



INSTALLATION, SERVICE & MAINTENANCE MANUAL

FOR BRUSHLESS 3-PHASE AC GENERATORS WITH THE FOLLOWING PREFIXES

W4; W4. D & HW4; HW4. D

HDW4; HDW4. D & HW4Z

SAFETY PRECAUTIONS

Before operating of the generator please read the generating set operation manual and this generator manual and become familiar with it and the equipment.

Safe and efficient operation can only be achieved if the equipment is correctly operated and maintained.

Make sure the installation meets applicable safety and local electrical codes. Have all installation performed by a qualified electrician.

Do not operate the generator when protective covers or lead box cover is removed.

Cut off the engine starting circuit before carrying out maintenance. Cut off the closing circuit and / or put up a warning sign on open circuit breakers used for connection to power network or other generators, to avoid accidental closing.

Observe all **IMPORTANT**, **CAUTION**, **WARNING** and **DANGER** notices, defined as:

IMPORTANT! Important refers to hazard or unsafe method or operation which can result in product damage or related equipment damage.

CAUTION! Caution refers to hazard or unsafe method or operation which can result in product damage or personal injury.

WARNING! Warning refers to a hazard or unsafe method or operation which can result in severe personal injury or possible death.

DANGER! Danger refers to immediate hazard which can result in severe personal injury or death.

Due to our policy of continuous improvement, details in this manual which were correct at time of printing, may now be due for amendment. Information included must therefore not be regarded as binding. If you get any questions please contact with us.

FOREWORD

The function of this book is to provide the user of the generator with an understanding of the principle of operation, the criteria for which the generator has been designed, and the installation and maintenance procedures, specific areas where the lack of care or use of incorrect procedures could lead to equipment damage and/or personal injury are highlighted, with **warning** and/or **caution** notes, and it is **important** that the contents of this book are read and understood before proceeding to install or use the generator.

The service, sales and technical staff of our company are always ready to assist and reference to the company for advice is welcomed.

WARNING! Incorrect installation, operation, service or replacement of parts can result in severe personal injury or death, and/or equipment damage.

Service personnel must be qualified to perform electrical and mechanical service.

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Chapter 1 INTRODUCTION

1.1 Introduction

1.1.1 Characteristics

W4, W4.D series brushless 3-phase synchronous generator for land use, when coupled with diesel engine or other prime movers with an over-speed not exceeding 120% rated speed, makes up a complete unit or mobile power station and may be used as both a power source, for illumination and various equipments and the spare power source for service field such as communication equipments, hotels, high buildings, markets and hospitals etc. They may be used in automatic power station, too. The relevant HW4, HW4.D series 3-phase synchronous generator for marine use, when coupled with diesel engine or other prime movers with an over-speed not exceeding 120% rated speed, also make up a complete unit fixed in cabin and may be used as a power source, illumination, etc.

W4, W4.D series brushless generator for land use adopts brushless harmonic exciting system, thus the ability of electric power delivered and the reliability of operation are greatly advanced, and maintenance period is prolonged.

The relevant HW4, HW4.D, HDW4, HDW4.D series marine brushless AC synchronous generator and HW4Z marine shaft generator are developed at the basis of the former generator model whose performance are general the same with each other. The generator adopts 60 degree drip-proof protective structure, which can prevent dripping water which is the range of 60 degree angle along the vertical line from entering the interior of generator. As customer's requirement we can produce generator with higher IP class for marine use. The insulation and metal parts are suit to the wet, mould, and salty environment.

W4, W4.D series generator for land use, HW4, HW4.D series generator for marine use and HW4Z marine shaft generator can be provided with additional device to meet the user's requirement for parallel operation.

HW4 and HW4.D series generator for marine use has 8 different specific frame sizes, from 180 to 560, two enclosure protection classes IP21, IP23, rated power 12kW-2500kW, rated voltage 400V, rated frequency 50Hz, rated speed 600r/min, 750r/min, 1000r/min, 1500r/min, 1800r/min and 3000r/min. As user's requirement the generator also can be 60Hz, 400V, 480V, 690V or others.

HDW4, HDW4.D series generator for marine use has 2 different specific frame sizes, from 180 to 200, enclosure protection class IP23, rated power 10kW-36kW, rated voltage 230V, rated frequency 50Hz, rated speed 1500r/min. As user's requirement the generator also can be 60Hz, 220V, 240V or others.

HW4Z series marine shaft generator has 8 different specific frame sizes, from 180 to 560,

two enclosure protection classes IP21, IP23, rated power 12kW–2000kW, rated voltage 400V, speed range 1350–1800r/min. As user' s requirement the generator also can be 60Hz, 400V, 480V, 690V or others.

The series have a overall salient rotor, steel structure body, H class insulation.

The detailed technical manual can be provided as requirement.

1.1.2 The standards

As for W4, W4.D series three-phase generator for land use the following standards are suitable:

GB 755 Rotating electric machines - Rating and performance;

GB/T 15548 General specification for three - phase synchronous generators driven by reciprocating internal combustion engine;

JB/T 3320.1 Specification for small size brushless three - phase synchronous generator; Standard (IEC60034) recommended by the International Electric Committee.

As for HW4, HW4.D, HW4Z series three-phase generator for marine use the following standards are suitable:

GB/T 7060 General specifications for rotary electric machines in ships;

GB/T 12975 General specifications for synchronous generator in ship;

Standard (IEC60034) recommended by the International Electric Committee.

As for HDW4, HDW4.D series single-phase generator for marine use the following standards are suitable:

GB/T 7060 General specifications for rotary electric machines in ships;

JB/T 4401.1 Specification for small single-phase synchronous generator in ships;

Standard (IEC60034) recommended by the International Electric Committee.

1.2 Brief introduction for the model of generator

Example:

KF/SB - H D W 4 Z .D - 12 - 6P
1 2 3 4 5 6 7 8 9

1--Product code

2--Product model (H means for marine use, no sign means for land use)

3--Phase code (D means single phase, G means high voltage generator, no sign means low voltage three phase)

4--W means brushless

5--Product series code (Low voltage series is 4, high voltage series is 5)

6--Type code (Z means shaft generator, B means variable-speed constant frequency constant

voltage generator, S means double regulator generator, no sign means ordinary)
 7--Bearing (D means single, no sign means two)
 8--Power
 9--Poles (No sign means for 4 poles)

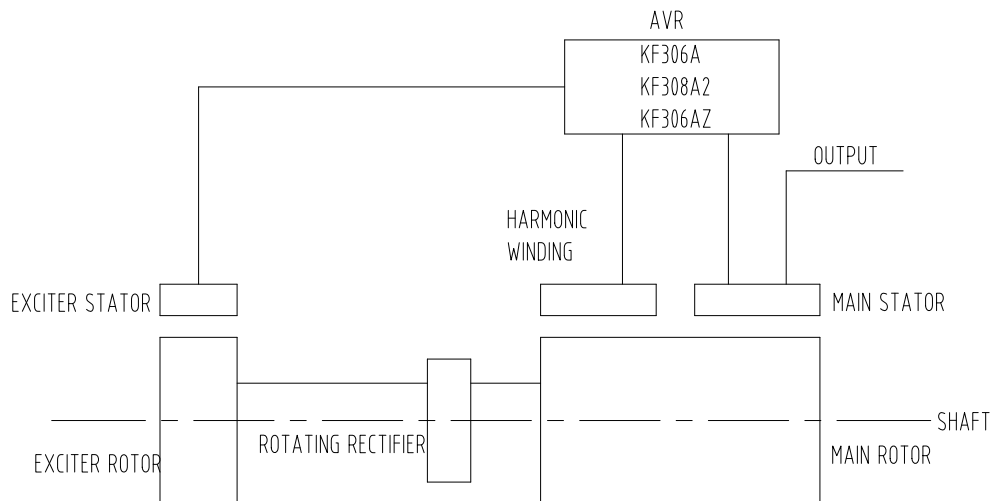
1.3 Nameplate

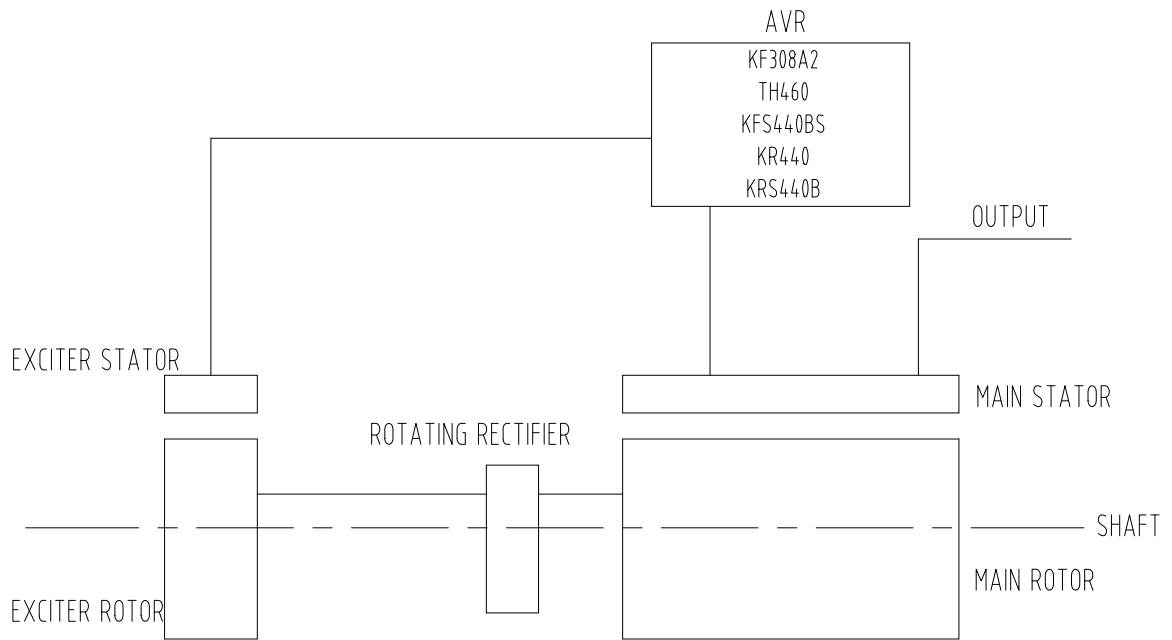
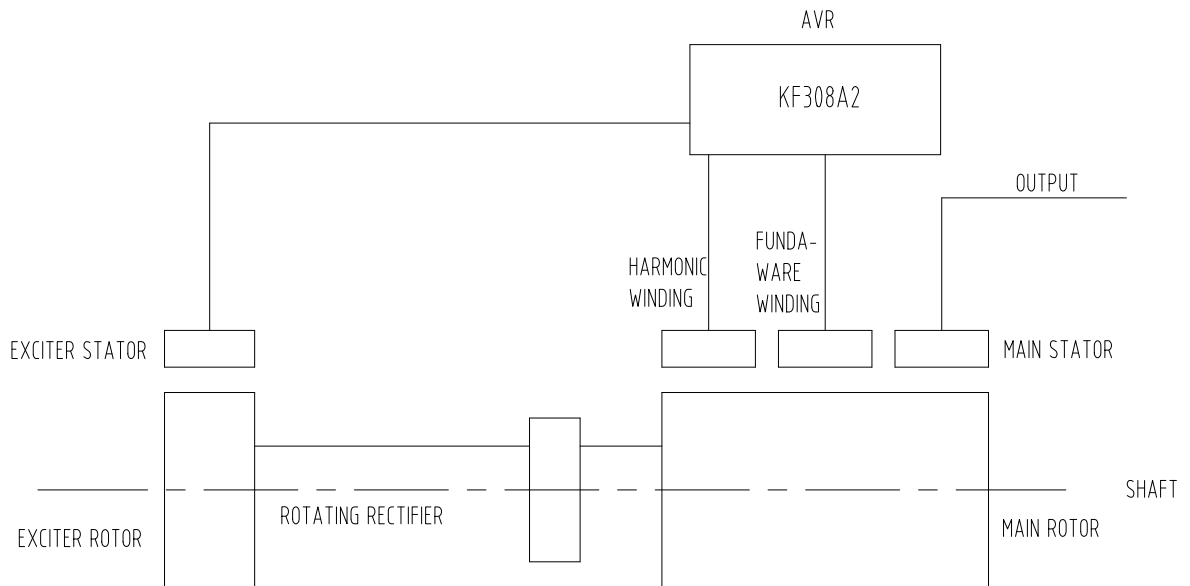
There is a nameplate on the generator.

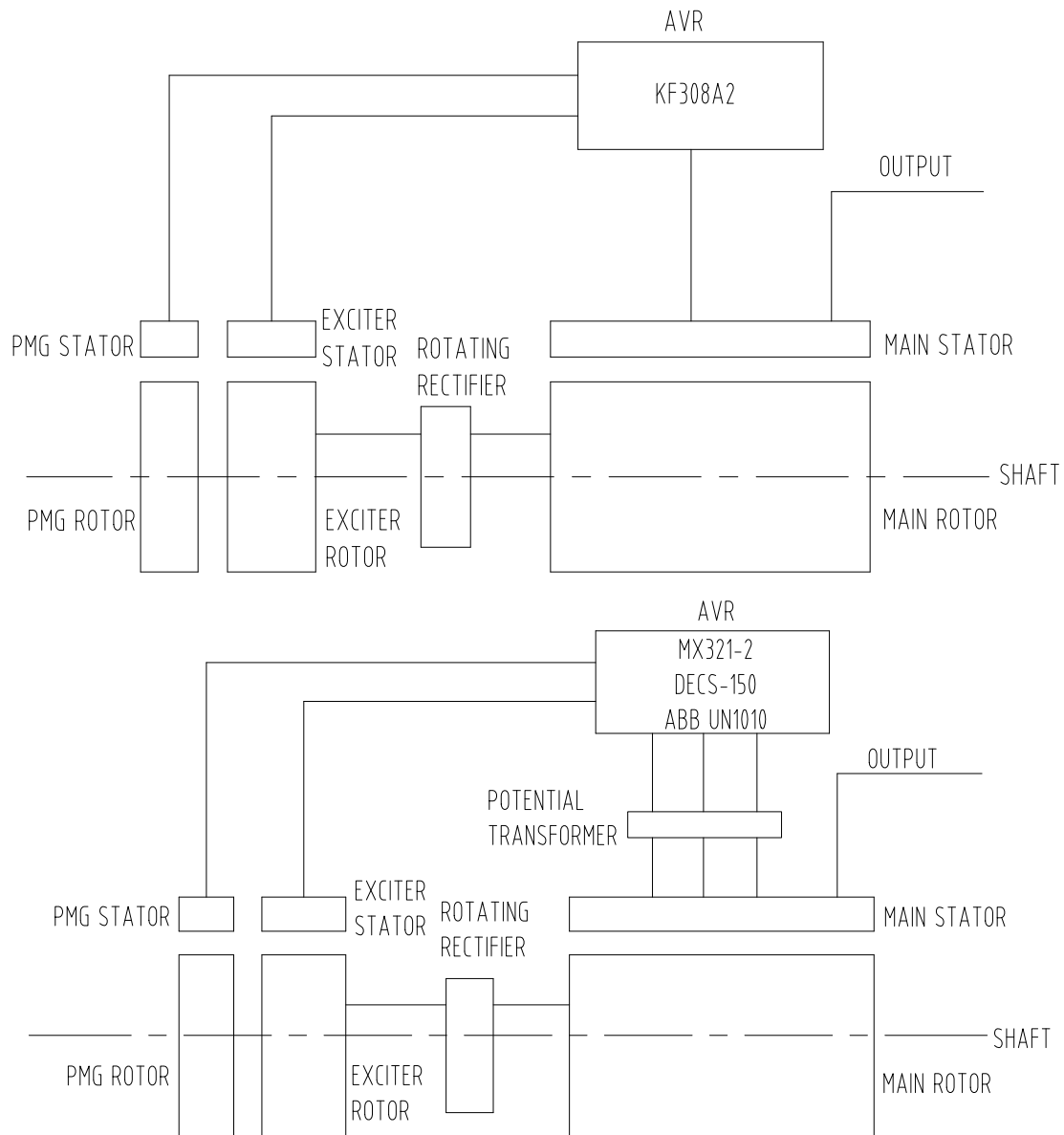
Chapter 2 OPERATING PRINCIPLE

After starting the generating set the residual magnetism of the generator provide magnetic field of exciter with exciting current after rectification (If the excitation mode is P.M.G. excitater, the exciting current is provided by P.M.G.), the armature voltage of exciter gradually increases then the AC voltage is send to magnetic field of main generator after rectification by rotary rectifier to form voltage in main generator. When the rotational speed near the rated value the AVR make the voltage of the generator increase quickly then keep at a rated value. (see the following functional block diagram).

Due to some reasons such as load change, rotational speed change, temperature of windings there would be increase or decrease trend of terminal voltage of generator. The AVR can check the tiny voltage deviation and quickly increase or decrease exciting current to keep the end voltage approximately stable.







Chapter 3 APPLICATION ENVIRONMENT

W4, W4.D series generators for land use is prepared for humid-tropic climate or ordinary climate conditions. The environmental conditions which the generator can be used are as following:

- (1) Altitude above sea level not over 1000 meters;
- (2) Temperature of cooling air -15°C – $+40^{\circ}\text{C}$ or -40°C – $+40^{\circ}\text{C}$ if required;
- (3) Relative humidity of cooling air: not exceeding 95% for humid tropic type (at 25°C);
not exceeding 90% for ordinary type (at 25°C);
- (4) Places with dew condensation (for humid-tropic type only);
- (5) Places with mould formation (for humid-tropic type only).

Note: If the altitude and the temperature of cooling air of the place where the generator runs don't conform with these conditions mentioned above, the output of the generator would

be revised according to stipulations given in GB 755 “Rotating electric machines - Rating and performance” or IEC 60034-1 recommended by the International Electric Committee.

The environmental conditions which the HW4、HW4.D series generator for marine use can be used are as following:

- (1) Altitude above sea level 0 meter;
- (2) Temperature of cooling air not exceeding 45°C;
- (3) Relative humidity of cooling air: not exceeding 95%;

(4) Places with dew condensation, salt fog, oil fog, and mould formation;

(5) Transverse swing not exceeding 22.5° , transverse inclination not exceeding 22.5° , longitudinal swing not exceeding 10° , longitudinal inclination not exceeding 10° , vibration not exceeding class II, shock not exceeding class II. We also can produce generator with higher protection class if required.

Note: If the altitude and the temperature of cooling air of the place where the generator runs don' t conform with these conditions mentioned above, the output of the generator would be revised according to stipulations given in GB/T 7060 “General specifications for rotary electric machines in ships” or IEC 60034-1 recommended by the International Electric Committee.

