

# TURBO GENERATOR SERIES

## GUANGZHOU GUANGZHONG ENTERPRISE GROUP CORP.

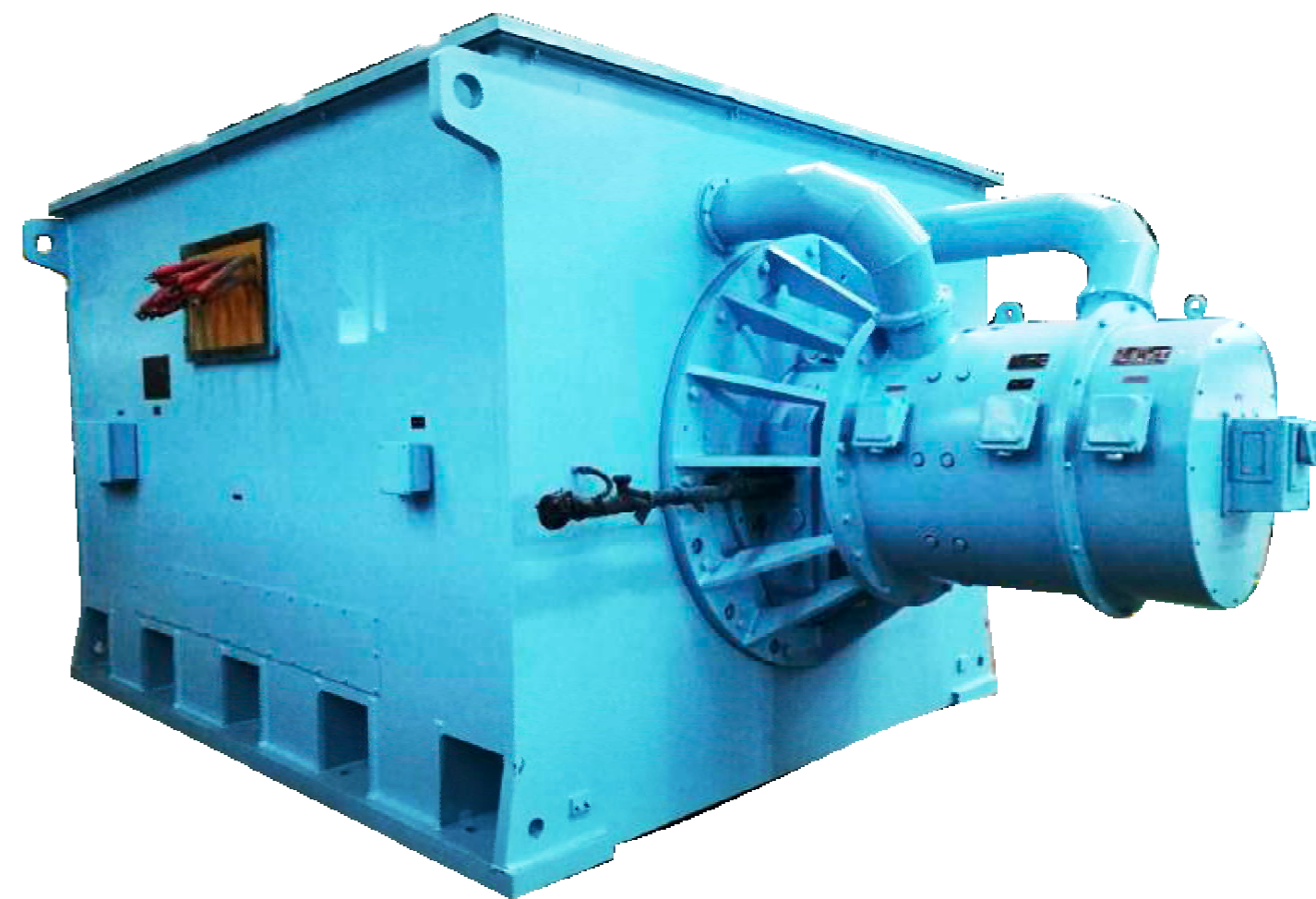
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GUANGZHOU GUANGZHONG ENTERPRISE GROUP CORP.





