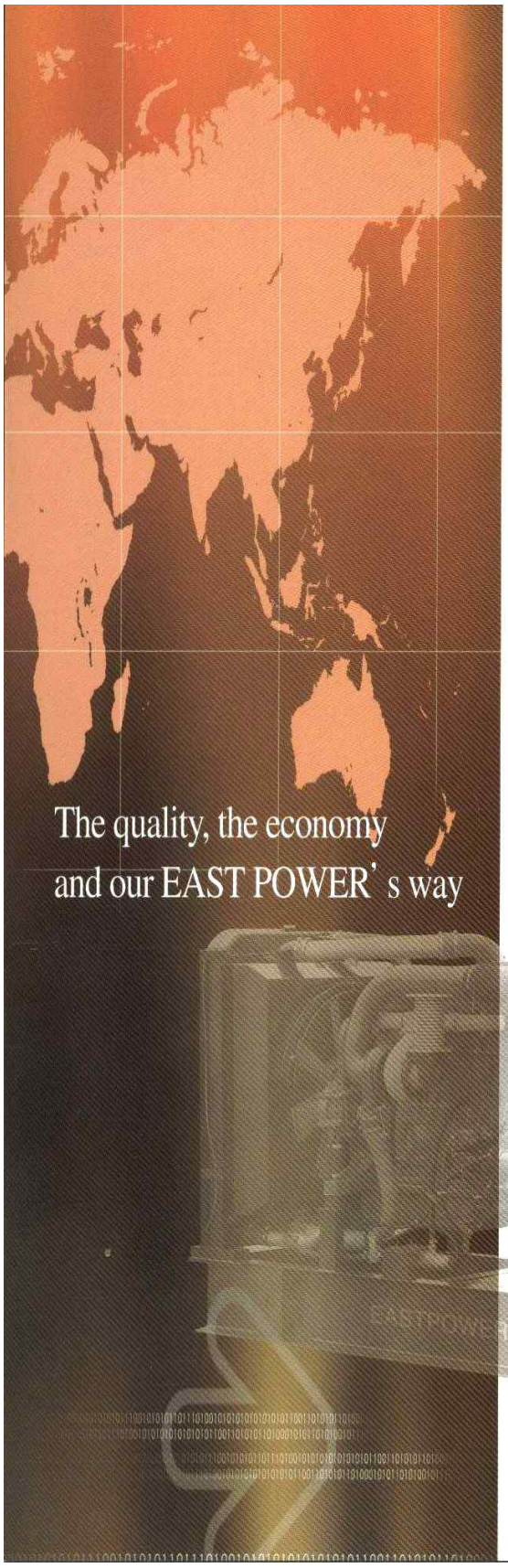


Foreword

EASTPOWER CO., LTD is always ready to meet customer's requirement with factory-supported warranty, parts supply and services as well as visits of trained field service technician.

This manual has been prepared to furnish customers/operators with better and easier access to proper operation, trouble finding, trouble shootings. maintenance etc. It also covers technical description of the gen-set including installation, operation and maintenance.
The photos, illustrative pictures, diagrams and drawings in the manual will be helpful to enhance operator's understanding of the equipment and adequate operation of the generator set.

The contents of the manual can be, without prior notice, modified and altered whenever it is necessary. Any question and suggestion related to improvement of the products and easier way of maintenance, operation and service will be appreciated and accommodated for correction, change, and improvement of the products.

Please call any time to the Company's Engineering Department +82-31-943-3541 or send FAX to +82-31-943-3540.

2016.11

CONTENTS 7

SECTION 1. SAFETY RULES

1.1. General

The generator set is designed for safety in use in the correct manner. However the responsibility for safe operation rests with those who install, use and maintain these products. The following safety precautions are offered as a guide, which, if conscientiously followed will minimize the possibility of accidents throughout the useful life of this equipment. Before performing any procedure of operating technique, it is up to the user to ensure that it is safe. The generator set should only be operated by personnel who are authorized, trained and delegated to do so.

There are many potential hazards that can occur during operation of the generator set which can not be anticipated. Therefore a warning cannot be included in the manual for every possible circumstance that might involve a potential hazard. In particular, operators should ensure to operator the set in a safe environment by first removing all dangerous elements from around the diesel generator set.

Should a procedure not specially recommended be used then you must satisfy yourself that it is safe and will not damage the generator set.

This manual was prepared for the standard diesel generator set manufactured and supplied by us with extra information given in the relevant sections for the special models, such as the sound-proof or trailer type.

⚠ Warning/Danger/Important

Install, use and operate this generator set only in full compliance with any pertinent National or Local Code, Standard, Rules, or other requirements

A. Read and understand all safety precautions and warnings before operating or performing maintenance of the generator set.
B. Failure to follow the instructions, procedures and safety precautions in this manuals may increase the possibility of accidents and injuries.
C. Do not alter or adjust any part of the generator set assembled and supplied by us without our approval as we cannot be held responsible for faults or accidents so caused.
D. It is very important to regularly carry out periodic checks suggested in this manual to maximize the generator set's working life and prevent accidents in advance.
E. Never start the generator set when components are unsafe.
F. Do not attempt to operate the generator set when conditions are unsafe.
G. If the generator set is unsafe, fit danger notices and disconnect the battery negative(-) leads so that it cannot be started until the condition is corrected.
H. Make sure to disconnect the negative lead of the battery from the generator set prior to attempting any repair work or cleaning of the inside of the sound proof or trailer type generator set enclosure structure.

1.2 Installation And Handling

An installation guide is included in section 4 of this manual and must be consulted before choosing a location for your gen-set. Wiring code and safety regulations must be consulted. If in doubt, contact your dealer who will be pleased to offer you advices. This manual covers procedures for installation and handling of generator sets.

⚠ Warning/Danger/Important

A. Electrical works, including earth-grounding and installing, should be carried out in compliance with local regulation related to such electrical work.
B. Install stationary generator set under cover where they will not be exposed to rain, snow, sleet, flood, water, direct sunlight, freezing temperature, or wind driven precipitation.
C. Exhaust fumes from all indoor generator set must be piped out of via leak-free and heat resistance pipes as exhaust emissions are hazardous. Piping work and any installation of equipment related to exhaust should be carried out in compliance with relevant local regulations, standard, and other regulations. The pipes and silencer should not use inflammable materials, nor should any inflammable materials be placed near the pipes and silencer. Protection equipment capable of meeting safety gas emitted from the exhaust pipe is within the legal limit.
D. Never lift the generator set using the engine or alternator lifting lugs. Connect lifting equipment to the hole in the bed frame of the generator set. Refer the Installation section in this manual for further details including lifting of sound-proof generator set.
E. Ensure the lifting rigging and supporting structure is in good condition and has a capacity suitable for the load.
F. Keep all personnel away from the generator set when it is suspended.
G. Make sure all personnel are clear of the generator set if the type is a sound-proof or weather-proof one, before closing or latching enclosure doors.
H. Check the floor that the generator set will be installed on is flat and without a slope. When the floor slopes, the generator set should be arranged horizontally using packing material that is sufficiently strong to support the weight of the generator set.
I. For trailer type generator sets, install the set on the flat floor if possible and fix all the wheels. Do not move the generator set while it runs.
J. Do not install or use the generator set in any classification of hazardous environment unless it has been specifically designed.
K. Do not expose to rain or snow while installing a sound-proof weather-proof or trailer generator set outdoors because running a set in such exposed conditions is very dangerous. Also, load line connection parts and loading equipment should not be exposed to rain or snow.

1.3. Fire And Explosion

Fuels and fumes associated with generator set can be flammable and potentially explosive. Proper care in handling these materials can dramatically limit the risk of the fire or explosion. However, safety dictates that fully charged class BC and class ABC fire extinguishers should be constructed where the generator set is installed.

⚠ Warning/Danger/Important

A. Keep the room, the floor and the generator set clean and ventilated.
B. Clean up immediately spills of fuel, oil, battery electrolyte or coolant when such spills occur.
C. Never store flammable liquids near the engine. Store oily rags in metal covered containers.
D. Do not smoke or allow sparks, flames or other sources of ignition around fuel or batteries. Fuel vapors are explosive. Hydrogen gas generated by charging batteries is also explosive.
E. Turn off or disconnect the power to the battery charger before making or breaking connections with the battery.

F. Keep grounded conductive objects, such as tools, away from exposed live electrical parts, such as terminals, to avoid arcing. Sparks and arcing might ignite or vapors.
G. Avoid refilling the fuel tank of the bed frame while the engine is running.
H. Do not attempt to operate the generator set with any known leaks in the fuel system.
I. The excessive build up of unburned fuel gases in the exhaust system can create a potentially explosive condition. This build-up can occur after repeated failed start attempts, valve testing drain plugs, if equipped, and allow the gases to dissipate before attempting to restart the generator set.
J. Use fuel, oil and cooling water that are appropriate.

1.4. Mechanical Safety Consideration

A. Do not attempt to operate the generater set with safety guards removed, while the generator set is running do not attempt to reach under of around the guards to do maintenance or for any other reason.
B. Keep hands, arms, long hair, loose clothing and jewellery away from pulley, belts and other moving parts.
C. Some moving parts can not be seen clearly when the set is running.
D. Keep access doors on enclosures, if equipped, closed and locked when not required to be open.
E. Avoid contact with hot oil, hot coolant, hot exhaust gases, hot surfaces and sharp edges and corners.
F. Wear protective clothing including groves and hat when working around the generator set.
G. Do not remove the radiator filler cap until the coolant has cooled. Then loosen the cap slowly to relieve any excess pressure before removing the cap completely.

1.5. Chemical Safety Considerations

Fuels, oils, coolants, lubricants and battery electrolyte used in this generator set are typical of the industry. However they can be hazardous to personnel if not treated properly.

⚠ Warning/Danger/Important

A. Do not swallow or allow skin contact with fuel, oil, coolant, lubricants or battery electrolyte. If swallowed, seek medical treatment immediately. Do not induce vomiting soap and water.
B. Do not wear clothing that has been contaminated by fuel or lube oil.
C. Wear an acid resistant apron and face shield or goggles when servicing the battery. If electrolyte is spilled on skin or clothing, flush immediately with large quantities of water.

1.6 Noise Safety Considerations

Generator sets that are not equipped with sound attenuating enclosures can produce noise levels of 105dBA. Prolonged exposure to noise level above 85dBA is hazardous to hearing.

⚠ Warning/Danger/Important

A. Ear protection must be worn when operating or working around an operating generator set.

1.7 Electrical Safety Considerations

Safe and efficient operation of electrical equipment can be achieved only if the equipment is

correctly installed, operated and maintained.

⚠ Warning/Danger/Important

A. The generator set must be connected to the load only by trained and qualified electricians who are authorized to do so, and in compliance with relevant electrical codes, standards, and other regulations. Where required, their work should be inspected and accepted by the inspection agency prior to operating the generator set.
B. Ensure the generator set is effectively earthed in accordance with all relevant regulations prior to operation.
C. The generator set should be shutdown with the battery negative(-) terminal disconnected prior to attempting to connect or disconnect load connections.
D. Do not attempt to connect or disconnect load connections while standing in water or on wet soggy ground.
E. Do not touch electrically energized parts of the generator set and/or interconnecting cables or conductors with any part of the body or with any non insulated conductive object.
F. Replace the generator set terminal box cover as soon as connection or disconnect of the load cables is complete when it is worn or damaged. Do not operate the generator set without the cover securely in place.
G. Make sure the bolt securing the load line to the terminal is not loosened or released. Keep the bolt tight at all times.
H. Connect the generator set only to load and/or electrical systems that are compatible with its electrical characteristics and that are within its rated capacity.
I. Be sure all electrical power is disconnected from electrical equipment being serviced.
J. Keep all electrical equipment clean and dry. Replace any wiring where the insulation is cranked, cut, abraded or otherwise degraded or corroded. Keep terminals clean and tight.
K. Insulate all connections and disconnected wires.
L. Use only class BC or Class ABC extinguishers on electrical fires.

1.8 First aid for electric shock

⚠ Warning/Danger/Important

A. Do not touch the victim's skin with bare hands until the source of electricity has been turned off.
B. Switch off power, if possible.
C. Otherwise pull the plug or pull the cable away from the victim.
D. If this is not possible, stand on dry insulating material and pull the victim clear or the conductor preferably using insulated material such as dry wood.
E. Immediately contact a hospital or doctor to treat patients who have been injured by the generator set.

SECTION 2 GENERAL DESCRIPTION OF GENERATOR SET

Refer to Figure 2-1. The major components of the gen-set are clearly shown. Stationary or mobile units are available with each package including an alternator, diesel engine, exhaust, cooling system, and a control system.

Full technical details of the engine, alternator and control panel are contained in other sections of this manual.

The engine is equipped with a close control governor which will hold the engine speed within the tolerance necessary to deliver the rated power and frequency per DIN6271, MG-12.43 and BS5514

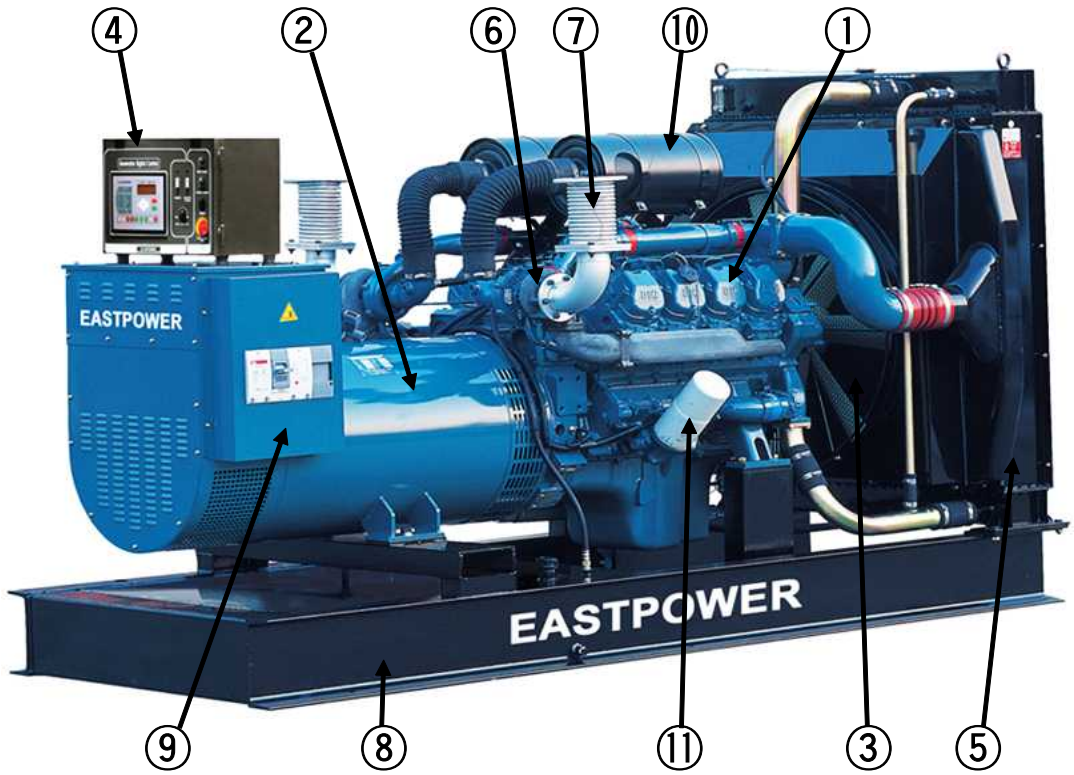


Fig. 2-1 Typical Generator Set Configuration

No.	Name	No.	Name
①	Diesel Engine	⑧	Bed Frame
②	Alternator	⑨	Load Terminal
③	Fan	⑩	Air Cleaner
④	Control Panel	⑪	Oil Filter
⑤	Radiator		
⑥	Turbo Charger		
⑦	Bellows		

2-1 Diesel Engine

The engine is equipped with a close control governor which hold the engine speed within the tolerance necessary to deliver the rated power and frequency per DIN 6271 and BS5514.

The engine incorporated in the generator set is of proven reliability and is specifically designed to operate in conjunction with an alternator. The engine is of heavy duty industrial type with 4 stroke compression ignition and is fitted with all accessories necessary to provide a reliable power supply.

2.1.1 Main Components

1) Cylinder Block

The cylinder block is a high strength cast iron components. The inlet air receiver and most of the cooling water and lubricating oil channels are integrated parts of the cylinder block.

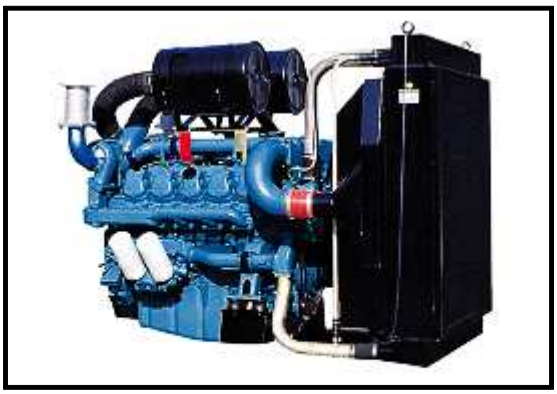


Fig. 2-2 Doosan Diesel Engine

2) Pistons

The mono-block pistons have forced oil cooling space. The low temperature level of these pistons combines extremely low wear rates with a low lube oil consumption.

3) Cylinder Liner

The cylinder liner are made of fine-grained vanadium cast with good running properties and excellent wear resistance. oil and water resistant rubber rings are used for the sealing between the water space and the crankcase.

4) Cylinder Head

The cast iron cylinder heads have centrally positioned fuel valves and inserted valve seat rings made of special heat resistant cast steel for both inlet and exhaust valve.

The exhaust valves are made of a special cast alloy material for resistance against high temperature corrosion.

5) Crankshaft

The crankshaft is of the forged type, precisely ground to high hardness in order to reduce wear in

the journal pins to minimum. The counterweight is installed to alleviate the structural imbalance of the rotational crankshaft. Flanges are fitted at both ends for mounting of flywheel, and if necessary, a vibration damper can be the from the end of the shaft.

6) Cam shaft

The cam-shaft is assembled in sections, each with fixed cams for inlet valve and exhaust valve for each cylinder. The Cam-shaft is driven by specially made and heat-treated gear wheels to reduce noise and wear. Cam-shaft bearings, push rod rocker arms and gears are lubricated by integrated and forced oil system of the engine.

7) Connecting Rods

Connecting rods are die forged in the small-end. They are equipped with bearing bushings and in the big-end with shell- beatings of similar type as the main bearings.

2.3 Fuel System

Diesel fuel contains hydrocarbons. Do not mix with oxidized metallic or solid substances.

The fuel requirements of the diesel engine are based on DIN51601, BS2869 and ASTMD975. Refer to the fuel recommendations in this manual.

The engine torque is transmitted, via the coupling, to the injection pump cam-shaft which in turn drives the feed pump which sucks in fuel from the fuel tank and delivers it to the fuel filter. The fuel passes through the fuel filter and is fed to the fuel injection pump. The injection pump forces the fuel, under high pressure, through the injection lines to the nozzles where it is injected into the precombustion chambers.

The diesel engines, which are equipped with fuel injection pumps of high quality and high precision, have mechanical governors for the supply of low power and electronic governors for the supply of high power depending upon the type being used, The governors maintain the correct amount of fuel injection depending upon the load and speed: Keep the varying ratio of rotational speed at 5%(for mechanical governors), and at 1%(for electrical governors); and are consequently necessary components of generator sets.

Since the fuel injection pump is built of very precise components, foreign materials in the fuel can damage the plunger causing the inner components to seize each other. In order to prevent this, a fuel filter is mounted on the front of the injection pump, thus enabling only clean fuel to be injected.

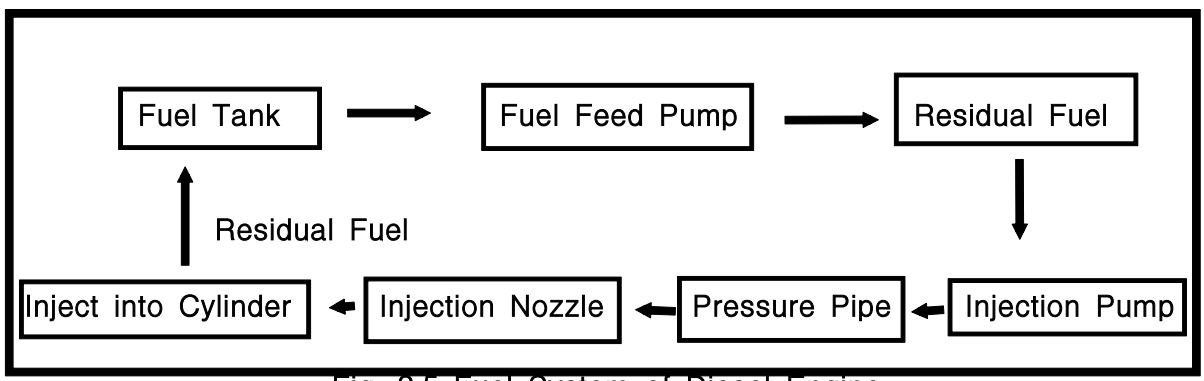


Fig. 2.5 Fuel System of Diesel Engine

2-3 Lubricating System

The lubricating system of the engine consists of various components such as the oil pump, oil cooler, full flow filter.

In general, oil circulated by the oil pump is cooled by the oil cooler and refined by the full- flow oil filter while passing through the filter. The oil flows out from the oil filter and into the bearings inside the engine through the main oil gallery inside the cylinder block thus reducing friction, while acting to cool seal, protect against corrosion and clean adds well as functioning to distribute stress. Some engines have an oil filter in front of the oil cooler to filtrate the supply oil.

The oil pump runs from the crank gear of the engine and a relief valve inside the pump diverts oil flow into the oil pan when the pressure exceeds a limit thus preventing oil from exceeding the oil line.

The drain unit mounted on the bottom of the oil pan is used to remove oil from the cylinder head and inside the engine.

Periodically replace the oil filter which is part of the engine lubricating system, so that clean oil can be preserved at all times. Foreign material (e.g. dust chip carbohydrate etc,.) injected with the oil can scratch the slideway accumulate or bind on to parts causing the lubrication system to loose efficiency, This condition can cause the inner components to seize each other. permitting of frictional heat.

Consequently, the oil filter is indispensable for removing foreign material before the oil is injected into the slideway.

In the cylinder block, because the oil filter is installed between the oil pump and the main oil gallery, the circulating oil can be kept clean at all times as it passes through the filter.

◆ Behavior of Lubricating Oil

1) Reduction of friction
   (1) Prohibits excessive metal-to- metal friction enabling the engine to run smoothly.
   (2) Coats moving parts with a strong oil film.
2) Cooling
   (1) Lubricating oil absorbs friction heat.
3) Sealing
   (1) Prohibits compressed gas from leaking out between cylinder and piston ring, protecting against power loss.
4) Anti-corrosion
   (1) Prevents, moisture from contacting with parts thus protecting against corrosion.
5) Cleansing
   (1) Prevents dust, chip, and carbon, etc. from being introduced.
6) Stress Distribution
   (1) Distributes local pressure to reduce the surrounding stress instantly or partially, thus preventing oil membrane from breaking.

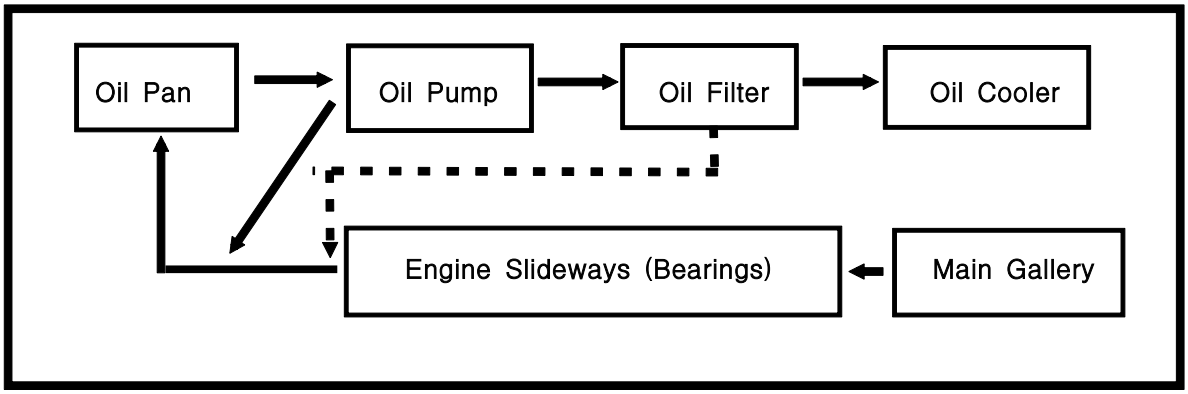


Fig. 2-6 Lubricating System of Diesel Engine

2.4 Cooling System

Cooling method can be classified into water cooling and air cooling types. The former method is used in the diesel engines of EastPower generator sets. This method can be further sub-divided into radiator cooling and heat exchanger cooling. Specifically the cooling system of EastPower generator sets use radiator cooling.

The cooling water is circulated through the cylinder block by the water pump to cool the engine, The cooling water passing through the cylinder heads cools the exhaust port (this reduces the temperature of the exhaust gas) and the precombustion chambers, The cooling water outflow from the cylinder heads flows into the radiator through the cooling water outlet pipe.

The thermostat, installed between the cooling water outlet pipe and radiator in order to control the cooling water temperature of the engine, protects the engine from overcooling at start-up and keeps the engine at the proper temperature.

When the cooling water temperature is lower than the thermostat operating temperature, the thermostat and thus the cooling path remain closed so the cooling water cannot flow into the radiator and the engine is not overcooled in this case, the cooling water is repeatedly circulated through the bypass pipe of the engine so that the engine temperature quickly reaches the operating temperature.

Generally, Doosan, the engine manufacturer uses five types of thermostats: 71℃, 76.5℃, 79℃, 82℃ and 83℃ alternatively.

For proper operation of the diesel generator set, a cooled air inflow to the inside of the enclosure or to the generator room is very important because the performance of the generator set depends upon this.

The alternator is mounted on the diesel engine and the damper plate, which is of the flexible steel disc type. The cooled-air inflow removes heat that is being generated by the alternator and the engine as it passes through the engine and across the alternator, This cooling air passed through the generator set and flows out to the generator room or the external enclosure via the radiator under the influence of the suction generated by the rotating cooling fan.

The cooling air flows at its lowest temperature to the generator room and is supplied to the alternator by the fan mounted on the alternator and consequently, both engine and alternator remain at their proper operating temperature.

For ventilation, attention should be paid especially to diesel engines of generator sets that are used to deliver standby or prime power. For details, refer to the section on installation of the generator set in this manual.

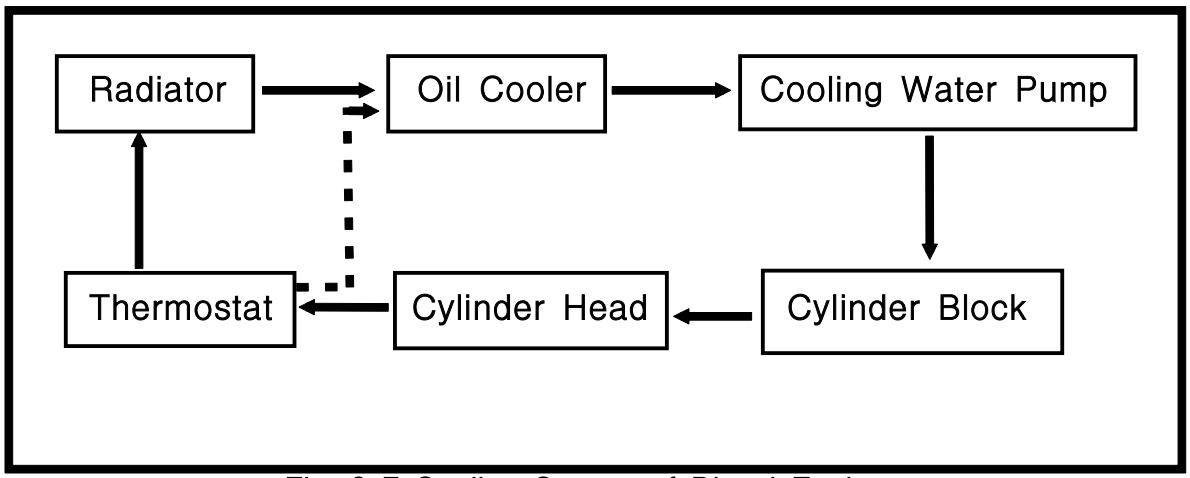


Fig. 2-7 Cooling System of Diesel Engine.

2.5 Engine Governor

Horsepower requirements of an engine may vary continually due to fluctuating loads; therefore, a means must be provided to control the amount of fuel required to hold the engine speed reasonably constant during such load fluctuations.

The primary function of the governor system is to maintain engine speed in relation to various load requirements. This is accomplished by the governor which senses engine speed and controls the engine fuel rate.

In order to maintain a constant frequency, the engine speed must remain constant. The engine speed governor maintains engine speed within limits regardless of the steady load. As the alternator load increases the engine speed is reduced. Because the speed must remain relatively constant, the governor, sensing engine speed, will increase fuel flow to the engine, thus adjusting horsepower to a point sufficient to maintain engine speed and compensate for the load change. The same principle is applied when the load decreases. As the load is reduced the speed will increase, and the governor will then reduce fuel delivery thus decreasing the horsepower to maintain the proper speed.

◆ Summary of Governor Types

1) Mechanical governors, which are relatively simple will satisfy the needs of the most installations where precise frequency control is not required, In the EastPower diesel generator set, the mechanical governors are used in 175KW or lower types.

* Speed control
  Steady state : ±2.5%
* Speed drop : Nonadjustable
* No load-full load regulation
  : less than 1% to 5%
* Parallel : Not recommended

2) Electronic governors, which are more complex, will supply the needs of the most demanding

frequency control. They can be used with precise tine control and automatic unattended paralleling and share load(kW) with similarly equipped units without speed drop.

* Speed control
  Steady states :
  Single unit : ±1.0 %
  Parallel unit : ±1.0%
* Speed drop : adjustable
* No load - full load
  Parallel Load Sharing / Isochronize Operation

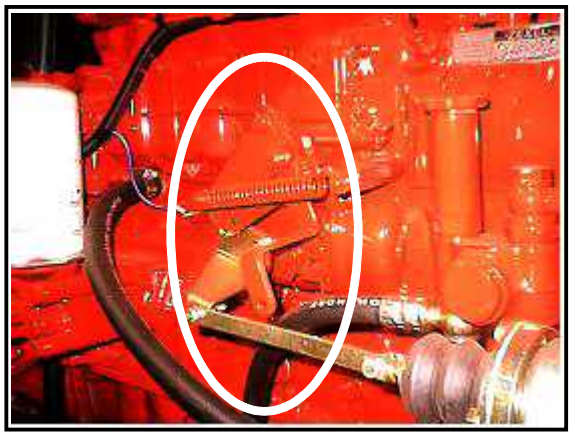


Fig. 2-10 Mechanical Governor

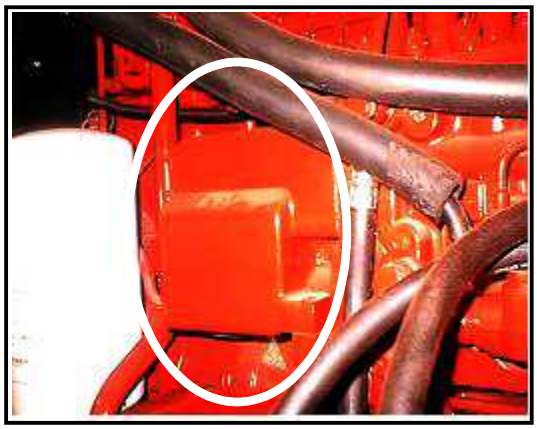


Fig. 2-11 Electronic Governor

2.6 Alternator

The alternator is designed and manufactured to accord with standard of CEI 2--3, VDE 0503, NFC51-100-111 and 112,bs4999-5000, NEMA, and another on request. The alternator is a synchronous rotating field type unit which produces alternating current. This alternator unit is completely self-contained and is designed and constructed to provide trouble free operation, easy maintenance and long service life.

Mechanical characteristics : The casting in steel and shield covers in cast iron, Shaft in high tensile steel. Very sturdy rotor to withstand the runaway speed of engines and with a damper cage which allows good running with single phase, distorting loads. Life lubricating bearings, brushless exciter easy to be disassembled, forms B3/B14 and B2, all standard SAE.

Ventilation. : Axial with air inlet from the opposite drive end.
Rotation : Both directions.
Enclosure : IP 21 standard(on request higher protections).

Electrical Characteristics : Insulation is obtained with H class materials, Impregnation : VPI, Enamel copper wire : 200℃, Voltage is adjusted by means of an electronic regulator, fed by special winding, isolated from the main one, which protects the regulator from outside, 2/3 pitch windings ; avoids excessive neutral currents and ensures low waveform distortion.

Voltage accuracy : From no load to full, cosØ 0.8
: at constant revolving speed is ±1.
Transient Voltage Dip : Below 18% when applying the full load at cosØ 0.8
Single Phase Running : Power equal to 0.85 times the three phase stated in the nameplate
Frequency : 50/60HZ.

Voltages : Standard alternators are equipped with a main winding with 12 or 4 terminals, star with neutral connection, Special voltages available on request

Manual Voltage Adjustment : ±5 % of the nominal value. It is possible to use an external reostat for remote control adjustment.

