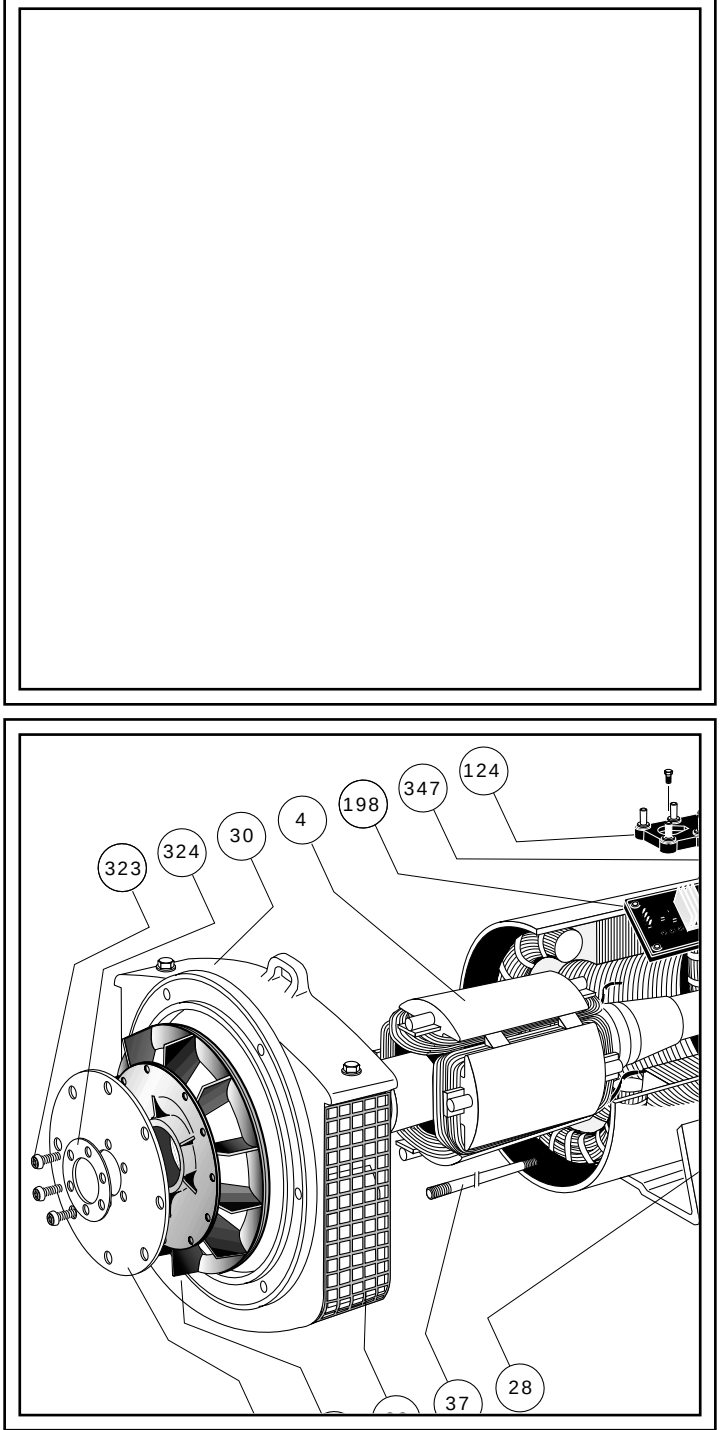
ALTERNATORS

Réf. 2950 - 4.33/d - 09.01



PART NUMBER : 277- 805

2000 / 3000 SERIES

Installation and maintenance

This manual applies to the alternator mounted on the genset.

The latest addition to a whole new generation of products, this range benefits from the experience of one of the largest manufacturers in the world, using advanced technology and incorporating strict quality control.

We would like to draw your attention to the contents of this maintenance manual. By following certain important instructions during installation, use and servicing of your alternator, you can look forward to many years of trouble-free operation.

CONTENTS

1 - RECEIPT

1.1 - Standards and Safety measures

Our alternators comply with most international standards and are compatible with:

- the recommendations of the **International Electro technical Commission** IEC 34-1, (EN 60034).
- the recommendations of the **International Standards Organisation** ISO 8528.
- the European Community directive on Electromagnetic Compatibility (EMC) 89/336/EEC.
- the European Community directives 73/23/EEC and 93/68/EEC (Low Voltage Directive).