CNC composite machining center



Rotor installation



Dh8 high speed dynamic balancing machine



Stator installation

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## Introduction

Guangzhou Guangzhong Enterprise Group Co., Ltd. with the 70 years history is the core enterprise of Guangzhou Intelligent Equipment Industry Group. It is the backbone enterprise of China's machinery industry and the key enterprise of equipment manufacturing industry in Guangdong province. The company has the strong technical force, sophisticated equipment, advanced test methods. The design and manufacturing qualification has been recognized by domestic and international authoritative institutions, with a number of qualifications for design, manufacturing, measurement, installation. The company has made a number of China's first machine products, filling a number of gaps of the domestic machine manufacturing technology ; Over the past 70 years, it has produced thousands of varieties of machinery and equipment products for more than 20 countries and regions in China and in the world.

In 2007, after the former Guangzhou Electric Machinery Factory Co., Ltd. was integrated into Guangzhong Group through asset restructuring. Relying on the large and precise processing equipment of the group, the company introduces domestic first-class design technology and high-end talents and adopts new design methods. On the basis of the original medium size motors and generators, the company focuses on the development of generator production. Currently, the company has the design and production of 2-pole and 4-pole invisible- pole turbo generators with voltage class from 3kV to 13.8kv of 36MW or less.

The 2-pole series and 4-pole series generators produced by the company can be matched with steam turbine, industrial turbine, gas turbine, diesel engine and other main engines. The generators are widely used in garbage power generation, mobile power station, self-provided power station, residual heat and pressure power generation, biomass power generation, offshore platform and other industries.



Turbo generator



# Turbo Generator Series

# PRODUCT



## Features of turbo generator products

- 1 The generator above 3MW produced by the company can be combined with four kinds of rotating speed towing motors, namely 3000, 3600, 1500 and 1800r/min, available for users to choose the two international general power supply frequency of 50Hz and 60Hz, in which 3000 (3600) r/min corresponding to 2-pole invisible-pole generator, and 1500 (1800) r/min corresponding to 4-pole invisible-pole generator.
- 2 The company produces 2-pole and 4-pole turbo generators, drawing on years of domestic and foreign experience in manufacturing and operation of 3-40mw generators and summarizing the deficiencies. In the electromagnetic scheme, the most advanced simulation software and the finite element method are used to optimize the design of the motor, reducing the stator slot leakage repulsion and motor end magnetic leakage of traditional products; In the ventilation, the traditional and old-fashioned centrifugal ventilation with high noise and low efficiency has been eliminated, reducing vibration and noise, so that the operation reliability and the overall efficiency are improved, 0.2% ~ 0.6% higher than the national standard and domestic similar products.
- 3 The generator can adopt coaxial brushless excitation mode or static SCR rectifier excitation mode according to users' requirements.
- 4 The motor is air-cooled.
- 5 All the parts and components of the products are inspected by first class index in the national classification standard. The motor is tested before delivery to ensure the quality of synchronous generator.

## Product features

The structures of our generators are unique in providing multiple structures on request:



### Traditional type

After the performance test of the complete machine, the motor and the rotor are shipped separately, and they are re-installed at the site after being calibrated center. The cooler is in the cooler room under the generator stator in the traditional way. This structure is reliable and economical and is most commonly used. This structure is mainly used in the dipole turbo generator produced by our company.



### Pedestal bearing integral type

The stator, rotor, pedestal bearing and exciter of the motor are installed as a whole, the cooler is shipped separately, and the stator and rotor are not re-calibrated center at the site. This structure is convenient for installation and debugging, and not necessary to build a cooler room. But it is heavier and more expensive than the traditional model. The quadrupole turbo generators produced by our company mainly adopt this structure and are used for generating units above 30MW.



### End cap bearing integral type

The stator, rotor, end cap bearing and exciter of the motor are installed as a whole, the cooler is shipped separately, and the stator and rotor are not re-calibrated center at the site, cheaper than pedestal bearing integral type. The air cooler is installed directly above the generator, and the weight and the price are somewhere in between the above two structures. Our four-pole turbo generators mainly adopt this structure.