Wave Form : The wave form of the voltage at the load and applying a balanced linear three phase load with a harmonic residual less than 4 %. Lower value can be on request

Radio Frequency Interference : Normally of G degree according to VDE 0875 standard, N and K degree available on request

Ratings : They refer to the following conditions : ambient temperature not higher than 40 deg .C, altitude not over 1000 meter a.s.l. continuous duty cos 0.8.

Operating In Particular Environmental Conditions : Altitude higher than1000 meter a.s.l., it is necessary a de-rating of 4 % each 500 meter of increase. If the ambient temperature exceed 40 deg.C. it is necessary to de-rate 4% each 5 deg. C of increase.

Overloads : 10% for one hour every 6 hours. Short overloads may even be very high(2.I times the rated current).

Accessories and Special Features : Control panel, air filter, EMI filter, SAE adaptor, special voltages. Other special features are available on request.

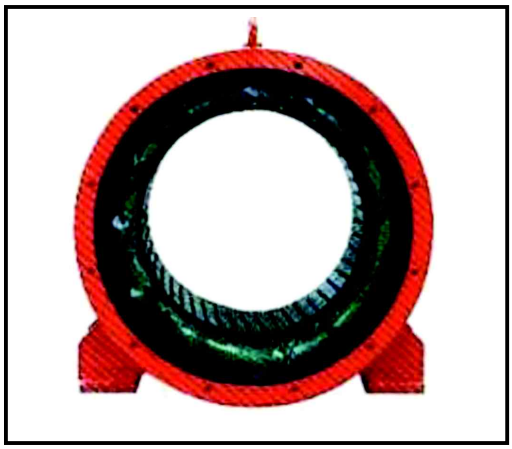


Figure. Frame and Stator assembly

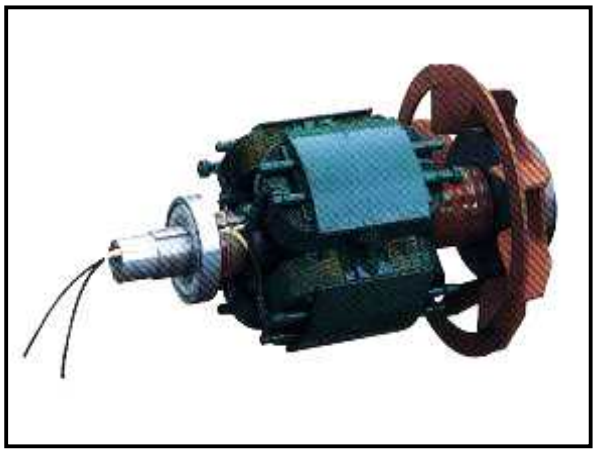


Figure. Rotor Assembly

Figure. Exciter Rotor/Exciter Stator

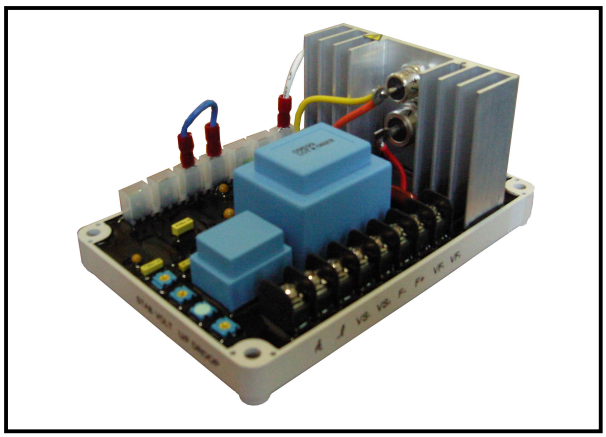
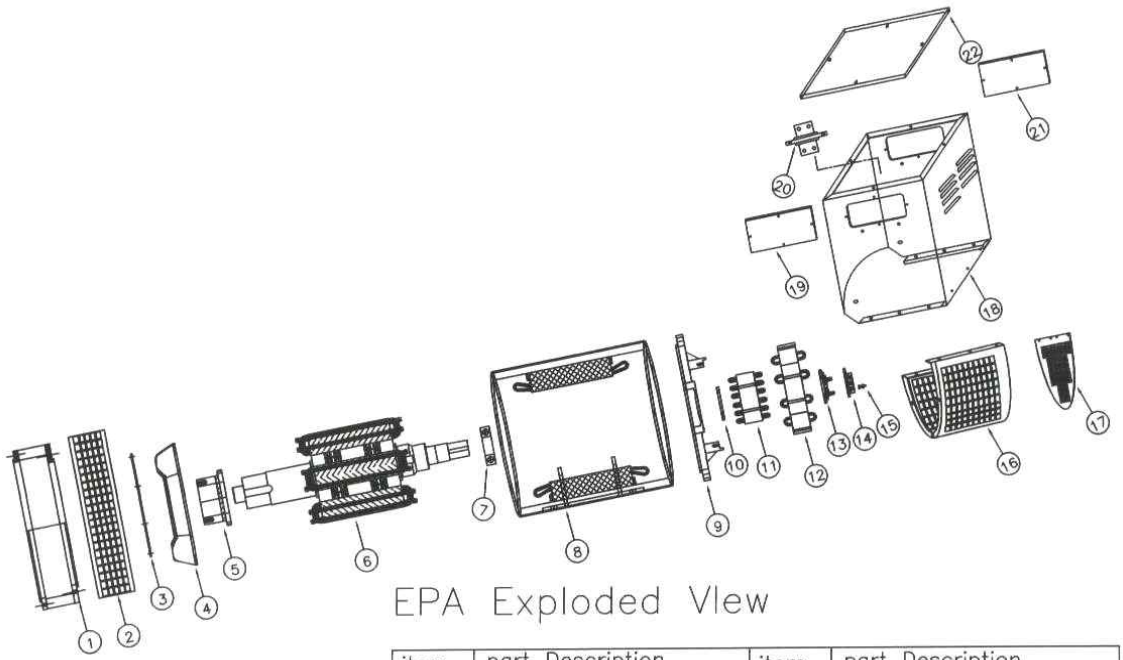


Figure. Automatic Voltage Regulator



item	part Description	item	part Description
1	Adapter	13	Diode Bracket
2	Screen Assembly	14	Exciter Bridge Assembly
3	Disc Plate	15	Diode
4	Fan	16	Rear Screen
5	Drive Hub	17	Rear Screen Cover
6	Main Rotor Assembly	18	Conduit Box
7	Rear Ball Bearing	19	Plate Cover
8	Main Stator Assembly	20	Load Terminal
9	Rear Bracket	21	Plate Cover
10	Ex- Ring	22	Conduit Box Cover
11	Exciter Rotor	23	
12	Exciter Stator	24	

Figure 2-13. Alternator Construction

2.7 Vibration Isolation

All generator sets are fitted with vibration isolators which are designed to reduce vibration being transmitted from the rotating mass of the generator set to the foundation of which the generator set is mounted. Vibration isolators are switched to suit the particular duty and are fitted between the engine alternator feet and the base-frame. Alternatively, on larger models the vibration isolators are fitted between the base-frame and the foundation.

2,8 Fuel Tank and Base Frame

On sets up to approx. 600KVA, the design of the base frame incorporates an integral fuel tank with a capacity of approximately 8 hours operation. The tank is provided with fittings to facilitate either manual or automatic filling. The base frame is manufactured from heavy gauge sheet steel and welded to form a rigid assembly. On larger machines a separate fuel tank is required to provide the fuel supply. A separate fuel tank is required to provide the fuel supply. A separate fuel tank can be supplied on request.

SECTION 3 TECHNICAL SPECIFICATION

1. EASTPOWER GENERATOR SET ◆ Standard Type

Genset Model		EPG-60	EPG-90	EPG-130	EPG-170	EPG-200	EPG-250
MAKER		EASTPOWER CO., LTD					
Ratings(KW), Standby/Prime	60HZ	60/55	90/82	130/118	170/155	200/180	250/225
	50HZ	48/44	70/64	100/90	145/132	176/160	225/205
Generator		Revolving Field Type					
Voltage		380/220V, 416/208V, 440/220V					
Phase & Wire		3Ph 4W					
Frequency		50/60 [HZ]					
RPM		1500/1800 [RPM]					
Pole		4 POLE					
Power Factor		0.8 (Lagging)					
(%)		89 %	93%				
Insulation		H CLASS					
Wiring		Y					
Excitation		Brushless Self Excitation					
Cooling Method		Fan					
Bearing		Single Ball Bearing					
Ventilation Class		I P 2 1					
Model		P034TI	DB58	D1146	D1146T	DE12T	P086TI	P126TI-3
Maker		DAEWOO Heavy industries and machinery Co., Ltd.						
Rated Output (PS) Standby / Prime	1800	82/75	95/87	143/130	202/170	270/245	303/279	375/343
	1500	65/57	80/73	116/105	160/145	226/205	270/240	343/304
RPM		1500/1800						
Bore x Stroke [mm]		102×100	102×118	111×139	111×139	123×155	111×139	123 x155
No. of Cylinder		4 Cylinder	6 Cylinder					
Governor		Mechanical RSV					Electronic	
Displacement [L]		3,268	5,785	8,071	8,071	11,051	8,071	11.051
Lube Oil Capacity [L]		6.5	19	15.5	15.5	23	15.5	23
Fuel Consumption [L/Hr]	1800	15.6	18.1	26.6	35.1	49	56.8	68.2
	1500	12.5	15.3	20.8	27.	41	48.4	59.6
Starting Motor [KW]		4.5	4.5	4.5	4.5	6.0	6.0	6.0
Battery		120AH X 2				150AH × 2		
Lub Oil Type		CD or CE Class by API Rule						
Cooling System		Radiator Water Cooling Type						
Starting Type		Electric Starter DC 24V						
C W Capa.[L]		8.5	12	14	14	19	14	19
Aspiration		Turbo	Naturally		Turbo		Turbo & Inter-cooler	
Combustion System		Direct Injection						
Rotating Direction		Counter Clockwise from rear						

ITEM		EPG-275	EPG-300	EPG-330	EPG-360	EPG-400	EPG-450	EPG-500	EPG-550	EPG-610	EPG-660	EPG-700	EPG-750
MAKER		EASTPOWER CO., LTD											
Ratings(KW) Standby/ Prime	60HZ	275/ 250	300/ 270	330/ 300	360/ 327	400/ 364	450/ 409	500/ 455	550/ 500	610/ 550	660/ 600	700/ 636	750/ 682
	50HZ	245/ 223	250/ 227	290/ 260	320/ 288	370/ 320	400/ 360	440/ 400	480/ 436	528/ 480	-	600/ 546	660/ 600
Generating		Revolving Field Type											
Voltage		380/220V, 400/231, 415/240V, 440, 220V, 220/127V, 480V, 460V											
Phase & Wire		3Ψ 4W											
Frequency		50/60 [HZ]											
RPM		1500/1800 [RPM]											
Pole		4 POLE											
Power Factor		0.8 (Lagging)											
(%)		93~95%											
Insulation		H CLASS											
Wiring		Y											
Excitation		Brushless Self Excitation											
Cooling Method		Fan											
Bearing		Single Ball Bearing											
Ventilation Class		I P 2 1											
Model		P126TI	P126TI-II	P158LE-2	P158LE-1	P158LE	DP158LC	DP158LD	D180LA	D180LA	DP222LA	DP222LB	DP222LB
Maker		DOOSAN INFRACORE Heavy Industries and Machinery Co., Ltd.											
Ratings [PS] (Standby/ prime)	1800	405/ 378	465/ 422	491/ 447	546/ 498	602/ 547	697/ 634	756/ 687	836/ 760	899/ 817	1002/ 911	1063/ 967	1126/ 1023
	1500	370/ 328	-	437/ 399	492/ 444	563/ 494	610/ 555	693/ 630	750/ 682	832/ 756	-	903/ 821	983/ 894
RPM		1500/1800											
Bore x Stroke [mm]		123 x 155		128 x 142									
No. of Cylinder		6		8					10		12		
Governor		Electronic											
Displacement [L]		11.051	11.051	14,618	14,618	14,618	14,618	14,618	18.273	18.273	21.927	21.927	21.927
Lube Oil Capacity[L]		23	23	28	28	28	22	22	34	34	40	40	40
Fuel Consumption [L/Hr]	1800	76.5	82.5	91.3	103	115.7	123.8	139.6	154.1	165.3	179	192.8	203.8
	1500	66.2	-	75.9	86.1	102.9	110.9	127.8	135.4	149.5	-	162.7	172.8
Starting Motor [KW]		6.0	6.0	7	7	7	7	7	7	7	7	7	7
Battery		150AH × 2		200AH × 2									
Lub Oil Type		CD or CE Class by API Rule											
Cooling System		Radiator Water Cooling Type/Heat Exchange Type											
Starting Type		Electric Starter DC 24V											
C. W Capa. [L]		19	19	20	20	20	20	20	21	21	23	23	23
Aspiration		Turbo & Inter-cooler											
Combustion System		Direct Injection											
Rotating Direction		Counter Clockwise from Rear											

SPECIFICATIONS OF CONTROL PANEL(1/2)

- Mounted Control Panel type

Item	Specifications	Digital Type	Analog Type
Meters & Gauges	Voltmeter	○	○
	Amperemeter	○	○
	Wattmeter	○	△
	Frequency & Tachometer	○	○
	Running Hour Meter	○	○
	Coolant Temp. Gauge	○	○
	Lube Oil Pressure Gauge	○	○
	Lube Oil Temp. Gauge	○	○
	Battery Voltmeter	○	○
Control Button & Switchs	Emergency Stop Button	○	○
	Lamp Test / Reset Button	○	○
	Voltage/Ampere Select S/W	○	○
	Off / Run / Auto	○	○
Circuit Breaker	Low Oil Pressure	○	○
	High Coolant Temperature	○	○
	Overspeed	○	○
	Overvoltage Relay (EOVR)	○	△
	Undervoltage Relay (EUVR)	○	△
	Overcurrent Relay (EOCR)	○	△
	Ground Overcurrent Relay (EOCGR)	△	△
	Starting Failure	○	○
Cummunica-tions Functions	Remote Control	Dry contact signal & computer control	Dry contact signal & computer control
	Remote Monitoring	Remote monitering by computer program	Remote monitering by computer program

Note) 1. "○" : Standard. "△" : Option. "×" : Not Available

2. The above specification is based on the standard set mounted control panel type.

☞ Specificatios are subject to change without prior notice.

SPECIFICATIONS OF CONTROL PANEL(2/2)

- Self Standing Control Panel type

Item	Specifications	Digital Type	Analog Type
Meters & Gauges	Voltmeter	○	○
	Amperemeter	○	○
	Wattmeter	○	○
	Frequency & Tachometer	○	○
	Running Hour Meter	○	○
	Coolant Temp. Gauge	○	○
	Lube Oil Pressure Gauge	○	○
	Lube Oil Temp. Gauge	○	○
	Battery Voltmeter	○	○
Control Button & Switchs	Emergency Stop Button	○	○
	Lamp Test / Reset Button	○	○
	Voltage/Ampere Select S/W	○	○
	Off / Run / Auto	○	○
Circuit Breaker	Low Oil Pressure	○	○
	High Coolant Temperature	○	○
	Overspeed	○	○
	Overvoltage Relay (EOVR)	○	○
	Undervoltage Relay (EUVR)	○	○
	Overcurrent Relay (EOCR)	○	○
	Ground Overcurrent Relay (EOCGR)	△	△
	Starting Failure	○	○
Cummunica-tions Functions	Remote Control	Dry contact signal & computer control	Dry contact signal & computer control
	Remote Monitoring	Remote monitering by computer program	Remote monitering by computer program

Note) 1. "○" : Standard. "△ " : Option. "×" : Not Available

2. The above specification is based on the standard set self standing control panel type.

☞ Specificatios are subject to change without prior notice.

3. LUBRICATING OIL RECOMMENDATIONS

3.1 TYPE OF OIL

The industrial diesel engine should be lubricated with a good quality oil conforming to API CD or CE class specifications All he major oil companies formulate oils to the above specifications.

3.2 Grade Of Oil

Use oil of : (When the sump heater is not installed)

SAE10W/30	:	for starting temperatures below - 15°C (without sump heater)
SAE15W/40	:	for starting temperatures from - 15°C to 0°C
SAE30	:	for starting temperature from - 0°C to 30°C
SAE40	:	for starting temperature above - 30° C

Note) Doosan Infracore Co., Ltd. provides you with SAE15W/40 for four seasons as standard.

3.3 Oil Change Periods

Generally, lubricating oil should be replaced for every month that involves consecutive operation or for every 200 hours of operation, whichever is shorter. For the emergency generator set, the oil should be replaced twice a year. However, the oil and oil filter should be replaced after the first 20 hours of operation. For details, refer to the Operation & Maintenance Manual of each engine.

As the oil deteriorates, it is essential that the following parameters must not be exceeded all the oil change point, i. e. 200 hours

1. The viscosity of the oil must not increase by more than 10cSt at 100°C
2. The total base number of the oil should not reduce to less than 50% of the value of new oil.
3. The flash point of the oil should exceed 1%
4. The water content of the oil must not exceed 1%
5. The fuel content of the oil must not exceed 1%
6. Oil samples should be taken from the mean sump oil level of the engine.

3.4 Engine Operation

Excessive periods of idling or repeated cold starts should be avoided. as they will cause excessive dilution of the oil by fuel, requiring more frequent oil changes and dangerously lowering the flash point of the oil

Should there be a lubricating oil supply problem, or if the fuel being used contains more than 0.5% sulphur, Daewoo Heavy industries Limited must be consulted to give advice in selecting a suitable grade.

⚠ Warning/Danger/Important

Non-compliance with these instructions will invalidate the warranty offered with the generator set, and may result in damage to the engine.

4. Cooling Water Recommendations

⚠ Warning/Danger/Important

do not remove the drain plug from the cylinder block or the cooling water cap from the radiator before the cooling water at high temperature is depressurized.
Before removal, always stop the engine and wait for the cooling water to cool.
Avoid skin contact with antifreeze by wearing hand protection.

4.1 Diesel Engine Cooling System

The cooling system og an engine contains many different materials e. g. cast iron. aluminum, copper, solder, rubber(various types) To maintain these materials in good condition and free of corrosion it is essential to use a very good quality coolant.

4.2 Additives To Water

To maintain the diesel engine. additives should not only be used to prevent the engine from corroding, but also used to prevent the cooling system from eroding the system.

Due to the complexity of the cooling system it is necessary to use an additive that contains a balanced package of corrosion inhibitors. Under no circumstances should an additive containing nitrites. borates, phosphates, chromate, nitrates, or silicates be used, as these materials are not compatible with the materials used in the cooling system.

When mixing the anti-freeze with the water always follow the manufacturer's recommendation, which is to add the anti-freeze to the water to the correct concentration before adding to the engine cooling system. Mixing water to anti-freeze can lead to blockage of water passages and subsequent loss of water flow causing overheating.

4.3 Water Quality

The water that is mixed with the additive must have the following characteristics :

Chloride less than 80 PPMV (parts per million by volume)
Sulphated less than 80 PPMV
Total hardness less than 200 PPMV
pH of water between 7 to 7.5 (i.e. neutral to slightly alkaline)

4.4 Maintenance Of Cooling Water

The water/anti-freeze mixture should be regularly replaced in operating engines once a year

In engines used for standby duty. it is essential to maintains the water/anti-freeze mixture at the correct alkalinity level i. e. the pH should not increase above 7.5. in winter or cold seasons, the ratio of water and antifreeze should be as per the manufacturer's details or adjusted according to the following table based on the ambient temperature. A hydrometer only shows the proportion of ethylate glycol, and is not a measure of protection against corrosion.

Do not add more that 50% anti-freeze to water in summer. You should mix cooling water with 35% anti-freeze and 3-5% DCA4 inhibitor. The cooling water system should be filled slowly. Take

care to remove the air completely from the cooling system especially the cylinder heads. and check after filling the level of the cooling water and running the engine for a short time.

Ambient Temperature(″C)	Cooling Water(%)	Anti-freeze(%)	Specific gravity(+20°)
Over -10	85	15	1.048
-10	80	20	1.048
-15	73	27	1.048
-20	67	33	1.048
-25	60	40	1.055
-30	56	44	1.060
-40	50	50	1.063

⚠ **Warning/Danger/Important**

Failure to follow the above recommendations may result in engine damage and will invalidate the engine warranty

5. Fuel Recommendations

Fuel should be wholly hydrocarbon oil derived from petroleum. with which small quantities of additives may be incorporated for the improvement of ignition or other characteristics and should conform to ASTM D975, DIN 51601, BS 2869, Use ASTM 975 No 2-D fuel if you expect temperatures above -7°C(20°F) and ASTM975 No. 1-D fuel it you expect temperatures below -7°C(20°F). if fuels other than the above classes are considered. the operator must consult Daewoo Heavy industries & Machiner Co., Ltd. and ensure that the appropriate grade of approved fuel is used.

5.1 Fuel Requirements

⚠ **Warning/Danger/Important**

if the following recommendations are not followed. the warranty of the generator set will be invalidated and the diesel engine may be seriously damaged.

DIN 51601		Test method
1. Specific gravity (15°C)	0.0815-0.0855 g/m/	DIN 51757
2 Kinematic viscosity (20°C)	1.8-10cSt(m/m/s)	DIN 51550
3. Pour point summer winter	Fuel with the pour point at 0°C-12°C	DIN 51428
4. Flash point(Abel-Pensky)	55°C or move	DIN 51755
5. Volatility UP to 350°C UP to 250°C	 85% or more (volume) 65% or more (volume)	DIN 51751
6. Other contents * Water * Sulphur * Ash * Solid particles (0.015mm or greater) * Carbon residue(10% distilled)	Max 0.1%(weight) Max 0.50%(weight) Max 0.02%(weight) Max 50mg/l Max 0.1%(weight)	DIN 51582 DIN 51768 DIN 51575 DIN 51592 DIN 51551
7. Cetane number	45 or more	
8. copper corrosion test (100°C)	Max 1	DIN 51759

The specifications contained in the following recommendations do not always applied to all nations. Therefore, if you use fuel whose specification does not conform to the recommended valle, contact the Service Department of Engine manufacturer Daewoo Heavy Industries & Machinery Co., Ltd.

BS 2869 (A1, A2)		Test method
1. Kinematic viscosity (37.8°C)	1.6-6.0cSt (mm/s)	IP 71
2. Pour point Summer Winter	 Fuel with the pour point at 0°C Fuel with the pour point at -7°C	IP 219
3. Flash point (Pensky-Martens)	55°C or more (volume)	IP 34
4. Volatility Up to 350°C	90% or more (volume)	IP 123
5. Other contents Water Sulphur Ash Deposit	 Max 0.1%(volume) Max 0.50%(volume) Max 0.01%(volume) Max 0.01%(volume)	 IP 74 IP63 IP4 IP 53
6. Carton residue (10% distilled)	Max 0.1%(weight)	
7. Cetane number	45 or more	IP 41
8. Copper corrosion test (100°C)	Max 1	IP 154
ASTM D975 (1-D, 2-D)		Test method
1. Kinematic viscosity (37.8°C)	1.4-4.3cSt (mm/s)	-D 455
2. Pour point	Refer to the note b) of ASTM	-2500
3. Flash point	37.8°C or more (1-D) 51.7°C or more (2-D)	-93
4. Volatility min 282°C min 338°C	 90% (volume)	 -D 86
5. Other contents Water Sulphur Ash Deposit	 Max 0.1%(volume) Max 0.71%(weight) Max 0.02%(weight) Max 0.01%(volume)	 -D 95 -D 1551 -D 482 -D 473
6. Carbon residue (10% distilled)	Max 0.35%(weight)	
7. Cetane number	45 or more	-D 524
8. Copper corrosion test (100%)	Max 3	-D613 -D130

SECTION 4 INSTALLATION

1. General Installation Criteria

As an introduction to the contents of this manual, the following are the basic criteria to be observed during installation ;

1) Proper choice of the generator set in relation to the needs of the electric load and the operating environmental conditions (temperature altitude, humidity) for which it is designed.
2) Proper dimensioning of the room housing the set(s). If the installation is in a closed environment, to allow good accessibility to the engine and the generator for normal maintenance operations and for possible repairs.
3) Again for a closed environmental, adequate combustion of the quantity of air necessary for combustion in the engine and for cooling(radiator and alternator) the generator set, as will as air (clean and fresh) for roon ventilation.
4) Correct use of fuels and lubricants.
5) Thorough attention to the problems connected with the safety of supervisory personnel or those persons involved in running the set.
6) Thorough attention to the problems connected with sound emissions.

It is always necessary to refer to the specific laws of each single country that govern individual aspects in different ways, and in particular :

* Noise
* Emissions
* operation in dangerous environments
* Limitations on installed power
* Electric systems and safety devices
* Amounts of fuel in areas designed for installation

⚠ Warning

The combustion engine includes components and fluids that during operation. are subjected to high temperatures and it is equipped with moving pulleys and belts : be careful when approaching this equipment! The final used must operate the generator set under the maximum safety conditions.

2. Lifting

Do not lift the generator set by the lifting eyes attached to the engines and/or alternator. These lifting eyes are only used during generator assembly and are not capable of supporting the entire weight of the generators. The mounting skid of each generator set includes four holes for attaching the lifting device. These holed are strategically placed to avoid damage to generator components by lifting cables and to maintain balance during lifting. In some cased, it may be necessary to remove protruding generator components (air cleamer) to avoid damage by lifting cables.

A four-point lifting method is necessary to lift the generator set.

To maintain generators balance during lifting, the lifting apparatus must utilize the four skid lifting holes mentioned in the previous paragraph. One method of lifting generators uses and apparatus of hooks and cables joined at a single rigging point. The use of spreader bars is necessary with this method to avoid damage to the set during the lifting procedure.

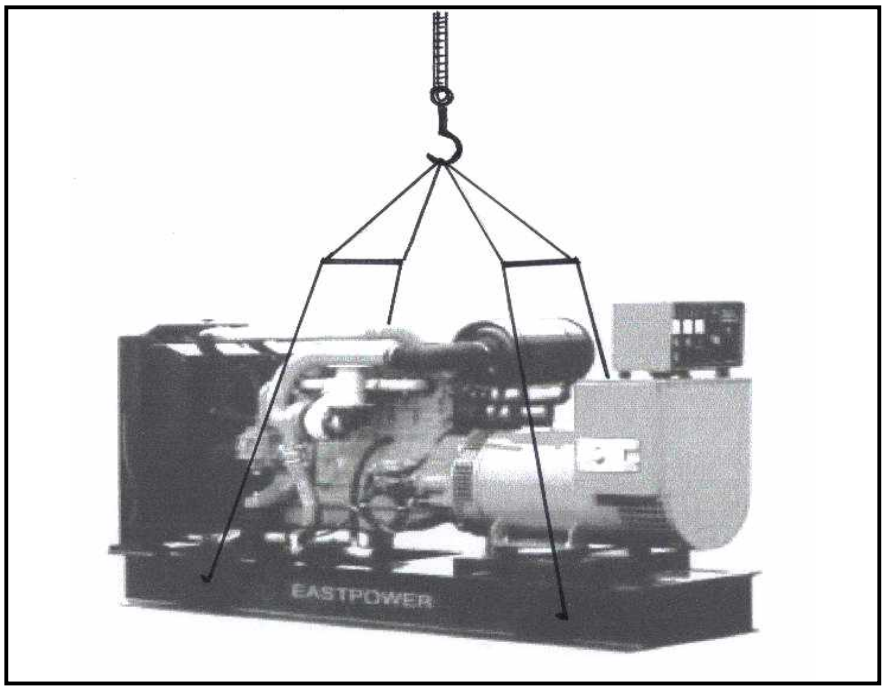


Figure 4-1 Typical Generator Set Lifting Apparatus

The spreader bars should be slightly wider than the generator skid so the set is not damaged by lifting cables and only vertical force is applied to the skid while lifting. The generator sets may also be lifted by placing bars through the skid lifting holes and attaching hooks to the ends of the bars.

A specially designed lifting fixture is often used to lift the larger standby generators. The fixture usually includes adjustable cables to adapt to different size generators and to compensate for unit imbalance.

In all cases, be sure the components of the lifting device (cables, chains, bars are properly sized for the weight of the generator set.

◆ Self-standing Fuel Tank

if using lifting rope or strap, protect the rope of strap from sharp fuel tank edges. The lifting contactor determines the type and suitability of the separate fuel tank lifting device.

Lift the self0standing fuel tank ad one unit if shipped separately from the generator set. Use lifting eyes if equipped on separate fuel tank.

In all other cases, remove the mounting hardware between the generator set and self-standing fuel tank. Lift the generator set and self-standing fuel tank. Lift the generator set and self-standing furl tank separately.

It is not necessary to drain fuel tank when lifting just the fuel tank.

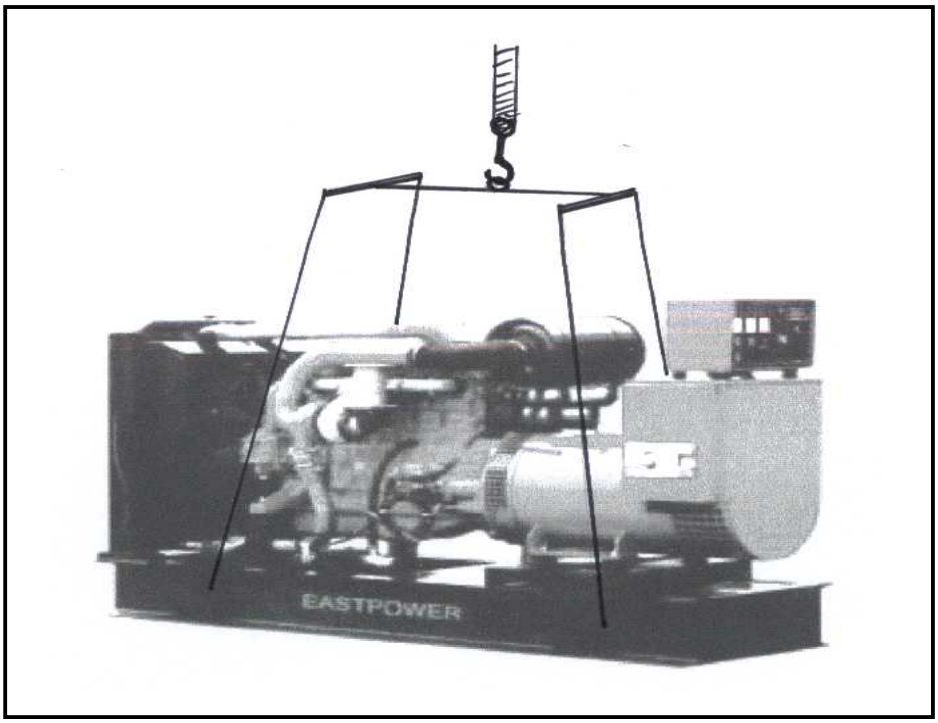


Figure 4-2. Generator Set lifting Fixture

3. Transportation Of The Generator Set

The transporting vehicle/trailer must be sized for the dimension and weight of the generator set. Consult the set dimensional drawing or contact the factory for information(weight, dimensions) relevant to planning transport.

The overall height of a generator set in transit(including vehicle/trailer) must not exceed 4.5m(13.5ft) unless special hauling permits are obtained (check Federal, State, and local laws prior to transporting). Larger units should be transported on low-boy-type trailers with a deck height of 635mm(25in) or less to meet clearance requirements.

Large (unpacked) generator with radiators with radiators should be loaded with the radiators should be loaded with the radiator facing the rear to reduce wind resistance while in transit.

Radiators with free-wheeling fans must have the fan secured to prevent rotation that might introduce flying objects to the radiator core or fan blades.

Be sure the generator set is securely fastened to the vehicle/trailer and covered with a tarpaulin. Even the heaviest of units is capable of movement during shipment unless properly sized chain routed through the mounting holes of the skid chain routed through the mounting holes of the skid. Use chain tighteners to remove slack from the mounting chain. Cover the entire unit with a heavy-duty tarpaulin and secure tarpaulin to the generator or trailer.

4. Unloading

Before undertaking any handling operation, make sure that the equipment to be used is suitable and strong enough to perform the correct without any danger.

1) Maintain the slings in the correct positions and at the correct angles.
2) Use the lifting eyes provided on the equipment
3) Lower the generator set in a position as close as possible to its position in service.
4) Check that thee floor is capable of taking the weight of the set without difficulty.
   If not, lay planks for its removal to the building of the plat.

4-1 Inspection Of Materials

It is advisable, upon receipt of the generator set, to check that the materials correspond to the indications given on the delivery docket accompanying the shipment. If damage is noted, the carrier must be advised immediately.

4-2 Preliminary Installation of Generator Sets

To avoid inopportune star-up, etc. during preliminary installation of automatic control generator sets and when making electrical connections, it is necessary to carry out the following instructions :

1) Start-up batteries disconnected from the generator set,
2) Operation control mode on the panel in the "STOP/OFF" position.

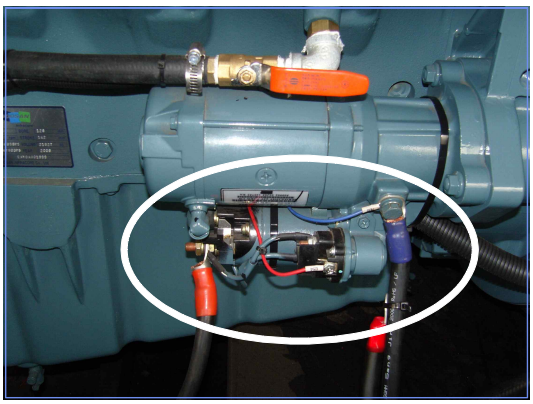


Fig. 4-8 View of Starter disconnected batteries

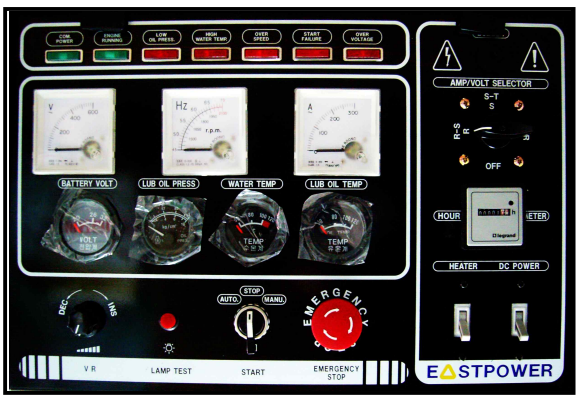


Fig. 4-9 Control Panel (Analog Type)

4-3 Safety Standards For Diesel Engines

The room and the installation of the generator set (bed frame, tank, air intake gas exhaust) must comply with the "Safety Standard' in force in the country in which the set is installed.