Chapter 4 INSTALLATION

4.1 Installation

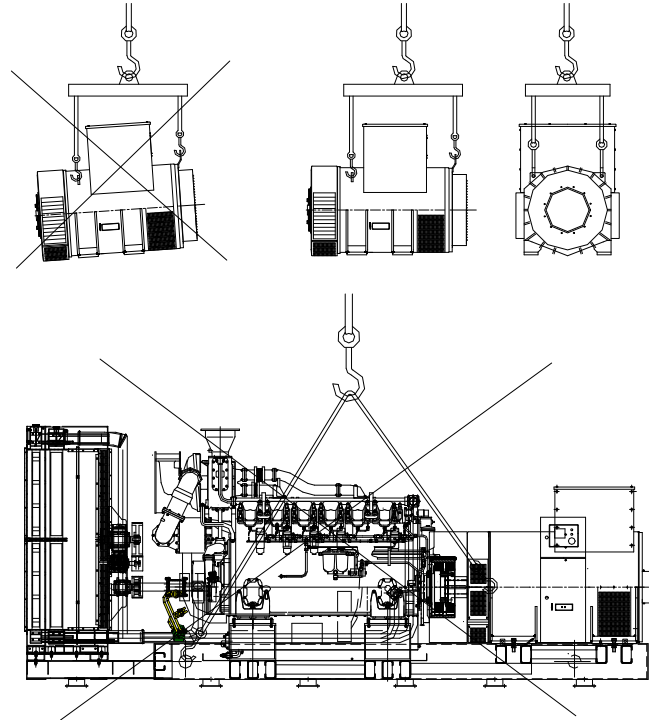
The installation place of the generator should be clean and easy to ventilate, maintain and overhaul. There is no steam, oil fog or other harmful air near the generator and no obstacle in the ventilation vent and no hot source to influence the cooling. If the prime mover of the generator is an engine , it must be avoided that the engine' s exhaust and the hot part to influence the temperature of the air into the generator at the least lever. The installation base must be strong enough to bear the weight of generating set.

4.2 Lifting

Steel wire line of suitable length and lifting capacity must be used when lifting the generator. The generous-sized lifting rings are for lifting the generator alone. The must not

be used to lift the gen-set. Be careful to avoid personal injury or equipment damage when handle the generator.

WARNING! Incorrect lifting or inadequate lifting capacity can result in severe personal injury or equipment damage.

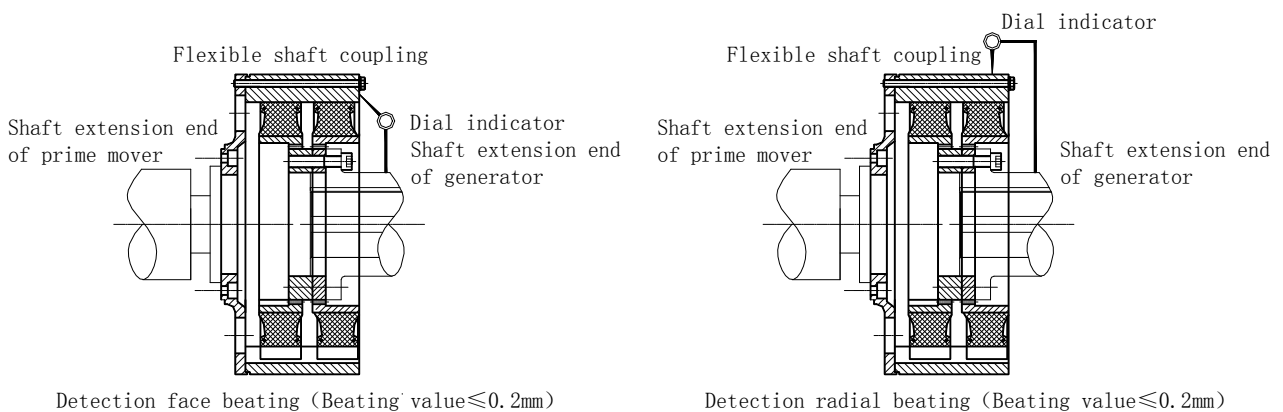


4.3 Coupling with the prime mover

When coupling with the prime mover, the bearings of generator do not bear the axial pressure.

4.3.1 Two bearing generators

A flexible shaft coupling should be fitted when assembling, you should carefully measuring the concentricity and parallelism of the two coupling. It is better to add a transition flange for a large number of gen-set assembled. One end of the flange shall joint with the end cover of generator, the other end of the flange shall joint with the end cover of prime mover. Add a coupling flange can make the assembling easy.



Detection face beating (Beating value $\leq 0.2\text{mm}$)

Detection radial beating (Beating value $\leq 0.2\text{mm}$)

4.3.2 Single bearing generators

A flexible steel plate should be fixed. Coupling the flexible steel plate with the engine flywheel and coupling the generator front end with the engine flywheel end, then the assembly of engine and generator is completed.

Notice: It is suggested that coupling steel plate with flywheel adopts 10.9 level and above strength bolt and hardened washer. Do not use elastic washer, or it will lead to steel plate damage because of stress increase.

Caution! Incorrect generator alignment can result in personal injury and/or equipment damage.

4.4 A. V. R.

A. V. R. coupled with W4, W4.D series generator is installed in the terminal box.

A. V. R. which is KF306A, KF308A2, TH460, KR440, KRS440B, MX321-2 is coupled with W4, W4.D, HW4, HW4.D series three phase AC generator.

A. V. R. of HDW4, HDW4.D series single AC generator is TH460.

A. V. R. of HW4Z series three phases marine shaft generator is KF306AZ.

The digital voltage regulator has ABB UN1010 and Basler DECS-150.

4.4.1 KF306A

4.4.1.1 Overall dimensions

The overall dimensions of KF306A shown in figure 4-1.

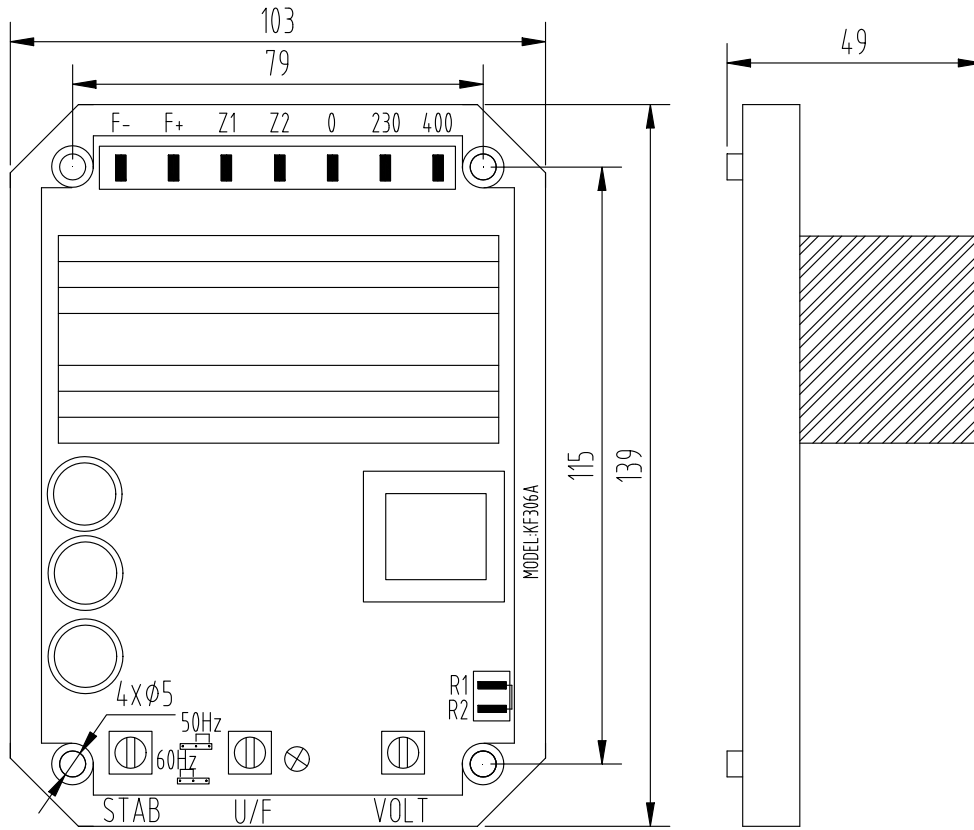


Figure 4-1

4.4.1.2 Wiring

The wiring diagram of KF306A shown in figure 4-2.

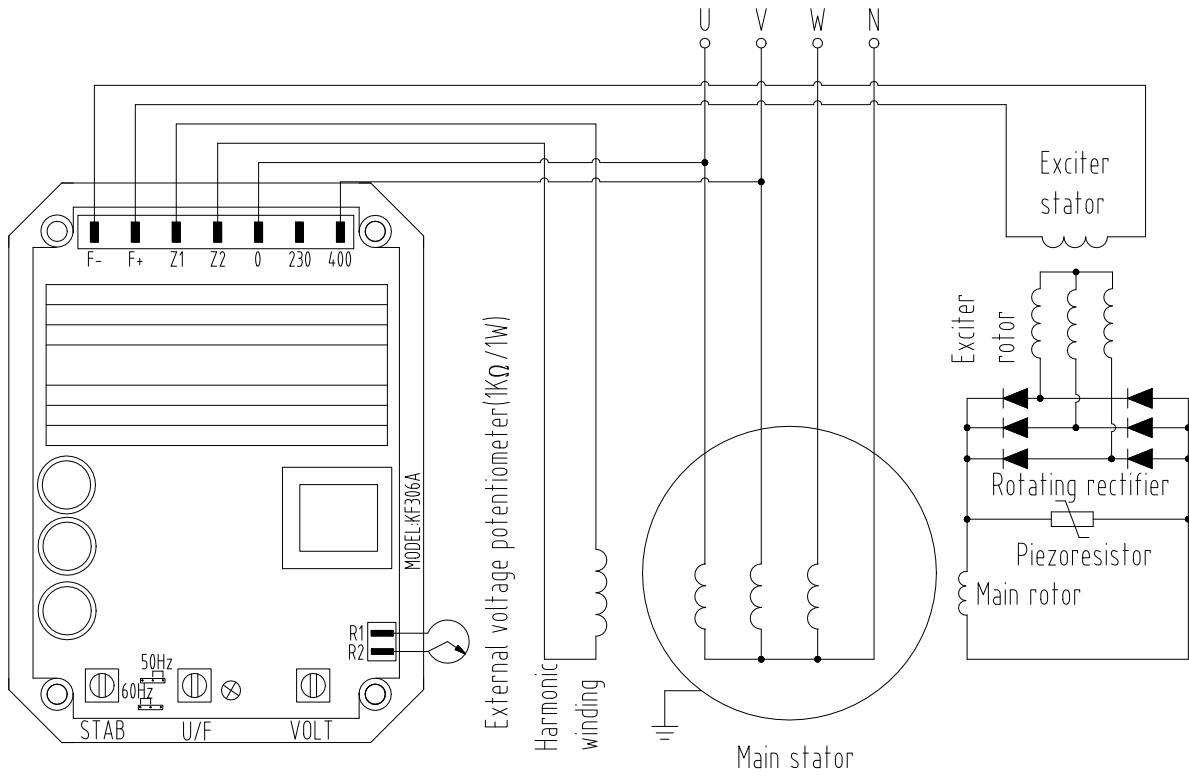


Figure 4-2

4.4.1.3 Performance parameters

1. Sensing input Voltage 150~260 VAC/260~515 VAC
Frequency 50Hz~60Hz (Jumper selectable)
2. Power input Voltage 40~180 VAC
Harmoni stator、AUX. stator
Frequency 40~500 Hz
3. Output Voltage Max 190 VDC
Current Max 8 ADC/10 s
4. Voltage regulation ±1% RMS (With 4% engine governing)
5. Voltage build-up above 5 VAC/30 Hz @ AVR terminals
6. Thermal drift 0.05% drift value @ 1 °C change in AVR ambient.
7. External volts adjustment rheostat ±12% with 1 kΩ 1 W trimmer
8. Under frequency protection 45 Hz @ 50 Hz alternator; 55 Hz @ 60 Hz alternator
9. Vibration 1.5G @5 ~30Hz 5.0G @ 30~500Hz
10. Relative Humidity < 95%
11. Operating temperature -40~+65 °C
12. Storage temperature -40~+80 °C
13. Size 139×103×49 (mm)

4.4.2 KF308A2

4.4.2.1 Overall dimensions

The overall dimensions of KF308A2 shown in figure 4-3.

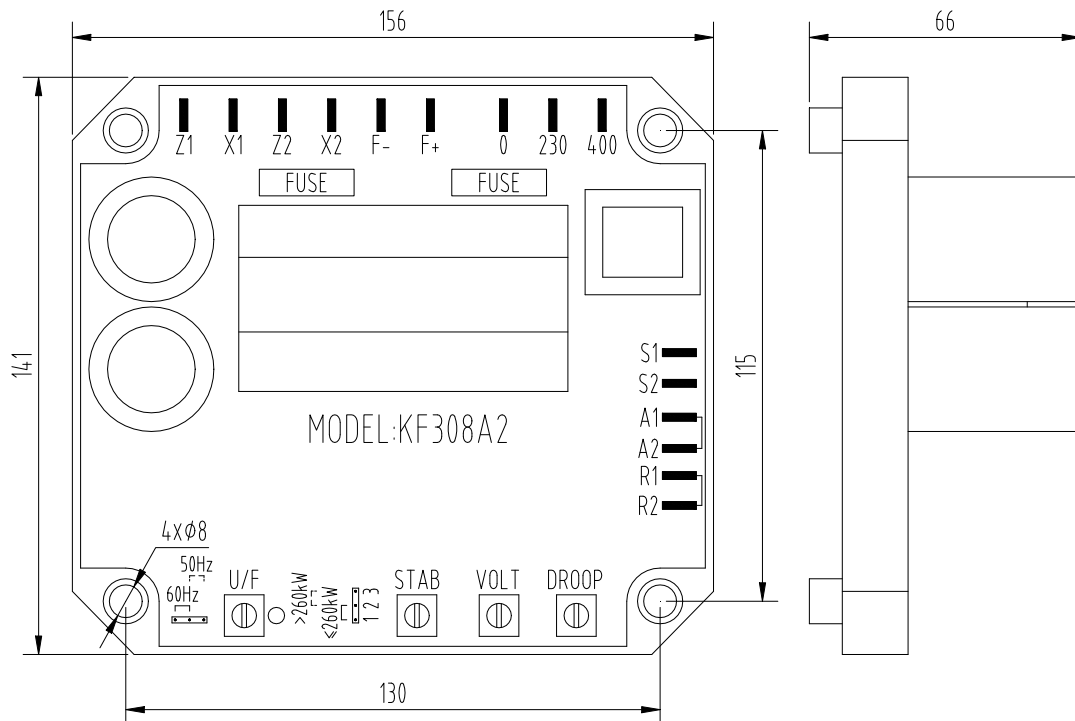


Figure 4-3

4.4.2.2 Wiring

The wiring diagram of KF308A2 shown in figure 4-4、4-5、4-6、4-7.

