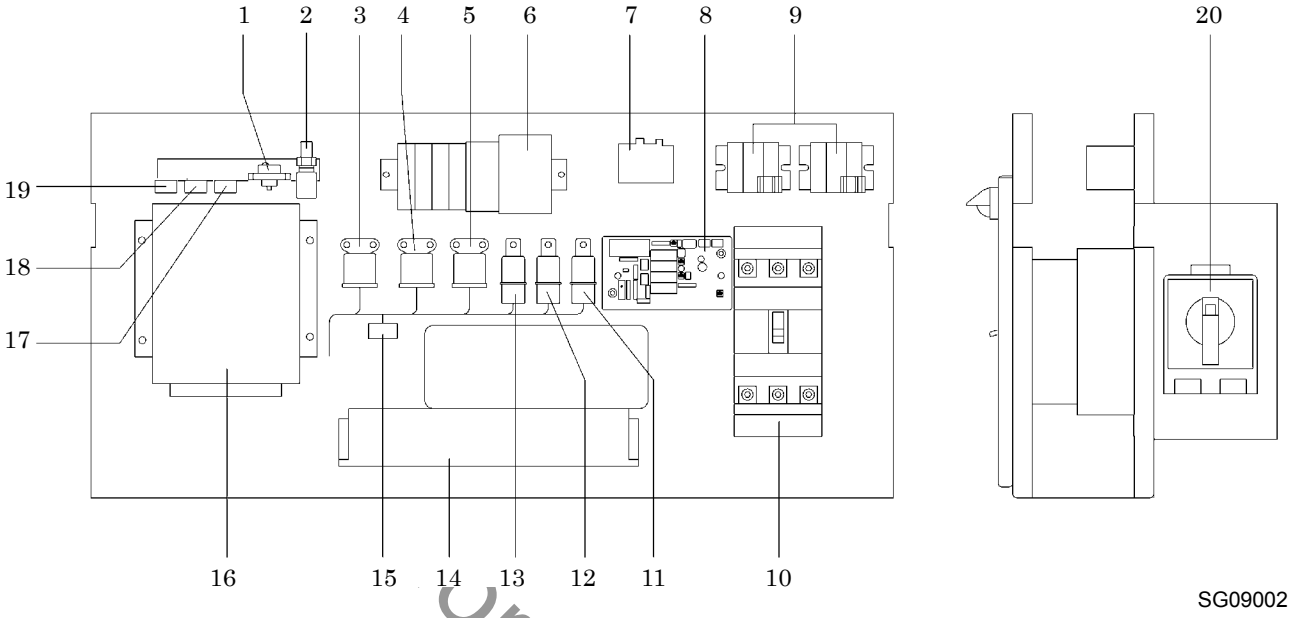
Note:
After tightening the two bolts, tighten again the bolt tightened firstly.

⑫ Connect the suction control valve (SCV) connector.
⑬ Wipe off the fuel which was leaked at replacement work.
⑭ Start the engine, and make sure there is no fuel leaked from the installation part of the suction control valve (SCV).

3. Electrical Parts

3.1 Installation Positions of Electrical Appliances

65kVA



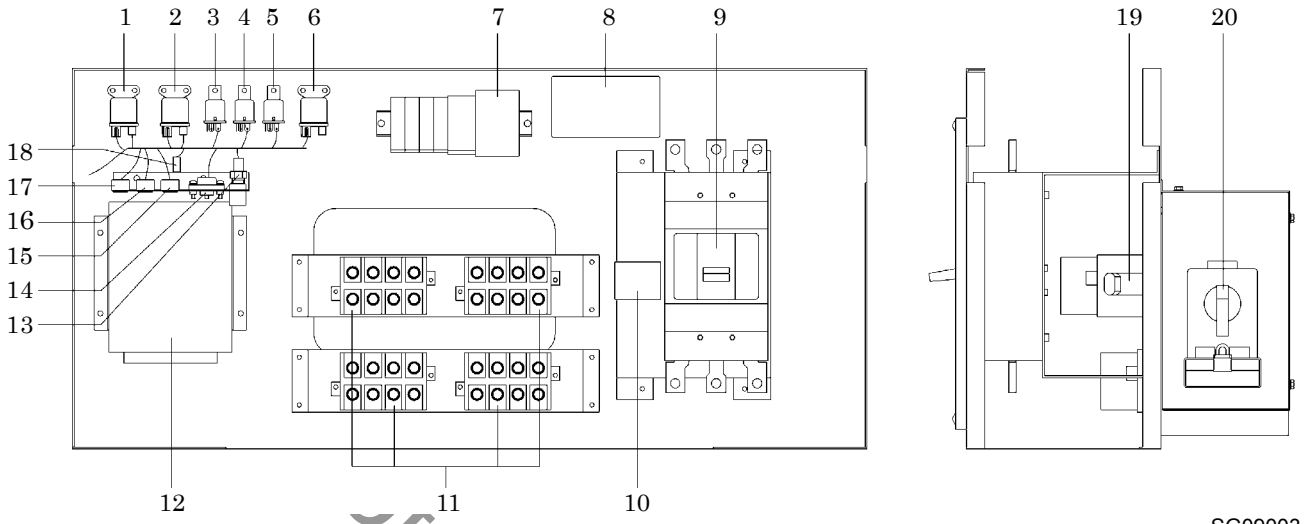
SG09002

1. Barometric pressure sensor
2. Intake air temperature sensor
3. Starter relay (SY)
4. Glow relay (GR)
5. Magnetic switch (MR1)
6. Automatic operation unit
7. Thermal relay
8. Automatic voltage regulator (AVR)
9. Current transformer
10. Three-phase circuit breaker
11. Fuel pump relay (FR)
12. Safety relay (SR)
13. Main relay (MR2)
14. Terminal plate
15. Fuse (60A)
16. Controller (ECM)
17. Fuse (15A)
18. Fuse (20A)
19. Fuse (10A)
20. Voltage selector switch ※

※The voltage selector switch is provided on the output terminal plate of the right bonnet.

3. Electrical Parts

125kVA



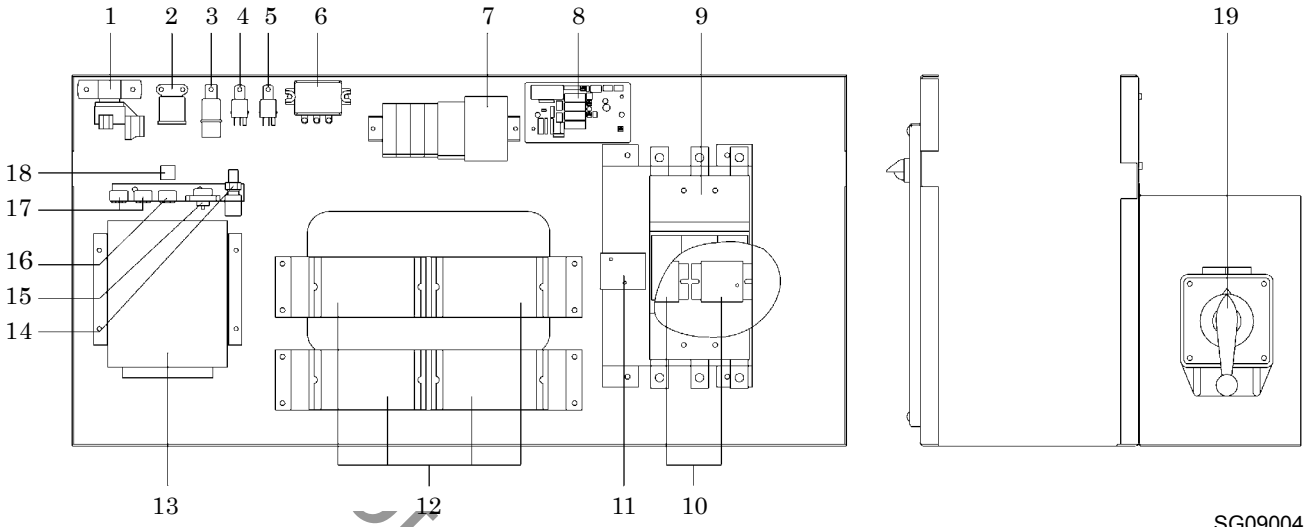
SG09003

1. Starter relay (SY)
2. Glow relay (GR)
3. Main relay (MR2)
4. Safety relay (SR)
5. Fuel pump relay (FR)
6. Magnetic switch (MR1)
7. Automatic operation unit
8. Automatic voltage regulator (AVR)
9. Three-phase circuit breaker
10. Thermal relay
11. Terminal plate
12. Controller (ECM)
13. Intake air temperature sensor
14. Barometric pressure sensor
15. Fuse (15A)
16. Fuse (20A)
17. Fuse (10A)
18. Fuse (60A)
19. Current transformer
20. Voltage selector switch ※

※The voltage selector switch is provided on the output terminal plate of the right bonnet.

3. Electrical Parts

150kVA



1. Starter relay (SY)
2. Glow relay (GR)
3. Fuel pump relay (FR)
4. Main relay (MR2)
5. Safety relay (SR)
6. Magnetic switch (MR1)
7. Automatic operation unit
8. Automatic voltage regulator (AVR)
9. Three-phase circuit breaker
10. Current transformer
11. Thermal relay
12. Terminal plate
13. Controller (ECM)
14. Intake air temperature sensor
15. Barometric pressure sensor
16. Fuse (15A)
17. Fuse (10A)
18. Fuse (60A)
19. Voltage selector switch ※

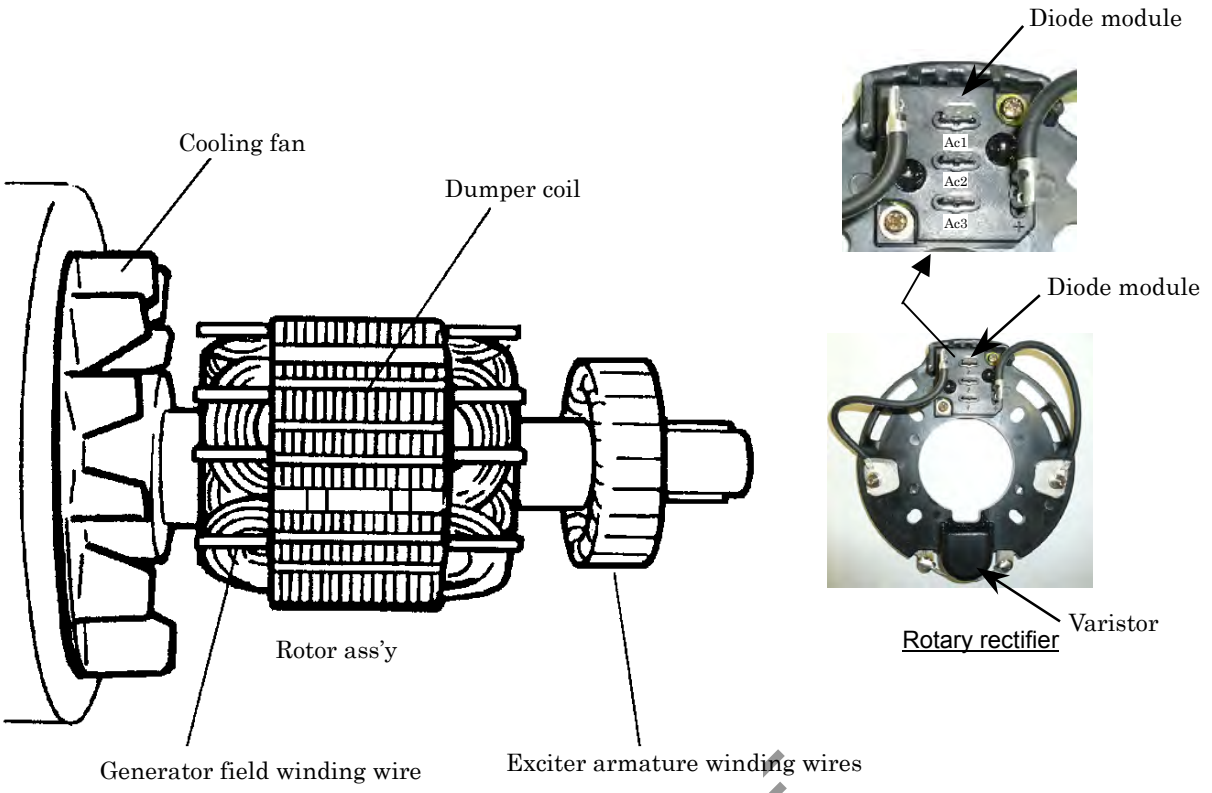
※The voltage selector switch is provided on the output terminal plate of the right bonnet.

3.2 Electrical Parts of Generator

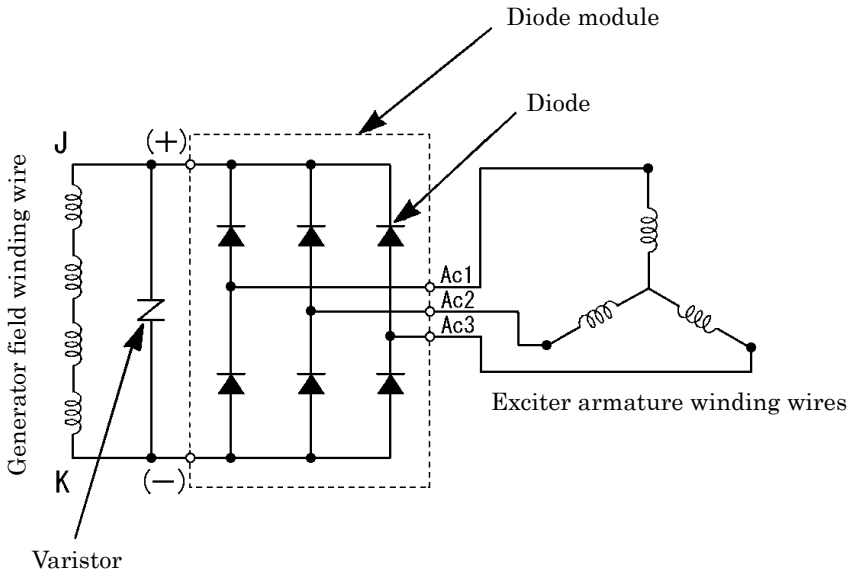
3.2.1 Rotary rectifier

65kVA

Cable connection of rotary rectifier (diode module) is full wave rectifier circuit. Varistor is connected for whole protection in the circuit as protection of diode.



SG09029



SG09107

How to check whether diode module functions correctly or not

If excessive voltage is applied to diode module, or if excessive current flows, interior diode will be damaged. If diode module damaged, generator does not generate electricity. In order to check whether diode module is in good order or not, it is necessary to check resistance according to the following procedures.

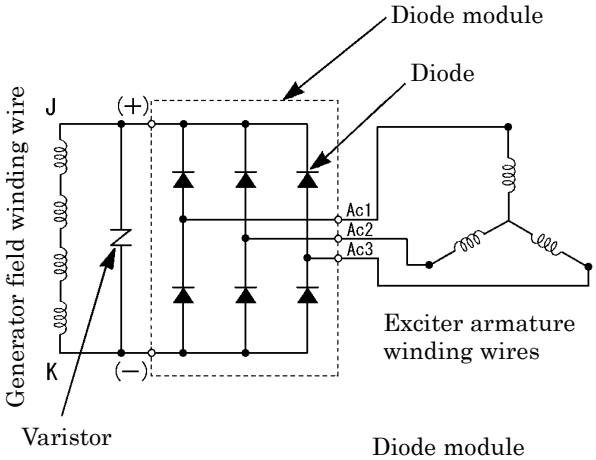
< Procedures >

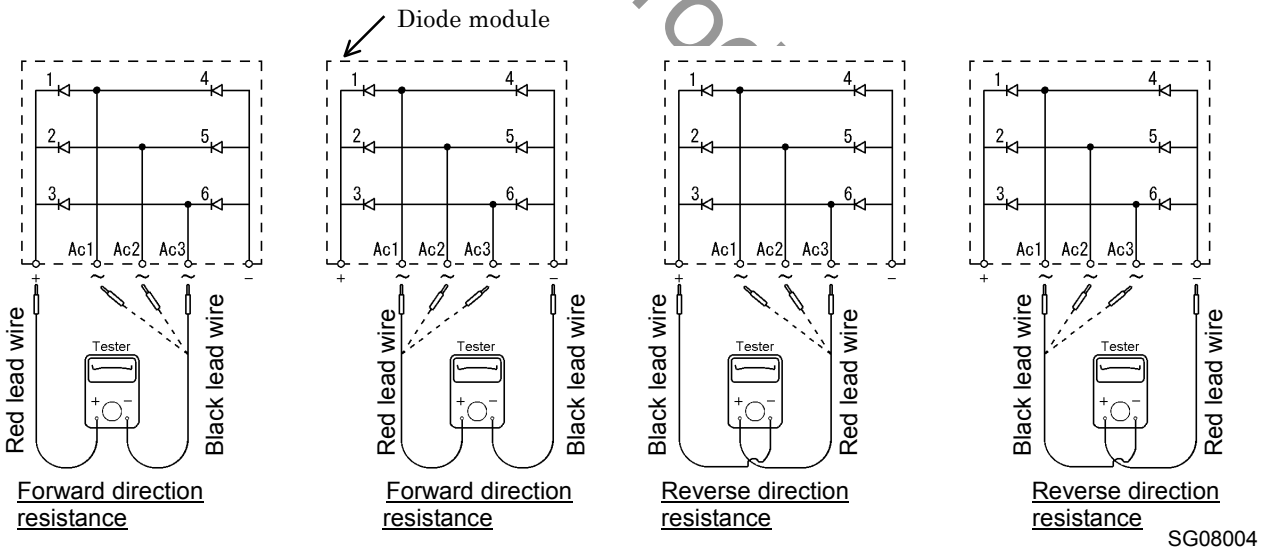
①Remove end cover of generator.

②Removing end cover, you can see diode module. Then disconnect all cables connected to the diode module.

③Availing of resistance measurement range of the tester, measure forward direction resistance and reverse direction resistance of each diode. When forward direction resistance is found less than 10Ω and reverse direction resistance more than 100kΩ, the diode is in good order. When diode is found electric current flowing in both forward and reverse directions, the diode is judged to be in disorder.

When any diode is judged to be in disorder during the inspection, it is necessary to replace it by a good one.





Testing method of resistance of diode module

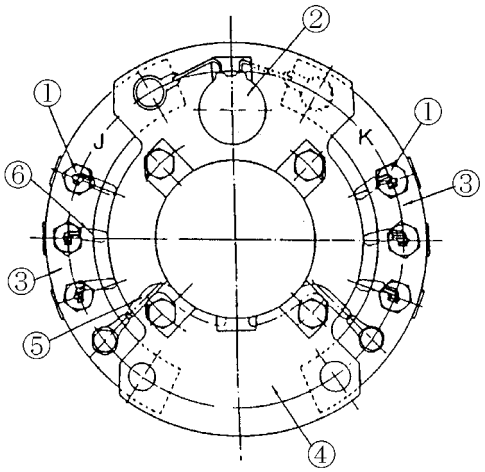
Direction of diode	Tester lead pole		Tester value
	Red lead wire	Black lead wire	
Forward direction	(+)	Ac1	less than 10Ω
	(+)	Ac2	
	(+)	Ac3	
	Ac1	(−)	
	Ac2	(−)	
	Ac3	(−)	

Direction of diode	Tester lead pole		Tester value
	Red lead wire	Black lead wire	
Reverse direction	Ac1	(+)	more than 100kΩ
	Ac2	(+)	
	Ac3	(+)	
	(−)	Ac1	
	(−)	Ac2	
	(−)	Ac3	

3. Electrical Parts

125 / 150kVA

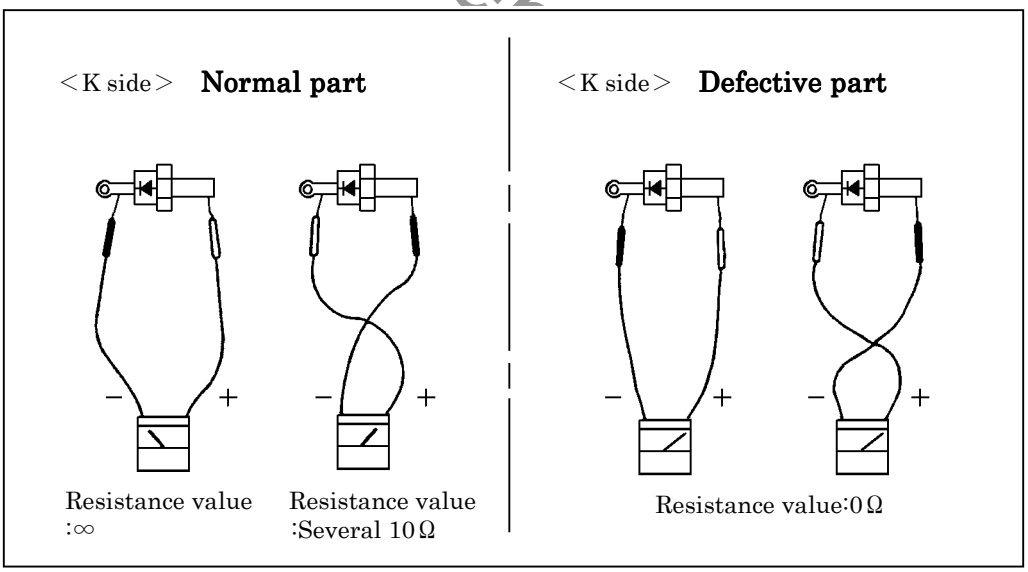
① Silicon rectifier
② Varistor
③ Conductive plate
④ Insulating plate
⑤ Lead wire (alternator)
⑥ Lead wire (exciter)



AS-016

How to check whether silicon rectifier (diode element) functions correctly or not

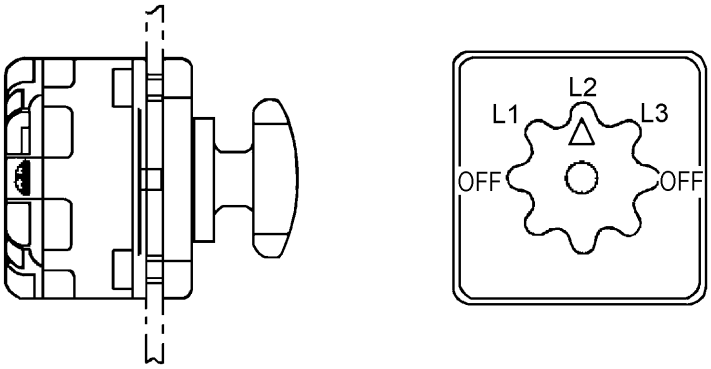
Check the silicon rectifier (diode element) according to the resistance range of circuit meter.
When the anode side of good silicon rectifiers are connected to the circuit (+) and cathode side to the circuit (−), the gauge shows infinite (∞), and anode side to (−) and cathode side to (+), the gauge shows several 10Ω.



SG09078

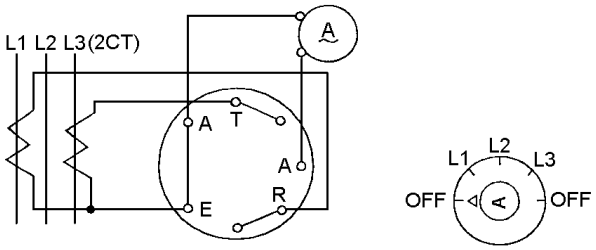
Note: The rotary rectifier is equipped with 3 sets of silicon rectifiers of forward direct polarity at the K side and 3 of reverse direction polarity at the J side. So take care not to make a mistake in the polarities.

3.2.2 AS (Ammeter change-over switch)



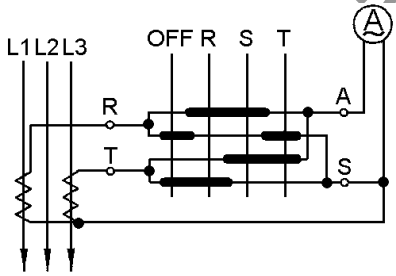
SG09015

Diagram: AS for 125 /150kVA



SG06069

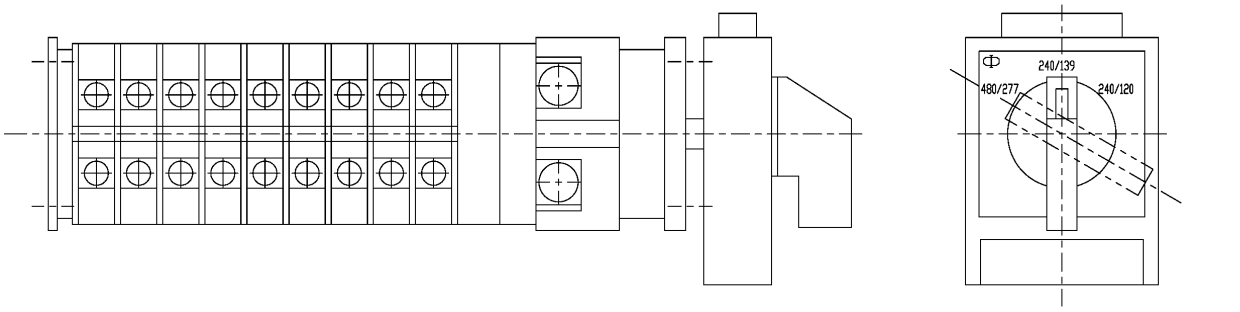
Diagram: Interior cable connection for 125 / 150kVA



SG06068

Diagram: Interior cable connection for 65kVA

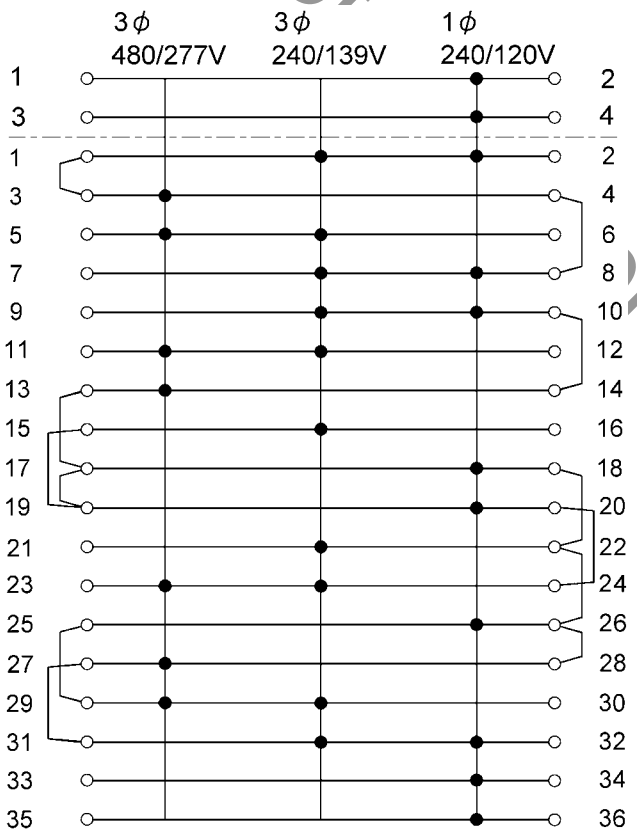
3.2.3 Voltage selector switch



SG06016

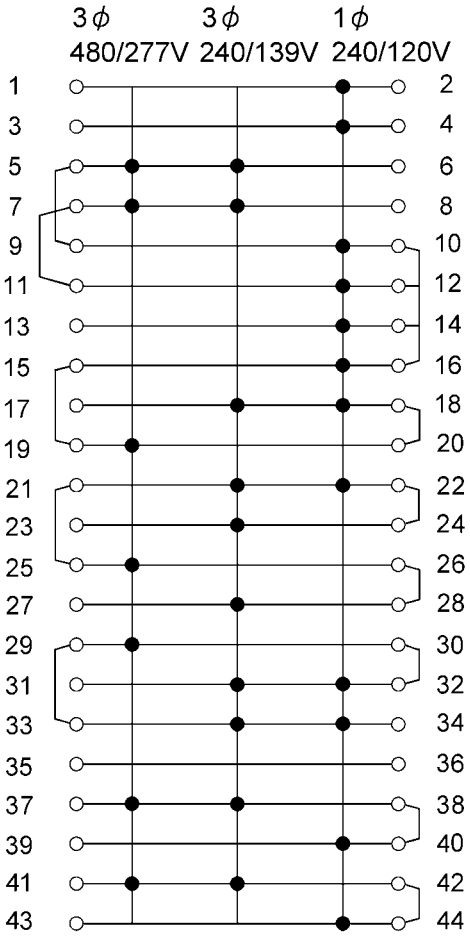
System of contacts arrangement

65kVA



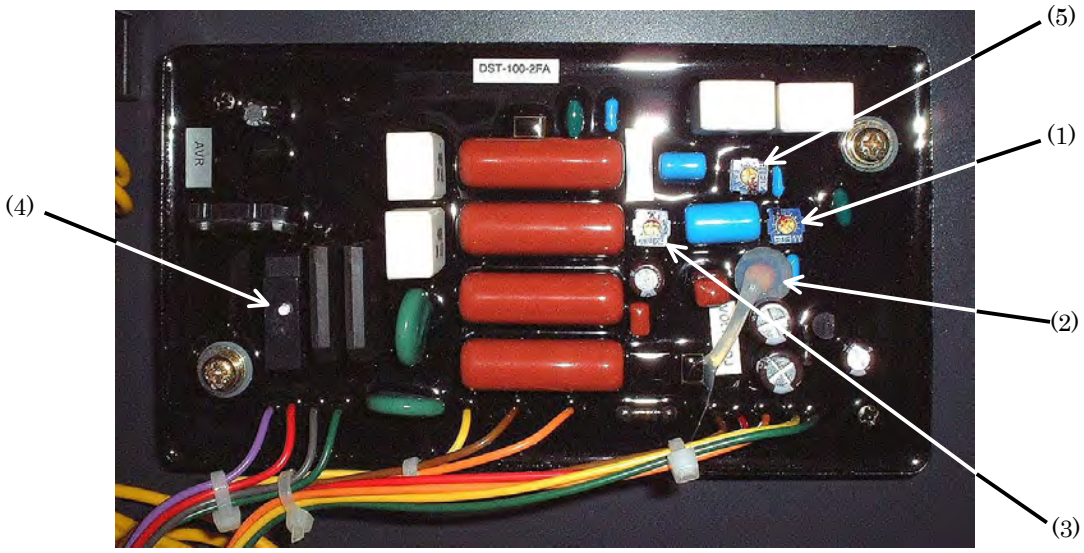
SG06017

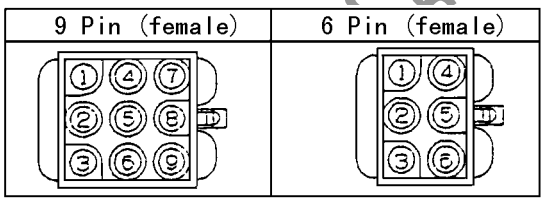
125 / 150kVA



SG06018

3.2.4 AVR (Automatic voltage regulator : DST-100-2FA4)





9 Pin (female)			6 Pin (female)	
1:Brown	4:Yellow	7:Purple	1:Brown	4:Yellow
2:Red	5:Green	8:Gray	2:Red	5:Green
3:Orange	6: ／	9: ／	3:Orange	6: ／

SG06019

	Name	Function
(1)	V. F. ADJ	V/Hz adjust variable resistor
(2)	VOLT. ADJ	Voltage setting variable resistor
(3)	STAB. ADJ	Stability adjust variable resistor
(4)	CPR	Over-excitation protection circuit protector
(5)	Time constant, ADJ	Time constant adjustment

AVR CONNECTOR

		Line color	Connection	Remarks
6 pins (female)	1	Brown	Hand trimmer	Variable resistor 2kΩ 5W
	2	Red	Hand trimmer	
	3	Orange	NIL	
	4	Yellow	No.5 of connector 6P	To get corner frequency 57Hz, No.5 connector 6P and No.4 connector 6P short circuited
	5	Green	No.4 of connector 6P	
	6		NIL	
9 pins (female)	1	Brown	Generator cable No.3	
	2	Red	Generator cable No.4	AVR power supply (Generator cable No.3 & No.4)
	3	Orange	Generator cable E3	Detect generator output voltage between generator cable No.3 and E3
	4	Yellow	Generator cable J	Field winding of exciter
	5	Green	Generator cable K	Field winding of exciter
	6		NIL	
	7	Purple	Generator cable U	Auxiliary winding
	8	Gray	Generator cable V	Auxiliary winding
	9		NIL	

3. Electrical Parts

AVR is adjusted and set prior to delivery from factory. Accordingly, it is not necessary to adjust it unless the machine equipped with a new AVR functions abnormally. If upon test operation, there is any trouble such as voltage hunting, adjust it according to the following procedures.

Adjustment of AVR

1. Start engine, and adjust the frequency to 62.5Hz at no load operation.
2. Turn the voltage adjuster (hand trimmer) on the instrument panel fully to the right to the maximum position.
3. Under this condition, turn the voltage adjuster of AVR in the control panel, using a driver, so that the upper value of voltage may meet the value mentioned in the following table.

Notching position of voltage adjustment (VOLT.ADJ): 6.5/10 ※

Voltage / Frequency	240V	480V
62.5Hz	252V	504V

4. The driver slot of voltage adjusting volume of AVR should be coated with silicon caulking paste and fully sealed.

Adjustment of stability

It is possible to adjust the response speed of generator output voltage at no load operation by the adjusting volume knob of stability.

1. Turning the volume knob of stability adjustment clockwise reduces the response speed, and voltage overshoot value becomes a little (in the direction of stability).
2. Turning it counterclockwise raises the speed and voltage shooting value becomes bigger (in the direction of instability).

Notch position of stability adjusting volume (STAB.ADSJ) : 4/10 ※

Adjusting time constant

Instantaneous characteristic is set at the best point. So it is not necessary to adjust it. (Adjustment is prohibited.)

The notching position of time constant adjustment volume : 1/10 ※

Protection against excessive exciting current

A circuit protector (CPR) is built-in in the power supply for prevention of AVR damage due to the excessive exciting current caused by wrong cable connection or disconnection to detective inlet terminal of AVR.

If this device functions, the white push button at the top of CPR is kept pressed up. In order to reset it, push the white button on after getting rid of the cause of the excessive exciting current flow.

※:Position of notching

The top of volume resistance is marked " arrow" at the one of the variable cross holes for showing the set up position.

Adjusting V/Hz characteristic

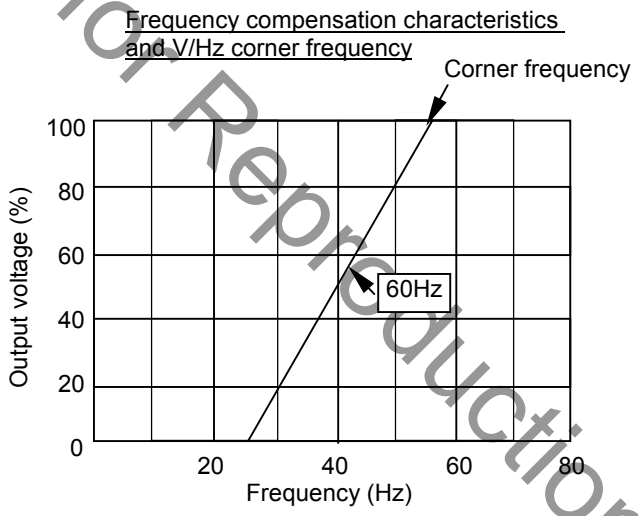
If at the start stage of engine, voltage adjustment and stability adjustment have been already done, it is not necessary to adjust the V/Hz characteristic. But if at no load operation any trouble of voltage adjustment function occurs, or voltage disappears, adjust V/Hz characteristics, according the following procedures.

1. Turn V/Hz characteristics volume knob(V.F.ADJ) fully clockwise. (Notching position ;10/10)
2. Start engine and adjust the frequency to 57Hz and then slowly turn V/Hz characteristic volume knob (V>F>ADJ) counterclockwise to set it at the position of voltage drop approx. 1% of the rated voltage (see the table undermentioned).