5 Location

Selecting a location for the generator set can be the most important part of any installation procedure. Always locate the generator set in an area that will provide adequate ventilation and physical protection for the unit. For the purposes of simplifying maintenance and inspection requirements it will also be important to place the generator set in such a position so as to allow easy movement around the machine without overcrowding.

The location should be clean dry and have good drainage capabilities. Should the location be outdoors protect the generator set with a weatherproof enclosure (option).

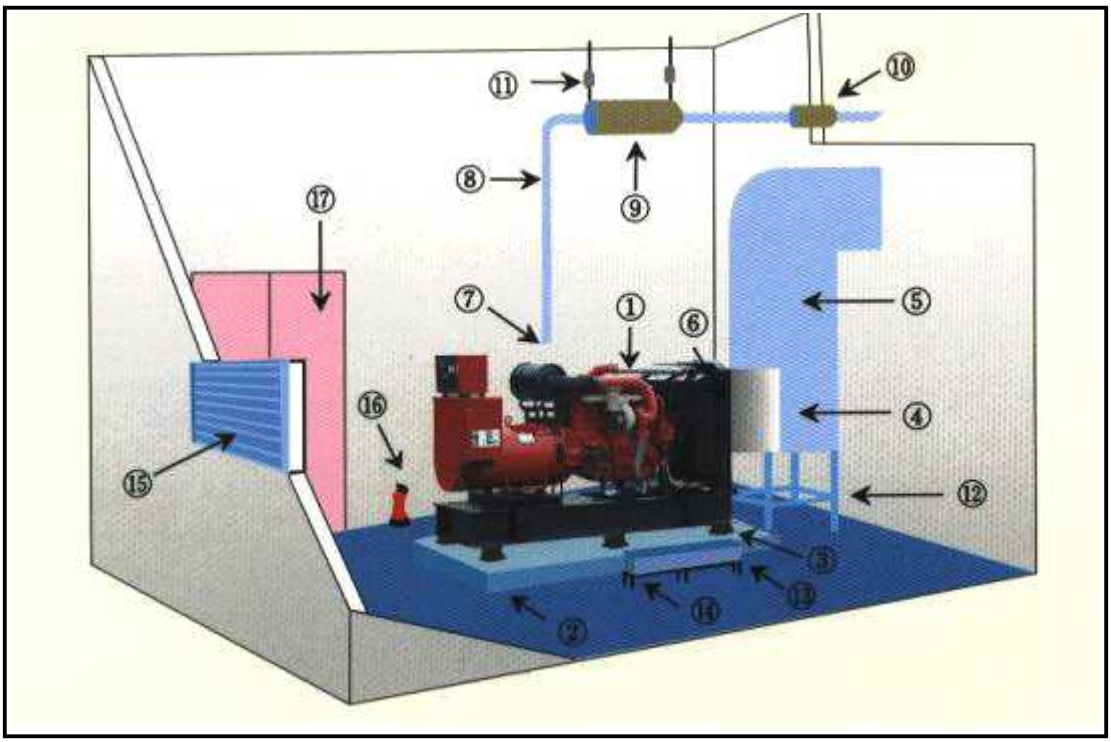


Fig 4-10 Typical Installation of Standard Generator Set

1. Generator set
2. Foundation
3. Vibration Isolator Spring
4. Exhaust Air Duct Pipe
5 Exhaust Air Duct
6. Canvas
7. Bellows
8. Exhaust Gas
9. Silencer
10. Thimble
11. Vibration Hanger
12. Exhaust Air Duct Support
13. Battery
14. Battery Support
15. Intake Air Grill
16. Fire Extinguisher
17. Door

Another point to keep in mind is the space required to undertake major overhaul or service operations. In some cases it may be necessary to remove major components.

6. Foundation

The foundation may be located on soil, structural steel, building floors etc., provided the total weight of the foundation and generator set package does not exceed the allowable bearing load of the support. Allowable bearing loads of structural steel can be obtained from Engineering Handbooks while local building codes will provide the allowable gearing loads for different types of soil.
Doors must be seized to allow access in and out for the complete generator set and outlet vents can often be made removable to floor level to provide an access point.

Certain types of soil, such as fine clay, loose sand or sand bear the ground water level, are particularly unstable under dynamic loads and will require a foundation of substantially

increased area, Specific information concerning the bearing opacity of the soil at site should be obtained from local sources and not exceed local building code standards.

The area of the supports which carries the load must be adjusted to accommodate the surface material. To determine the pressure(p) exerted by the generator set, devide the total weight(W) by the total surface area(A) of the rails or pads.

$$P = W/A \ (kPa = kg/m^3, \ psi = lb/in^2)$$

The pressure imposed by the generator set weight must be less than the load carrying capacity of the applicable material noted in the previous chart.

Refer to Figure 4-11. A reinforced concrete pad makes the best foundation. A pad with sufficient mass in proportion to the size of the generator set will provide the rigid support necessary to minimize deflection and vibration. Typically this should be 150 mm to 300mm(6 to 12′) deep and a mass at least equal to that of the generator sets.

The foundation depth should be sufficient to attain a minimum weight equal to the generator set wet weight.

Liquid	g/㎤	lb/u.s. gal	Specific Gravity
Water/Glicol	1.030	8.55	1.030
Water	1.000	8.30	1.000
Lub Oil	0.916..	7.60	0.916.
Light Diesel	0.855	7.10	0.855
Gas Oil	0.800	6.70	0.800

Table 4-1 Liquid weight

Typical Material	Safe Bearing Load		
	kg/㎠	kPa	psi
Rock Hardpan	5.0	482	70
Hard clay, gravel and coarse sand	4.0	386	56
Loose Medium sand and medium clay	2.0	193	28
Loose fine sand	1.0	96.4	14
Soft clay	0-1.0	0-96.4	0-14

Table 4-2 Safe Bearing Load

FD = W/DxBxL
FD = Foundation Depth, m (ft)

W = Total wet weight of generator set , kg(lb)
D = Density of concrete, kg/㎥(lb/ft^3) (2403 kg/㎥ or 150lb/ft^3)
B = Foundation width, m (ft)
L = Foundation length, m (ft)

The foundation length and width should exceed the length and width of the generator set a minimum 300mm (1ft) on all sides.

Suggested concrete mixture by volume is a : w : 3 ; of cement, sand aggregate with a maximum 100mm (4 inch) slump with a 28 day comprehensive strength of 270kg/㎠ (3000 psi).

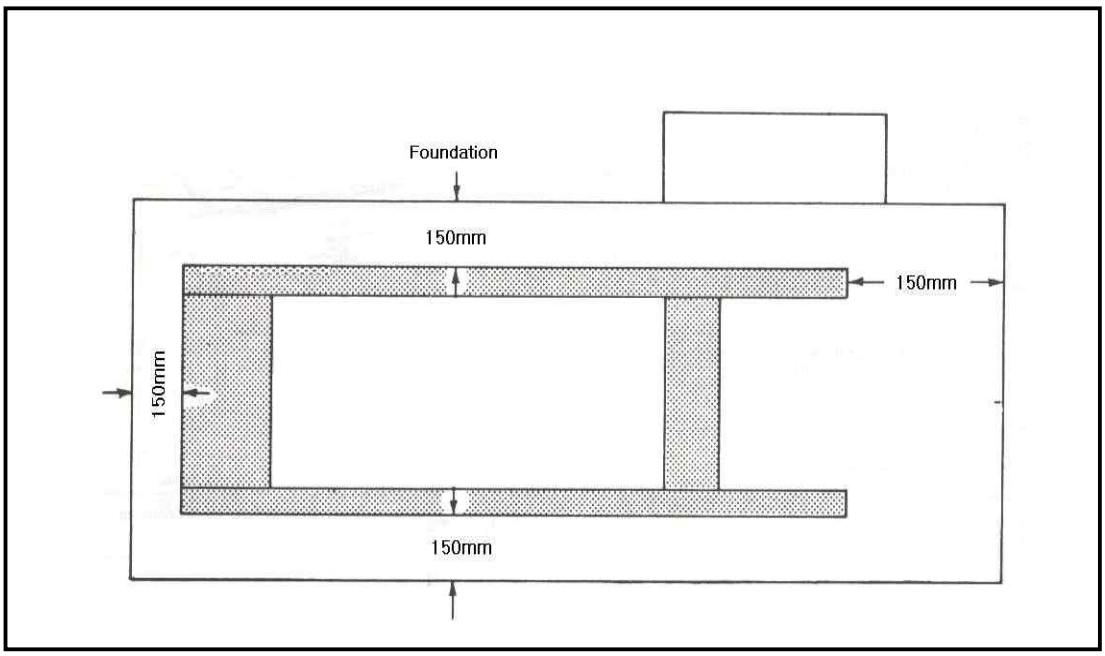
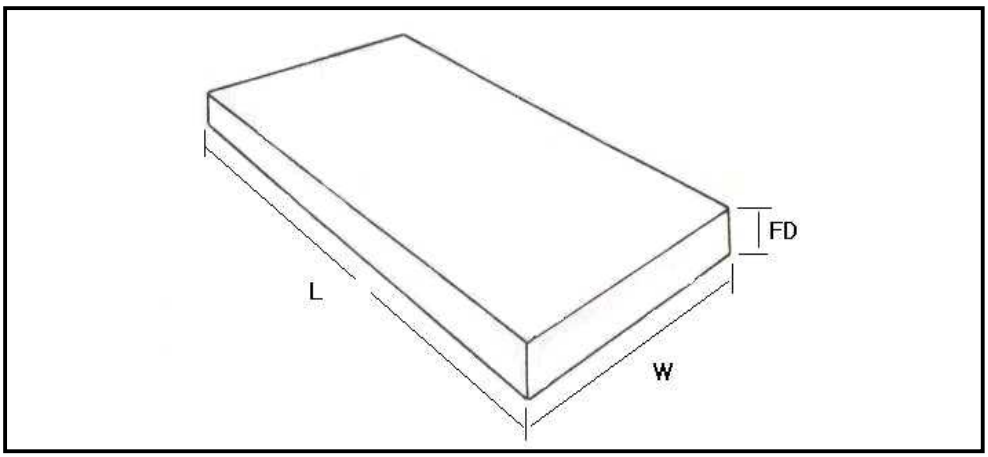


Fig. 4-11 Foundation

Table 4-3 Recommended Foundation Dimension of Generator Set



(a)

Foundation							
Model	Length (L)	Width (W)	Depth (FD)	Model	Length (L)	Width (W)	Depth (FD)
EPG-60DD	2500	1140	250	EPG-400DD	3300	1450	300
EPG-90DD	2600	1140	300	EPG-450DD	3300	1450	300
EPG-130DD	2600	1140	300	EPG-500DD	3500	1450	300
EPG-170DD	2900	1220	300	EPG-550DD	3500	1450	300
EPG-200DD	2900	1150	300	EPG-610DD	3700	1450	300
EPG-250DD	3200	1240	300	EPG-660DD	3700	1450	300
EPG-275DD	3200	1240	300	EPG-700DD	3700	1450	300
EPG-300DD	3300	1450	300	EPG-750DD	3900	1450	300
EPG-320DD	3300	1450	300				
EPG-360DD	3300	1450	300				
EPG-400DD	3300	1450	300				

(b)

The Foundation should be reinforced with 150mm (6″) by 150mm (6″) square No.8 gauge (about Φ 4mm) steel wire fabric or equivalent, horizontally placed 150mm (6″) apart.

An alternate method of reinforcing is to place No.6 reinforcing bars on 300mm (12″) centers horizontally Bars should clear the foundation surface a minimum of 75mm(3″).

When effective vibration isolation equipment is used, the depth of floor concrete required is that needed for structural support of the static load. If isolators are not use아 generator set vibration will be transmitted to the facility floor and the floor must be capable of supporting 125% of the generator set weight. This additional capability is required t withstand vibratory loads.

If the generator set is to operate in parallel with other units, the possibility of out-of-phase parallelling and resultant increased torque reactions demand a stronger foundation. This foundation must be designed t withstand a weight which is 3.0 tines the dead weight of the generator set.

* ISOLATION

It is advisable that the principal foundation of each, machine rests on bedrock or solid earth; completely independent of other foundations cement work, walls or operating platforms.

This layout drawing, Figure 4-19, shows a typical generator set installation. It is meant as a guide only. Full details of the particular unit should be assessed and the installation layout designed to suit the requirements of your site.

When installing the generator set of the sound-proof type and weather-proof type generator set depends upon the formula of standard type's, and should be fully larger than the length and width of the enclosure joint to the bed frame of the generator set.

1) The main circuit breaker position can vary according to the requirements of the installation. Main Circuit Breaker is mounted beside the control panel as a standard specification. It may also be mounted remote from the generator set.

Figure 4-12 Standard Mounted Type Panel Control and main Circuit Breaker

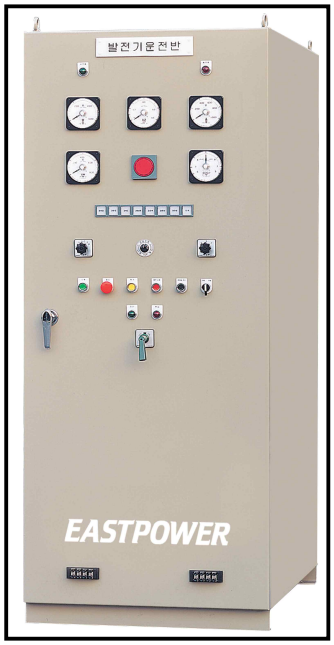


Figure 4-13 Self-standing Type Control Panel

Table 4-4 Main Circuit Breaker Capacity, 60Hz/50Hz (A)

Main Circuit Breaker Capacity, 60Hz/50Hz (A)					
Model	220V	380V	Model	220V	380V
EPG-60DD	225/225	125/125	EPG-400DD		800/800
EPG-90DD	400/350	225/225	EPG-450DD		1000/900
EPG-130DD	630/500	400/300	EPG-500DD		1000/1000
EPG-170DD	630/630	400/400	EPG-550DD		1200/1200
EPG-200DD	800/700	400/400	EPG-610DD		1200/1200
EPG-250DD	1000/900	630/500	EPG-660DD		1200/1200
EPG-275DD	1000/1000	630/630	EPG-700DD		1200/1200
EPG-300DD	1200/1200	630/630	EPG-750DD		1200/1200
EPG-330DD	1200/1200	800/700			
EPG-360DD	1200/1200	800/800			

* Based on Mounted Control Panel type and MCCB
* Not applied to MCCB

2) The Control panel can be made to allow wall mounting

3) Depending on cable routing to the generator set room and terminal points at the generator set, the power cables may be installed for bottom entry from ducts or floor trenches.

4) Operating should be provided behind the alternator for incoming cold air and directly in front of the radiator for outgoing hot air. The cold air first passes over the alternator, then the engine picking up radiant heat as if passed, It then passes through the radiator and is discharged through a duct to the outside of the generator set room.

* VIBRATION

The design of the generator set is such that only minimal vibration is transmitted to the foundation. Anti vibration is mounts are fitted Between engine / alternator and bed frame or in larger capacity generator sets vibration isolators are mounted below the bed frame.

In generator room situated on upper floors special attention to vibration isolation is necessary. Often spring type vibration isolators will be needed.

It is necessary to ensure that building structures are capable of supporting the generator set, fuel storage and accessories.

Table 4-5 Recommended anti-vibration Spring Capacity of Generator Set

Recommended anti-vibration Spring Capacity of Generator Set			
Model	Capa(kg) x Q'ty	Model	Capa(kg) x Q'ty
EPG-60DD	350 x 6	EPG-400DD	450 x 10
EPG-90DD	450 x 6	EPG-450DD	450 x 10
EPG-130DD	450 x 6	EPG-500DD	450 x 10
EPG-170DD	550 x 6	EPG-550DD	550 x 10
EPG-175DD	550 x 6	EPG-600DD	550 x 10
EPG-200DD	550 x 6	EPG-660DD	650 x 10
EPG-250DD	550 x 6	EPG-700DD	650 x 10
EPG-275DD	550 x 6	EPG-750DD	650 x 10
EPG-300DD	550 x 6		
EPG-330DD	450 x 10		
EPG-360DD	450 x 10		

7. Grounding

Ground in accordance will any applicable National Local or Federal Standard, Code, or Regulation. Regulations vary and advice should be sought from the local supply utility s to their requirements.

The factory connects the frame If the alternator to the frame of the generator set. Therefore the complete mass of the generator set is at the same potential,. The connection if required of the generator winding star point/neutral to earth is the responsibility of the installation technicians.

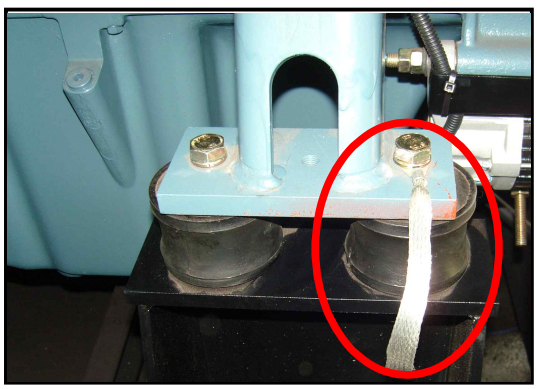


Figure 4-12 Standard Mounted Type Panel Control and main Circuit Breaker

Figure 4-13 Self-standing Type Control Panel

8. Air Inlet

An ample flow of clean cool air is refired to support combustion and dissipate heat, These conditions will drastically effect both engine life and performance. Apparently 70% of the heat value of the heat value of fuel consumed by an engine will be rejected to the cooling system and exhaust.

Normally the inlet can be taken from the area surrounding the installation site. However in some cases the condition of the air surrounding the machine may warrant ducting the air from the outside or another room.

When it does become necessary duct air in the air filter should remain mounted to the engine as opposed to a remote mounting (such as on a roof or in another room). This will eliminate the possibility of dirt leaking through the duct work upsteam of the air filter.

When outside are is used, proper duct design is important. The pressure drop through the duct must be as low as possible to maintain high density.

The length, size and shape of the duct must be carefully planned to minimize air flow restriction, The installation should be planned so that the shortest possible intake duct is used and a pre-cleaner is installed on the outside inlet opening.

As duct length increase, the diameter should also be increased. Diameter should also be increased when bends or elbow are added.

Only seamless or welded steel piping should be used for ducting.

A useful rule for evaluating an intake system design is that the total pressure drop to the engine-mounted air cleaner should be 50mmH_2O of water or less.

Overhead ducts should be supported on spring hangers to isolate pipe vibrations from the building frame. Long intake ducts may require supports attached to the byilding structure. When rigidly mounted in this manner, a flexible connection should be included between the engine manifold and the duct to prevent transmission of vibration and stain on the air cleaner, Good quality rubber hose should be used secured by heavy-duty clamp that tighten over the full circumference.

When air is drawn from the equipment room, make certain that it is fume free. Where a choice is available, the pickup should be low, near floor level rather than high near ceiling.

Regardless of system used, the combustion air intake should be located in a place where the air is as clean and cool as practical.

Table 4-6 Air Consumption of Generator Set

Model	Radiator Type (m³/min)	Model	Radiator Type (m³/min)
EPG-60DD	226	EPG-400DD	1000
EPG-90DD	289	EPG-450DD	1125
EPG-130DD	359	EPG-500DD	1247
EPG-170DD	455	EPG-550DD	1247
EPG-175DD	455	EPG-610DD	1509
EPG-200DD	535	EPG-660DD	1509
EPG-250DD	802	EPG-700DD	1509
EPG-275DD	802	EPG-750DD	1855
EPG-300DD	1000		
EPG-330DD	1000		
EPG-360DD	1000		

⚠ Note

Value in figures and tables given in this manual a re for reference purposes only, so allowances should be made in consideration of the real site conditions and the specifications of the generator set.

9. Cooling And Ventilation

The radiant heat given off by the engine, generator and exhaust piping can result in a temperature high enough to adversely affect operating and maintenance personnel or the performance of the generator set. Locate the generator set in a room or area that this heat as well as the heat radiated from the engine cooling water by the radiator.

Point to remember in any type of installation :

1) Ensure that hot air is positively discharged fro, the building by fitting a flexible connection between the radiator and the duct (optionally available). The flexible connector reduces vibration transmitted to the exhaust duct during operation, prevent the hot air passing through the exhaust duct outdoors.

2) The size of the operating should be calculated to ensure that excessive restriction is not imposed on the flow of cooling air. Operating should at least be as big as the table 4-7 but, as a guide, an area of 150% of the core area of the radiator should be allowed for.

3) For weather protection, louvers should be fitted t the intake and exhaust openings. These can be either of the fixed or movable type, the latter being opened automatically by air cylinder hydraulic cylinder or electric motor when the generator set starts(optionally available).

Manually operates moveable louvers may be acceptable in some cases. but they are not acceptable for automatic standby units. Radiator air could not be depended upon to move the louver vanes.

Table 4-7 Recommended Air Inlet/Outlet Section, Radiator Cooling

Model	Air Inlet Aperture Min. Section (㎡)	Air Outlet Duct Min. Section (㎡)
EPG-60DD	0.541	0.451
EPG-90DD	0.541	0.451
EPG-130DD	0.541	0.451
EPG-170DD	0.756	0.63
EPG-175DD	0.756	0.63
EPG-200DD	0.886	0.738
EPG-250DD	1.145	0.954
EPG-275DD	1.145	0.954
EPG-300DD	1.145	0.954
EPG-330DD	1.918	1.598
EPG-360DD	1.918	1.598
EPG-400DD	1.918	1.598
EPG-450DD	1.918	1.598
EPG-500DD	1.918	1.598
EPG-550DD	1.918	1.598
EPG-610DD	1.918	1.598
EPG-660DD	2.374	1.978
EPG-700DD	2.374	1.978
EPG-750DD	2.374	1.978

Note) Exhaust Air Speed : 12m/s with a cooling fan in use
ΔT (indoor) : 10℃, radiator cooling type

10. Exhaust

The exhaust system is used to direct exhaust gases to non-confirmed areas and reduce the noise to the tolerable levels. When designing a system the main objective is to minimize back pressure. Excessive back pressure in an exhaust system will create horsepower loss and increase the engine operating temperature.

Excessive back pressure usually results from ones or a combustion of the following:

* Exhaust pipe diameter too small
* Exhaust pipe too long
* Too many sharp bends in the exhaust system
* Too small an exhaust silencer or incorrect silencer design.

The permissible back pressure of the EastPower Gen-set is limited to 600mmAq. and the exhaust gas pipes usually consist of seamless smooth steel tubes.

Where the bend radii are requires in an exhaust system, always make the radius at least 150% of the inside diameter of the pipe.

As most exhaust system designs are governed by the physical characteristics of the building or room in which they are located it is of the utmost importance that the exhaust pipe be routed in a path offering the least amount of turns or bends so not to increase back pressure by any more than absolutely necessary.

The data in the table 4-9 shown below refers to smooth 90 % curved bends with an average

Table 4-8 Recommended Least Exhaust Ducts.

Model	Quantity x Diameter (Exhaust Ducts)			Model	Quantity x Diameter (Exhaust Ducts)		
	Basic (≤5m)	≤20m	≤30m		Basic (≤5m)	≤20m	≤30m
EPG-60DD	1 x 65A	1 X 100A	1 X 100A	EPG-400DD	1 x 125A	2 x 125A	2 x 150A
EPG-90DD	1 x 65A	1 X 100A	1 X 100A	EPG-450DD	1 x 125A	2 x 125A	2 x 150A
EPG-130DD	1 X 100A	1 X 100A	1 X 100A	EPG-500DD	1 x 125A	2 x 150A	2 x 150A
EPG-170DD	1 X 100A	1 X 100A	1 X 125A	EPG-550DD	1 x 125A	2 x 150A	2 x 150A
EPG-175DD	1 X 100A	1 X 100A	1 X 125A	EPG-610DD	1 x 125A	2 x 150A	2 x 175A
EPG-200DD	1 X 100A	1 X 100A	1 x 125A	EPG-660DD	1 x 125A	2 x 150A	2 x 175A
EPG-250DD	1 X 100A	1 X 100A	1 x 125A	EPG-700DD	1 x 125A	2 x 150A	2 x 175A
EPG-275DD	1 X 100A	1 X 100A	1 x 125A	EPG-750DD	1 x 125A	2 x 150A	2 x 175A
EPG-300DD	1 x 125A	2 x 125A	2 x 125A				
EPG-330DD	1 x 125A	2 x 125A	2 x 125A				
EPG-360DD	1 x 125A	2 x 125A	2 x 150A				

bending radius that is 1.5 times the internal diameter d and represent the equivalent length l_e of the corresponding rectilinear pipe having the same bend load loss.

For each band, these equivalent lengths are to be added to the actual rectilinear part of the ducts in order to compute the back pressure with the relative exhaust.

Be sure that all pipes are will supported and that springs or other dampers are used at points of high vibration. Due to the heat radiation of the exhaust pipes it is recommended that all piped be located at least 250mm from any combustible material. Wrapping the exhaust pipes with high temperature insulation or installing fitted insulating sections will aid in preventing excessive heat radiation within the room.

The thimble guard which is greater than 150mm in diameter should be installed where the ducts passes through a wall or a roof.

As shown in Figure 4 - 26 bevel the end of the pipe at a 30° - 45°. Should the pipe end be horizontal, bevel the pipe from the top back to the bottom. This will not only reduce the noise levels at the outlet but also minimize entrance of precipitation on horizontal pipes.

Table 4-9 Equivalent length of the corresponding rectilinear pipe

Internal Diameter d (mm)	Equivalent Length l_e (m)	Internal Diameter d (mm)	Equivalent Length l_e (m)
40	0.5	125	2.2
50	0.7	150	2.8
65	0.9	200	4.0
80	1.2	250	5.4
100	1.7	300	6.7

The level or height at which the outlet is situated should be sufficient to prevent fumes and odors from becoming an annoyance or potential hazard, Also, an exhaust pressure actuated rain cap is recommended for use on vertical outlet pipes.

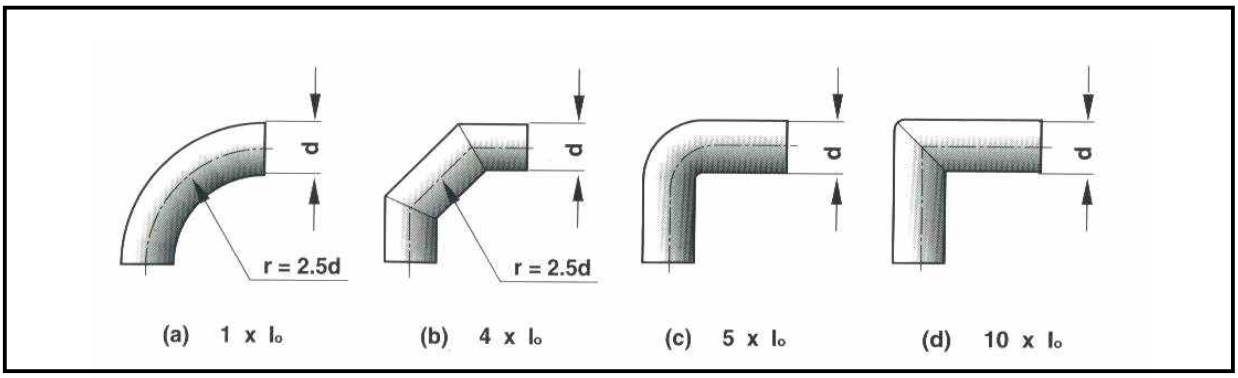


Figure 4-24 Different Types of Bends Compared in terms of Equivalent Lengths

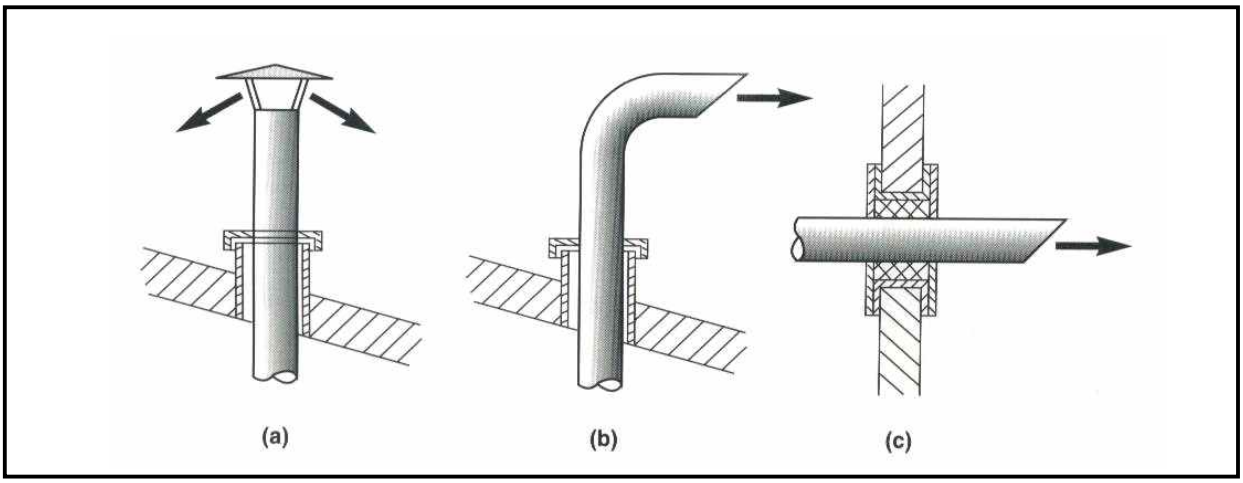


Figure4-25 Examples of External Exhaust Installations with Protection against Water Filtrations

Any long horizontal or vertical piping should include water legs and drain traps at their lowest points so that water does not reach either the silencer or the engine. It is also recommended that a alight slope downward from the silencer to the water leg or rain trap be added to assure the proper removal of water.

By locating the silencer as close to the engine as possible you will be able to minimize the noise level in the exhaust piping.

Each machine installation should have it's own exhaust system and should not be connected to a system accommodating more than one generator set as the possibility of exhaust gas and condensation back-flow may cause permanent damage to an idle engine.

⚠ Warning/Danger/Important

Inhalation of exhaust fumes is potentially lethal. The correct installation of exhaust gas cannot be over emphasized. Additionally, prolonged exposure to engine exhaust noise can be damaged to hearing. A Generating set should never be operated without a fully installed exhaust system and all personnel in close vicinity should wear ear protection.

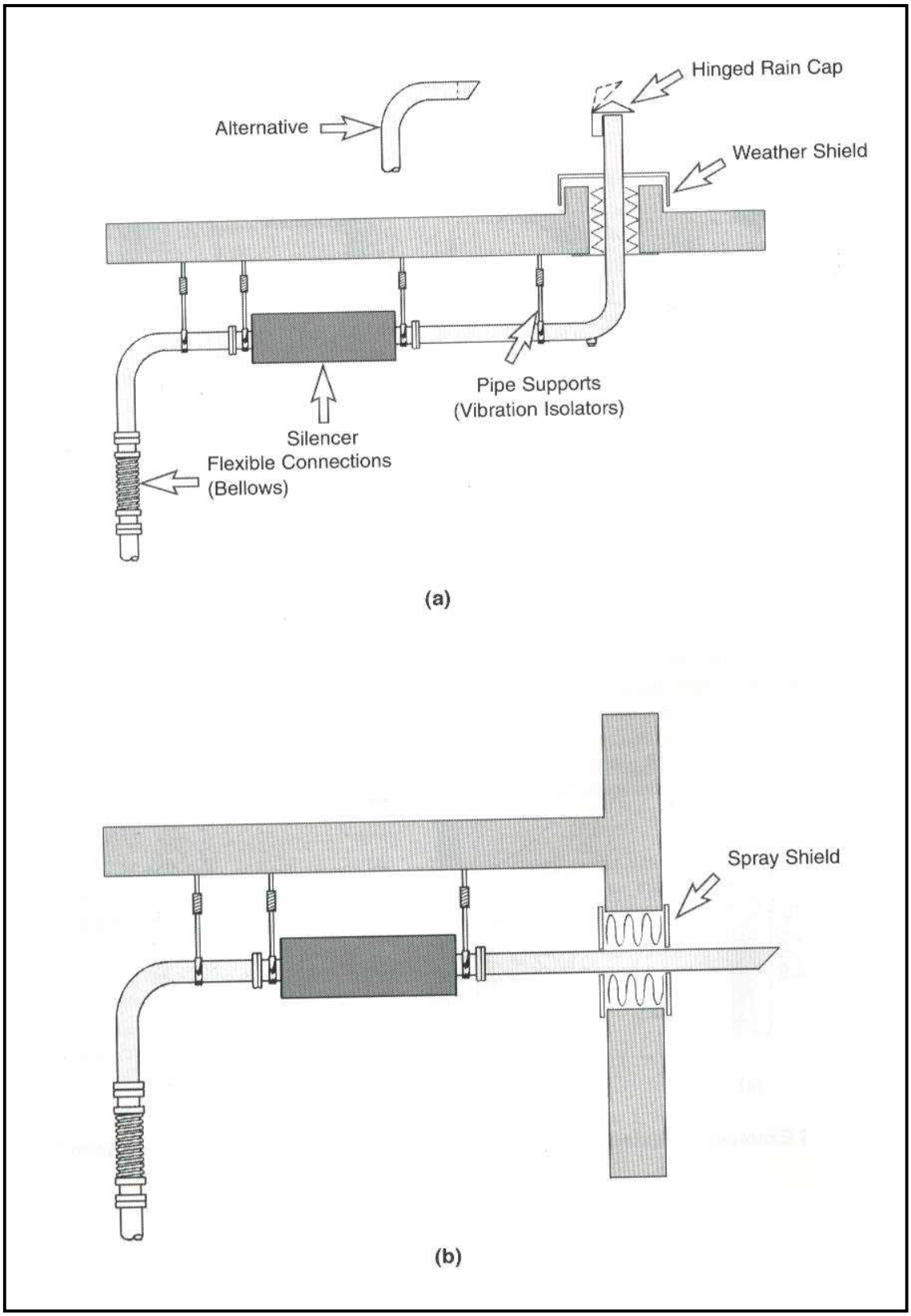


Figure 4-26 Typical Exhaust Installations

11. Flexible Connections

The exhaust piping should be connected via a flexible joint located on the engine exhaust outlet. This connection serves three proposes

1) It relieves some of the weight of the exhaust piping from the engine.
2) It isolates the exhaust system from vibration.
3) It allows for some movement of either the generator set or exhaust system components.