## Execution standard

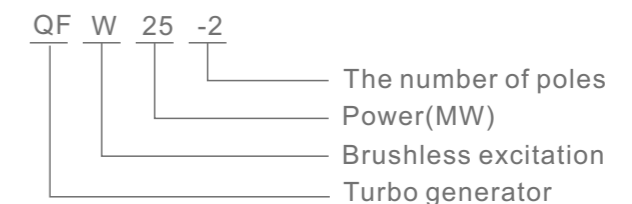
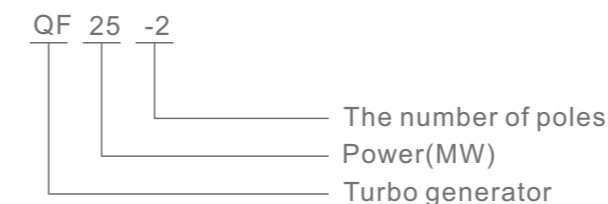
The generators are designed and manufactured in accordance with GB/T 7064 technical requirements for invisible-pole synchronous generator, (This standard is equivalent or stricter than IEC600304-3:2007). And the latest version of the following standards are regarded as the design and manufacturing standards for generators:

- IEC60034-1 Rotating electrical machines - Part 1: Rating and performance
- IEC60034-3 Rotating electrical machines - Part 3: Specific requirements for cylindrical rotor synchronous machines
- IEC60034-4 Rotating electrical machines - Part 4: Methods for determining synchronous machine quantities from tests
- Gb755 Rate and performance of rotating motor
- GB/T 7064 Technical requirements for invisible-pole synchronous generator
- GB/T 1029 Test method for three-phase synchronous motor
- GB/T 7409.3 Technical requirements for excitation system of large and medium-sized synchronous generator
- JB/T 7784 Technical requirements for alternating current exciter for turbine synchronous generator

## Power supply performance index "tolerance" :

project	Voltage fluctuation	Frequency fluctuation	Efficiency	Noise
Tolerance index	±5%	±2%	-0.1×(1-η)	+3dB

## Model specification



- Power range: 3000 ~ 36000kW
- Rated voltage : 3 ~ 13.8kV
- Rated frequency : 50Hz、60Hz
- The number of poles: 2 poles/4 poles
- Insulation class : F / F
- Vibration velocity (3.8mm/s)(2 poles) , 2.8mm/s(4 poles)
- Efficiency : 0.2 percentage points higher than the national standard
- Cooling mode: air-cooled type
- Protection class: IP54, IP55, IP44, etc
- Work system: S1
- Synchronous speed : 3000r/min , 3600r/min , 1500r/min , 1800r/min
- Power factor : 0.8、0.85
- Working environment: temperature: -10°C ~ +40°C
- Altitude: the standard altitude is 1000m, but the products from 1000m to 3500m can be provided
- Configuration standard: indoor standard type
- Option: outdoor (W), humid heat zone (TH), dry heat zone (TA), outdoor humid heat zone (THW), outdoor dry heat zone (TAW), extreme cold zone under guaranteed water supply (Note: special requirements of ambient temperature, altitude, power supply voltage and frequency should be specified in the agreement.)



## CONFIGURATION INTRODUCTION

By learning and absorbing the advanced technology of many countries such as America, Germany, France, Britain and Italy, our company adopts the advanced design method and design software introduced in this century. By the finite element analysis of electromagnetic field and temperature field, the traditional products are optimized. We modify the structures according to users' requirements, included that the traditional cooling structure of turbo generator is changed, greatly improving the reliability of the generator.

### Structure feature

Generators can be traditional type of assembly at the site or integrated type, and motor protection class are IP44 and IP54. As mentioned above, they may be equipped with air coolers of overhead type or pit type or other forms upon request.

The motor includes stator, rotor, bearing, end cover, air-water cooler, brushless excitation (or static controllable excitation).

The brushless excitation generator is coaxial with its auxiliary engine.

The bearing has two types of structure: end cover type (not adjustable) and end cover--seat type (adjustable), end cover--seat type (adjustable) structure (see P03) is the original creation of our company. The generator in this structure not only can be delivered as the whole machine, and the stator and rotor are not recalibrated center at the site, but also is convenient to axis micro modulation for operation and maintenance for the power plant.

