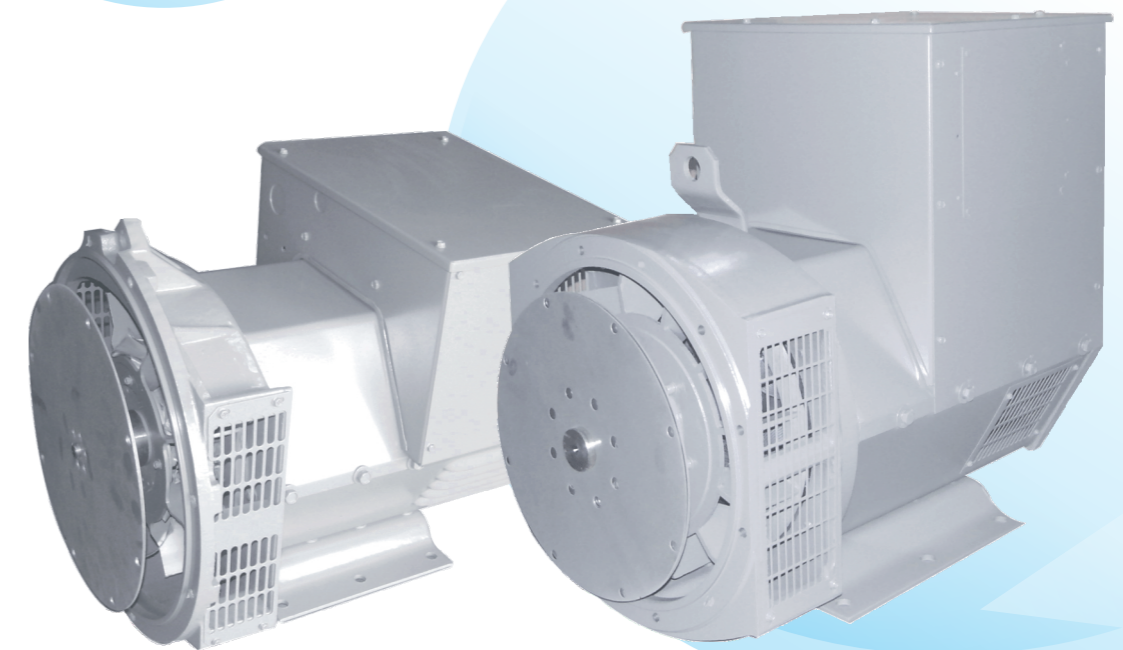


WIRMAN

A.C. BRUSHLESS SYNCHRONOUS GENERATOR



**INSTRUCTIONS FOR
OPERATION AND MAINTENANCE**

CE ISO9001

CHAPTER FIVE

Spare Parts and Service

5.1 List of Spare Parts

In fields of key application, the alternator should be accompanied with a set of spare parts as follows:

1. One set of diodes (six diodes and 1 piezoreitor);
2. Automatic voltage regulator (1 piece);

5.2 After-Sale Service

The after-sale department of our company provides comprehensive technical consultation and site service.

5.3 Quality Warranty Period of Alternator

The quality warranty period of the alternator shall be twelve months from the date the alternator leaves the factory or 1000 hours from the date the alternator is applied, whichever occurs first. Trouble occurs in the quality warranty period of the alternator under normal application and is caused completely from materials and technology after inspection by our company, we'll make decision to repair or to replace.

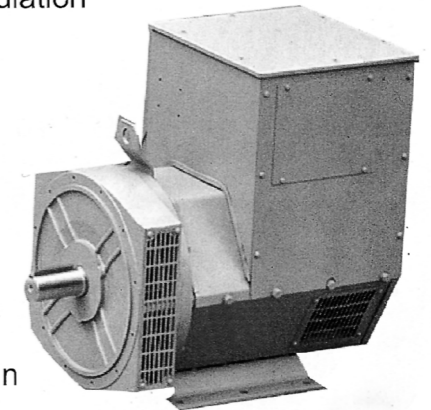
Certificate of Alternator Product

Model of Product		No. of Production	
Capacity (KW)		Current (A)	
Number of Phase	Three-Phase	Connection Style	Y
Power Factor	$\cos\phi=0.8$	Bearing	Single <input type="checkbox"/> Double <input type="checkbox"/>
Voltage (V)		Insulation Class	H
Frequency (Hz)	50 <input type="checkbox"/> 60 <input type="checkbox"/>	Protection Class	Ip22
Speed (r/min)	1500 <input type="checkbox"/> 1800 <input type="checkbox"/>	Working Style	Continuous
Tested by		Date	
After inspection and test this product is in accordance with all stipulations of electric professional standard and is allowed to leave the factory.			