Long piping runs should be divided into sections separated by additional flexible connections. This will also compensated for the expansion and contraction of the piping itself due to temperature change.

Any insulation material used for a flexible connection should allow for the expansion and contraction of the connections, due to temperature change

12. Fuel Systems

The fuel system must be capable of delivering to the engine a clean and continuous supply of fuel. When designing a fuel system, always incorporate the requirements of Local, State, federal, Codes, Which may pertain to either the fuel system or the electrical apparatus utilized by the system.

12.1 Diesel Fuel Bulk Storage

Bulk fuel storage is the most preferable method of providing fuel supply. This method allows bulk fuel purchases which will minimize dirt and contamination possibilities, especially when the fuel is seldom used. The bulk storage tank may be located either above or below the ground

A vent must be installed on the main tank to relieve the air pressure created by filling the tank as will as preventing a vacuum whin the tank as furl is consumed. The tank bottom should be rounded and placed on a 2 degree tilt to assure a concentrated settling of both water and sediments.

At the low point of other tank a drain valve should be installed to remove water that may accumulate due to condensation.

Underground tank must be pumped periodically to remove this water. This is best done by placing a tube through the filter pipe to the low end of the tank. For these reasons it is imperative that the tank be placed in or on stable ground to assure that eventual setting does not change the location of the low point of the tank. Burying the tank below the frost line will help in avoiding seasonal setting.

Another consideration to be made when locating the main tank is the height difference between it and the auxiliary tank (day tank). Do not place either tank at a level that would exceed the pump lift capabilities. Also keep in mind the possibilities of pressure drop created by excessive horizontal distances and pipework bends.

The fuel delivery line carrying fuel to the engine and fuel return line for carrying excessive furl back to the tank should be no smaller than the fitting sizes on the engine. For longer runs or extremely low ambient temperature increases the size of these lines to ensure adequate flow.

The fuel lines can be made of any fuel compatible material such as steel pipe or fuel line tube that will tolerate ambient conditions. Return piping should be or the same material and one size larger.

The fuel delivery line should pick up the fuel from a point no lower than 50mm from the bottom of the tank. If at all possible locate this line at the end of the tank opposite that of the return line and at the high end of the tank. Flexible fuel lines should be used at point between the tank and engine(preferably adjacent to the generator set) to avoid the potential damage that could be created by vibration.

12.2 Day Tanks

All standard generator sets are provided with a day tank, built in the bed frame, This day tank will supply a fuel directly. The day tank is recommended to be used under the standby emergency condition..

12.3 Filters and Traps

Clean fuel will aid in attaining maximum engine life and dependability. Primary filters are recommended for use between the engine filters and the transfer pump. Water and sediment traps should also be included upstream of the transfer pump. however, on border line pump installations do not increase fuel line restrictions to a point exceeding the capabilities of the pump.

13. Fire Precautions

When designing a generator set installation the following points should be noted :

1) In the room should be designed so that there is an easy escape route for operating personnel in the event of fire within the room.
2) A recommended type of the extinguisher or fire extinguishing system should be provided to fight the fire.
3) Gravity operated fire valves operated by fusible links, mounted above the engine, can be installed in the fuel lines.

Table 4-12 Capacity of Daily Tank built in the Bed Frame

Model	Capacity(Liter)	Model	Capacity(Liter)
EPG-60DD	160	EPG-360DD	300
EPG-90DD	160	EPG-400DD	300
EPG-130DD	160	EPG-450DD	300
EPG-170DD	215	EPG-500DD	300
EPG-175DD	215	EPG-550DD	370
EPG-200DD	195	EPG-610DD	370
EPG-250DD	215	EPG-660DD	390
EPG-275DD	215	EPG-700DD	390
EPG-300DD	300	EPG-750DD	390
EPG-330DD	300		

4) The room should be kept clean and free from accumulated rubbish which can be installed in the fuel lines.

14. Starter Batteries

Resistance in the starting circuit has a significant effect on the starting ability of the engine. Therefore, the batteries should be located as close as possible to the generator set (batteries should be accessible for servicing)

Maintenance procedures should be carried out rigorously since the batteries have to be in perfect condition to start the diesel engine.

⚠ Warning/Danger/Important

Batteries give flammable gas. Do not smoke or create spark or naked flames adjacent to batteries.

- ▶ EPG-60DD ~EPG-130DD : 120AH X 2
- ▶ EPG-170DD~EPG-300DD : 150AH X 2
- ▶ EPG-320DD~EPG-750DD : 200AH X 2

15. Electrical Connection

Only fully qualified and experienced electrical technicians should be allowed to carry out electrical installation service and repair work.
The Electrical connection to the generator set should be made with flexible cable to prevent the transmission of vibration and possibile damage to the alternator or circuit breaker terminals.
If it is not convenient to use flexible cable throughout then a link box can be insulated close to the set with a flexible connection between it and the set.
The cable may be laid in a duct or on cable tray. When bending cable reference must be made to the recommended minimum bending radius.
No rigid connection should be made between the generator set and the cable support system, e. g. cable tray.
When single core cable are used the gland plate must be of non-ferrous material, e. g. aluminium, brass or a non metallic material.
The cable must be suitable for the voltage being used and adequately sized t o carry the related current with allowance made for ambient temperature method of installation, proximity of other cables, etc.
All connection should be carefully checked for integrity. Phase rotation must be checked for compatibility with the installation. This is virtually important when connection is made to an auto transfer switch. or if the machine is to be paralleled.

15.1 Protection

The cables connecting the genset with the distribution system should be protected by means of a circuit breaker, fuses or other means to disconnect the generator set in case of overload or short circuit.
When planning distribution system it is important to ensure that a balanced load is presented to your generator set. If loading on one phase is excessive in comparison t the other two phases this will cause overheating in the alternator windings, imbalance in the phase to phase voltage output and possible damage to sensitive 3 Phase equipment connected to the system. Ensure that no phase current exceeds that of the current rating of the genset.
It may be necessary to reorganize the electrical distribution system if a genset is to be connected to an existing installation.

15.2 Power Factor

The power factor (Cos phi) of the connected load should be determined. Power factors below 0.8 will overload the generator. The generator will provide it's kilowatt rating and will operate

satisfactorily from 0.8 to unity power factor.
Particular attention must be given to installation with automatic or manual power factor correction equipment to ensure that a leading power factor is not present under any conditions. This will lead to voltage instability on the generator output and may result in damaging over voltages.

⚠ Warning/Danger/Important

The load power factor compensator, for use with a commercial electric power source, should be automatically isolated while the generator set is in operation.

15.3 Grounding Requirements

Regulation vary and advice should be sought from the local supply utility as to their requirements. The factory connects the frame of the alternator to the frame of the genset therefore the complete mass of the generator set is at the same potential. The connection if required of the generator winding star point/neutral to earth is the responsibility of the installation technicians.

15.4 Alternator Re-connection

The alternator can be re-connected to suit different voltage ranges. Details of re-connection procedure are given in the alternator section. Be sure to check cables, circuit breakers, current transformers and ammeters are suitable before operation at a different voltage.

15.5 Parallel Running

When two or more generators are operating in parallel, depending on the type of generator circulation currents may occur if all neutrals are grounded or otherwise connected together.
Extra equipment will be required for the standard engine and alternator to allow satisfactory paralleling. Check with your supplier for details.

⚠ Warning/Danger/Important

Never work while the generator set is running. Stop the generator and open the circuit breaker on the power cable before working pm the alternator or it's connections.

Table Recommended Phase cable section

Phase cable section thickness (㎟) x cores							
Model	220V	380V	440V	Model	220V	380V	440V
EPG-60DD	35 x 1	35 x 1	70 x 1	EPG-360DD	95 x 2	120 x 2	240 x 3
EPG-90DD	35 x 1	70 x 1	120 x 1	EPG-400DD	185 x 2	185 x 2	240 x 3
EPG-130DD	70 x 1	120 x 1	95 x 2	EPG-450DD	185 x 2	185 x 2	240 x 3
EPG-170DD	185 x 1	185 x 1	150 x 2	EPG-500DD	120 x 4	185 x 2	185 x 4
EPG-175DD	185 x 1	185 x 1	150 x 2	EPG-550DD	120 x 4	185 x 2	185 x 4
EPG-200DD	185 x 1	185 x 2	185 x 2	EPG-610DD	120 x 4	120 x 4	240 x 4
EPG-250DD	95 x 2	95 x 2	240 x 2	EPG-660DD	185 x 3	185 x 3	300 x 4
EPG-275DD	95 x 2	95 x 2	240 x 2	EPG-700DD	185 x 3	185 x 3	300 x 4
EPG-300DD	95 x 2	120 x 2	300 x 2	EPG-750DD	185 x 3	185 x 3	300 x 4
EPG-330DD	95 x 2	120 x 2	300 x 2				

15.6 Start Up

Before starting the genset, see section 5 of this manual.

15.6 Control System

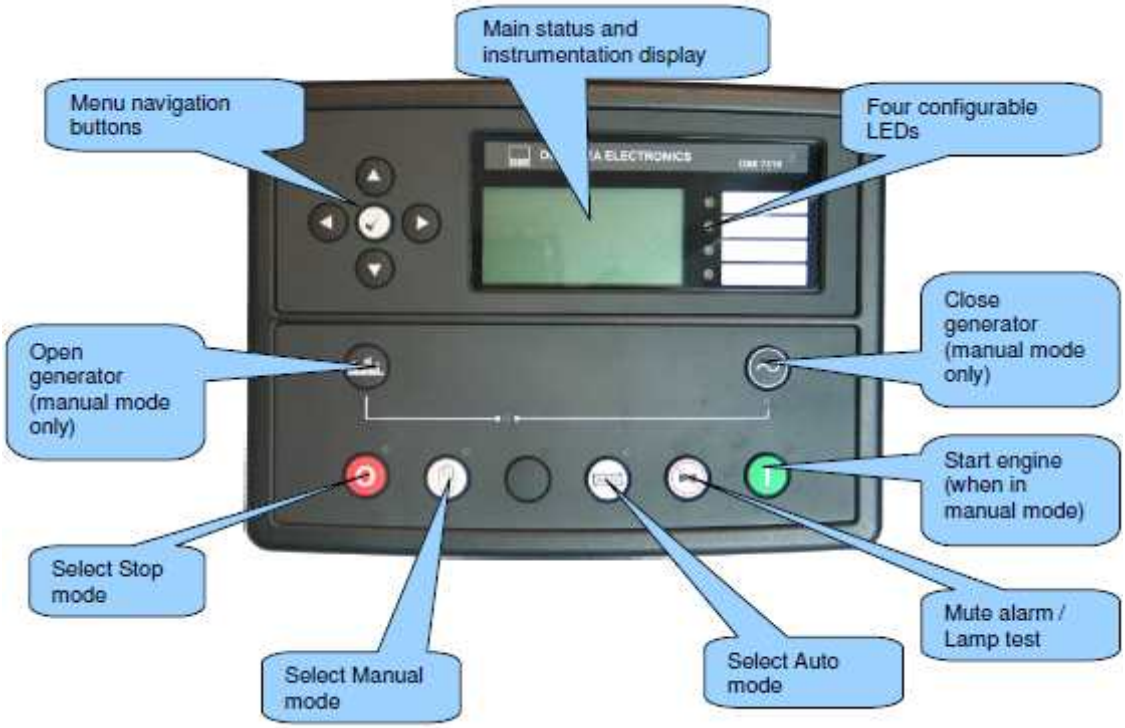
The Control System Consists of :-

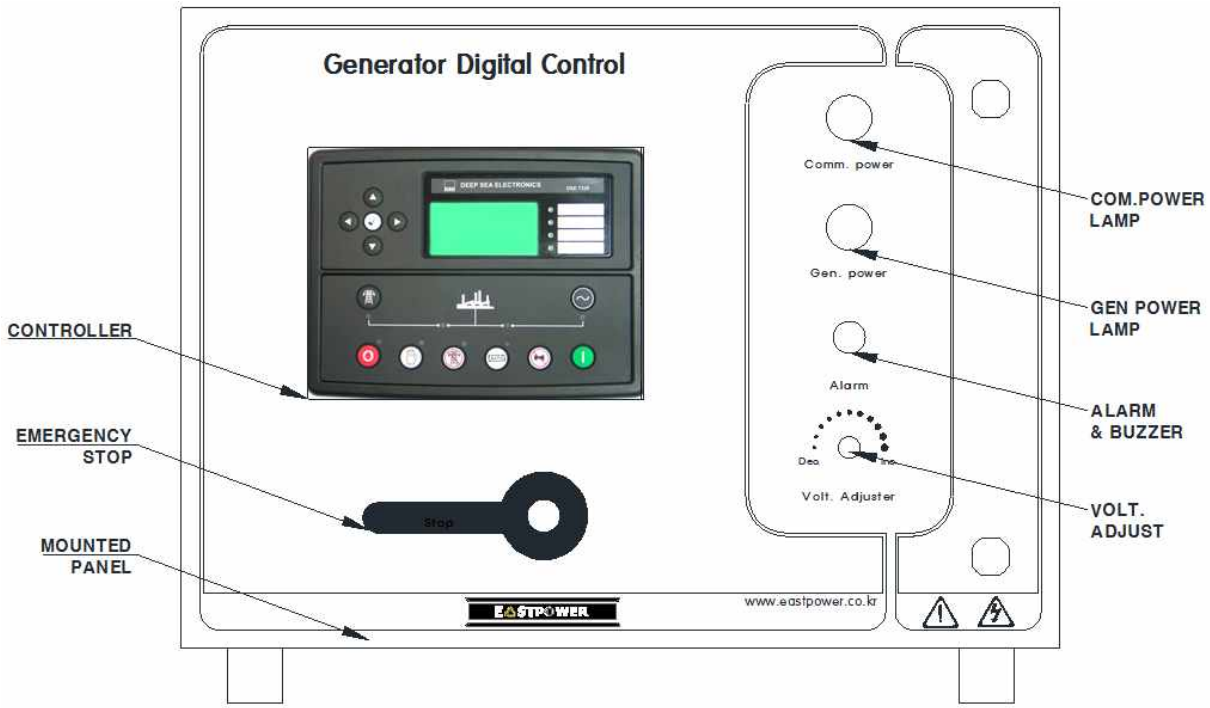
A) Set Mounted Control Panel providing a means of starting and stopping the Generator set, Monitoring its operation and output and causing the engine to automatically shut down in the event of a critical condition arising, e. g. low oil pressure, high coolant temperature.

B) An Alternator Circuit Breaker providing a means of switching the Generator output and automatically disconnecting the Generator output and automatically disconnecting the load in the even of overload.

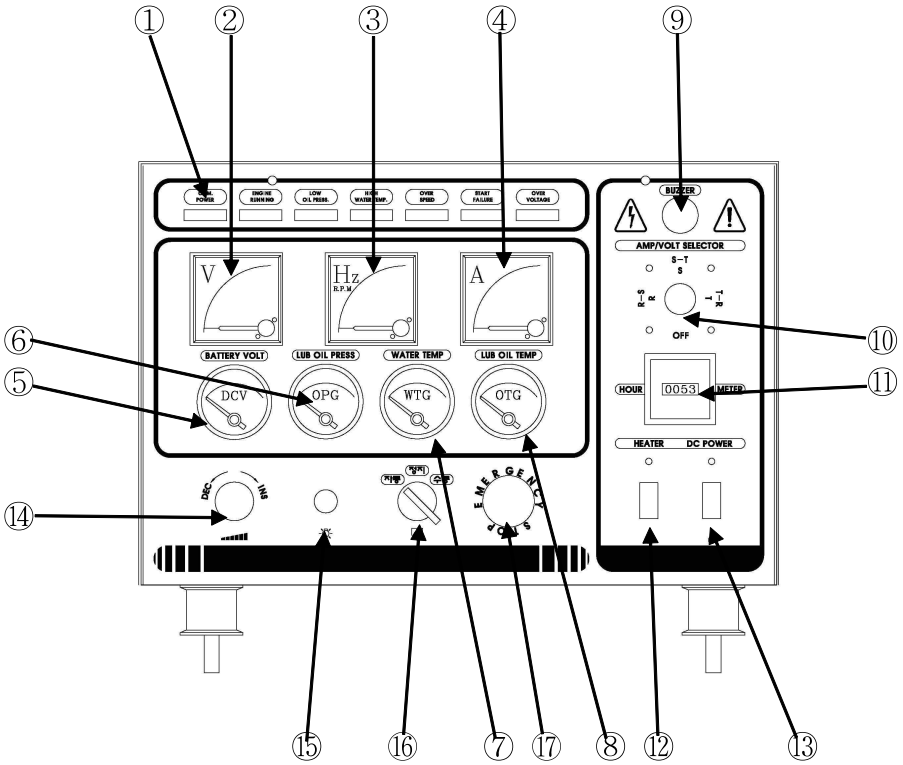
SECTION 5 CONTROL SYSTEMS AND OPERATIONS(DEEPSEA 7320)

1.1 Digital Control type(DEEPSEA 7320)





1.2 Analog control type



NO.	Componets	NO	Componets
1	Lamp	10	Amp/Volt Selector
2	Volt Meter	11	Hour Meter
3	Hz Meter	12	Heater Switch
4	Ampere Meter	13	DC Power Switch
5	Battery Meter	14	Volt. Adjuster
6	Lub Oil Press Meter	15	Lamp Test
7	Water Temp Meter	16	Manu/Auto/Stop S/W
8	Lub Oil Temp Meter	17	Emergency Stop
9	Buzzer		

5.2 **Control systems and operations** - for preparing of Operation

When preparing for operation there are a few precautionary measures to take, many of which are explained in the Safety and Installation section of this manual. These measures are a minimum of what must be achieved to for safe opiating conditions.

Before starting your machine be sure that it is positioned on a level surface so that proper liquid levels can are obtained. Check engine oil, radiator coolant, battery electrolyte and fuel levels.

Be sure that the Genset will be operated in well ventilated area with all exhaust fumes piped away.

⚠ Warning/Danger/Important

A. Before connecting batteries, ensure control panel is switched off.
B. Adequate grounding of the genset is necessary.
C. No smoke, use of open flames, filling fuel during operation, Spilled or vaporized fuel is strictly prohibited.
D. Never attempt to disconnect a load connection or maintenance while in operation.
E. Disconnect the battery when major service is being done.
F. As the battery system is negative earth, the negative connection should be disconnected first and reconnected last.
G. The cover of control panel should not be removed while in operation.
H. Always shut down the Genset and switch off circuit breaker prior to connecting on disconnecting load cables. Only start when a sound connection has been made,

5.3 Initial Start-up

The following procedure should be used to make the initial start-up of the Genset.
These steps are critical and must be followed closely to avoid complications in operating the Genset

1) Position the machine on a level surface so that proper amount of liquid can be added.
2) Check the engine oil and coolant levels replenishing if necessary.
3) Fill the tank.
4) Fill the battery with suitable electrolyte for the of batteries supplied, if not already wet charged.
5) Dispose of any insecure items or debris in the vicinity of the genset that may inhibit operation or could cause injury.
6) The following procedure should be used when starting the Generator set for the first time or when it has been out of service for a time for maintenance purposes.
(Note : The generator may be stopped at any time by selecting "STOP" position on the Control Switch)

1. Ensure any auxiliary AC supply is switched off elsewhere, e. g. for heaters or battery charger.
2. Ensure the circuit breaker is switched off.
3. Ensure the select switch is turned off "STOP" position.
4. Connect the batteries to the engine.
5. Prime the fuel system using the hand priming pump and bleed entrapped air from the fuel filter - see engine manual for details.
6. Turn on auxiliary AC supply, if appropriate.
7. If a battery charger is fitted when the supply is turned on the battery voltmeter reading will increase, indicating that he trickle charger is working.
8. If a water heater is fitted, after approximately 5 - 10 minuted, tightly touch the jacket water heater on the engine, this should be warm and water should have started to circulate by convection through the engine block.
9. Turn the select switch to right from position "OFF(STOP)" to crank the engine.
If engine does not start for more than 7 seconds, Turn the select switch to left from position "maun" to stop the engine.

Do not crank the engine for more than 5 - 7 seconds should the engine fail to start. Allow an interval of appropriately 10 seconds between cranking attempts, and the engine still not have started after four cranking attempts, refer to the should engine

manual to determine the cause of failure to start.

10. After the engine has been started check for any abnormal noise or vibration.
11. Check fluid leakage or high temperature.
12. Check the control panel for indications of abnormal particular, in particular above normal engine temperature or below normal oil pressure.
13. Immediately the engine reaches full operating speed the voltmeter should be checked to ensure that the voltage has reached the correct operating level. The voltage is factory set at the voltage regulator and needs no further adjustment, Should the output voltage be incorrect, Adjustment of the voltage should only be carried out by a qualified technician, Two means of voltage adjustment are available.

    - ▶ Fine adjustment - this is achieved by varying the setting of a potentiometer mounted inside the automatic voltage regulator which is fitted to the alternator terminal box.
    - ▶ Coarse adjustment - this is achieved by reconnecting the alternator windings at alternator terminal box. Details of these connections can be found in the Alternator Section This work should only be carried be a qualified technician.

14. The frequency output voltage should also be checked on the panel meter. No load frequency is approx 52Hz for 50Hz unit and approx 62.5Hz for 60Hz unit in case of mechanical GOV used engine.
15. When the generator is producing voltage check the phase rotation of the generator by connecting a phase rotation meters to the terminals on the generator side of the circuit breaker. (Caution : Do not close the circuit breaker). This check should be carried out by qualified technician and the result noted for use later if Genset is to be connected to an existing system.
16. After the voltage and frequency checks have been made, shut the machine down by putting the select switch to the "STOP(OFF)" position, connect the load and restart the operation.

⚠ **Warning/Danger/Important**

Always shut the gen-set down prior to connecting, or disconnecting, load cables. Only restart when a sound connection has been made.

5.4 Shutdown Procedure

To shut the Genset down, turn off the load using the circuit breaker, and put the select switch "STOP(OFF)" position. In case of an emergency where immediate shutdown is necessary the switch should burned to the position "STOP" immediately without disconnecting the load.

5.5 Normal Startup Procedure

On subsequent starts follow the procedure explained below. This start up procedure must be strictly adhered to ensure select switch is turned off Position "STOP".

1) make a visual check of the entire gen-set. Watch for signs of leaks from the engine fuel system, cooling system or lubrication seals.
2) Check the generator for obstructions in the cooling air ventilation screens.
3) Check the engine oil, water and fuel levels plenishing if necessary.

⚠ Warning/Danger/Important

4) Check the generator and control panel for heavy accumulation of dust and dirt, cleaning where necessary ad these can pose an electrical hazard or give rise to cooling problems.
5) Check the air filter restriction indicator (if fitted).
6) Check the condition and tension of the fan and alternator belts.
7) Check all hoses for loose connections or deterioration.
8) Check the battery terminals for corrosion, cleaning where necessary.
9) Check the battery electrolyte level and fill with distilled water if necessary.
10) Refer to the engine manual for specific engine maintenance requirements.
11) Dispose of any insecure items or debris in the vicinity of the genset that may inhibit operation or could cause injury.
12) Drain condensate traps in the exhaust system, if so equipped and check for exhaust leaks.
13) Check the battery voltage reading the battery voltmeter to the select switch "STOP" position. A fully charged battery will indicate a voltage of 13 -14 volts on a 12 volt system, 24 - 27 volts on a 24 volt system. Return the select switch the off Position "STOP" immediately after this check.
14) The following procedure should be used when starting the Generator.

With the Alternator Circuit Breaker switched off, turn the select switch from Position "STOP" through Position "menu"(start) select switch to crank the engine. When the engine starts, release the select switch immediately

Do not crank the engine for more than 5 - 7 seconds, should the engine fail to start.
When the engine does not start, turn the select switch to "STOP" position.
Allow an interval of approximately 10 seconds between cranking attempts and should the engine still not have started after four cranking attempts, refer to the engine manual to determine the cause of failure to start.

Drain condensate traps in the exhaust system, if so equipped and check for exhaust system, if so equipped and check for exhaust leaks.
15) Check for any abnormal noise or vibration.
16) Check for fluid leakage.
17) Check control panel for indications of abnormal operation, particularly abnormally high temperature or abnormally low oil pressure.
18) Switch on the Alternator Circuit Breaker Load may be applied immediately to the genset. However, maximum step load that can be accepted in any one step independent on the operating. With the Genset cold (not more than 20 degree °C/ 68 Degree °F) the maximum step load acceptance is approximately 50% of rated output. However, with genset at normal operating temperature (approx. 85 degrees °C/ 185 degree °F) the maximum load that can be accepted in one step is 70 -100% of the Genset rating. These figures are given as a guide only and the relevant technical data sheet should be consulted when in doubt.

⚠ Warning/Danger/Important

Always Shut the Genset down prior to connecting or disconnecting, load cables. Only restart after a sound connection has been made.

By turning the select switch to the "OFF" position "STOP" the genset will shut down and reset the protective circuit after a fault orientated shut down.

If any time the generator stops because of a fault, the fault should be rectified before trying to restart the generator.

The control system is of the relay timer type based on a double sided printed circuit board. The ECU is off board fuse protected and apart from controlling the starting and stopping of the engine also provides the engine protection against damage due to high temperature and low oil pressure. Should any of these problems arise, the relevant relay in the control system is energized, lighting an LED indicator on the board and removing the feed to the fuel control solenoid thus stopping the engine.

The control system provides basic protection for the engine against both high temperature and low oil pressure. Engine coolant temperature is monitored by the high temperature switch located on the engine. This is normally an open switch designed to close at 103 degrees °C (217 degree °F). On closing. relay R1 energizes and self latched lighting indicator LD1 which is a red coloured light emitting diodes fitted to the rear of the board. the second set of contacts on R1 opens to break the circuit energizing the control relay. This closed the fuel solenoid valve shutting down the engine. The fault indication lamp remains lit and the engine licked out until the fault has been acknowledged and reset by putting the select switch to "STOP".

Engine lubrication oil pressure is also monitored to check for an excessively low pressure condition This is monitored by and engine mounted, normally closed, switch which opens under normal running condition. Should the oil pressure fail to or below 12 p. s. i. (0.8 bar) the switch will close. This in turn, energizes Relay R5 which self latches lighting indicator LD5 on the rear of the board. Again the second set of contacts opens causing the fuel solenoid valve to close by operating of the contacts of the now decentralized CR relay. Reset is effected by putting the select switch to the "STOP" position.

To prevent these channels from inhibiting the start-up of the set, a delay on energies comer relay is fitted. This has a variable delay which allows the oil pressure to build up and stabilizes before enabling the fault channel as will as allowing an initially warm engine to cool before enabling the fault channel.

2) Start and Stop

Turn the select switch from Position "stop" to Position "Manu"(start) to crank the engine. When the engine starts release the select switch immediatel

Returning the select switch to the off position "STOP" stops the set.

5.7 Operation

a) carry out pre-start Checks :-
- Alternator Circuit Breaker Off
- Engine coolant level
- Engine oil level
- Fuel level
- Battery voltage
- All electrical contacts secure
- Control panel select switch in the Off Position "STOP"

b) Turn the select switch from Position "STOP" to position "Manu"(start) to crank the engine. The select switch must be held in this position until the engine fires as the starter motor will disengage.

When the engine starts, release the select switch immediately, allowing it to maintaing Position "Manu"(start).
The select switch must not be turned to Position "STOP" when the engine is running.

c) Switch on the Alternator Circuit Breaker

1) Do not crank the engine for more than 5 - 7 seconds should the engine fail to start. Allow an interval of approximately 10 seconds between cranking attempts, and should the engine still not have started after four cranking attempts refer to the engine manual to determine the cause of failure to start.
2) A period of 15 seconds is allowed for oil pressure to develop, starting from when the select switch is first moved to Position "Manu"(start). After this interval, should the oil pressure not have reached the proper specified operating point or when running, should the pressure drop below this level, then the Genset will shut down and start-up will be inhibited. The LOW OIL PRESSURE fault light will be illuminated and no attempt should be made to start the set until the cause has been traced and remedied.
Any of the shut downs may be reset by switching the select switch to the Off Position "STOP". While this also resets the panel for starting as described above, no attempt should be made to start the set until the indicated fault has been found and corrected.

At this point your machine should be running normally; the protective switched i. e. low oil pressure, high engine coolant temperature and overspeed (if fitted) will be open and sensing their respective operating conditions. In the event of a fault the relevant fault circuit will operate and shut down the Genset.

5.8 Control Panel Equipment

The control panel is matched with an instrument panel consisting of the following:

1) Generator Instrumentation

The A.C. instrumentation provided is as follows ;

1 no. ammeter with selector switch, to monitor the current in each phase.
1 no. voltmeter and selector switch to monitor the phase to phase and phase to neutral output voltage.
1 no. hours run meter monitoring the running time of the engine (useful for establishing maintenance periods)
1 no. frequency meter monitoring the frequency of the alternator output.

The following description explains the function of each instrument:-

▶ The AC voltmeter indicated the voltage the Genset is applying to the load. The reading indicated by the voltmeter will vary depending on the connections made inside the alternator terminal box, the setting of the voltage regulator and the position of the voltmeter selector switch. It should not however vary when the set is operating. In the

event of the excitation failing the output voltage level will fall to approximately 20 - 40 volts.

- The AC ammeter indicated current being delivered which is dependent on the connected load. The meter displays current on each phase which is selected by meant of the ammeter selector switch.
- The frequency meter indicates the frequency of the generator output. The engine maintains a relatively constant speed under governor control so as to provide proper operating frequencies of 50 Hz or 60z when the generator is operating at full rated load. At partial loads the frequency will be some percent higher than normal depending on the droop of the governor. In practice at no load frequencies of approximately 52.2 and 62.5 Hz respectively are normal. (In case of mechanical GOV.)

2) **Engine Instrumentation**

The Engine instrumentation is as follows:-

1 no. engine lube oil pressure gauge.
1 no. engine coolant temperature gauge
I no. battery voltmeter

The following description explains the function of each instrument and gives the proper reading for normal operation.

- The engine water temperature is connected to the engine at an access port which allows it to sense the temperature of the engine coolant. This gauge continually monitors the temperature of the coolant during operation. The normal operating temperature should be approximately 85 Deg. °C (185 Deg. °F) This is an electrical device operating from the genset battery when the engine is running.
- The engine oil pressure gauge monitors engine oil pressure from the moment the engine is cranked. The proper engine oil pressure rating should be approx 3.0 bar - 3.7 bar (45 - 50 p. s. i.) at 1800 rpm or 2.6 - 3.3 bar (35 -45 p. s. i.) at 1500rpm. Again, this is an electrical device operating from the battery when the engine is running.
- The DC battery voltmeter indicates the state of charge of the battery and can also give an indication of loading of the circuitry when various functions are used. When the engine is at standstill the normal battery voltage will be 12 - 14 volt on a 12 volt system and 24 - 27 volt system on a 24 volt system Upon starting the engine the needle will move forwards the left and will read approximately 70% of normal with the needle oscillating as the engine cranks. When the engine has started the voltmeter will return to it's normal value.

3) **Fault Lights**

The Fault lights indicate that a shut down has been initiated by the protective circuitry.

4) **Key-switch**

1. On generators with semi-auto facility, the select switch is a 3 position switch which controls starting the motor manually and automatic start and stop.(Standard)
   Position "O" Stop/Reset
   Position "I" Manual Start (Manually operating function)
   Position "II" Auto Start-Stop Position

2. The select switch is a heavy duty 4 position switch which provides a means of controlling or interrupting the battery supply to the control system, thermostat and

starter motor.(Option spec.)

Position "B" Stop/Reset
Position "ACC" DC supply to control system
Position "R1,R2" DC supply to control system and thermostat
Position "C" DC supply to control system, thermostat and starter motor.

5.9 Alternator Circuit Breaker

The molded case circuit breaker (MCB/MCCB) is of sufficient rating for the machine output. The machine output os switchable through this devise, handle up being "ON". The breaker will carry it's rated current continuously but will trip to the mid position if the rating of any one phase is exceeded for a period depending on the percentage overload and the MCB/MCCB characteristics. The breaker must then be moved to the "OFF" position before re-closing.