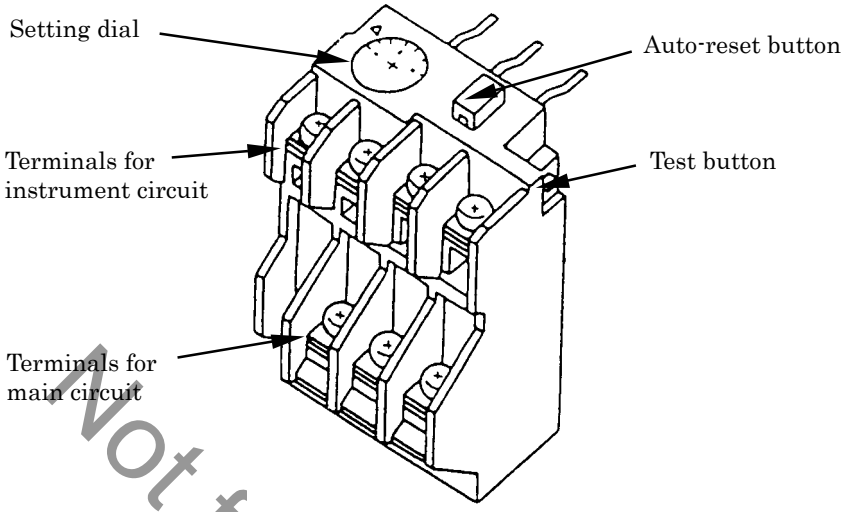
Notching position of V/Hz characteristics volume (V.F.ADJ) : 3/10

Voltage / Frequency	240V	480V
57Hz	238V	475V

3. The frequency compensation characteristic and V/Hz corner frequency are shown in the following table.



3.2.5 Thermal relay



SDG-002

Thermal relay set value

	unit	65kVA	
Rated voltage	V	240	480
Rated current	A	152	76
Detected current at rated operation	A	76	
CT ratio		5/100	
Wound rolls (Rolls of cables through CT)		1 roll	
Set value	A	3.5	

	unit	125kVA		150kVA	
Rated voltage	V	240	480	240	480
Rated current	A	300	150	361	180
Detected current at rated operation	A	150		180	
CT ratio		5/200		5/300	
Wound rolls (Rolls of cables through CT)		1 roll		1 roll	
Set value	A	3.5		2.8	

Tripping of over current is set to be reset automatically.

3.3 Electronic Control System of Engine

The engine control system is electronic control system which maintains optimum combustion status of engine all the time according to operating conditions. It consists of the following components.

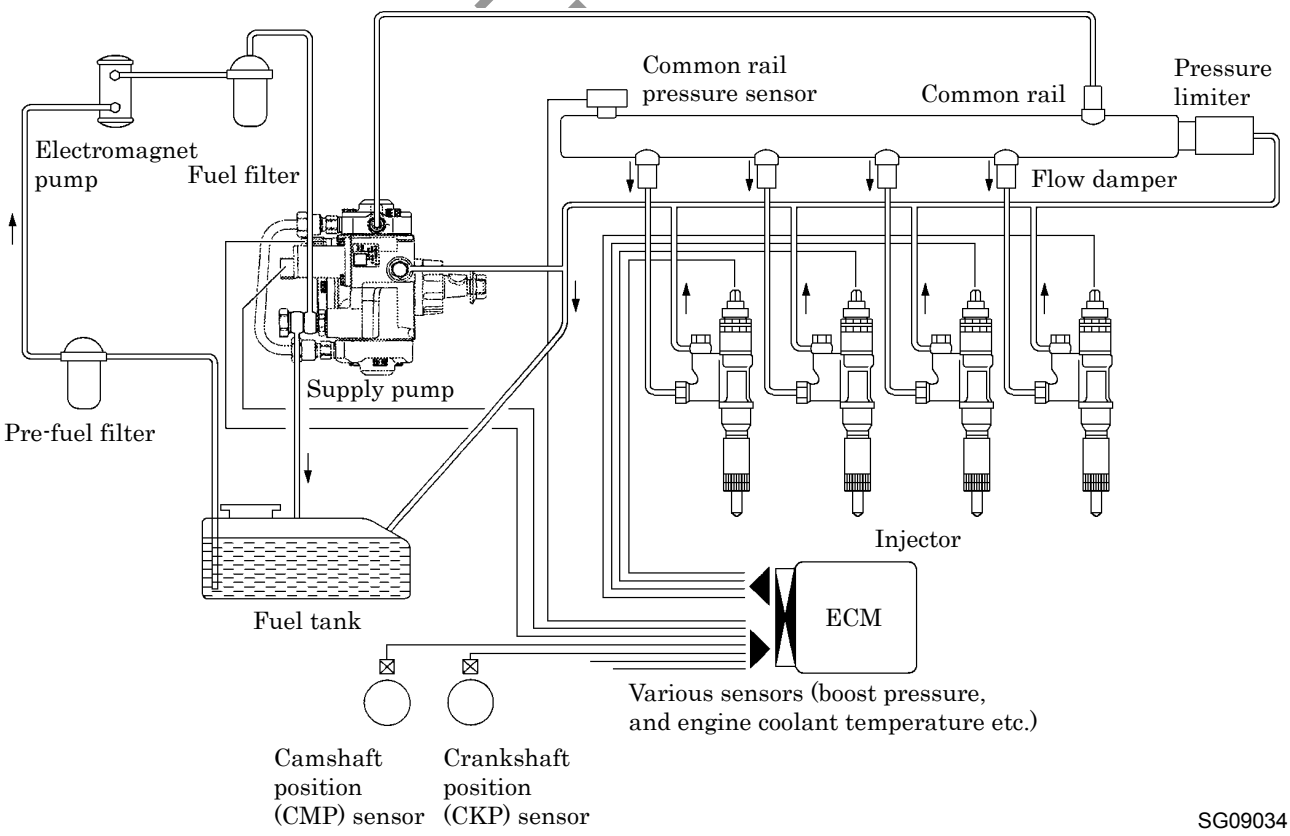
① Electronic control fuel injection system (Common rail type)
② EGR (Exhaust gas recirculation)
③ Idle speed control

The engine control system also has the following system control functions other than engine control.

④ QOS (Quick On Start) system
⑤ Engine speed signal output
⑥ Self-diagnosis function
⑦ CAN (Controller Area Network) communication

3.3.1 Electronic control fuel injection system (Common rail type)

ECM (engine control module) detects such information as engine RPM, engine load etc (signals from various sensors). Base on the information, ECM sends electrical signal to supply pump and injectors to properly control fuel injection of each cylinder and injection time in this system.



(1) Fuel system

Fuel is supplied to supply pump from fuel tank and then sent to common rail after it is pressurized by pressure pump. At the time fuel volume supplied to common rail is controlled by suction control valve (SCV).

(2) Injection pressure control

Fuel injection pressure is controlled by fuel pressure control in common rail. ECM counts fuel pressure in common rail, based on engine RPM and fuel injection volume and it controls suction control valve (SCV) and sends proper fuel volume by pressure to common rail.

(3) Injection time control

ECM counts proper fuel injection timing from engine RPM and fuel injection volume.

(4) Injection rate control

In order to improve combustion in cylinders, at first a little fuel is injected (pre-injection) to ignite, and then once ignited, fuel is injected 2nd time (main injection). Control of injection timing and injection volume is performed by controlling injectors.

(5) Fuel injection correction

ECM counts fundamental injection volume according to signals of boost pressure sensor, crankshaft position (CKP) sensor, camshaft position (CMP) sensor. At the time, suction control valve (SCV) switching timing and injector live timing is controlled according to such conditions as common rail pressure and engine coolant temperature. Then they are corrected to be most suitable injection timing and injection volume.

3.3.2 EGR (Exhaust gas recirculation) control

EGR is a exhaust gas recirculation system. Part of the exhausted gas is mixed again together with intake air to control oxygen density in combustion chamber in order to soften combustion and to lower combustion temperature. Thus, nitrogen oxides "NOX" can be reduced. Such device in which cooling device is equipped is called as cooled EGR system.

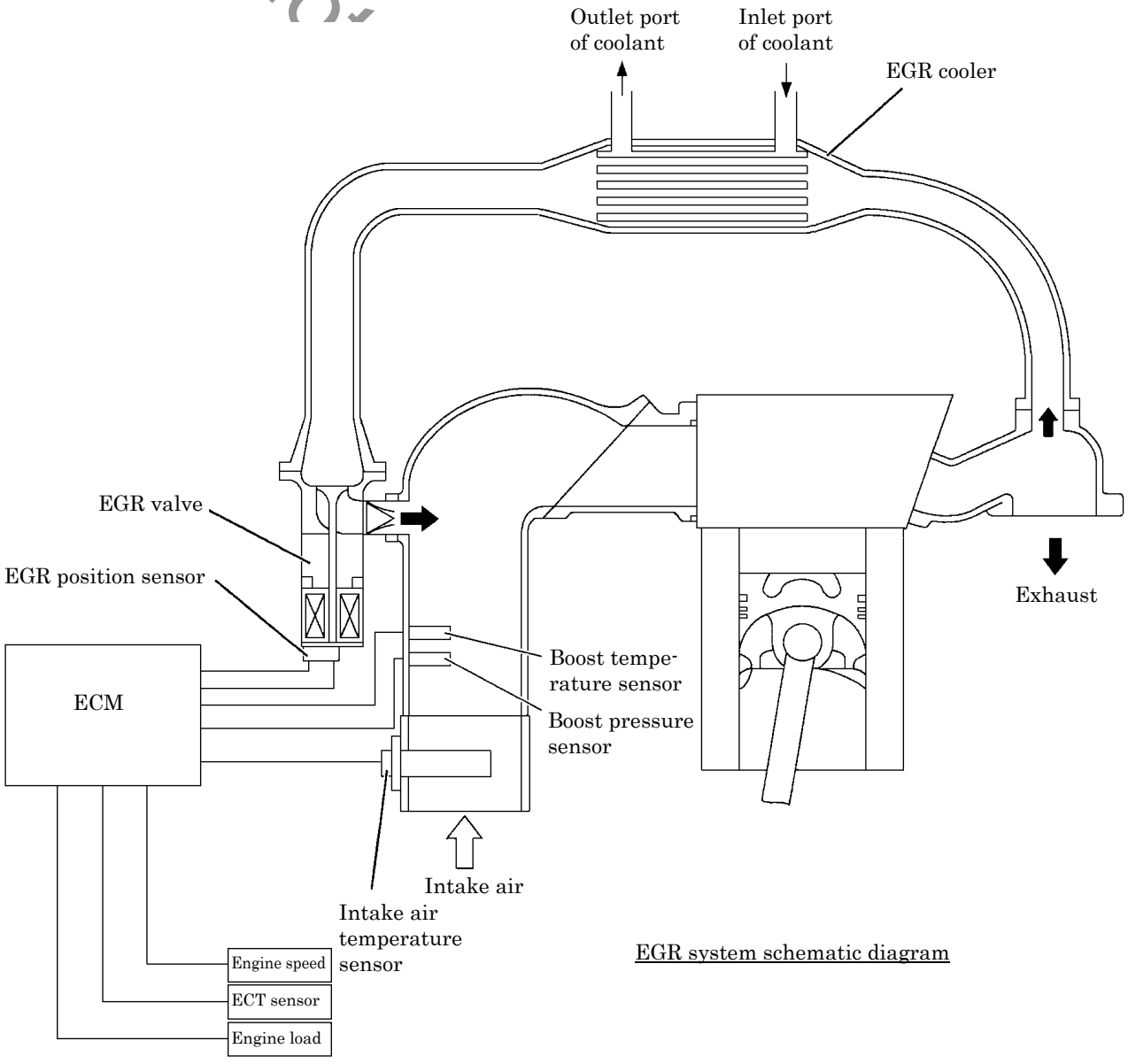
High temperature EGR gas exhausted is cooled through cooler and the cooled gas is mixed and cooled. Thus combustion gas temperature is cooled and NOX reduction is fulfilled more effectively than usual EGR gas.

Further, cooled intake air density increases and accordingly intake air increases.

Thus, combustion becomes perfect and it causes fuel consumption increase and PM black smoke reduction.

EGR function

ECM is to operate EGR motor according to such engine conditions as engine RPM, and engine load, and to control EGR valve lift. Valve lift is detected by EGR position sensor.



EGR system schematic diagram

SG09035

3.3.3 Idle speed control

When placing engine speed switch at “LOW” position at start-up, engine starts at low speed and warming up operation begins. During this operation, it is possible to control idling speed, using “Frequency adjustment switch” and also to adjust the proper speed according to engine coolant temperature.

Frequency adjustment switch

UP

While you are pushing “UP” side, engine speed rises, and it can raise idling speed.

DOWN

While you are pushing “DOWN” side, engine speed drops and it can lower engine idling speed, but it can not be lowered lower than the lowest speed.

Control when key switch is OFF

Engine speed which is adjusted by frequency adjustment switch is memorized in ECM and on next start, engine runs at engine speed adjusted when key switch is OFF.

3.3.4 Preheating control

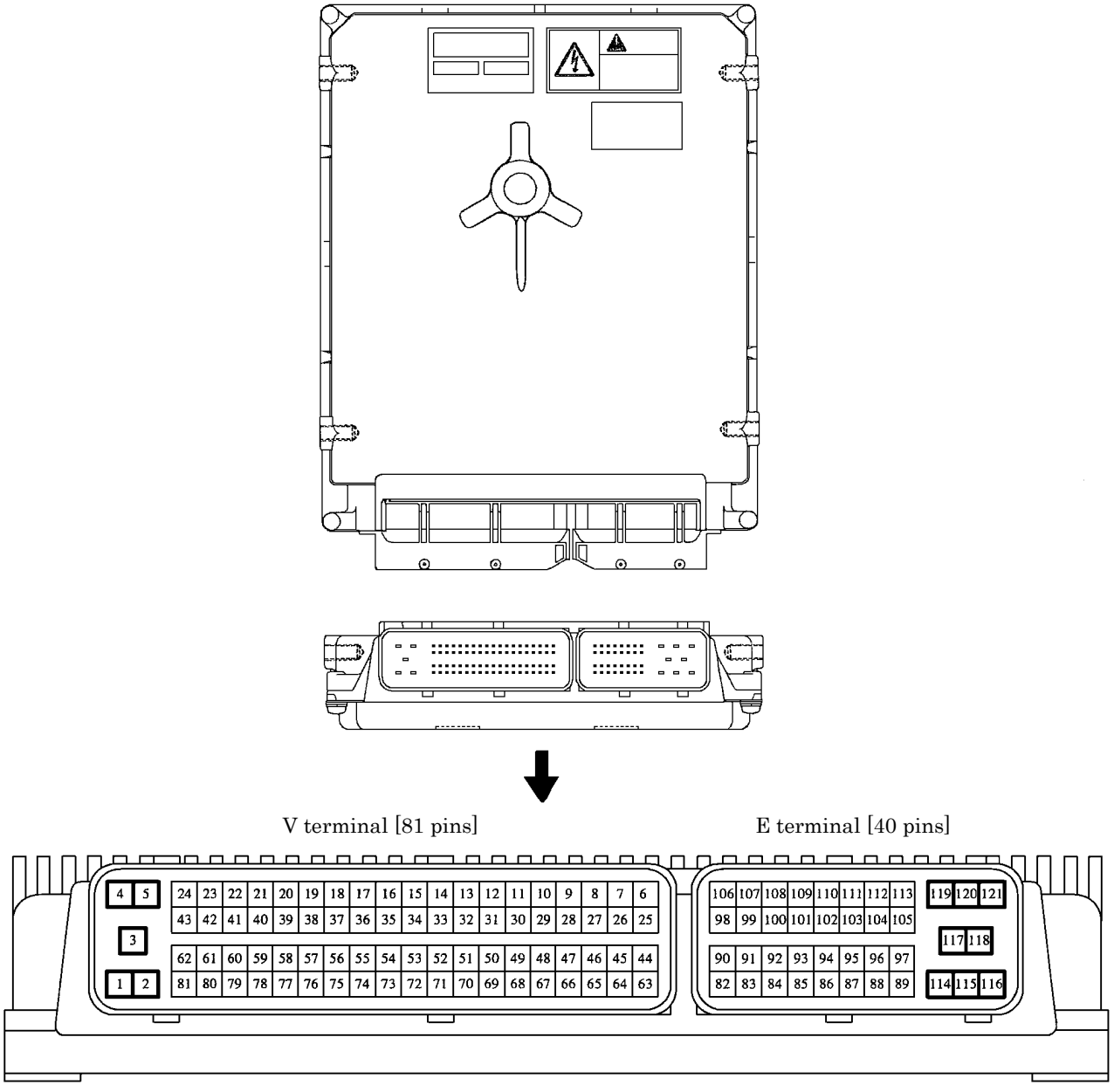
QOS (Quick On Start) system

The ECM determines the period required for glow (pre-glow, glow, after-glow), and operates the glow relay and QOS indicator lamp. QOS system allows to make the starting at cold weather easier and reduce white smoke and noise at starting. When turning the key switch to ON, the ECM detects the engine coolant temperature by signal from engine coolant temperature (ECT) sensor and changes the period for glow so that the proper starting conditions can be achieved all the time. Also, after-glow function allows to stabilize idling immediately after starting.

3.4 Electrical Parts of Engine

3.4.1 Engine control module (ECM)

65kVA	Part number:44390 02600
125kVA	Part number:44390 02400
150kVA	Part number:44390 02300

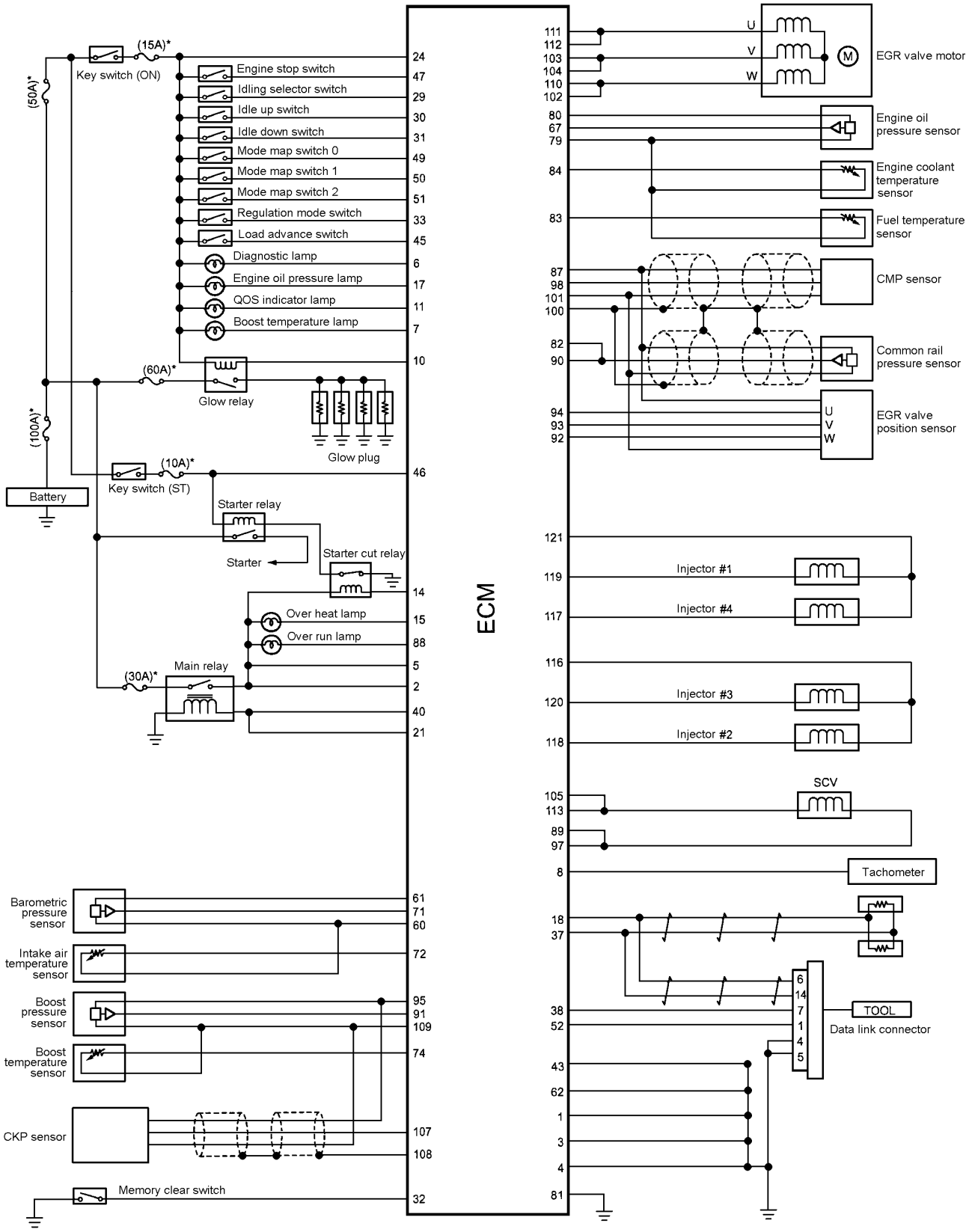


SG09037

3. Electrical Parts

(1) General wiring diagram of engine control module (ECM)

- Some sensors are not connected to ECM depending on each model having its special specifications.
- Some sensors have input-output to ECM by signal of CAN communication. For the details, see engine wiring diagram of actual unit.



SG09038E

(2) List of V terminal function (81 pins)

65 / 125 / 150kVA

Pin No.	Line color	Connection	Function
V1	B	Grounding	
V2	R/G	Main relay (MR2)	Power supply
V3	B	Grounding	
V4	B	Grounding	
V5	R/G	Main relay (MR2)	Power supply
V6	L/B	Monitor lamp CN1-6 terminal (Diagnosis lamp)	No power exists during usual operation. When engine trouble, interior contact in ECM is "ON", and it connects ground to sends power. Thus diagnosis lamp of monitor lamp glows. At the time, it makes engine stop once, and when the starter switch is placed to "ON" again, and push diagnosis switch to send electricity to V52 terminal, the lamp begins to flicker and this shows engine trouble at present and past.
V7	Br/R	Monitor lamp CN1-2 terminal (Boost temperature lamp)	No power exists during usual operation. When boost temperature rises higher than specified one, interior contact in ECM is "ON", and it connects ground to sends power. Thus, boost temperature rise warning lamp glows. ●Warning lamp lighting temperature : 185° F (85℃)
V8	Y/L	Auto start unit CN6-2 terminal	It outputs engine speed. ●Revolution ratio (pulse type) : 1 revolution per 4 pulses
V9	—	NIL	
V10	B/G	Glow relay (GR)	No power exists during usual operation. When power is sent to V24 terminal, preheating starts. When preheating, interior contact in ECM is "ON", and it connects ground to sends power. Thus glow relay (GR) works to preheat. ECM decides glow timing (pre-glow, glow and after-glow), according to engine coolant temperature and it sends power to V10 terminal each time to function glow relay (GR).
V11	L/Y	Monitor lamp CN1-5 terminal (Glow lamp)	No power exists during usual operation. When preheating, interior contact in ECM is "ON", and it connects ground to sends power. Thus preheating lamp glows.
V12	—	NIL	
V13	—	NIL	

＜65～150kVA＞

Pin No.	Line color	Connection	Function
V14	B/W	Safety relay (SR)	No power when starting. After starting, engine speed rises and exceeds 750min^{-1} interior contact in ECM is “ON”, and it connects ground to sends power. Thus safety relay (SR) functions to cut power to starter motor. [During auto starting] V46 terminal receives start signal. When this condition is kept, it works to put ON/OFF power to V14 terminal「one second start→5 seconds starter motor stop」working operation.
V15	G/W	Monitor lamp CN1-7 terminal (Water temperature lamp)	No power exists during usual operation. When engine coolant temperature rises up to emergency stop level, interior contact in ECM is “ON”, and it connects ground to sends power. Thus engine coolant temperature rise emergency stop lamp glows. ●Emergency stop lamp lighting temperature：221° F (105℃)
V16	－	NIL	
V17	G/R	Monitor lamp CN1-14 terminal (Oil pressure lamp)	No power exists during usual operation. When engine oil pressure drops down to emergency stop level, interior contact in ECM is “ON”, and it connects ground to sends power. Thus engine oil pressure drop emergency stop lamp glows. ●Emergency stop lamp lighting pressure：15psi (0.1MPa)
V18	B/W	Tool (TECH2) No.6 terminal	TECH2 connection terminal (CAN communication) With connection of scan tool (TECH2), it is possible to diagnose engine control system and to check system.
V19	－	NIL	
V20	－	NIL	
V21	Y/R	Main relay (MR2)	When power is sent to V24 terminal, it works main relay (MR2). Thus main relay (MR2) is switched and when power is supplied to V2 and V5 terminal, voltage is applied to electromagnet pump relay (FR) to operate the pump.
V22	－	NIL	
V23	－	NIL	
V24	R/W	15A fuse	Switch “ON” starter switch to input (ACC) signal. Preheating starts.
V25	－	NIL	
V26	－	NIL	
V27	－	NIL	
V28	－	NIL	

＜65～150kVA＞

Pin No.	Line color	Connection	Function
V29	GY/R	Frequency adjuster	No power exists during usual operation. When placing frequency adjuster switch “UP”or “DOWN”, it is switched “ON”. Combination of V30 and V31 terminal switching makes engine speed “UP” and “DOWN”.
V30	Br/W	Frequency adjuster (UP)	No power exists during usual operation. When frequency adjuster switch is placed “UP”, it is switched “ON”. Engine speed rise limit : 15% higher than rated speed.
V31	B/Y	Frequency adjuster (DOWN)	No power exists during usual operation. When frequency adjuster switch is placed “DOWN”, it is switched “ON”. Engine speed fall limit : Down to low idle speed.
V32	G	External input connector No.5 terminal (option)	Resetting terminal of past trouble memory. When terminal is “ON” between option connector No.5 and No.2 (ground) terminals, past trouble memory is reset.
V33	W/B	External input connector No.1 terminal (option)	Operation mode switching input terminal. No power exists during usual operation. When power supply of ECM is “ON”, and terminal between option connector No.1 and No.4 terminal is placed “ON”, operation mode is switched to “Regulation operation” mode.
V34	－	NIL	
V35	－	NIL	
V36	－	NIL	
V37	W/B	Tool (TECH2) No.14 terminal	TECH2 connection terminal (CAN communication) With connection of scan tool (TECH2), it is possible to diagnose engine control system and to check system.
V38	Br/G	Tool (TECH2) No.7 terminal	
V39	－	NIL	
V40	Y/R	Main relay (MR2)	When power is sent to V24 terminal, it works main relay (MR2). Thus main relay (MR2) is switched and when power is supplied to V2 and V5 terminal, voltage is applied to electromagnet pump relay (FR) to operate the pump.
V41	－	NIL	
V42	－	NIL	
V43	B	Grounding	
V44	－	NIL	
V45	G/B	External input connector No.6 terminal (option)	Operation mode switching input terminal. No power exists during usual operation. When terminal between option connecter No.6 and No.4 terminal is placed “ON”, operation mode is switched to “Driving ahead load” mode. [In order to minimize operation speed loss due to load increase, engine speed is raised. (only one time)]

＜65～150kVA＞

Pin No.	Line color	Connection	Function
V46	R/L	Starter switch C terminal Auto start unit CN7-8 terminal	Inputting start signal.
V47	B/R	External input connector No.3 terminal (option)	External input terminal for engine emergency stop. When option connector is placed “ON” between No.3 and No.4 terminals, engine is brought to emergency stop.
V48	－	NIL	
V49	R/W	15A fuse	Operation mode (frequency) switching input terminal. “ON” : 60Hz constant (It is possible to change frequency with combination of V49, V50 and V51 terminal switching. This unit is set to 60Hz constant operation with this terminal directly connected to 15A fuse.)
V50	R/B	Engine speed switch External input connector No.2 terminal (option) [Connection terminal is available only for 125kVA]	Operation mode (frequency) switching input terminal. When power is inputted (When “ON”), and V50 terminal is switched with “Engine speed switch”, operation mode is switched as follows: “OFF” (high side) : 60Hz constant “ON” (low side) : idling speed [But when power is on accel sensor terminal (V20, V41, V42, V63 and V64 terminal), the speed coincides with voltage. (All accel sensor terminals used for this unit are blank, no power exists during normal operation.)]
V51	R/W	15A fuse	Operation mode (frequency) switching input terminal. “ON” : 60Hz constant (It is possible to change frequency with combination of V49, V50 and V51 terminal switching. This unit is set to 60Hz constant operation with this terminal directly connected to 15A fuse.)
V52	Y/B	Tool (TECH2) No.1 terminal Diagnosis switch	When engine stops with starter switch “ON”, and diagnosis lamp is “ON”, make diagnosis switch “ON” or connect V52 terminal directly to ground. Then diagnosis lamp begins to blink. Blinking pattern shows present and past engine troubles.
V53	－	NIL	
V54	－	NIL	
V55	－	NIL	
V56	－	NIL	
V57	－	NIL	
V58	－	NIL	
V59	－	NIL	
V60	G/O	Barometric pressure sensor SG terminal	Grounding
V61	Lg/R	Barometric pressure sensor VC terminal	Power supply for barometric pressure sensor (DC5V)

＜65～150kVA＞

Pin No.	Line color	Connection	Function
V62	B	Grounding	
V63	－	NIL	
V64	－	NIL	
V65	－	NIL	
V66	－	NIL	
V67	L/Y	Oil pressure sensor OUT terminal	It detects engine oil pressure. Pressure detecting voltage signal is high, when pressure is high, and it is low, when pressure is low.
V68	－	NIL	
V69	－	NIL	
V70	－	NIL	
V71	P	Barometric pressure sensor OUT terminal	It detects barometric pressure. It counts barometric pressure from voltage signal, and it corrects fuel injection volume (high altitude compensation).
V72	Lg	Intake air temperature sensor	It detects intake air temperature of unit under operation. In order to optimize fuel injection control with ECM, it detects intake air temperature at unit in use (In front of engine air intake device).
V73	－	NIL	
V74	B/R	Boost temperature sensor	It detects intake air temperature in intake manifold.
V75	－	NIL	
V76	－	NIL	
V77	－	NIL	
V78	－	NIL	
V79	B/Y	Oil pressure sensor SG terminal	Grounding
		Water temperature sensor grounding terminal	
		Fuel temperature sensor grounding terminal	
V80	W/B	Oil pressure sensor VCC terminal	Power supply for engine oil pressure sensor (DC5V)
V81	B	Grounding	

(3-1) List of E terminal function (40 pins)

65 / 125kVA

Pin No.	Line color	Connection	Function
E82	W(Br)	Common rail pressure sensor OUT terminal	It detects common rail pressure (fuel pressure). It detects fuel pressure in common rail and it converts it voltage signal and inputs it. It is used for fuel injection control. Pressure detecting voltage signal is high, when pressure is high, and it is low, when pressure is low.
E83	Y/G	Fuel temperature sensor	It detects fuel temperature. Fuel temperature sensor changes resistance value according to change of internal thermistor temperature. ECM detects voltage which changes according to temperature change and it counts fuel temperature and uses it for control of supply pump. Voltage is low, when fuel temperature is high and resistance is little, and it is high, when fuel temperature is low, and resistance is large. (Resistance of thermistor is little, when temperature is high, and it is large, when temperature is low.)
E84	R/B	Water temperature sensor	It detects engine coolant temperature. It detects voltage which changes according to resistance and then it counts engine coolant temperature.
E85	－	NIL	
E86	－	NIL	
E87	R(Y)	CAM angle sensor ＋terminal	Power supply for left sensors (DC5V)
	R(L)	Common rail pressure sensor VCC terminal	
	L	EGR motor position sensor power supply terminal	
E88	Y	Monitor lamp CN1-13 terminal	No power exists during usual operation. When engine speed rises up to emergency stop set speed, interior contact in ECM is “ON”, and it connects ground to sends power. Thus overspeed warning lamp glows. ●Emergency stop set speed： 2070min^{-1} (69Hz)
E89	R/B	Suction control valve (SCV)	Grounding
E90	W(Br)	Common rail pressure sensor OUT terminal	It detects common rail pressure (fuel pressure). It detects fuel pressure in common rail and it converts it voltage signal and inputs it. It is used for fuel injection control. Pressure detecting voltage signal is high, when pressure is high, and it is low, when pressure is low.

＜65～125kVA＞

Pin No.	Line color	Connection	Function
E91	L	Boost pressure sensor OUT terminal	It detects engine intake boost (intake air pressure). It counts boost (intake air pressure) from detected voltage signal for fuel injection control. Voltage is high, when pressure is high, and it is low, when pressure is low.
E92	G/Y	EGR motor posision sensor W terminal	It detects valve lift of EGR (exhaust, gas, re-circulation) valve.
E93	G/W	EGR motor posision sensor V terminal	
E94	G/B	EGR motor posision sensor U terminal	
E95	R/W	Boost pressure sensor 5V terminal	Power supply for left sensors (DC5V)
	R(V/W)	Crank angle sensor ＋terminal	
E96	－	NIL	
E97	R/B	Suction control valve (SCV)	Grounding
E98	W(T)	CAM angle sensor output terminal	It inputs camshaft position (CMP) signal. CMP signal is caused when cam position of camshaft passes camshaft position (CMP) sensor. ECM judges cylinder according to CMP signal, and it decides crank angle and counts fuel injection control and engine speed. This control is performed based on crankshaft position (CKP) signal detected by E107 terminal, but in case crankshaft position (CKP) sensor is in trouble, it is performed based on camshaft position (CMP) signal.
E99	－	NIL	
E100	B/W	Shield line	Grounding
E101	B(O/B)	CAM angle sensor －terminal	Grounding
	B(L/W)	Common rail pressure sensor SG terminal	
	L/W	EGR motor position sensor grounding terminal	
E102	W/L (－)	EGR DC motor W terminal [Connection terminal is available only for 65kVA]	It operates EGR DC motor, and it controls valve lift of EGR valve. ECM decides EGR gas volume based on engine speed and engine load ratio (fuel injection volume) and it operates EGR valve by EGR DC motor, and also it controls EGR gas volume to be mixed in engine intake air.
E103	W/B	EGR DC motor V terminal	
E104	W/B (－)	EGR DC motor V terminal [Connection terminal is available only for 65kVA]	
E105	R/W	Suction control valve (SCV)	When power stays on, fuel is sent to common rail by pressure. Fuel injection volume to common rail is controlled by control of power supply timing of suction control valve (SCV).
E106	－	NIL	

＜65～125kVA＞

Pin No.	Line color	Connection	Function
E107	W (Gr/B)	Crank angle sensor	It inputs crankshaft position (CKP) signal. CKP signal is caused when convex portion of flywheel passes through sensor position. ECM judges cylinder according to CKP signal, and it decides crank angle and counts fuel injection control and engine speed. This control is performed based on CKP signal, but in case crankshaft position (CKP) sensor is in trouble, it is performed based on camshaft position (CMP) signal detected by E98 terminal.
E108	B/W (B)	Shield line	Grounding
E109	R/L	Boost pressure sensor SG terminal	Grounding
		Boost temperature sensor grounding terminal	
	B (W/B)	Crank angle sensor －terminal	
E110	W/L	EGR DC motor W terminal	Same as E102 – E104 terminal
E111	W/R	EGR DC motor U terminal	
E112	W/R (－)	EGR DC motor U terminal [Connection terminal is available only for 65kVA]	
E113	R/W	Suction control valve (SCV)	When power stays on, fuel is sent to common rail by pressure. Fuel injection volume to common rail is controlled by control of power supply timing of suction control valve (SCV).
E114	－	NIL	
E115	－	NIL	
E116	R	Injector 2,3	Power supply for injector 2 & 3
E117	L/W	Injector 4	When power stays on, it injects fuel to injector 4.
E118	L/R	Injector 2	When power stays on, it injects fuel to injector 2.
E119	L	Injector 1	When power stays on, it injects fuel to injector 1.
E120	L/Y	Injector 3	When power stays on, it injects fuel to injector 3.
E121	W	Injector 1,4	Power supply for injector 1 & 4

※ : Line color in ( ) shows the line color for 125kVA.

