PT Series PMG Alternator

Operation Manual



FUJIAN POWERTRANS MACHINERY CO., LTD.

Notice

- 1. Dear customer, Thanks for using our PT series PMG Alternator. Our products will serve you with stable and durable performance.
- 2. This manual describes the products characteristics, installation methods, troubleshooting, warranty clauses, precautions, etc.
- 3. Before using, please be sure to read this manual carefully and master the correct operation methods. So as to ensure the products can run in the best condition.
- 4. Our products are constantly improving the performance and quality, and the specifications shall be upgraded accordingly. The manual may have some discrepancies with the actual products, please be aware of it.
- 5. Please keep this manual properly. Our customer service are your backup in 24hrs, welcome to contact us at any time.

General instruction

1. Product Overview

- 1.1 Our permanent magnet frequency conversion generation technology originated in 1999. After decades of practical exploration and dedicated research, we have awarded a number of national invention patents. The PT series is our most advanced generation PMG alternator, it is permanent magnet frequency conversion, high efficiency, AC synchronous alternator. PT series PMG alternator completely solve all disadvantages of traditional PMG alternator and realized the long-term stable and reliable operations in various working conditions.
- 1.2 PT Series meet general international and national standards, has premium performance, excellent quality and maintenance-free. The alternator and prime mover can be rigidly connected or elastically connected. As the small power station, it can be used for land, marine, civil, military and other fields for power generation.

2. Performance advantages

- 2.1. High magnetic energy conversion rate: 1.5 times of the traditional brushless alternator.
- 2.2. Strong inductive load capacity: 2.5 times of the national standards, it can directly start the asynchronous motor with its 100% capacity and run continuously.
- 2.3. High efficiency and energy saving: small internal resistance, low temperature rise, low power ratio, and the PMG genset fuel consumption is 35%-40% lower than the traditional gensets.
- 2.4. Strong overload capacity: 1 hour (120%), 50 hours (100%).
- 2.5. Strong application ability: automatic speed and voltage regulation, stepless frequency conversion, can keep the motor torque unchanged.
- 2.6. Maintenance-free: Compared with traditional alternators, PMG alternators need no

maintenance for any electronic accessories such as AVR, brushes, slip rings, rectifiers, etc.

Characters

1. Mechanical Characters

- 1.1. Housing material: Steel, Cast iron, Alloy
- 1.2. Overall structure: Open, Semi-enclosed, Fully enclosed
- 1.3. Permanent magnet material: high-quality and high-performance NdFeB magnet, which has ultra-high intrinsic coercivity and magnetic induction coercivity, and the working temperature can be maximum 150°C, which is higher than the actual rotor temperature of the PMG alternator, ensuring that the permanent magnet does not lose magnetism for a long time.
- 1.4. High-performance enameled copper wire: The winding use 180-grade polyesterimide enameled wire (temperature resistance up to 180°C), with stable electrical performance, strong overload capacity, good heat shock resistance, high breakdown temperature resistance, and good moisture resistance.
- 1.5. High-quality silicon steel sheet: The use of high-magnetic conductivity, low-loss high-quality silicon steel sheet can effectively improve the efficiency of the PMG alternator, reduce eddy current loss, and reduce the temperature rise.
- 1.6. High-grade insulation varnish: The winding used H-grade (temperature resistant 180°C) silicone resin insulating paint, which has good thermal conductivity, high electrical insulation performance, good adhesion, high mechanical strength, can effectively reduce the noise generated by electromagnetic action, and has good moisture resistance, corrosion resistance, and salt spray resistance.
- 1.7. High-quality bearings: maintenance-free, high performance, long life, environmental friendly, reliable and durable excellent performance.
- 1.8. In the rotor design, a special inlaid structure is adopted to effectively improve the efficiency and prevent damage to the permanent magnet.
- 1.9. In the stator design, it is different from the existing synchronous alternator, increase the efficiency and reduce the losses.
- 1.10. Installation types: single bearing with standard SAE plate connection, double bearings with standard shaft, flange end cover connection and transmission wheel connection.

2. Electrical characters

2.1. Rated voltage 350-460 V, rated frequency 45-60 HZ; rated speed 1350-1800rpm/min; three-phase four-wire system.

2.2. The increase and decrease of the frequency and voltage can be adjusted by the RPM. The

starting modes can be set as Zero speed, fixed speed, variable frequency, etc. Variable frequency running is available.

2.3. The alternator is a permanent magnet variable frequency brushless high-efficiency AC synchronous alternator.

- 2.4. Insulation class: H
- 2.5. Protection level: IP23 IP44 IP62
- 2.6. Temperature rise: ≤50°C
- 2.7. Three-phase voltage adjustable range: $0 \sim 480$ V
- 2.8. Working conditions: ambient temperature $-30 \sim +50$; relative humidity has no limit.