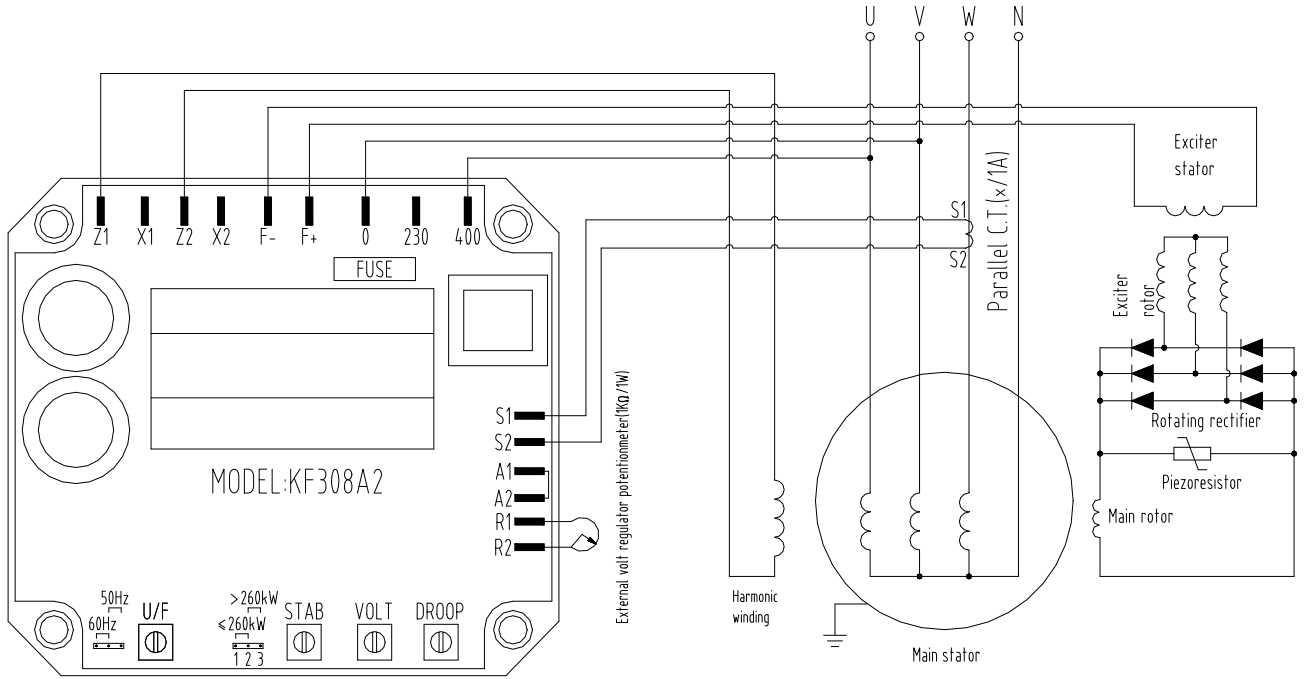


Figure 4-4

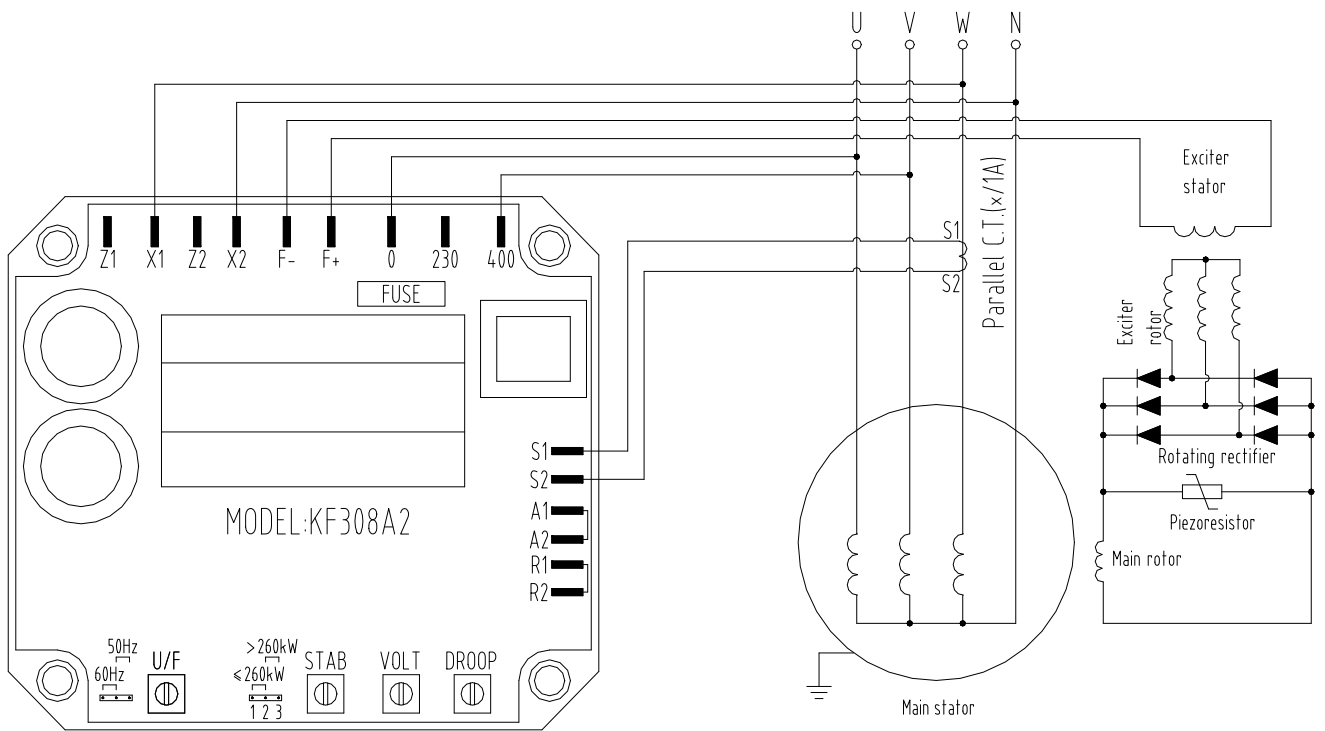


Figure 4-5

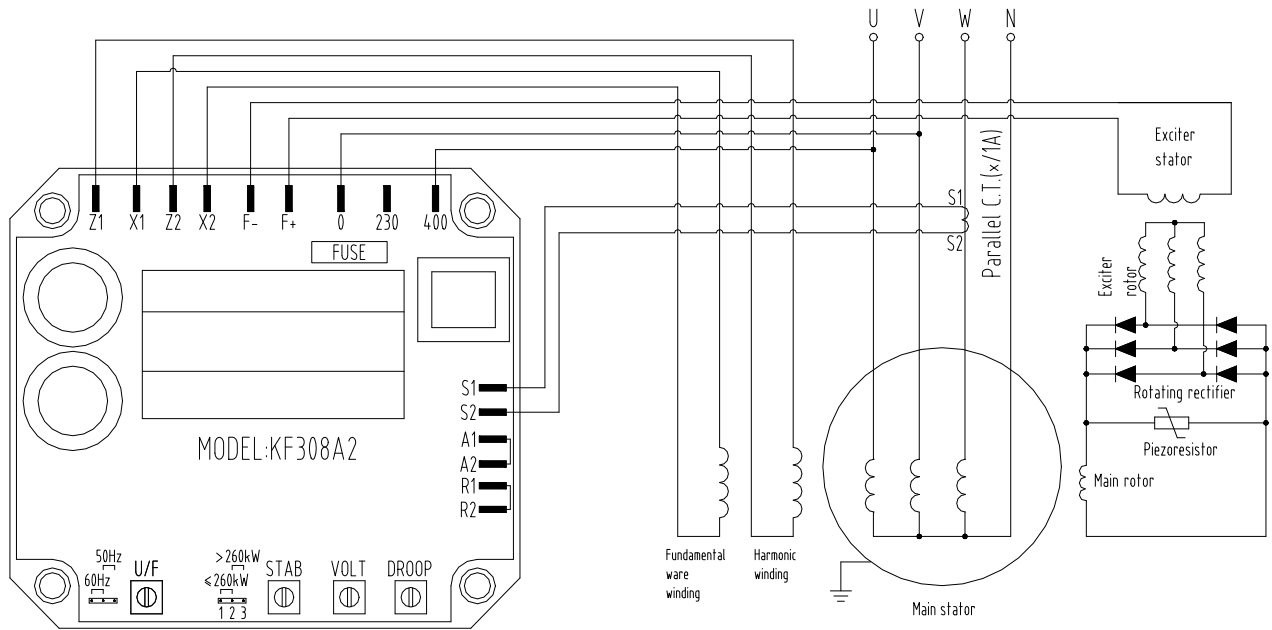


Figure 4-6

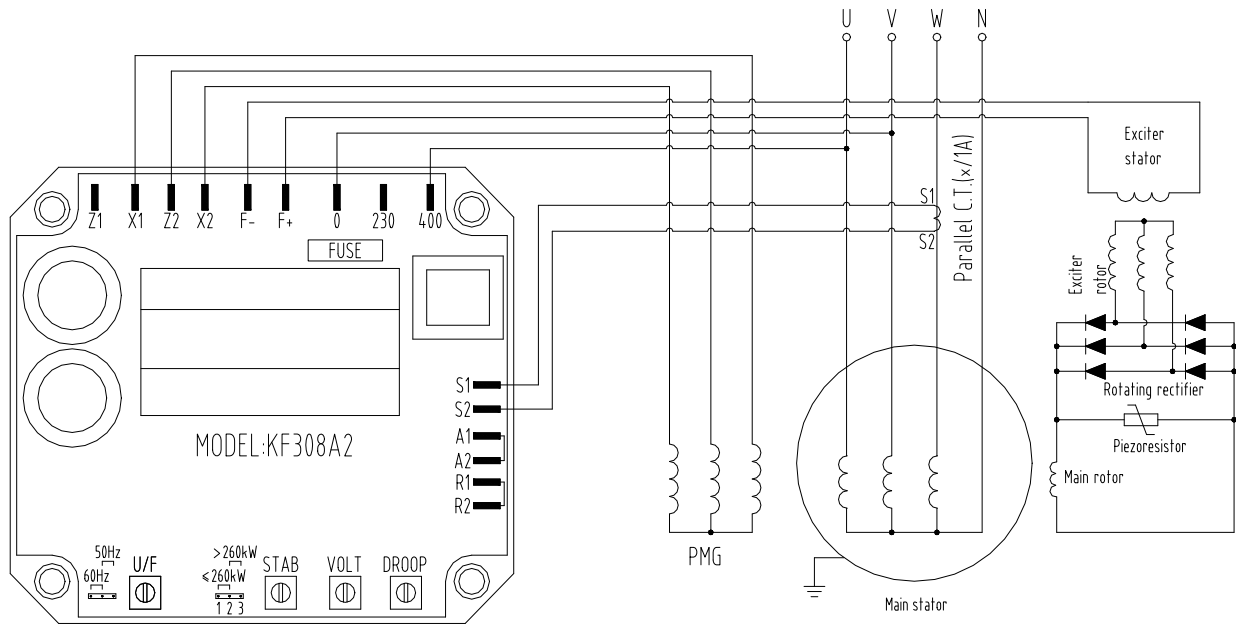


Figure 4-7

4.4.2.3 Performance parameters

1. Sensing input Voltage 150~260 VAC/260~515 VAC
Frequency 50Hz~60Hz (Jumper selectable)
2. Power input Voltage 40~240 VAC
Harmoni stator、AUX. stator、Harmoni stator and AUX. stator、PMG
Frequency 40~500 Hz
3. Output Voltage Max 200 VDC
Current Max 12 ADC/10 s
4. Voltage regulation less than $\pm 0.5\%$ RMS (With 4% engine governing)
5. Voltage build-up 5 VAC/30 Hz @ AVR terminals

6. Thermal drift 0.05% drift value @ 1 °C change in AVR ambient.
7. External volts adjustment rheostat $\pm 12\%$ with 1 k Ω 1 W trimmer
8. Analogue input external $\pm 0-1\text{VDC}$, Generator voltage is $\pm 0-10\%$
9. Quadrature droop input N:1A
Max for 4% droop (PF=0.8)
10. Under frequency protection 45 Hz @ 50 Hz ; 55 Hz @ 60 Hz
11. Vibration 1.5G @5 ~30Hz 5.0G @ 30~500Hz
12. Relative Humidity < 95%
13. Operating temperature -40~+65 °C
14. Storage temperature -40~+80 °C
15. Size 156×141×63 (mm)

4.4.3 KF306AZ

4.4.3.1 Overall dimensions

The overall dimensions of KF306AZ shown in figure 4-8.

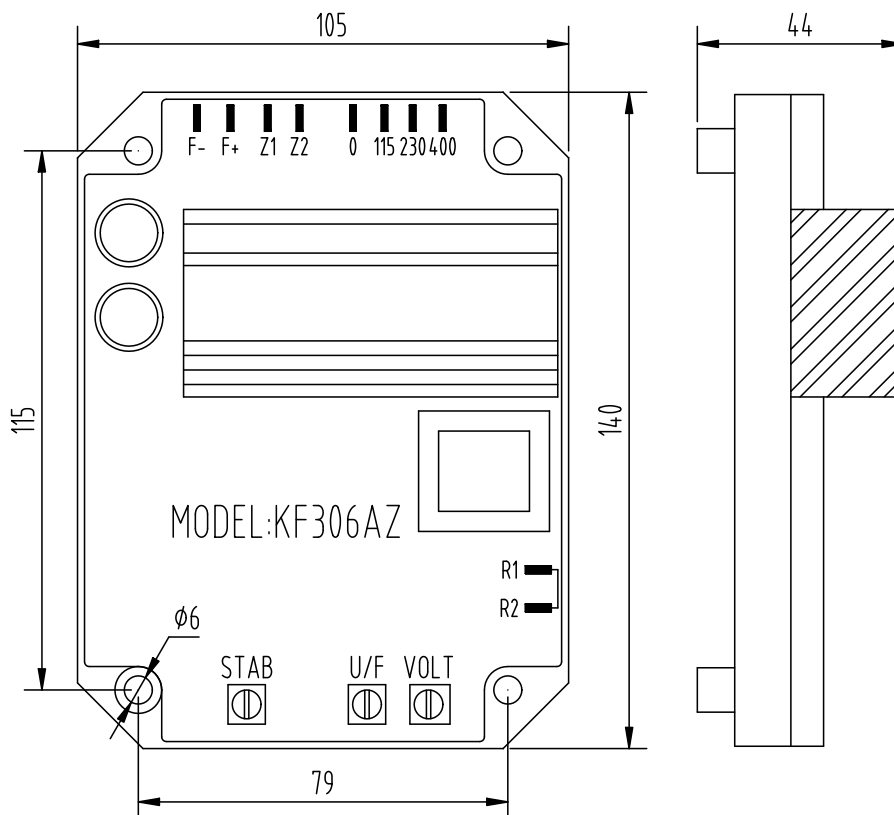
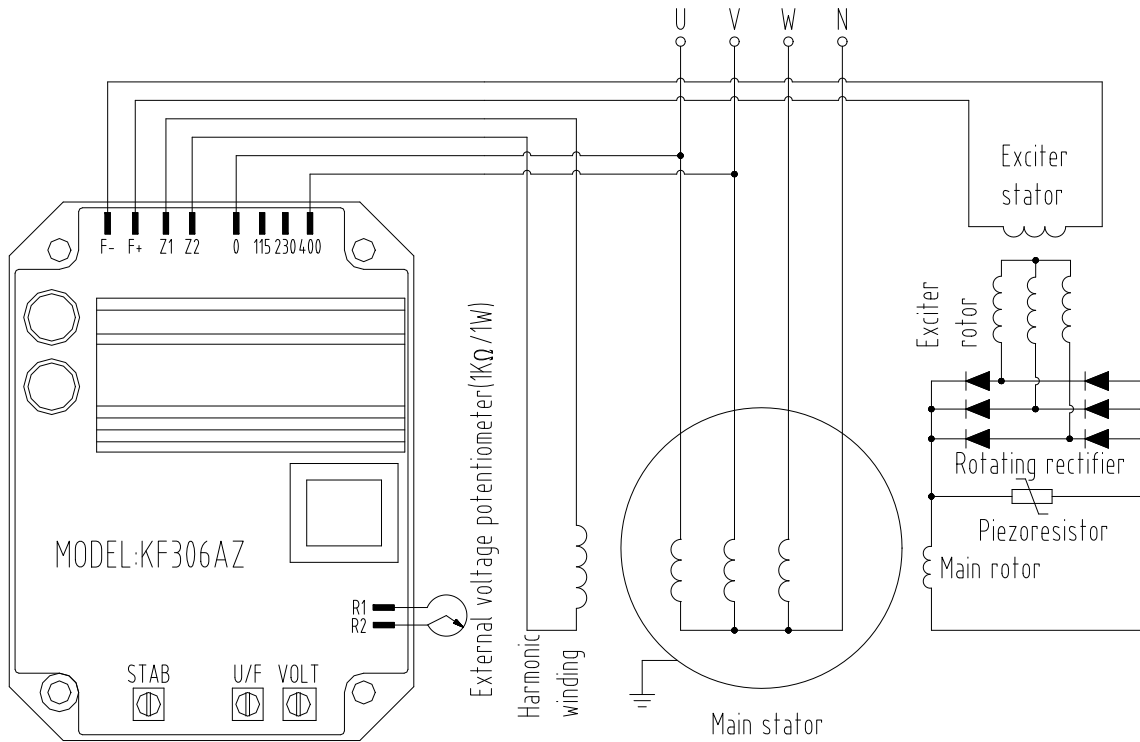


Figure 4-8

4.4.3.2 Wiring

The wiring diagram of KF306A2 shown in figure 4-9.



4.4.3.3 Performance parameters

- | | |
|-----------------------------------------------------------------------|-------------------------------------|
| 1. Sensing input | Fundamental wave/Harmonic, Max 140V |
| 2. Maximum excitation voltage output | 120V/8ADC/10s |
| 3. Detection voltage input | 115/230/400VAC |
| 4. Generator magnetic field resistance | $\geq 5 \Omega$ |
| 5. Steady state voltage regulation rate | $\leq \pm 1\%$ |
| 6. Voltage regulation range | $\geq 15\%$ |
| 7. Minimum remanent excitation voltage | $\geq 5V/30Hz$ |
| 8. R1-R2: External voltage regulator potentiometer 1KΩ/1W Fine-tuning | $\pm 12\%$ |
| 9. Operating temperature | -40~+65 °C |

4.4.4 TH460

4.4.4.1 Overall dimensions

The overall dimensions of TH460 shown in figure 4-10, figure 4-11.

4.4.4.2 Wiring

The three phase wiring diagram of TH460 shown in figure 4-12, Single-phase wiring shown in figure 4-13.

4.4.4.3 Performance parameters

1. Input Voltage 85~125 VAC/170~250 VAC (Jumper selectable)
 Frequency 50/60 Hz (general)
 Phase 1
 Wire 2
2. Output Voltage Max 90 VDC @ 207 VAC input
 Current continuous 4 ADC; Intermittent 6 ADC for 10 sec
 Resistance 15 Ω minimum
3. Voltage regulation $\pm 1\%$ (With 4% engine governing)
4. Thermal drift 0.1% drift value @ 40 $^{\circ}\text{C}$ change in AVR ambient (After 10 minutes)
5. Typical system response Field current to 90% 80 ms
 Machine Volts to 97% 300 ms
6. External volts adjustment rheostat $\pm 5\%$ with 1 k Ω 1 W trimmer
7. Under frequency protection Set point 93% Hz
 Slope 170% down to 30 Hz
8. Unit power dissipation 10 W maximum
9. Voltage build-up 3.5 V @ AVR terminals
10. Environmental Vibration 20~100 Hz 50 mm/sec
 100 Hz~2 kHz 3.3 g
 Operating temperature -40~+70 $^{\circ}\text{C}$
 Relative Humidity 0~60 $^{\circ}\text{C}$ 95%
 Storage temperature -55~+80 $^{\circ}\text{C}$