5.10 Maintenance

No regular maintenance is required for the control system. However, to ensure that the generating set is always available for service when required, the following is recommended;-

1) Every two weeks, carry out an operation test on the system as illustrated in paragraph 5.7a and 5.7b. Check and replenish fuel levels.
2) Every four weeks, carry out an operational test on the system as illustrated in 5.7a paragraph and paragraph 5.7b. The Genset should be operated on at least 50% load for 2-3 hours.
3) Every six month, check security of all connections, tighten as necessary.
4) For other specific case of troubles, please refer to Trouble shooting guide in Section 6 of this manual

SECTION 6. MAINTENANCE

1. General

A good maintenance programme is the key to long generator set life Below is a program that should keep your machine in top running condition.

Also included in this programme are routine maintenance operators required for the engine and alternator (see Engine Maintenance and Alternator Maintenance Manuals for further details)

It is good practice to have all the maintenance and service operations performed by trained personnel that are familiar with generator set maintenance.

This, along with a good service records system, should aid in developing an efficient maintenance program.

The service records of each generator set should include information such as complete nameplate data with model and serial numbers. all drawing and wiring diagrams. spare parts stock lists, as well as a service schedule and a copy of this manual.

These records will allow quick reference and may help diagnosing a problem in the future.

6.1. Daily Operation

Prior to starting your generator set. it is necessary to check the oil and fuel level in the engine. Should the level be low. simply add the necessary amount.

Also check the radiator coolant level and battery electrolyte prior to starting.

< NOTE >

The radiator and engine cooling system must be drained and flushed every 12 months. Replace the coolant with a mixture of ethylate glycol and water as specified in this manual. Do not use a leak sealing type of anti-freeze Should a 100% water solution be used,. a non-chromate rust inhibitor must be added. After a routing start has been made, observe the control panel gauges and meters. Be sure they monitor the correct readings for that particular phase of operation. After the machine has warmed up, it is recommended that a general check on the overall machine and control panel be made to ensure that the generator set is running properly.

6.2 Preventative Maintenance

Depending on the application of each generator set the requirement for preventive maintenance operations will vary. The following schedule is outlined with intervals based on the calendar and hours of service. The maintenance requirement should be carried out when the first interval is met (hourly or calendar periods).

All preventive maintenance requirements associated with the engine are detailed in the engine manual. Refer to the engine manual for specific requirements and incorporate them into your routine schedule.

If your generator set is used as an emergency equipment or used around once a week, you must

check up by running the generator set once a week at least.

The table 6-1 shows the summary of daily maintenance. For details, refer to the operations & maintenance guide manual.

The table can also be used as a daily check list by a user.

Table 6-1 Daily Maintenance Check Points

	Daily Maintenance or at Each Start Up			
NO	Check Point		Result	Remedy
1.	Generator Set	*Potential leaks from the engine fuel system cooling system or lubrication leaks		Tighten
2.	Alternator	*Obstructions in the cooling air ventilation screens		Clean any heavy accumulations
		*Heavy accumulation of dust and dirt		
3.	Control Panel	*Heavy accumulation of dust and dirt		
4.	Air Cleaner Element	*Heavy accumulation or dust and dirt		Replace if necessary
5.	Fuel Gauge	*Fuel level		Replenish if necessary
6.	Radiator	*Engine coolant level		Replenish
		*Radiator cap condition		
		*Obstructions of air flow		
7	Fan	*Rotation Condition		
8	Belts	*Tension Condition		Tighten or Replace if necessary
9.	Hoses	*Connection condition		
10	Oil Level	*Engine oil level and condition		Replenish if necessary
11	Battery	*Terminals for corrosion		Removal
		*Electrolyte level		Fill with distilled water if necessary
		*Voltage level		Recharging
12	Engine	*Specific engine maintenance requirements		Refer to the engine maintenance manual
Start the generator set after all checks have been made				
13	Exhaust system	* Exhaust gas leakage		Tighten
14	Noise or Vibration	* Any abnormal condition		
15	Generator Set	* Fluid leakage		
		* High temperature		
16	Items	* Dispose of any unnecessary items in the vicinity of the generator set		Clean if necessary
17	Control Panel	* Indications of abnormal operation		Refer to service manual

6.2.1 Maintenance Every Six Months Or 250 Hours

1) Repeal the daily requirements.
2) Check all safety devices by electrically simulating a fault to ensure that all system will function properly in the event of a fault
3) Clean all battery cap vents.
4) Start the generator set and observe the control panel to be sure that all gauges and meters are operating property
5) Tighten all exhaust connections.
6) Tighten all electrical connections
7) Refer to the engine maintenance manual. for further details.

6.2.2 Cooling Water

1) Check the cooling water level by opening the filler cap- on the top of the radiator or by reading the gauge level on the top of the radiator, and the cooling water if necessary.
2) Replace the radiator filler cap if it is damaged or the joint is loose.
3) When injecting antifreeze solution. first drain out the old antifreeze solution from the cylinder block and radiator, and then flush them with cleaning solution.
4) Check up the mixed percent of antifreeze and cold water.
5) When adding the antifreeze solution. you must follow the table 6-2 indicating the ratio of antifreeze in volume depending upon the ambient temperature.

Table 6-2 **Antifreeze Solution and Freezing Point**

Antifreeze solution (%)	Freezing Point (°C)
20	-10
27	-15
33	-20
40	-25
44	-30
50	-40

(1) if you add antifreeze in excess of 50% in volume. the engine may be overheated Avoid this.
(2) As the individual freezing points corresponding to the above proportions of antifreeze are subject to change slightly according to the kind of antifreeze. you must follow the specifications provided by the antifreeze manufacturer.
6) As the ratio of antifreeze in the mixture decreases each time new coolant is added to make up for the loss in old coolant resulting from engine operation. check the mix ratio with every replenishment of coolant. and top up as necessary
7) To prevent corrosion or air bubbies in the coolant path. be sure to add a specific additive. i. e. corrosion inhibitor, to the coolant.
   * Type : DAC65L
   * Mix ratio : 1.5/of inhibitor to 50? of coolant
     (Namely, add corrosion inhibitor amounting to 3% of water capacity)
8) Add antifreeze at least 5% in volume to prevent possible engine corrosion in hot weather

6.2.3 Fan Belt

1) Use a fan belt of specified dimensions. and replace if damaged.. frayed, or deteriorated.

2) Check the fan belt tension
If belt tension is lower than the specified limit, adjust the tension by relocating the charging alternator and idle pulley. (Specified deflection: 10-15mm When pressed down with thumb)

6.2.4 Engine Oil

1) Check oil level using the oil dip stick and replenish if necessary.
2) Check the oil level on a level ground, engine cooled. The oil level must be between MAX and MIN lines on the stick.
3) Engine oil should be changed at the specified intervals. Oil in the oil filter also should be changed simultaneously.

Suggested engine oils

SAE NO	API NO
15W40	CD grade or above

6.2.5 Oil Filter

1) Check for oil pressure and oil leak, and repair or replace the oil filter if necessary.
2) Replace the oil filter element simultaneously at every replacement of engine oil.

6.2.6 Fuel Filter

1) Drain water from within the cartridge by loosening the cock under the filter periodically.
2) The fuel filter element should be replaced every 400 hours operation.

6.2.7 Air Cleaner

1) Damaged air cleaners should immediately be replaced.
2) Clean or replace the element periodically.

6.2.8 Battery

1) Check the battery for damage or leaking of battery fluid (electrolyte) from cracks on the battery. Replace the battery if damaged.
2) Check battery fluid level and add distilled water if necessary.
3) Measure the specific gravity of the electrolyte in the battery. Recharge the battery if the hydrometer readings are lower than the specified limit.
4) If the DC Volt Meter of the control panel indicates a value less than a reference . Check up and recharge batteries.

For details, refer to the maintenance manual.

6.3 Periodic Check List

Table 6-3 Periodical inspections and determination of maintenance term

items of maintenance			Setting	Daily	10-20Hr	100 Hr	200 Hr	400 Hr	1000 Hr
Engine	Leakage	Check		O					
	Fastening	Check		O					
	Mounting	Check				O			
	Valve Clearance	Check			O			O	
	Compression Pressure	Check							O
	State of Exhaust Gas	Check		O					
Fuel System	Injection Nozzle Pressure & Spray Pattems	Check						O	
	Fuel Level	Check		O					
	Fuel Filter Element	Replace						O	
	Fuel Strainer	Clean					O		
	Fuel Filter	Replace							O
Lub. System	Oil Level	Check		O					
	Oil Filter Element	Replace			O		O		
	Oil Strainer	Clean				●			O
Lub. Oil	Engine Oil	Change					O		
	Lub. System	Supply				O			
	Bearing Grease	Supply						O	
Cooling System	Belt Tension	Check	Deflec-tion: 10mm(')	O					
	Cooling Water Level	Check		O					
Intake Air System	Air Cleaner	Check		O					
Electric System	Battery Electrolyte Capacity	Check		O					
	Battery Gravity	Check					O		
	DC Charging Alternator	Check					O		
	Starter	Check					O		
	Wire Connection	Check	O						

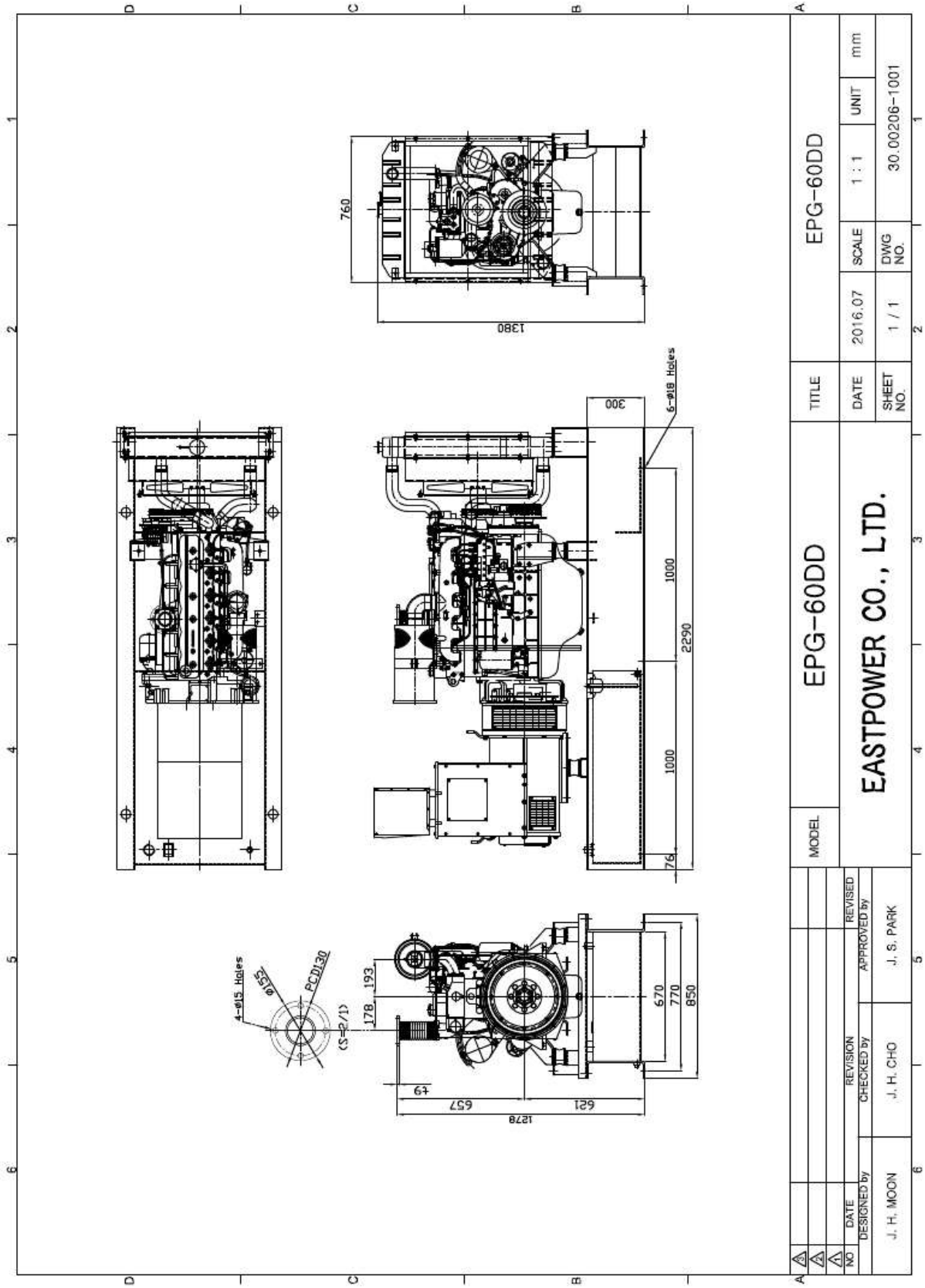
1) The 10-20 Hr column is only applied to new engine or the overhauled
2) For the generator set used for an emergency, the engine oil should be replaced twice a year at least (in spring and autumn)
3) "●" : Initial
4) To carry out maintenance and trouble shooting engine should be stopped in cold condition.
5) (') : When pressed down with thumb.

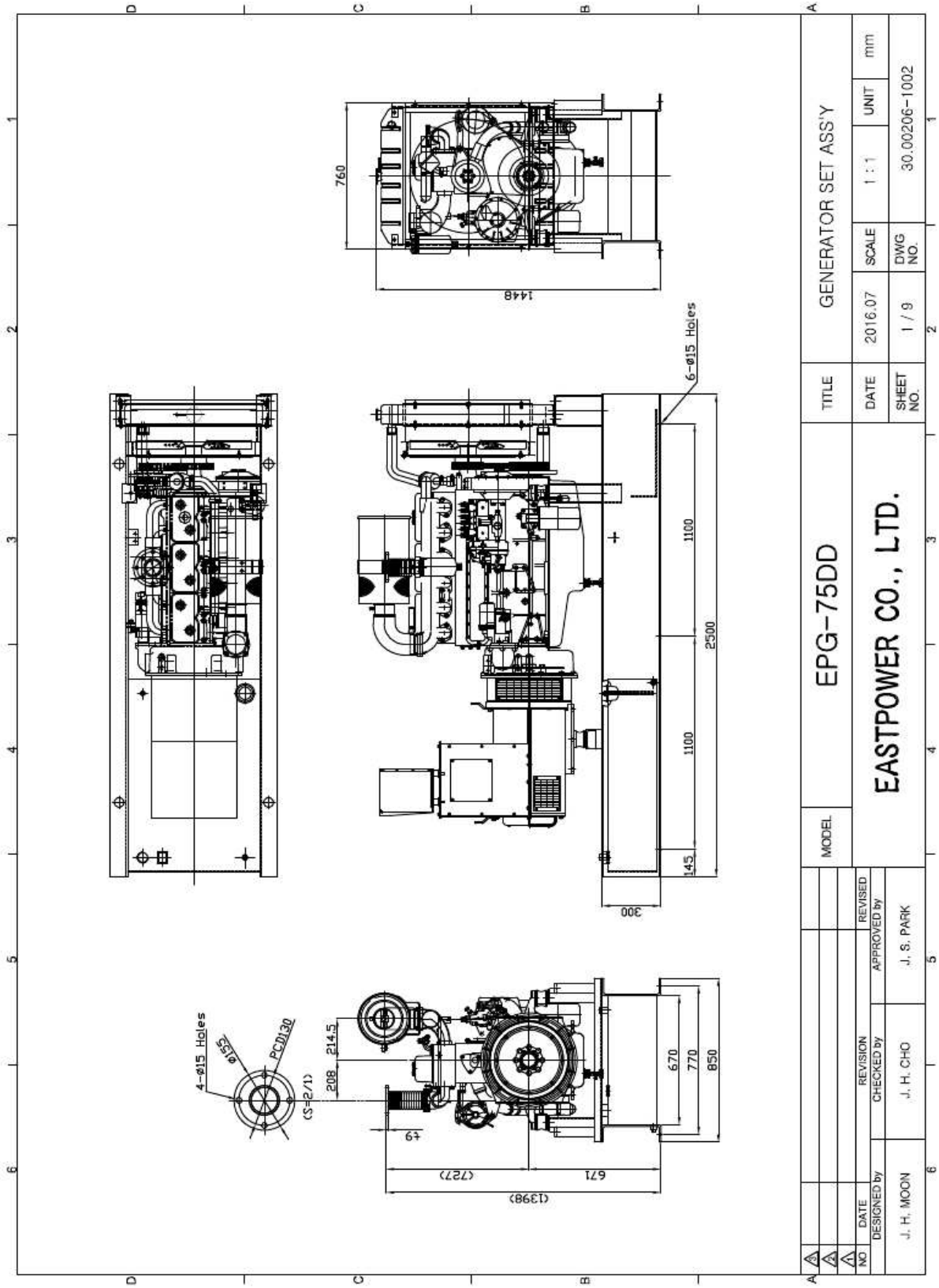
6.4 Trouble Shooting Guide

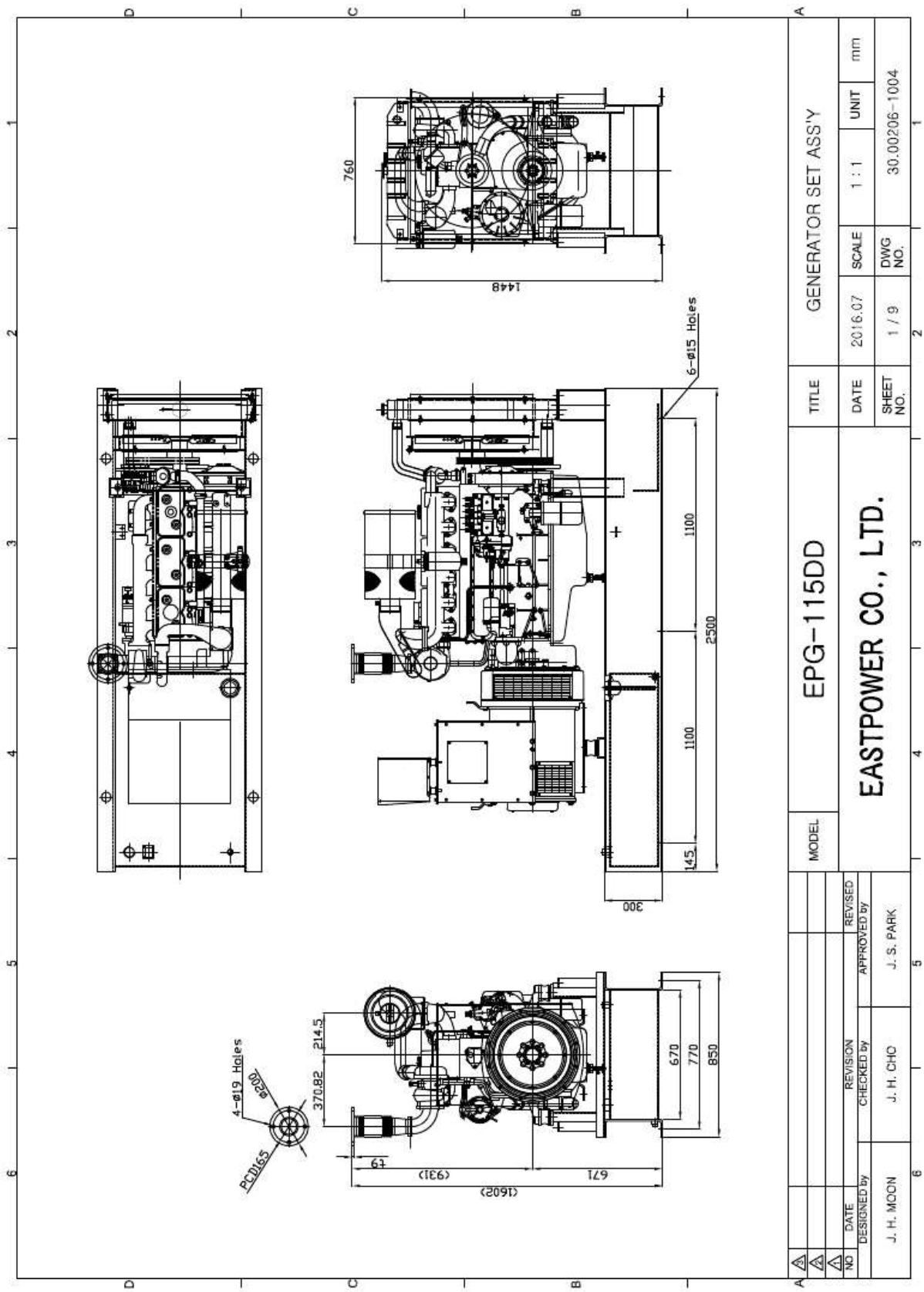
Fault	Symptom	Remedy
Engine fails to start	Engine does not crank	Step 1. Check operation of Control Panel. 2. Check no red fault light is lit - reset, if required after remedying fault. 3. a. Check battery voltage on panel meter, If it is not registering voltage, check fuses supplying D C power, If voltage is O. K, go to step 4. 3. b. If all th above checkout is O. K., then recharge the batteries with separate battery charger and reconnect to set(switch off Genset when connecting and disconnecting battery lead) 4. Check supply to slave solenoid on starter motor. This is done by connecting a DC voltmeter between this connection and battery negative, Try staring the engine using Key-switch. If the meter registers a voltage then the starter motor/solenoid is faulty. Replace, Check wiring from panel for loose connections or cuts.
	Engine cranks but does not fire	Step 1. Check fuel level. 2. Check the wiring to the fuel solenoid FCS and the voltage at the FCS. Check fuel lines and fuel filter for obstructions. 3. If "white smoke comes from exhaust fuel id being admitted to the engine but the engine is not firing Refer to engine manual for further checks. 4. Check voltage output of PCB board to ECU(Engine Control Unit). If signal not present replace ECU PCB
Engine stops on fault	Low oil pressure lamp lights	Step 1. Check oil level 2. Refer to engine manual. 3. Check oil pressure switch with test gauge. replace if faulty. Once the fault has been identified and rectified reset by selecting key-switches to "o" off /Reset.
Engine stops on fault	High Engine temperature lamp lights	Step 1. Check engine was not overloaded. 2. Check radiator and ventilation for obstructions. 3. Check fan belt tension. 4. Refer to the engine manual 5. Check ambient temperature is within design limits of genset. Once the fault has been identified and rectified, reset by selecting Key-switch to "O" OFF/Reset. Start engine and run off load to cool engine(with circuit breaker switch off for 10 minutes)

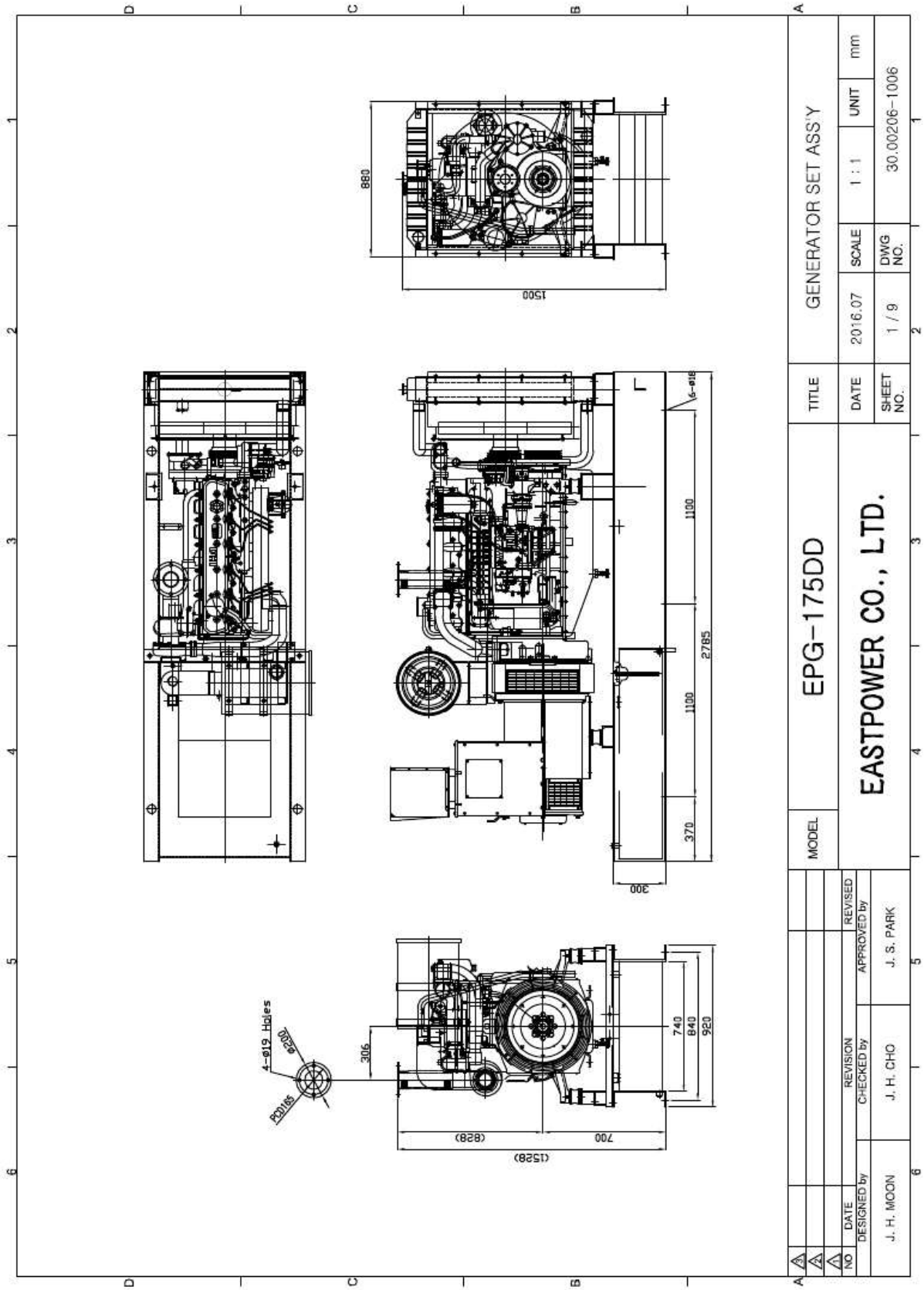
Fault	Symptom	Remedy
No voltage produced when generator is running	No voltage on voltmeter	Step 1. Check voltmeter selector switch is not switched off. 2. Check fuses in AVR(Automatic Voltage Regulator). 3. Check voltage alternator terminals, rotating diodes, and rated speed of engine with independent meter. If voltage is correct check wiring between alternator and panel. Check voltmeter. Replace if necessary.
No voltage produced when generator is running (continued)	Generator does not stop	Step 1. Check Key switch operation 2. Check fuel control solenoid(FCS). Replace, if needed
Generator does not go on load	Generator running	Step 1. Check circuit breaker is switched on. 2. Check generator is producing voltage. If not, see section on "No Voltage produced".
Engine Jacket Water Heater fails (If fitted)	Engine block is cold	Step 1. Check auxiliary supply os available. 2. Check water level in radiator. Check for water leaks around generating set. 3. Check relay 5X1 and contactor HC are energized, 4. Check heater and start for continuity. Replace if necessary.
Trickle battery charger fails (If fitted)	Battery lose charges over period of time	1. Check auxiliary supply is available. 2. If all above O. K replace battery charger.