(3-2) List of E terminal function (40 pins)

150kVA

Pin No.	Line color	Connection	Function
E82	W	Common rail pressure sensor OUT terminal	It detects common rail pressure (fuel pressure). It detects fuel pressure in common rail and it converts it voltage signal and inputs it. It is used for fuel injection control. Pressure detecting voltage signal is high, when pressure is high, and it is low, when pressure is low.
E83	Y/G	Fuel temperature sensor	It detects fuel temperature. Fuel temperature sensor changes resistance value according to change of internal thermistor temperature. ECM detects voltage which changes according to temperature change and it counts fuel temperature and uses it for control of supply pump. Voltage is low, when fuel temperature is high and resistance is little, and it is high, when fuel temperature is low, and resistance is large. (Resistance of thermistor is little, when temperature is high, and it is large, when temperature is low.)
E84	R/B	Water temperature sensor	It detects engine coolant temperature. It detects voltage which changes according to resistance and then it counts engine coolant temperature.
E85	—	NIL	
E86	—	NIL	
E87	R	Common rail pressure sensor VCC terminal EGR motor position sensor power supply terminal	Power supply for left sensors (DC5V)
E88	—	NIL	
E89	R/B	Suction control valve (SCV)	Grounding
E90	Br	Common rail pressure sensor OUT terminal	It detects common rail pressure (fuel pressure). It detects fuel pressure in common rail and it converts it voltage signal and inputs it. It is used for fuel injection control. Pressure detecting voltage signal is high, when pressure is high, and it is low, when pressure is low.
E91	L	Boost pressure sensor OUT terminal	It detects engine intake boost (intake air pressure). It counts boost (intake air pressure) from detected voltage signal for fuel injection control. Voltage is high, when pressure is high, and it is low, when pressure is low.

＜150kVA＞

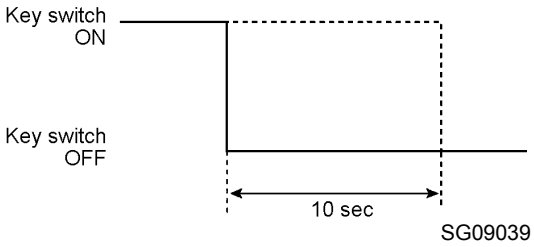
Pin No.	Line color	Connection	Function
E92	G/Y	EGR motor position sensor W terminal	It detects valve lift of EGR (exhaust, gas, re-circulation) valve.
E93	G/W	EGR motor position sensor V terminal	
E94	G/B	EGR motor position sensor U terminal	
E95	R/W	Boost pressure sensor 5V terminal	Power supply for boost pressure sensor (DC5V)
E96	－	NIL	
E97	R/B	Suction control valve (SCV)	Grounding
E98	W	CAM angle sensor ＋terminal	It detects camshaft position (CMP) signal. CMP signal is caused when cam position of camshaft passes camshaft position (CMP) sensor. ECM judges cylinder according to CMP signal, and it decides crank angle and counts fuel injection control and engine speed. This control is performed based on crankshaft position (CKP) signal detected between E107 – E106 terminals, but in case crankshaft position (CKP) sensor is in trouble, it is performed based on camshaft position (CMP) signal.
E99	B	CAM angle sensor －terminal	
E100	B/W	Shield line	Grounding
E101	B	Common rail pressure sensor SG terminal EGR motor position sensor grounding terminal	Grounding
E102	Y	Monitor lamp CN1-13 terminal	No power exists during usual operation. When engine speed rises up to emergency stop set speed, interior contact in ECM is “ON”, and it connects ground to sends power. Thus overspeed warning lamp glows. ●Emergency stop set speed : 2070min^{-1} (69Hz)
E103	W/B	EGR DC motor V terminal	Same as E110 & E111 terminal.
E104	－	NIL	
E105	R/W	Suction control valve (SCV)	When power stays on, fuel is sent to common rail by pressure. Fuel injection volume to common rail is controlled by control of power supply timing of suction control valve (SCV).
E106	B	Crank angle sensor －terminal	It detects crankshaft position (CKP) signal. CKP signal is caused when convex portion of flywheel passes through sensor position. ECM judges cylinder according to CKP signal, and it decides crank angle and counts fuel injection control and engine speed. This control is performed based on CKP signal, but in case crankshaft position (CKP) sensor is in trouble, it is performed based on camshaft position (CMP) signal detected between E98 – E99 terminals.
E107	W	Crank angle sensor ＋terminal	

＜150kVA＞

Pin No.	Line color	Connection	Function
E108	B/W	Shield line	Grounding
E109	R/L	Boost pressure sensor SG terminal	Grounding
		Boost temperature sensor grounding terminal	
E110	W/L	EGR DC motor W terminal	It operates EGR DC motor, and it controls valve lift of EGR valve. ECM decides EGR gas volume based on engine speed and engine load ratio (fuel injection volume) and it operates EGR valve by EGR DC motor, and also it controls EGR gas volume to be mixed in engine intake air.
E111	W/R	EGR DC motor U terminal	
E112	—	NIL	
E113	R/W	Suction control valve (SCV)	Same as E105 terminal.
E114	G/R	Injector 2	When power stays on, it injects fuel to injector 2.
E115	G/B	Injector 4	When power stays on, it injects fuel to injector 4.
E116	R	Injector 4,5,6	Power supply for injector 4, 5 & 6
E117	L/W	Injector 3	When power stays on, it injects fuel to injector 3.
E118	L/R	Injector 6	When power stays on, it injects fuel to injector 6.
E119	L	Injector 1	When power stays on, it injects fuel to injector 1.
E120	L/Y	Injector 5	When power stays on, it injects fuel to injector 5.
E121	W	Injector 1,2,3	Power supply for injector 1,2 & 3

(4) Power supply "OFF" for ECM

Power in ECM is not yet "OFF" 10 seconds after key switch is OFF. In case that it is necessary to switch OFF power supply by clear memory (See 4.6.2), it is necessary that you should wait longer than 10 seconds after switching OFF key switch of power supply.



(5) Removal of ECM

1. Switch OFF key switch.
2. Remove minus cable of battery.
3. In order to make removal job easier, remove parts such as relays around ECM.
4. Remove ECM connector from ECM. (81 pins and 40 pins connectors)
5. Loosen fixing bolts (nuts) and remove ECM.

(6) Installation of ECM

Install ECM in reverse order to disassembly.

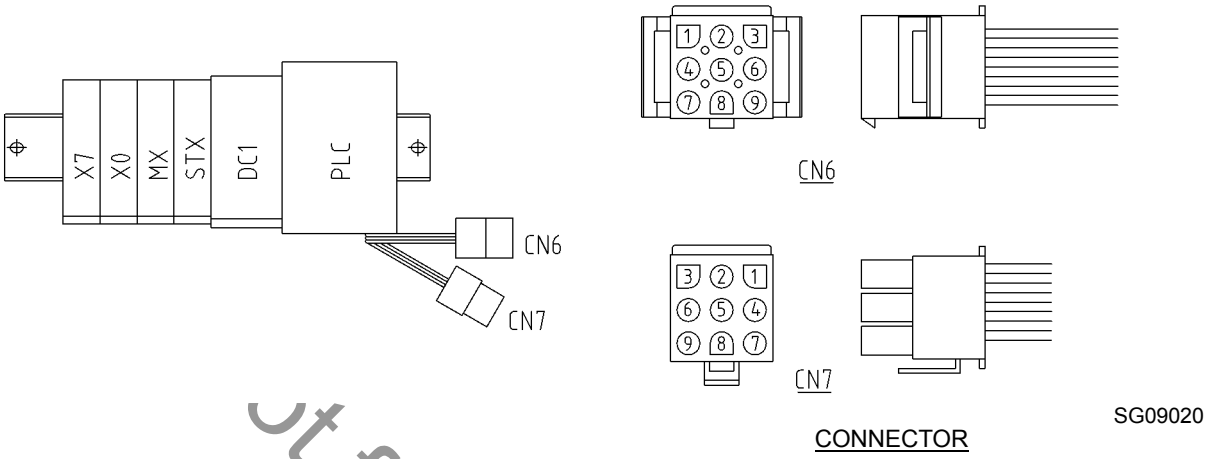
On replacement of ECM, make sure to learn EGR valve position, taking the following procedures.

1. Switch ON key switch "ON".
2. Switch OFF key switch.
3. Wait for 10 seconds in the conditions.

Without learning ECG valve position, EGR diagnostic trouble code (DTC) will be detected.

3.4.2 Auto start unit (Automatic operation unit)

65～125kVA Part number:46760 46210
150kVA Part number:46760 43810



SG09020

CONNECTOR

List of functions

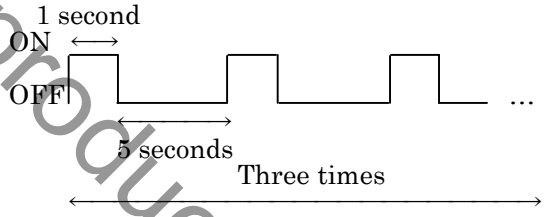
Pin No.	Line color	Connection	Function
CN6-1	B/R	10A fuse	■Power supply This detects engine speed, pulse conversion, air filter clogging and water level rise in oil fence.
CN6-2	Y/L	ECM V8 terminal	It inputs engine speed. (1 revolution per 4 pulses)
CN6-3	Y/G	Air filter differential pressure indicator	No power exists during usual operation. Air filter differential pressure rises “ON”. When air filter differential pressure indicator is “ON” for 10 seconds, interior contact of Y3 terminal is switched “ON” and warning lamp glows. ●Function differential pressure : More than 0.9psi (6.2kPa)
CN6-4	Y/R	Manual-Auto selector switch	Power supply for remote start-stop switch. With CN6-4 terminal power supply input, remote start-stop switch (external output terminal plate A1-A2 terminals) is “ON”, XO relay works.
CN6-5	W/L	Oil fence level switch	No power exists during usual operation. Fluid level in oil fence rises “ON”. When oil fence level switch is “ON” for 10 seconds, interior contact of Y5 terminal is switched “ON” and warning lamp glows. ●Warning lamp lighting capacity : More than 1/3 of blank capacity

Pin No.	Line color	Connection	Function
CN6-6	Y/W	Remote start-stop switch (Via external output terminal plate A1 terminal)	Remote start-stop switch connector terminal. With CN6-4 terminal power supply input, remote start-stop switch is "ON", XO relay works. Thus the relay is switched, power is sent to PLC unit via DC12V-DC24V converter (DC1). And XO relay works and voltage is applied to PLC unit XO terminal. Then 2 seconds later, interior contact of Y1 terminal is "ON" and preheating starts. Then when X6 terminal detects, preheating finished, interior contact of Y2 terminal is "ON" and starter motor begins cranking and start engine. **■Stop** Remote start-stop switch is "OFF" to make XO relay switch "OFF", but power is supplied to PLC unit itself for 5 seconds with power input from CN6-1 terminal. Then after engine performs cooling operation for 5 seconds, interior contact between COM0-Y0 terminals is "OFF", and engine is brought to stop. **■In case pushing emergency stop button** When pushing emergency stop button on operation panel, power supply of auto start unit CN6-1 terminal is shut down to stop immediately.
CN6-7	—	Generator unit T7 terminal	It detects generator unit (L1-L3) generating power. When engine automatically starts, no power exists on X7 relay. And in case no voltage is applied to X7 terminal, interior contact of PLC unit Y1, Y2 terminal is "OFF" and to stop engine start and to cancel auto re-start function.
CN6-8	—	Generator unit T9 terminal	
CN6-9	B	Grounding	

Pin No.	Line color	Connection	Function
CN7-1	L/Y	ECM V11 terminal	It detects preheating finish when starting. While preheating, interior contact of ECM V11 terminal is "ON" and then power flows. When "OFF", preheating is completed.
CN7-2	—	NIL	
CN7-3	G/Y	Monitor lamp CN1-12 terminal (Air filter clogging warning lamp)	No power exists during usual operation. When air filter differential pressure indicator is "ON" for 10 seconds, interior contact of Y3 terminal is "ON" and air filter clogging warning lamp glows.

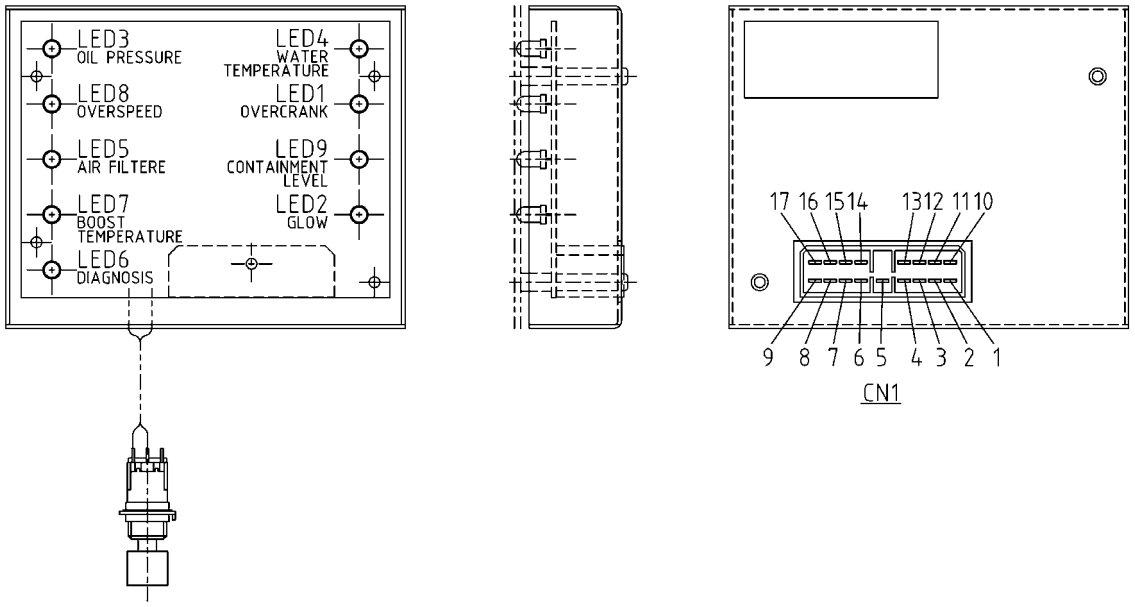
Pin No.	Line color	Connection	Function
CN7-4	L/W	Monitor lamp CN1-11 terminal (Start stall warning lamp)	It outputs start stall signal. No power exists during usual operation. When automatically starting, interior contact of PLC unit Y2 terminal is "ON" and it outputs start signal to starter relay, X3 terminal detects engine start speed (more than 750min^{-1}). At the time, if within 5 seconds engine start speed is not inputted, auto start cranking ends without success, and if auto start operation is repeated and 3 times without success, interior contact of PLC unit Y4 terminal is "ON", and start stall signal is outputted to monitor panel CN1-11 terminal.
CN7-5	B/L	Monitor lamp CN1-3 terminal (Oil fence water level rise warning lamp)	No power exists during usual operation. When oil fence level switch is "ON", interior contact of Y5 terminal is "ON" and oil fence water level rise warning lamp glows.
CN7-6	L	Tachometer (Via monitor lamp CN1-8 terminal)	It outputs engine speed. (2 revolutions per 1 pulse) Engine speed (1 revolution per 4 pulses) inputted from ECM is converted for tachometer (2 revolutions per 1 pulse) and outputted.
CN7-7	R/Y	Starter switch ACC terminal MR1 relay	Power supply for engine starting when automatically starting. When remote start-stop switch is "ON", XO relay works to supply power to PLC unit XO terminal, and 2 seconds later interior contact of Y1 terminal is "ON". Thus MX relay works, and engine power supply is outputted from CN7-7 terminal. Outputted power from CN7-7 is to activate MR1 relay and supply power to ECM for starting preheating.

<table>
<tr><th>Pin No.</th><th>Line color</th><th>Connection</th><th>Function</th></tr>
<tr><td rowspan="2">CN7-8</td><td rowspan="2">R/L</td><td>Starter switch C terminal</td><td rowspan="2">It outputs start signal when automatically starting.
When PLC unit X6 terminal (CN7-1 terminal) detects end of preheating Y2 terminal interior contact is “ON” to activate STX relay and it outputs start signal to starter relay from CN7-8 terminal.
Start signal is inputted to X3 terminal (CN6-2 terminal). When engine speed exceeds 750min^{-1}, Y2 terminal interior contact is “OFF” and cuts output. Thus automatic start cranking operation is brought to stop.
After start signal is outputted, engine speed to be inputted to X3 terminal will not rise (not geared), Y2 terminal interior contact is kept “ON”, power is supplied “ON” and “OFF” to engine controller (ECM) V14 terminal. Again, repeat one second start and 5 seconds stop, automatic start operation. Unless engine speed inputted to X3 terminal will exceed 750min^{-1} even after it is repeated three times, Y4 terminal interior contact is “ON”, start stall signal is outputted from CN7-4 terminal to make overcrank warning lamp glow.

< Function of ECM V14 terminal interior contact when it is not geared >
 
</td></tr>
<tr><td>Starter relay (SY)</td></tr>
<tr><td>CN7-9</td><td>—</td><td>NIL</td><td></td></tr>
</table>

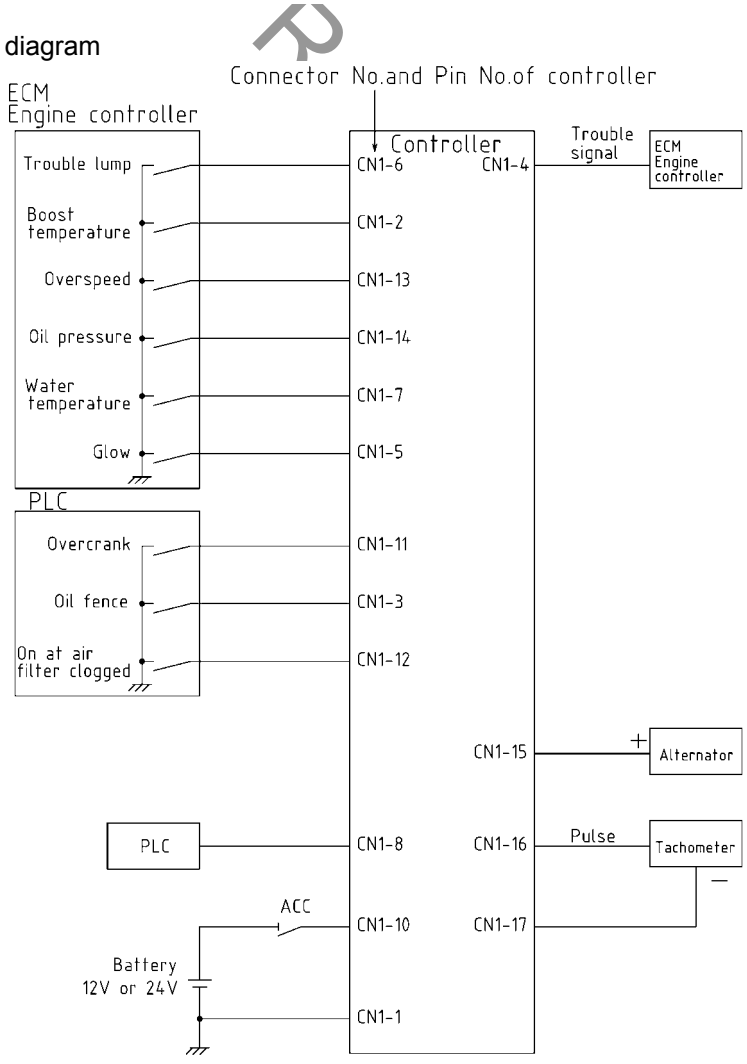
3.4.3 Emergency lamp

65～125kVA Part number:46870 47901
150kVA Part number:46870 47401



SG09021

(1) External schematic diagram



SG09022E

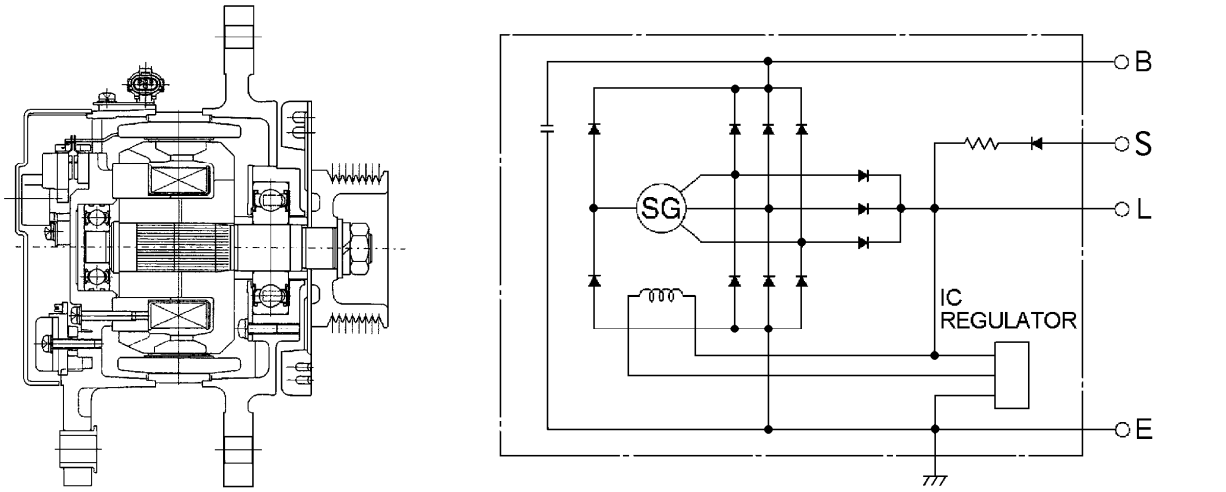
(2) List of functions

Pin No.	Line color	Connection	Function
CN1-1	B	Grounding	
CN1-2	Br/R	ECM V7 terminal	No power exists during usual operation. When boost temperature (intake air pressure) rises higher than set temperature, interior contact in ECM is "ON" and boost temperature (intake air pressure) rise warning lamp glows. ●Warning lamp lighting temperature : 185° F (85℃)
CN1-3	B/L	Auto start unit CN7-5 terminal	No power exists during usual operation. When oil fence level switch is "ON", interior contact of auto start unit Y5 terminal is switched "ON" and warning lamp glows. ●Warning lamp lighting capacity : See 3.4.8.
CN1-4	Y/B	ECM V52 terminal	When engine stops with starter switch "ON", and diagnosis lamp is "ON", make diagnosis switch "ON" or connect ECM V52 terminal directly to ground. Then, diagnosis lamp begins to blink and present and past engine troubles are shown.
CN1-5	L/Y	ECM V11 terminal	No power exists during usual operation. When preheating, interior contact of ECM V11 terminal is "ON", and it connects ground to sends power. Thus preheating lamp glows.
CN1-6	L/B	ECM V6 terminal	No power exists during usual operation. When engine is in disorder, interior contact of ECM V6 terminal is "ON", and it connects ground to sends power. Thus diagnosis lamp of monitor glows. When diagnosis lamp glows, it stops engine once. With starter switch "ON", push diagnosis switch to supply power to ECM V52 terminal. Then, diagnosis lamp begins to blink and present and past engine troubles are shown.
CN1-7	G/W	ECM V15 terminal	No power exists during usual operation. When engine coolant temperature rises up to emergency stop set temperature, interior contact of EMC V15 terminal is "ON", and it connects ground to sends power. Thus engine water temperature rise emergency stop lamp glows. ●Emergency stop lamp lighting temperature : 221° F (105℃)
CN1-8	L	Auto start unit CN7-6 terminal	It detects engine speed. It detects engine speed converted to tachometer (2 revolutions per 1 pulse).
CN1-9	—	NIL	
CN1-10	R/W	15A fuse	Power supply

Pin No.	Line color	Connection	Function
CN1-11	L/W	Auto start unit CN7-4 terminal	It inputs start stall signal. No power exists during usual operation. Upon auto start, interior contact of auto start unit Y2 terminal is "ON". When it outputs start signal to starter relay, X3 terminal detects engine start speed (more than 750 min^{-1}). At this time, when start speed is not inputted within 5 seconds and automatic cranking comes to end without success. Repeat auto start, and in case that engine will not start even after three times trial, interior contact of auto start unit Y4 terminal is "ON" and output start stall signal to monitor panel CN1-11.
CN1-12	G/Y	Auto start unit CN7-3 terminal	No power exists during usual operation. When air filter differential pressure indicator is "ON" for 10 seconds, interior contact of auto start unit Y3 terminal is "ON" and air filter clogging warning lamp glows.
CN1-13	Y	EMC E88 terminal (65～125kVA) ECM E102 terminal (150kVA)	No power exists during usual operation. When engine speed rises up to emergency stop set speed, interior contact of EMC E88 (E102) terminal is "ON" and it connects ground to sends power. Thus overspeed warning lamp glows. ●Emergency stop set speed : 2070min^{-1} (69Hz)
CN1-14	G/R	ECM V17 terminal	No power exists during usual operation. When engine oil pressure drops down to emergency stop set pressure, interior contact of ECM V17 terminal is "ON" and it connects ground to sends power. Thus engine oil pressure drop emergency stop warning lamp glows. ●Emergency stop lamp lighting pressure : 15psi (0.1MPa)
CN1-15	W	Alternator L terminal (Only for 65～125kVA)	It inputs alternator signal.
CN1-16	W/G	Tachometer Engine speed detection terminal	It outputs engine speed. (2 revolutions per 1 pulse)
CN1-17	B/P	Tachometer Grounding terminal for engine speed detection	Grounding terminal for tachometer engine speed detection. In order to show engine speed pulse signal outputted from CN1-16 terminal to tachometer, pulse signal at minus side is necessary and so diode is added at ground circuit, and ground level of tachometer is raised 1.2V higher.

3.4.4 Alternator

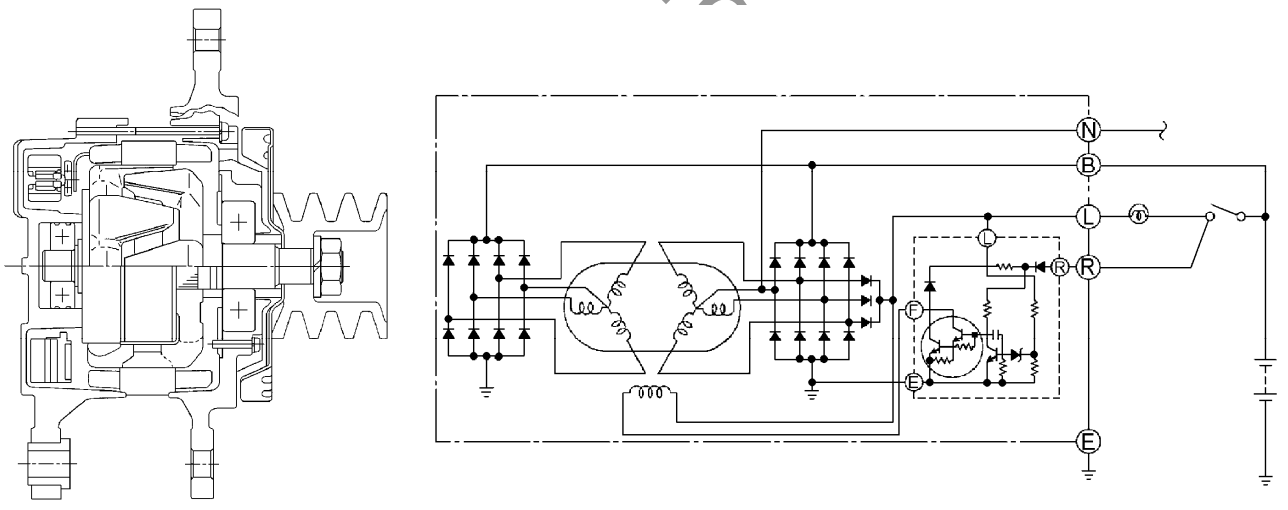
65 / 125kVA



SG09016-1

Voltage – Current	12V－110A
Regulator adjusted voltage	14.4±0.3

150kVA

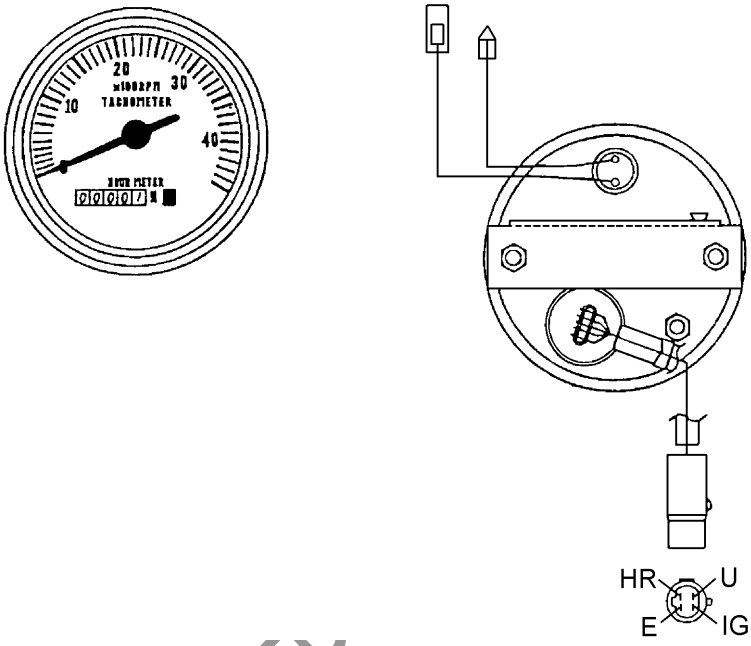


SG09017

Voltage － Current	24V－50A
Regulator adjusted voltage	28.5±1

3.4.5 Tachometer (with hour-meter)

65～125kVA Part number:36146 05901
150kVA Part number:36146 06200



SG06074

Tachometer of 65～125kVA

(1) Specifications

	65～125kVA	150kVA
Operation voltage	10～16V	20～30V
Operation temperature	-4° F～140° F (-20℃～60℃)	
Revolution ratio (pulse type)	2 revolutions per 1 pulse	

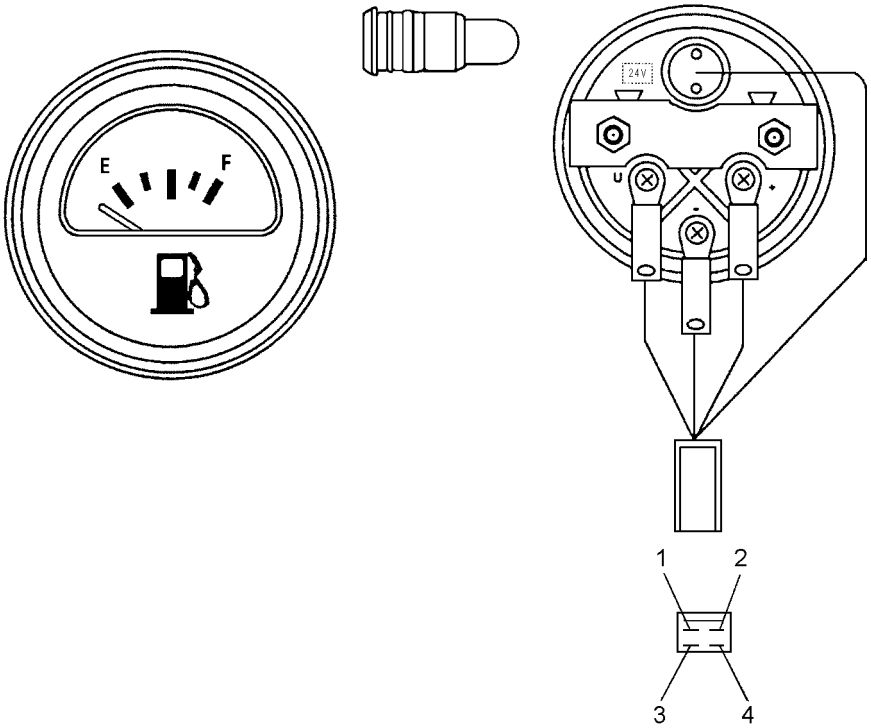
(2) List of functions

Pin No.	Line color	Connection	Function
E	B/P	Grounding	
HR	RW[W]	15A fuse [Alternator L terminal]	Input of hour-meter function signal
IG	R/W	15A fuse	Power supply for tachometer
U	W/G	Emergency lamp CN1-16 terminal	Detection of engine revolutions
Male coupler	Y/W	Panel light switch	Power supply for lighting
Female coupler	B	Grounding	Ground for lighting

[ ] shows line color and connection of 150kVA.