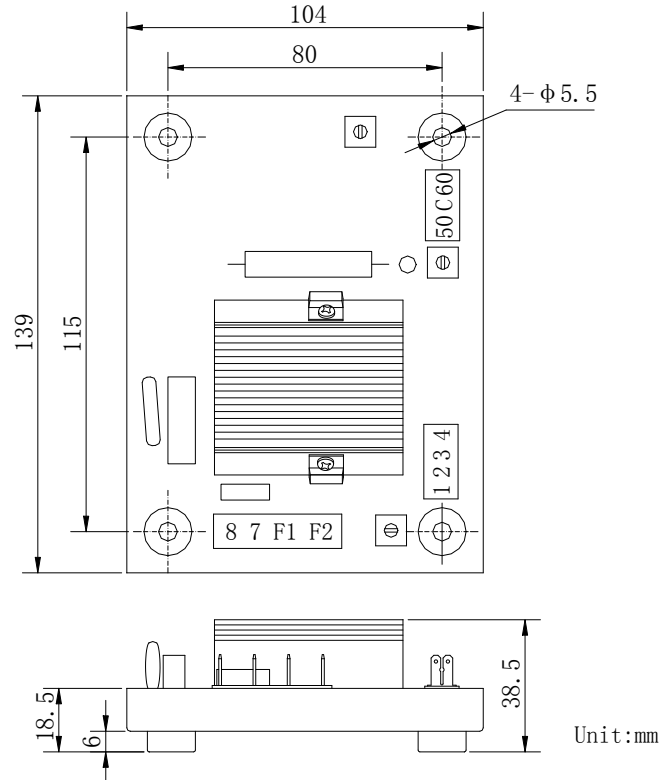


Figure 4-10

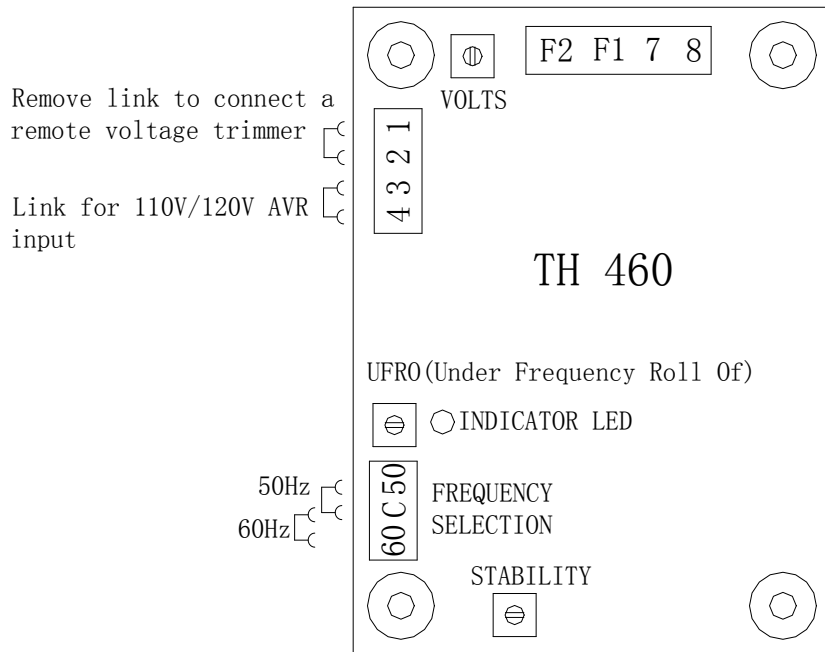


Figure 4-11

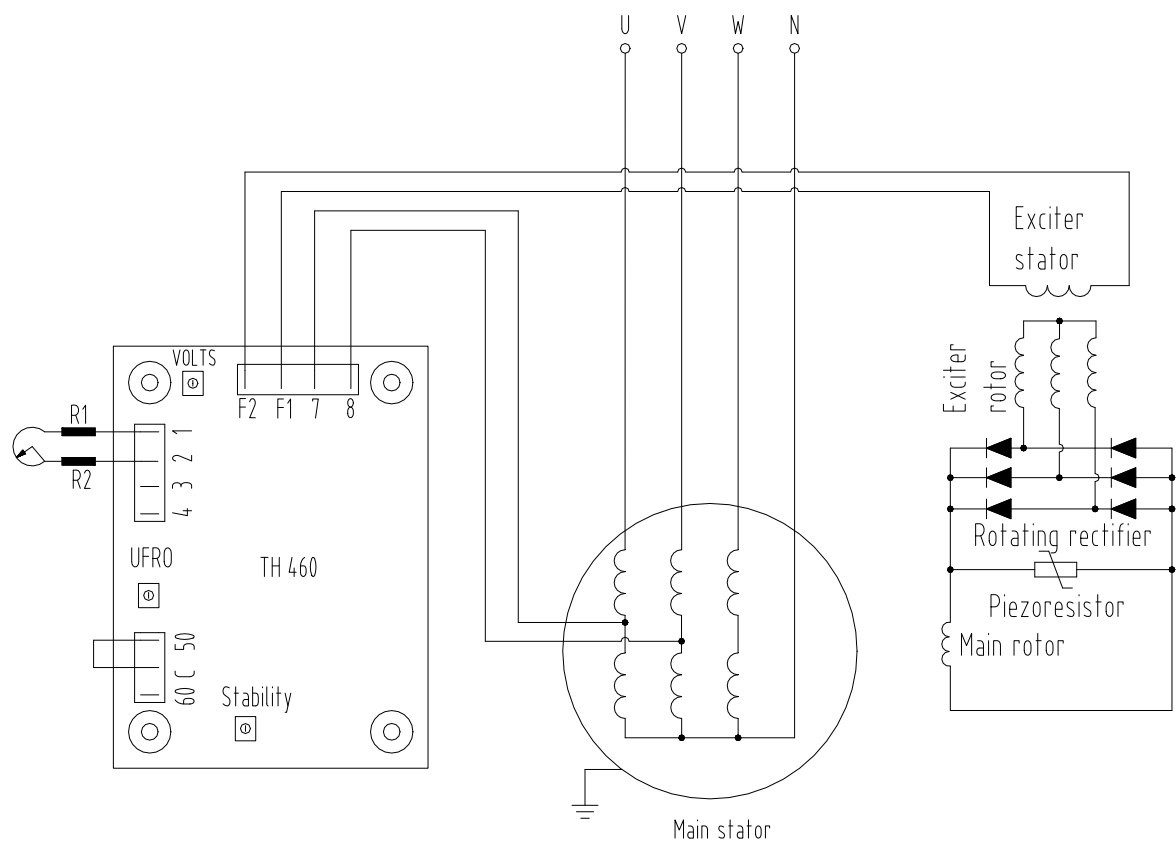


Figure 4-12

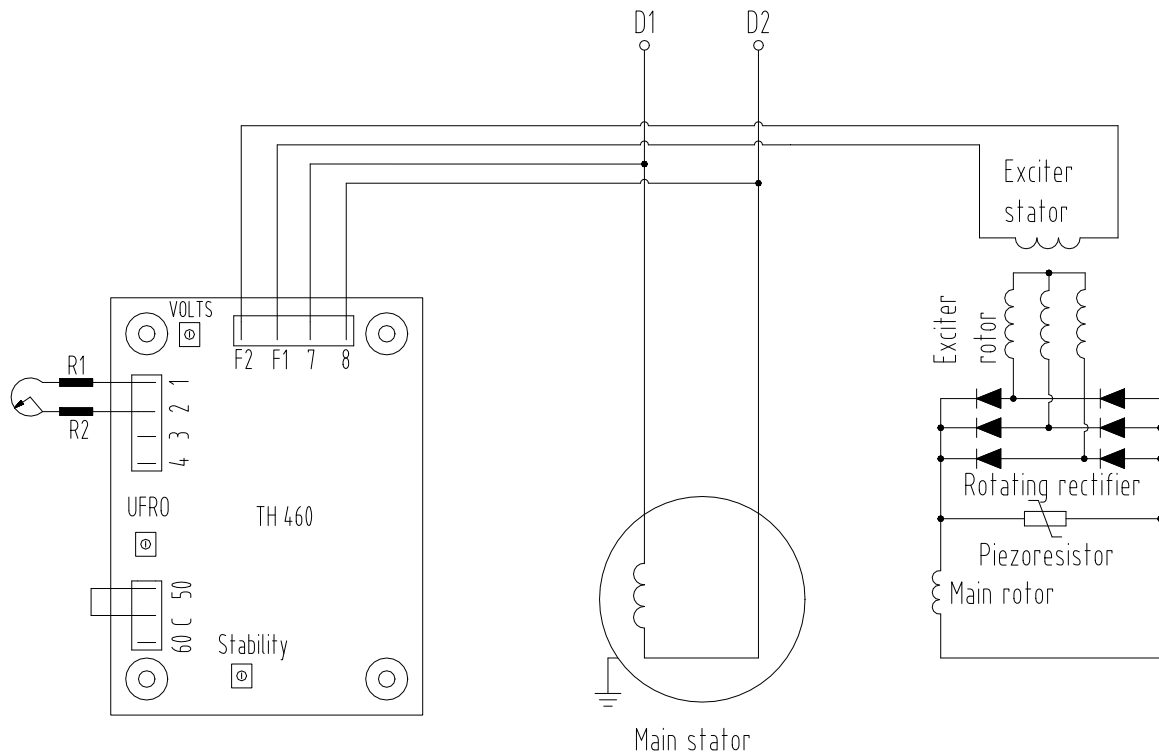


Figure 4-13

4.4.5 KR440

4.4.5.1 Overall dimensions

The overall dimensions of KR440 shown in figure 4-14, figure 4-15.

4.4.5.2 Wiring

The wiring diagram of KR440 shown in figure 4-16.

4.4.5.3 Performance parameters

1. Sensing input Voltage 170~260V or 340~520V (Jumper selectable)
 Frequency 50Hz~60Hz (general)
 Phase 2
 Wire 2
2. Power input Voltage 170~260V (AC, maximum)
 Frequency 50Hz~60Hz (general)
 Phase 1 or 2
 Wire 2
3. Output Voltage Max 90 VDC @ 207 VAC input
 Current Continuous 4 ADC; Intermittent 6 ADC for 10 sec
 Resistance 15 Ω minimum
4. Voltage regulation ±1% (With 4% engine governing)
5. Thermal drift 1% drift value @ 40 °C change in AVR ambient (After 10 minutes)
6. Typical system response Field current to 90% 80 ms
 Machine Volts to 97% 300 ms

- 7. External volts adjustment rheostat $\pm 10\%$ with 1 k Ω 1 W trimmer
- 8. Under frequency protection Set point 95% Hz
Slope 170% down to 30 Hz
- 9. Unit power dissipation 12 W maximum
- 10. Voltage build-up 3.5 V @ AVR terminals
- 11. Analogue input ± 1 V for 13% generator volts change
- 12. Quadrature droop input Burden 10 Ω
Max sensitivity 0.07 A for 5% droop (PF=0)
- 13. Environmental Vibration 20~100 Hz 50 mm/sec
Operating temperature -40~+70 $^{\circ}\text{C}$
Relative Humidity 0~60 $^{\circ}\text{C}$ 95%
Storage temperature -55~+80 $^{\circ}\text{C}$

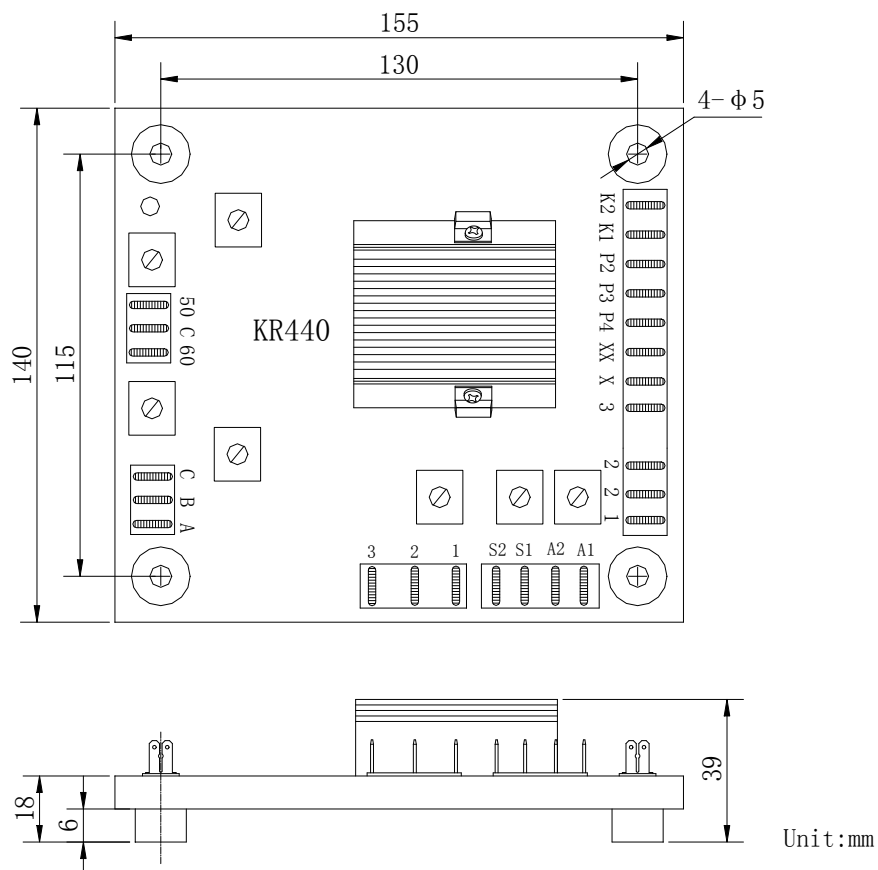


Figure 4-14

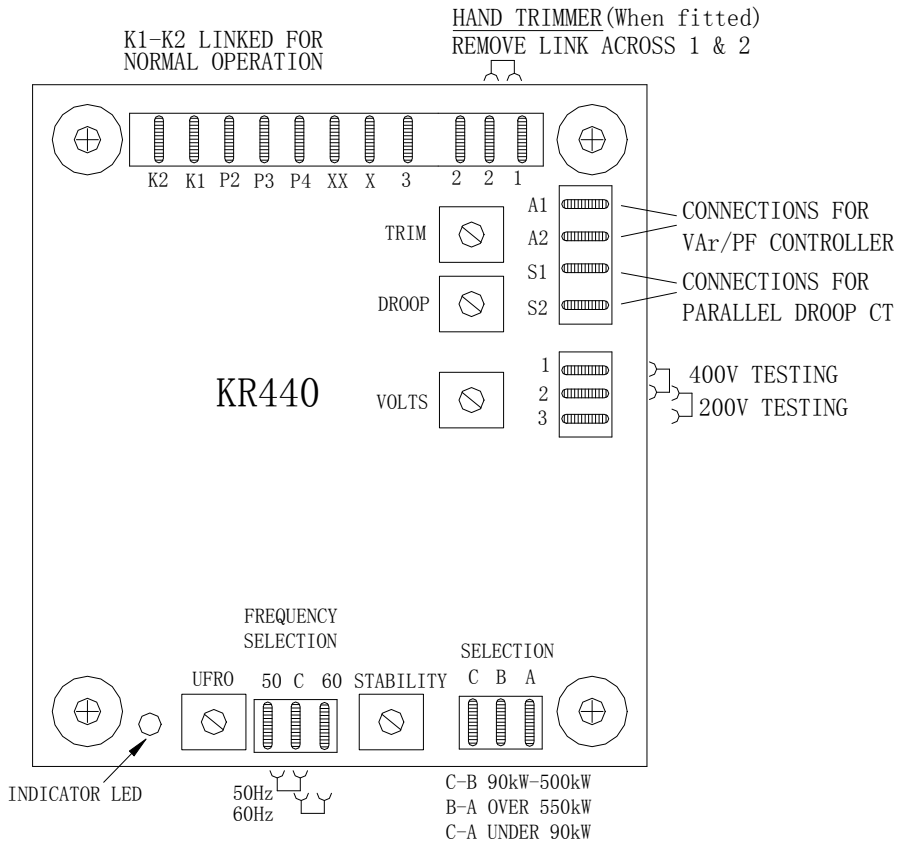


Figure 4-15

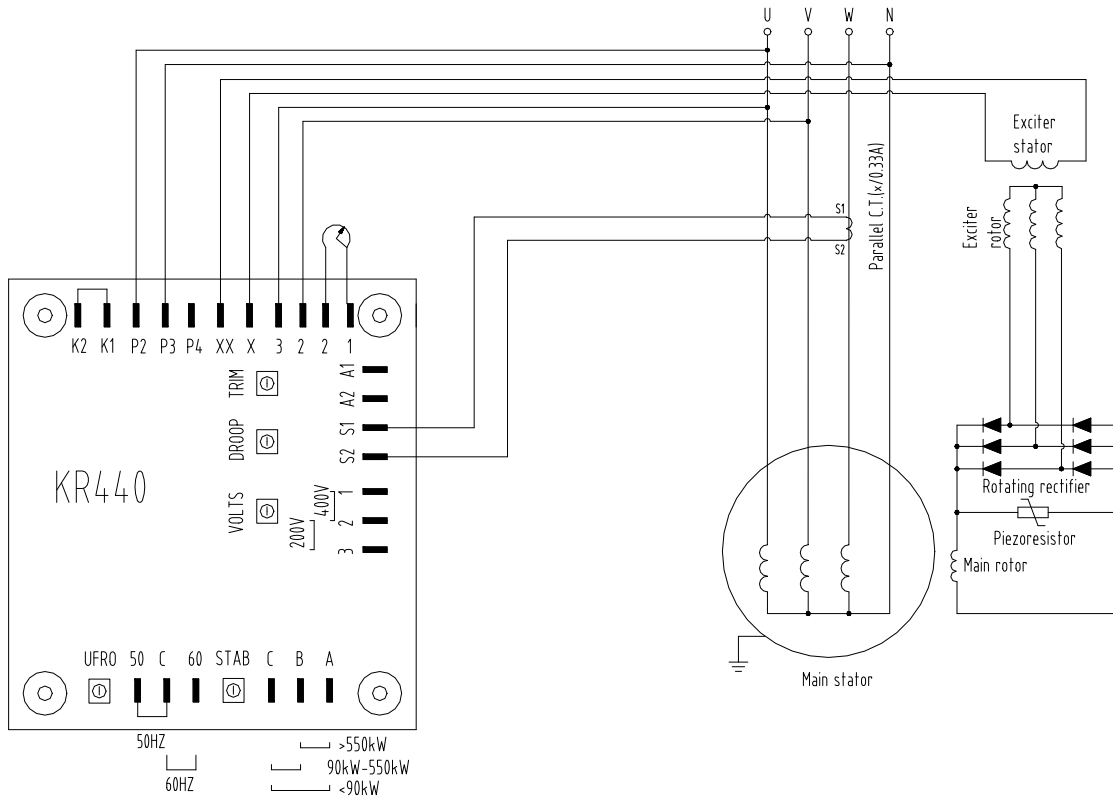


Figure 4-16

4.4.6 KRS440B

KRS440 is a half wave phase controlled thyristor type AVR and forms part of the excitation system for a brushless generator. The design employs Surface Mount Technology (SMT) for high integration of features in a small footprint AVR.

4.4.6.1 Overall dimensions

The overall dimensions of KRS440B shown in figure 4-17, figure 4-18.

4.4.6.2 Wiring

The wiring diagram of KRS440B shown in figure 4-19 & 4-20.

4.4.6.3 Performance parameters

1. Sensing input Voltage 170~264V or 352~528V
 Frequency 50Hz~60Hz (general)
 Phase 2
2. Power input Voltage 100~264V $\pm 10\%$ Phase 1
 Frequency 50Hz/60Hz
3. Output Voltage Max 82 VDC @ 200 VAC input
 Current Continuous 4 ADC; Intermittent 7.5 ADC for 10 sec
 Resistance 15 Ω minimum (when the power voltage is less than 175V, 10
 Ω minimum)
4. Voltage regulation $\pm 1\%$ (With 4% engine governing)
5. Thermal drift 0.02% drift value @ 1 $^{\circ}\text{C}$ change in AVR ambient
6. Typical system response A.V.R. response 20 ms
 Field current to 90% 80 ms
 Machine Volts to 97% 300 ms
6. External volts adjustment rheostat $\pm 10\%$ with 1 k Ω 1 W trimmer
8. Under frequency protection Set point 92~94% Hz
9. Unit power dissipation 12 W maximum
10. Voltage build-up 4 V @ AVR terminals
11. Analogue input Maximum input ± 5 VDC
 Sensitivity $\pm 1\text{V}$ for 5% Generator Volts
 Input resistance 1k Ω
12. Quadrature droop input Burden 10 Ω
 Max sensitivity 0.07 A for 5% droop (PF=0)
 Max. input 0.33 A
13. Over excitation protection Set point 75 VDC
 Time delay 10~15 seconds (Fixed)