They are CE marked with regard to the LVD (Low Voltage Directive) in their role as a machine component. A declaration of incorporation can be supplied on request.
Before using your generator for the first time, read with care the contents of this installation and maintenance manual, supplied with the machine. All operations performed on the generator should be undertaken by qualified personnel with specialist training in the commissioning, servicing and maintenance of electrical and mechanical machinery. This maintenance manual should be retained for the whole of the machine's life and be handed over with the contractual file.
The various operations described in this manual are accompanied by recommendations or symbols to alert the user to the risk of accidents. It is vital that you understand and take notice of the different safety symbols opposite.

WARNING

Safety symbol for an operation capable of damaging or destroying the machine or surrounding equipment.

Safety symbol for general danger to personnel.

Safety symbol for electrical danger to personnel.

1.2 - Checks

On receipt of your alternator, check that it has not suffered any damage in transit.
If there are obvious signs of knocks, contact the transporter (you may be able to claim on their insurance) and after a visual check, turn the machine by hand (if twin bearing) to detect any malfunction.

1.3 - Identification

The alternator is identified by means of a nameplate (fig 1) fixed on the terminal box .
Make sure that the nameplate on the machine conforms to your order.
The machine name is defined according to various criteria (see below).

A.C. SYNCHRONOUS GENERATOR

SERIAL N° *FRAME* *WDG*

ISO 8528-3 IEC 34-1 BS 5000-PT3 NEMA MG1-22 VDE 0530

- Fig 1 -

1.4 - Storage

Whilst awaiting installation, the machines should be stored:

- away from humidity: in conditions of relative humidity of more than 90%, the machine insulation can drop very rapidly to just above zero at around 100% ; monitor the state of the anti-rust protection on unpainted parts.

For storage over an extended period, the machine can be placed in a sealed enclosure (heatshrunk plastic, for example) with dehydrating sachets inside, away from significant and frequent variations in temperature to avoid any condensation during storage.

2 - TECHNICAL CHARACTERISTICS

2.1 - Electrical characteristics

The 2000/3000 series alternators are machines without sliprings and revolving field brushes, wound as "2/3 pitch"; 12-wire, with class H insulation and a field excitation system available in either "SHUNT" fig 2 or "AREP" fig 3 or "PMG" fig 4 version (see sections 2.3, 2.4, 2.5). Interference suppression conforms with standard EN 55011, group 1, class B.

2.1.1 - Options

- Stator temperature detection probes
- Space heaters

2.2 - Mechanical characteristics

- Steel frame
- End shields in cast iron or aluminium
- Ball bearings greased for life
- Mounting arrangement

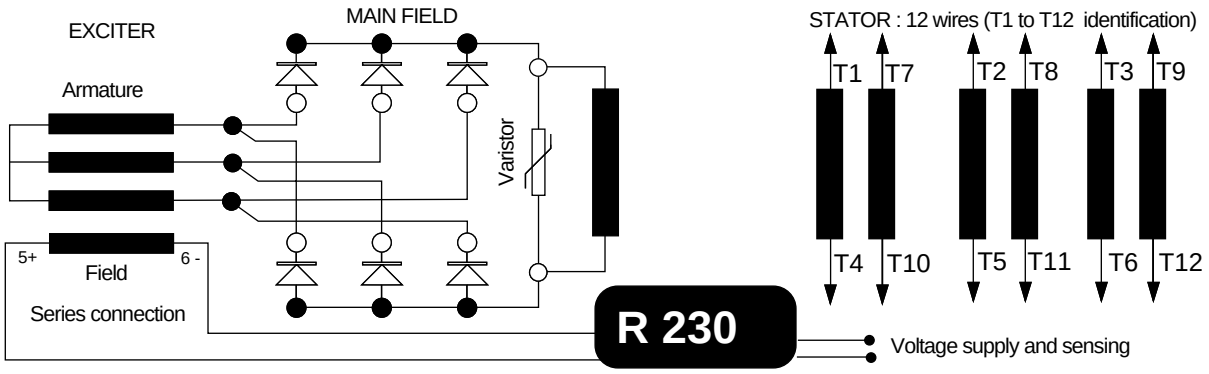
MD 35 STANDARD: single bearing, with standard feet and SAE coupling discs