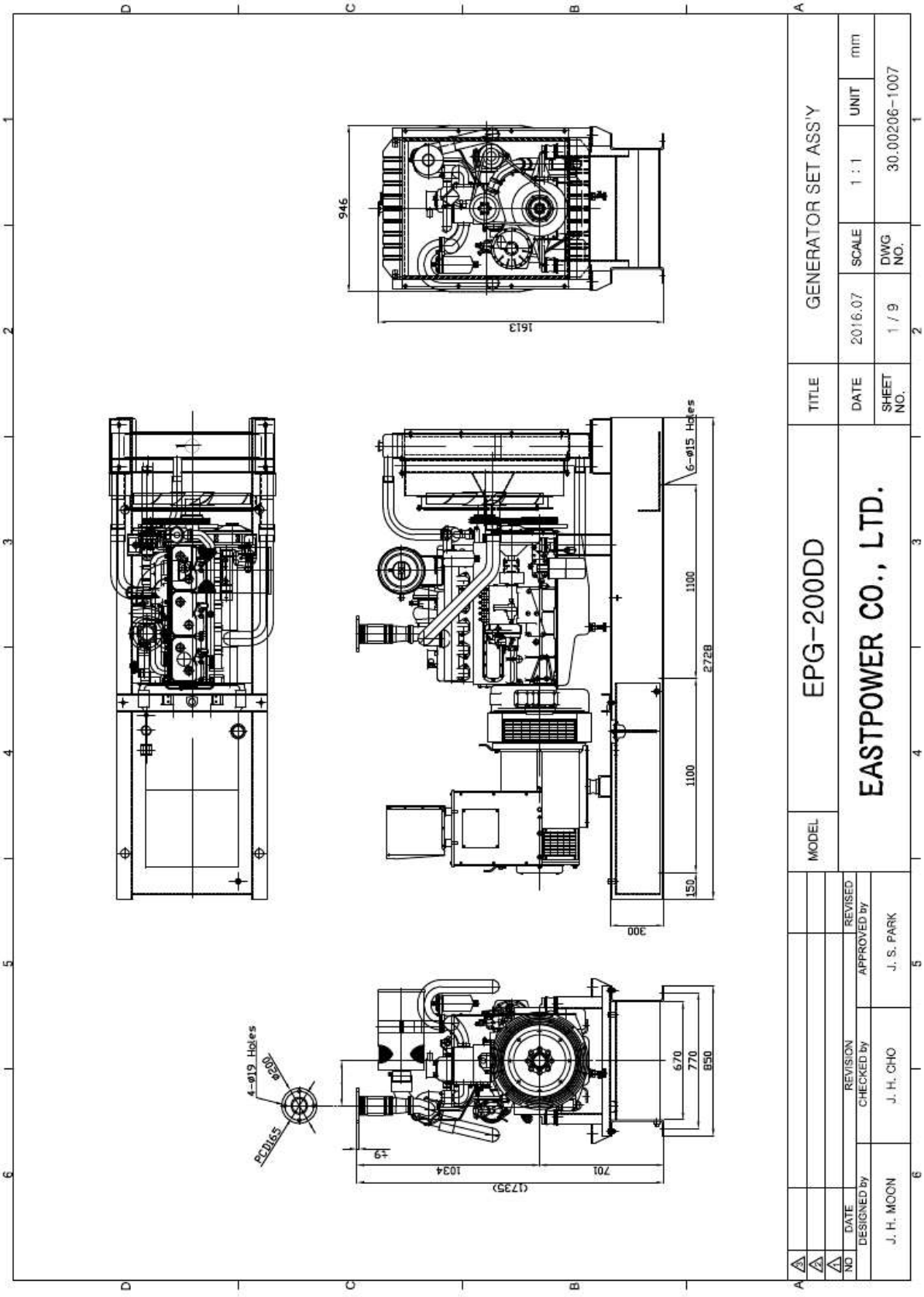
SECTION 7. DRAWING

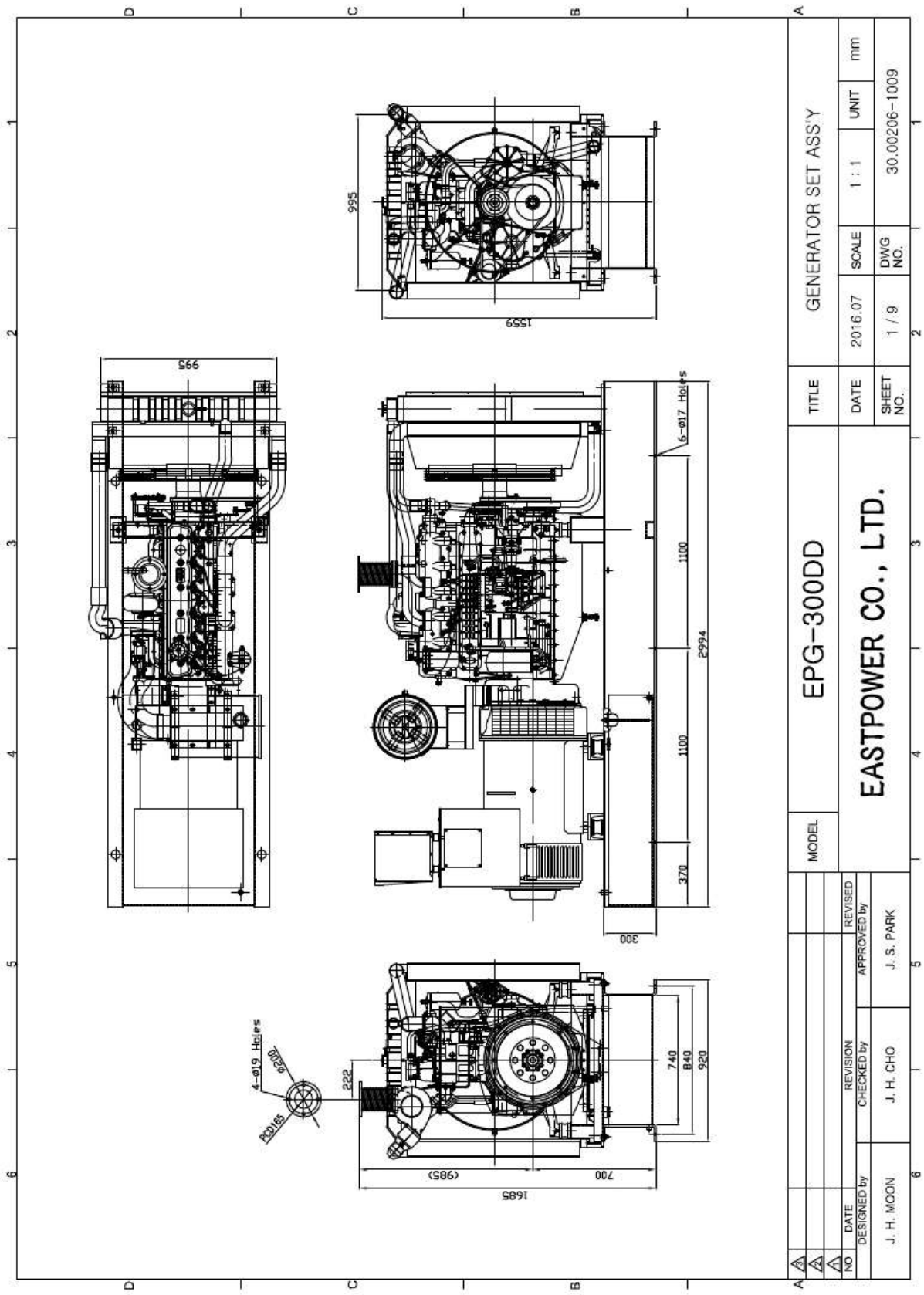


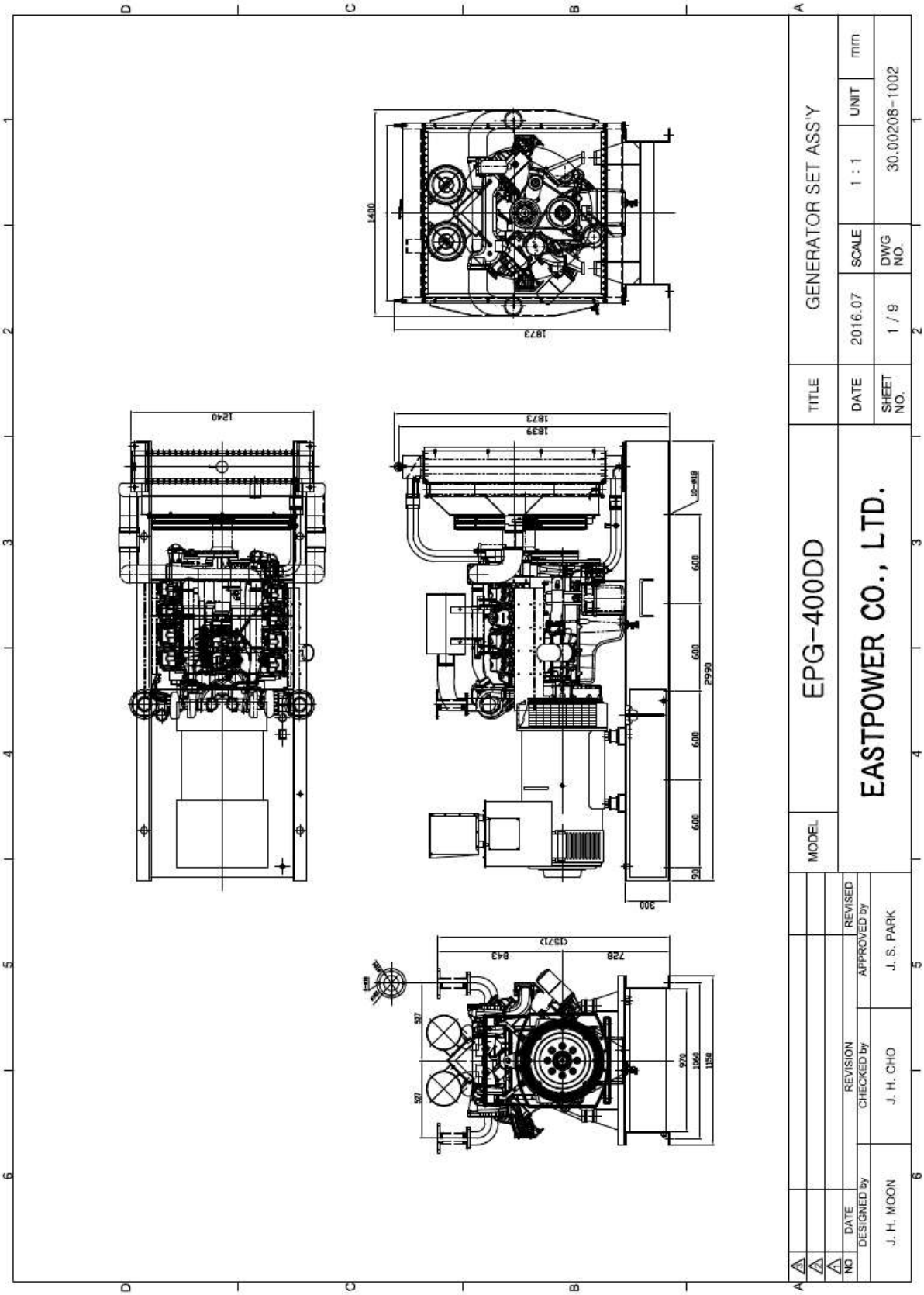

760
1448
6-ø15 Holes
1100
1100
2500
145
300
4-ø15 Holes
ø55
PCD130
(S=2/1)
208
214.5
64
(727)
671
(1398)
670
770
850
MODEL
EPG-75DD
TITLE
GENERATOR SET ASS'Y
DATE
2016.07
SCALE
1 : 1
UNIT
mm
SHEET NO.
1 / 9
DWG NO.
30.00206-1002
EASTPOWER CO., LTD.
NO
REVISION
DATE
DESIGNED by
CHECKED by
APPROVED by
REVISED
J. H. MOON
J. H. CHO
J. S. PARK

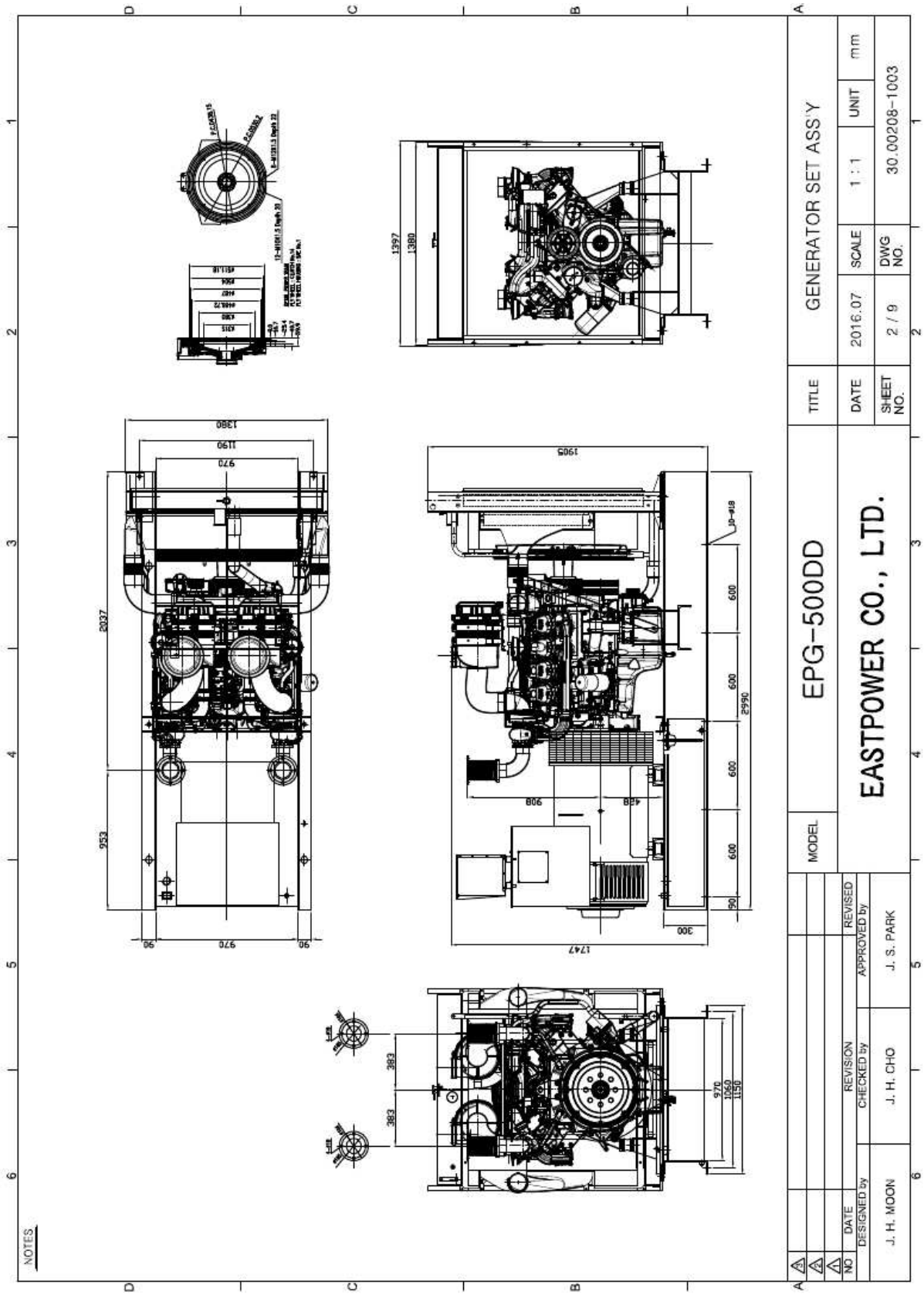

760
1448
6-ø15 Holes
1100
1100
1100
145
2500
300
4-ø19 Holes
ø200
PCD165
214.5
370.82
67
(931)
671
(1602)
670
770
850
GENERATOR SET ASS'Y
EPG-115DD
EASTPOWER CO., LTD.
TITLE
DATE
2016.07
SCALE
1 : 1
UNIT
mm
SHEET NO.
1 / 9
DWG NO.
30.00206-1004
MODEL
NO
DATE
REVISION
DESIGNED by
CHECKED by
APPROVED by
J. H. MOON
J. H. CHO
J. S. PARK

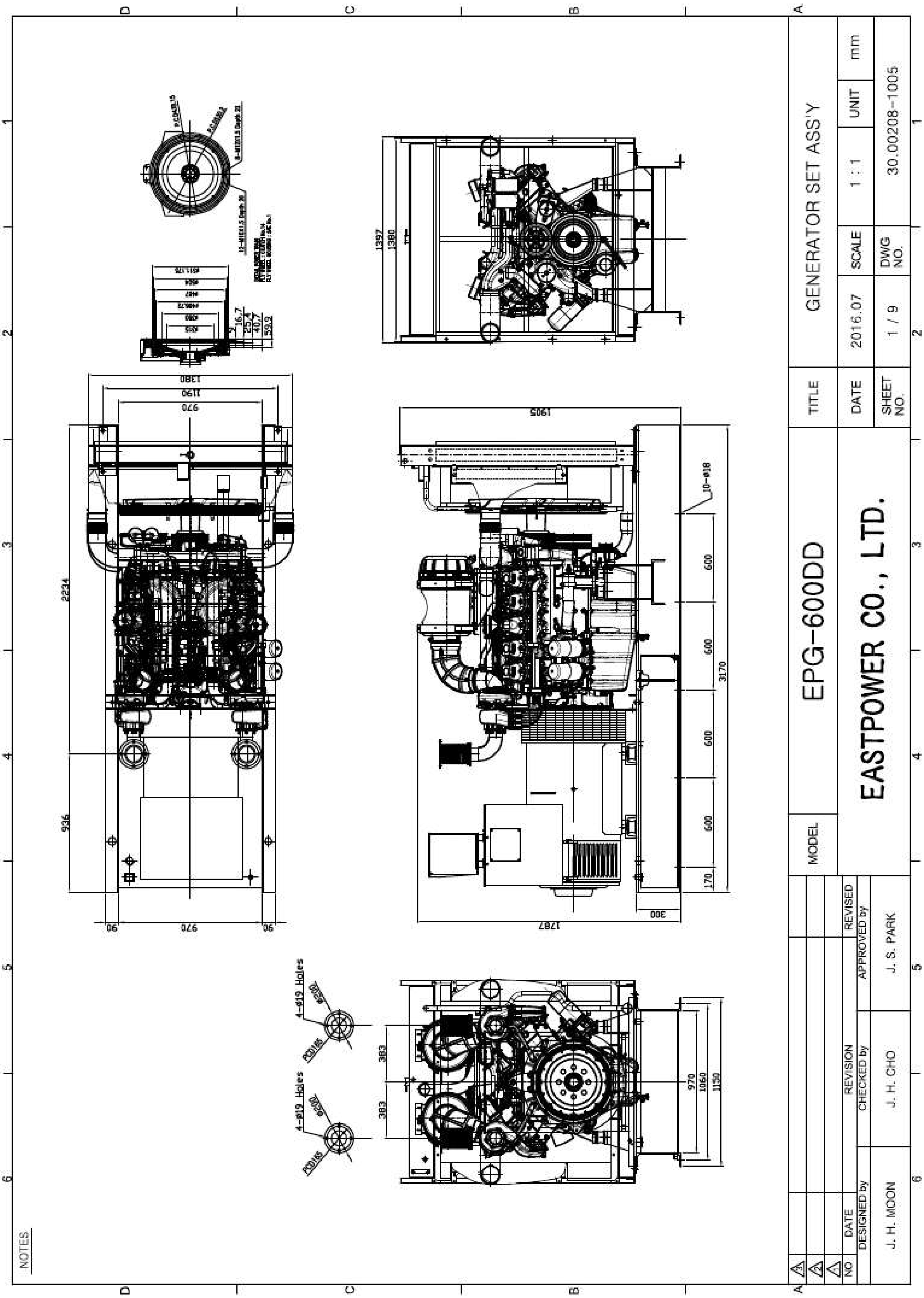

EPG-175DD
EASTPOWER CO., LTD.
GENERATOR SET ASS'Y
MODEL
TITLE
DATE
2016.07
SCALE
1 : 1
UNIT
mm
SHEET NO.
1 / 9
DWG NO.
30.00206-1006
DESIGNED by
J. H. MOON
CHECKED by
J. H. CHO
APPROVED by
J. S. PARK
REVISION
REVISED
DATE
NO
4-ø19 Holes
PCD165
ø220
306
740
840
920
700
(828)
(1528)
1500
880
1100
1100
370
2785
300

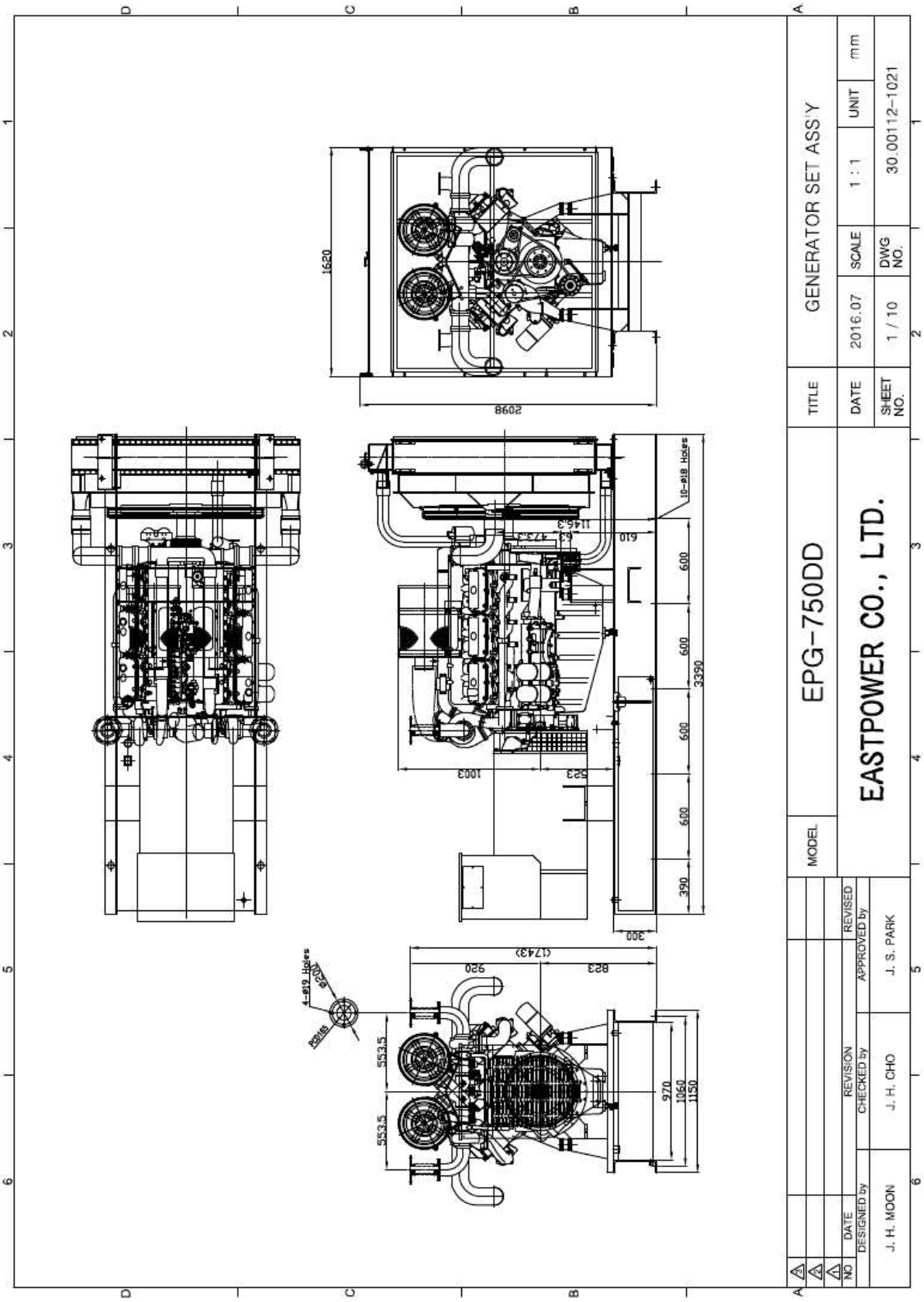

946
1613
6-ø15 Holes
1100
1100
2728
150
300
4-ø19 Holes
ø600
PCD565
670
770
850
79
1034
701
(1735)
GENERATOR SET ASS'Y
EPG-200DD
EASTPOWER CO., LTD.
TITLE
MODEL
DATE
2016.07
SCALE
1 : 1
UNIT
mm
SHEET NO.
1 / 9
DWG NO.
30.00206-1007
NO
DATE
REVISION
DESIGNED by
J. H. MOON
CHECKED by
J. H. CHO
APPROVED by
J. S. PARK

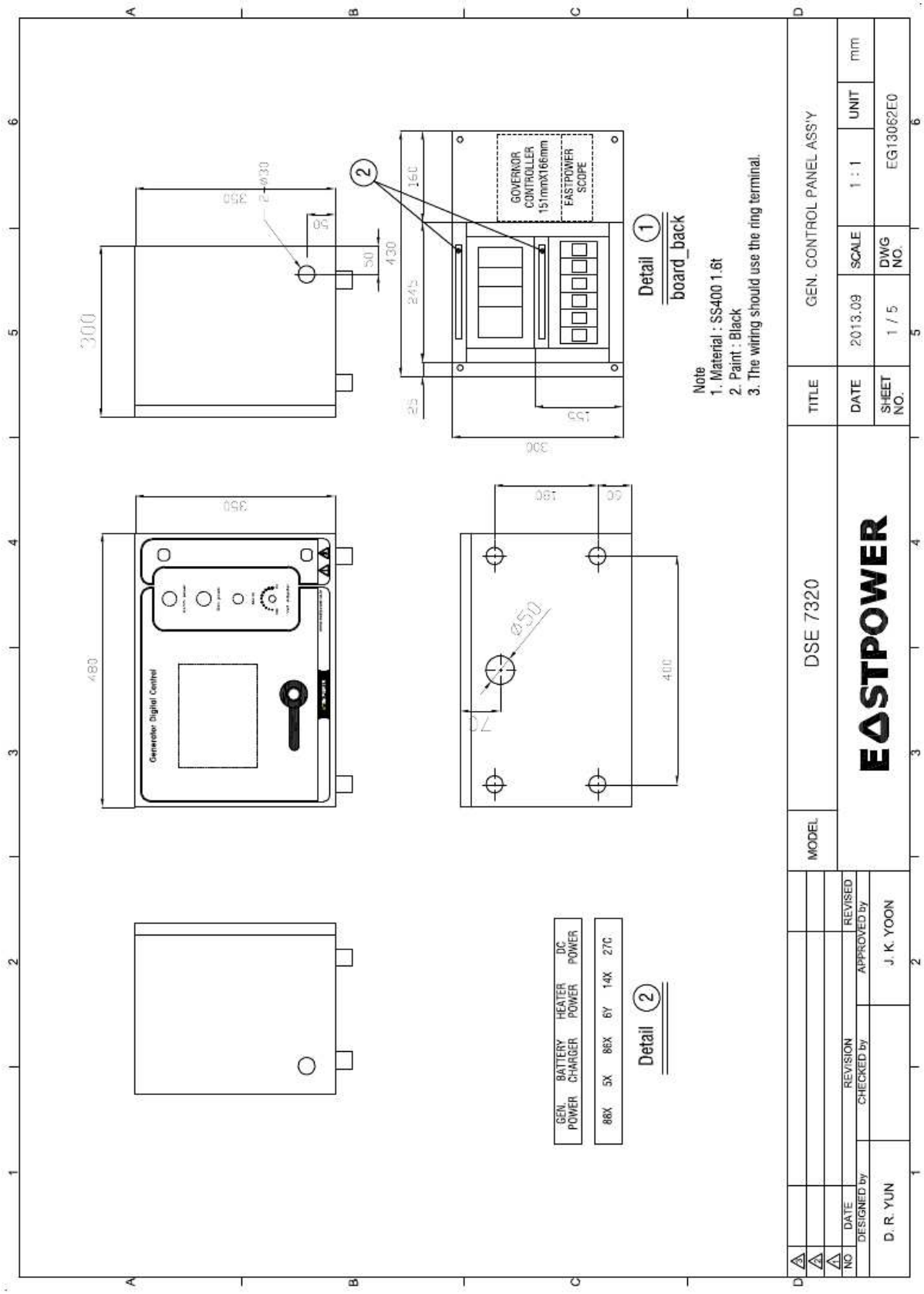

995
1559
995
6-Ø17 Holes
1100
1100
370
2994
300
4-Ø19 Holes
Ø200
PCD165
222
740
840
920
(985)
700
1685
GENERATOR SET ASS'Y
EPG-300DD
EASTPOWER CO., LTD.
TITLE
MODEL
DATE
2016.07
SCALE
1 : 1
UNIT
mm
SHEET NO.
1 / 9
DWG NO.
30.00206-1009
NO
REVISION
DATE
DESIGNED by
J. H. MOON
CHECKED by
J. H. CHO
APPROVED by
J. S. PARK

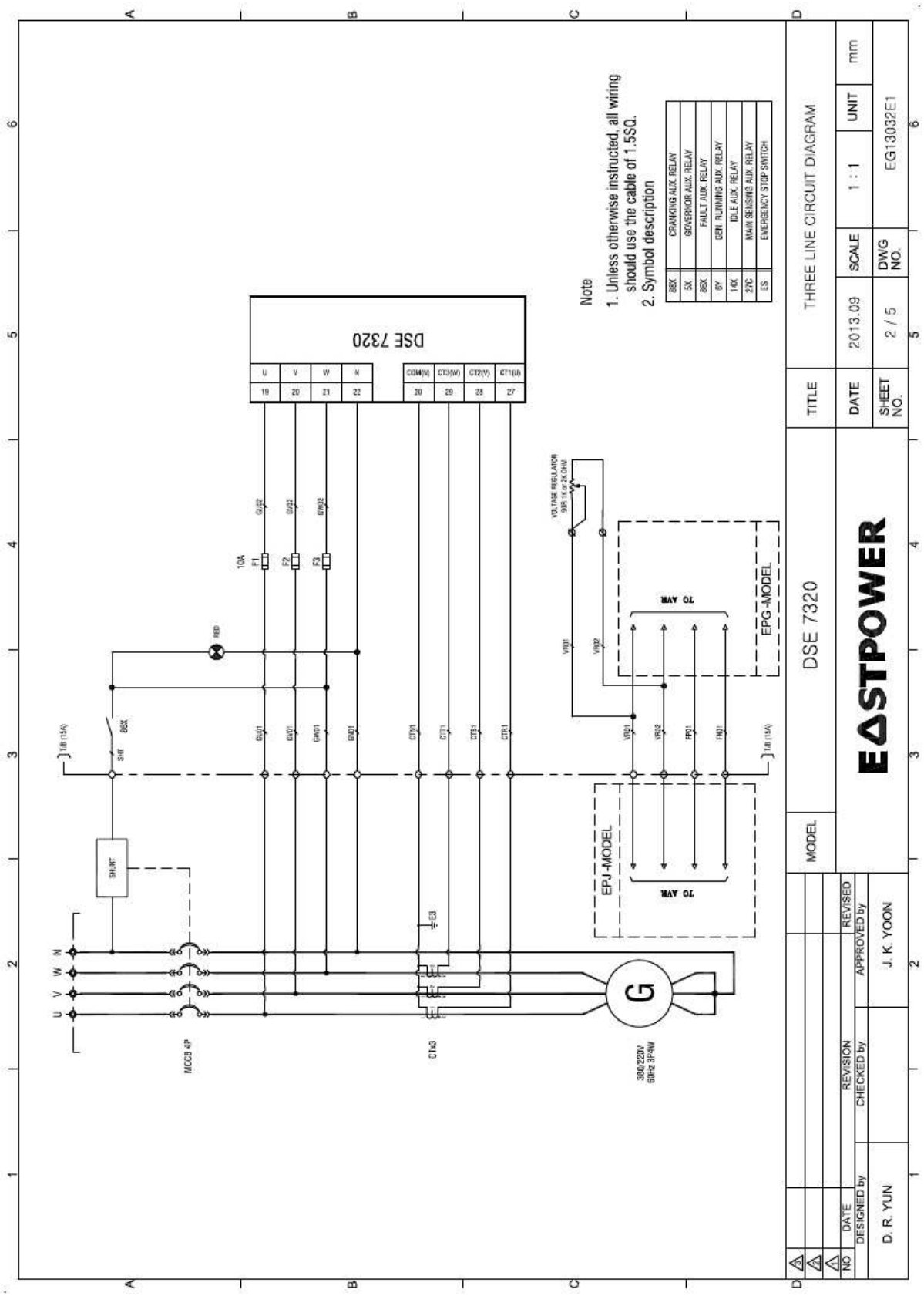

GENERATOR SET ASS'Y
EPG-400DD
EASTPOWER CO., LTD.
TITLE
MODEL
DATE
2016.07
SCALE
1 : 1
UNIT
mm
SHEET NO.
1 / 9
DWG NO.
30.00208-1002
NO
REVISION
DATE
DESIGNED by
CHECKED by
APPROVED by
REVISED
J. H. MOON
J. H. CHO
J. S. PARK
1873
1839
1240
2990
600
300
728
843
1400

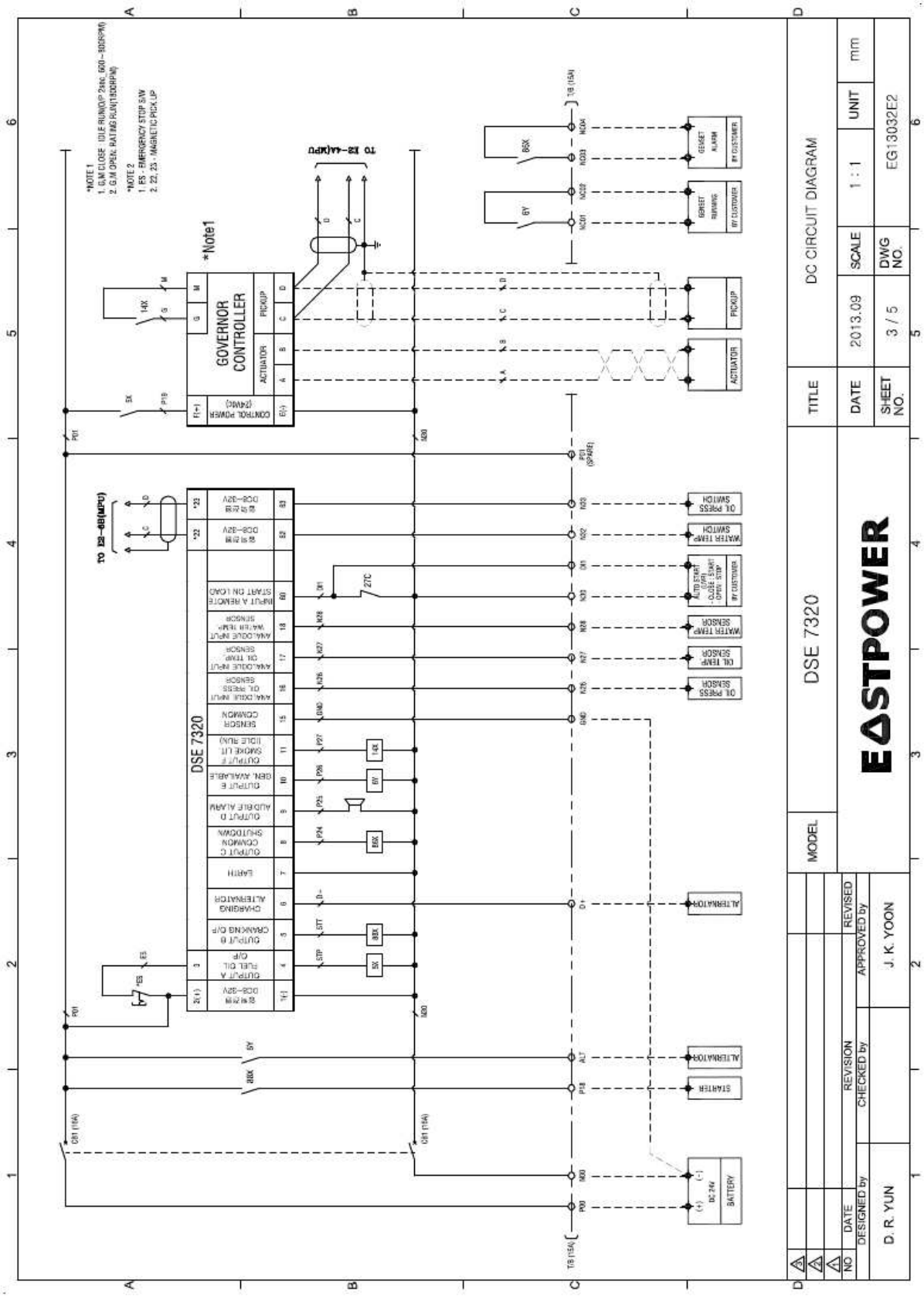

NOTES
MODEL
EPG-500DD
EASTPOWER CO., LTD.
TITLE
GENERATOR SET ASS'Y
DATE
2016.07
SCALE
1 : 1
UNIT
mm
SHEET NO.
2 / 9
DWG NO.
30.00208-1003
NO
DATE
REVISION
DESIGNED by
CHECKED by
APPROVED by
REVISED
J. H. MOON
J. H. CHO
J. S. PARK

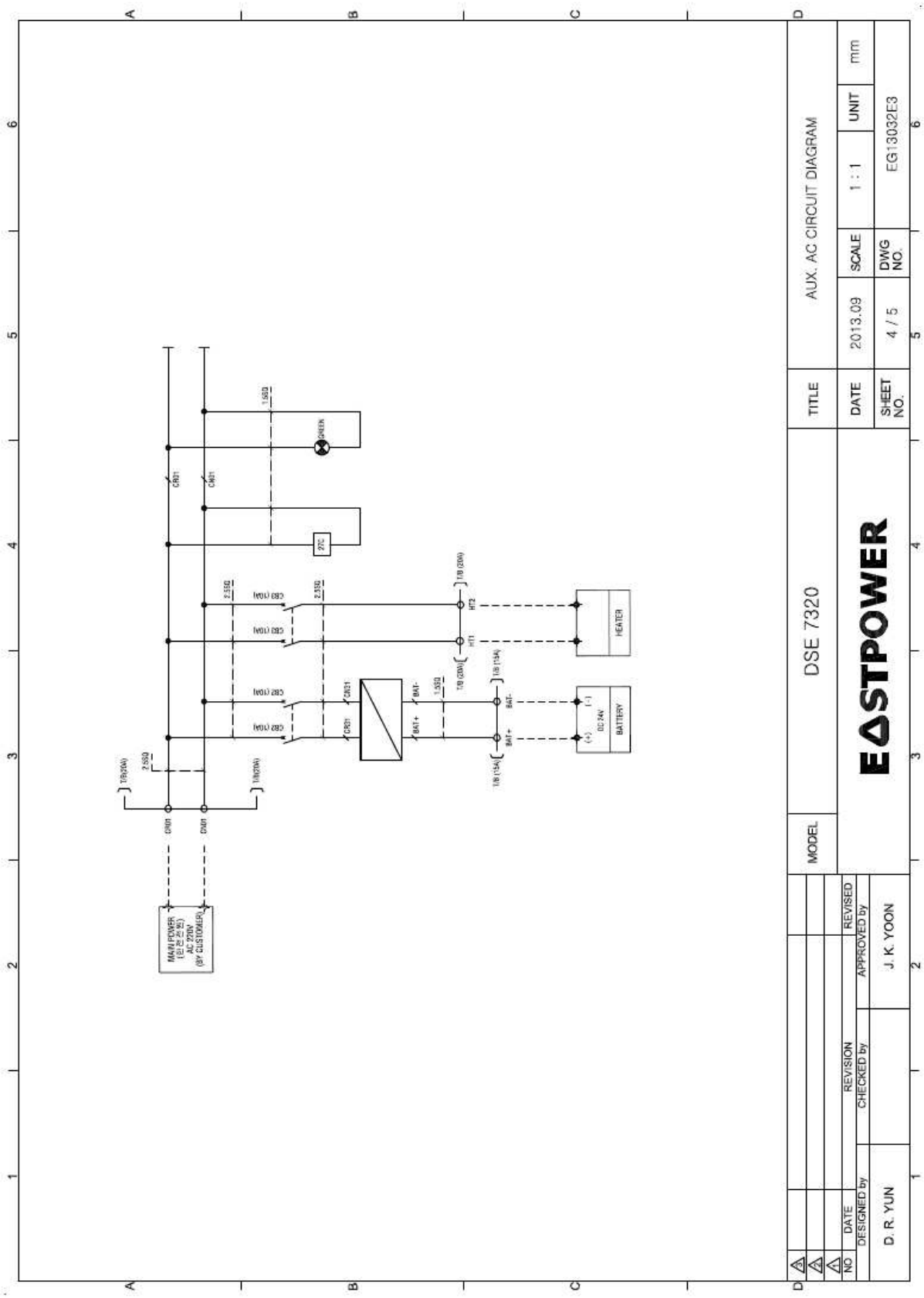

GENERATOR SET ASS'Y
TITLE
UNIT
mm
SCALE
1 : 1
DATE
2016.07
DWG NO.
30.00208-1005
SHEET NO.
1 / 9
MODEL
EPG-600DD
EASTPOWER CO., LTD.
NO.
DATE
REVISION
REVISED
DESIGNED by
J. H. MOON
CHECKED by
J. H. CHO
APPROVED by
J. S. PARK
NOTES
4-ø19 Holes
PCD165
10-ø18
2234
936
1380
1190
970
90
1905
3170
1787
300
170
600
1397
1380
383
1060
1150