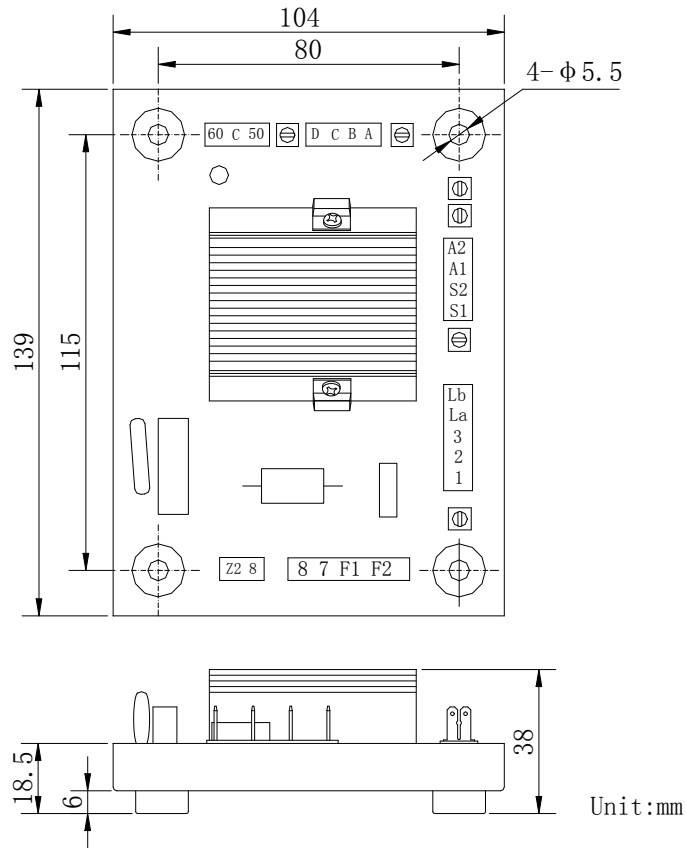


Figure 4-17

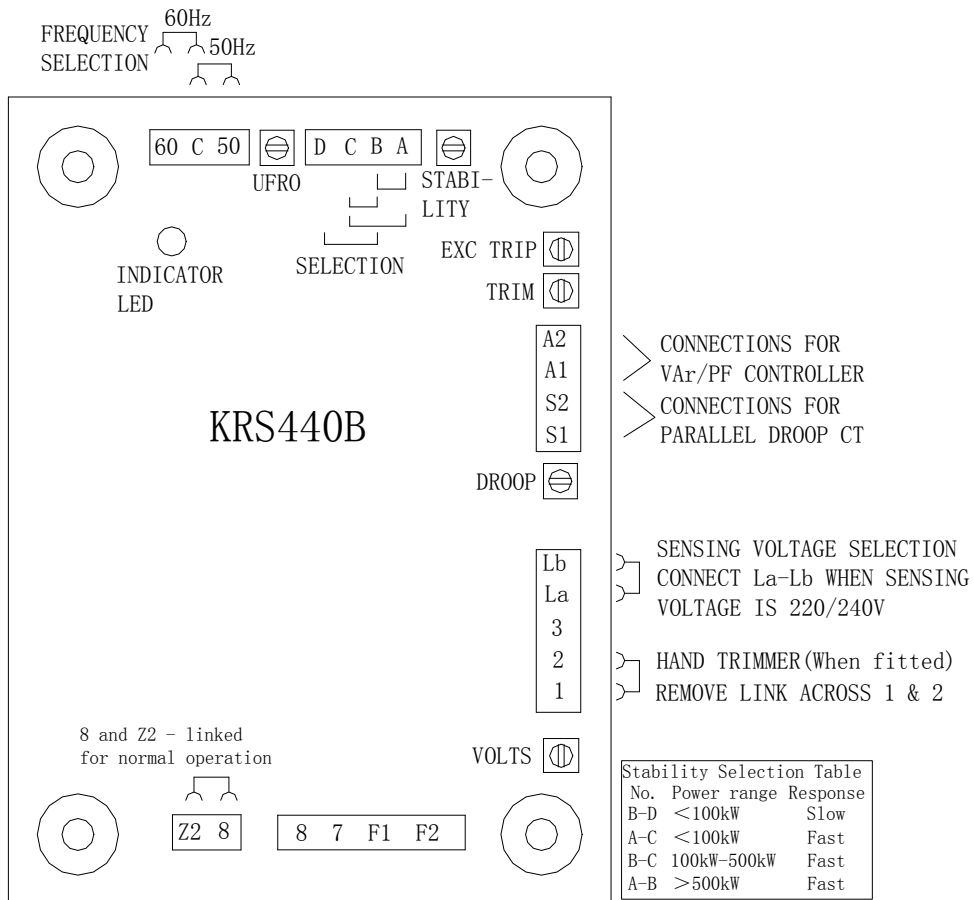


Figure 4-18

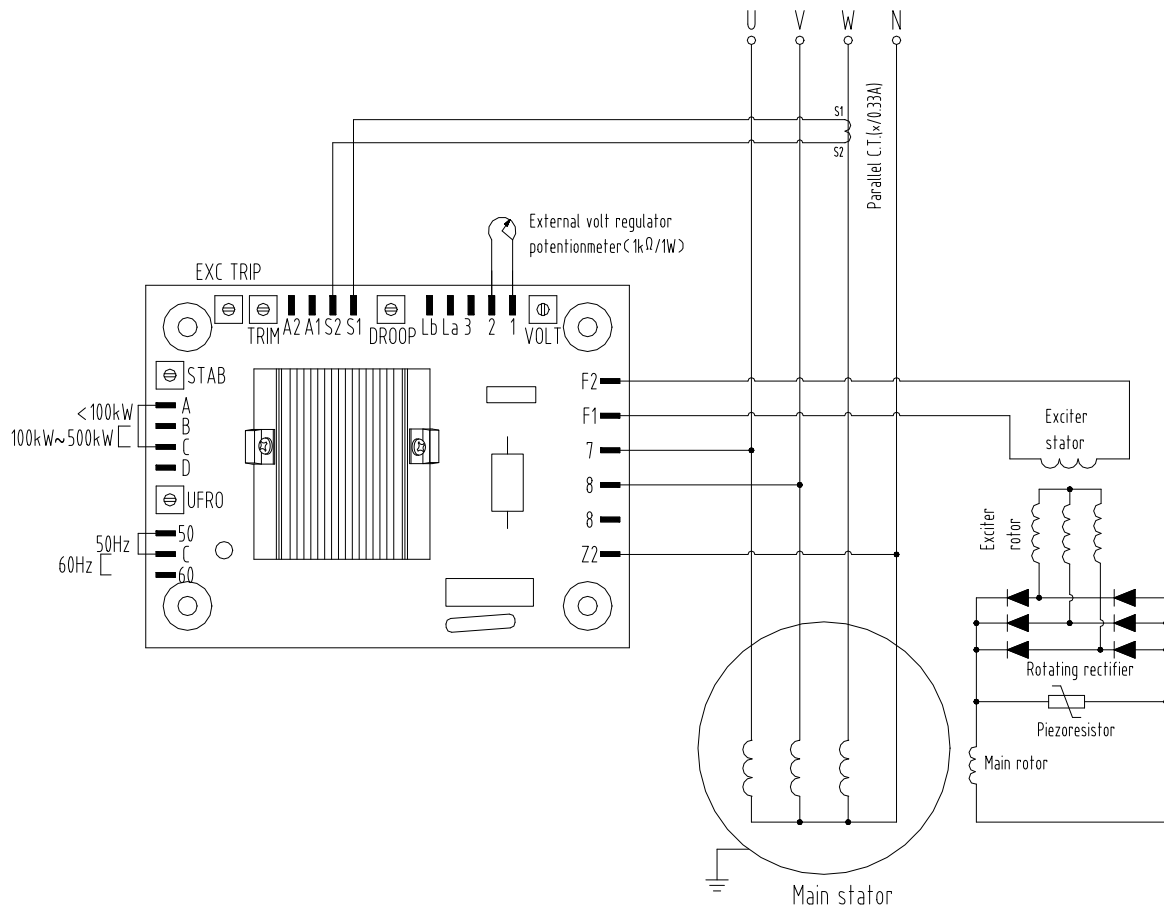


Figure 4-19 Electrical wiring of three phase four wire generator

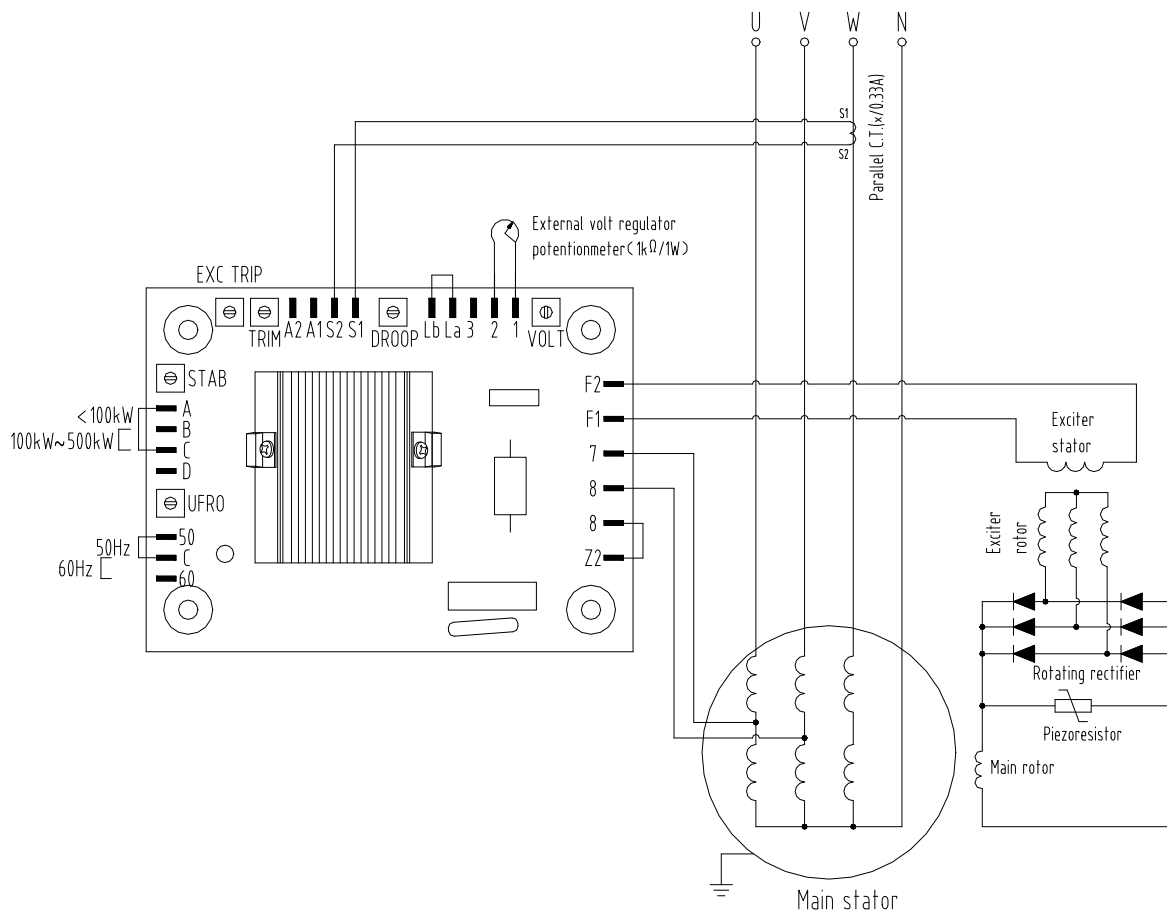


Figure 4-20 Electrical wiring of twelve wire generator

4.4.7 MX321-2

4.4.7.1 Overall dimensions

The overall dimensions of MX321-2 shown in figure 4-21, figure 4-22.

4.4.7.2 Wiring

The wiring diagram of MX321-2 shown in figure 4-23.

4.4.7.3 Performance parameters

1. Sensing input Voltage 190~240V
 Frequency 50Hz~60Hz (Jumper selectable)
 Phase 2 or 3
2. Power input (PMG) Voltage 170~220 V
 Current 3 A / phase
 Frequency 100~120 Hz
 3 phase 3 wire
3. Output Voltage Max 120 VDC
 Current Continuous 3.7 ADC (note 1); Intermittent 6 ADC for 10 sec
 Resistance 15 Ω minimum
4. Voltage build-up above 5 VAC @ AVR terminals
5. Unit power dissipation 18 W maximum
6. Current compensation load 10 Ω
7. Voltage regulation < $\pm 0.5\%$ RMS (With 4% engine governing)
8. Thermal drift 0.02% drift value @ 1 $^{\circ}\text{C}$ change in AVR ambient (note 2).
9. Over excitation protection Set point 75 VDC
 Time delay 8~15 seconds (Adjustable)
10. External volts adjustment rheostat $\pm 10\%$ with 5 k Ω 1 W trimmer (note 3)
11. Under frequency protection Set point 95% Hz (note 4)
 Slope 100~300 % down to 30 Hz
12. Soft start ramp time 0.4~4 seconds (Adjustable)
13. Current limit input 10 Ω burden
 Sensitivity range: 0.5~1A
14. Analogue input Maximum input +/- 5 VDC (note 5)
 Sensitivity 1V for 5% Generator Volts
 Input resistance 1K Ω
15. Quadrature droop input Burden 10 Ω
 Max sensitivity 0.22 A for 5% droop (PF=0)
 Max. input 0.33 A
16. Over voltage detector input Set point: 300 V
 Time delay: 1 second (Fixed)
17. Overvoltage detector input: 300 VAC (the default value) Time delay 1 second (fix)
18. CB trip coil volts: 10~30 VDC/0.5Amp
19. Vibration 3.3G @100~2 KHz
20. Operating temperature -40~+70 $^{\circ}\text{C}$ (note 6)
21. Relative Humidity < 95%
22. Storage temperature -40~+85 $^{\circ}\text{C}$

Note appended:

- (1) The current decreases linearly from 3.7Amp to 2.7Amp at 50~70 degrees centigrade
- (2) 10 minutes after operation
- (3) The modal D applied to the regulator may have to reduce the rated capacity of the generator first. Please discuss with the factory
- (4) This is the factory default value, which is semi restricted. If you want to adjust it, you can choose across the line
- (5) Any device connected to the analog input must be fully floating (insulated from the ground point) and its insulation must be up to 500 VAC
- (6) Without condensation

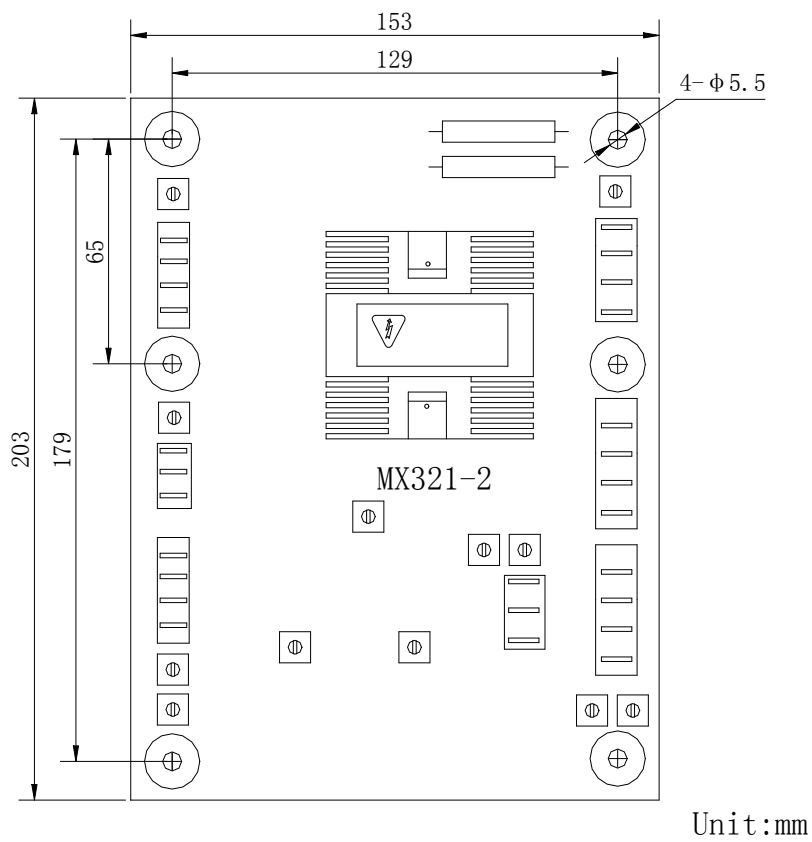


Figure 4-21

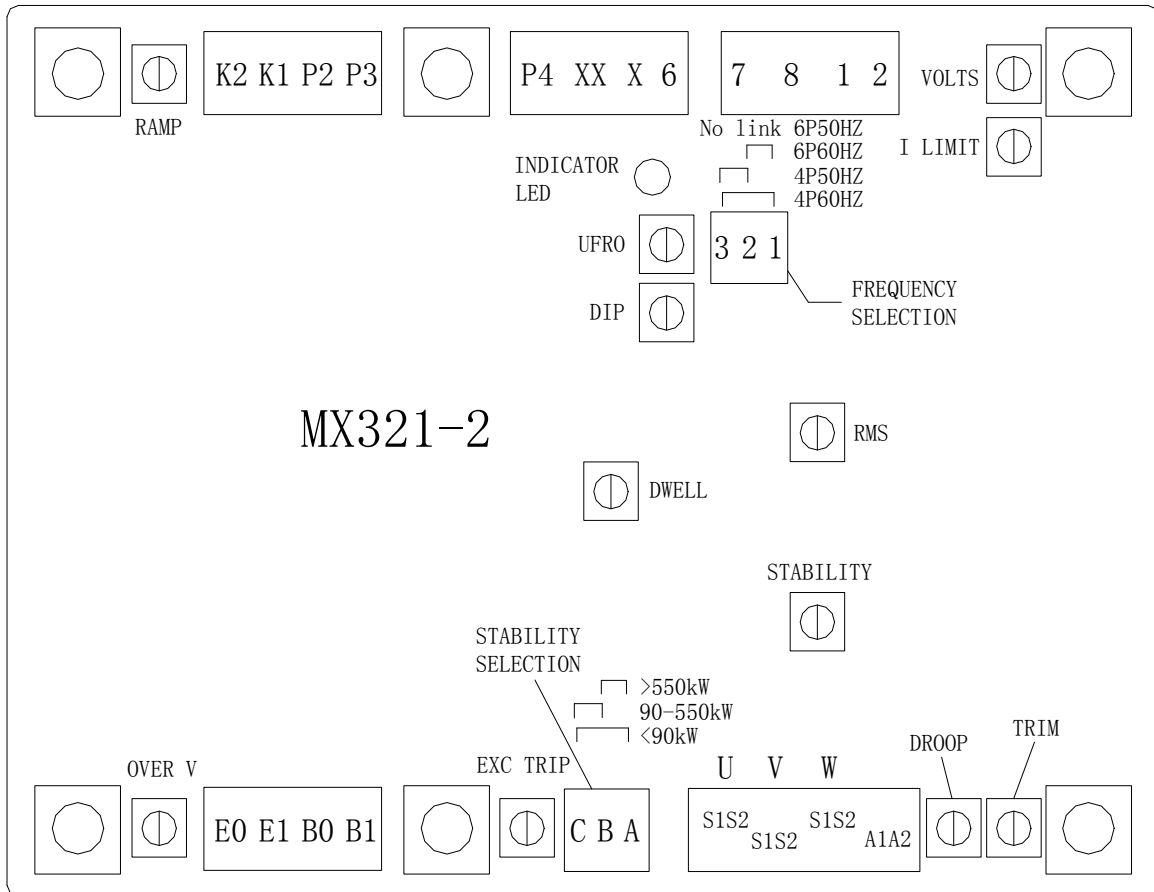


Figure 4-22

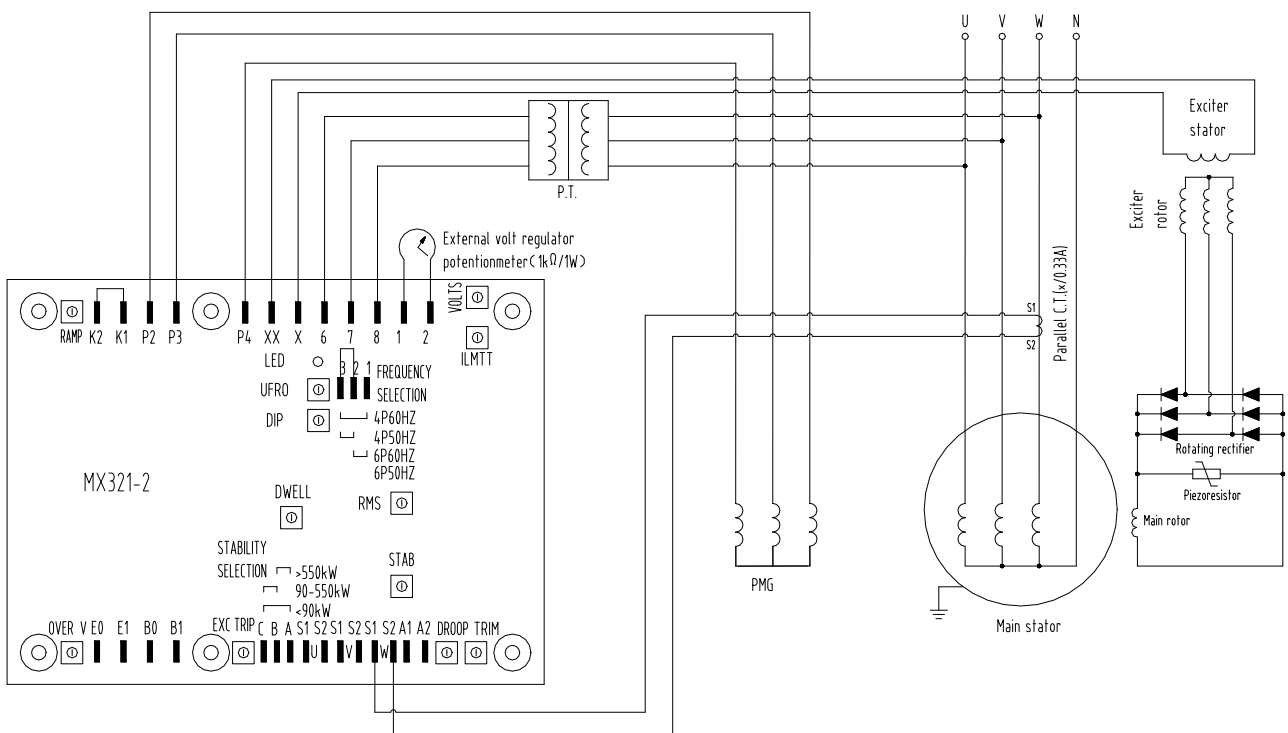


图 4-23

4.4.8 KFS4440BS

4.4.8.1 Overall dimensions

The overall dimensions of KFS440BS shown in figure 4-24.