3.4.6 Fuel gauge

65～125kVA Part number:36158 00500
150kVA Part number:36158 00601



SG09025

(1) Position of meter pointer

Pointer position	Resistance value (Ω)	※Remaining fuel [gal. (L)]
E	95	10.3 (39)
1/2	32.5	54.4 (206)
F	7	96.4 (365)

※ marked : The figures of the remaining fuel in the table are for model 65kVA

(2) List of functions

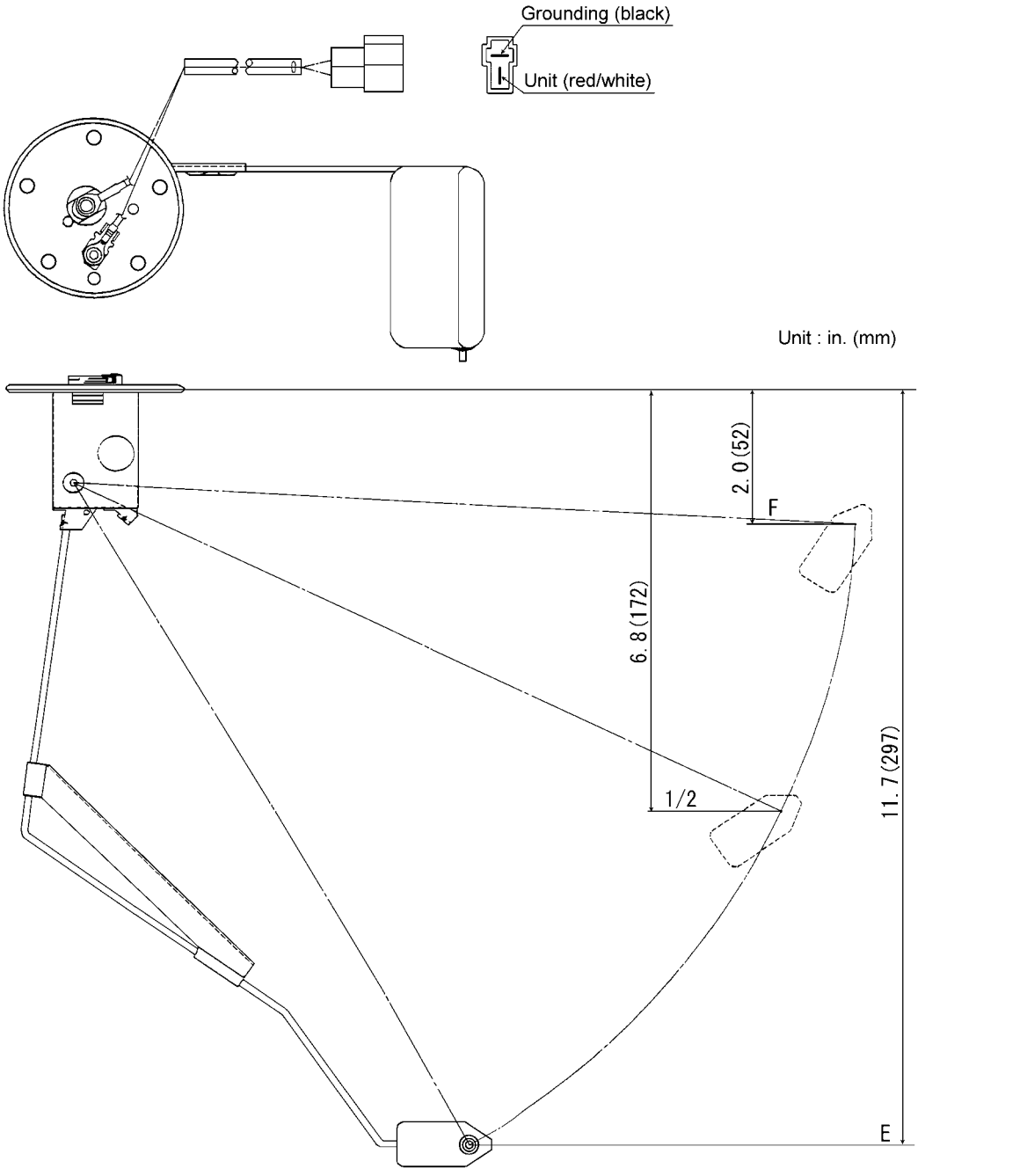
Pin No.	Line color	Connection	Function
1	R/W	15A fuse	Power supply for fuel gauge
2	G	Sending unit	Detector for remaining fuel
3	Y/W	Panel light switch	Power supply for lighting
4	B	Grounding	

(3) Lamp specifications

Model	Lamp specifications
65～125kVA	12V 3.4W
150kVA	24V 3W

3.4.7 Sending unit

65kVA Part number:36159 03000
125 / 150kVA Part number:36159 00600



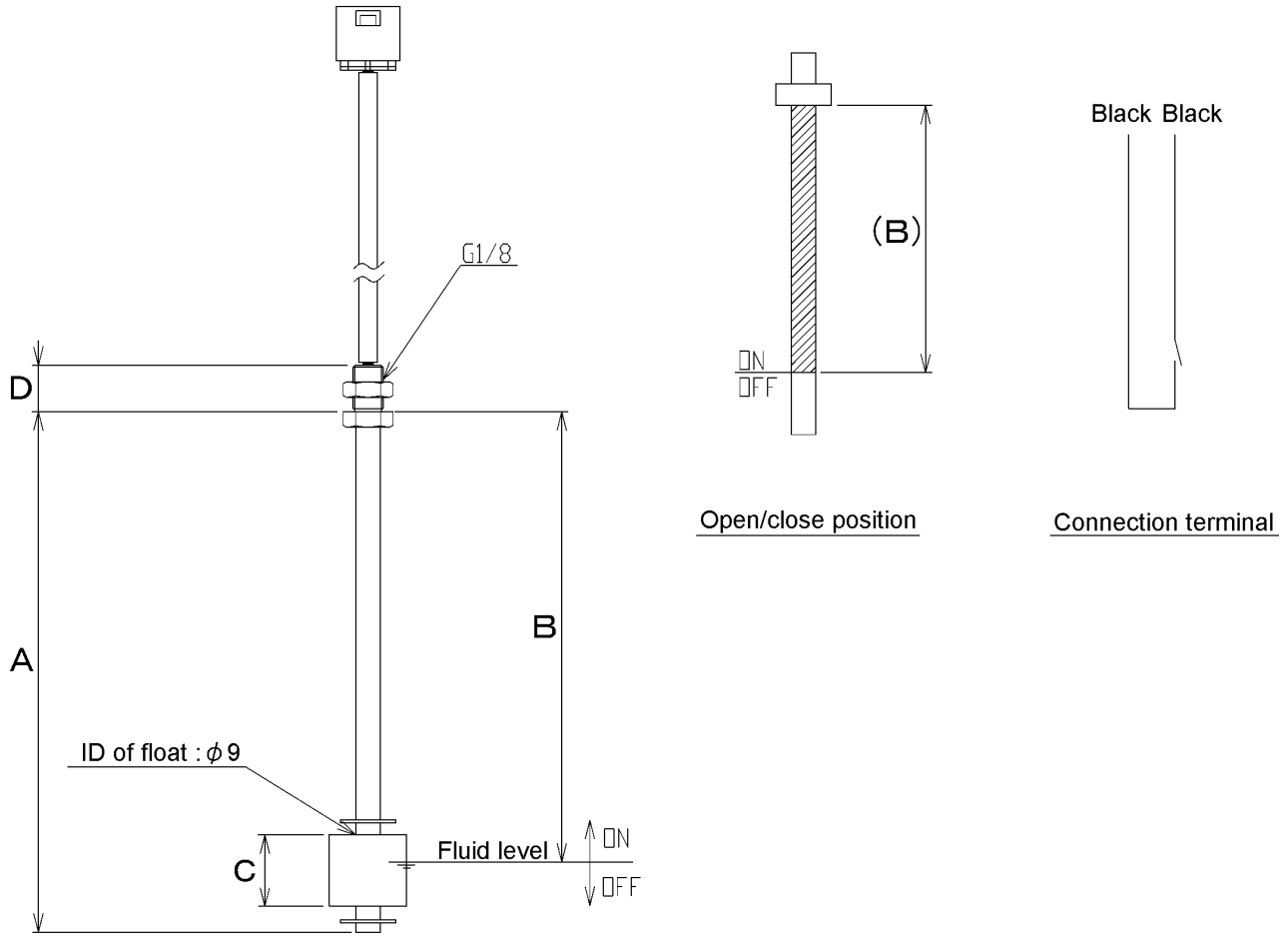
Sending unit of 65kVA

Pointer position	Resistance value (Ω)	Remaining fuel [gal. (L)]		
		65kVA	125kVA	150kVA
E	110	10.3 (39)	19.3 (73)	21.4 (81)
1/2	32.5	54.4 (206)	93.0 (352)	103.6 (392)
F	3	96.4 (365)	180.0 (680)	200.0 (756)

Above fuel residual volume are based on calculated values.

3.4.8 Oil fence level switch

65kVA Part number:46813 08100
125 / 150kVA Part number:46813 08000



(1) Specifications

	65kVA	125kVA	150kVA
Maximum working current	AC 0.5A, DC 0.5A		
Maximum primary contact resistance	Less than 100mΩ (excluding lead line)		
Fluid level in oil fence when warning lamp glows [gal. (L)] (Level switch is ON)	17.3 (65.4)	14.5 (55)	45.4 (172)

Fluid level in oil fence in above table shows the value calculated, not actually measured.

(2) Dimensions Unit : in. (mm)

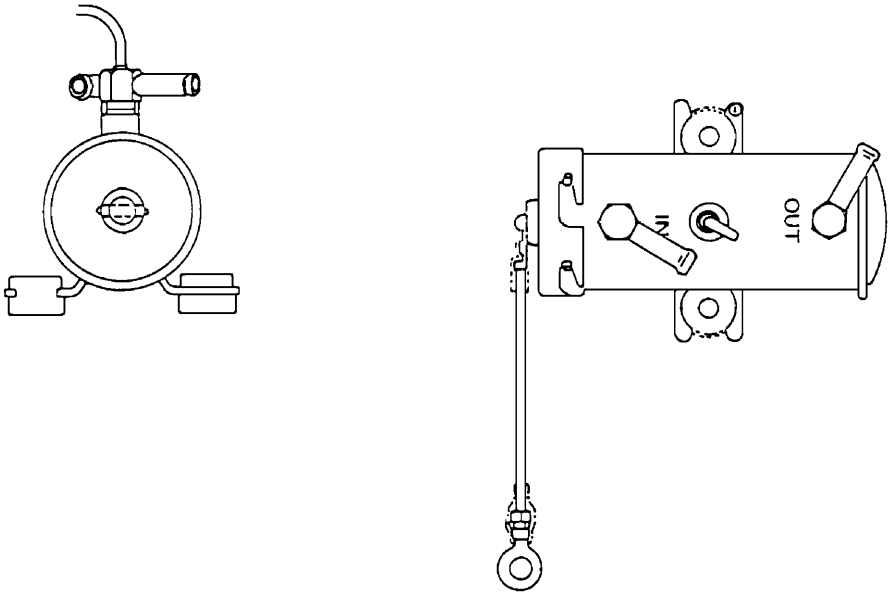
	65kVA	125 / 150kVA
A	6.85 (174)	12.76 (324)
B	5.83 (148)	11.73 (298)
C	0.98 (25)	←
D	0.59 (15)	←

3.4.9 Electro-magnetic pump for bleeding air from fuel line

Type with built-in filter

65 / 125kVA Part number:43650 02600

150kVA Part number:43650 02500



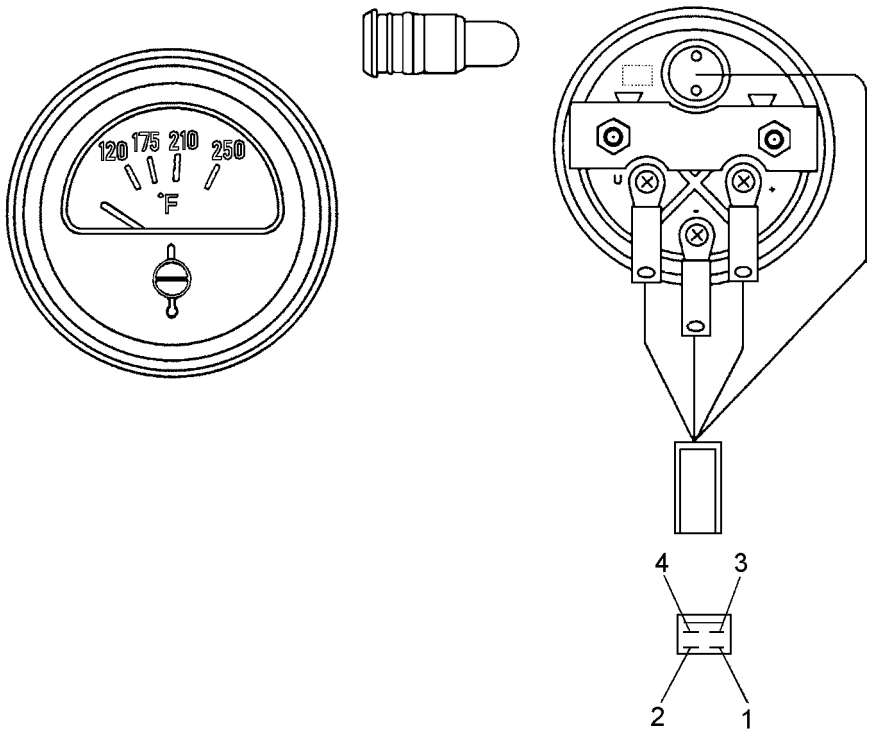
SG06076

Specifications

Model	65S～125kVA	150kVA
Rated voltage	12V	24V
Operating current	1.5A (Max)	1.5A (Max)
Delivery capacity	More than 0.34gal./min (1.3L/min)	More than 0.37gal./min (1.4L/min)

3.4.10 Coolant water temperature gauge

65kVA Part number:36145 06800
125kVA Part number:36145 06500
150kVA Part number:36145 06700



SG06040

Coolant water temperature gauge of 125kVA

(1) List of functions

Pin No.	Line color	Connection	Function
1	B	Grounding	
2	Y/W	Panel light switch	Power supply for lighting
3	W/B	Water temperature sensor	Detector for water temperature
4	R/W	15A fuse	Power supply for water temperature gauge

(2) Temperature range and resistance value of sensor

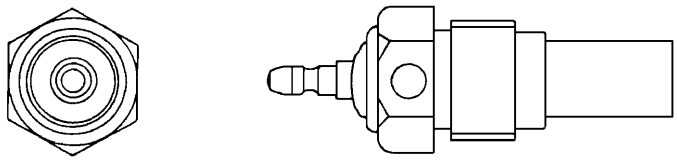
65kVA		125kVA		150kVA	
Temperature range [° F (℃)]	Sensor resistance value (Ω)	Temperature range [° F (℃)]	Sensor resistance value (Ω)	Temperature range [° F (℃)]	Sensor resistance value (Ω)
120 (49)	248	120 (49)	156	120 (49)	350
160 (71)	109	175 (79.5)	52.3	160 (71)	170
210 (99)	42	210 (99)	28.4	210 (99)	63.5
250 (121)	22	250 (121)	17	250 (121)	36.2

(3) Lamp specifications

Model	Lamp specifications
65～125kVA	12V 3.4W
150kVA	24V 3W

3.4.11 Thermo sensor for water temperature gauge

65kVA Part number:44334 17600
125kVA ISUZU part number: Contact Isuzu
150kVA Part number:44364 00100



SG06077

Characteristic of temperature resistance

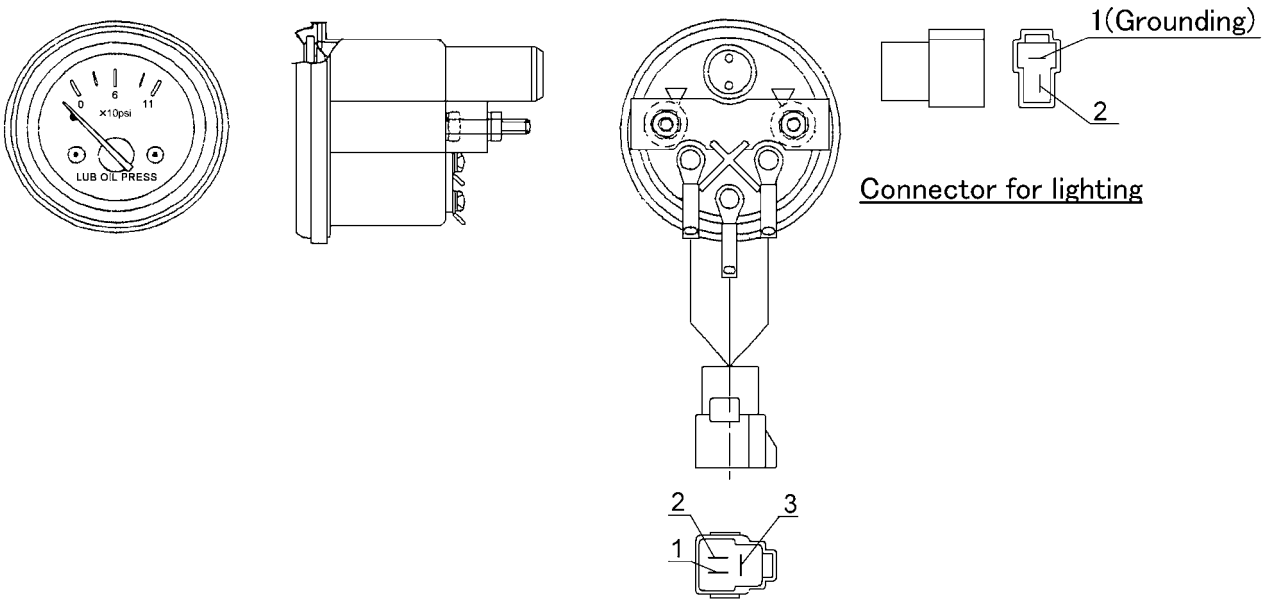
65kVA		125kVA	
Temperature [˚F (℃)]	Resistance value (Ω)	Temperature [˚F (℃)]	Resistance value (Ω)
140 (60)	146.6	122 (50)	130.0
—	—	176 (80)	48.5
—	—	212 (100)	26.7
239 (115)	24.3	230 (110)	20.0

Characteristic of temperature resistance

150kVA	
Temperature [˚F (℃)]	Resistance value (Ω)
95 (35)	670.0
176 (80)	118.0
221 (105)	54.5
239 (115)	42.0

3.4.12 Oil pressure gauge

65～125kVA Part number:36143 03600
150kVA Part number:36143 03800



SG06041E

(1) Indicated pressure and Standard current value

Indicated pressure [psi (MPa)])	0	60(0.41)	113.8(0.78)
Resistance value (Ω)	83	43	12.3

(2) List of functions

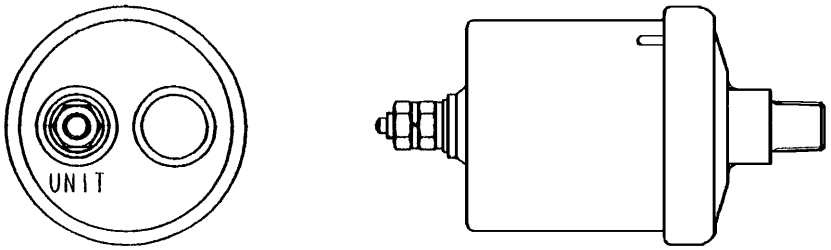
Pin No.	Line color	Connection	Function
1	R/W	15A fuse	Power supply for oil pressure gauge
2	G/B	Oil pressure sensor	Detector for oil pressure
3	B	Grounding	

(3) Lamp specifications

Model	Lamp specifications
65～125kVA	12V 3.4W
150kVA	24V 3W

3.4.13 Oil pressure sensor for oil pressure gauge

Part number:44365 00300



SG06042

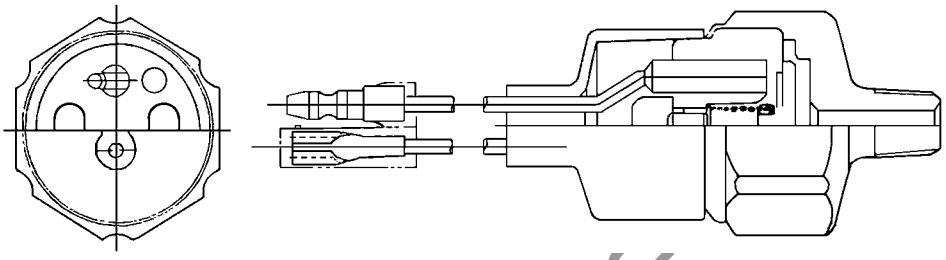
Standard pressure and Standard resistance value

Standard pressure [psi (MPa)])	0	60(0.41)	113.8(0.78)
Standard resistance value (Ω)	83	43	12.3

3.4.14 Others

(1) Engine oil pressure switch (for emergency stop)

Accessory for engine

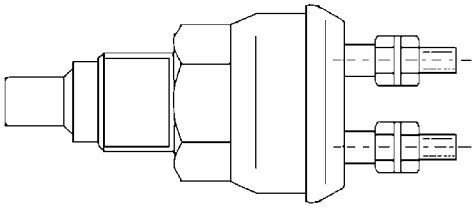


SG09033

Setting pressure	OFF in case of less than 15psi (0.1MPa)

(2) Engine water temperature switch (for emergency stop)

Accessory for engine

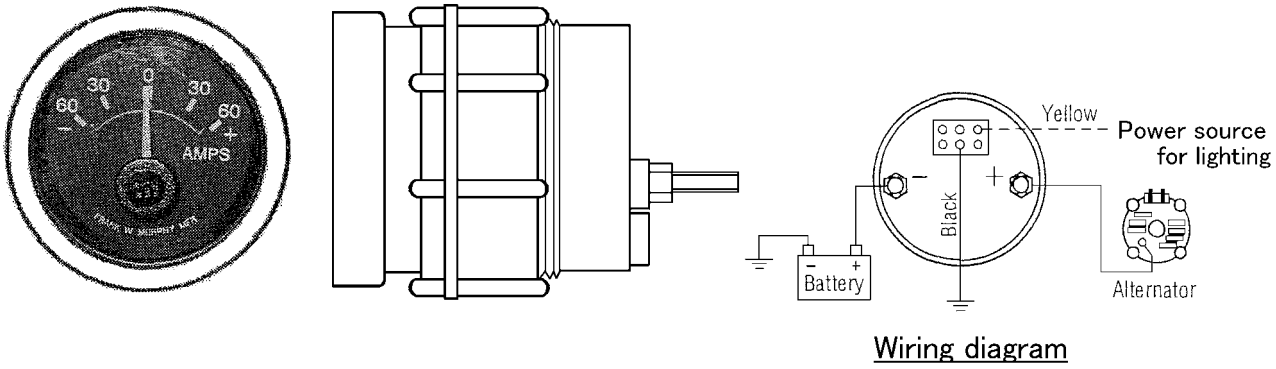


SG06078

Setting temperature	OFF in case of more than 221° F (105℃)

3.4.15 Ammeter for battery charging

65～125kVA Part number:46154 15300
150kVA Part number:46154 15500



Wiring diagram

SG06043E

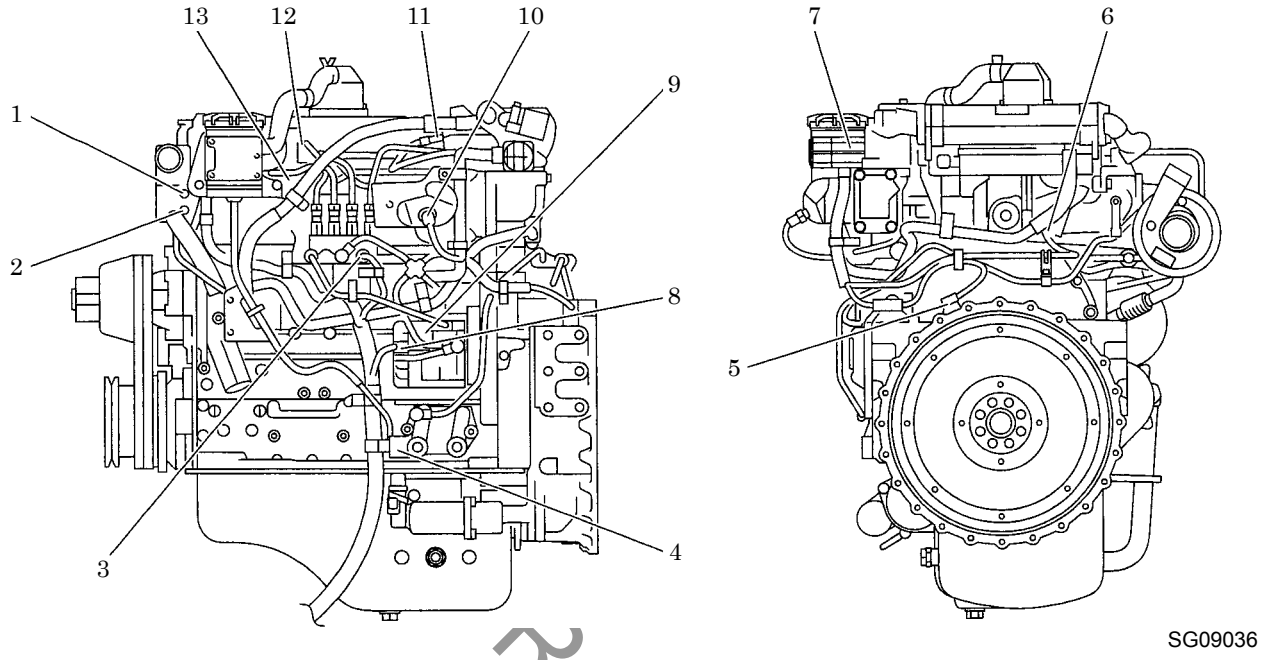
Power supply voltage specifications

65～125kVA	DC12V
150kVA	DC24V

3. Electrical Parts

3.5 Electronic Control Engine Component

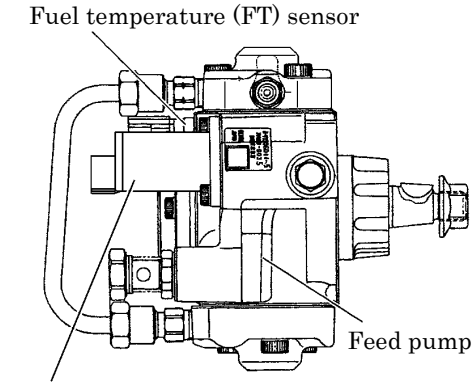
3.5.1 Engine component location diagram



1. Engine coolant temperature (ECT) sensor
2. Overheating switch
3. Common rail pressure sensor
4. Engine oil pressure sensor
5. Crankshaft position (CKP) sensor
6. Camshaft position (CMP) sensor
7. EGR valve
8. Suction control valve (SCV)
9. Fuel temperature (FT) sensor
10. Boost temperature sensor
11. Boost pressure sensor
12. Injector
13. Glow plug

3.5.2 Supply pump

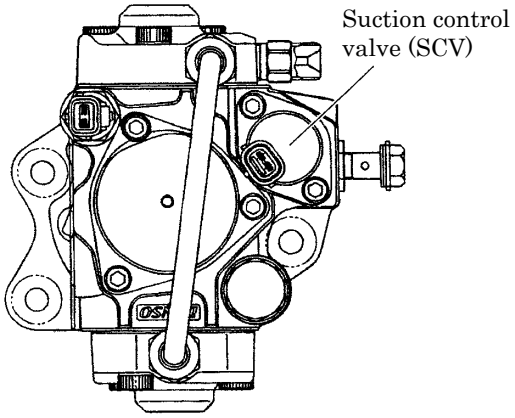
The supply pump pressurizes fuel using engine output, and pressure-feeds fuel to common rail. The supply pump has suction control valve (SCV), fuel temperature (FT) sensor and feed pump.



SG09040

3.5.3 Suction control valve (SCV)

The suction control valve (SCV) is installed onto supply pump section and controls pressure feed of fuel (discharge amount) to common rail. The engine control module (ECM) regulates period of electric conduction of suction control valve (SCV) to regulate the fuel discharge amount.



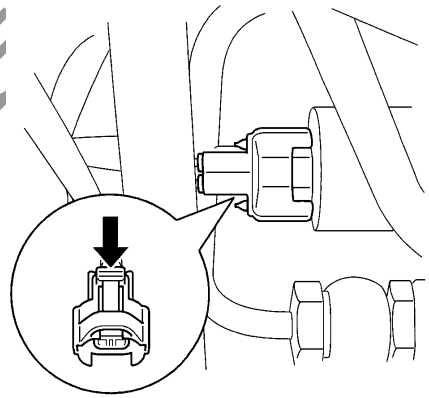
SG09041

Note:

The connector parts of suction control valve (SCV) are different in color between 12V and 24V.

12V : Light gray

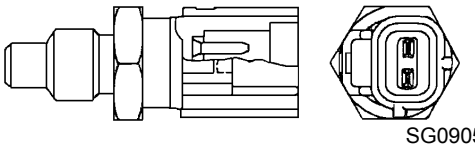
24V : Light brown



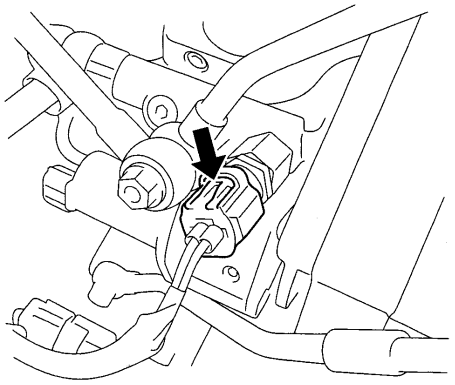
SG09042

3.5.4 Fuel temperature (FT) sensor

The fuel temperature (FT) sensor is installed onto the supply pump, and the thermistor changes the resistance according to the temperature. The resistance is low when the fuel temperature is high, and is high when the temperature is low. The ECM energizes the voltage 5V to the fuel temperature (FT) sensor through pull up resistance, and calculates fuel temperature based on change of voltage to use for various controls such as supply pump control etc. If the resistance is low (temperature is high), the voltage becomes low; if the resistance is high (temperature is low), the voltage becomes high.



SG09054



SG09055

Removal

Do not replace the fuel temperature (FT) sensor.

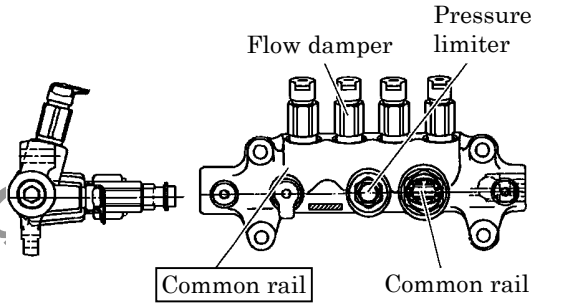
If it is faulty, replace it as supply pump assembly.

3.5.5 Common rail

The common rail receives fuel from supply pump, holds the common rail (fuel) pressure and distributes fuel to each cylinder. The common rail has common rail pressure sensor, flow damper and pressure limiter.

Note:

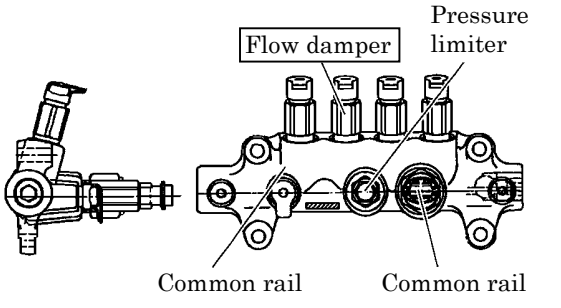
For work procedure, refer to “Engine section” in the service manual.



SG09056

3.5.6 Flow damper

The flow damper is installed onto outlet port to each injector of common rail, limits pressure pulsation in common rail and prevents over-injected fuel from injector. When the flow damper operates, fuel supply to injector is stopped.



SG09056

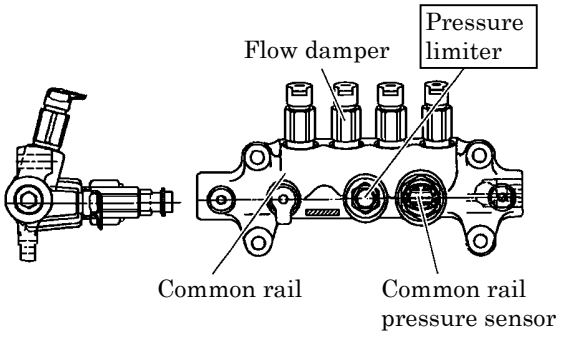
Removal

Do not replace the flow damper.

If it is damaged, replace it as common rail assembly.

3.5.7 Pressure limiter

The pressure limiter operates to release the pressure in common rail when the pressure becomes extremely high.



SG09056

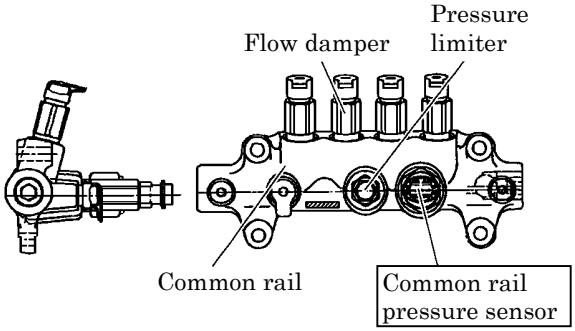
Removal

Do not replace the pressure limiter.

If it is damaged, replace it as common rail assembly.

3.5.8 Common rail pressure sensor

The common rail pressure sensor is installed onto common rail, detects fuel pressure in common rail, converts the pressure into the voltage signal and sends it to ECM. Voltage becomes higher as pressure becomes higher, and lower as one dose lower. ECM calculates the actual common rail pressure (fuel pressure) based on the voltage signal sent from sensors and uses it for fuel injection control etc.

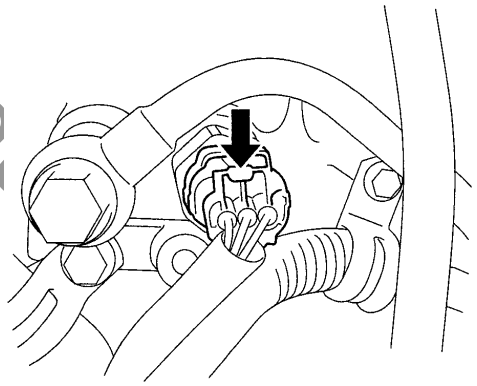


SG09056

Removal

Do not replace the common rail pressure sensor.

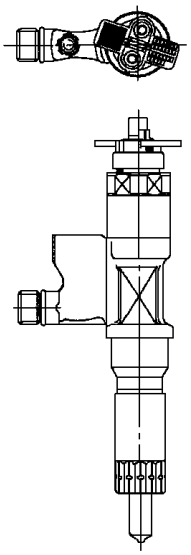
If it is damaged, replace it as common rail assembly.



SG09057

3.5.9 Injector

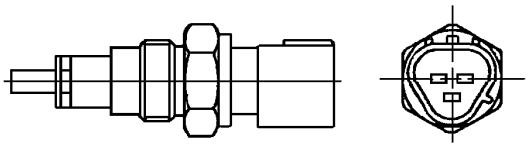
The injector is installed onto cylinder head section and is conrtolled by ECM to inject fuel. The ECM raises the voltage for operating injectors internally, energizes to injector, and regulates period of electric conduction of injector to control fuel injection amount and injection timing.



SG09058

3.5.10 Engine coolant temperature (ECT) sensor

The engine coolant temperature (ECT) sensor is installed onto engine block, and the thermistor changes the resistance according to the temperature. Resistance is low at high engine coolant temperature and high at low engine coolant temperature. The ECM energizes the voltage 5V to the ECT sensor through pull up resistance, and calculates engine coolant temperature based on change of voltage to use for various controls such as fuel injection etc. If the resistance is low (temperature is high), the voltage becomes low; if the resistance is high (temperature is low), the voltage becomes high.



SG09059

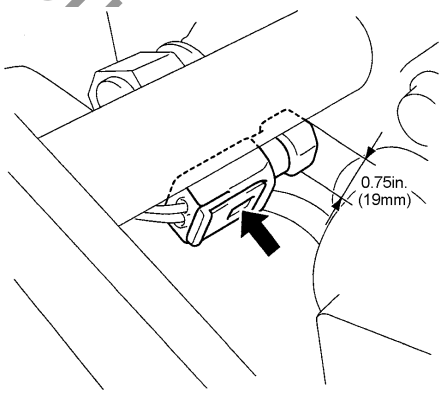
Removeal

Disconnect the connector and remove it with 0.75in. (19mm) wrench.

Installation

Apply Loctite 572 before installing it.

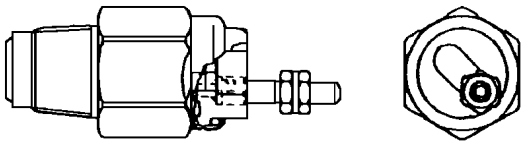
: 14.5～21.7lb･ft [19.6～29.4N･m (200～300kgf･cm)]



SG09060

3.5.11 Overheating switch

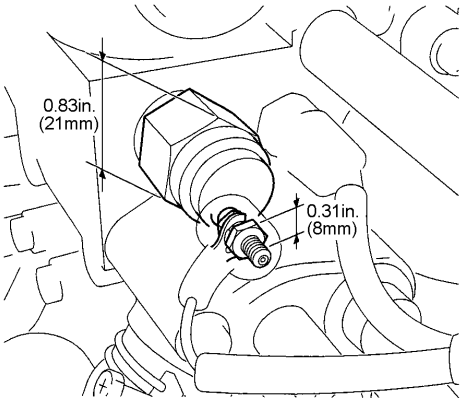
The overheating switch is installed on the water outlet pipe, and it is turned ON when the engine coolant temperature exceeds 221° F (105℃).



SG09061

Removal

Loosen the nut using a 0.31in. (8mm) wrench to remove the harness, and remove the sensor using a 0.83in. (21mm) wrench.



SG09062

Installation

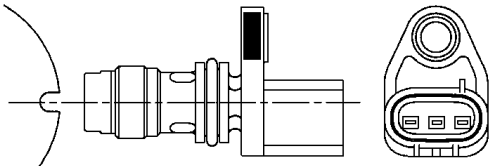
:

Sensor : 20～25lb·ft [27～34N·m (275～347kgf·cm)]

Nut : 0.6～0.7lb·ft (7.1～8.9lb·in)
[0.8～1.0N·m (8.2～10.2kgf·cm)]

3.5.12 Crankshaft position (CKP) sensor

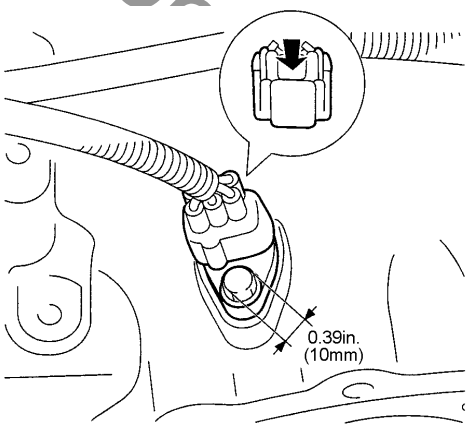
The crankshaft position (CKP) sensor is installed onto flywheel housing and produces the CKP signal when the convex portion of flywheel passes the sensor. The ECM distinguishes the cylinders by the CMP signal input from camshaft position (CMP) sensor, determines the crank angle and uses it to contorl fuel injection and calculate the engine speed. These contorls are performed, usually based on CKP signal. However it is done, based on CMP signal if the crankshaft position (CKP) sensor is faulty.



SG09063

Removal

Disconnect the connector, and remove the 0.39in. (10mm) mounting bolt and sensor.