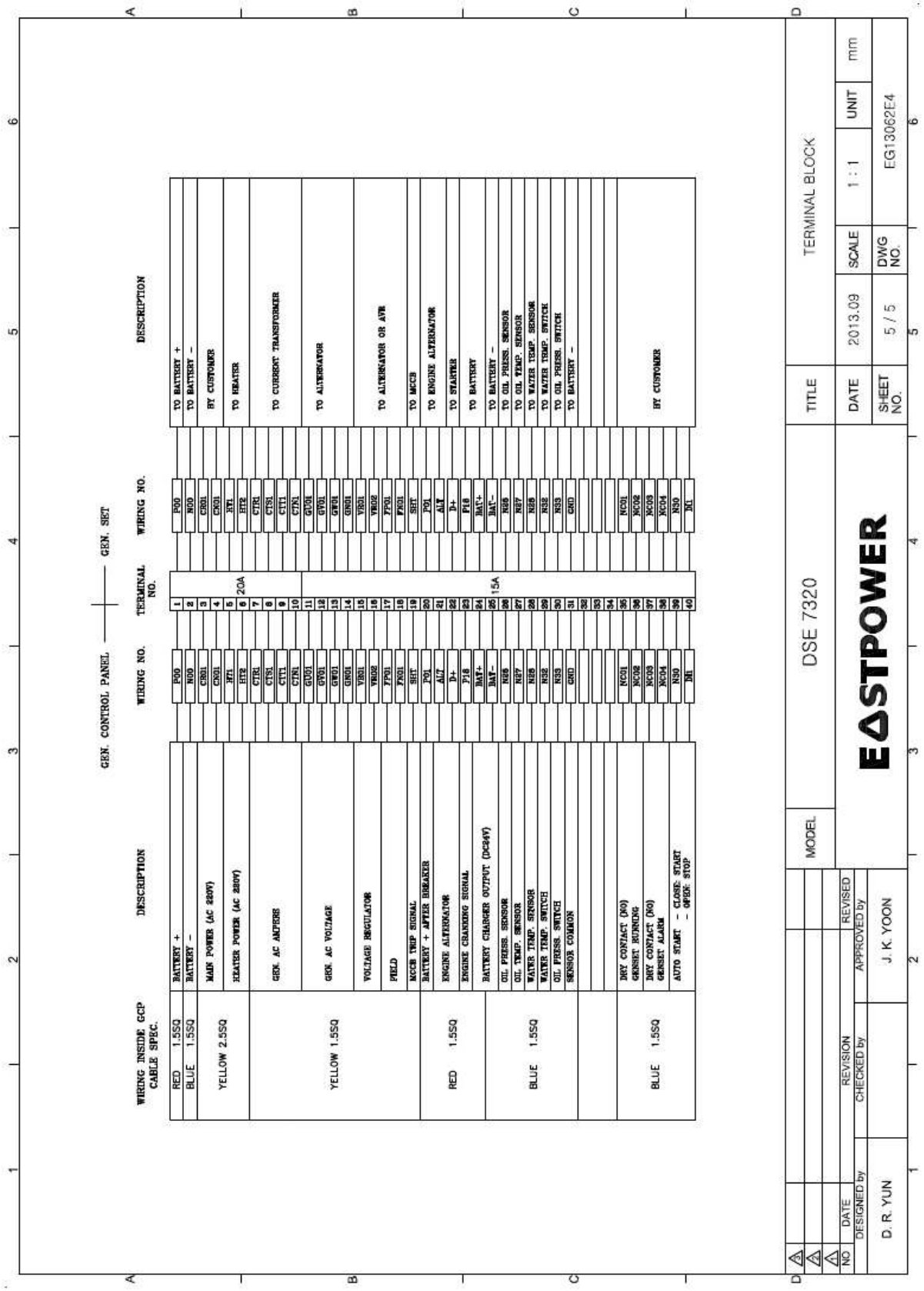

GENERATOR SET ASS'Y
EPG-750DD
EASTPOWER CO., LTD.
MODEL
TITLE
DATE
2016.07
SCALE
1 : 1
UNIT
mm
SHEET NO.
1 / 10
DWG NO.
30.00112-1021
REVISION
DESIGNED by
CHECKED by
APPROVED by
J. H. MOON
J. H. CHO
J. S. PARK
DATE
NO
REVISED
2098
1620
10-ø18 Holes
610
600
600
600
600
390
3390
300
1003
523
1145.3
920
823
(1243)
4-ø12 Holes
ø2015
553.5
553.5
970
1060
1150

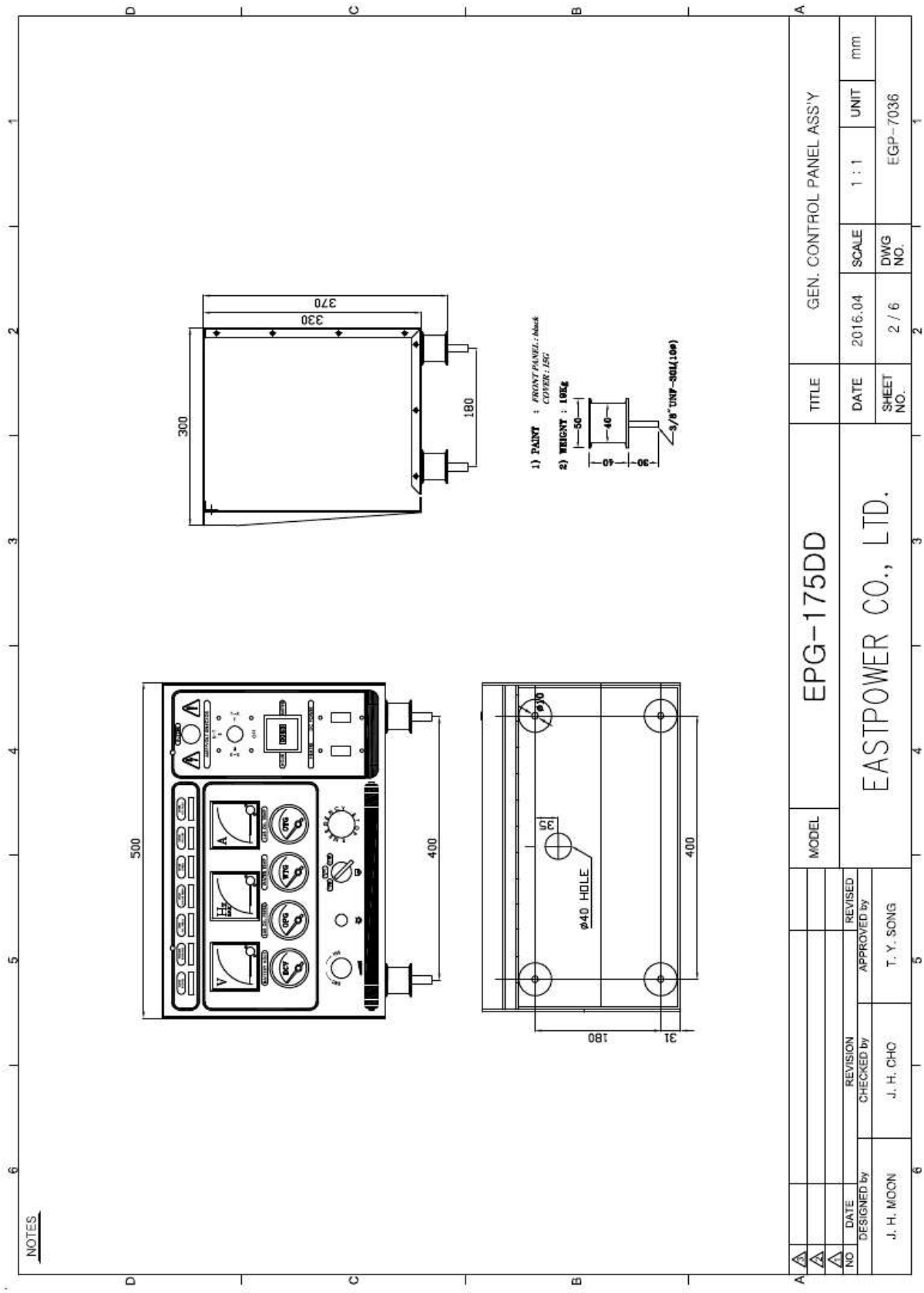

GOVERNOR CONTROLLER 151mmX166mm
EASTPOWER SCOPE
Detail ① board_back
Note
1. Material : SS400 1.6t
2. Paint : Black
3. The wiring should use the ring terminal.
Generator Digital Control
Detail ②
GEN. POWER
BATTERY CHARGER
HEATER POWER
DC POWER
86X
5X
86X
6Y
14X
27C
DSE 7320
EASTPOWER
GEN. CONTROL PANEL ASS'Y
EG13062E0
D. R. YUN
J. K. YOON
DESIGNED by
CHECKED by
APPROVED by
DATE
REVISION
REVISED
TITLE
DATE
2013.09
SCALE
1 : 1
UNIT
mm
SHEET NO.
1 / 5
DWG NO.

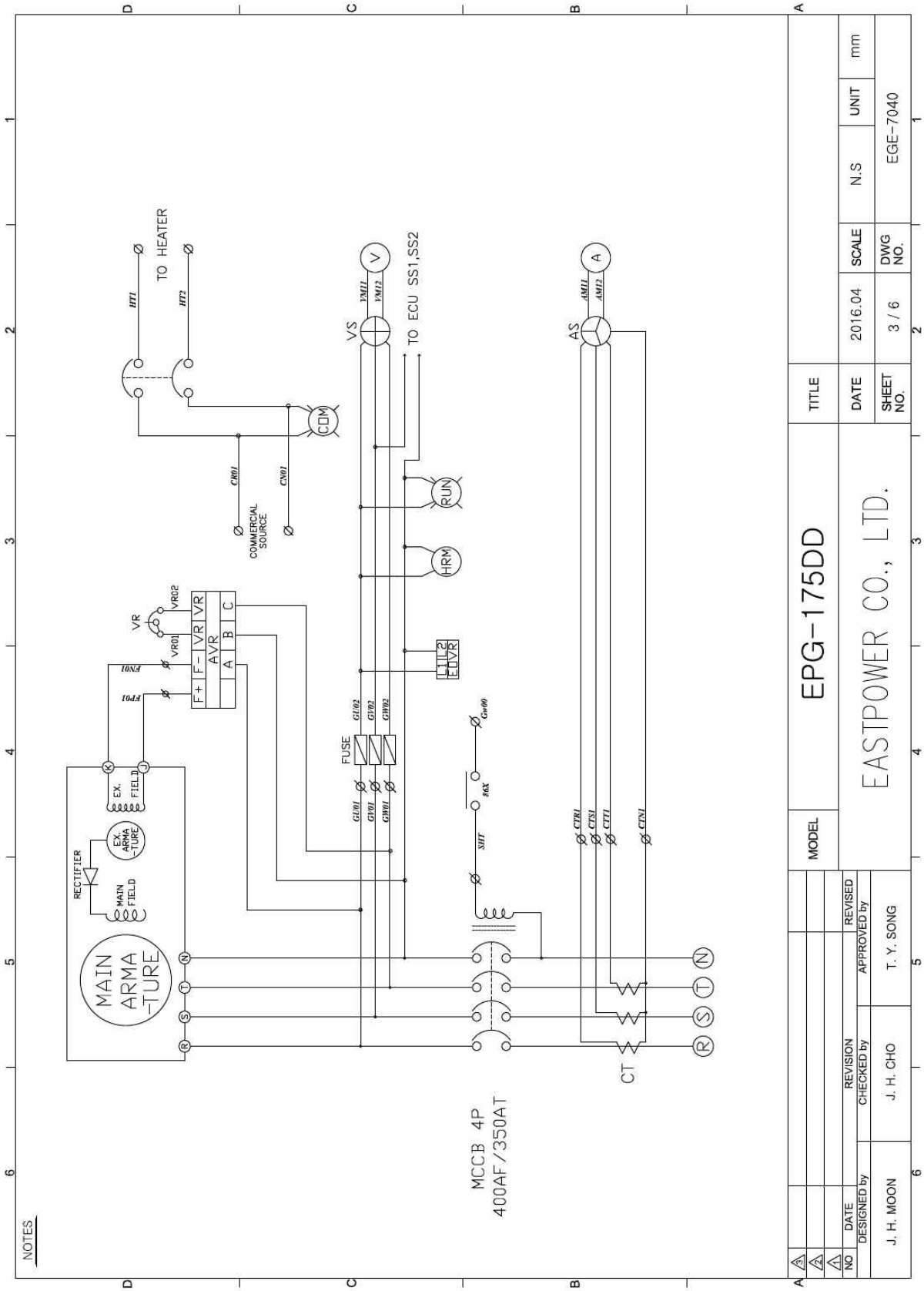

Note
1. Unless otherwise instructed, all wiring should use the cable of 1.5SQ.
2. Symbol description
88X CRANKING AUX. RELAY
5X GOVERNOR AUX. RELAY
86X FAULT AUX. RELAY
6Y GEN. RUNNING AUX. RELAY
14X IDLE AUX. RELAY
27C MAIN SENSING AUX. RELAY
ES EMERGENCY STOP SWITCH
DSE 7320
U V W N
COM(N) CT3(W) CT2(V) CT1(U)
20 29 28 27
19 20 21 22
10A
F1 F2 F3
RED
86X
SHT
SHUNT
MCCB 4P
CT#3
380/220V
60Hz 3P4W
G
EPJ-MODEL
EPG-MODEL
TO AVR
VOLTAGE REGULATOR
TITLE
THREE LINE CIRCUIT DIAGRAM
DATE
2013.09
SCALE
1 : 1
UNIT
mm
SHEET NO.
2 / 5
DWG NO.
EG13032E1
MODEL
DSE 7320
EASTPOWER
REVISION
DESIGNED by
D. R. YUN
CHECKED by
APPROVED by
J. K. YOON

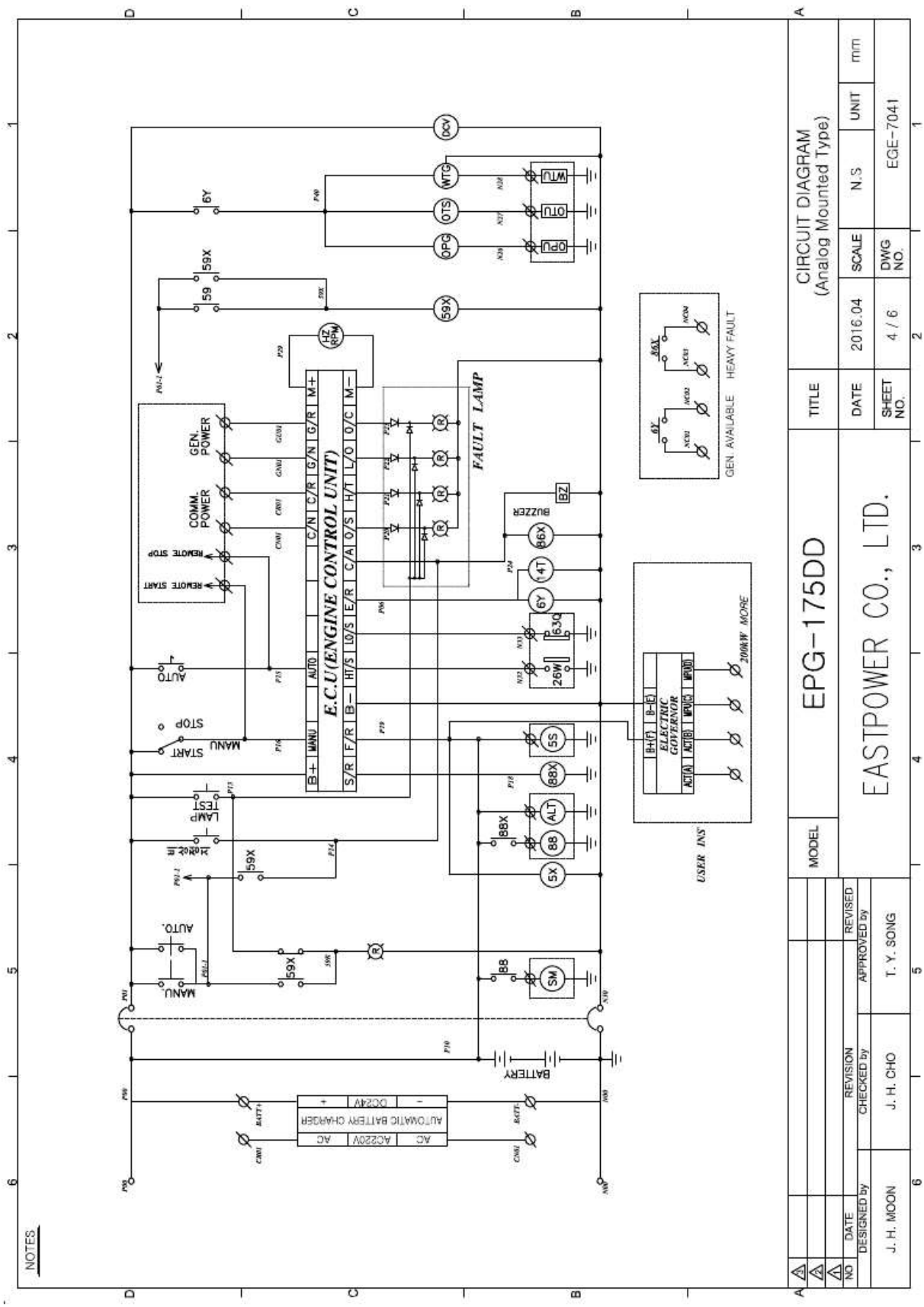

*Note1
GOVERNOR CONTROLLER
DSE 7320
MODEL
DSE 7320
TITLE
DC CIRCUIT DIAGRAM
DATE
2013.09
SCALE
1 : 1
UNIT
mm
SHEET NO.
3 / 5
DWG NO.
EG13032E2
EASTPOWER
DESIGNED by
D. R. YUN
CHECKED by
APPROVED by
J. K. YOON
REVISION
REVISED
DATE
NO

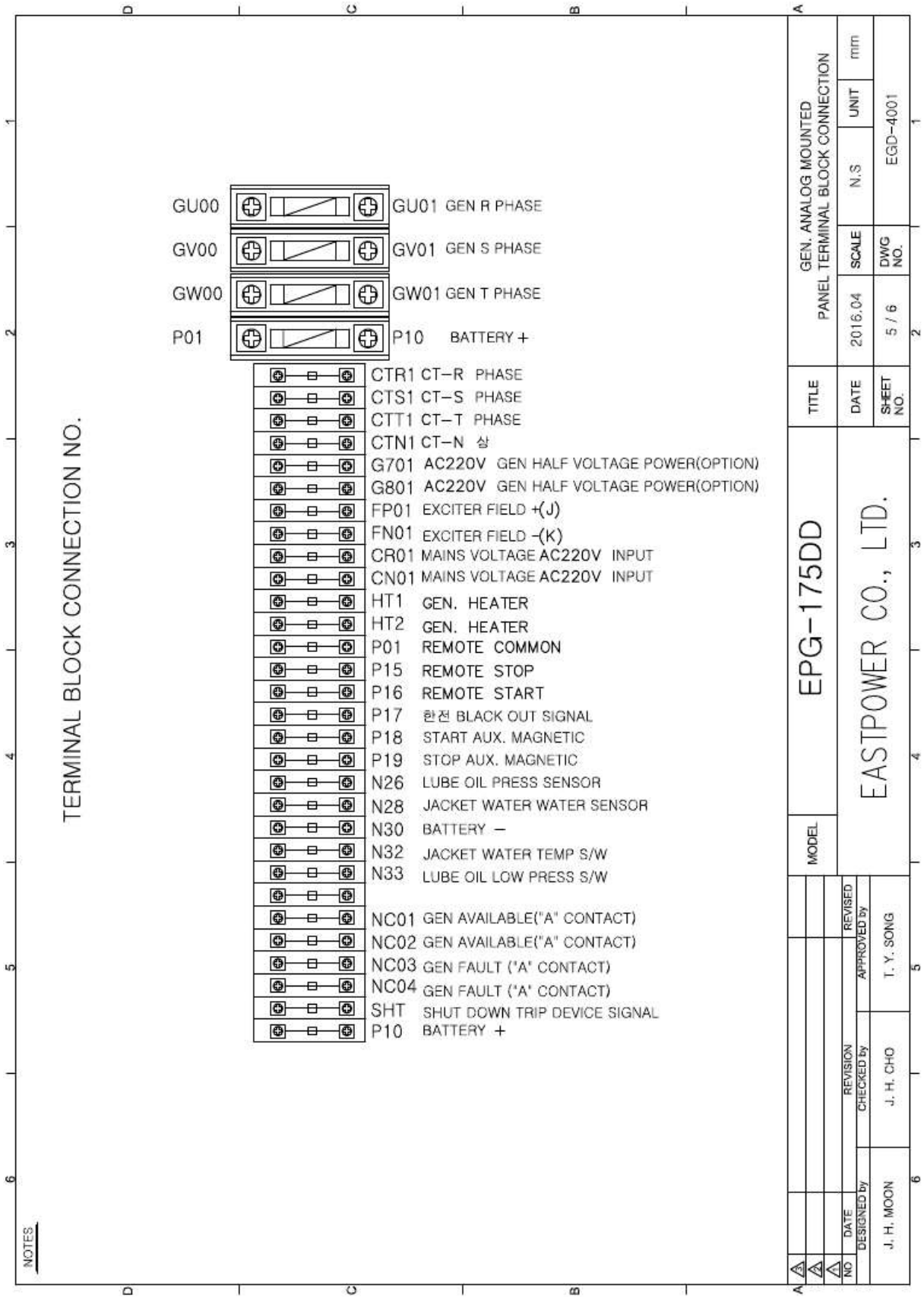

MAIN POWER
(단상 2선식)
AC 220V
(SF CUSTOMER)
CB01
CB02
CB03
CB04
CB31
HEATER
BATTERY
DC 24V
BAT+
BAT-
HT1
HT2
DSE 7320
AUX. AC CIRCUIT DIAGRAM
EASTPOWER
EG13032E3
2013.09
4 / 5
1 : 1
mm
D. R. YUN
J. K. YOON

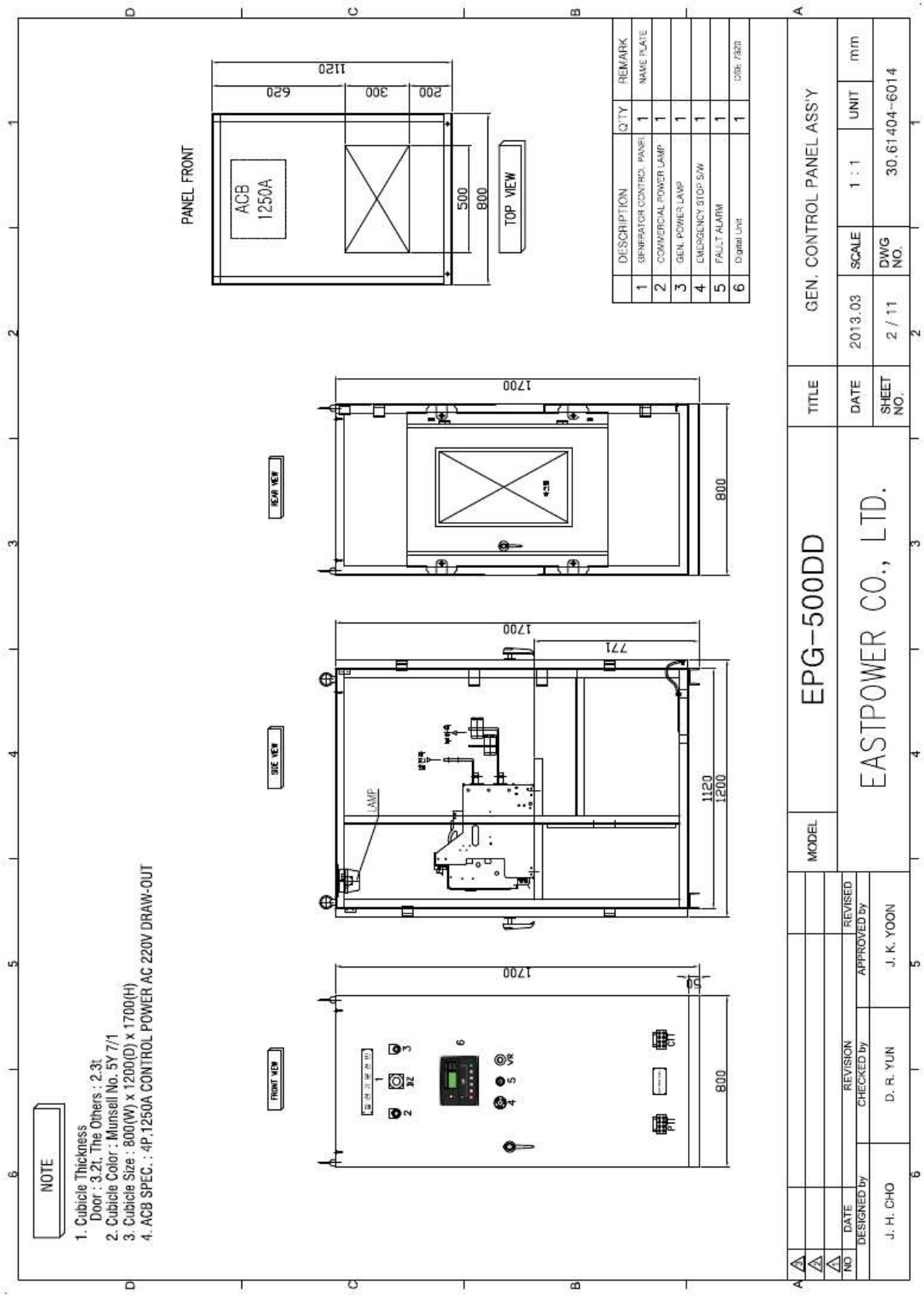

GEN. CONTROL PANEL
GEN. SET
WIRING INSIDE GCP CABLE SPEC.
DESCRIPTION
WIRING NO.
TERMINAL NO.
WIRING NO.
DESCRIPTION
RED 1.5SQ
BLUE 1.5SQ
YELLOW 2.5SQ
YELLOW 1.5SQ
RED 1.5SQ
BLUE 1.5SQ
BLUE 1.5SQ
BATTERY +
BATTERY -
MAIN POWER (AC 220V)
HEATER POWER (AC 220V)
GEN. AC AMPERE
GEN. AC VOLTAGE
VOLTAGE REGULATOR
FIELD
MCCB TRIP SIGNAL
BATTERY + AFTER BREAKER
ENGINE ALTERNATOR
ENGINE CRANKING SIGNAL
BATTERY CHARGER OUTPUT (DC24V)
OIL PRESS. SENSOR
OIL TEMP. SENSOR
WATER TEMP. SENSOR
WATER TEMP. SWITCH
OIL PRESS. SWITCH
SENSOR COMMON
DRY CONTACT (NO)
GENSET RUNNING
DRY CONTACT (NO)
GENSET ALARM
AUTO START - CLOSE: START
- OPEN: STOP
TO BATTERY +
TO BATTERY -
BY CUSTOMER
TO HEATER
TO CURRENT TRANSFORMER
TO ALTERNATOR
TO ALTERNATOR OR AVR
TO MCCB
TO ENGINE ALTERNATOR
TO STARTER
TO BATTERY
TO BATTERY -
TO OIL PRESS. SENSOR
TO OIL TEMP. SENSOR
TO WATER TEMP. SENSOR
TO WATER TEMP. SWITCH
TO OIL PRESS. SWITCH
TO BATTERY -
BY CUSTOMER
20A
15A
DSE 7320
MODEL
EASTPOWER
TITLE
TERMINAL BLOCK
DATE
2013.09
SCALE
1 : 1
UNIT
mm
SHEET NO.
5 / 5
DWG NO.
EG13062E4
NO
DATE
REVISION
REVISED
DESIGNED by
D. R. YUN
CHECKED by
APPROVED by
J. K. YOON

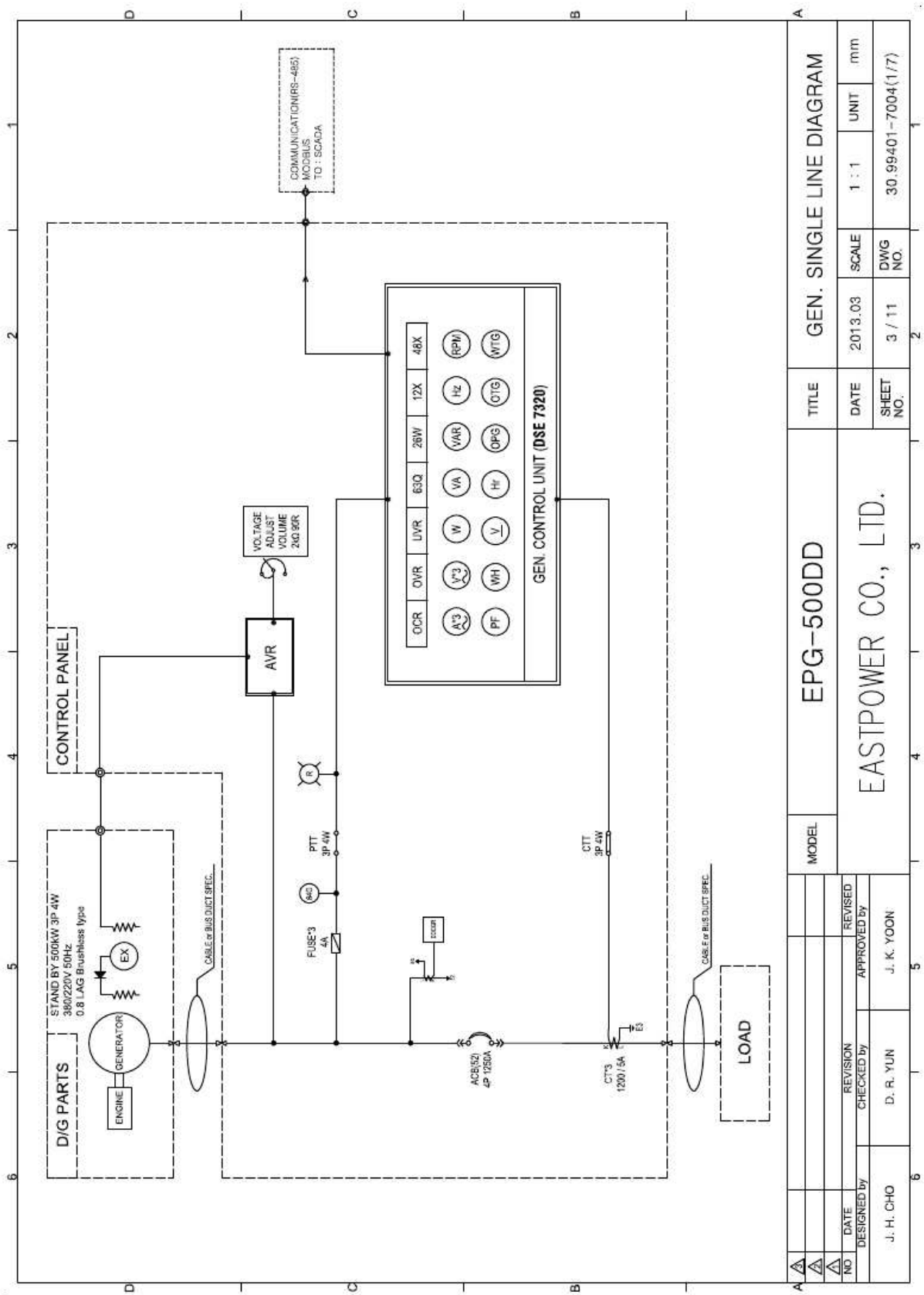

NOTES
EPG-175DD
EASTPOWER CO., LTD.
GEN. CONTROL PANEL ASS'Y
EGP-7036
J. H. MOON
J. H. CHO
T. Y. SONG
370
330
300
180
500
400
ø40 HOLE
180
31