4.4.8.2 Wiring

The wiring diagram of KF460S shown in figure 4-25.

4.4.8.3 Performance parameters

1. Power input: (P1 - P2) fundamental wave, maximum 300VAC; 50HZ/60HZ
2. Maximum excitation voltage output: 120V/12ADC/10s; continuous output 6ADC
3. Detect voltage input (L1 - L2):400V/550V;
4. Low frequency protection 50/60Hz is optional; (SW2-2/ON: 60Hz; SW2-2/OFF: 50Hz)
5. The magnetic field resistance of the generator $\geq 10 \Omega$.
6. The steady-state voltage regulation rate $\leq \pm 0.5\%$.
7. Voltage temperature drift $\leq \pm 0.05\%$.
8. Transient voltage deviation $\leq -15\%$; $\leq +20\%$; Voltage recovery time $< 1.0S$.
9. Voltage regulation range $\geq \pm 20\%$
10. Minimum remanent excitation voltage $\geq 5V/25Hz$.
11. R1-R2: External potentiometer 4.7K Ω /5W Voltage tuning $\geq 10\%$.
12. Working environment temperature: $-40^{\circ}C \sim 65^{\circ}C$.

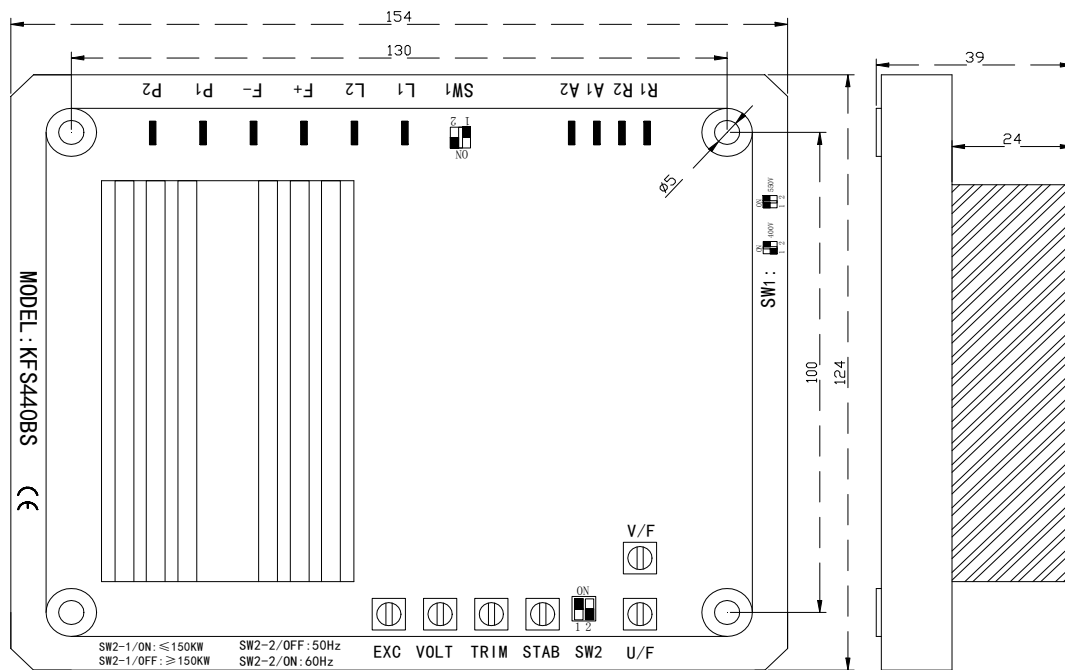
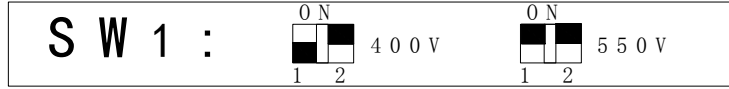


Figure 4-24

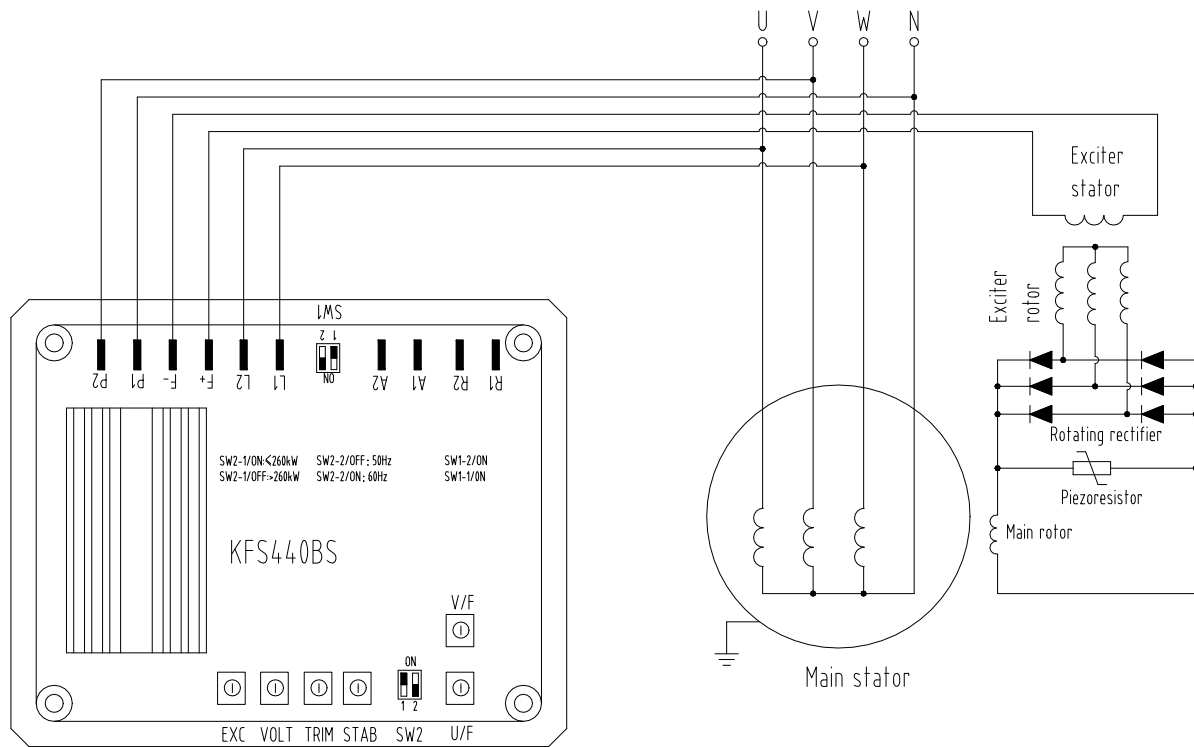


Figure 4-25

4.4.9 ABB UN1010

4.4.9.1 Overall dimensions

The overall dimensions of ABB UN1010 shown in figure 4-26

4.4.9.2 Wiring

The wiring diagram of ABB UN1010 shown in figure 4-27.

4.4.9.3 Performance parameters

1. DC rated output: excitation voltage 250 Vdc, excitation current 10Adc;
2. Strong excitation output: the maximum excitation output can reach 20Adc@300Vdc under 300Vac input;
3. DC resistance of excitation winding: minimum 10 ohms;
4. AC power input: three phase AC, 9~250Vac, 40~600HZ; Single phase AC 16~250 Vac, 40~600HZ; DC, 18~300Vdc;
5. detection input: single phase or three phase 10~200HZ, 0~450Vac;
6. Adjustment accuracy: from no-load to full load, above $\pm 0.2\%$;
7. Temperature drift: temperature change 50°C in one hour, Voltage change $\pm 0.5\%$;

8. Voltage excitation: automatic voltage excitation is provided internally, requiring minimum residual voltage of generator not less than 9Vac;
9. Power compensation: Yes;
10. Parallel function: Yes;
11. Strong excitation function: Yes (2 times);
12. Over excitation shutdown :Yes;
13. Size: 302×170×111 (mm) ;
14. Weight: 2.8kg;

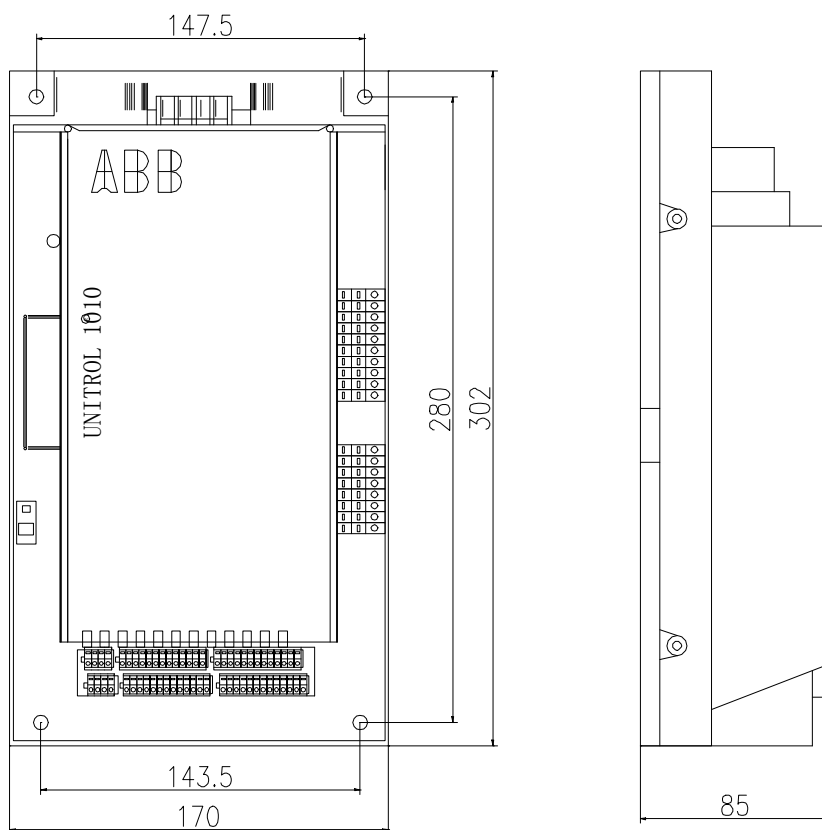


Figure 4-26

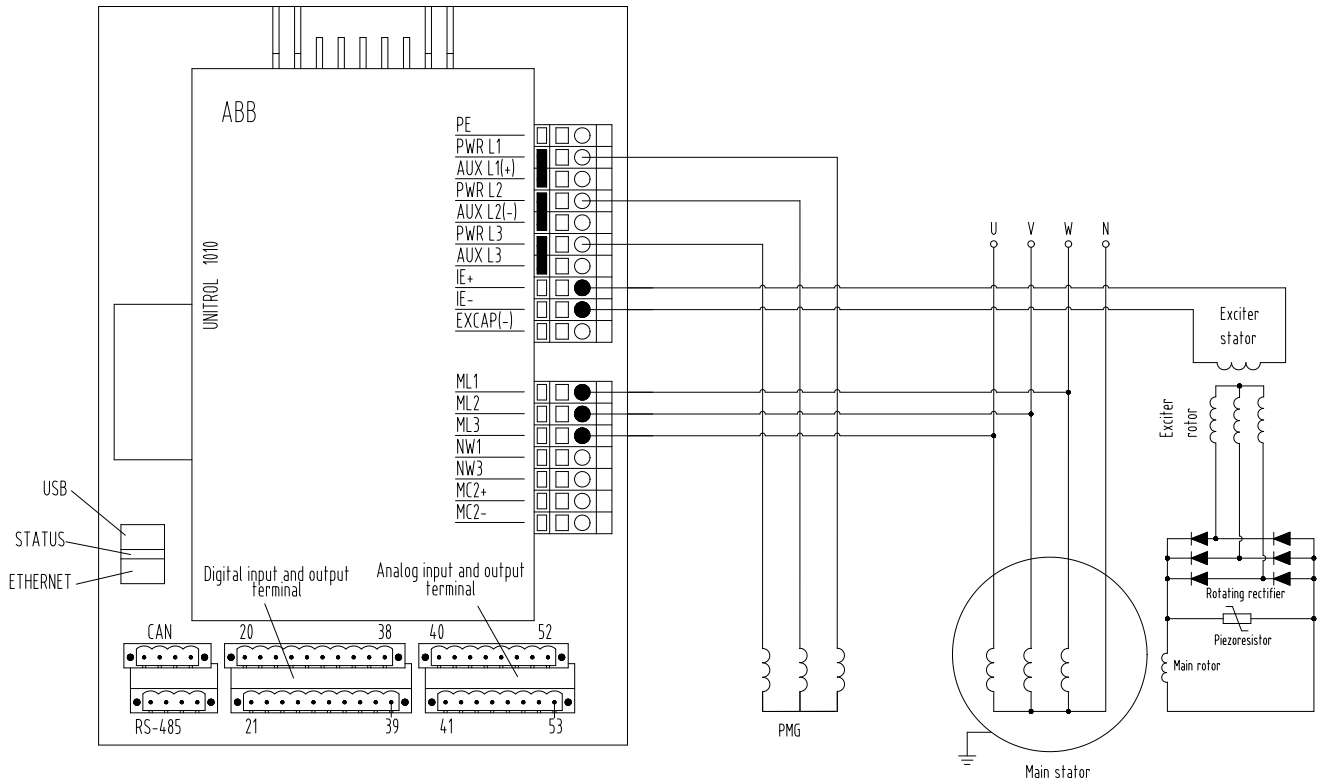


Figure 4-27

4.4.10 DECS-150

4.4.10.1 Overall dimensions

The overall dimensions of DECS-150 shown in figure 4-28

4.4.10.2 Wiring

4.4.10.3 Performance parameters

AC running power and DC running power

1. Full load continuous current: 10A@55°C (131° F)
7A@70°C (158° F)
2. Power input configuration: single phase and three phases
3. Power input frequency: dc, 50~500Hz

63Vdc	125Vdc
-------	--------
4. Rated input voltage: 120Vac, 125Vdc 240Vac, 250Vdc
5. Full load continuous voltage : 63Vdc 125Vdc
6. Minimum excitation resistance: 9 Ω 18 Ω
7. 10 second strong excitation: 100Vdc, 11Adc 200Vdc, 11Adc