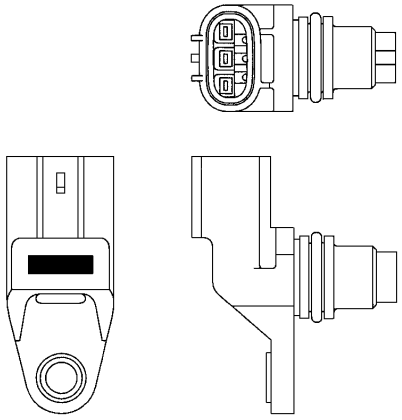
SG09064

Installation

: 11～18lb·ft [14.7～24.5N·m (150～250kgf·cm)]

3.5.13 Camshaft position (CMP) sensor

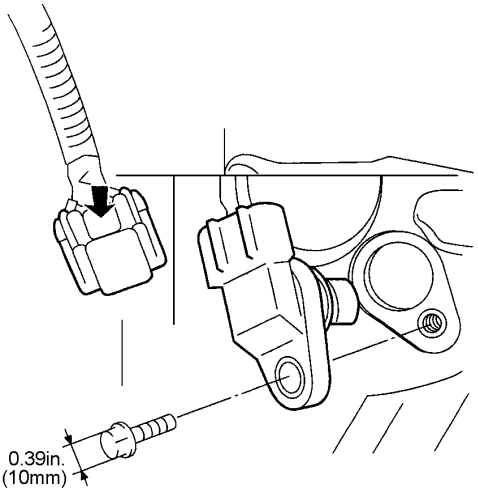
The camshaft position (CMP) sensor is installed onto the rear of cylinder head and produces the CMP signal when the cam portion of camshaft passes the sensor. The ECM distinguishes the cylinders by the CMP signal input from camshaft position (CMP) sensor, determines the crank angle and uses it to contorl fuel injection and calculate the engine speed. These contorls are performed, usually based on CKP signal. However it is done, based on CMP signal if the crankshaft position (CKP) sensor is faulty.



SG09065

Removal

Disconnect the connector, and remove the 0.39in. (10mm) mounting bolt and sensor.



SG09066

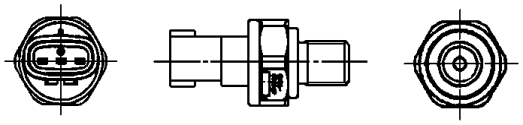
Installation

Apply a coat of engine oil to the O-ring.

: 5.8±1.4lb·ft (69±18lb·in)
[7.8±2N·m (80±20kgf·cm)]

3.5.14 Engine oil pressure sensor

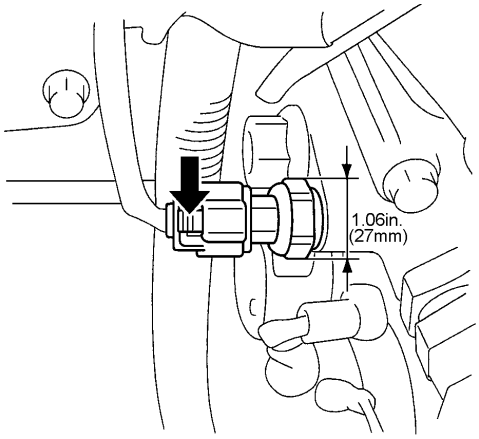
The engine oil pressure sensor is installed near the starter motor of the cylinder block; it detects engine oil pressure, converts the pressure into the voltage signal and sends it to ECM. Voltage becomes higher as pressure becomes higher, and lower as one does lower.



SG09067

Removal

Disconnect the connector and remove it with 1.06in. (27mm) wrench.



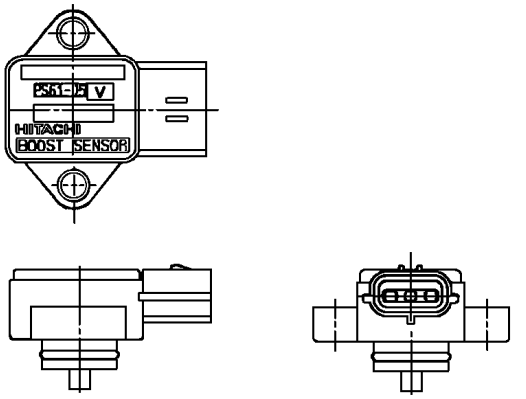
SG09068

Installation

: 30lb·ft [41N·m (420kgf·cm)]

3.5.15 Barometric pressure sensor

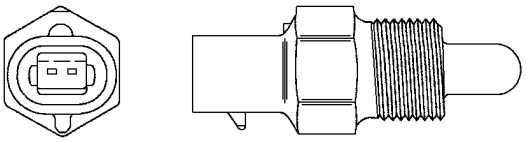
The barometric pressure sensor is installed onto the machine side and converts the barometric pressure into voltage signal. The ECM calculates barometric pressure by voltage signal and performs fuel injection amount correction (high-altitude correction) etc. by barometric pressure.



SG09069

3.5.16 Intake air temperature (IAT) sensor

The intake air temperature (IAT) sensor is installed onto the machine side and detects the temperature of intake air for optimum fuel injection control.



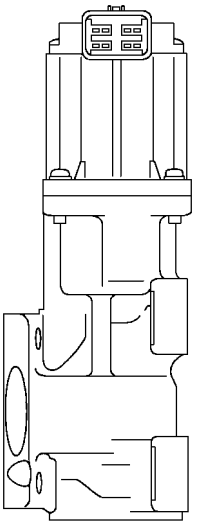
SG09070

: 8.0～12.0lb･ft (96～144lb･in)
[10.8～16.3N･m (110～166kgf･cm)]

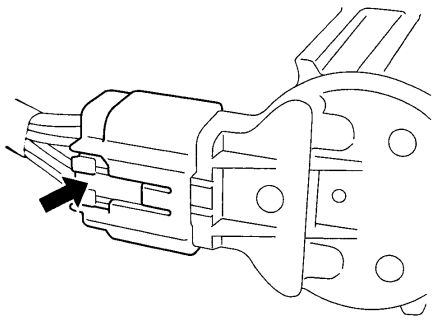
3.5.17 EGR position sensor

It is installed in EGR valve and detects the valve lift amount of EGR.

Note:
Do not disassemble the EGR position sensor. If it is faulty,replace it as EGR valve assembly.



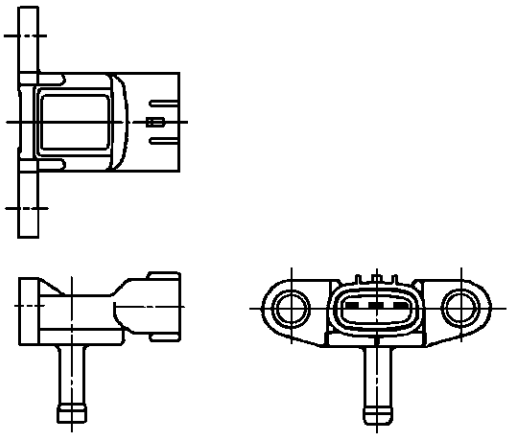
SG09071



SG09072

3.5.18 Boost pressure sensor

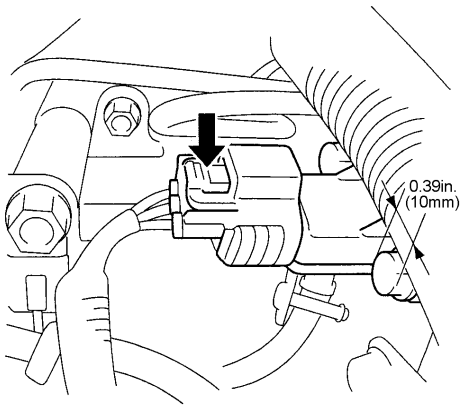
The boost pressure sensor uses the pressure hose between the boost pressure sensor and intake pipe, detects boost (intake air pressure), converts the pressure into the voltage signal and sends it to ECM. Voltage becomes higher as pressure becomes higher, and lower as one dose lower. ECM calculates the boost (intake air pressure) based on the voltage signal sent from sensors and uses it for fuel injection control etc.



SG09073

Removel

Disconnect the connector, and remove the two 0.39in. (10mm) mounting bolts, hoses and sensor.



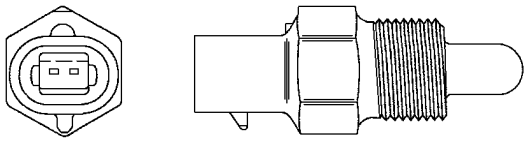
SG09074

Installation

: 3.0～4.4lb･ft (35～53lb･in)
[4～6N･m (40.8～61.2kgf･cm)]

3.5.19 Boost temperature sensor

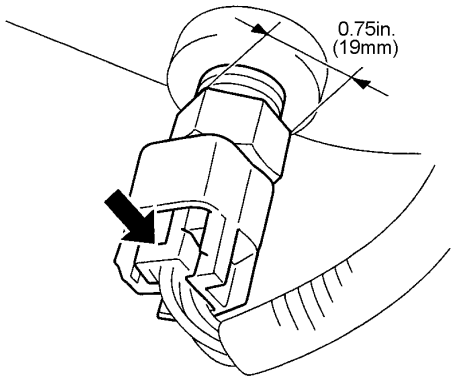
The boost temperature sensor is installed onto the EGR valve upstream side of intake manifold. The sensor is thermistor type. The resistance in the sensor changes as the temperature changes.



SG09070

Removal

Disconnect the connector and remove it with 0.75in. (19mm) wrench.



SG09075

Installation

: 8.0～12.0lb･ft (96～144lb･in)
[10.8～16.3N･m (110～166kgf･cm)]

4. Troubleshooting

4.1 Repairing Procedures

When performing failure diagnosis, pay special attention to the followings, observing general cautions.

4.1.1 Safety caution

(1) Removing such cap and/or plug for receiver tank, fuel tanks and pipes where pressure is loaded, stop the machine and relieve all the interior pressure. Install measuring instruments connected firmly.
(2) When doing the job with co-worker(s) together, make sure to give signal to the other person(s) and do not allow other persons to come near to the job site.
(3) Take care not to touch hot portions and not to be involved in turning portions.

4.1.2 Caution during failure diagnosis

(1) Do not make haste to disassemble the unit
If the unit is disassembled urgently,
1. You may disassemble the other portions which are not related with the trouble.
2. The cause of trouble may be missing.
The unnecessary reparations require more spare parts and man-hours, and reparation costs will increase more. What is worse, you will lose reliance or trust from clients, operators and users.
Therefore, it is absolutely necessary to investigate the trouble more carefully in advance and to follow the required procedures for failure diagnosis.

(2) Ask the clients about the trouble in details
In order to prevent misunderstanding and incorrect judgment about the trouble, it is necessary to ask users or operators about the following questions.
1. Is there any other disorder than the trouble he has informed?
2. Anything abnormal occurred before this trouble?
3. Did this trouble happen unexpectedly? Or the unit had been operated in bad conditions before?
4. When and how did this trouble occur?
5. Had he repaired the unit before this trouble occurred?
6. Did he not experience similar trouble before?

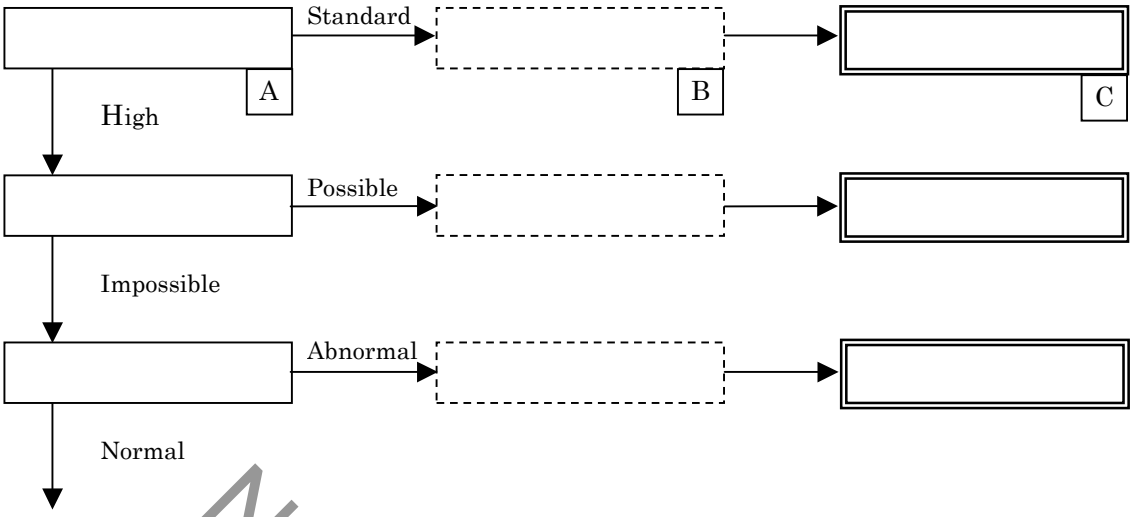
(3) Inspection items before starting diagnosis
Sometimes such trouble may be caused owing to routine mishandling of the unit. Before starting failure diagnosis, check the following items.
1. The engine runs short of engine oil or its oil is not dirty?
2. Check each cable connection for any disconnection.
3. Check the other portions for any damage.

(4) Confirmation of trouble
Discuss with user(s) and/or operator(s) sufficiently about the trouble. As a result, judge whether their judgment is based on the numerical comparison or sentimental basis. Make him (them) understand well the reparation or correction you have finished.
Then check and confirm by yourself the cause of the trouble.
Note) Never proceed any investigation or measurement which may cause further greater damage.

(5) Procedures of diagnosis
When you become well experienced, you can find out the cause easily during the process of confirmation (4). But easy understanding could cause unexpected failure. So check and judge it according to the following procedures.
1. Check the easiest thing or portion first.
2. Investigate the most possible cause.
3. Check the other things connected to the trouble.
4. Check for the possibility of any other troubles.
5. Start proper and careful investigation on this trouble.

(6) Prevention of repeated occurrence of similar trouble
Even if you have repaired the trouble, unless you get rid of the fundamental cause of the trouble, it will repeatedly occur. Therefore, perform full investigation of the trouble, and it is absolutely necessary to remove the basis of the trouble.

4.1.3 How to use the failure diagnosis



1. In the troubleshooting column something abnormal is mentioned in lined parenthesis.

2. In the troubleshooting column the cause of the said trouble is mentioned in dotted parenthesis.

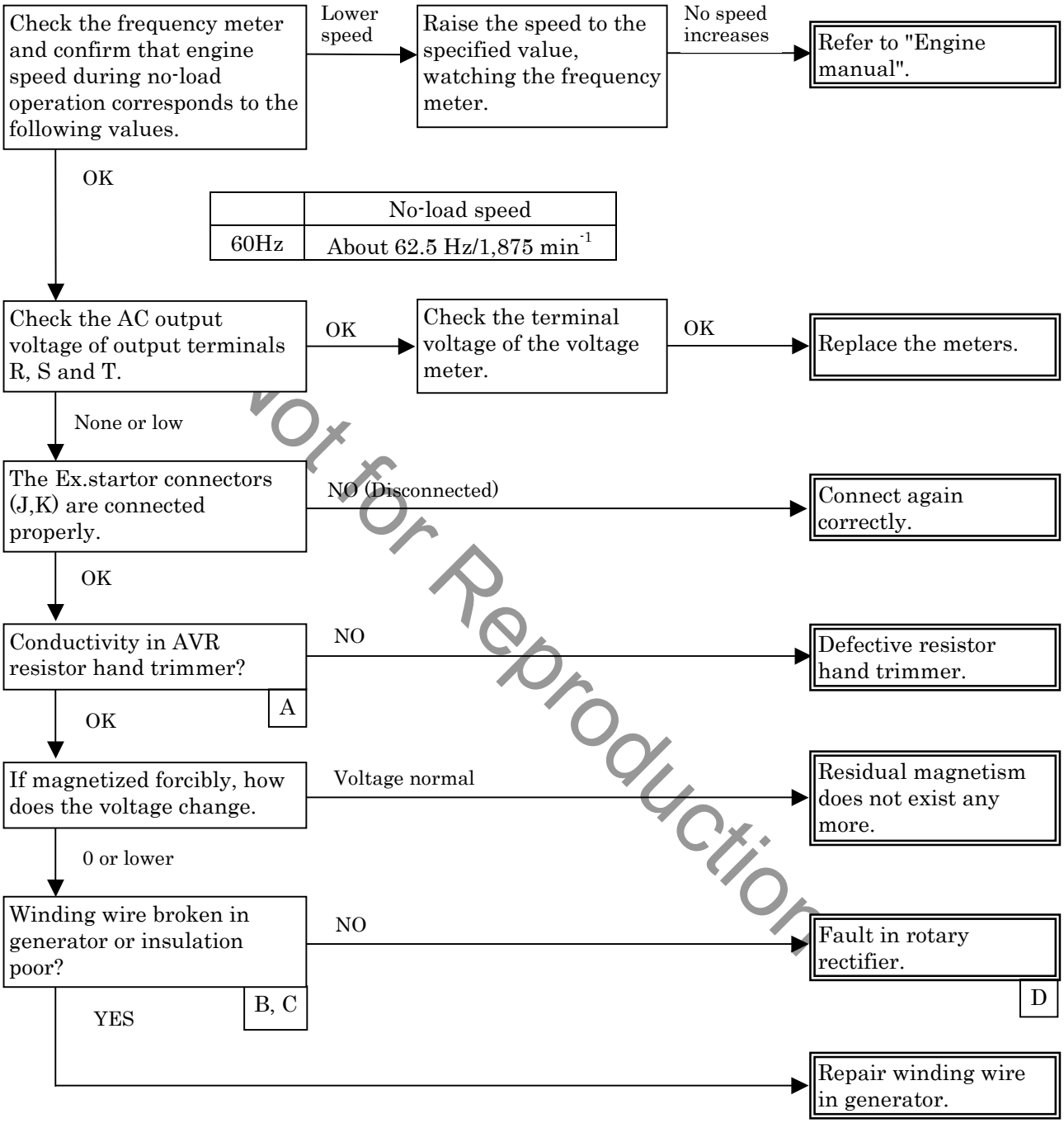
3. In the troubleshooting column the countermeasures or treatment are mentioned in the double lined parenthesis.

4. A under each column means the index of explanation.

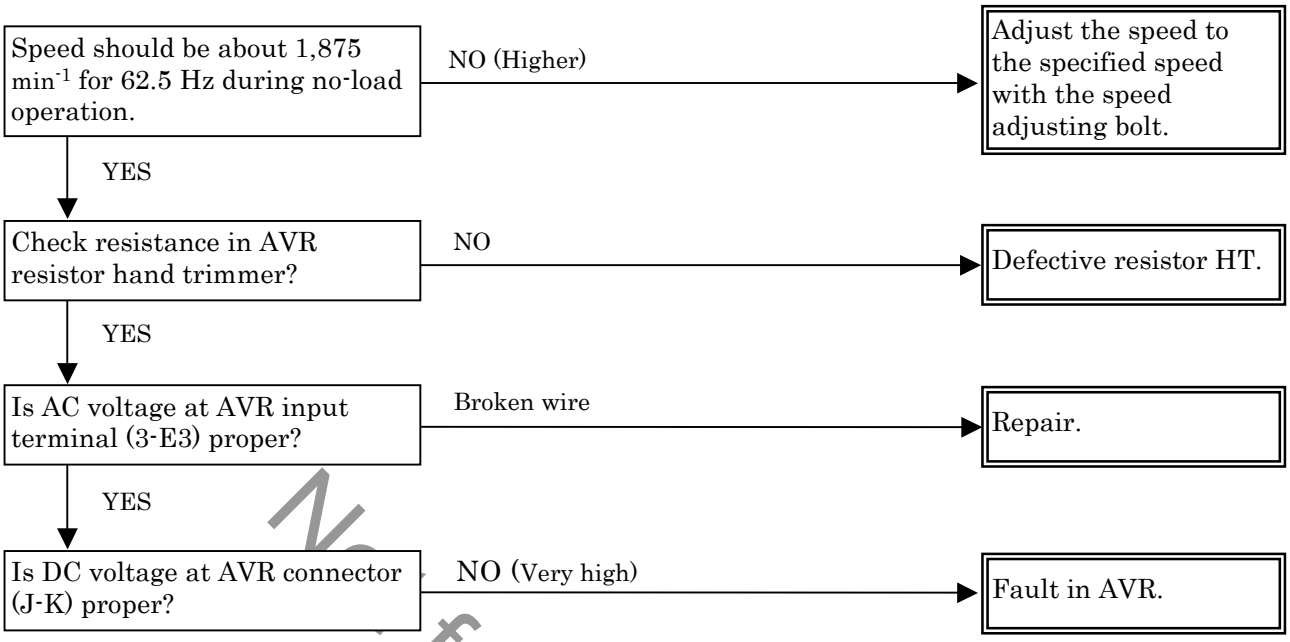
4. Troubleshooting

4.2 Generator Troubleshooting

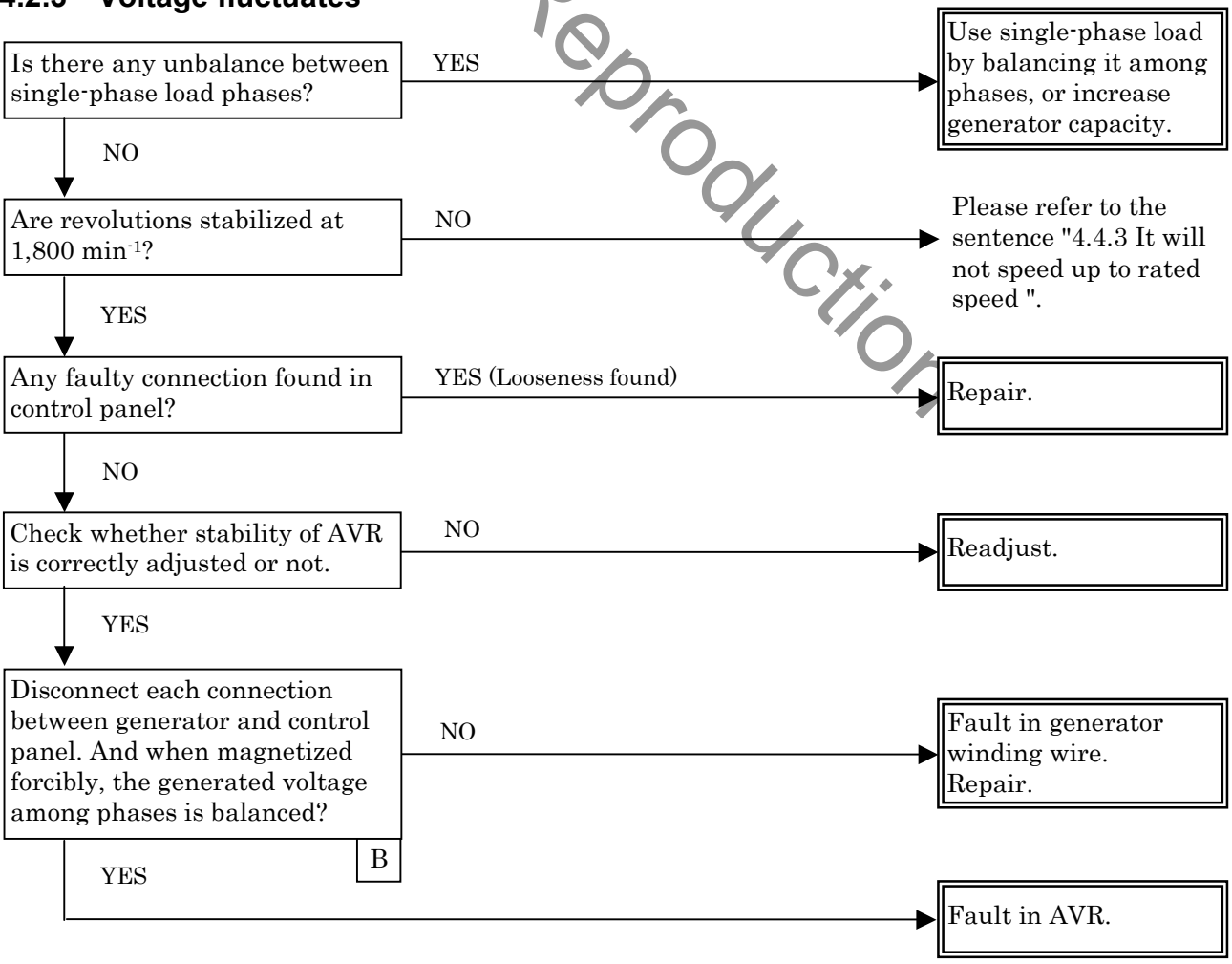
4.2.1 No voltage is generated or voltage too low



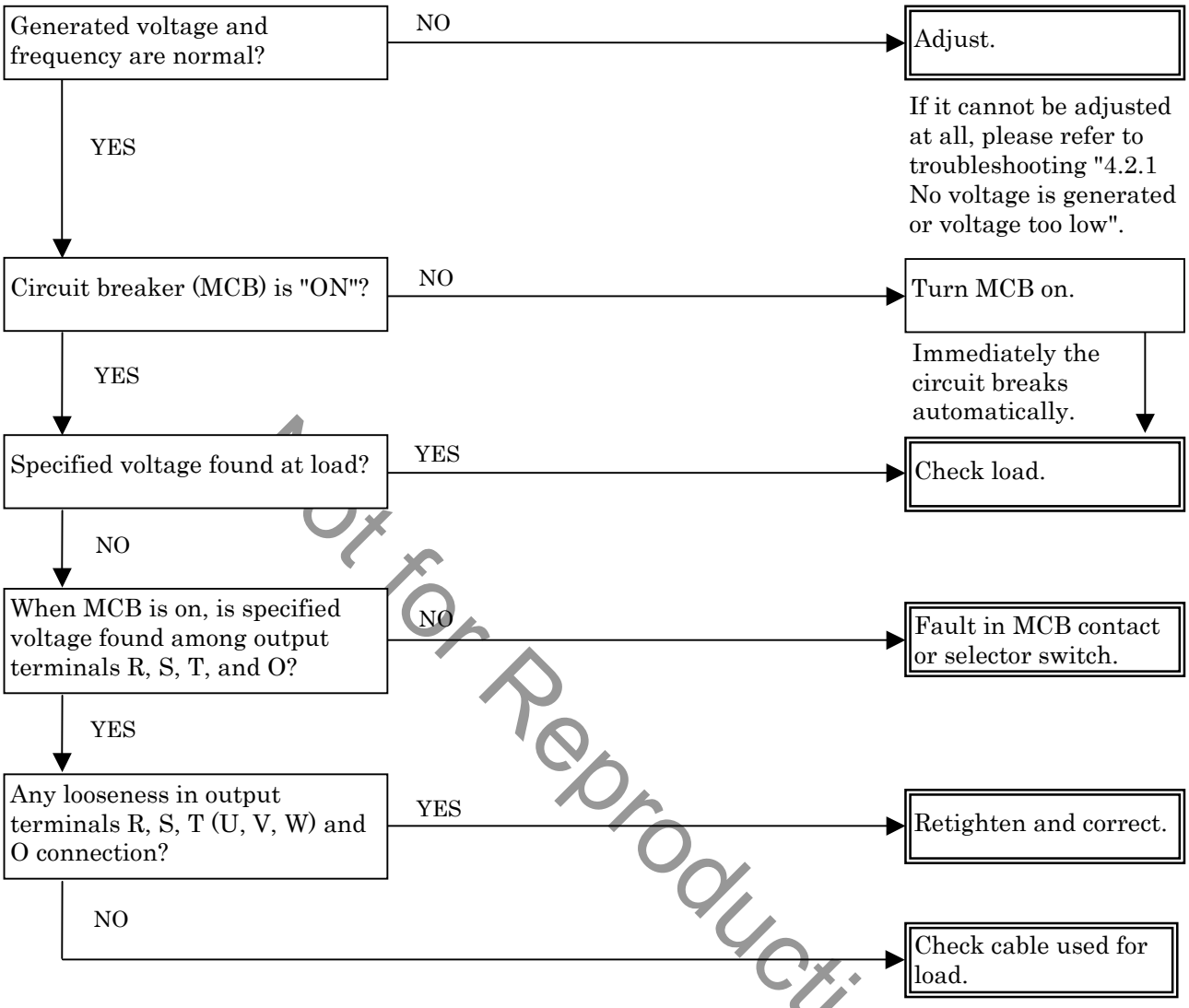
4.2.2 Voltage is very high or it cannot be adjusted



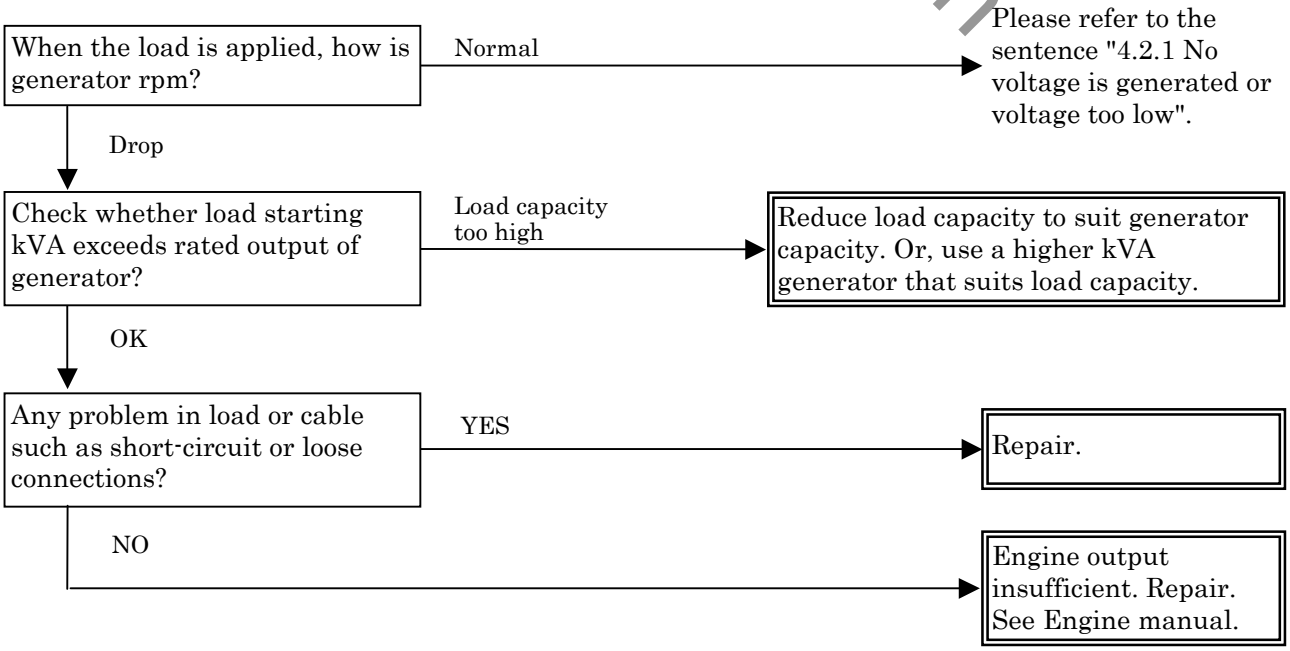
4.2.3 Voltage fluctuates



4.2.4 Load cannot be operated

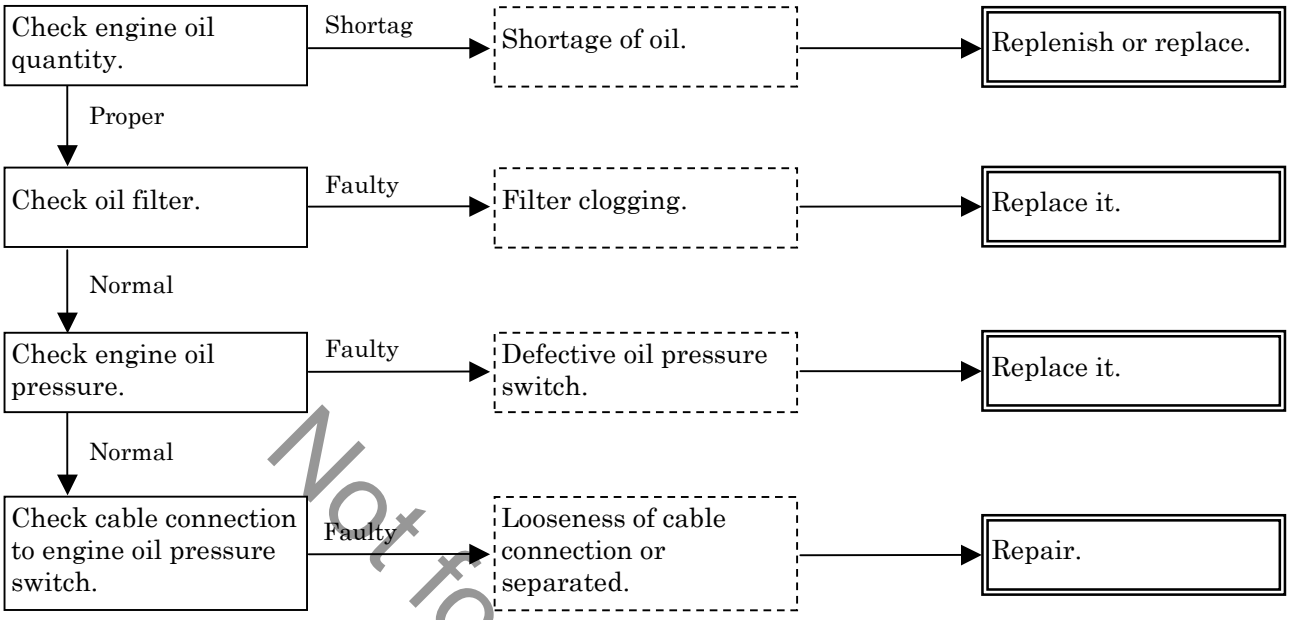


4.2.5 Voltage drops when load is applied

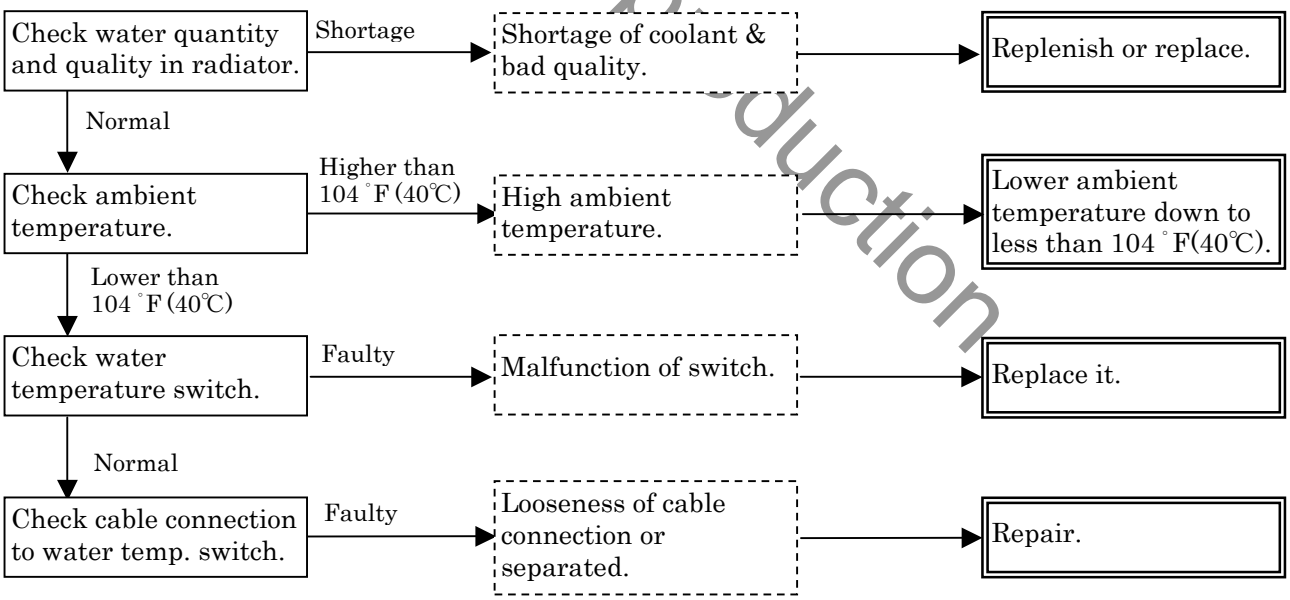


4.3 Emergency Switch Functions

4.3.1 Engine oil pressure drop is shown in monitor and it stops



4.3.2 Engine coolant temperature rise is displayed in monitor, and engine will stop

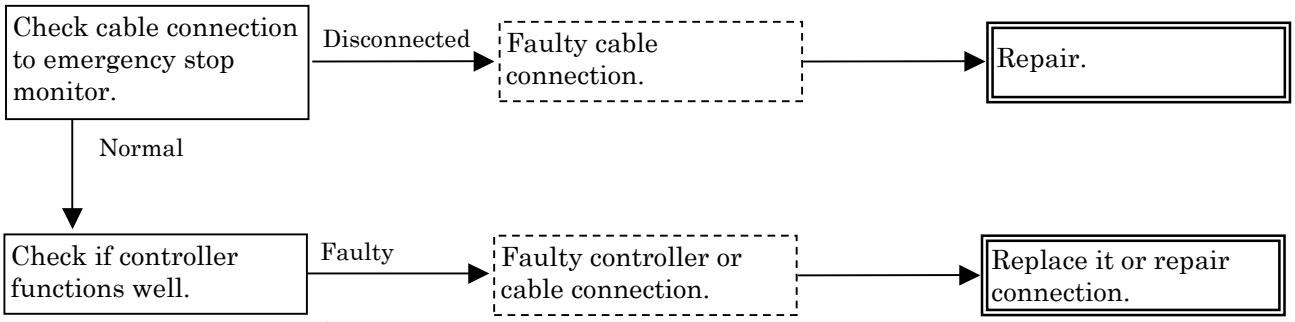


4. Troubleshooting

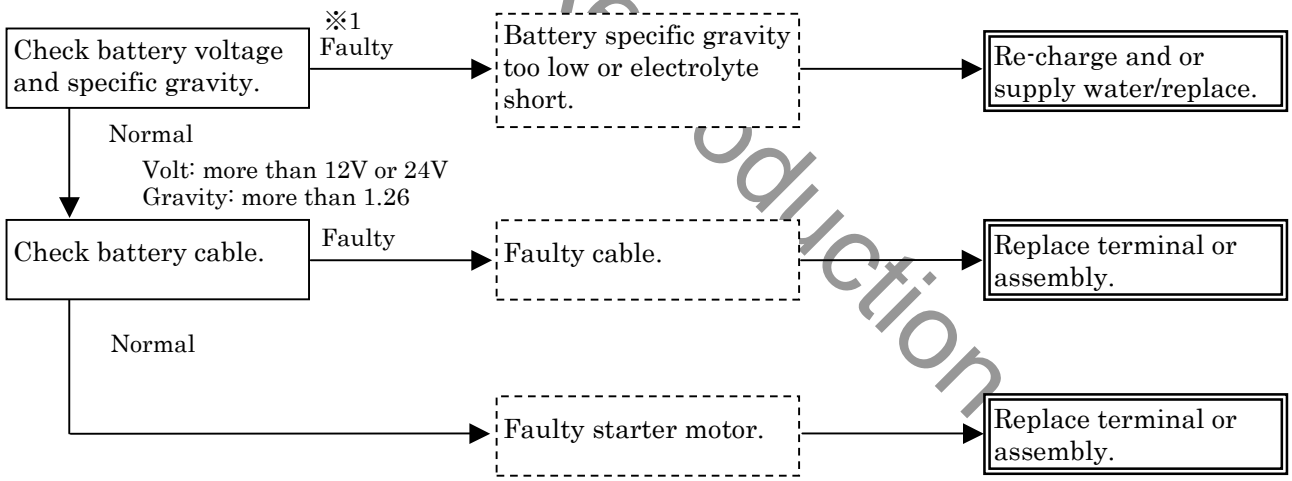
4.4 Engine Troubleshooting

4.4.1 Anything abnormal is not shown, but it sometimes stops without its cause shown

(Excluding the cases of faulty contact of starter switch and fuse broken)