The bearing is fully considered the dual measures to prevent shaft current,

### Stator

The stator core is laminated with high-quality cold-rolled silicon steel sheets coated with class 155 (F) insulating paint on both sides. Our company adopts the advanced anti-magnetic leakage and shock absorption measures superior to domestic products, improving the efficiency and stability of the motor, and reducing the noise and temperature rise. The stator end is fixed by end hoop, bracket and binding. Magnetic leakage protection measure is adopted in the close part of the frame and the end.

The stator coil is made of multistrand glass wire wrapped in flat copper wire, full F class insulation, in the most advanced three-level corona prevention measures, greatly improving the operation reliability and extending the motor life.

The anti-condensation heaters are installed in the lower cavity at both ends of the stator frame. The heaters start to work after the synchronous generator stops, thus, the air temperature in the synchronous generator is higher than the ambient temperature, preventing cold condensation.

### Rotor

The rotor forgings are forged with high strength and high quality alloy steel, which meet JB/T 7026-2004 "technical conditions for rotor forgings for turbo generators below 50MW" and have good magnetic conductivity and mechanical properties. After the forgings enter the factory, both ends of the sampling test and ultrasonic detection can ensure the reliability of the quality and the performance of the forgings.

Rotor winding is edgewinded with high quality copper wire, using Nomex composite insulation as the main insulation. The end of the winding is fixed with an insulating pad. After the whole rotor is solidified by integral mould pressure, the two ends are covered with diamagnetic high-strength alloy steel guard ring.

The rotor of the 4-pole generator is equipped with damping windings, while the rotor of the 2-pole generator uses the closed loop of slot wedge and guard ring to form damping effect. The generator set can protect the end and guard ring within the time of asymmetric short circuit protection, and the rotor can reliably bear the forced torque of two-phase short circuit.

The rotor speed avoids the critical speed. Axial fans are installed at both ends. The rotor passes the dynamic balance test, and the 1.2 times rated speed overspeed test, ensuring insulation performance and reliable mechanical strength. The rotor can reliably bear the forced torque in two-phase short circuit.

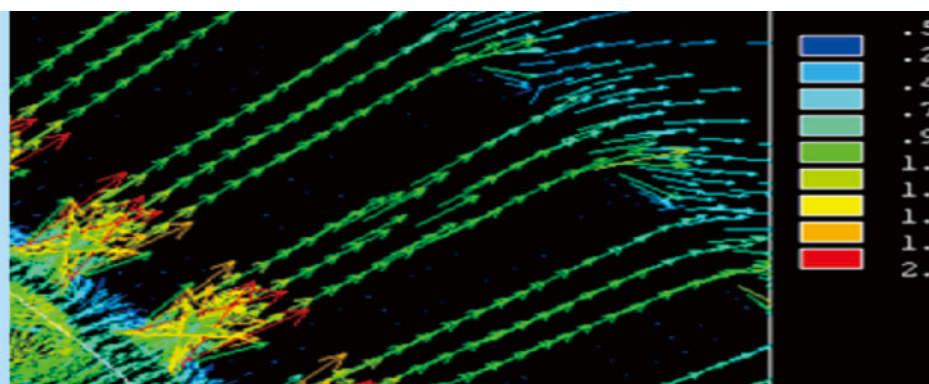
### Bearing

The generator bearing is the sliding bearing with pressure oil circulation, with automatic centering. Both sides of the bearing are equipped with oil inlet and outlet holes, the users can choose one side for oil inlet and outlet according to the situation.

The motors of 15MW and above have high pressure oil jacking device. The generator shares an oil supply system with the steam turbine.

In order to prevent the shaft current forming a loop through the bearing, causing the bearing bush to be damaged by the shaft current, the bearing used by the motor (excited end) is insulated according to the standard, and the stator grounding brush is installed at the steam end.