Installation

1. Inspection

Before receipted, please check the following items:

1.1. Check the shipping list with the actual product.

1.2. Check if there are any damages, rust, or missing accessories.

1.3. The rotor was fixed for the preventing the bearings damaged during the transportation, check the fixture and remove it.

1.4. Manually rotate the shaft by hand or simple tools and ensure it can rotate smoothly.

1.5. Check the nameplate and confirm the output power, voltage, current, frequency, speed, and production date.

2. Storage

If the PMG alternator is stored for more than 3 months between the arrival and the first time operation, or if it would stop running for more than 3 months after operation, please proceed the following steps:

2.1. Set the PMG alternator in a normal installation position, cover it with a waterproof cloth, and place it in a dry environment.

2.2. Shaft rotation: Every 3 months (and before long-term storage), run the PMG alternator for few minutes, or rotate the shaft by hand for dozens of turns.

2.3. High quality maintenance-free bearings: If the storage period exceeds 5 years, pay attention to the bearing noise during the trial running, and replace the bearing if it was confirmed that there is noise.

2.4. Winding insulation resistance to ground: For the PMG alternator that have stopped running for a long time, measure the winding insulation resistance every 6 months or before the start of operation. The PMG alternator can be used only when the insulation resistance is more than $2M\Omega$ at room temperature.

3. Installation

3.1. Installation location

3.1.1. The permanent magnet generator should be installed in a well-ventilated place, and the heat generated by the generator should not be recirculated back to the air intake side. In places with extremely high ambient temperatures, when the heat is radiated or conducted, the load should be reduced.

3.1.2. The air intake of the permanent magnet generator cooling fan should be kept at a distance of more than 20 cm from the wall.

3.1.3. It should be installed on a solid, rigid foundation where external vibrations will not be transmitted to the motor. If the vibration is large during operation, the bearing life will be reduced.

3.2. Installation precautions

The PMG alternators were provided to the supporting manufacturers as a part of the generator set. The Coaxiality of the PMG alternator and the engine must be aligned when assembled to avoid abnormal operations and/or the early worn out.

3.2.1. For installing the single-bearing PMG alternator to the engine, need a solid adjustable plate to be fixed at the bottom of the PMG alternator. By adjusting the position of the PMG alternator on the plate to ensure the coaxiality. In order to reduce the vibration of the genset, it is recommended to use an elastic coupling to minimize the torsional vibration. When aligning the double bearings PMG alternator, the axial and radial deviations between the PMG alternator and the engine should be checked. The deviation should be less than 0.2mm, otherwise the transmission connection part would be easier to be worn out, and the unbalancing force on the bearings would cause the bearings damage.

3.2.2. When the double bearings PMG alternator and the engine were installed by the transmission belt, need a solid adjustable plate to fix at the bottom of the PMG alternator. By adjusting the position of the plate to ensure the parallelism between the alternator shaft and the engine shaft, and adjust tightness of the transmission belt. If the deviation is too large, the unit will vibrate greatly, the transmission belt will wear out quickly, and the bearing will be damaged due to uneven force on the bearing.

3.2.3. When the single bearing PMG alternator is installed to the engine directly, alignment is very important. If the alignment is not accurate, the winding of the PMG alternator and the engine transmission connection part will vibrate. In order to ensure the alignment accuracy, need

to insert the metal shims under the feet of the PMG alternator according to the actual deviation.

3.2.4. Angle alignment: refers to the angle difference between the bearing line of the PMG Alternator and the center line of the engine crankshaft. Usually this center line error is caused by the inserted metal shims, and too much angle difference can easily cause the genset vibration.

3.2.5. Angle correction: Fix a dial indicator on the shaft of the permanent magnet generator to measure the deviation. Turn the engine clockwise to face the flywheel. At each reading, do not reverse the engine due to compression, and read the total deviation number (maximum positive value ~ maximum negative value) after one rotation. If the upper reading is positive and the lower reading is negative, it indicates that the permanent magnet generator bearing position is high. The position of the permanent magnet generator can be lowered by removing an equal amount of shims from under the permanent magnet generator installation foot. If the left and right deviations are large, the permanent magnet generator base should be pried to obtain a smaller deviation.

4. Electrical wiring

4.1. There are insulated terminals in the junction box for phase and neutral connection and spare grounding screws. The additional grounding point is on the foot of the PMG alternator.