Generator and bus voltage detection

1. Configuration: single phase or three-phase three wire

2. 50Hz voltage range: 100Vac \pm 10%

200Vac \pm 10%

400Vac \pm 10%

60Hz voltage range: 120Vac \pm 10%

240Vac \pm 10%

480Vac \pm 10%

600Vac \pm 10%

3. Frequency: rated 50/60Hz

4. Power consumption: < 1VA/ phase

Generator current detection

1. Configuration: single phase or three-phase

Independent input with crosscurrent compensation

2. Rated current: 1Aac or 5Aac

3. Frequency: 50/60Hz

1Aac Detection power consumption: <0.1VA

5Aac Detection power consumption: <0.3VA

Physics

1. weight:3.95lb

2. size: 163 \times 302 \times 82mm

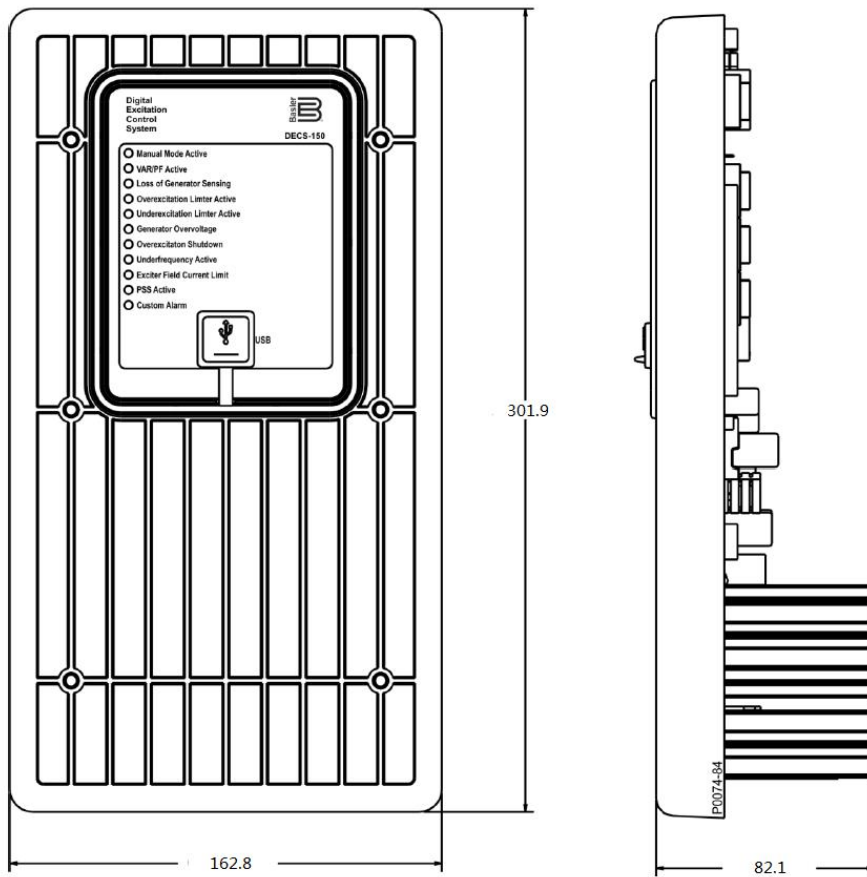


Figure 4-28

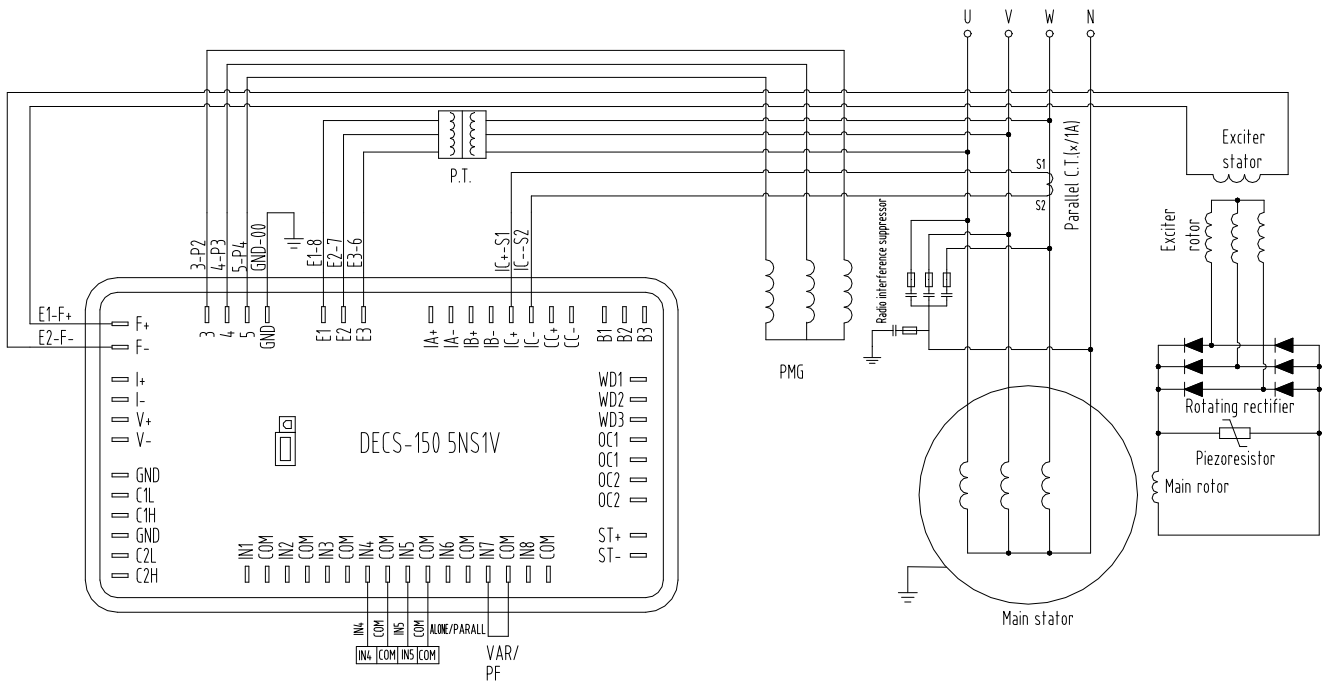


Figure 4-29

4.5 Inspection prior to operation

After delivery, storage, installation, and assembly to ensure the reliability of the generator it is necessary to make pre-running checks.

4.5.1 Insulation check

This series generator has fine insulation structure, no need drying only if it excessively gets damp. The insulation resistance is easy to get damp, it may be checked by megohmmeter (Notice: the connection between AVR and windings should be cut off to avoid destroy electronic parts.) The windings (including stator armature winding, rotor exciting winding, stator exciting winding of exciter, rotor armature winding of exciter, stator winding of P.M.G.) insulation resistance to earth is not lower than 1 million ohms. If insulation resistance value is less than 1 million ohms, the above drying or other methods should be taken to promote the insulation resistance.

Important! The windings have been H.V. tested during manufacture and further H.V. testing may degrade the insulation with consequent reduction in operating life. Should it be necessary to demonstrate H.V. testing, for customer acceptance, the tests must be carried out at reduced voltage level i.e. (Test Voltage = $0.8 \times (2 \times \text{Rated Voltage} + 1000)$).

4.5.2 Earth connection check

The earthing bolts on the generator frame should be effectively earthed and the earthing conductor should have enough wide section and connect with the water pipe or metal plate under ground to ensure well earthing.

4.5.3 Rotation direction check

The rotation direction should be in accordance with the direction of generator plate. reverse direction will result in reverse phase.

4.5.4 Connection wires check

The terminal box can accept cable entry from left side (View from the drive end. Right side if necessary, take special order).

Incoming cables should be supported from either below or above the box level and at a sufficient distance from the centre line of the generating set so as to avoid a tight radius at the point of entry into the terminal box panel, and allow movement of the generator set on its anti-vibration mountings without excessive stress on the cable.

Before operation please check the wire connection between generator, switchboard, AVR according to the schematic diagram.

IMPORTANT! To avoid the possibility of debris entering the generator, remove the panel before drilling.

4.5.5 Assembling check

The bolts in each parts should be firm. Check should be taken inside generator to ensure there is no foreign matter. If dust be found on coil or rotor it should be get rid off by compressed air. Rotate the rotor by tool or hand to ensure it runs smoothly.

4.6 Generating set test

DANGER! During testing it may be necessary to remove covers to adjust controls exposing live terminals or components. Only can personnel qualified to perform electrical service carry out test and/or adjustment.

4.6.1 Instruments and cable for test

Connect any instrument wiring and cabling required for initial test purposes with permanent or spring-clip type connectors. Minimum instrumentation for testing should be line-line or line to neutral voltmeter. Hz meter, load current meter and power meter. If reactive load is used a power factor meter is needed.

IMPORTANT! All cabling voltage class should higher than generator rating voltage when preparing cabling for load test. Ensure the cabling terminals are on generator winding terminals and firm.

4.6.2 Initial start-up

Make sure that all engine manufacturer' s pre-running procedures have been completed and the speed of generator do not exceeds the 120% rated speed before starting the generating set.

IMPORTANT! Over-speeding of the generator during initial setting of the speed governor can result in damage to the generator rotating components.

Additionally, anti-clockwise turn the potentiometer of AVR for voltage adjusting and fixing and make the no-load voltage to the lower limit value, Start the generating set and run on no-load at nominal frequency. Slowly turn the potentiometer clockwise until the voltage reach it rated value.

IMPORTANT! Do not increase the voltage above the rated generator voltage shown on the generator nameplate.

4.6.3 Test and adjustment prior to operation

4.6.3.1 Test and adjustment at no-load

Start the engine until rated speed and the generator should set up the voltage by itself. As the voltage class required by the users the potentiometer of AVR can be adjusted to set the voltage in 95~105% rated voltage, no need to adjustment again. In the process of setting voltage note the generator voltage, phases (check by turning the voltage change-over switch.) and

running.

4.6.3.2 Test and adjustment at load

After the above test close the air-switch and remain at load power factor at 1.0 and 0.8 (lagging), gradually increase load to full load then reduce load to no-load. In this process the stable voltage regulation rate in no excess of the nameplate. Watch the switchboard indication normal or not and check whether there is overheating in the generator parts.

After the adjustment and test mentioned above are carried, the generator can normally run alone.

IMPORTANT! The correct method of adding load and stopping machine: Firstly, start prime mover to rated speed, then gradually add load to the generator; If you want stop machine, you must gradually decrease load until the load is zero from the generator. Stopping machine with load is easily lead to loss of excitation and fault of the generator.

Chapter 5 ACCESSORIES

Generator control accessories (such as parallel additional devices, external voltage regulator) may be fitted, as an option, in the generator control panel or connection according to the section 4 by the user as accessories.

5.1 External voltage regulation

A external volts adjustment rheostat can be fixed to the control panel. The schematic & wire diagram see part 4.4 about A.V.R. .

5.2 Parallel operation

It is very important to understand the following notices before parallel operation, it is essential that the phase sequences of parallel generator or the power network are the same, at the same time, the following conditions must be met:

1. Frequency must be the same.
2. Voltage must be the same.
3. Phase angle of voltage must be the same.

A variety of techniques, varying from simple synchronizing lamps to fully automatic synchronizers, can be used to ensure these conditions are met.

CAUTION! Failure to meet these conditions before closing the interconnecting circuit breaker between two or more running generators will generate excessive mechanical and electrical stresses, resulting in serious damage to the generators and associated equipment.

Once connected in parallel a minimum instrumentation lever per generator of voltmeter, ammeter, watt meter (measuring total power per generator), and frequency meter is required in order to adjust the engine and generator controls to share kW in relation to engines ratings and kVAr in relation to generator ratings.

It is important to recognise that:

kW load is derived from the engine, the speed governor characteristics determine the kW sharing between sets.

kVAr load is derived from the generator, and the excitation control characteristics determine the kVAr sharing.

To set up the governor Read generating set manufacturer's instructions for setting controls.

IMPORTANT! If the neutral point of several alternators are connected each other or connected with the neutral point of voltage transformer and load, the neutral line current will be produced. In order to avoid the over heat of alternator, the neutral line current can not exceed the 50% rated current of alternator. If the neutral line current exceeds the value mentioned above, the inductor or other measures must be used to limit the neutral line current.

5.2.1 DROOP

Quadrature droop is the most commonly used method of kVAr sharing. The droop circuit creates a generator voltage characteristic that falls with decreasing power factor (increasing kVAr). This is achieved with an additional current transformer (C.T.) and a burden resistor on the AVR board(DTW5: Add reactive adjusting resistance RP1). The C.T. provides a signal dependent on the current phase angle (i.e. the power factor). This and a percentage of the burden resistor voltage are summed into the AVR circuit. Increasing droop is obtained by turning the 'DROOP' control potentiometer(DTW5: Rotary handle rotation of RP1) clockwise.

Generally 5% droop at full load current zero p.f. is sufficient to ensure kVAr sharing. If the droop accessory C.T. has been supplied with the generator it will have been tested to ensure correct polarity and set to a nominal level of droop. The final level of droop will be set during generating set commissioning. Although nominal droop setting may be factory set it is advisable to go through the setting procedure below.

5.2.2 Droop setting procedure

Depending upon available load the following settings should be used – all are based on rated current level.

0.8 p.f. load (at full load current)	set droop to 3%
zero p.f. load (at full load current)	set droop to 5%

Setting the droop with low power factor load is the most accurate.

Run each generator as a single unit at rated frequency or rated frequency + 4% depending upon type of governor and nominal voltage. Apply available load to rate current of the generator. Adjust 'DROOP' control potentiometer(DTW5: Rotary handle rotation of RP1) to give droop in line with above table. Clockwise rotation increases amount of droop. Refer the section for the appropriate AVR to establish the location of the droop potentiometer.

Note 1) Reverse polarity of the C.T. will raise the generator voltage with load. The polarities S1&S2 shown on the wiring diagrams are correct for clockwise rotation of the generator looking at the drive end. Reversed rotation requires S1 & S2 to be reversed.

Note 2) the most important aspect is to set all generators equal. The precise level of droop is less critical.

Note 3) A generator operated as a single unit with a droop circuit set at rated load 0.8 power factor is unable to maintain the usual 0.5% regulation. A shorting switch can be connected across S1 & S2 to restore regulation for single running.

Caution: Loss of fuel to an engine can cause its generator to motor with consequent damage to the generator windings. Reverse power relays should be fitted to trip main circuit breaker.

Caution: Loss of excitation to the generator can result in large current oscillations with consequent damage to generator windings. Excitation loss detection equipment should be fitted to trip main circuit breaker.

Chapter 6 SERVICE & MAINTENANCE

WARNING! Service and fault finding procedures present hazards which can result in severe personal injury or death. Only personnel qualified to perform electrical and mechanical service should carry out these procedures. Ensure engine-starting circuits are disabled before commencing service or maintenance procedures. Isolate any anticondensation heater supply.

Ensure engine starting circuits are disabled before commencing service or maintenance procedures. Isolate any anti-condensation heater supply. In order to ensure safe operation of the generator and discover and eliminate the cause of faults beforehand, frequent maintenance and periodic overhaul are needed for the generator. The plan of periodic overhaul must be formulated and performed on time.

The generator featured with brushless, its maintenance and overhaul is less, the period between overhauls prolongs.

6.1 General maintenance

(1) The generator should be prevented from getting damp, when not in use, it should be covered with oil cloth to prevent the infiltration of moisture and foreign matters.

(2) During not use or operation, the generator should prevent mental dust, water, dust steam or other harmful air from entering into it.

(3) During operation, normal ventilation should be kept. Don't put anything on the cover of the generator to keep good heat dissipation and normal ventilation.

(4) Check the load of generator; the load current should not exceed their rated value. The exciting current should not exceed rated value given on the nameplate when the load factor is low and the current of phase with the strongest load.

(5) Check the temperature of every parts of generator. The temperature-rise of bearing should not exceed 55K, stator and rotor winding not exceed 125/125K.

(6) All the rotary parts should be tightly fastened in position. The generator should be without any friction and collision.

6.2 Maintenance items

6.2.1 Windings

The condition of the windings can be assessed by measurement of insulation resistance to earth.

Be careful in test when the winding is too dirty or wet. a 500 V megohmmeter should be used. if the insulation resistance to earth of all windings is below 1 M ohms it should be dried. If after drying out the insulation resistance does not rise up the insulation is judged to be damaged, therefore rewinding, re-insulation and re-treatment is necessary.

All insulation resistance or other high voltage test should not be performed before the windings are dried and cleaned (if needed).

6.2.2 Methods of drying out generators

Cold run: In the case of a generator in otherwise good condition that has not been run for

some time, and has been standing in damp, humid conditions a simple procedure may suffice. It is possible that simply running the generator set unexcited for a period of say 10 minutes will sufficiently dry the surface of the windings and raise the IR to greater than 1 Megohm, and so allow the unit to be put into service.

Blown air drying: Remove the covers from all apertures to allow the escape of the water-laden air. During drying, air must be able to flow freely through the generator in order to carry off the moisture. Direct hot air from two electrical fan heaters of around 1 - 3 kW into the generator air inlet apertures. Ensure the heat source is at least 300mm away from the windings to avoid over heating and damage to the insulation. Apply the heat and plot the insulation value at half hourly intervals. The process is complete when the parameters covered in the section entitled are met. Remove the heaters, replace all covers and re-commission as appropriate.

Short circuit method: Bolt a short circuit of adequate current carrying capacity, across the main terminals of the generator. The shorting link should be capable of taking full load current. Disconnect the cables from terminals "X" / "E1" and "XX" / "E2" of the AVR. Connect a variable DC supply to the "X" / "E1" (positive) and "XX" / "E2" (negative) field cables. The DC supply must be able to provide a current up to 2.0 Amp at 0 - 24 Volts. Position a suitable ac ammeter to measure the shorting link current. Set the dc supply voltage to zero and start the generating set. Slowly increase the dc voltage to pass current through the exciter field winding. As the excitation current increases, so the stator current in the shorting link will increase. This stator output current level must be monitored, and not allowed to exceed 80% of the generator's rated output current. After every 30 minutes of this exercise, stop the generator and switch off the separate excitation supply, measure and record the stator winding IR values, and plot the results. Once the Insulation Resistance is raised to an acceptable level - minimum value 1 Megohm the DC supply may be removed and the exciter field leads "X" / "E1" and "XX" / "E2" re-connected to their terminals on the AVR. Rebuild the genset, replace all covers and re-commission as appropriate. If the set is not to be run immediately ensure that the anti-condensation heaters are energised, and retest the generator prior to running.

Caution: Short circuit method should only be performed by a competent engineer familiar with safe operating practices within and around generator sets of the type in question.

Caution: The short circuit must not be applied with the AVR connected in circuit. Current in excess of the rated generator current will cause damage to the windings.

6.2.3 Bearing

The operating life of bearing depends on a number of factors, we cannot give you a exact operating life of bearing, but we can give you a caculation operating life of bearing accroding to generating set design. You can extend the service life of bearing if the generating set is in good centring and low viabration, as well as improve service conditions, periodically maintain and test. We will give user a reasonal bearing changing period according to bearing design life, grease and the suggestion of bearing manufacturer. For general service conditions, if the viabration is not exceeding the regulation of GB/T 2820.9-2002, service condition temperature is not exceeding 45°C, then the sealed bearing service life is 30000 hours, the service life of unsealed bearing is 40000 hours.

Suggest regularly checking overheating or noise in bearing life. If over vibration occurs

after a period it may be due to bearing wear and tear then need to check the condition of bearing. Or due to lack grease or even need to change the bearing. Always position the main rotor so that a full pole face of the main rotor core is at the bottom. Every effort must be made to establish a clean area around the generator when removing and replacing bearings. The bearings are a press fit on the shaft and can be removed with standard tooling, i. e. 2 or 3 legged manual or hydraulic bearing pullers.

If the bearing are to be refitted the bearing(s) and housing(s) must be thoroughly flushed out with clean solvent before re-assembly. Visually inspect all components after cleaning, for contamination. Place all components on the clean assembly surface. Do not use an air line to blow off excess fluid. Thoroughly clean the external surface of the grease gun nozzle using lint free cloth. Remove the bearing from its packaging. Only the outer race should be used to transmit load during assembly (NEVER use the inner race). Wipe off the preservative oil from the surface of the inner and outer rings - using lint free cloth only. Heat the Bearing and Cartridge assembly to 80°C above ambient with an induction heater (use induction heater, no other heat source is suitable). Slide the Bearing and Cartridge assembly over the shaft, pushing it firmly against the bearing seating shoulder. Rotate the assembly (including inner race) 45° in either direction, to provide correct alignment. The bearing must be held firmly in place until it is cool enough to positively self locate. Ensure cartridge is at ambient temp. before assembling bracket. Finally install the P.M.G. .

For unsealed bearing, you should periodically check the lubricating grease in the bearing housing each 1000 hours service time under normal load and the temperature is not exceeding 70°C, add 60-70g lubricating grease each time(exact adding grease weight depends on the grease volume in the bearing housing). Replace period is 4500 hours. If the working temperature of bearing more than 70°C, every 15°C, the add grease period and replace period should be halved. Should clear the old grease when replace the grease. Using kerosene to washing the old grease, then add new grease. We adopt ZL-3 lithium-based grease. Use of mixed lubricant is not allowed, the quantity of the lubricant to be filled in should be about 1/3-1/2 the capacity of the bearing chamber. Excessive grease may cause overheating of the bearings.