Electromagnetic field analysis



Structure design of adjustable three - machine type



Type test of end cap bearing motor in the workshop



# Turbo Generator Series SYSTEM

## Cooling system

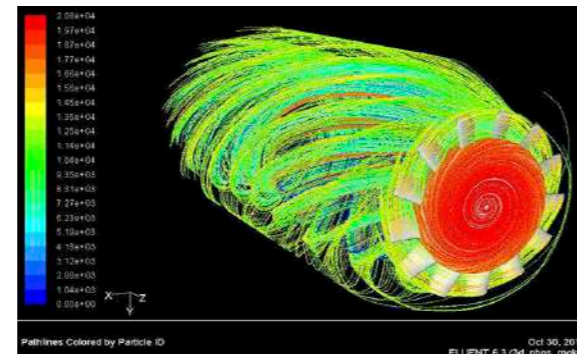
The generator adopts the completely enclosed air-water circulation cooling system.

The heat generated in the running process of the generator passes through the insulation of wires and rods of stator and rotor, and then is carried into the air cooler by the flowing air. After being cooled in the air cooler, it enters the generator again to form a circulating cooling loop. Air - cooled appliances are configured with the margin of 25-40%.

The cooling system is double-loop, namely the independent air cooling system inside the synchronous generator and the external cooling water circulation system. The air inside the motor with the heat from the windings enters the air- water cooler. After the heat exchanges with the closed flowing water in the cooling pipe, it enters the inside of the stator and the rotor. The two cooling media do not cross, and there is no possibility that the cooling medium is polluted by the outside.

The ventilation system of generator is designed by finite element modeling according to the principle of air flow and the output of synchronous generator. The company deliberately eliminates some centrifugal fans which have been used for many years, and gives full play to the unique advantages in wing design by adopting axial flow fans, thus reducing air loss and noise as well as improving efficiency.

Air cooler is composed of more than 4 groups of extruded cooling pipes. The material of the cooling pipe base is navy copper. When one of the coolers stops working, the synchronous generator can continue to work within the normal temperature rise range with at least 80% rated load.



The finite element design analysis of ventilation system

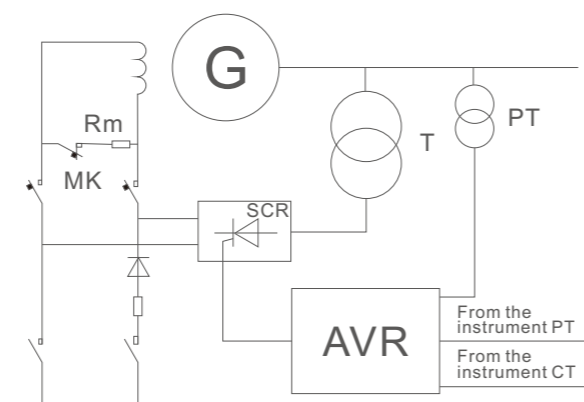
## Excitation system

The company provides static SCR rectifier excitation system and coaxial brushless excitation system, and provides one system according to the users' needs.

Static SCR brush excitation system is adopted.

Generator excitation is supplied by double main channel and double control channel static SCR system. With automatic excitation regulation,  $\cos\phi$  has functions of brake, forced excitation, forced reduction and automatic magnetic extinction. When a channel fails, it can continue to generate electricity without stopping working, convenient to maintenance.

The excitation current is controlled by a two-channel microcomputer excitation regulator so as to control the terminal voltage and power factor of the motor. It has excellent regulation functions of constant voltage, constant reactive power, constant power and synchronous motor vibration prevention. Each channel has automatic and manual control functions. In case of failure, it can automatically and undisturbedly switch to the spare channel and block the faulted channel at the same time.