The Brushless ALTERNATOR OUTSTANDING QUALITY

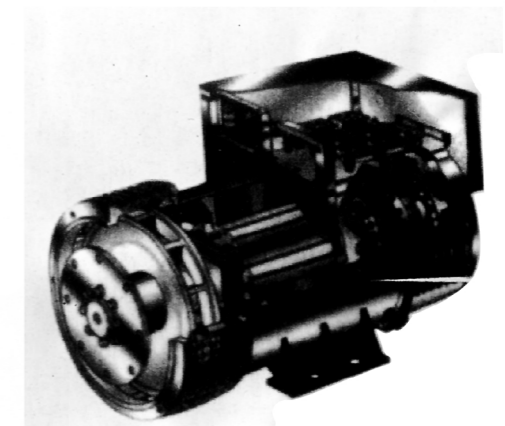
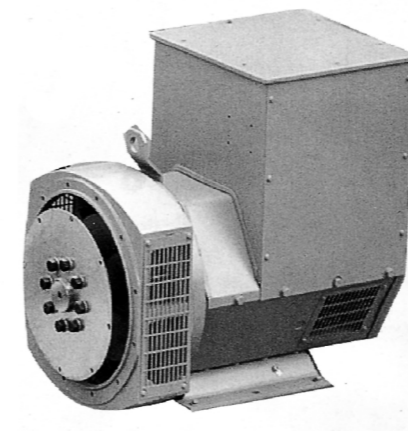
Main Data of BC Brushless Three-Phase Synchronous Generator

Rated Voltage:	400V, 660V
Rated Frequency:	50HZ or 60HZ
Rated Speed:	1500r/min or 1800 r/min
Power Factor:	0.8 (lagging)
Working Style:	continuous
Exciting Style:	brushless, self-exciting, self-radiating
Insulation Class:	Class H
Voltage-Regulating System:	AVR automatic regulation
Protection class:	Ip22
Regulating Rate of Steady Voltage:	$\pm 0.5\%$
Regulating Rate of Transient Frequency:	$\pm 15\%$
Regulating Rate of Steady Frequency:	$\leq 3S$
Over Current:	$3-5I_e \geq 5S$
Overload Capacity:	$1.5I_e \geq 2min$



Outer housing is rolled and shaped by steel sheet so it has small volume, fast heat radiation and high strength

Single- and double-bearing structures with good concentricity are available



Structure Diagram of BC Brushless Alternator

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- 3.2 Selection of Setting of Terminals.....(4)
- 3.3 Adjustment of Stability.....(5)
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4. Repair and Maintenance

- 4.1 Test of Insulation Resistance of Winding.....(6)
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- 4.3 Trouble of Alternator and Remedies.....(6)

5. Service and Spare Parts

- 5.1 List of Spare Parts.....(10)
- 5.2 Technical Service.....(10)
- 5.3 Quality Warranty Period of Alternator.....(10)

Remedy:measure output voltage of the alternator.
If it is normal,replace the voltmeter of the control panel.

c)High Voltage of the Alternator

1.Unsuitable Setting of AVR “VOLT” Potentiometer or External Potentiometer

Remedy:adjust AVR “VOLT” or the external potentiometer on AVR to make the voltage of the alternator at normal value.

2.AVR Trouble

Remedy:check connections of AVR and replace AVR.

d)Unstable Voltage of the Alternator

1.Unsuitable Speed of the Engine

Remedy:check stability of speed of the engine by the speedometer(or frequency meter).

2.Unsuitable Setting of AVR Stability

Remedy:reset the stability of AVR potentiometer under stable speed and no-load status of the alternator,see section 4.3 for the method.

3.Connection Wires are Loosened or Broken

Remedy:carefully check connection wires of the alternator to ensure all connections and inserts of the alternator are under normal status.

4.Low insulation Resistance of Winding

Remedy:measure insulation resistances of all windings by the mega-ohm meter,which should be higher than $1M\Omega$.