When add the grease, be sure there is not impurity on the nipple, using the nipple to inject the grease to interior bearing, the operate alternator about ten minutes which make the redundant grease out of bearing, you can open the grease drain below bearing cover to grease drain. Check the there is or not grease in the PMG cover on the Non-driving end. Wiping the grease.

6.2.4 Maintenance inside generator

Disassemble the generator, blow the interior of the generator with dry and compressed air. Careful blowing is necessary for the terminal board, terminals and silicon elements to prevent from leaky, to ensure an effective dissipation, the winding surface, the cooling fan and all the ventilation passages should be well blown.

6.2.4.1 Disassembling procedure

Single bearing generator:

- (1) Remove the fixing screws on coupling disc, dismantle coupling disc.
- (2) Remove the fixing screws on D.E. adapter, dismantle D.E adapter.
- (3) Remove the fixing screws on N.D.E. bracket shield, dismantle N.D.E. bracket shield.
- (4) Remove the stator and rotor of PMG (If have. Details refer to 6.2.6).
- (5) Remove the N. D. E. bearing cover (If have), then remove the fixing screws on N. D. E. bracket,

dismantle N.D.E bracket.

(6) Lift the rotor assembly from the stator assembly slowly.

(7) Dismantle the N.D.E bearing by a jack screw.

Two bearing alternator:

(1) Remove the fixing screws on N.D.E. bracket shield, dismantle N.D.E. bracket shield.

(2) Remove the stator and rotor of PMG (If have. Details refer to 6.2.6).

(3) Remove the N.D.E. bearing cover (If have), then remove the fixing screws on N.D.E. bracket, dismantle N.D.E bracket.

(4) Remove the D.E. bearing cover (If have), then remove the fixing screws on D.E. adapter, dismantle D.E adapter.

(5) Lift the rotor assembly from the stator assembly slowly.

(6) Remove the bearing waved washer outside bearing, then dismantle the bearing by a jack screw.

6.2.4.2 Assembling procedure

All the contact surfaces of the machine parts are to be thoroughly cleaned. The procedure to assembling is approximately the reverse of dismantling. Ensure the stator winding not to be damaged by collision with rotor during assembling.

6.2.4.3 Cautions during dismantling and assembling the machine

(1) When the terminal ends are dismantled, the marks on the terminals have to be checked. The marks must be distinct and correct. The terminals must be reassembled one by one to their original positions. Wrong wiring should be avoided absolutely.

(2) The disassembled parts should be carefully kept. Neither lose nor lay them at will, the parts should be handled with care and prevented from deformation due to collision.

(3) On replacing the rotating rectifier elements, it is to be noticed that the direction of the new element must be the same as that of the element to be replaced. The direction of the element may be checked by measuring its forward and reverse resistances with an universal avometer. The forward direction resistance (direction of conducting) is low, usually less than several thousand ohms while reverse direction resistance ought to be very high, say, larger than 1 million Ω .

(4) When the exciting windings and terminal ends are replaced, the magnetic poles must be checked. The magnetic coil should be connected in positive against negative sequence.

(5) When the weight of rotor changed the moving balance should be rectified. The method of rectifying balance are usually by adding weight, that is, adding weight on alternator fan and balance ring of N.D.E end.

(6) The dismantled bearings should be covered with clear paper to avoid the ingress of dust. If dust had adhered to them, the lubricant grease should be totally replaced.

(7) When the D.E adapter, N.D.E bracket, D.E bearing and N.D.E bearing are to be re-assembled to the machine, the adaptor spigots and the fastening bolts should lightly be oiled. The bolts for the D.E adapter and N.D.E bracket should be screwed in uniformly and simultaneously. Tighten them at same time.

(8) After complete the re-assembly, turn the rotor of the generator slowly by hand or with other tools to see whether free rotation is obtained.

6.2.5 A. V. R.

In case of A.V.R. trouble, please ask the specialist to remedy, or mail it to our works for repair, or order some spare parts from our work.

6.2.6 Remove and install permanent magnet generator (P.M.G.)

(1) Remove 4 screws holding the sheet metal cylindrical cover at the no-drive end and remove the cover.

(2) Disconnect the P2, P3, P4 terminal from the A.V.R. .

(3) Remove the 4 threaded pillars and clamps holding the PMG stator onto the end bracket.

(4) Tap the stator out of the 4 spigots and withdraw. The highly magnetic rotor will attract the stator. Take care to avoid contact which may damage the windings.

(5) Remove the bolt in the centre from the rotor shaft and pull off the rotor. It may be necessary to gently tap the rotor away. Take care to tap gently and evenly - the rotor has ceramic magnets which are easily broken by shock.

IMPORTANT! The rotor assembly must not be dismantled.

Installation is a reversal of the above procedure.

6.3 Generator magnetizing

When generator is not in used for long time or generator stops with load, it may cause generator lose magnetism that is lack of residual magnetism. The phenomenon of failure is that generator cannot set up voltage when reaching rated speed. At this point you need to take the following steps to magnetizing.

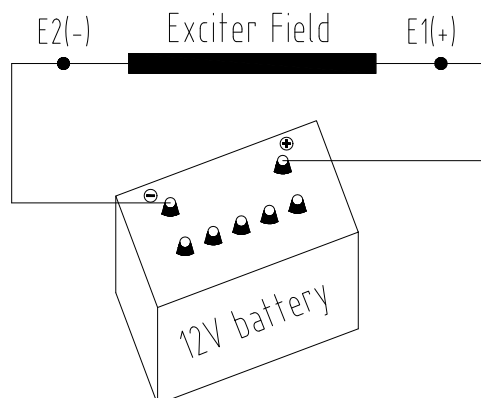
(1) Stop the generator set, make sure that generator is in stationary state.

(2) Remove E1 and E2 wire of exciter stator from AVR

(3) Connect positive and negative pole of 12V battery to E1 and E2 wire of exciter separately, and then it lasts for two or three seconds. It is important to note that battery polarity cannot connect oppositely.

(4) Connect E1 and E2 wire of exciter stator to AVR again and be careful not to incorrect.

(5) Restart generator set.



6.4 Trouble and remedy

See appendix 1.

Chapter 7 A. C. GENERATOR WARRANTY

7.1 Warranty period

In respect of a. c. generators the Warranty Period is eighteen months from the date when the goods have been notified as ready for despatch or twelve months from the date of first commissioning (whichever is the shorter period).

7.2 Trouble after sales

We will make good by repair, or at our option, by replacement, any fault that under proper use appears in the goods within the warranty period. Provided, on examination by us, the defect is solely due to defective material or workmanship. The defective part is to be promptly returned, carriage paid, to us at the factory, our Subsidiary or, if appropriate to the Dealer who supplied the goods. All identification marks and numbers must be intact to aid identification.

We shall be under no liability for defects in :

(1) Any goods which have not been properly installed in accordance with our recommended installation practices as detailed in the "Installation, Service and Maintenance Manual" .

(2) Continue to use after fault, or should find fault but continue to use.

(3) Products that have been improperly used or stored or which have been repaired, adjusted or altered by any person except our authorised agents or ourselves; Any second-hand goods, proprietary articles or goods not of our own manufacture although supplied by us, such articles and goods are being covered by the warranty (if any) given by the manufacturers.

Our liability shall be fully discharged by either repair or replacement as above, and in any event shall not exceed the current list price of the defective goods.

Our liability under this clause shall be in lieu of any warranty or condition implied by law as to the quality or fitness for any particular purpose of the goods, and save as expressly provided in this clause we shall not be under any liability, whether in contract, tort or otherwise, in respect of defects in goods delivered or for any injury, damages or loss resulting from such defects or from any work undone in connection therewith.

All claims must contain full particulars of the alleged defect, the description of the goods, the Serial Number, the date of purchase, and the name and address of the Vendor (as shown on the manufacturer's identification plate). For Spare Parts, claims must contain the order reference under which the goods were supplied.

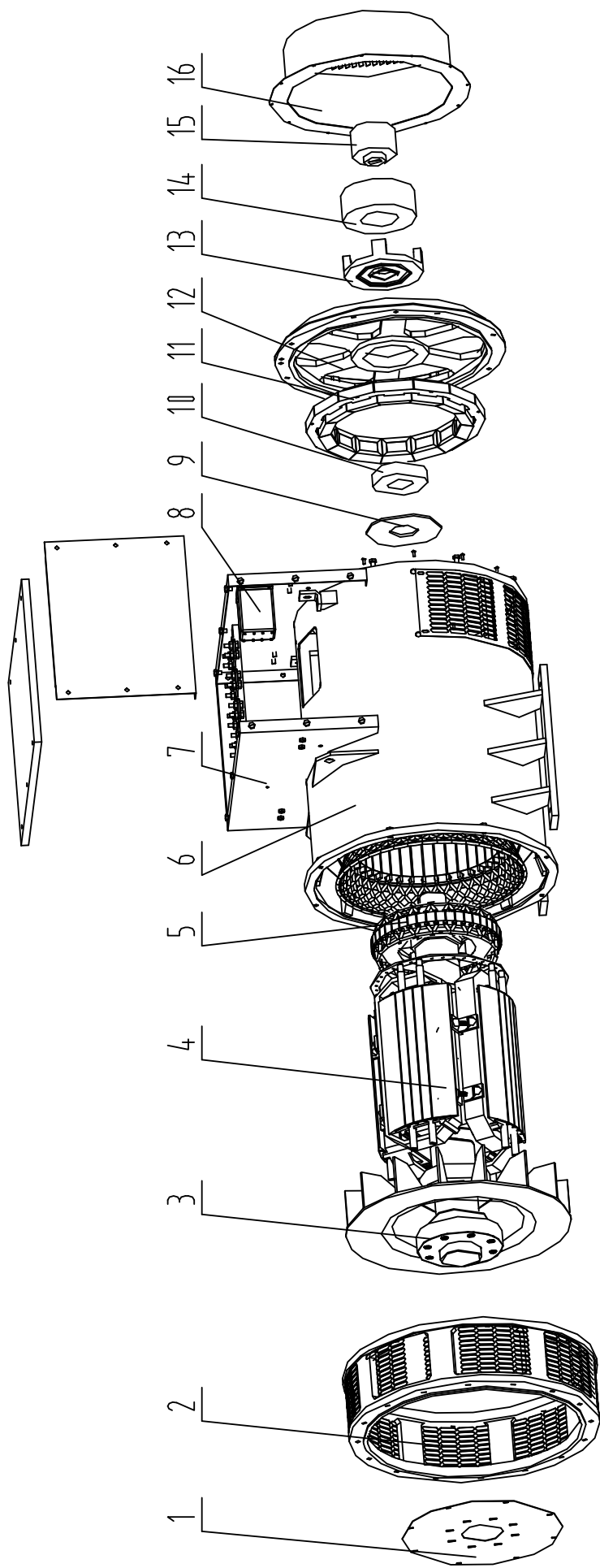
Our judgement, in all cases of claims, shall be final and conclusive and the claimant shall accept our decision on all questions as to defects and the exchange of a part or parts. Any part repaired or replaced, under warranty, will be returned to the customer free of charge. We shall not be liable for any expenses that may be incurred in removing or replacing any part sent to us for inspection or in fitting any replacement part supplied by us.

APPENDIX

Electrical faults

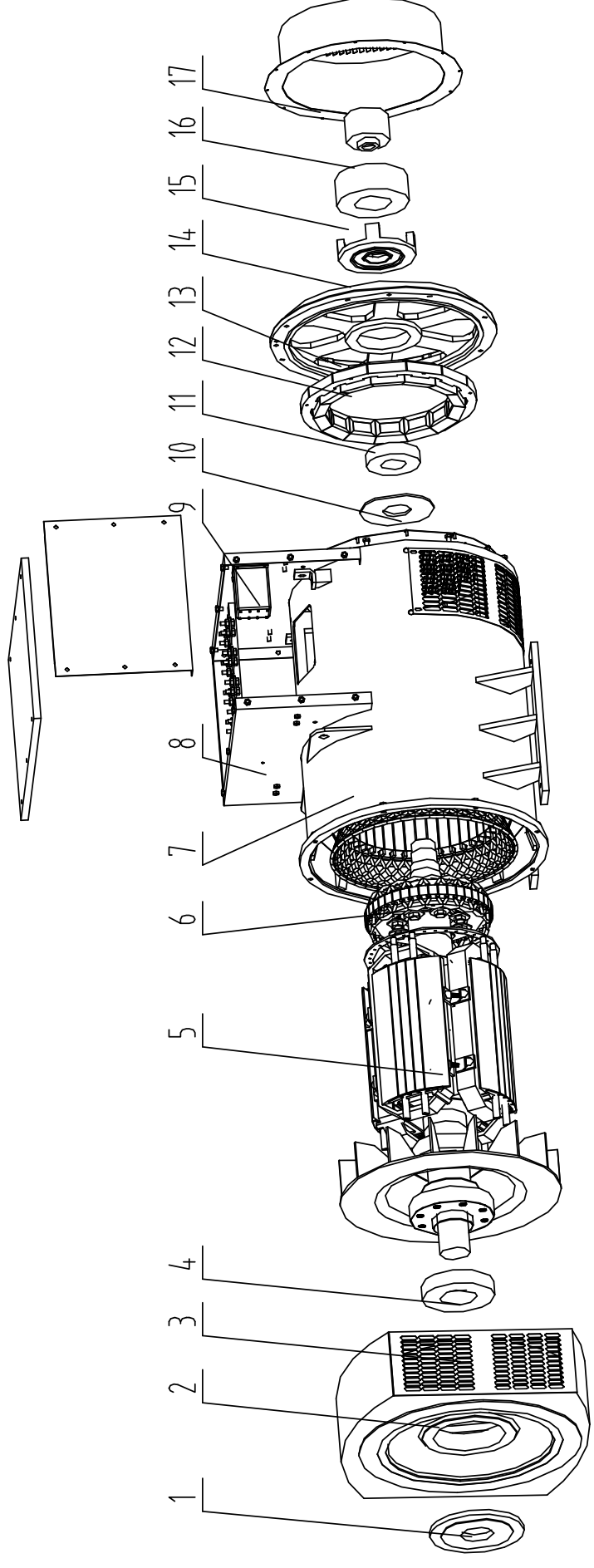
Troubles	Causes	Check and remedy	
No voltage at no load on start-up	Wrong wiring	Check carefully, correct the wiring according to the wire diagram	
	The residual magnetism of generator cannot build-up voltage	Filling generator magnetism according to item 6.3	
	The alternator has less residual magnetism, thus the voltage can not be set up	Charge the field winding by use of a battery with its positive pole connected to E1(+) and negative pole to E2(-), set up voltage.	
	P.M.G. terminal voltage is too low or no terminal voltage	Disconnect the P2、P3、P4 terminal from the A.V.R. , check the resistance between 3 lines, the measured resistance value should be within $5 \Omega + 10\%$ (below frame 355) or 2.6Ω within $+ / - 10\%$ (frame 355 and above). If the resistance is not balanced and/or is not correct, replace the stator permanent magnet machine	
		If resistance between P2, P3 and P4 line of P.M.G. is right, need to replace the rotor of P.M.G.	
	The field winding of the main generator or the exciter is broken or short-circuit	Measure relevant winding resistance of the coils with an avometer. If the resistance is infinite, reconnect the broken winding; if the value is zero, change or treat the coils	
	Rotating silicon rectify components breakdown short, forward and reverse are conducted	When the forward and reverse resistance measured by avometer is zero, change it	
	A V R	Power output cable don' t connected well	Reconnect power output cable
		The fuse is damaged	Replace the fuse
		AVR damaged	Replace the AVR
The no-load voltage is too low or too high	The speed is too low or too high	Regulate the speed to rated value	
	Partial short circuit of the exciting winding	The field current is too large, the field winding of the main generator is overheat and severely vibrated, the DC resistance of the field winding is much less than normal	
	Faults of the rotating rectifier	Break F1 or F2, check with avometer, the forward and the reverse resistance of the diode, replace the damaged elements	
	A V R	Wrong wiring	Check carefully, correct the wiring according to the wire diagram Wrong measure voltage cause output voltage low or ungovernable
		The rectifying point of voltage is too low or too high	Clockwise or counterclockwise turning rectifying potentiometer, till meet voltage requirement

	The rectifying point of remote voltage is too low or too high	Clockwise or counterclockwise turning remote rectifying potentiometer, till meet voltage requirement
	AVR damaged	Replace the AVR
Voltage oscillations	AVR damaged	Replace the AVR
Voltage couldn't be adjusted	AVR damaged	Replace the AVR
Over-heating of the generator	The alternator overload	Reduce down the load to the rated value given on the nameplate
	Low power factor	Check the power factor to ensure the exciting current not to exceed the value given on the nameplate
	Low speed	Keep the speed at rated value
	Partial short circuit of the winding of the generator	Detecting the fault position. Replace or repair the damaged oil
	Ventilating passage obstructed	Clean the obstacle. Dismantle the machine and blow the interior of the machine thoroughly
Over-heating of the bearing	Over-wear of the bearing	Replace with new one
	Grease brand is wrong or grease has impurities or grease is too much	Using kerosene to washing the old grease, then add new grease by the regulation. Use of mixed lubricant is not allowed, the quantity of the lubricant to be filled in should be about 1/3-1/2 the capacity of the bearing housing.
	Poor alignment with the engine	Check and adjust the alignment
Excessive vibration	Poor alignment with the engine	Adjust the alignment
	Bad dynamic balance of the rotor	Adjust the dynamic balance
	Vibration of the engine	Check the engine
	Bent shaft	Adjust the shaft
	Short circuit of the field winding of the main generator	Check the resistance of main field to determine whether it is normal



Single bearing generator

- 1. Coupling disc 2. D.E. adapter 3. Shaft hub 4. Rotor assembly 5. Exciter armature 6. Stator assembly
- 7. Terminal box 8. AVR 9. Inside cover of D.E. bearing 10. N.D.E. bearing 11. Exciter field 12. N.D.E. bracket
- 13. Outside cover of N.D.E. bearing 14. PMG stator 15. PMG rotor 16. N.D.E. cover



Two bearing generator

- 1, cover of D.E. bearing 2, D.E. adapter 3, D.E. cover 4, D.E. bearing 5, Rotor assembly 6, Exciter armature
- 7, Stator assembly 8, Terminal box 9, AVR 10, Inside cover of D.E. bearing 11, N.D.E. bearing 12, Exciter field
- 13, N.D.E. bracket 14, Outside cover of N.D.E. bearing 15, PMG stator 16, PMG rotor 17, N.D.E. cover

Kungfu Sci-tech Co., Ltd.
(Originning From Jiangxi Sanbo Electric Head Works)
No. 3088
Ziyang Road
Yaohu high-tech development Zone
Nanchang City
Jiangxi Province
China
Tel. +86 0791 88350706
Fax. +86 0791 88350712
Service Centre +86 0791 88350703
P. C. 330096
Mail kfs@kungfus.cn
Web <http://www.kungfus.cn/>