The excitation power supply

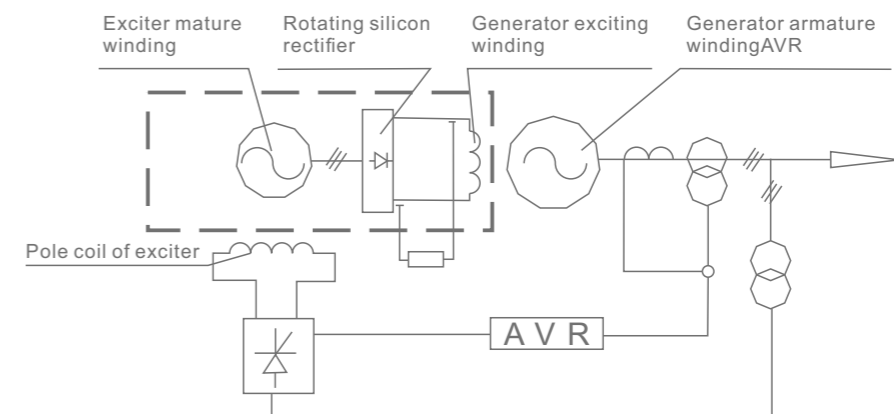
The finite element design analysis of ventilation system

## Brushless excitation system with coaxial AC exciter

The 2-pole generator is a two-engine generator with coaxial AC exciter. AC main exciter is of armature structure. The rotor core is made of high-quality cold-rolled silicon steel sheets, and the armature coil is a double-layer coil, which is led to the rotary-mounted rectifier plate by binding three outgoing wires with weft free belt.

The 4-pole generator is a three-engine generator with coaxial AC exciter and permanent magnet. The AC exciter provides excitation for the generator rotor, the electricity generated by the permanent magnet machine is supplied to the stator excitation after rectified by the excitation regulation cabinet, and the three-phase AC electricity generated by the exciter mature is supplied to the rotor excitation of the turbo generator after the full wave rectified by the rotating rectifier.

The output circuit can automatically adjust the excitation parameters by current and voltage double feedback and by adjusting the excitation current of the stator of the exciter with automatic excitation regulating microcomputer (PLC) device.



Schematic diagram of brushless excitation system

## Measurement device

In order to ensure the reliable operation of the generator, measuring devices are installed in the key positions of the generator to monitor its operation. The standard configuration of these measuring devices includes:

(1) There are 12 temperature measuring elements (8 elements of 4.5mw and below) embedded in the stator of motor above 6MW, model Pt100, monitoring the temperature of the upper and lower layers of windings and the core. The motors above 25MW can also be equipped with resistance temperature measuring elements in steam inlet and outlet according to users' requirements;

(2) Each bearing is equipped with a thermometer for measuring the oil temperature of the bearing, and the bearing seat is equipped with the temperature measuring elements holes of the buried remote transmission elements;

**The air inlet temperature of the generator should not exceed 40°C in the basic working environment. The allowable temperature appreciation of the main components relative to cooling air is as follows:**

Parts	Temperature measurement	Temperature limit
Stator winding	Buried thermometers between the upper and lower coils in the groove	90 ( 115 ) K
Stator core	Buried thermometers	80 ( 100 ) K
Rotor winding		90 ( 115 ) K

**Note:** outside the brackets are the limits assessed by class B, and inside the brackets are the actual standard limits of class F. Generally, the bearing oil inlet temperature is 35°C-45°C, bearing oil outlet temperature is 65°C, bearing bush temperature is 80°C.