5.AVR is Damaged

Remedy:adjust the stability potentiometer on AVR. If it fails to work,it means AVR is damaged and should be replaced.

e) Imbalance of Voltages of the Alternator

1.Trouble of the Windings of Main Stator

Remedy:disconnect external wires of the alternator and test it by exciting separation method.When the Alternator set is under static state,disconnect leads F1 and F2 of the stator of the exciter and connect the positive pole of the battery with F1 and the negative pole with F2,start the alternator set and measure its output voltage.If three phases are imbalanced it means the main stator of the alternator is damaged. Under no-load state,feel the housing of the alternator by hand to see if some part is specially hot.

2.Trouble of External Three-Phase Wires of Load

Remedy:check external wires to see if some phase is connected shortly with the ground to cause imbalance of three phases.

3.Uneven Load of Three Phases of the Alternator

Remedy:in case loads are concentrated on one phase,it can cause imbalance of voltage of three phases.Measure current of each phase by the clip-on amperemeter and redistribute loads on each phase if necessary.

f)Bad Regulating Rate of Voltage(over 2.5% Un under load)

1.Too Large of Speed Drop of the Engine

Remedy:check the speed drop of the engine from no-load to full-load of the engine.The correct speed drop should be no more than 5%.

2.Too Long Wires of load

Remedy:check change of output voltage from no-load to full-load of the alternator.It should be no more than 2.5% of the rated voltage.If the voltage is lower at the load terminal due to longer wire,it can be solved by increasing output voltage of the alternator.

which should be in accordance with standard values in following table.If someone is off the standard value then the part should be repaired.

Check Method of Diode

Disconnect soft leads of the rectification diode on the terminals and measure resistances in forward and backward directions.Good diode should have a very large backward resistance(infinitely great) and a very low forward resistance.If the diode is damaged, when measuring with 10K grade,both forward and backward directions are all conductive or have infinitely great readings.

Check Method of Piezoresistor(surge arrestor):

Disconnect the piezoresistor and measure its resistance.If it is connected shortly(very lower resistance),it means the piezoresistor is damaged and should be replaced.

5.Main Stator is Damaged

Remedy:when the alternator set is under static state,disconnect leads F1 and F2 of the stator of the exciter and connect the positive pole of the battery with F1 and the negative pole with F2,start the alternator set and measure its output voltage. If it is very lower and three phases are unbalanced it means the main stator is damaged and should be repaired or replaced.

6.Load is not Disconnected when starting the Machine Set

Remedy:as the alternator is loaded,voltage cannot be built up when it is started.Check the main switch on the control panel and restart the machine.

7.Trouble of the Permanent Magnetic Generator (PMG)

Remedy:disconnect terminals P2,P3 and P4 of PMG from AVR and measure insulation resistances against the ground and DC resistance.The three-phase resistances should be balanced and in accordance with standard values.Start the machine set and make the alternator run under 1500 r/min, measure three-phases voltages P2,P3 and P4,it should be within 160V-180V and three phases are balanced.If resistances of three phases are imbalanced or not in accordance with standard values voltages of three phases are lower than 160V imbalanced,then the stator of PMG should be replaced;if voltages are lower than 160V but resistances and voltages of three phases are balanced, then the rotor of PMG should be replaced.

8.External Potentiometer is Broken

Remedy:disconnect K1 and K2 from AVR,check resistance of the external potentiometer,it should be within 0-10K.If it is broken,AVR cannot work.

B)Low Voltage of the Alternator

1.Lower Speed of the Engine

Remedy:check speed of the engine by speedometer and regulate the speed of the engine to the rated speed(there is an alarm LED on the AVR.If the lamp lights it means the speed is lower).

2.Unsuitable Setting of AVR "VOLT" or External Potentiometer

Remedy:adjust AVR "VOLT" or the external potentiometer under the rated speed to set the voltage of the alternator at normal value.

3.Voltmeter of the Control Panel is Damaged

CHAPTER ONE

Brief Introduction

1.1 Technical Performance

BC serial alternator is brushless,self-exciting,automatic voltage regulating AC alternator which is in accordance with the China's state standard Gb755-2000,international standard IEC34-1,V.D.E.0530, Part III of Bs5000 and other international standards.