4.2. According to the specified rated current value to choose the cable diameter to avoid the cable overheating.

4.3. The three-phase four-wire external cable should be connected to the screws which marked with U, V, W, and N (neutral line) on the terminals.

4.4. The cable ends should be connected by copper joints. When stripping the cable insulation layer, the insulation layer should be retained to \leq 5mm away from the copper joint.

4.5. The minimum space between cables should be kept. When the voltage is less than 500V, the space between the cables should be more than 8mm; when the voltage is $500V \sim 1KV$, the space between the cables should be more than 14mm.

4.6. The external cables should to be fixed to the terminal by 8.8 grade steel screws with shock-proof washers.

5. Electrical inspection

5.1. Before running the PMG alternator, disconnect the external load equipment and use a 500VDC DC insulation resistance tester (such as megger) to measure the resistance among the windings of the PMG alternator and the resistance between the windings and the frame.

5.2. The insulation resistance of new and dry windings is above $100M\Omega$. If the insulation resistance is lower than $100M\Omega$, it may be caused by moisture or dust. During operation, the winding insulation resistance may decrease due to changes of the environment and working conditions.

5.3. Whether the PMG alternator is brand new or used, it should be stopped since its winding insulation resistance is less than $2M\Omega$. The winding should be dried, disassemble the rotor so as to clean and drying the winding thoroughly.

5.4. The methods of improving the winding insulation resistance.

5.4.1. Dry the PMG alternator in an oven at 100° C for 24 hours.

5.4.2. The DC power supply used should be in the range of 0-24V and can provide 1.0A current. Use a suitable cable (be able to withstand the rated current of the PMG alternator) to short-circuit the main windings on the main terminal. Place an AC clamp ammeter on the short-circuited cable and turn on the PMG genset to monitor the short-circuit current. During the entire drying process, the current must not exceed the rated current of the PMG alternator. Normally the drying process takes 3 hours. After the drying procedure, measure the winding insulation resistance. If it is higher than $2M\Omega$, the PMG alternator can be put into use. If it's lower than $2M\Omega$, the above drying procedure needs to be repeated.

6. Mechanical inspection

6.1. The rotor rotates smoothly without touching any parts.

6.2. All bolts, fasteners and electrical connections are suitably fixed.

6.3. Inside the terminal box, there should be clean, free of debris and cable residues.

6.4. The fan cover and terminal box cover are installed for protections, should not be opened until the unit is shut down.

Operation

1. Trail operation

1.1. In principle, the PMG alternator should run at the lowest possible speed with unloaded at the initial operation stage. After confirming that there is no abnormality, start the loaded

operation.

1.2. Check the following items after starting.

- 1.2.1. If there is abnormal noise from the bearings?
- 1.2.2. If there are any abnormal noise or vibrations inside?
- 1.2.3. If there are any abnormal smells such as burning insulation?
- 1.2.4. At rated RPM, if the voltage and current are match the rated values.

2. Routine operation

After the above trail operation and inspections, follow the steps of single unit operation, no-load operation, and full-load operation. If there is no abnormality, then the routine operation can be started.

Failures

1. Troubleshooting: If there are any abnormal situations occur during the operation, it should be stopped immediately for inspection and troubleshooting.

2. Mechanical failures: vibration, noise, abnormal temperature, bearing

Failures/Causes	How to solve
Single bearing with SAE connection:	Refer to <installation 3.2=""> for</installation>
Coupling misalignment	troubleshooting
 Defective installation of the common chassis 	
Connected with double bearings:	
The parallelism deviation between the PMG	
alternator and the engine output shaft is too big	
The inappropriate tightness of the transmission	
belt	
■ Worn out of the transmission belt	
■ The engine power is too small to match the	Change bigger power engine
alternator cause the engine stalled	
 Alternator overload operation 	Change suitable alternator
• Load equipment failure causes the load current	Refer to <installation 5.1=""> for</installation>
and power increased	troubleshooting
■ The load on one phase of the alternator is too	
and causes the unbalanced load vibration	
Short circuit on the alternator stator	
■ The alternator was hit and the coupling plate	Replace the corresponding parts or return to
was damaged	the factory for repair
■ The alternator was hit, the stator and rotor are	
misaligned, damaged or short-circuited	
■ The alternator was hit and the fan was	

damaged or loosen	
■ Alternator overheat (35°C higher than ambient	Check the fan is working normally or not,
temperature)	check the alternator is overloaded or not
■ The bearing tilt and big vibration	Check the alignment or replace the bearings
■ The bearing overheat (50°C higher than	
ambient temperature)	
■ The bearing grease emulsification, raceway	
depression, steel ring corrosion	

Clectrical Failures:

Failures	Causes	How to solve
Alternator	■ The alternator voltage meter is	Check the alternator output voltage and control
not	damaged or wrong wiring	panel circuit or replace the voltmeter.
generating	■ Loose or disconnected wiring	Use multimeter to check the fault point of the
electricity	points	circuit, tighten it or re-solder it.
	 Stator winding damaged 	Refer to <installation 5.1=""> to check the</installation>
		insulation between the alternator phases and the
		ground.
Output	Loading cable is too long	Increase the output voltage, or move the genset
voltage too		closer to the load equipment
low	■ The voltage meter failure	Check the alternator output voltage and control
		panel circuit or replace the voltmeter.
	■ The alternator speed too low	The engine speed can be adjusted according to
		actual demands.
	■ Load equipment failure causes	Check the load equipment circuit diagram and
	alternator overload	repair or replace the load equipment.
Output	■ The alternator voltage meter is	Check the alternator output voltage and control
voltage too	damaged	panel circuit or replace the voltmeter.
high	■ The alternator speed too high	Reduce the alternator speed, less than
		1800RPM.
Output	■ The alternator speed unstable	Check the engine speed and adjust it to a stable
voltage		level.
fluctuate	■ The connections of the load	Check the fault points of load equipment and
dramatically	equipment or the alternator are	alternator circuit, and tighten or re-weld them.
	loosen	
	• The insulation resistance of	Refer to <installation 5.1=""> to check the load</installation>
	the load equipment or alternator	equipment and alternator circuits, check the
	winding is low	insulation between the load equipment and the
		alternator windings, and among the phases and
		the ground.

Output	■ External load cable or	Refer to <installation 5.1=""> to check the</installation>
voltage	inductive load equipment	insulation between the external load cables and
imbalance	failure . Single-phase operation	the inductive load equipment, and among the
		phases and the ground, if these caused the
		three-phase voltage imbalance.
	■ Uneven load on three phases	When the single-phase load is concentrated on
	of the alternator	one phase, it will cause three-phase voltage
		imbalance. Measure the current of each phase
		and redistribute the load of each phase.
	■ The alternator stator winding	Measure the voltage at the alternator output
	failures	terminal when running with no load. If the
		three phases are unbalanced, the stator winding
		of the alternator is damaged. The alternator
		need to be returned for repairing.
Overheat of	■ Load equipment failure causes	Check the load equipment circuit diagram and
the external	alternator overload	repair or replace the load equipment.
loading	■ The external loading leads is	Use thicker external loading leads.
cable	too thin	
	■ The external loading leads is	Increase the output voltage, or move the genset
	too long	closer to the load equipment
Load	■ The load equipment	Check the fault points of load equipment, and
equipment	connection is loose or	tighten or re-weld them.
problems	disconnected	
	■ The load equipment is	Check the load equipment circuit diagram and
	damaged.	repair or replace the load equipment.
	 Reversed rotation of load 	Exchange the positions of any two of the three
	equipment	U, V, W live wires.

Warranty

- 1. The warranty period of the PT series PMG alternator is 18 months from the production date on the nameplate.
- 2. In warranty period, with correct operation conditions and the failures were only caused by the product materials and/or production procedures, our company will provide free spare parts for replacements.
- 3. During the period that after the warranty period and within 60 months from the production date, if the failure of PMG alternator is completely caused by materials and/or manufacturing under the condition of correct operation, our company will charge for the replacement spare parts.
- 4. For improper operations, unauthorized dismantling, modifications, and other force majeure, the company will not assume the warranty responsibility

Notice

1. Before using (installation, operation, maintenance, inspection), please read this manual carefully. The PMG alternator operator should be qualified and familiar with the relevant knowledge, safety measures and precautions.

2. Ensure the correct connection of the external load cable.

3. The PMG genset should be preheated for 10 to 20 minutes to ensure the normal operation of all components before increase the loaded operation.

4. When the loading increased, pay attention to the voltage and current changes. If there is any abnormality, the genset should be stopped and checked.

5. It is forbidden to disassemble any parts of the PMG alternator and the cover with safety marks when the genset is working.

6. The PMG alternator should be well grounded during installation to ensure personal safety. For the transmission connection style, a protective cover should be installed around the transmission wheel and the transmission belt to ensure personal safety.

7. When starting a high-power device during the operation, it is recommended to start from zero RPM to reduce the impact of the equipment on the PMG alternator and the engine.

8. It is strictly forbidden to overload the PMG alternator. If any abnormal situation occurs during the operation, it should be stopped immediately and contact us in time. It is not allowed to handle it without authorization to avoid unnecessary losses.

9. POWERTRANS company reserves the final right of interpretation of this instruction manual.

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