## PRODUCT SPECIFICATION

### Typical technical data of the company's QF (QFW) series 2-pole steam turbine products

Model	Power		Voltage	Electric current	Power factor	Speed	Efficiency	Total weight	Rotary inertia	Journal/shaft diameter length	Distance of centers (gas/excitation)	Height of centers
	PN	PA	UN	IN	Cosφ	nN	η	G	GD2			
	kVA	kW	V	A		r/min	%	t	t-m2	mm	mm	mm
QF-1.5-2	1875	1500	400	2706.3	0.8	3000	95.66	9.874	0.3	φ140/140	1280/1430	400
QF-1.5-2	1875	1500	6300	171.8	0.8	3000	95.8	10.082	0.23	φ140/140	1350/1500	400
QF-1.5-2	1875	1500	10500	103.1	0.8	3000	95.31	11.384	0.25	φ140/140	1485/1485	400
QF-3-2	3750	3000	6300	343.7	0.8	3000	96.68	13.2		φ140/140	1390/1390	500
QF-3-2	3750	3000	10500	206.2	0.8	3000	96.585	14.5	0.45	φ140/140	1790/1780	500
QF-6-2	7500	6000	6300	687.3	0.8	3000	97.24	21.2	1.1	φ180/180	1840/1840	630
QF-6-2	7500	6000	10500	412.4	0.8	3000	97.25	28.15	1.1	φ180/180	2080/2155	630
QF-7.5-2	9375	7500	6300	859.2	0.8	3000	97.35	21.2	1.1	φ180/180	1840/1840	630
QF-7.5-2	8824	7500	6300	808.7	0.85	3000	97.35	21.2	1.1	φ180/180	1840/1840	630
QF-7.5-2	9375	7500	10500	515.5	0.8	3000	97.41	28.6	1.1	φ180/180	2080/2155	630
QF-7.5-2	9375	7500	11000	492.1	0.8	3000	97.41	28.6	1.1	φ180/180	2080/2155	630
QF-12-2	15000	12000	10500	825	0.8	3000	97.61	43.1	2.3	φ200/200	2330/2330	630
QF-15-2	18750	15000	6300	1718	0.8	3000	97.67	35.2	2	φ200/200	2180/2395	630
QF-15-2	17647	15000	6300	1617.2	0.85	3000	97.7	35.2	2	φ200/200	2395/2180	630
QF-15-2	17647	15000	10500	970.3	0.85	3000	97.7	42.7	2.3	φ200/200	2330/2330	630
QF-20-2	25000	20000	6300	2291	0.8	3000	97.7	44.2	3.1	φ250/250	2400/2400	700
QF-20-2	25000	20000	10500	1375	0.8	3000	97.8	44.1	3.1	φ250/250	2400/2400	700
QF-25-2	31250	25000	6300	2864	0.8	3000	97.8	52.7	4.94	φ280/280	2880/2880	750
*QF-25-2	29412	25000	6300	2695	0.85	3600	97.7	50.5	4.75	φ280/280	2850/2850	750
QF-25-2	31250	25000	10500	1718.3	0.8	3000	97.66	52.0	4.94	φ280/280	2780/2780	750
QF-30-2	35294	30000	6300	3235	0.85	3000	97.93	55	4.94	φ280/280	2750/2750	750
QF-30-2	37500	30000	10500	2062	0.8	3000	97.73	54.5	5.4	φ280/280	2880/2880	750
QF-30-2	35294	30000	10500	1941	0.85	3000	97.81	75	5.4	φ280/280	2880/2880	750
QF-36-2	45000	36000	6300	4123.9	0.8	3000	98.04	65	6.3	φ300/300	3025/3025	800
QF-36-2	45000	36000	10500	2474.4	0.8	3000	98.05	65	6.3	φ300/300	3025/3025	800
QF-40-2	50000	40000	10500	2749.4	0.8	3000	98.22	75	6.3	φ300/300	3025/3025	800

**Note:** ( 1 ) Only QF model is listed in the table, QFW series data is the same, excitation mode is the only change;  
 ( 2 ) The weight in the table is the general structure form, which can be selected according to the users' requirements;  
 ( 3 ) Only 50Hz products are listed except the 25MW item with "\*" refers to 60Hz products.  
 Our company can meet all the users' requirements such as speed (frequency), power factor, voltage level, etc .