Mechanical Performance

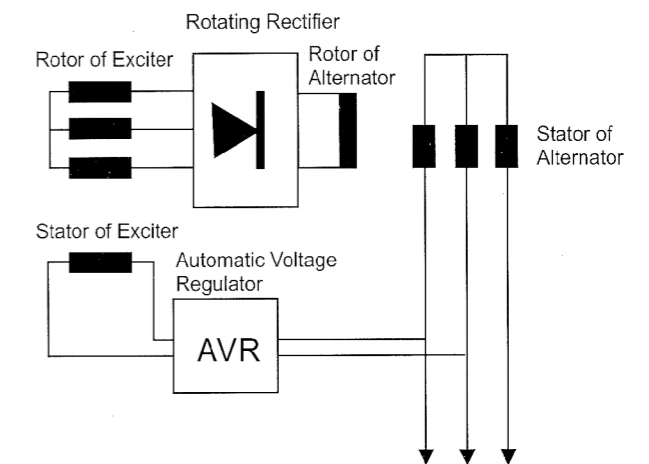
- steel structure base;
- double-bearing structure;
- Insulation class for all land-use or marine alternators is IP23,which can prevent water drip having the angle less than 60° with the vertical direction dropping into the alternator to cause damage;
- The single-bearing alternator adopts multi-sizes plate clutch,which is easy to be connected with the flywheel of various kinds of engine;
- The sealed ball-bearing is adopted so no grease is needed to add.

Electric performance

- Insulation Class H;
- All stator windings of alternator is wound in 2/3 pitch therefore triple harmonic is effectively eliminated;
- The regulating rate of steady voltage is $\pm 0.5\%$.

1.2 Working Principle

When the alternator is driven,the stator of the alternator generates some residual magnetic voltage. After getting residual magnetic voltage from the



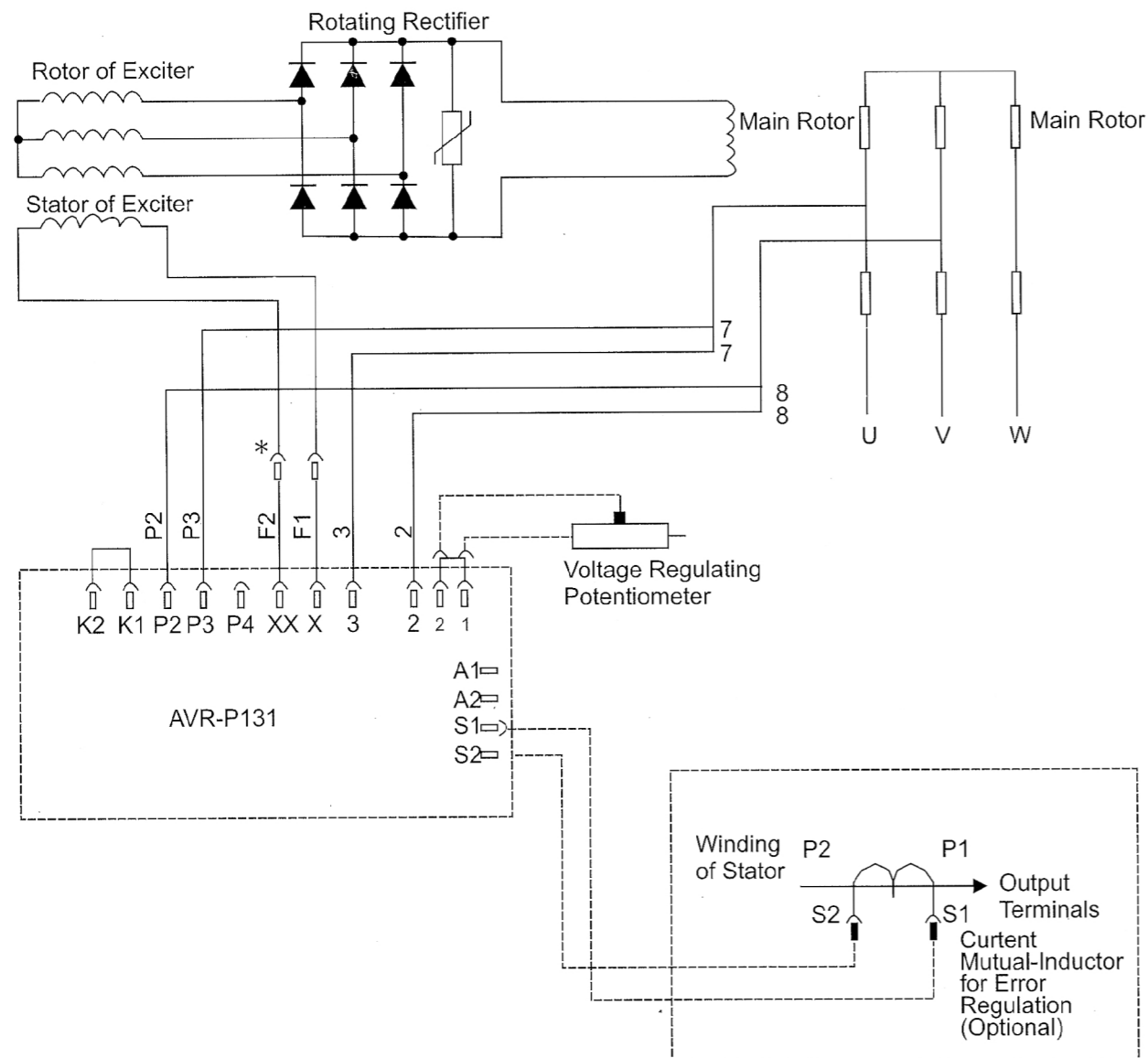
stator,the automatic voltage regulator outputs an exciting current to the stator of the exciter,then the rotor of the exciter generates three-phase alternating current,which is rectified into direct current by the rotating rectifier,and is outputted to the exciting winding of the rotor of the alternator thus to increase the field of the rotor of the alternator,and the voltage of the stator of the alternator is risen up.The voltage-built course is in circulation continuously so the alternator can steadily generates rated voltage in a quite shorter period of time.