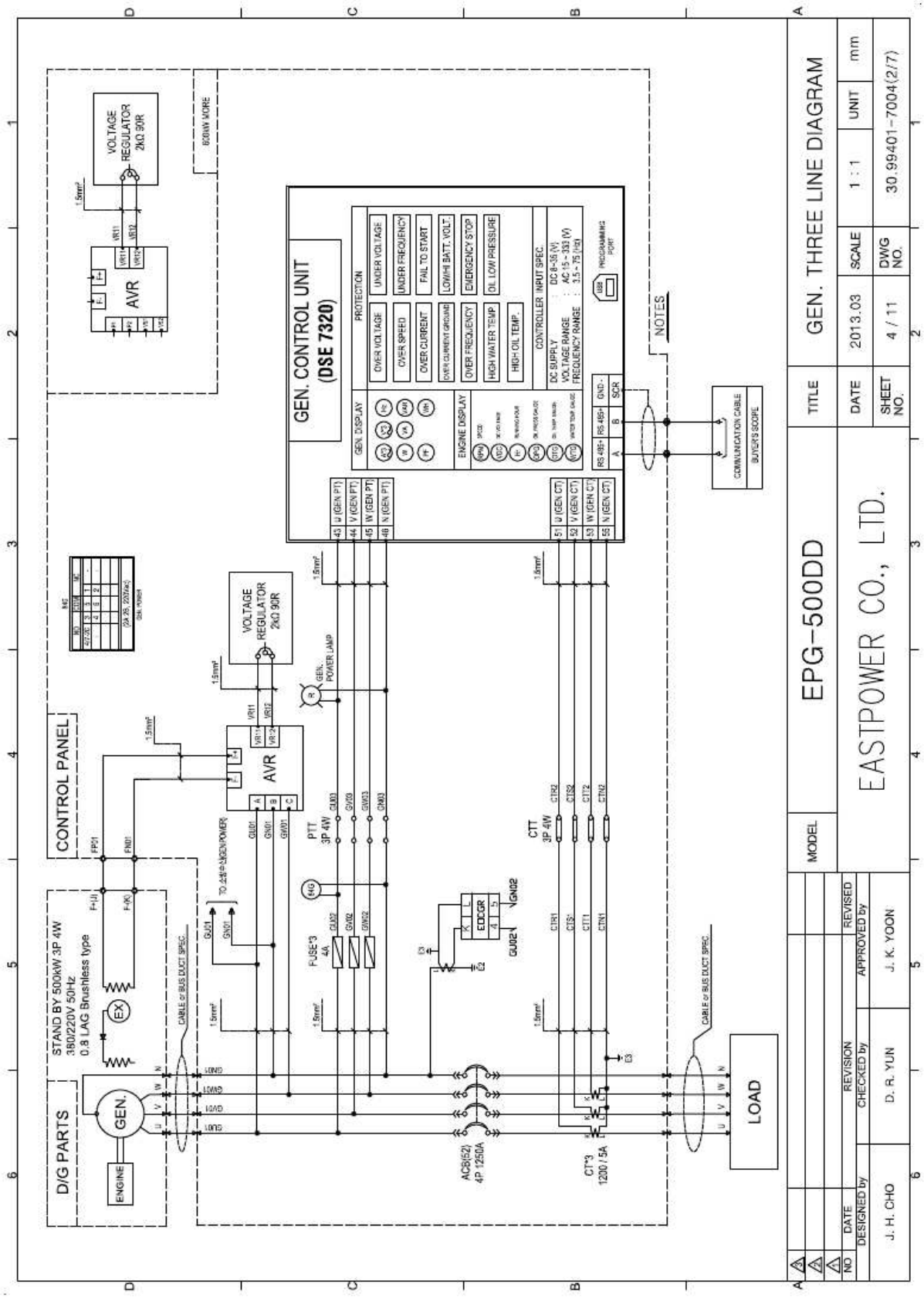

NOTES
TO HEATER
HT1
HT2
CM01
CN01
COMMERCIAL SOURCE
CDM
VS
VM11
VM12
V
TO ECU SS1,SS2
RUN
HRM
L1L2
EDVR
AS
AM11
AM12
A
VR
VR02
VR01
FN01
FP01
F+
F-
VR
AVR
A
B
C
EX.
FIELD
RECTIFIER
EX. ARMA -TURE
MAIN FIELD
MAIN ARMA -TURE
FUSE
GU02
GV02
GW02
GU01
GV01
GW01
Gen80
86X
SHT
CTR1
CTS1
CTT1
CTN1
CT
MCCB 4P
400AF/350AT
R
S
T
N
MODEL
EPG-175DD
TITLE
EASTPOWER CO., LTD.
DATE
2016.04
SCALE
N.S
UNIT
mm
SHEET NO.
3 / 6
DWG NO.
EGE-7040
NO
DATE
REVISION
REVISED
DESIGNED by
J. H. MOON
CHECKED by
J. H. CHO
APPROVED by
T. Y. SONG

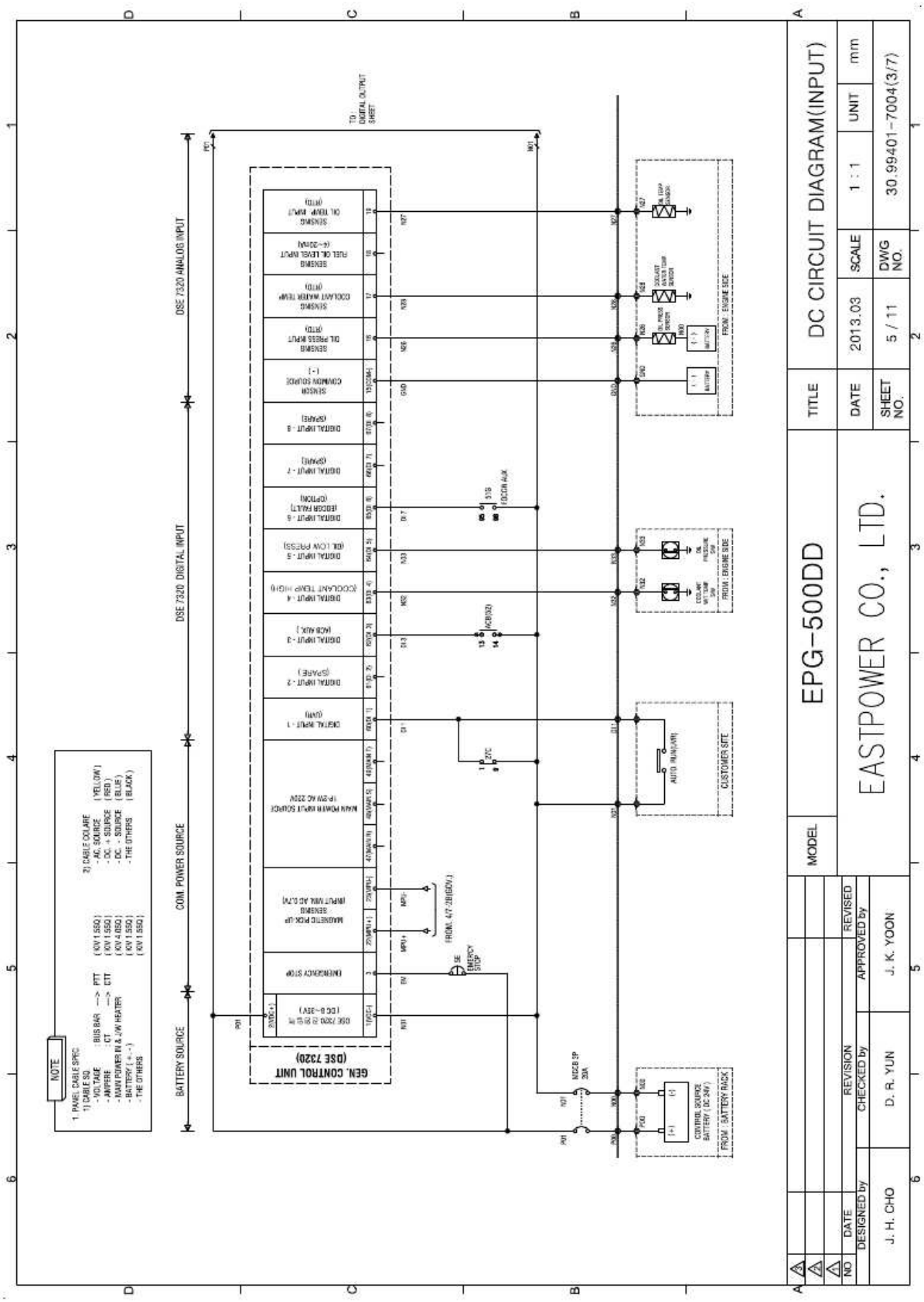

E.C.U(ENGINE CONTROL UNIT)
FAULT LAMP
ELECTRIC GOVERNOR
AUTOMATIC BATTERY CHARGER
BATTERY
BUZZER
GEN. POWER
COMM. POWER
REMOTE START
REMOTE STOP
AUTO
MANU
STOP
START
LAMP TEST
GEN AVAILABLE
HEAVY FAULT
USER INS'
NOTES
MODEL
EPG-175DD
TITLE
CIRCUIT DIAGRAM
(Analog Mounted Type)
DATE
2016.04
SCALE
N.S
UNIT
mm
SHEET NO.
4 / 6
DWG NO.
EGE-7041
EASTPOWER CO., LTD.
REVISION
DESIGNED by
J. H. MOON
CHECKED by
J. H. CHO
APPROVED by
T. Y. SONG

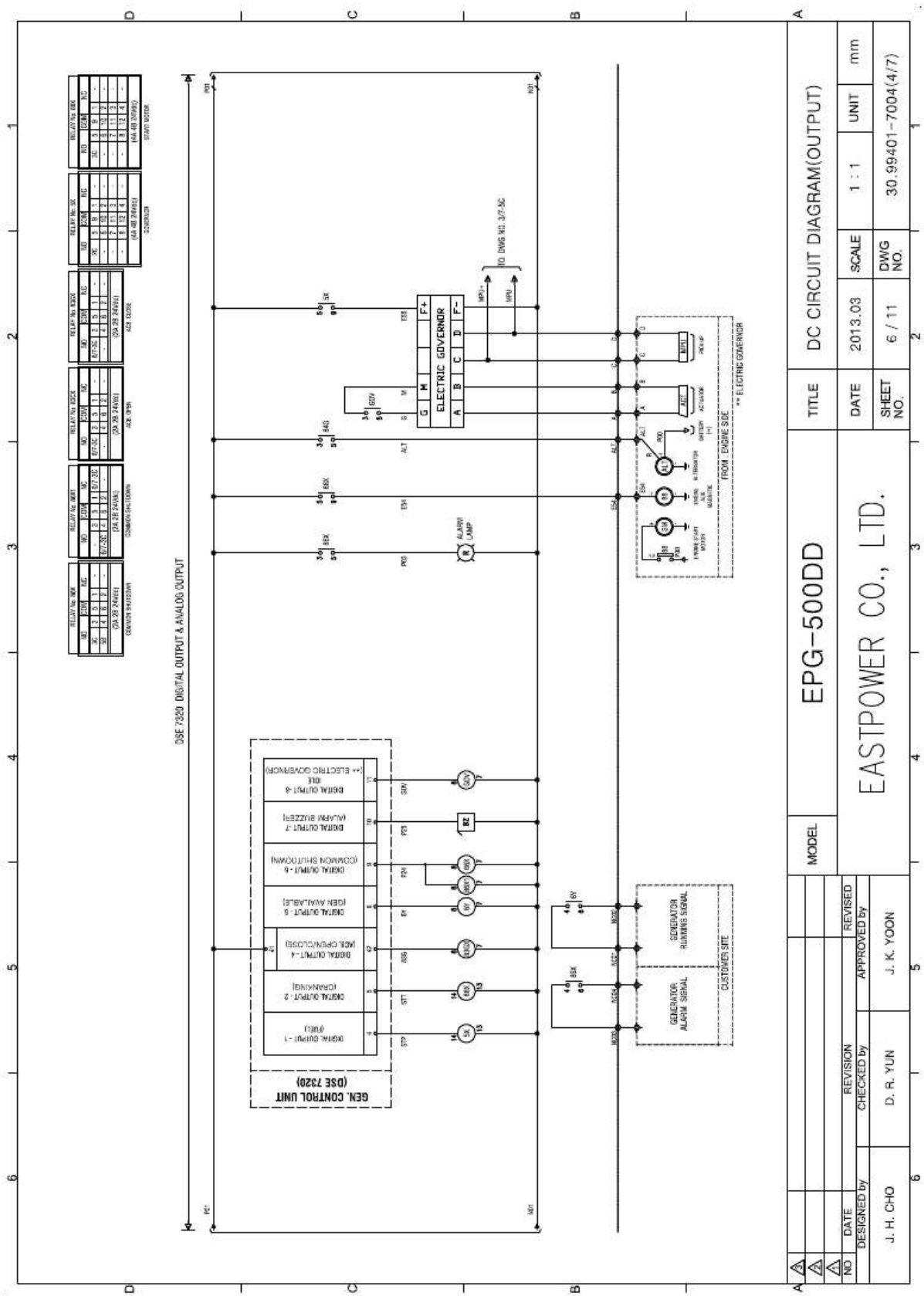

TERMINAL BLOCK CONNECTION NO.
GU00
GU01 GEN R PHASE
GV00
GV01 GEN S PHASE
GW00
GW01 GEN T PHASE
P01
P10 BATTERY +
CTR1 CT-R PHASE
CTS1 CT-S PHASE
CTT1 CT-T PHASE
CTN1 CT-N 상
G701 AC220V GEN HALF VOLTAGE POWER(OPTION)
G801 AC220V GEN HALF VOLTAGE POWER(OPTION)
FP01 EXCITER FIELD +(J)
FN01 EXCITER FIELD -(K)
CR01 MAINS VOLTAGE AC220V INPUT
CN01 MAINS VOLTAGE AC220V INPUT
HT1 GEN. HEATER
HT2 GEN. HEATER
P01 REMOTE COMMON
P15 REMOTE STOP
P16 REMOTE START
P17 한전 BLACK OUT SIGNAL
P18 START AUX. MAGNETIC
P19 STOP AUX. MAGNETIC
N26 LUBE OIL PRESS SENSOR
N28 JACKET WATER WATER SENSOR
N30 BATTERY -
N32 JACKET WATER TEMP S/W
N33 LUBE OIL LOW PRESS S/W
NC01 GEN AVAILABLE("A" CONTACT)
NC02 GEN AVAILABLE("A" CONTACT)
NC03 GEN FAULT ("A" CONTACT)
NC04 GEN FAULT ("A" CONTACT)
SHT SHUT DOWN TRIP DEVICE SIGNAL
P10 BATTERY +
NOTES
GEN. ANALOG MOUNTED
PANEL TERMINAL BLOCK CONNECTION
TITLE
DATE 2016.04
SHEET NO. 5 / 6
SCALE N.S
DWG NO. EGD-4001
UNIT mm
MODEL EPG-175DD
EASTPOWER CO., LTD.
REVISION
NO DATE
DESIGNED by J. H. MOON
CHECKED by J. H. CHO
APPROVED by T. Y. SONG

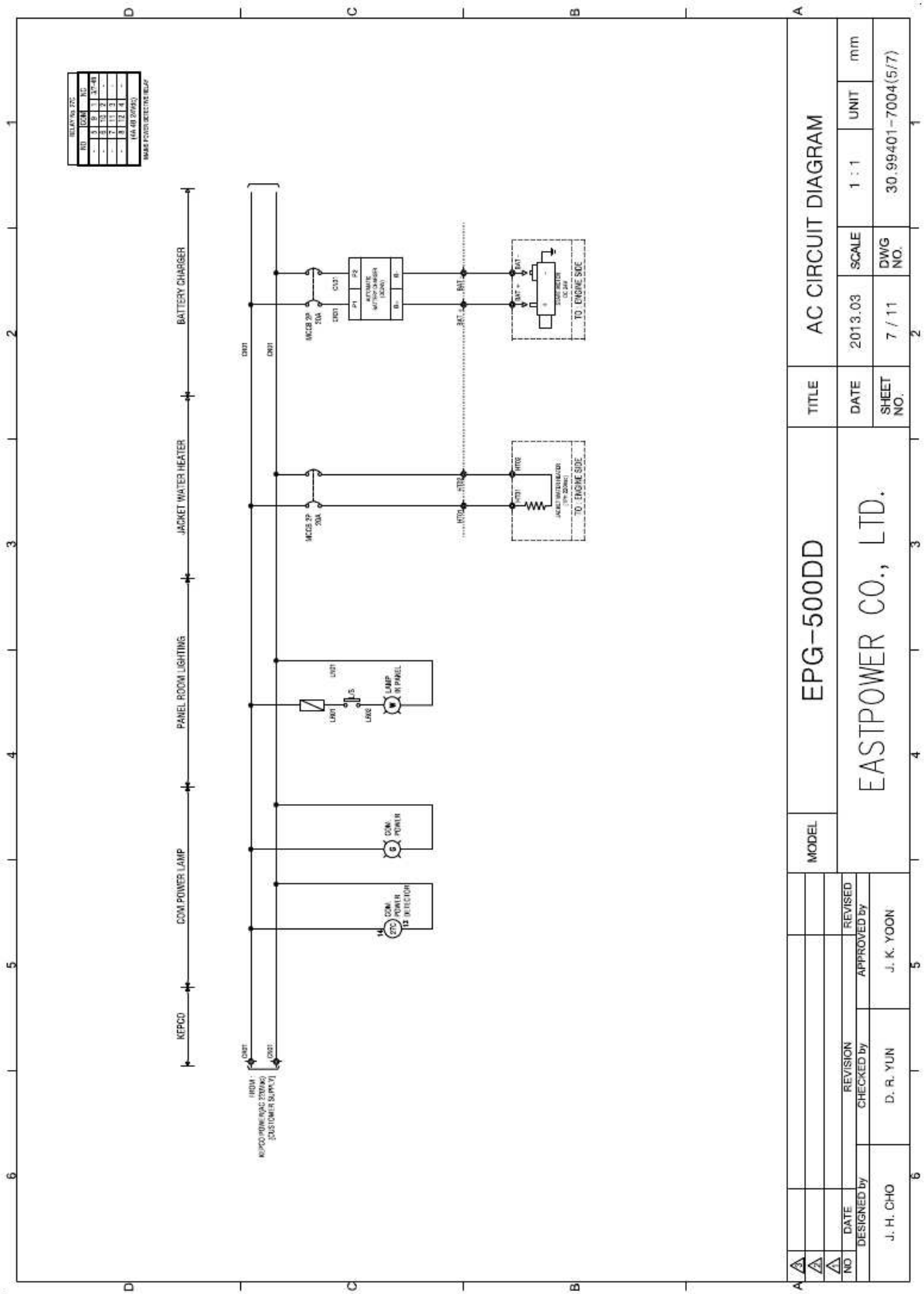

NOTE
1. Cubicle Thickness
Door : 3.2t, The Others : 2.3t
2. Cubicle Color : Munsell No. 5Y 7/1
3. Cubicle Size : 800(W) x 1200(D) x 1700(H)
4. ACB SPEC. : 4P 1250A CONTROL POWER AC 220V DRAW-OUT
PANEL FRONT
ACB 1250A
TOP VIEW
1120
620
300
200
500
800
DESCRIPTION
QTY
REMARK
1 GENERATOR CONTROL PANEL 1 NAME PLATE
2 COMMERCIAL POWER LAMP 1
3 GEN. POWER LAMP 1
4 EMERGENCY STOP S/W 1
5 FAULT ALARM 1
6 Digital Unit 1 DSE 7320
REAR VIEW
SIDE VIEW
FRONT VIEW
LAMP
1700
771
800
1120
1200
50
MODEL
EPG-500DD
TITLE
GEN. CONTROL PANEL ASS'Y
DATE
2013.03
SCALE
1 : 1
UNIT
mm
SHEET NO.
2 / 11
DWG NO.
30.61404-6014
EASTPOWER CO., LTD.
NO
DATE
REVISION
DESIGNED by
CHECKED by
APPROVED by
J. H. CHO
D. R. YUN
J. K. YOON

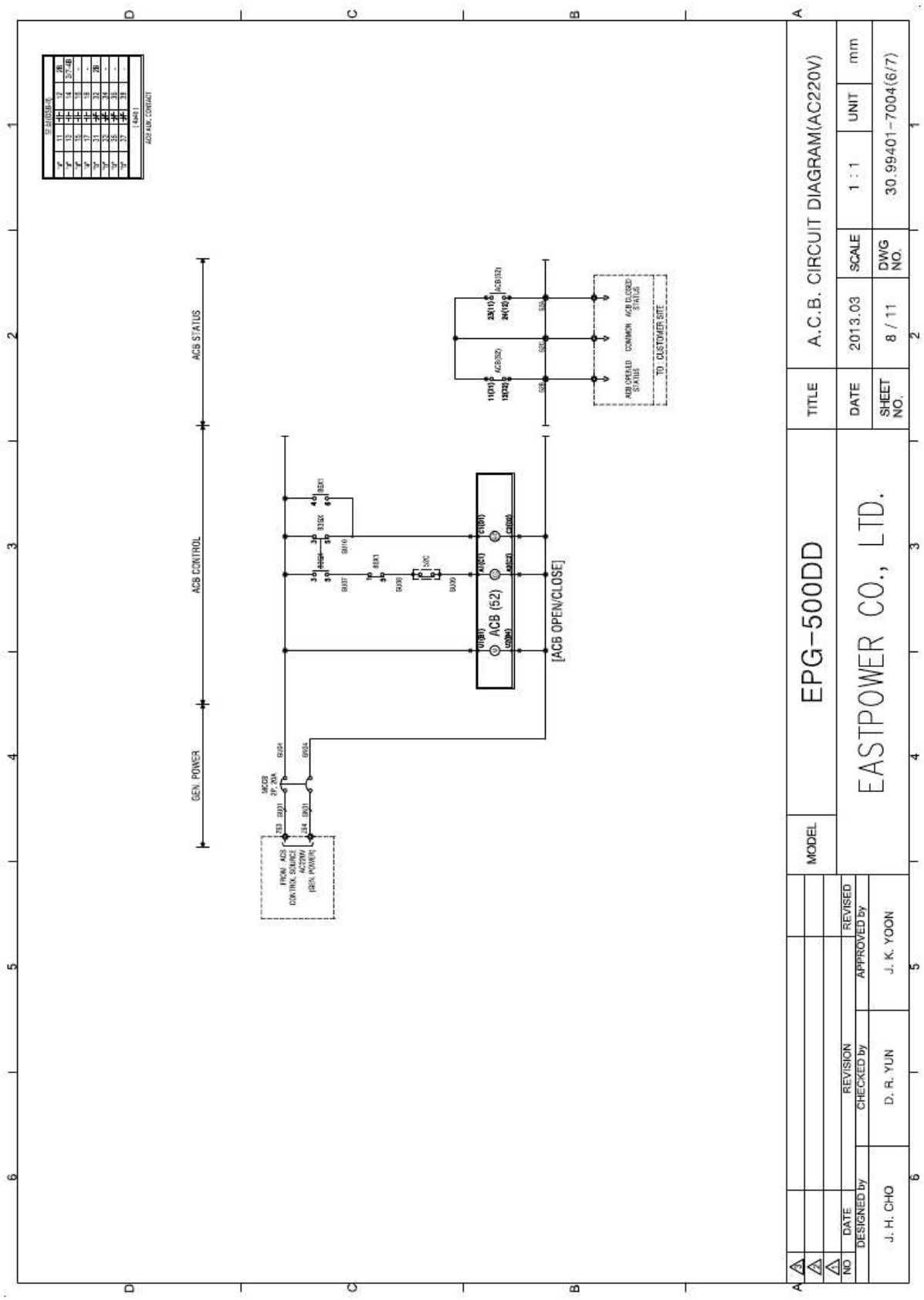

COMMUNICATION(RS-485)
MODBUS
TO : SCADA
CONTROL PANEL
D/G PARTS
STAND BY 500KW 3P 4W
380/220V 50Hz
0.8 LAG Brushless type
ENGINE
GENERATOR
EX
AVR
VOLTAGE ADJUST VOLUME 2kΩ 9CR
GEN. CONTROL UNIT (DSE 7320)
OCR
OVR
UVR
63Q
26W
12X
46X
RPM
Hz
VAR
QPG
OTG
WTG
VA
Hr
W
V
PF
WH
PTT 3P 4W
FUSE*3 4A
CTT 3P 4W
ACB(52) 4P 1250A
CT*3 1200 / 5A
CABLE or BUS DUCT SPEC.
LOAD
EPG-500DD
EASTPOWER CO., LTD.
GEN. SINGLE LINE DIAGRAM
2013.03
3 / 11
1 : 1
30.99401-7004(1/7)
mm
J. H. CHO
D. R. YUN
J. K. YOON

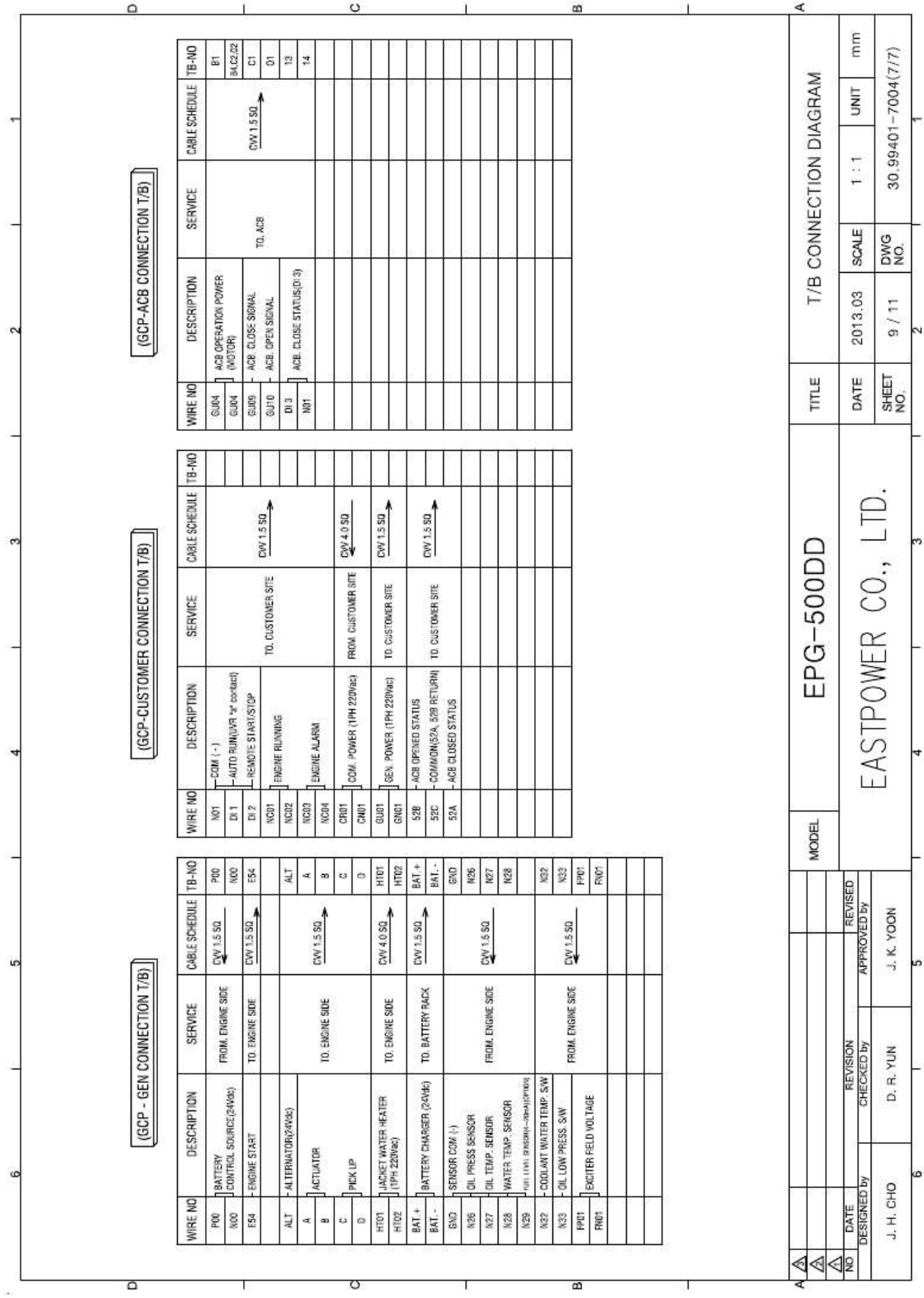

GEN. THREE LINE DIAGRAM
EPG-500DD
EASTPOWER CO., LTD.
MODEL
TITLE
DATE
2013.03
SCALE
1 : 1
UNIT
mm
SHEET NO.
4 / 11
DWG NO.
30.99401-7004(2/7)
GEN. CONTROL UNIT
(DSE 7320)
CONTROL PANEL
D/G PARTS
STAND BY 500kW 3P 4W
380/220V 50Hz
0.8 LAG Brushless type
GEN.
ENGINE
VOLTAGE REGULATOR 2kΩ 90R
AVR
PTT 3P 4W
CTT 3P 4W
FUSE*3 4A
EDOGR
AC8(62) 4P 1250A
CT*3 1200 / 5A
LOAD
NOTES
PROTECTION
OVER VOLTAGE
UNDER VOLTAGE
OVER SPEED
UNDER FREQUENCY
OVER CURRENT
FAIL TO START
OVER CURRENT GROUND
LOW/HI BATT. VOLT.
OVER FREQUENCY
EMERGENCY STOP
HIGH WATER TEMP
OIL LOW PRESSURE
HIGH OIL TEMP
CONTROLLER INPUT SPEC.
DC SUPPLY : DC8-35 (V)
VOLTAGE RANGE : AC 15 ~ 333 (V)
FREQUENCY RANGE : 3.5 ~ 75 (Hz)
GEN. DISPLAY
ENGINE DISPLAY
RS485+
RS485-
GND
SCR
COMMUNICATION CABLE
BUYER'S SCOPE
REVISION
DESIGNED by
CHECKED by
APPROVED by
DATE
J. H. CHO
D. R. YUN
J. K. YOON


DC CIRCUIT DIAGRAM(INPUT)
EPG-500DD
EASTPOWER CO., LTD.
MODEL
TITLE
DATE
2013.03
SCALE
1 : 1
UNIT
mm
SHEET NO.
5 / 11
DWG NO.
30.99401-7004(3/7)
NO
DATE
REVISION
REVISED
DESIGNED by
CHECKED by
APPROVED by
J. H. CHO
D. R. YUN
J. K. YOON
NOTE
1. PANEL CABLE SPEC
1) CABLE SQ
- VOLTAGE : BUS BAR ---> PTT (KV 1.5SQ)
- AMPERE : CT ---> CTT (KV 1.5SQ)
- MAIN POWER IN & J/W HEATER (KV 4.0SQ)
- BATTERY (+ , -) (KV 1.5SQ)
- THE OTHERS (KV 1.5SQ)
2) CABLE COLLARE
- AC SOURCE (YELLOW)
- DC + SOURCE (RED)
- DC - SOURCE (BLUE)
- THE OTHERS (BLACK)
BATTERY SOURCE
COM. POWER SOURCE
DSE 7320 DIGITAL INPUT
DSE 7320 ANALOG INPUT
GEN. CONTROL UNIT (DSE 7320)
TO DIGITAL OUTPUT SHEET
EMERGENCY STOP
MAGNETIC PICK UP SENSING INPUT MAX AC 0.7V
MAIN POWER INPUT SOURCE 1P 2W AC 220V
CUSTOMER SITE
AUTO MAN(AIR)
CONTROL SOURCE BATTERY (DC 24V)
FROM : BATTERY RACK
FROM : ENGINE SIDE
FROM : ENGINE SIDE
FROM : ENGINE SIDE
FROM : ENGINE SIDE


DSE 7320 DIGITAL OUTPUT & ANALOG OUTPUT
GEN. CONTROL UNIT
(DSE 7320)
ELECTRIC GOVERNOR
** ELECTRIC GOVERNOR
FROM ENGINE SIDE
GENERATOR RUNNING SIGNAL
GENERATOR ALARM SIGNAL
CUSTOMER SITE
EPG-500DD
EASTPOWER CO., LTD.
DC CIRCUIT DIAGRAM(OUTPUT)
2013.03
1 : 1
mm
6 / 11
30.99401-7004(4/7)
J. H. CHO
D. R. YUN
J. K. YOON


BATTERY CHARGER
JACKET WATER HEATER
PANEL ROOM LIGHTING
COM POWER LAMP
KEPCO
TO ENGINE SIDE
TO ENGINE SIDE
EPG-500DD
EASTPOWER CO., LTD.
AC CIRCUIT DIAGRAM
2013.03
7 / 11
1 : 1
30.99401-7004(5/7)
J. H. CHO
D. R. YUN
J. K. YOON


ACB STATUS
ACB CONTROL
GEN. POWER
ACB (52)
[ACB OPEN/CLOSE]
TO CUSTOMER SITE
EPG-500DD
EASTPOWER CO., LTD.
A.C.B. CIRCUIT DIAGRAM(AC220V)
2013.03
1 : 1
mm
8 / 11
30.99401-7004(6/7)
J. H. CHO
D. R. YUN
J. K. YOON


(GCP - GEN CONNECTION T/B)
(GCP-CUSTOMER CONNECTION T/B)
(GCP-ACB CONNECTION T/B)
EPG-500DD
EASTPOWER CO., LTD.
T/B CONNECTION DIAGRAM
2013.03
1 : 1
9 / 11
30.99401-7004(7/7)
J. H. CHO
D. R. YUN
J. K. YOON