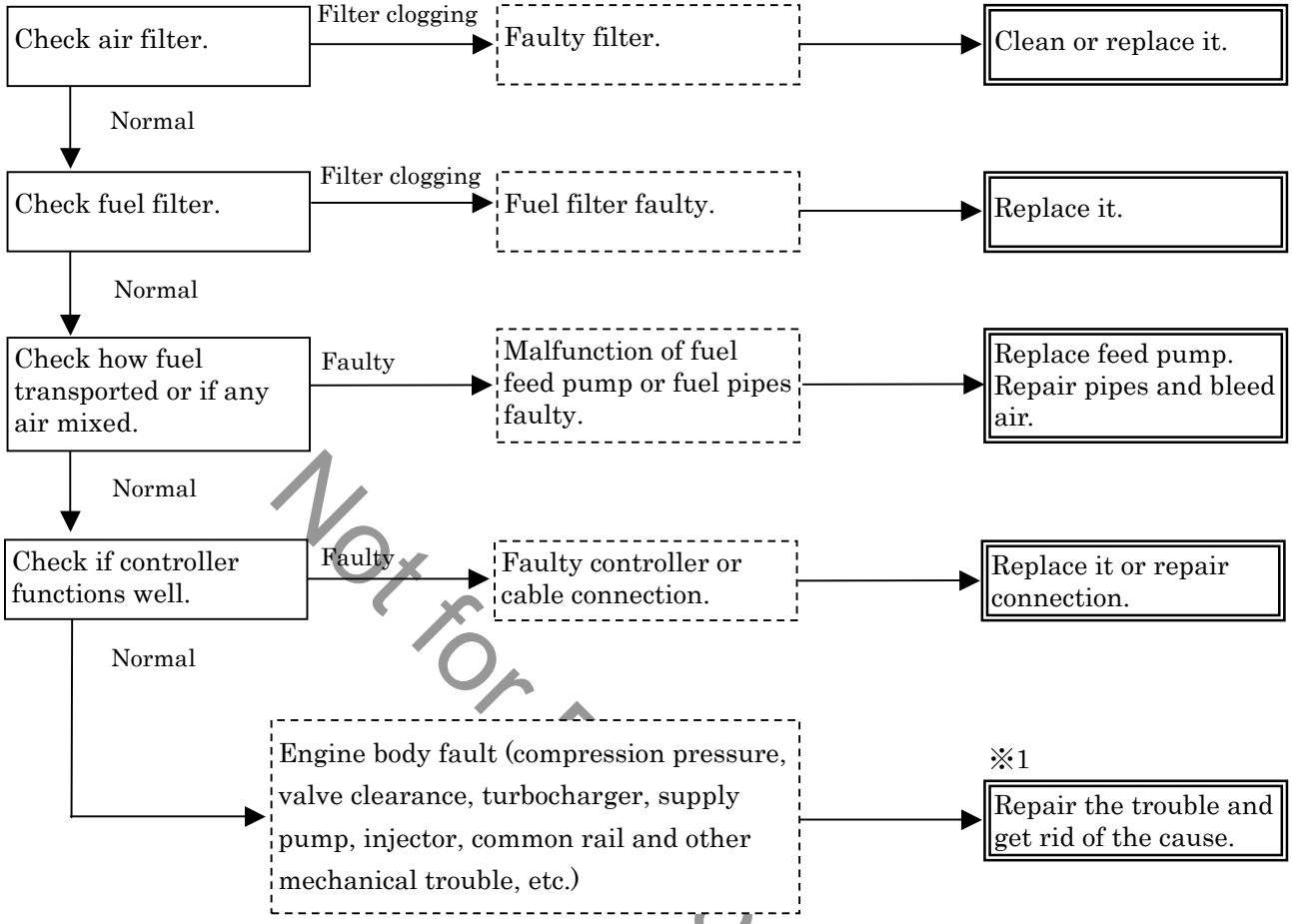


4.4.2 At start-up, starter rotates slowly



※1 : When starter switch is placed at the "START" position, the battery is not normal if B terminal voltage decreases by 10V or 20V.

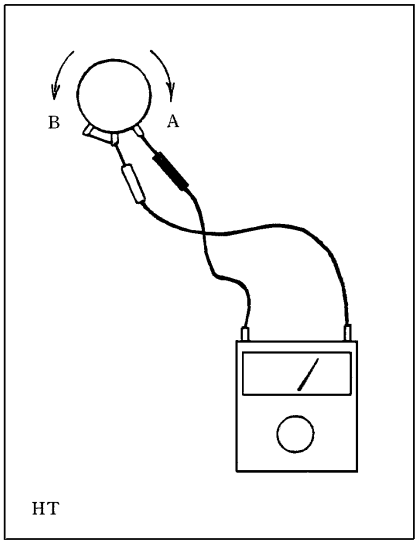
4.4.3 It will not speed up to rated speed



※1 : For the detailed countermeasures, refer to “Troubleshooting manual”, “Service manual” published by Isuzu Motors.

4.5 How to Check

[A] Checking for Disconnection of Voltage Adjusting Resistor Hand Trimmer



SG06067

Turn the knob right and left, and check if the resistance changes. It is normal if the resistance value is within the following ranges.

Resistance value : several Ω - 5kΩ

The resistance decreases when the knob is turned in the direction of A.

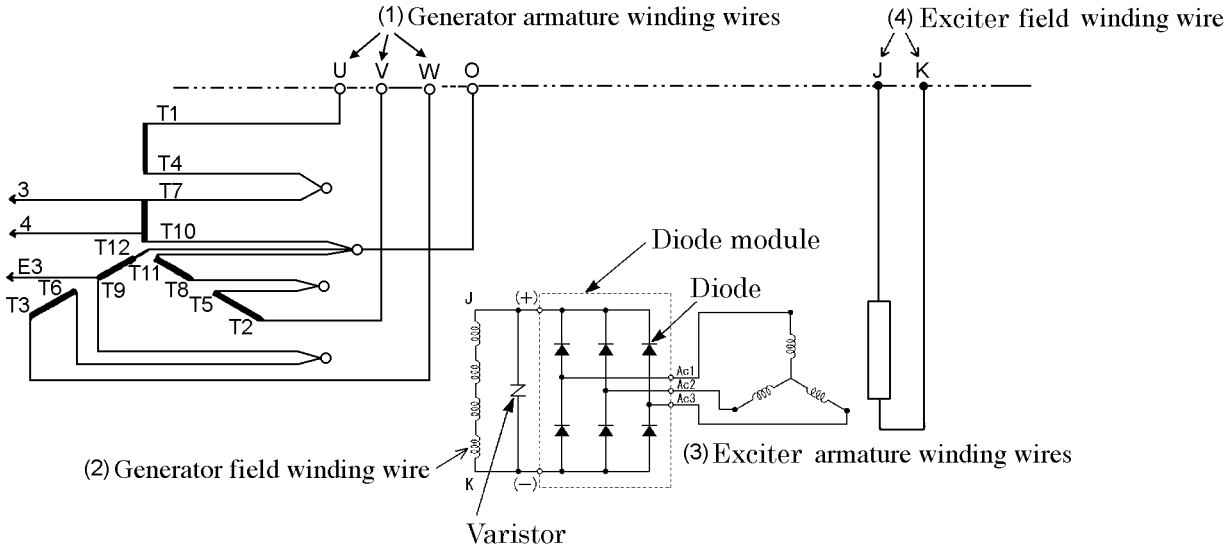
The resistance increases when the knob is turned in the direction of B.

Also make sure resistance varies smoothly.

[B] Measurement of Generator Winding Wires Resistance

The standard resistance value of each wire includes the generator's winding wires resistance value. (Please refer to the sentence "5.1 Generator's Winding Wires Resistance Value".)

65kVA



Voltage selection switch position 480/277V

SG10012E

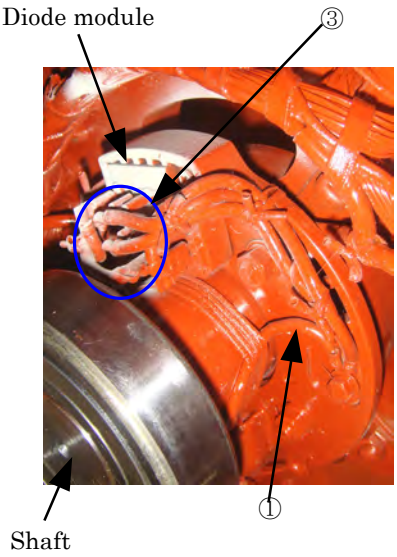
(1) Measurement of generator armature winding wires resistance

Remove all wires leading to the control panel terminal from the generator, and measure the resistance between the wires on the generator side. (Please explain how to check with voltage selector switch circuit.)

T1 terminal	−	T4 terminal	,	T7 terminal	− T10 terminal
T2 terminal	−	T5 terminal	,	T8 terminal	− T11 terminal
T3 terminal	−	T6 terminal	,	T9 terminal	− T12 terminal

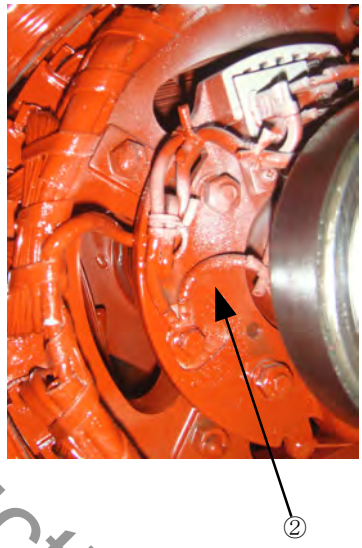
(2) Measurement of generator field winding wire resistance

Disconnect the wires ① and ② leading to the rotary rectifier, then measure the resistance between the wires.



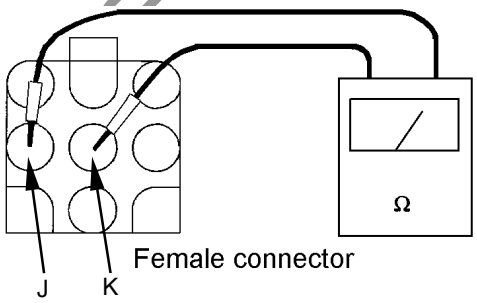
(3) Measurement of exciter armature winding wires resistance

Disconnect the wires ③ (three wires at center of diode module) leading to the rotary rectifier, and measure the resistance between the wires.



(4) Measurement of exciter field winding wire resistance

Disconnect 9P connector in the control panel, and measure the resistance at the connector on the generator side.

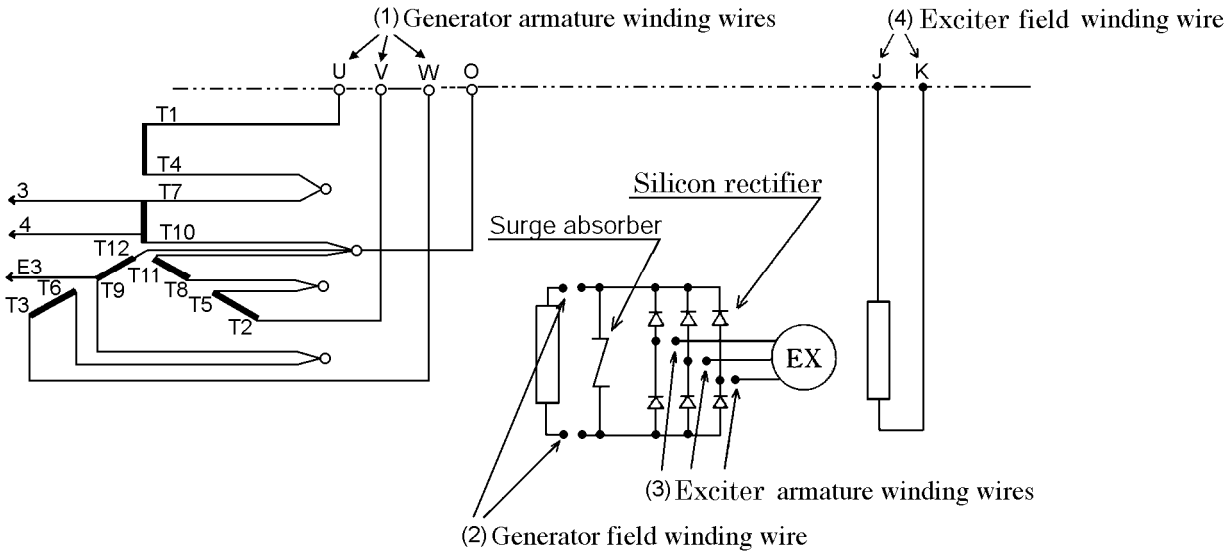


Between J & K terminal

SG06020

4. Troubleshooting

125 / 150kVA



Voltage selection switch position 480/277V

SG10028E-1

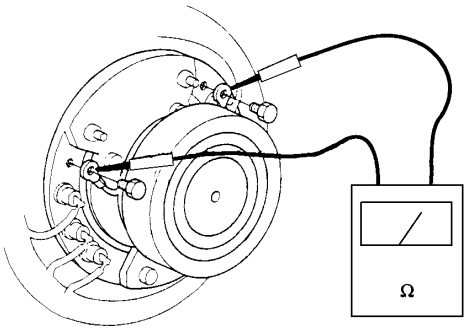
(1) Measurement of generator armature winding wires resistance

Remove all wires leading to the control panel terminal from the generator, and measure the resistance between the wires on the generator side. (Please explain how to check with voltage selector switch circuit.)

T1 terminal – T4 terminal , T7 terminal – T10 terminal
T2 terminal – T5 terminal , T8 terminal – T11 terminal
T3 terminal – T6 terminal , T9 terminal – T12 terminal

(2) Measurement of generator field winding wire resistance

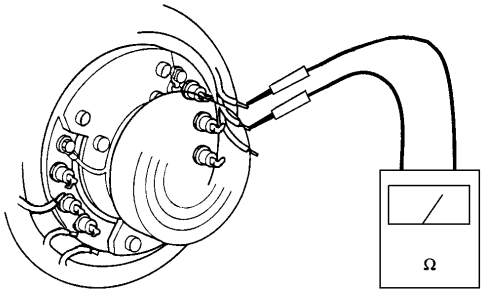
Disconnect the wires leading to the rotary rectifier, then measure the resistance between the wires.



6-15-2

(3) Measurement of exciter armature winding wires resistance

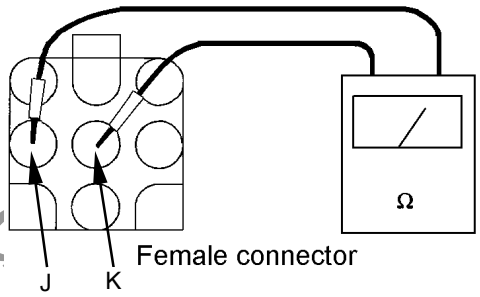
Disconnect the wires leading to the rotary rectifier, and measure the resistance between the wires.



6-15-3

(4) Measurement of exciter field winding wire resistance

Disconnect 9P connector in the control panel, and measure the resistance at the connector on the generator side.



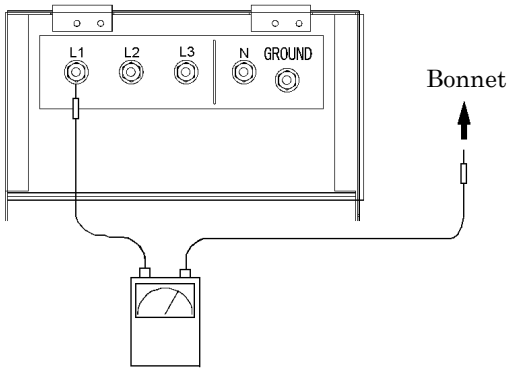
Between J & K terminal

SG06020

[C] Measurement of Insulation Resistance of Generator Winding Wires

Measurement is performed with a 500V megger. The situation is considered to be satisfactory if the measurement produces a result of 1M or more, while a result of less than that value indicates failure.

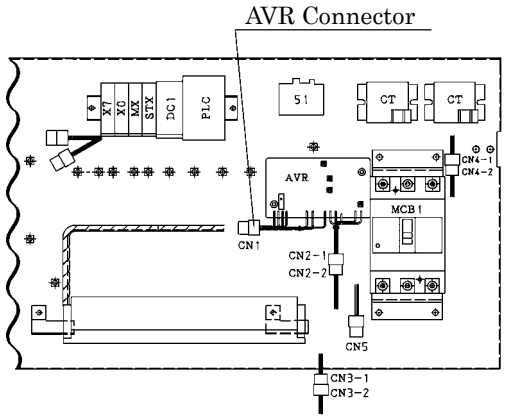
(1) Measurement of insulation resistance of generator armature winding wires



A040180-1

● (Procedure)(Megger tester required)

1. Remove the load side cable from the output terminal board.
2. Remove the cable between the terminal "N" and terminal "Ground" which are connected on the back of the output terminal plate.
3. Remove the AVR connector inside the generator control panel.
4. Switch ON the three-phase breaker, and then measure each insulation resistance between the terminals L1, L2, L3 terminal and bonnet.
5. Insulation resistance when measured with a 500V megger tester must be above 1 MΩ.
6. After finishing the measurement of insulation resistance, re-connect the cable between the terminal "N" and terminal "Ground".



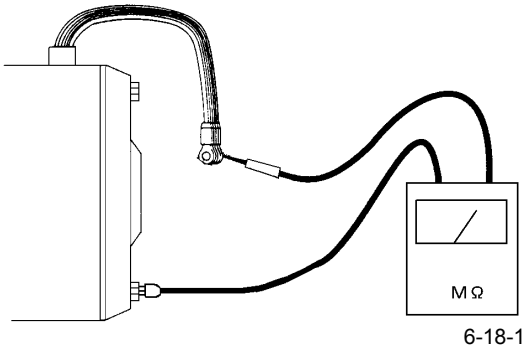
65kVA

SG09077

⚠ WARNING

● After making sure that the insulation resistance of the generator is higher than 1 MΩ, be sure to re-connect the cable between the terminal "N" and terminal "Ground" just as it was originally connected. If it is left disconnected, the grounding becomes imperfect so that it could cause electric shock.

● Disconnect all wires leading from the generator to the control panel terminals and short-circuit them, then measure the insulation resistance between the wires and the generator body.



6-18-1

(2) Measurement of insulation resistance of generator field winding wire and exciter armature winding wires

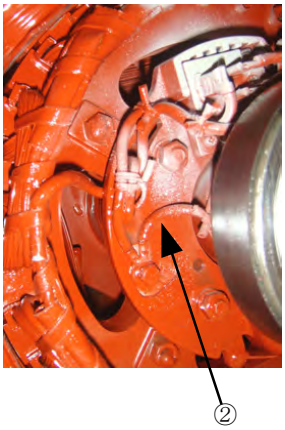
65kVA

Generator field winding wire

Disconnect the wires ① and ② leading to the rotary rectifier, then measure the insulation resistance between the disconnected wires ①, ② and the shaft.

Exciter armature winding wires

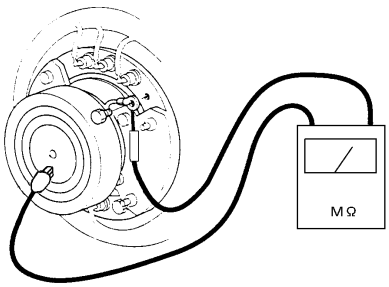
Disconnect the wires ③ (three pieces) and short-circuit them, then measure the insulation resistance between these wires and the shaft.



125 / 150kVA

Generator field winding wire

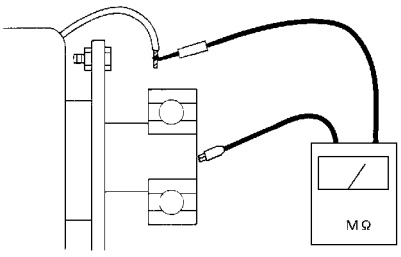
Disconnect the wires leading to the rotary rectifier, then measure the insulation resistance between the disconnected wires and the shaft.



6-18-2

Exciter armature winding wires

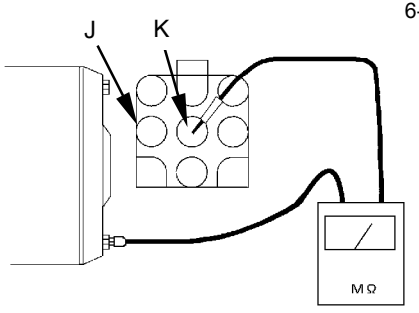
Disconnect the wires and short-circuit them, then measure the insulation resistance between these wires and the shaft.



6-18-3

(3) Measurement of insulation resistance of exciter field winding wire

Disconnect the field connector (J,K) in the control panel, and measure the resistance at the connector on the generator side.



Between J or K terminal & body

SG06021

[D] Checking Rotary Rectifier and Varistor

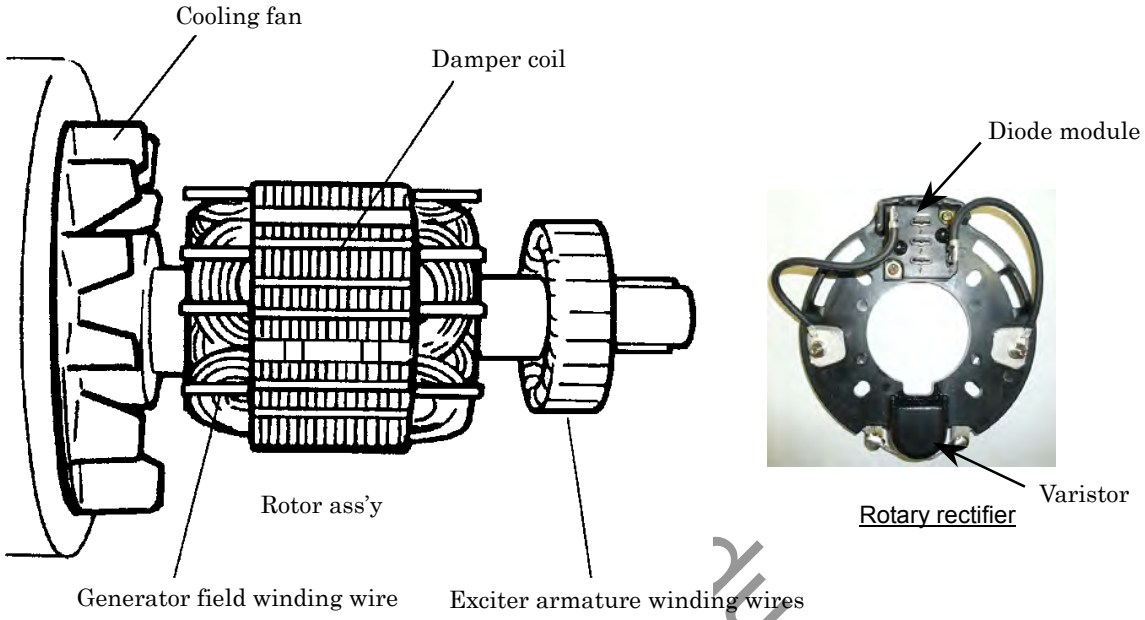
1. How to check rotary rectifier (diode module)

How to judge whether rotary rectifier (diode module) is in good order or in disorder. For the details, see "3.2.1 Rotary rectifier".

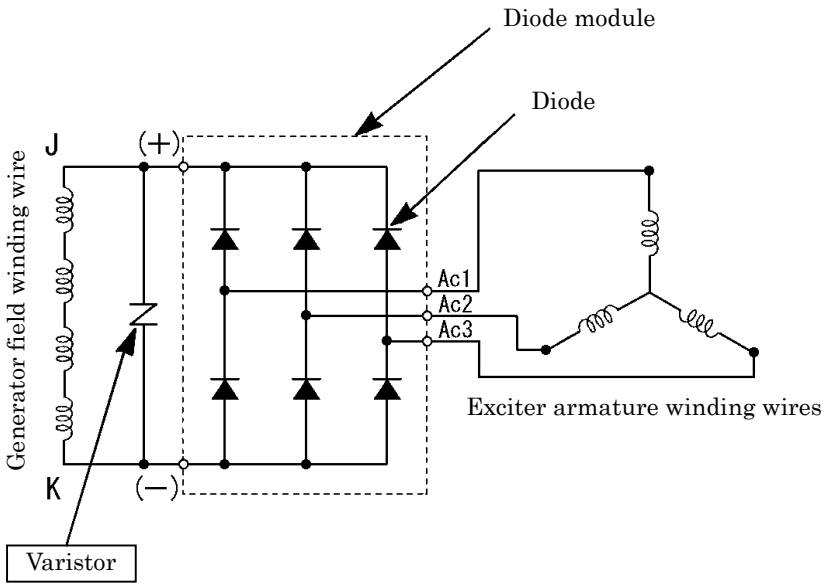
2. How to check varistor

65kVA

Remove varistor terminals and measure resistance between both terminals. It is good if the measured resistance is more than 100kΩ. (Tester range×kΩ)



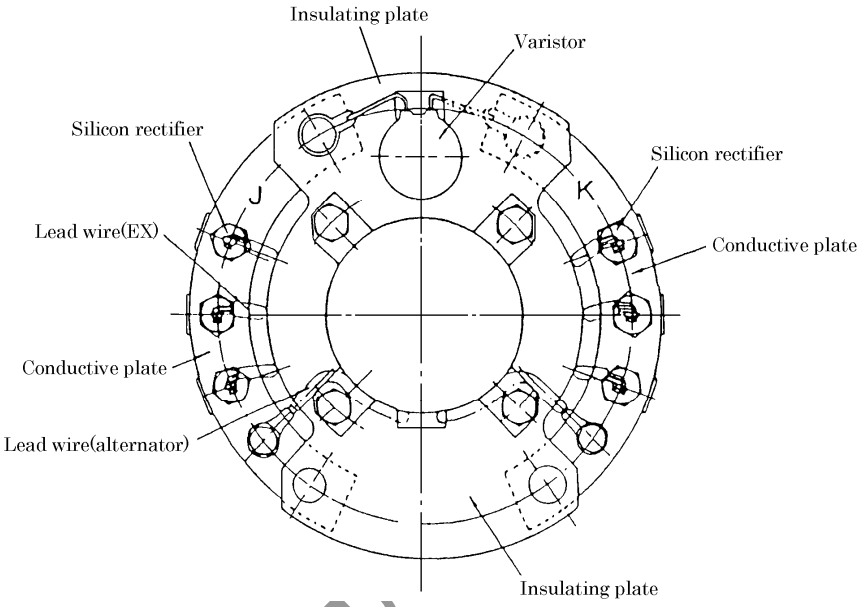
SG09029



SG09107

125kVA
150kVA (－0898)

Remove varistor terminals and measure resistance between both terminals. It is good if the measured resistance is more than 100kΩ. (Tester range×kΩ)



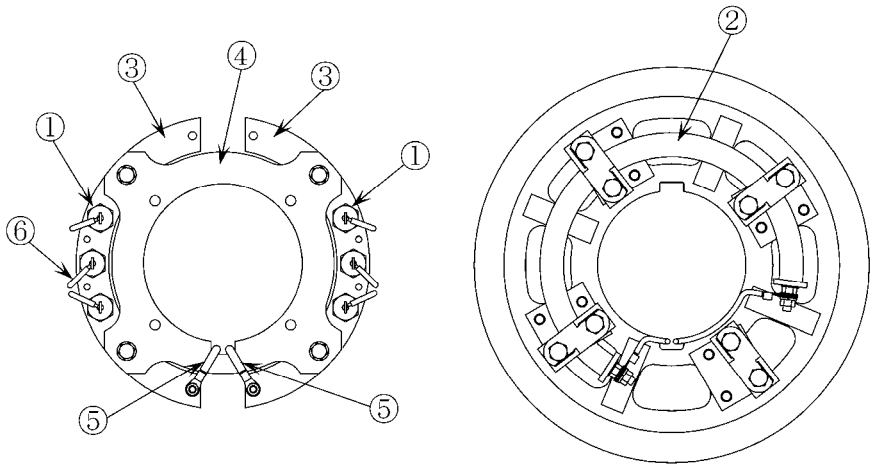
SG05092E

150kVA (0899－)

Remove surge absorber terminals and measure resistance between both terminals.
It is good if the measured resistance is 90Ω ±10%.

It is necessary to remove the rotor assembly when measuring because surge absorber is equipped at the rear side of exciter armature windings.

① Silicon rectifier
② Surge absorber
③ Conductive plate
④ Insulating plate
⑤ Lead wire (alternator)
⑥ Lead wire (exciter)



SG10126

4. Troubleshooting

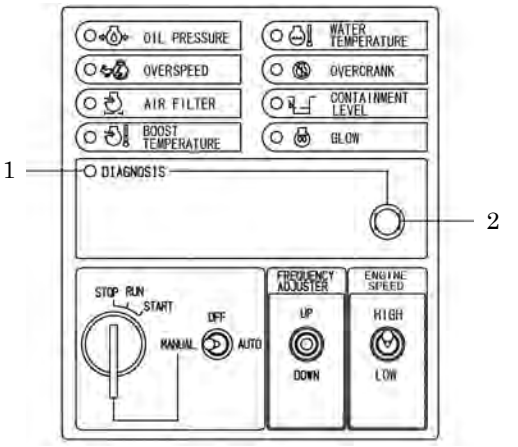
4.6 Engine Trouble Diagnosis Function

With regard to this electronic governor engine (Common rail electronic control fuel injection engine), this engine itself is equipped with trouble diagnosis function. When it is in trouble, it is possible to check and confirm how the trouble is by monitor lamp blinking pattern (flash code).

4.6.1 Engine trouble diagnosis

1. Check and confirmation of trouble

When engine fails, diagnosis lamp "1" on monitor panel lights. For the details of the trouble, press diagnosis switch "2" and then it displays trouble conditions with blinking pattern (flash code).



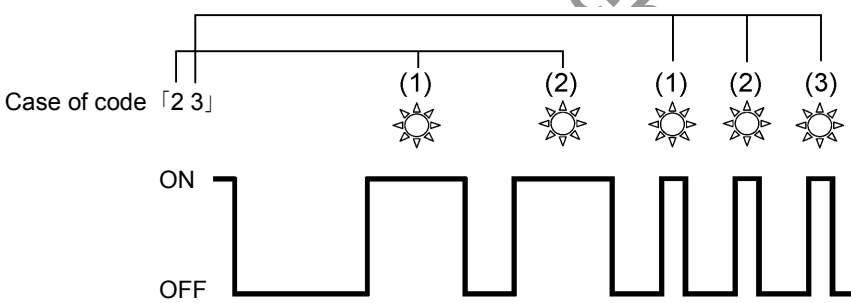
A090120

＜Procedure＞

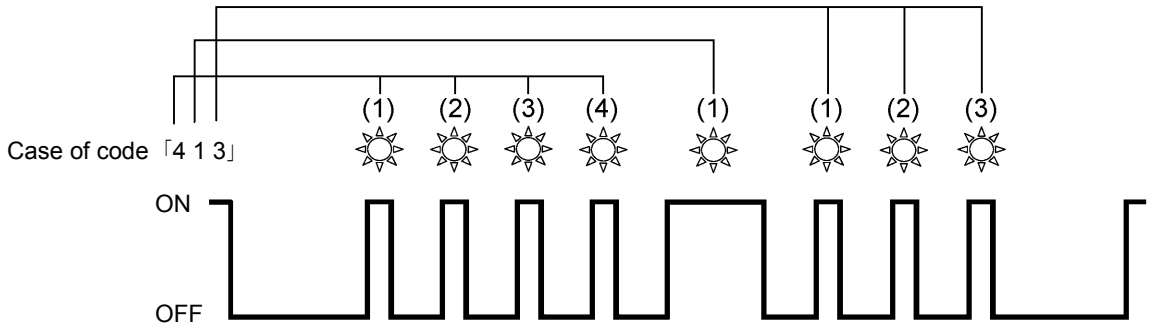
① Turn starter switch to "RUN" position and continue pressing diagnosis switch "2".

② While you are pressing diagnosis switch "2", diagnosis lamp "1" flickers (blinks) and its flickering (blinking) pattern (flash code) indicates the details of trouble.

[Example of blinking pattern (Flash code)]



Long interval blinking 2 times and short interval blinking 3 times mean blinking pattern (flash code)「23」.



SG09079

Short interval blinking 4 times and long interval blinking 1 time and short interval blinking 3 times mean blinking pattern (flash code)「413」.

Long interval blinking : approx. 1.2 seconds　　Short interval blinking : approx. 0.3 seconds

2. Display of diagnostic trouble code (DTC) by diagnosis lamp

Only when diagnostic trouble code (DTC) occurs during engine operation, diagnosis lamp is ON. During engine stop, diagnostic trouble code (DTC) displays both present and past diagnostic trouble code (DTC) by diagnosis lamp blinking pattern (flash code).