The alternator is suitable for the place where the maximum environmental temperature is 40°C and the elevation is 100 m downward.

In case the maximum environmental temperature is over 40°C and the elevation is over 100 m,the alternator is also allowed to be applied however the rated power shall be lowered referring to the rated power and environmental conditions,see QFW manual of sample.

CHAPTER TWO

Wiring Diagram of WSR31 AVR Alternator



- Connections are firm and reliable;
- Operating speed(frequency meter)is normal;
- Settings of protection device is correct.

Normal Troubles and Remedies:

—Mechanical Part:

- a)Trouble of the bearing,see Section 5.2 to find and take remedy.
- b)Large vibration:check centring and installing of the engine and the alternator,and possible cause are as follows:
 - 1.Coupling is not centred;
 - 2.Bad installation of common chassis.
 - 3.Resonance vibration occurs due to error calculation of torsion of the engine and the alternator.

c)Excess vibration from the alternator plus humming

1. One phase of 3-phase alternator is overloaded or grounded in short,beyond the level the alternator can accept;imbalance load causes much vibration of the alternator.

2.Stator of the alternator is connected shortly

d)Housing of the alternator is overheated(over 80°C).

- 1.Unreasonable design of air inlet or outlet,or it is blocked by foreign object
2. Unreasonable circulation of air feeding and discharging,hot air flows back to the air inlet.

3.The alternator is overloaded.

—Electric Part.

- a)The alternator does not generate electricity
 - 1.The voltmeter of the alternator is broken or wrong connections.

Remedy:check voltage at output terminals by the multimeter,if it exists,carefully check circuit of the control panel or replace the voltmeter.

2.Internal connection of the alternator is loosened or broken.

Remedy: check AVR,PMG connections by the multimeter and check trouble point as per the wiring chart of the alternator.

3.AVR is broken

Remedy: when the alternator set is under static state,disconnect leads F1 and F2 of the stator of the exciter and connect the positive pole of the battery With F1 and the negative pole with F2,start the alternator set and measure its output voltage.If it is about 400V and three phases are balanced it means all main stator and rotor,stator and rotor of the exciter and rotating rectifier are all running normally.Stop the machine and replace AVR,recover connections of the alternator and start the machine set,the voltage of the alternator should be normal.

4.The main rotor and the stator and the rotor of the exciter are damaged.

Remedy:when the alternator set is under static state,disconnect leads F1 and F2 of the stator of the exciter and connect the positive pole of the battery with F1 and the negative pole with F2,start the alternator set and measure its output voltage.If it is lower than 360V and three phases are balanced it means one of the rotating rectifier,main rotor,stator and rotor of the exciter has trouble.First or all to deny trouble in the rotating rectifier(diodes and piezor-resistor)by measurement.If six rectifying diodes and piezoresistor are all normal,then measure resistances of the main rotor,stator and rotor of the exciter,

CHAPTER FOUR

Repair and Maintenance

In case the alternator set is used as spare power supply or not used for a long time, it should check insulation of windings and bearings regularly.