### The typical technical data of the company's QF (QFW) series 4 -pole steam turbine products

Model	Power		Voltage	Electric current	Power factor	Speed	Efficiency	Total weight	Rotary inertia	Journal/shaft diameter length	Distance of centers (gas/excitation)	Height of centers
	PN	PA	UN	IN	Cosφ	nN	η	G	GD2			
	kVA	kW	V	A		r/min	%	t	t-m2	mm	mm	mm
QF5-4	6250	5000	3300	1093.5	0.8	1500	97	29	2.8	φ225/200	1385/1495	900
QF5-4	6250	5000	6300	572.8	0.8	1500	97	29	2.8	φ225/200	1385/1485	900
QF5-4	6250	5000	10500	343.7	0.8	1500	97	29	2.8	φ225/200	1385/1495	900
QF6-4	7500	6000	3300	1312.2	0.8	1500	97	30	3.2	φ250/260	1475/1585	900
QF6-4	7500	6000	6300	687.3	0.8	1500	97	30	3.2	φ250/260	1475/1585	900
QF6-4	7500	6000	10500	412.4	0.8	1500	97	30	3.2	φ250/260	1475/1585	900
QF8-4	10000	8000	3300	1749.5	0.8	1500	97.2	33	4.1	φ250/260	1615/1725	900
QF8-4	10000	8000	6300	916.4	0.8	1500	92.2	33	4.1	φ250/260	1615/1725	900
QF8-4	10000	8000	10500	549.9	0.8	1500	97.2	33	4.1	φ250/260	1615/1725	900
QF10-4	12500	10000	3300	2186.9	0.8	1500	97.4	38	5.2	φ280/260	1615/1665	1000
QF10-4	12500	10000	6300	1145.5	0.8	1500	97.4	38	5.2	φ280/260	1615/1665	1000
QF10-4	12500	10000	10500	687.3	0.8	1500	97.4	38	5.2	φ280/260	1615/1665	1000
QF12-4	15000	12000	3300	2624.3	0.8	1500	97.6	42	7.6	φ280/260	1710/1710	1000
QF12-4	15000	12000	6300	1374.6	0.8	1500	97.6	42	7.6	φ280/260	1680/1740	1000
QF12-4	15000	12000	10500	824.8	0.8	1500	97.6	42	7.6	φ280/260	1710/1710	1000
QF15-4	18750	15000	6300	1718.3	0.8	1500	97.6	45	7.6	φ280/260	1680/1740	1000
QF15-4	18750	15000	10500	1031	0.8	1500	97.6	45	7.6	φ280/260	1680/1740	1000
QF18-4	22500	18000	6300	2062	0.8	1500	97.7	64	11.8	φ300/260	1805/1865	1150
QF18-4	22500	18000	10500	1237.2	0.8	1500	97.7	64	11.8	φ300/260	1805/1865	1150
QF20-4	25000	20000	6300	2291.1	0.8	1500	97.7	64	11.8	φ300/260	1805/1865	1150
QF20-4	25000	20000	10500	1374.6	0.8	1500	97.7	64	11.8	φ300/260	1805/1865	1150
QF25-4	31250	25000	10500	1718.3	0.8	1500	97.8	75	14.4	φ315/260	1920/1980	1250
QF30-4	37500	30000	10500	2062	0.8	1500	97.9	90	17.5	φ320/320	2385/2445	1350
QF35-4	43750	35000	10500	2405.6	0.8	1500	98	105	18.6	φ350/320	2625/2625	1350

**Note:** ( 1 ) Only QF model is listed in the table, QFW series data is the same, excitation mode is the only change;  
 ( 2 ) The weight in the table is the general structure form, which can be selected according to the users' requirements;  
 ( 3 ) Our company can meet all the users' requirements such as speed (frequency), power factor, voltage level, etc .

### working condition

The basic working conditions of the generator are as follows:  
 Please specify the altitude of your order. The design parameters of this sample are suitable for the environment with an altitude of no more than 1000m. It should be installed in a clean workshop.  
 Ambient air degree shall not exceed 40°C, and internal air humidity shall not exceed 50%;  
 The cooling water temperature of the air cooler should be kept within the range of 6-33°C.  
 The cooling water pressure is 0.2Mpa, and the cooling water should have no corrosion effect on copper and iron.  
 The bearing oil supply meets the design requirements.  
 Appropriate measures or special supplies shall be taken if the above basic working conditions can not be met.

### Ordering instructions

Please specify the model, power, synchronous speed, voltage, frequency, power factor, installation structure, protection class, excitation mode (brushless excitation, static excitation), air cooler placement mode (top, pit, side), etc.

### Product scope

Turbo generator Excitation system regulator Conventional spare parts  
 Air-water cooler Installation accessories ( 1 ) 1 for each side of the rotating diode  
 ( 1 ) foundation bolt attachment tools ( 2 ) 1 set of bearing sealing ring  
 ( 2 ) Flat pad iron Spare parts ( 3 ) 1 set of bearing bush  
 ( 3 ) Tilting pad iron attachment technical data ( 4 ) 3 sets of detection brush  
 ( 4 ) adjusting shim