3. In case that past diagnostic trouble code (DTC) is memorized

It displays three times memorized trouble code. In case that more than two trouble codes are memorized, it displays them three times each in numerical order. After they are displayed in one round, they are displayed in numerical order again. This display continues while diagnosis switch is being pressed.

4. In case that no diagnostic trouble code (DTC) is memorized

Code「1」which shows code display start is repeatedly displayed.

5. Reading diagnostic trouble code (DTC) by scan tool (Tech2, EMPSⅢ)

It is possible to read diagnostic trouble code (DTC), using scan tool.

6. List of blinking patterns (Flash codes)

Blinking pattern	Results of trouble diagnosis	Item to be detected
14	Cam sensor fault (no signal)	Open circuit in sensor/wiring
	Cam sensor fault (signal fault)	Broken tooth/unnecessary signal mixed (such as short circuit with other wiring)
15	Crank sensor fault (no signal)	Open circuit in sensor/wiring
	Crank sensor fault (signal fault)	Broken tooth/unnecessary signal mixed (such as short circuit with other wiring)
16	Cam sensor out of phase	Camshaft gear/crankshaft gear installing angle is out of phase, or damage in gear
19	Starter cut relay fault	Starter cut relay fault
22	Intake air temperature sensor fault (low voltage fault)	Short circuit in sensor or harness
	Intake air temperature sensor fault (high voltage fault)	Open/short circuit/deterioration of sensor or harness
23	Engine coolant temperature sensor fault (low voltage fault)	Short circuit in sensor or harness
	Engine coolant temperature sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness
32	Boost pressure sensor fault (low voltage fault)	Open/short circuit/breakage of sensor or harness
	Boost pressure sensor fault (high voltage fault)	Short circuit in sensor or harness
34	Charge circuit fault (bank 1)	ECU charge circuit 1 fault (internal burnout, open circuit, etc.)
	Charge circuit fault (bank 2)	ECU charge circuit 2 fault (internal burnout, open circuit, etc.)
36	A/D conversion fault	A/D conversion fault
44	EGR position fault (Brushless specification)	Open/short circuit/breakage of sensor or harness
45	EGR valve control fault	Trouble/open circuit or valve engage/stuck drive motor side
51	CPU fault	CPU fault
52	CPU monitoring IC fault	Sub-CPU fault

Blinking pattern	Results of trouble diagnosis	Item to be detected
53	ROM fault	ROM fault
54	EEPROM fault	EEPROM fault
55	Voltage fault in 5V power supply 1	Power supply wiring short to sensor, or breakage in element/circuit for power supply regulation inside ECM
	Voltage fault in 5V power supply 2	
	Voltage fault in 5V power supply 3	
	Voltage fault in 5V power supply 4	
	Voltage fault in 5V power supply 5	
66	Glow relay fault	Open/short circuit/damage of relay or harness
67	Glow lamp fault	Open/short circuit/damage of lamp or harness
71	Barometric pressure sensor fault (low voltage fault)	Open/short circuit/deterioration of sensor or harness
	Barometric pressure sensor fault (high voltage fault)	Short circuit in sensor or harness
77	Check engine lamp fault	Lamp fault
118	Common rail pressure fault (1st stage)	Common rail pressure abnormal increase
	Common rail pressure fault (2nd stage)	
151	Common rail pressure fault (Excessive pressure feed in pump)	Common rail pressure abnormal increase
158	Injection nozzle common 1 drive system fault	Open/short circuit in injection common 1-side electrical wiring, EDU output part fault
159	Injection nozzle common 2 drive system fault	Open/short circuit in injection common 2-side electrical wiring, EDU output part fault
211	Fuel temperature sensor fault (low voltage fault)	Short circuit in sensor or harness
	Fuel temperature sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness
225	Pressure limiter open	Pressure limiter is opened
227	No pump pressure feed (fuel leakage)	Common rail pressure does not increase to the required area
	No pump pressure feed (fuel leakage)	Fuel leakage (large amount)
245	Common rail pressure sensor fault (low voltage fault)	Short circuit in sensor or harness
	Common rail pressure sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness
247	SCV drive system open circuit, +B short or ground short	Open/short circuit of SCV/harness
271	Open circuit injection nozzle #1 drive system	Open/short circuit in electrical wiring No.1 cylinder injection
272	Open circuit injection nozzle #2 drive system	Open/short circuit in electrical wiring No.2 cylinder injection
273	Open circuit injection nozzle #3 drive system	Open/short circuit in electrical wiring No.3 cylinder injection
274	Open circuit injection nozzle #4 drive system	Open/short circuit in electrical wiring No.4 cylinder injection
294	Engine oil pressure sensor fault (low voltage fault)	Open/short circuit/breakage of sensor or harness
	Engine oil pressure sensor fault (high voltage fault)	Short circuit in sensor or harness
295	Boost temperature sensor fault (low voltage fault)	Open/short circuit/breakage of sensor or harness
	Boost temperature sensor fault (high voltage fault)	Short circuit in sensor or harness

Blinking pattern	Results of trouble diagnosis	Item to be detected
416	Main relay system fault (Not enter)	Open/ground short circuit in harness, relay OFF anchoring
	Main relay system fault (Not enter)	Harness +B short, relay ON anchoring
542	Overheat	Overheat condition
543	Overrun	Engine speed abnormally high

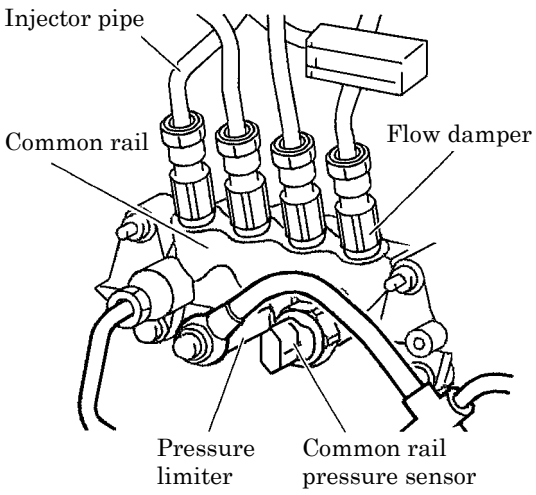
7. Necessary measures for the results of diagnosis trouble

See list of blinking patterns (flash codes) and results of diagnosis trouble mentioned on previous pages. For the detailed countermeasures, refer to "Troubleshooting manual", "Service manual" published by Isuzu Motors. (If scan tool is fitted, it is possible to check or read troubles by scan tool operation.)

Take special care in handling fuel system, and so refer to the following cautions.

＜Fuel pipes＞

- Never use such pipes as used high pressure pipes of fuel system and injector pipes. Make sure to replace used ones by new ones.
- Never change pressure limiter, common rail pressure sensor only. If they are in trouble, change it as an assembly and all fuel pipes.



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[Cautions about maintenance of fuel system]

- All the parts of fuel system and holes/clearances as fuel passage are precision-machined so that entrance of foreign matters affects so badly them to cause damages to fuel passage. Therefore, you should take special care to prevent them to enter fuel system.
  Before preparing maintenance work, wash your hands and never use working gloves for this job.
- If you remove high pressure pipes in fuel system, make sure to replace them by new ones. If you re-use them, it could damage sealing face and cause fuel leakage.
  Make sure to replace spare parts such as gasket and O-ring by new ones.

4.6.2 How to delete diagnostic trouble code (DTC)

1. Deletion of diagnostic trouble code (DTC)

When diagnostic trouble code (DTC) is memorized in engine control module (ECM) in case of system trouble. Even after troubled parts have been repaired, memory of diagnostic trouble code (DTC) will not be deleted in this case. It is necessary to compulsorily delete this memory, according to the following procedures.

2. Deletion by memory clear switch

1. Switch ON key switch.
2. Switch ON diagnosis switch.
3. Switch ON memory clear switch (connection of ECM V32 terminal and ground connection).
4. Wait for 3 seconds with these switches ON.
5. Switch OFF memory clear switch (connection of ECM V32 terminal and ground connection).
6. Switch OFF diagnosis switch.
7. Switch OFF key switch.
8. Wait for 10 seconds with the switches OFF.
9. Switch ON key switch.
10. Switch ON diagnosis switch.
11. Check and confirm that memories are deleted.

4.6.3 List of diagnostic trouble codes (DTC)

The following diagnostic trouble codes (DTC) are listed, based on those of ISUZU Engine model B1-4HK1X mounted on 125kVA.

The flash codes marked ☆ show the blinking flash patterns of the diagnostic lamps.

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DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0087	227	No pump pressure feed (fuel leakage)	Common rail pressure does not increase to the required area.	• Key switch input voltage is 9 V or more. • 900 rpm or more	Actual rail pressure is 15 Mpa (2,176 psi) or less.	Approx. 3 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P0088	118	Common rail pressure fault (1st stage)	Common rail pressure abnormal increase	• Key switch input voltage is 9 V or more. • DTC P0088, P0192, P0193 or P1635 is not detected. • Actual rail pressure is 2 MPa (290 psi) or more, and 70 rpm or more.	Rail pressure is more than 185 MPa (26,832 psi).	Approx. 5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P0088	118	Common rail pressure fault (2nd stage)	Common rail pressure abnormal increase	• Key switch input voltage is 9 V or more. • DTC P0088, P0192, P0193 or P1635 is not detected. • Actual rail pressure is 2 MPa (290 psi) or more, and 70 rpm or more.	Common rail pressure fault (1st stage) is completed, and rail pressure is more than 190 MPa (27,557 psi).	Approx. 5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P0089	151	Common rail pressure fault (Excessive pressure feed in pump)	Common rail pressure abnormal increase	• Key switch input voltage is 9 V or more. • DTC P0089, P0192, P0193 or P1635 is not detected. • Coolant temperature is 60°C (140°F) or more, and 375 rpm or more.	Actual rail pressure is 40 MPa (5,802 psi) or more higher than target rail pressure. And duty to SCV is 40% or more, or SCV target pressure feed is 90 mm^3/sec (0.0055 cu·in/sec) or less.	Approx. 5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P0090	247	SCV drive system open circuit, +B short or ground short	Open/short circuit of SCV/ harness	• Main relay power supply voltage is 9 V or more. • DTC P1630 is not detected. • SCV drive duty is between 15 and 85%.	When SCV drive current exceeds 2,450 mA or drops below 100 mA, or when the difference between target and actual current exceeds 1,000 mA or more.	Approx. 2 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2
P0107	71	Barometric pressure sensor fault (low voltage fault)	Open/short circuit/deterioration of sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1632 is not detected.	Barometric pressure sensor voltage is lower than 0.5 V.	Approx. 5 sec.	Due to back-up equivalent to 2,000 m (6,562 ft) • Black smoke emitted at high altitude **Back-up:** **Barometric pressure default setting (80 kPa {11.6 psi})** **EGR stopped**	ON	*2

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DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0108	71	Barometric pressure sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1632 is not detected.	Barometric pressure sensor voltage is more than 3.8 V.	Approx. 5 sec.	Due to back-up equivalent to 2,000 m (6,562 ft) • Black smoke emitted at high altitude **Back-up:** **Barometric pressure default setting (80 kPa {11.6 psi})** **EGR stopped**	ON	*2
P0112	22	Intake air temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1632 is not detected.	Intake air temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Not in particular **Back-up:** **Intake air temperature default setting (at starting: –10°C {14°F}, at running: 25°C {77°F})** **EGR stopped**	ON	*2
P0113	22	Intake air temperature sensor fault (high voltage fault)	Open/short circuit/deterioration of sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1632 is not detected. • 3 minutes or more has elapsed after starting engine.	Intake air temperature sensor voltage is more than 4.95 V.	Approx. 4 sec.	Not in particular **Back-up:** **Intake air temperature default setting (at starting: –10°C {14°F}, at running: 25°C {77°F})** **EGR stopped**	ON	*2
P0117	23	Engine coolant temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1633 is not detected.	Engine coolant temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2
P0118	23	Engine coolant temperature sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1633 is not detected. • 3 minutes or more has elapsed after starting engine.	Engine coolant temperature sensor voltage is more than 4.85 V.	Approx. 4 sec.	At normal temperature: Black smoke emission, greater engine combustion noise possible. During idling at low atmospheric temperatures: Rough idling, engine stall, white smoke emission possible. **Back-up:** **Coolant temperature default setting (at starting: –20°C {–4°F}, at running: 80°C {176°F})** **EGR stopped**	ON	*2
P0182	211	Fuel temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1633 is not detected.	Combustion temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Not in particular **Back-up:** **Fuel temperature default setting (at starting: –20°C {–4°F}, at running: 70°C {158°F})**	ON	*2
P0183	211	Fuel temperature sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1633 is not detected. • 3 minutes or more has elapsed after starting engine.	Combustion temperature sensor voltage is more than 4.85 V.	Approx. 4 sec.	Not in particular **Back-up:** **Fuel temperature default setting (at starting: –20°C {–4°F}, at running: 70°C {158°F})**	ON	*2

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DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0192	245	Common rail pressure sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1635 is not detected.	Common rail pressure sensor voltage is less than 0.7 V.	Nearly simultaneous to fault occurrence	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2
P0193	245	Common rail pressure sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1635 is not detected.	Common rail pressure sensor voltage is more than 4.5 V.	Nearly simultaneous to fault occurrence	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2
P0201	271	Open circuit in injection nozzle #1 drive system	Open/short circuit in electrical wiring No. 1 cylinder injector	• Main relay power supply voltage is 9 V or more. • 70 rpm or more • DTC P0611, P1261 or P0201 is not detected.	No injector 1 monitor input signal exists.	Approx. 2.5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P0202	272	Open circuit in injection nozzle #2 drive system	Open/short circuit in electrical wiring No. 2 cylinder injector	• Main relay power supply voltage is 9 V or more. • 70 rpm or more • DTC P0612, P1262 or P0202 is not detected.	No injector 2 monitor input signal exists.	Approx. 2.5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P0203	273	Open circuit in injection nozzle #3 drive system	Open/short circuit in electrical wiring No. 3 cylinder injector	• Main relay power supply voltage is 9 V or more. • 70 rpm or more • DTC P0612, P1262 or P0203 is not detected.	No injector 3 monitor input signal exists.	Approx. 2.5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P0204	274	Open circuit in injection nozzle #4 drive system	Open/short circuit in electrical wiring No. 4 cylinder injector	• Main relay power supply voltage is 9 V or more. • 70 rpm or more • DTC P0611, P1261 or P0204 is not detected.	No injector 4 monitor input signal exists.	Approx. 2.5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P0219	543	Overrun	Engine speed abnormally high	• Key switch input voltage is 9 V or more.	When engine speed is more than 2,070 rpm.	Approx. 1 sec.	Engine hunting possible **Back-up:** **Limited injection amount 1** **Limitation is lifted if the speed decreases**	Does not come on.	*2
P0237	32	Boost pressure sensor fault (low voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1634 is not detected.	Boost pressure sensor voltage is less than 0.1 V.	Approx. 3 sec.	Black smoke emitted **Back-up:** **Boost pressure default setting (150 kPa {21.8 psi})** **Boost pressure correction/EGR stopped**	ON	*2
P0238	32	Boost pressure sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1630 or P1634 is not detected.	Boost pressure sensor voltage is more than 4.9 V.	Approx. 3 sec.	Black smoke emitted **Back-up:** **Boost pressure default setting (150 kPa {21.8 psi})** **Boost pressure correction/EGR stopped**	ON	*2

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DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0335	15	Crank sensor fault (no signal)	Open circuit in sensor/wiring	• Key switch input voltage is 9 V or more. • CMP sensor pulse is normal. • DTC P0335, P0336, P0340, P0341, P1345 or P1634 is not detected. • Engine is running.	Cam signal exists but no crank signal.	When trouble occurs 14 out of 21 samples.	• Output lowering, white smoke emission, intense engine vibration possible • Engine stall possible (restart is possible when cam sensor is normal.) **Back-up:** **Control based on cam when cam sensor is normal**	ON	*1
P0336	15	Crank sensor fault (signal fault)	Broken teeth/ unnecessary signal mixed (such as short circuit with other wiring)	• Key switch input voltage is 9 V or more. • CMP sensor pulse is normal. • DTC P0335, P0336, P0340, P0341, P1345 or P1634 is not detected. • Engine is running.	Number of pulse for crank signal is mismatched.	When trouble occurs 14 out of 21 samples.	• Output lowering, white smoke emission, intense engine vibration possible • Engine stall possible (restart is possible when cam sensor is normal.) **Back-up:** **Control based on cam when cam sensor is normal**	ON	*1
P0340	14	Cam sensor fault (no signal)	Open circuit in sensor/wiring	• Key switch input voltage is 9 V or more. • Crank pulse is normal. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • Engine is running.	Crank signal exists but no cam signal.	When trouble occurs 7 out of 8 samples.	• Behavior does not change during engine running. (Engine is running at low speed, engine stall possible.) • After engine stalls, engine will not start. **Back-up:** **Engine running based on crank when it is normal** **After engine stops: Unable to identify cylinder (unable to restart)**	ON	*1
P0341	14	Cam sensor fault (signal fault)	Broken teeth/ unnecessary signal mixed (such as short circuit with other wiring)	• Key switch input voltage is 9 V or more. • Crank pulse is normal. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • Engine is running.	Number of pulse for cam signal is mismatched.	When trouble occurs 7 out of 8 samples.	• Behavior does not change during engine running. (Engine is running at low speed, engine stall possible.) • After engine stalls, engine will not start. **Back-up:** **Engine running based on crank when it is normal** **After engine stops: Unable to identify cylinder (unable to restart)**	ON	*1
P0380	66	Glow relay fault	Open/short circuit/damage of relay or harness	• Key switch input power supply voltage is higher than 8 V but lower than 16 V.	No glow relay monitor signal exists against glow relay drive instruction.	When trouble occurs 25 out of 30 samples.	Deterioration of startability at cold weather **Back-up:** **No back-up action**	ON	*1
P0381	67	Glow lamp fault	Open/short circuit/damage of lamp or harness	• Key switch input voltage is 9 V or more.	Glow lamp drive instruction signal is unmatched with glow lamp monitor signal.	When trouble occurs 25 out of 30 samples.	Operationality is not affected. **Back-up:** **No back-up action**	ON	*1

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DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0487	44	EGR position fault (Brushless specification)	Open/short circuit/breakage of sensor or harness	• Main relay input voltage is 9 V or more. • DTC P1630 or P1635 is not detected.	EGR position output signal is abnormal.	Approx. 3 sec. -	Exhaust gas is affected. **Back-up:** **Instruction to fully close EGR valve**	ON	*2
P0488	45	EGR valve control fault	Trouble/open circuit or valve engage/stuck in drive motor side	• DTC P1630, P1635 or P0488 is not detected. • Main relay voltage is between 9 and 16 V. • Difference between target EGR opening angle and actual one is 20% or less.	Difference between target valve lift and actual position is more than 20%.	Approx. 10 sec.	Exhaust gas is affected. **Back-up:** **Instruction to fully close EGR valve**	ON	*1
P0522	294	Engine oil pressure sensor fault (low voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1633 is not detected.	Engine oil pressure sensor voltage is less than 0.1 V.	Approx. 4 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2
P0523	294	Engine oil pressure sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1633 is not detected.	Engine oil pressure sensor voltage is more than 4.85 V.	Approx. 4 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2
P0601	53	ROM fault	ROM fault	—	ROM is faulty. Reflash failure	—	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2
P0603	54	EEPROM fault	EEPROM fault	—	EEPROM is faulty.	—	Operationality is not affected. **Back-up:** **No back-up action**	ON	*2
P0606	51	CPU fault	CPU fault	—	Sub-CPU detects main CPU fault in 100 msec after key switch ON. (SUB-CPU resets CPU.)	Nearly simultaneous to fault occurrence	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	Diagnosed for 100 msec only after KEY-ON.
P0606	52	CPU monitoring IC fault	Sub-CPU fault	• 480 msec or more has elapsed after key switch ON. • Key switch input power supply voltage is higher than 9 V.	RUN-SUB pulse does not change for 20 msec or more.	Nearly simultaneous to fault occurrence	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2
P0611	34	Charge circuit fault (bank 1)	ECU charge circuit 1 fault (internal burnout, open circuit, etc.)	• Main relay power supply voltage is 9 V or more.	When charge circuit bank 1 voltage inside ECU is low.	Approx. 1.5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2
P0612	34	Charge circuit fault (bank 2)	ECU charge circuit 2 fault (internal burnout, open circuit, etc.)	• Main relay power supply voltage is 9 V or more.	When charge circuit bank 2 voltage inside ECU is low.	Approx. 1.5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2

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DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0615	19	Starter cut relay fault	Starter cut relay fault	Key switch power supply voltage is between 8 and 16 V.	No starter cut relay monitor signal exists against starter cut relay drive instruction.	Approx. 5 sec.	• The starter cannot be operated if it fails in open condition (No drop in output) • The starter cannot be driven if it fails in closed condition (Not started) **Back-up:** **No back-up action**	ON	*1
P0650	77	Check engine lamp fault	Lamp fault	• Key switch input voltage is 9 V or more.	No check engine lamp monitor signal exists.	Approx. 1.5 sec.	Operationality is not affected. **Back-up:** **No back-up action**	ON	*1
P1093	227	No pump pressure feed (fuel leakage)	Fuel leakage (large amount)	• Key switch input voltage is 9 V or more. • 1,200 rpm or more • DTC P0192, P0193, P1093, P0091, P1291, P1292 or P1635 is not detected.	Actual rail pressure is 50 MPa (7,252 psi) or more lower than target rail pressure. And duty to SCV is 33% or less, or pressure feed is 28,000 mm^3/sec (1.7 cu·in/sec) or more.	Approx. 5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P1095	225	Pressure limiter open	Pressure limiter is opened.	• Key switch input voltage is 9 V or more. • DTC P1095, P0192, P0193, P1630, or P1635 is not detected. • 50 rpm or more	Pressure limiter is opened.	Approx. 1 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P1112	295	Boost temperature sensor fault (low voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 9 V or more. • DTC P1634 is not detected.	Boost temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Operationality is not affected. **Back-up:** **Boost temperature default setting (30°C {86°F})**	ON	*2
P1113	295	Boost temperature sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 9 V or more. • Coolant temperature is 50°C (122°F) or more. • 5 minutes or more has elapsed after starting.	Boost temperature sensor voltage is more than 4.94 V.	Approx. 4 sec.	Operationality is not affected. **Back-up:** **Boost temperature default setting (30°C {86°F})**	ON	*2
P1173	542	Overheat	Overheat condition	• Key switch input voltage is 9 V or more. • DTC P1630, P1633, P0117 or P0118 is not detected. • During operation	Coolant temperature is more than 105°C (221°F).	Approx. 5 sec.	Operationality is not affected. **Back-up:** **No back-up action**	Does not come on.	*2
P1261	158	Injection nozzle common 1 drive system fault	Open/short circuit in injector common 1-side electrical wiring, EDU output part fault	• Main relay power supply voltage is 9 V or more. • 70 rpm or more • None of the following DTC sets are detected; DTC P0611, P1261 and P0201; DTC P0611, P1261 and P0204.	No injector 1 and 4 monitor input signal exists.	Approx. 3 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1

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DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1262	159	Injection nozzle common 2 drive system fault	Open/short circuit in injector common 2-side electrical wiring, EDU output part fault	• Main relay power supply voltage is 9 V or more. • 70 rpm or more • None of the following DTC sets are detected; DTC P0612, P1262 and P0202; DTC P0612, P1262 and P0203.	No injector 2 and 3 monitor input signal exists.	Approx. 3 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*1
P1345	16	Cam sensor out of phase	Camshaft gear/ crankshaft gear installing angle is out of phase, or damage in gear.	• Key switch input voltage is 9 V or more. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • CMP sensor pulse is normal. • Crank pulse is normal.	Correct cam pulse does not exist in crank gap position.	When trouble occurs 9 out of 10 samples.	• Behavior does not change during engine running. • After engine stalls, engine will not start. **Back-up:** **No back-up action**	ON	*1
P1625	416	Main relay system fault (Not enter)	Open/ground short circuit in harness, relay OFF anchoring	• Key switch input voltage is 9 V or more. • DTC P1630 is not detected. • 3 seconds or more has elapsed after key switch ON. • Main relay drive indication ON	Main relay system voltage is 1 V or less with main relay coil output ON.	Approx. 2 sec.	Engine does not start. **Back-up:** **No back-up action**	ON	*2
			Harness +B short, relay ON anchoring	• DTC P1625 or P0606 is not detected.	Relay does not cut off despite of main relay coil output OFF indication.	Approx. 5 sec.	Vehicle power supply cannot be shut off. **Back-up:** **No back-up action**	ON	*1
P1630	36	A/D conversion fault	A/D conversion fault	—	A/D conversion failure	Immediately	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2
P1631	55	Voltage fault in 5 V power supply 1	Power supply wiring short to sensor, or breakage in element/circuit for power supply regulation inside ECM.	• DTC P1630 is not detected. • Key switch input power supply voltage is between 7 and 16 V.	Key switch power supply voltage is 5.5 V or more, or 4.5 V or less.	Approx. 0.5 sec.	Idling **Back-up:** **Same to accelerator sensor fault**	ON	*2
P1632	55	Voltage fault in 5 V power supply 2	Power supply wiring short to sensor, or breakage in element/circuit for power supply regulation inside ECM.	• DTC P1630 is not detected. • Key switch input power supply voltage is between 7 and 16 V.	Key switch power supply voltage is 5.5 V or more, or 4.5 V or less.	Approx. 0.5 sec.	Due to back-up equivalent to 2,000 m (6,562 ft) • Black smoke emitted at high altitude **Back-up:** **Same to barometric pressure and intake air temperature sensor fault**	ON	*2
P1633	55	Voltage fault in 5 V power supply 3	Power supply wiring short to sensor, or breakage in element/circuit for power supply regulation inside ECM.	• DTC P1630 is not detected. • Key switch input power supply voltage is between 7 and 16 V.	Key switch power supply voltage is 5.5 V or more, or 4.5 V or less.	Approx. 0.5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	*2

☆

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1634	55	Voltage fault in 5 V power supply 4	Power supply wiring short to sensor, or breakage in element/circuit for power supply regulation inside ECM.	• DTC P1630 is not detected. • Key switch input power supply voltage is between 7 and 16 V.	Key switch power supply voltage is 5.5 V or more, or 4.5 V or less.	Approx. 0.5 sec.	Black smoke emitted **Back-up:** **Same to boost pressure and boost temperature sensor fault**	ON	*2
P1635	55	Voltage fault in 5 V power supply 5	Power supply wiring short to sensor, or breakage in element/circuit for power supply regulation inside ECM.	• DTC P1630 is not detected. • Key switch input power supply voltage is between 7 and 16 V.	Key switch power supply voltage is 5.5 V or more, or 4.5 V or less.	Approx. 0.5 sec.	Engine stopped **Back-up:** **Engine stopped and can not restart**	ON	

About recovery from failure

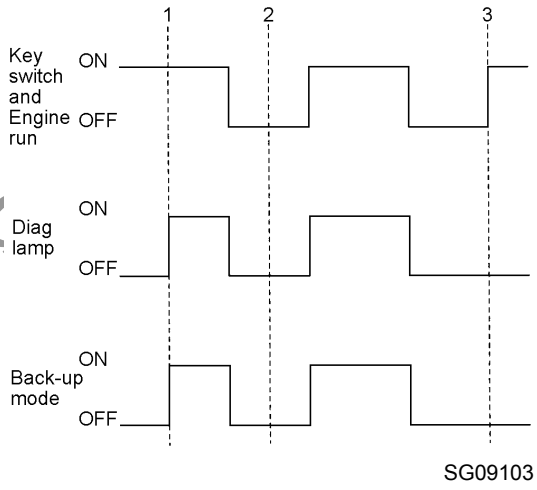
There are three modes for recovery from failure.

To clear the trouble displayed on the monitor of the machine, one more ignition cycle may be needed after the following ignition cycle.

*1:

Even if the diagnostic trouble code (DTC) has restored normally, the diagnosis lamp and back-up mode are not restored in the ignition cycle that the diagnostic trouble code (DTC) is detected. After turning the key switch OFF, diagnostic trouble code (DTC) diagnosis is performed when the vehicle starts again. If it is judged as normal, everything will be recovered to normal from the next ignition cycle.

1. Diagnostic trouble code (DTC) is detected
2. Repair and inspection
3. Returned to normal

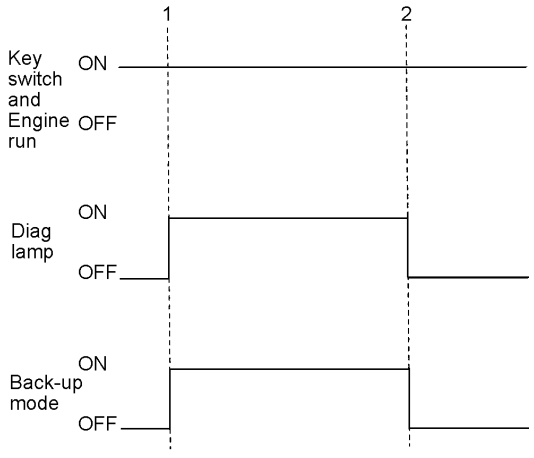


SG09103

*2:

When the diagnostic trouble code (DTC) has recovered to normal condition in the ignition cycle that the diagnostic trouble code (DTC) is detected, the diagnosis lamp and back-up mode will also be recovered.

1. Diagnostic trouble code (DTC) is detected
2. Returned to normal

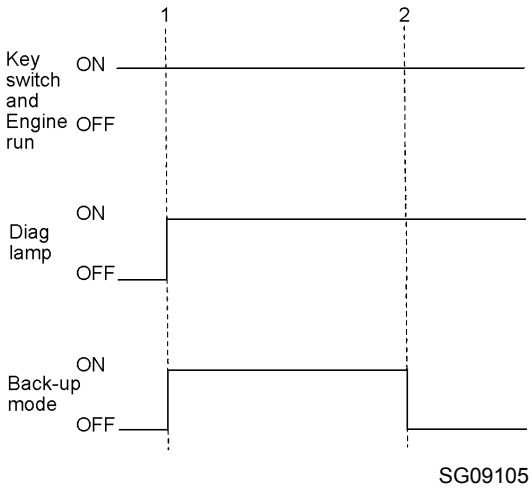


SG09104

*3:

When the diagnostic trouble code (DTC) has recovered to normal in the ignition cycle that the diagnostic trouble code (DTC) is detected, the back-up mode will be recovered normally, but the diagnosis lamp does not go off..

1. Diagnostic trouble code (DTC) is detected
2. Returned to normal



5. References

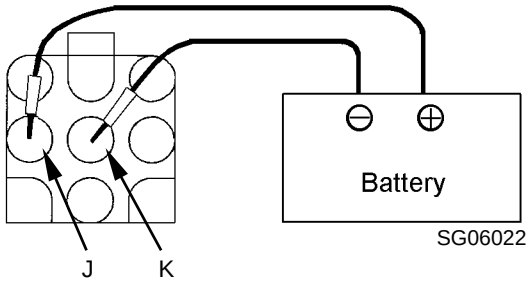
5.1 Generator's Winding Wires Resistance Value

[At the temperature of 68°F (20°C)]

			65kVA	125kVA	150kVA
Generator armature winding wires	Voltage selection switch position 480/277V	Ω	0.248 (T1–T2) (T2–T3) (T3–T1)	0.080 (T1–T2) (T2–T3) (T3–T1)	0.069 (T1–T2) (T2–T3) (T3–T1)
	—	Ω	0.062 (T1–T4) (T7–T10) (T2–T5) (T8–T11) (T3–T6) (T9–T12)	0.020 (T1–T4) (T7–T10) (T2–T5) (T8–T11) (T3–T6) (T9–T12)	0.017 (T1–T4) (T7–T10) (T2–T5) (T8–T11) (T3–T6) (T7–T12)
Generator field winding wire		Ω	3.035	2.765	1.574
Exciter armature winding wires		Ω	0.629	0.446	0.185
Exciter field winding wire		Ω	16.25	22.0	14.97
Auxiliary winding wires		Ω	1.364	1.14	1.012

5.2 Forced Excitation Method

1. Run the generator at the rated r.p.m.
2. Disconnect the field connector in the control panel, and apply the battery voltage to the exciter winding wire.
   J and (+) terminal of battery
   K and (-) terminal of battery



3. Magnetize for 1 to 2 seconds, then remove the wires and check if voltage is generated.
   Note: Thickness of lead wires between battery terminal and connector should be the same thickness as exciter field winding wires (J and K wires). It is dangerous that the wire may be overheating, they are too small in thickness.

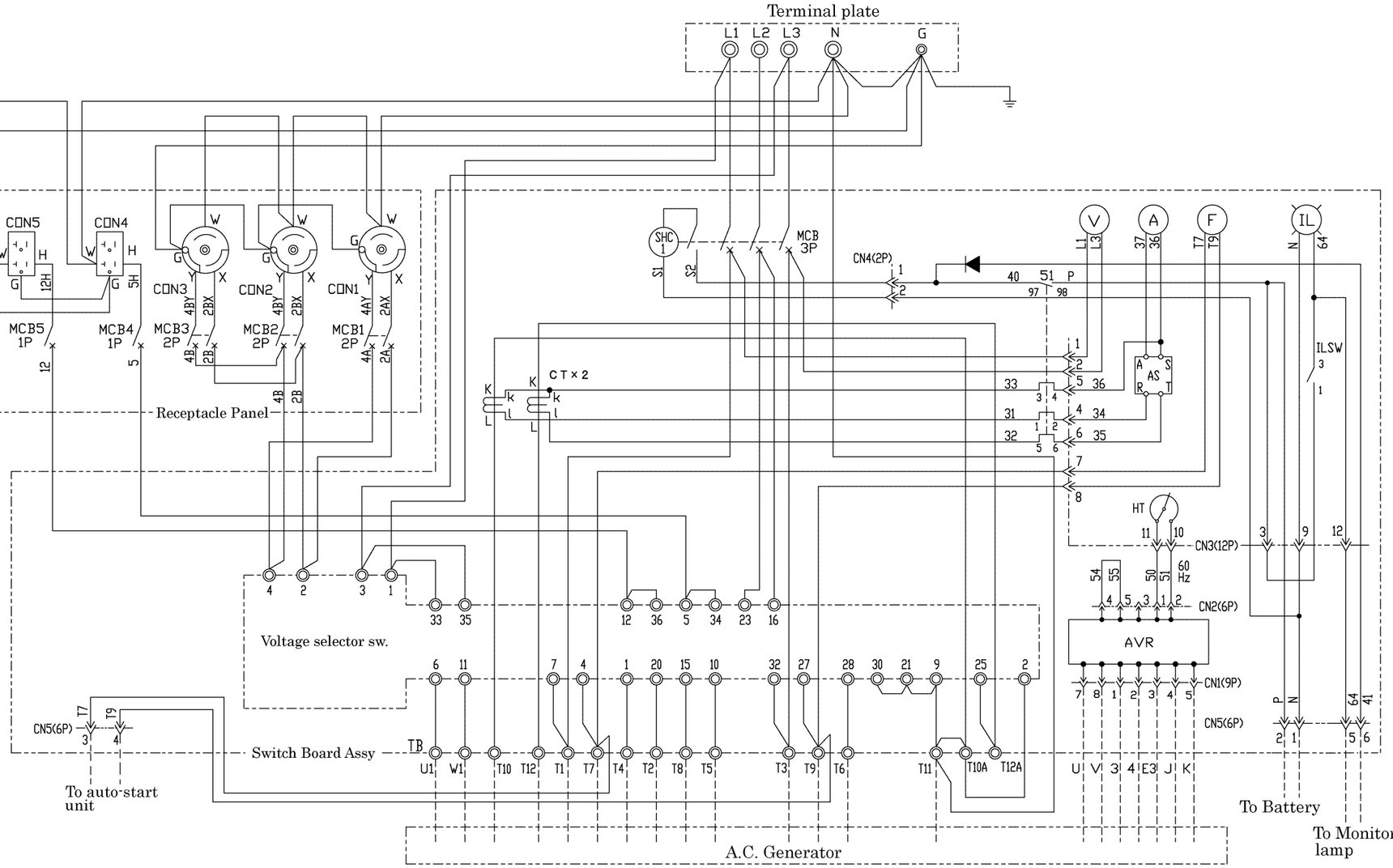
Generated voltage from forced excitation (at 480V) (V)

	Voltage generated (V) [at the temperature of 104°F (40℃)]	
	Battery 12V	Battery 24V
65kVA	455	580
125kVA	410	560
150kVA	520	600

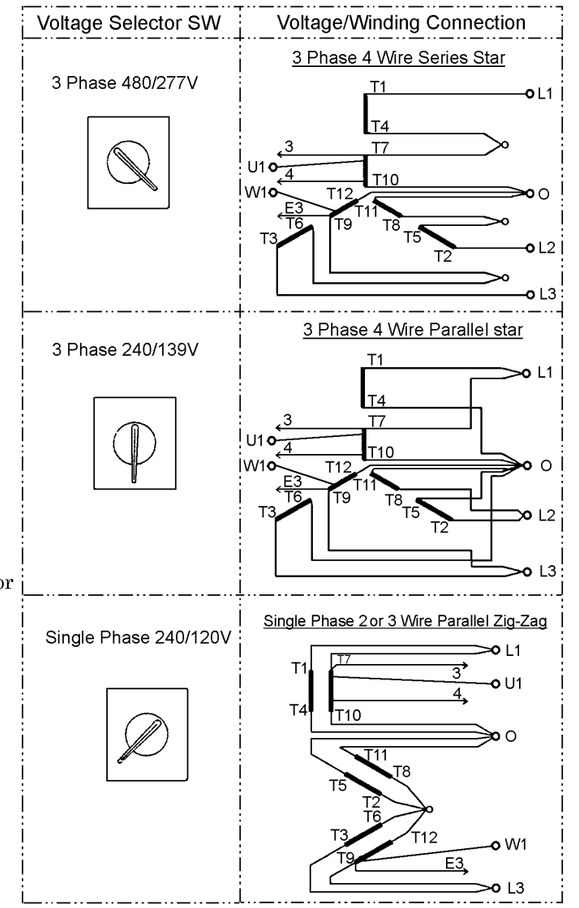
* The generating voltage is only for reference because it will change due to the ambient temperature.