4.1 Test of Insulation Resistance of Winding

The winding condition can be determined by measuring its insulation resistance. Normally it can be measured by 500V mega-ohm meter or similar ones.

The insulation resistance of all windings should be larger than $1M\Omega$. If it is lower than the said value the winding of the alternator should be treated as per the method mentioned in Section 2.4.

4.2 Inspection of the Bearing and Troubleshooting

Under normal condition the service life of the bearing shall be 40000 hours. As it is air-tight in application, no grease is needed to add in the course of application.

Causes	Trouble			Remedies
	Bearing squeals	Overheat of bearing	Bearing has knocking sound	
Large vibration and dent occurs on rolling trace.	●	●		Aim at the center of the alternator accurately
Grease emulsified due to damp environment	●	●		Replace sealed bearings
Big play gap of bearing			●	Replace sealed bearings
Bearing inclines	●	●		Check installation and reinstall if required
Bearing has been worn out	●	●		Replace bearing
Bearing has indent			●	Replace bearing

Replace Bearings

Bearings are pressed on the axle and can be removed by standard tools such as 2-claw or 3-claw manual or hydraulic puller which can pull down bearings directly from the axle.

1. Take out new bearing from the package.
2. Wipe out anti-rust oil on inner and outer surfaces of bearing with pile-free cloth.
3. Heat the bearing to 80°C in induction heater.
4. Install the bearing on the axle of the rotor.
5. Install the rotor on the place after the bearing is cooled down.

4.3 Rouble of Alternator and Remedies

In case voltage is abnormal after the alternator is operated, stop it immediately and check following

Items:

- Connections of alternator are in accordance with the wiring diagram;
- Connections are firm and reliable;
- Operating speed (frequency meter) is normal;
- Settings of protection device is correct.

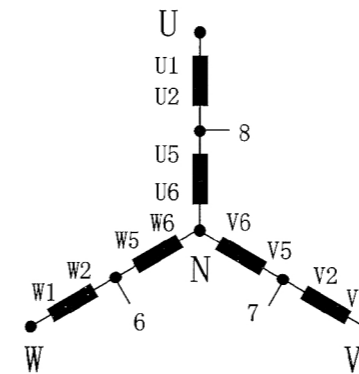
In case voltage is abnormal after the alternator is operated, stop it immediately and check following

items:

- Connections of alternator are in accordance with the wiring diagram;

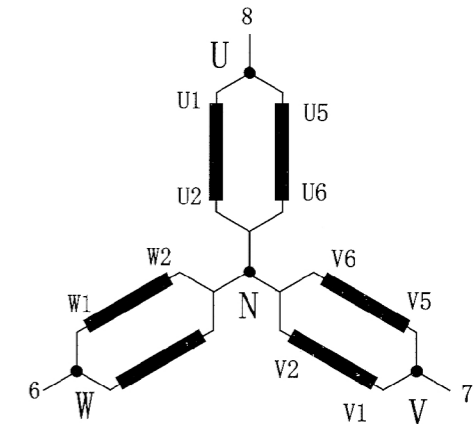
CONNECTION OF OUTPUT TERMINALS

Star Connection in Series
(3-phase-4-line system)
Output Terminals(U,V,W,N)



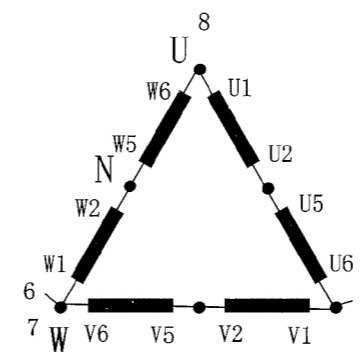
Output Voltage(L-L)
400V/50HZ
450V/60HZ

Star Connection in Parallel
(3-phase-4-line system)
Output Terminals(U,V,W,N)



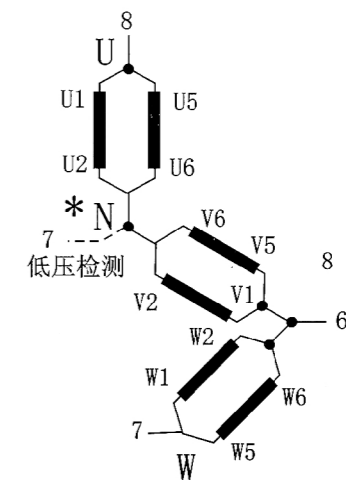
Output Voltage(L-L)
200V/50HZ
225V/60HZ

Delta Connection in Series
(3-phase-4-line system)
Output Terminals(U,V,W,N)