B 34 STANDARD: two bearing feet mounteed with standard bare shaft key wayed

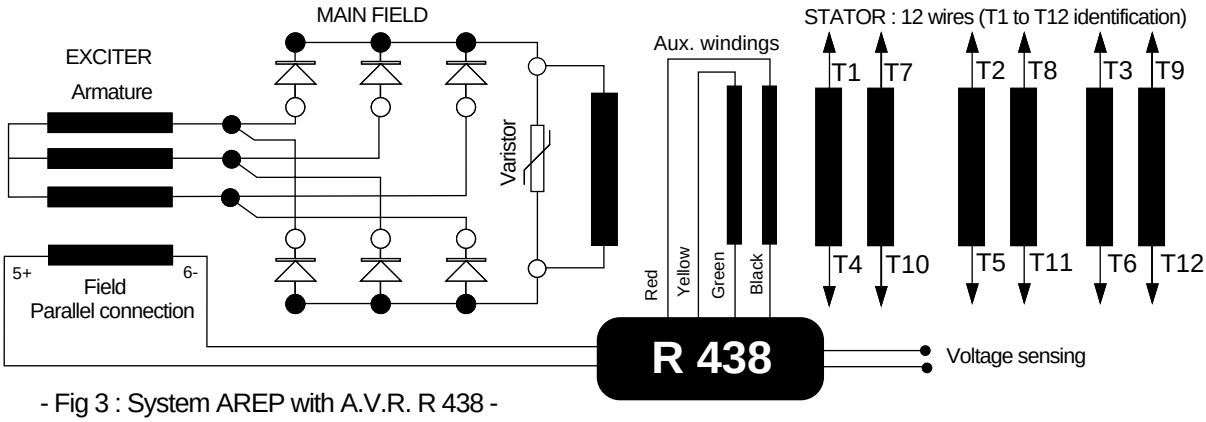
- Drip-proof machine, self-cooled
- Degree of protection: IP 23

2.2.1 - Options

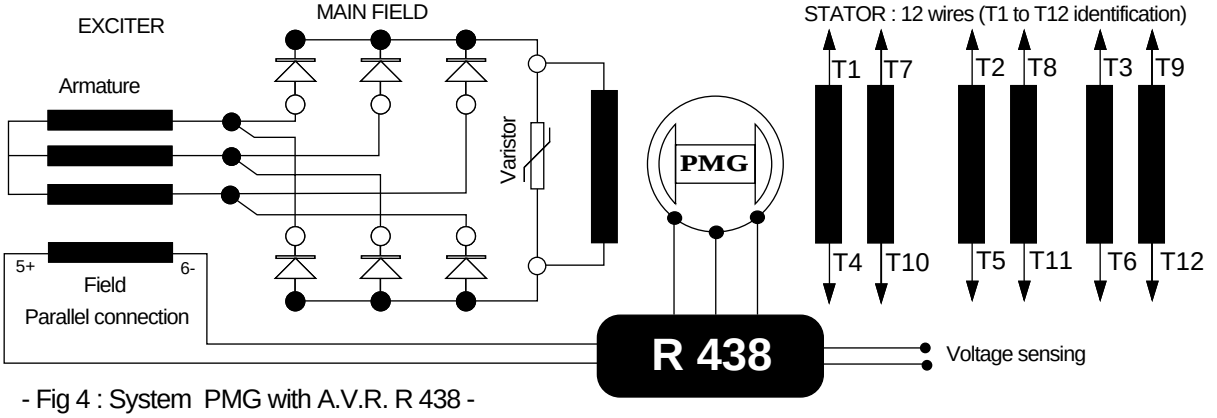
- Air input filter, air output labyrinth cowling