5.3 Generator Wiring Diagram

65kVA

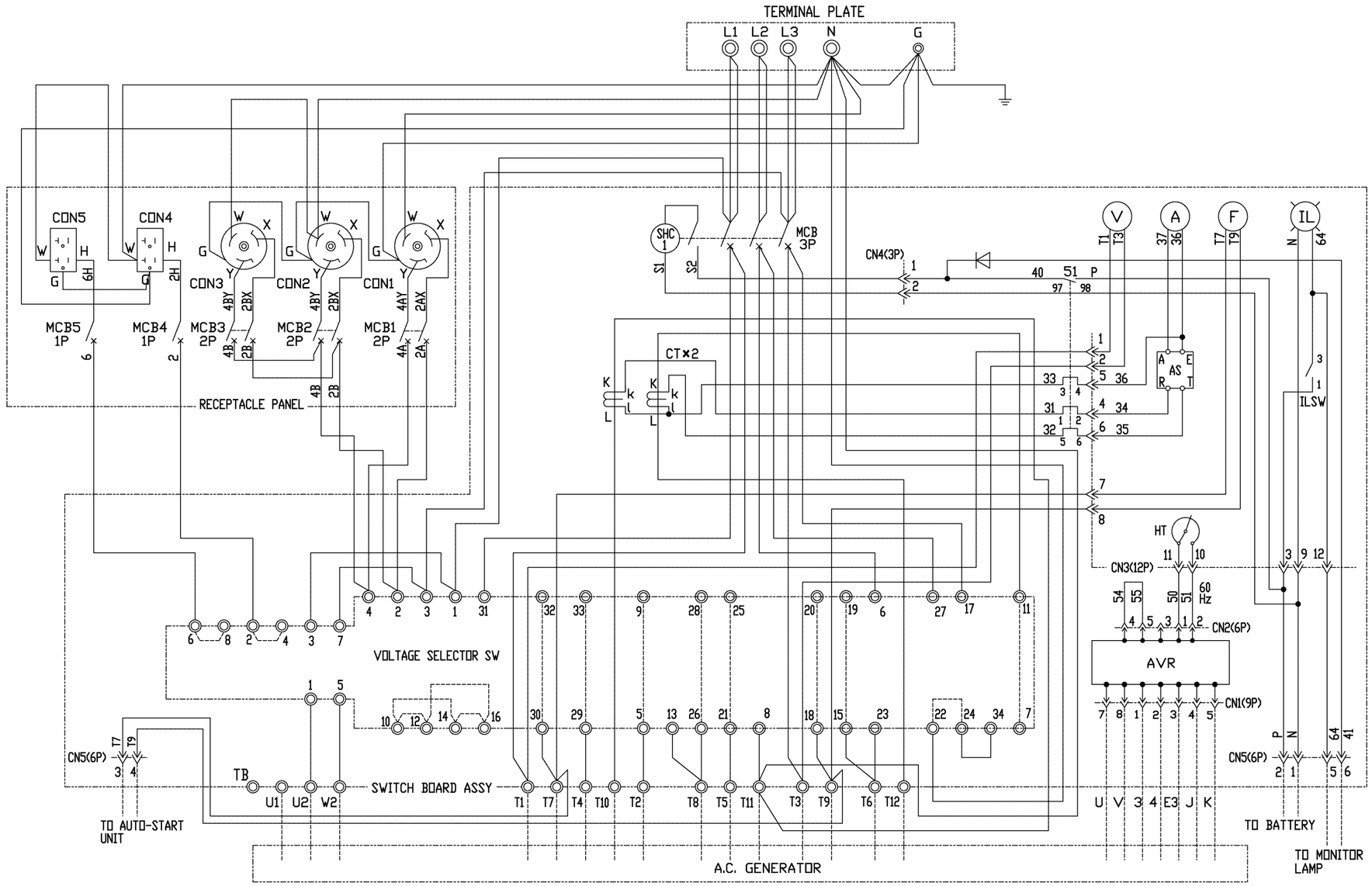


MCB	Molded case circuit breaker (three-phase)
MCB1－5	Molded case circuit breaker (single-phase)
SHC	Shunt coil
A	Ammeter
V	Voltmeter
F	Frequency meter
IL	Illumination lamp
CT	Current transformer
51	Thermal relay
AVR	Automatic voltage regulator
HT	Hand trimmer (voltage regulator)
AS	Ammeter change-over switch



5. References

125 / 150kVA



SG09007

MCB	Molded case circuit breaker (three-phase)
MCB1－5	Molded case circuit breaker (single-phase)
SHC	Shunt coil
A	Ammeter
V	Voltmeter
F	Frequency meter
IL	Illumination lamp
CT	Current transformer
51	Thermal relay
AVR	Automatic voltage regulator
HT	Hand trimmer (voltage regulator)
AS	Ammeter change-over switch

Voltage Selector SW	Voltage/Winding Connection
3 Phase 480/277V	3 Phase 4 Wire Series Star
3 Phase 240/139V	3 Phase 4 Wire Parallel star
Single Phase 240/120V	Single Phase 2or 3 Wire Parallel Zig-Zag

SG09005

5.4 Engine Wiring Diagram

65kVA

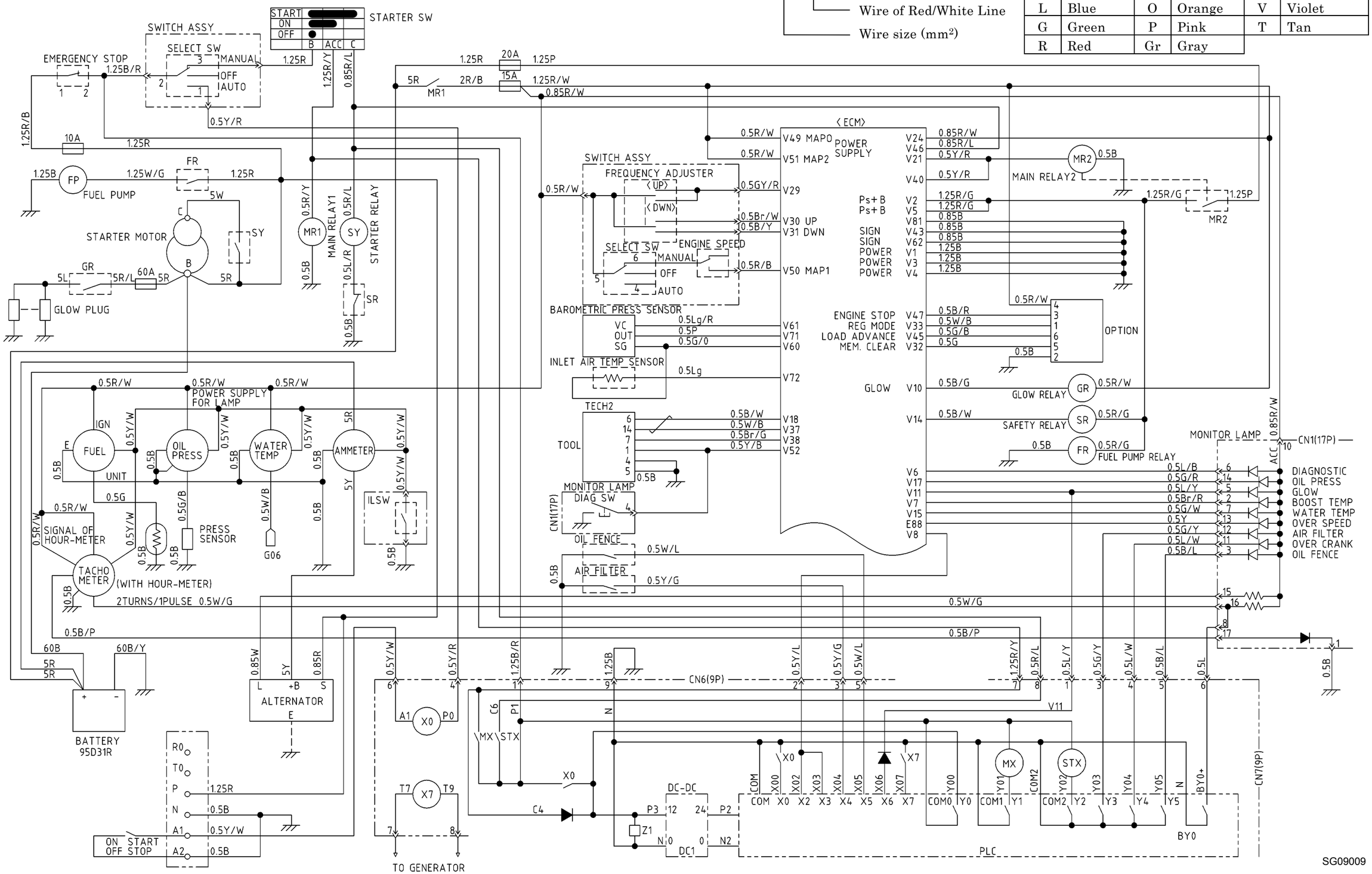
An Example

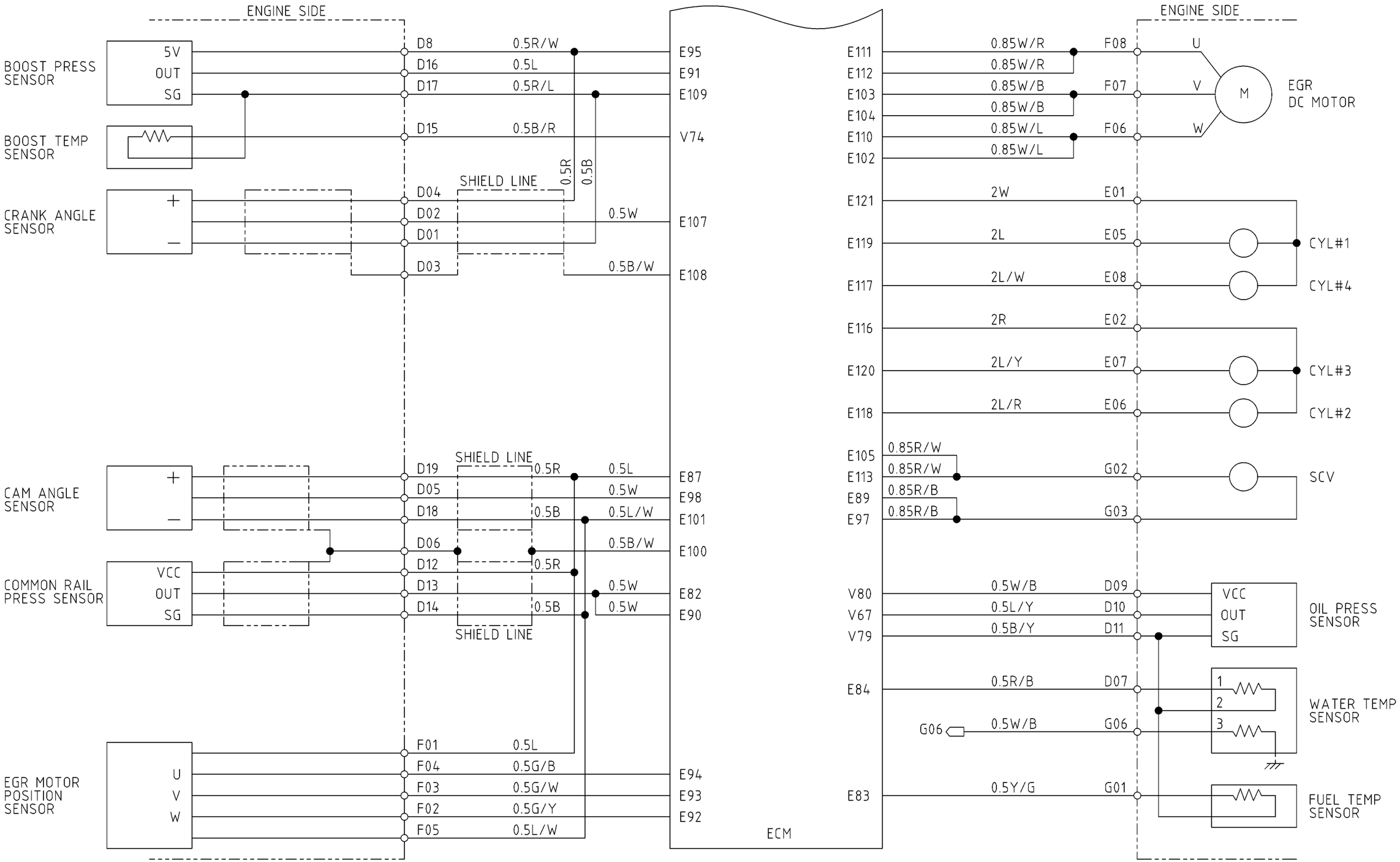
3 R/W

Wire of Red/White Line

Wire size (mm²)

B	Black	W	White	Lg	Light green
Y	Yellow	Br	Brown	Sb	Sky blue
L	Blue	O	Orange	V	Violet
G	Green	P	Pink	T	Tan
R	Red	Gr	Gray		




ENGINE SIDE
BOOST PRESS SENSOR
5V
OUT
SG
BOOST TEMP SENSOR
CRANK ANGLE SENSOR
+
−
D8
D16
D17
D15
D04
D02
D01
D03
0.5R/W
0.5L
0.5R/L
0.5B/R
SHIELD LINE
0.5R
0.5B
0.5W
0.5B/W
E95
E91
E109
V74
E107
E108
CAM ANGLE SENSOR
COMMON RAIL PRESS SENSOR
VCC
OUT
SG
D19
D05
D18
D06
D12
D13
D14
SHIELD LINE
0.5R
0.5L
0.5W
0.5B
0.5L/W
0.5B/W
0.5R
0.5W
0.5B
0.5W
E87
E98
E101
E100
E82
E90
EGR MOTOR POSITION SENSOR
U
V
W
F01
F04
F03
F02
F05
0.5L
0.5G/B
0.5G/W
0.5G/Y
0.5L/W
E94
E93
E92
ECM
E111
E112
E103
E104
E110
E102
E121
E119
E117
E116
E120
E118
E105
E113
E89
E97
V80
V67
V79
E84
E83
0.85W/R
0.85W/R
0.85W/B
0.85W/B
0.85W/L
0.85W/L
2W
2L
2L/W
2R
2L/Y
2L/R
0.85R/W
0.85R/W
0.85R/B
0.85R/B
0.5W/B
0.5L/Y
0.5B/Y
0.5R/B
0.5W/B
0.5Y/G
F08
F07
F06
E01
E05
E08
E02
E07
E06
G02
G03
D09
D10
D11
D07
G06
G01
U
V
W
M
EGR DC MOTOR
CYL#1
CYL#4
CYL#3
CYL#2
SCV
VCC
OUT
SG
OIL PRESS SENSOR
1
2
3
WATER TEMP SENSOR
FUEL TEMP SENSOR
G06
ENGINE SIDE

SG09010

5. References

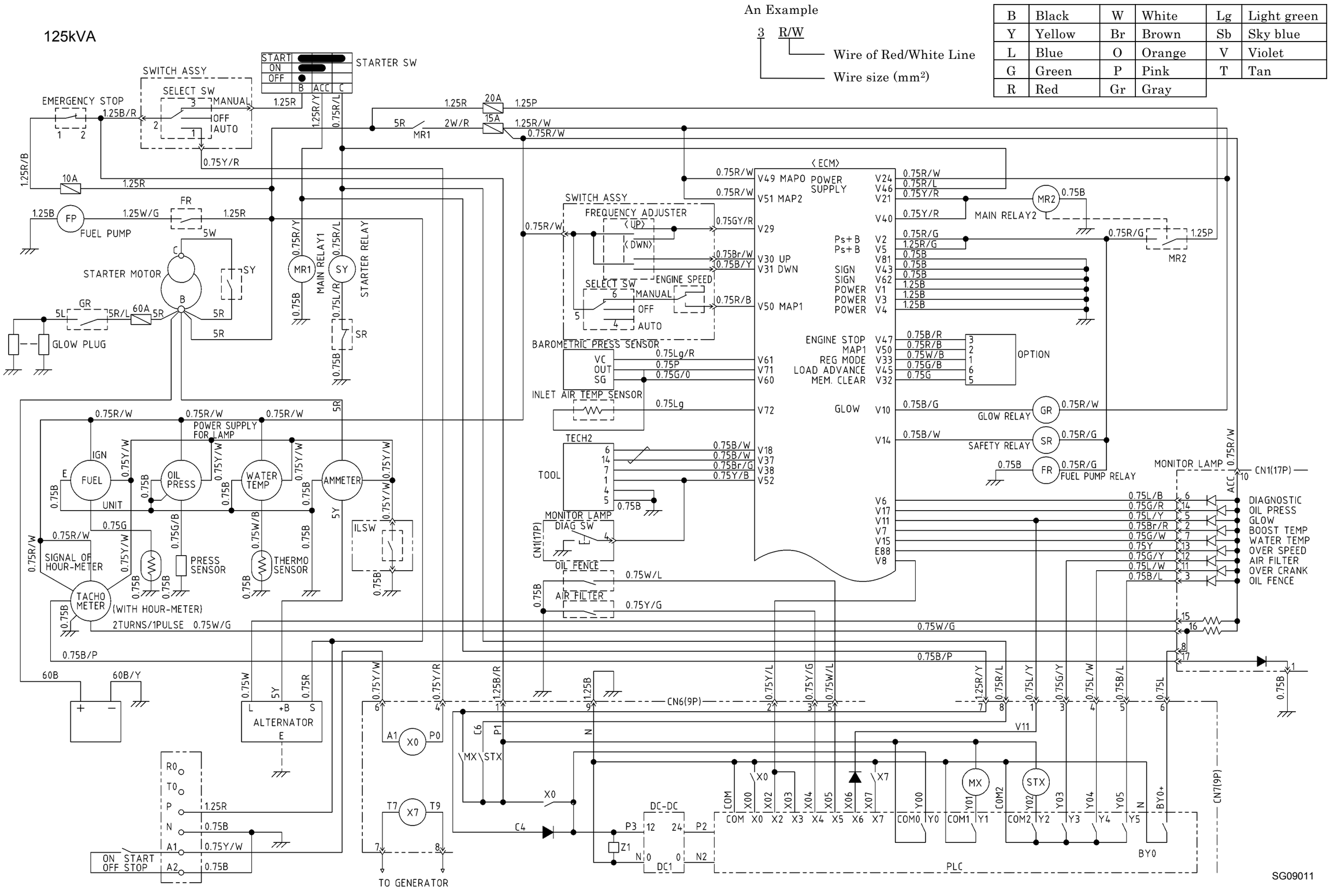
An Example

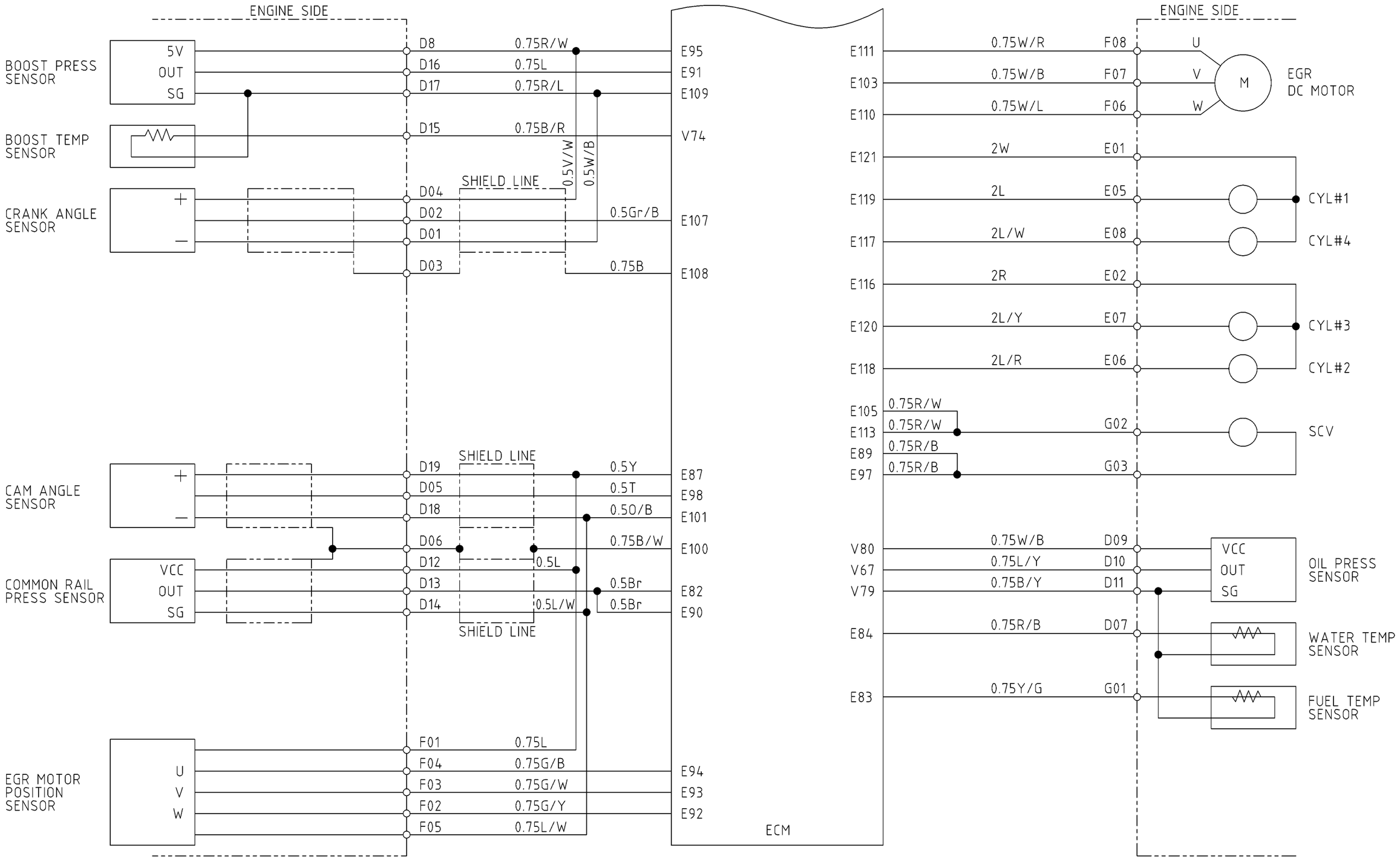
3 R/W

Wire of Red/White Line

Wire size (mm²)

B	Black	W	White	Lg	Light green
Y	Yellow	Br	Brown	Sb	Sky blue
L	Blue	O	Orange	V	Violet
G	Green	P	Pink	T	Tan
R	Red	Gr	Gray		




ENGINE SIDE
BOOST PRESS SENSOR
5V
OUT
SG
BOOST TEMP SENSOR
CRANK ANGLE SENSOR
+
−
D8
D16
D17
D15
D04
D02
D01
D03
0.75R/W
0.75L
0.75R/L
0.75B/R
SHIELD LINE
0.5V/W
0.5W/B
0.5Gr/B
0.75B
E95
E91
E109
V74
E107
E108
CAM ANGLE SENSOR
COMMON RAIL PRESS SENSOR
VCC
OUT
SG
D19
D05
D18
D06
D12
D13
D14
SHIELD LINE
0.5Y
0.5T
0.5O/B
0.75B/W
0.5L
0.5Br
0.5L/W
0.5Br
E87
E98
E101
E100
E82
E90
EGR MOTOR POSITION SENSOR
U
V
W
F01
F04
F03
F02
F05
0.75L
0.75G/B
0.75G/W
0.75G/Y
0.75L/W
E94
E93
E92
ECM
E111
E103
E110
E121
E119
E117
E116
E120
E118
E105
E113
E89
E97
V80
V67
V79
E84
E83
0.75W/R
0.75W/B
0.75W/L
2W
2L
2L/W
2R
2L/Y
2L/R
0.75R/W
0.75R/W
0.75R/B
0.75R/B
0.75W/B
0.75L/Y
0.75B/Y
0.75R/B
0.75Y/G
F08
F07
F06
E01
E05
E08
E02
E07
E06
G02
G03
D09
D10
D11
D07
G01
U
V
W
M
EGR DC MOTOR
CYL#1
CYL#4
CYL#3
CYL#2
SCV
VCC
OUT
SG
OIL PRESS SENSOR
WATER TEMP SENSOR
FUEL TEMP SENSOR

SG09012

5. References

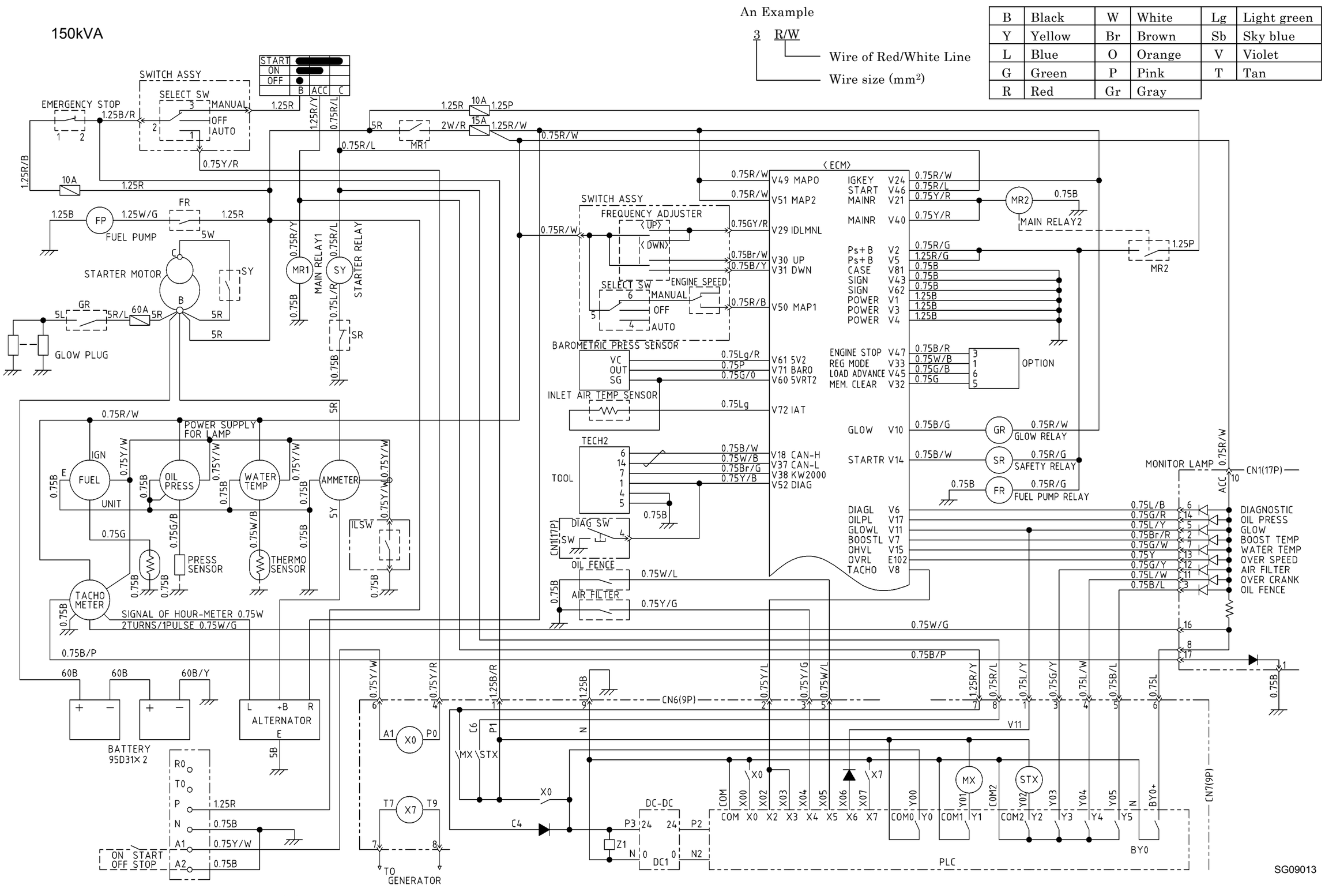
An Example

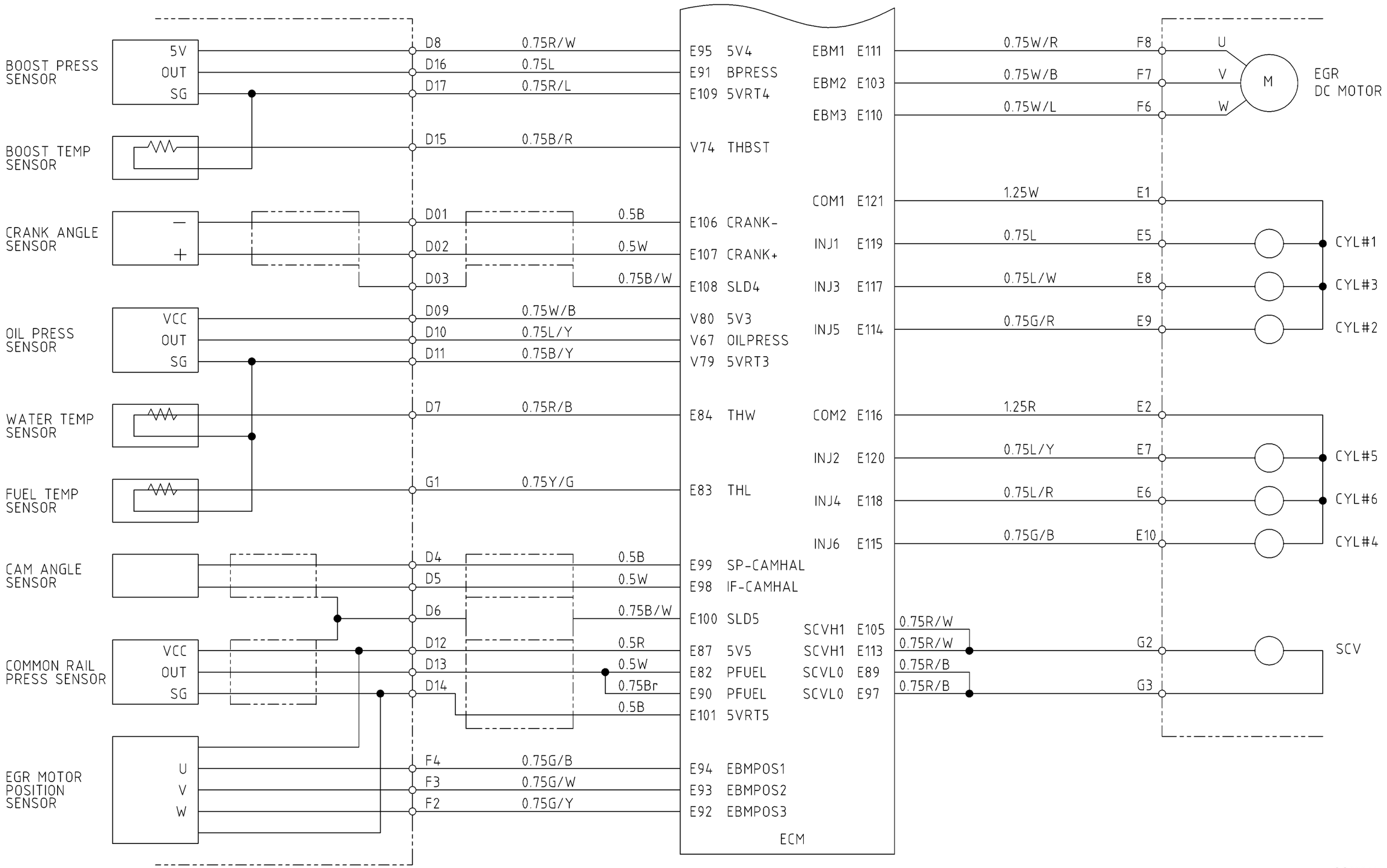
3 R/W

Wire of Red/White Line

Wire size (mm²)

B	Black	W	White	Lg	Light green
Y	Yellow	Br	Brown	Sb	Sky blue
L	Blue	O	Orange	V	Violet
G	Green	P	Pink	T	Tan
R	Red	Gr	Gray		




BOOST PRESS SENSOR
5V
OUT
SG
BOOST TEMP SENSOR
CRANK ANGLE SENSOR
OIL PRESS SENSOR
VCC
WATER TEMP SENSOR
FUEL TEMP SENSOR
CAM ANGLE SENSOR
COMMON RAIL PRESS SENSOR
EGR MOTOR POSITION SENSOR
U
V
W
D8 0.75R/W
D16 0.75L
D17 0.75R/L
D15 0.75B/R
D01 0.5B
D02 0.5W
D03 0.75B/W
D09 0.75W/B
D10 0.75L/Y
D11 0.75B/Y
D7 0.75R/B
G1 0.75Y/G
D4 0.5B
D5 0.5W
D6 0.75B/W
D12 0.5R
D13 0.5W
D14 0.75Br
0.5B
F4 0.75G/B
F3 0.75G/W
F2 0.75G/Y
E95 5V4
E91 BPRESS
E109 5VRT4
V74 THBST
E106 CRANK-
E107 CRANK+
E108 SLD4
V80 5V3
V67 OILPRESS
V79 5VRT3
E84 THW
E83 THL
E99 SP-CAMHAL
E98 IF-CAMHAL
E100 SLD5
E87 5V5
E82 PFUEL
E90 PFUEL
E101 5VRT5
E94 EBMPOS1
E93 EBMPOS2
E92 EBMPOS3
ECM
EBM1 E111
EBM2 E103
EBM3 E110
COM1 E121
INJ1 E119
INJ3 E117
INJ5 E114
COM2 E116
INJ2 E120
INJ4 E118
INJ6 E115
SCVH1 E105
SCVH1 E113
SCVL0 E89
SCVL0 E97
0.75W/R F8
0.75W/B F7
0.75W/L F6
U
V
W
M
EGR DC MOTOR
1.25W E1
0.75L E5
0.75L/W E8
0.75G/R E9
CYL#1
CYL#3
CYL#2
1.25R E2
0.75L/Y E7
0.75L/R E6
0.75G/B E10
CYL#5
CYL#6
CYL#4
0.75R/W
0.75R/W
0.75R/B
0.75R/B
G2
G3
SCV

SG09014