Output Voltage(L-L)
230V/50HZ
260V/60HZ

Zigzag-Shaped Connection in Parallel
(single-phase-3-line system)
Output Terminals(U,V,W,N)



Output Voltage(L-L)
220V/50HZ

CHAPTER THREE

Function and Adjustment of Automatic Voltage Regulator(AVR)

3.1 Electric Data of AVR

3.1.1 Input

Voltage 170V~250V(AV max.)
 Frequency 50~60(universal)
 Number of Phase single phase
 Number of Line 2

3.1.2 Output

Voltage when input voltage is AC 207V,the output max.DC can be 90V
 Current continuous output is 4A and allowed 6A
 instantaneous current can be 10 seconds
 Exciting Resistance min.is 15Ω

3.1.3 External Connected Resistor

Value of External Connected Resistor 10k Ω
 Setting Range of Voltage ≥10%

3.1.4 Mutual-Inductor(operating in parallel)

C.T.Capacity 2.5 VA

Current of Secondary Coil 1A

3.1.5 Setting of Low Frequency Protection

Set Protection Point 95% of rated frequency

3.1.6 Working Environment

Vibration 20~100Hz 50mm/sec
 Relative Humidity 0~60℃ 95%
 Working Temperature -40~+70℃
 Storage Temperature -55~+80℃

3.2 Selection of AVR Function of WSR 31

It should check following jumpers in order to ensure normal operation of the alternator set:

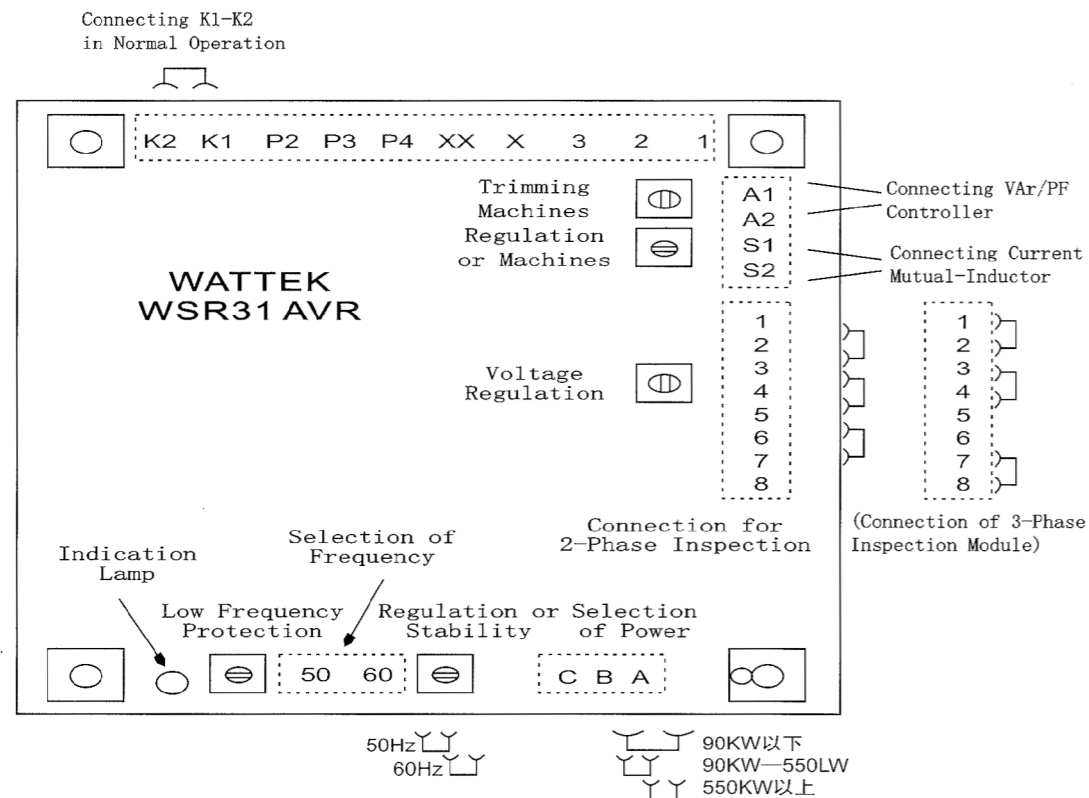
Selection of Frequency Terminals:

Operation under 50HZ Connecting C-50
 Operation under 60HZ Connecting C-60

Selection of Stability Terminals:

WH30~WH70 connecting A-C
 WH80~WH180 connecting B-C

Connection when Exciting is Broken Connecting K1-K2



3.3 Regulation of Stability

When the alternator is operating,if voltage is found unstable,it is necessary to reset the AVR stability

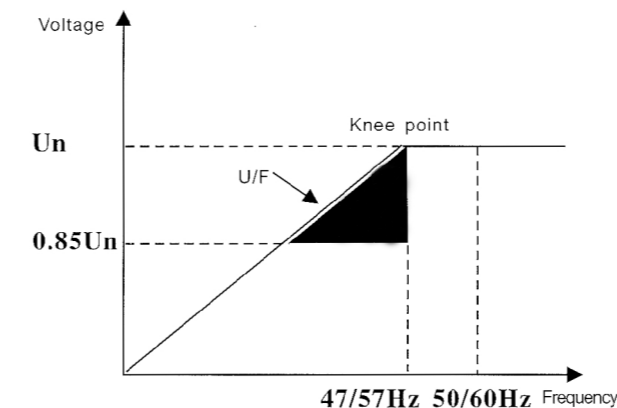
1.Make the alternator run under no-load to see if the speed is correct and stable.

2.Turn the potentiometer of “Regulation of Stability” clockwise to the end then turn counterclockwise slowly until the voltage of the alternator starts to fluctuate.

The correct setting is to turn a bit clockwise from the said position(it means the voltage of the alternator is stable but it is quite closing to The unstable area).

3.4 Setting of Voltage Drop When Frequency is Too Lower Due to Load Applied Abruptly

AVR has a low-speed protection circuit and its voltage-frequency(Hz)characteristic curve is as follows:



The UFRO control potentiometer is set at the position of “knee point” .

The symptoms when setting is unsuitable are as follows:a) one LED above the UFRO control potentiometer always lights under the load;b)the voltage regulating rate is lower under the load,i.e.the alternator is working on the inclining line of the characteristic curve at this time.

Turn clockwise to reduce frequency of the knee point and LED goes out.The best setting point is that when frequency is lower than normal range,i.e. frequency of 50Hz alternator is 47Hz while frequency of 60Hz alternator is 57Hz,the indication lamp goes out.

3.5 Adjustment of Error Adjustor When Alternators Are Operating in Parallel

It is very important to understand points for attention of operation in parallel for installation and set the error adjustor.When the alternator operates in parallel

with other alternators or the network,the most basic requirement is that the alternator should have same phase order with that of other alternators in parallel or the network. and following Conditions should be also met.

- 1.Frequencies should be identical (minor error is allowed).
- 2.Voltages should be identical(minor error is allowed).
- 3.Phase angles of voltages should be identical (minor error is allowed).

In order to meet conditions mentioned above,various kinds of method from simple synchronous test of lamp to full-automatic synchronous indicator can be used.

Alternators can all be operated in parallel.In order to ensure stable operation,the full-damping windings are equipped on all rotors.

The error adjustor consists of two parts:one current mutual-inductor and AVR.

Steps of installation are as follows:

1.Disengage the leads of the main stator W5 from the terminal,connect the current mutual-inductor in series between the terminal and W5.

2.Directly connect leads S1 and S2 at secondary side of the current mutual-indicator to S1 and S2 terminal row of AVR.

Steps of setting of the error adjustor are as follows

1.Make the alternator run under the rated frequency adjust no-load voltage to the rated value.

2.Apply load and adjust the rated current and the power factor to 0.8.

3.Turn the error regulation potentiometer on the AVR panel clockwise and set the voltage of the alternator to 98% of the rated value to make it run under the best error regulation characteristics of voltage.

Note 1.Connect the S1 and S2 of the current mutual-inductor reversely to make voltage of the alternator rise up when load increases.If the case occurs, reversely connect two leads of the current mutual-inductor,voltage of the alternator can lower down when load increases.

Note 2.When the alternator shall be operated singly, draw out two leads S1 and S2 of the current mutual-inductor from AVR and connect them shortly,it can ensure ±0.5% regulating rate of steady voltage of the alternator.