- Fig 2 : System Shunt with A.V.R. R 230 -



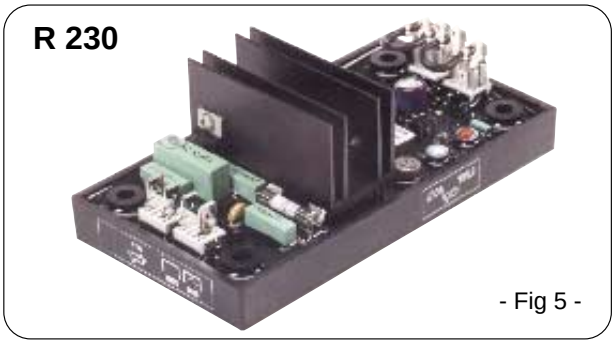
- Fig 3 : System AREP with A.V.R. R 438 -



- Fig 4 : System PMG with A.V.R. R 438 -

2.3 - SHUNT field excitation system

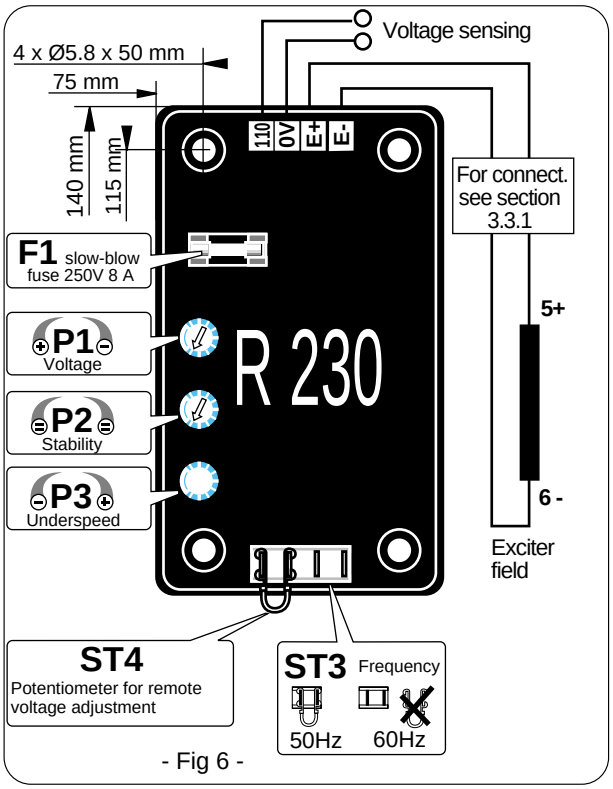
The alternator with Shunt field excitation is self-excited with a voltage regulator **R 230** "fig 5". The regulator monitors the exciter excitation current as a function of the alternator output voltage. Very simple in design, the alternator with Shunt excitation has no sustaining short-circuit capability.



- Fig 5 -

2.3.1 - R 230 regulator (see Fig 6)

- Voltage regulation: around ± 0,5%
- Voltage supply and sensing 85 to 139 V (50/60Hz)
- Rapid response time (500 ms) for a transient voltage variation amplitude of ± 20%
- Voltage setting **P1**
- Stability setting **P2**
- Power supply protected by 8 A fuse, slow-acting (tolerates 10 A for 10s).
- Frequency: 50 Hz with strap **ST3** - 60 Hz without strap **ST3**
- Factory set underspeed protection **P3** (see fig 7)

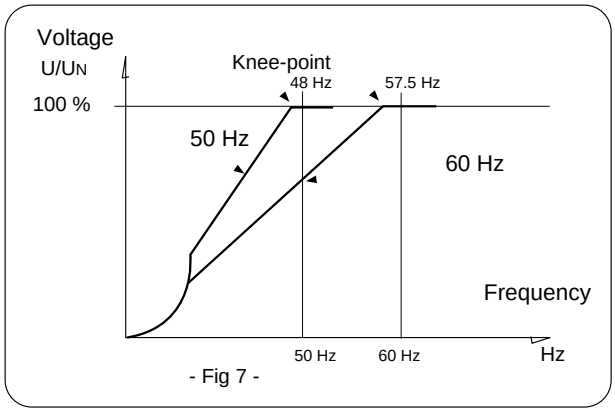


- Fig 6 -

2.3.2 - R 230 regulator options:

Potentiometer for remote voltage adjustment, 1000 Ω / 0.5 W min : adjustment range ± 5%.

- Remove strap ST4 .

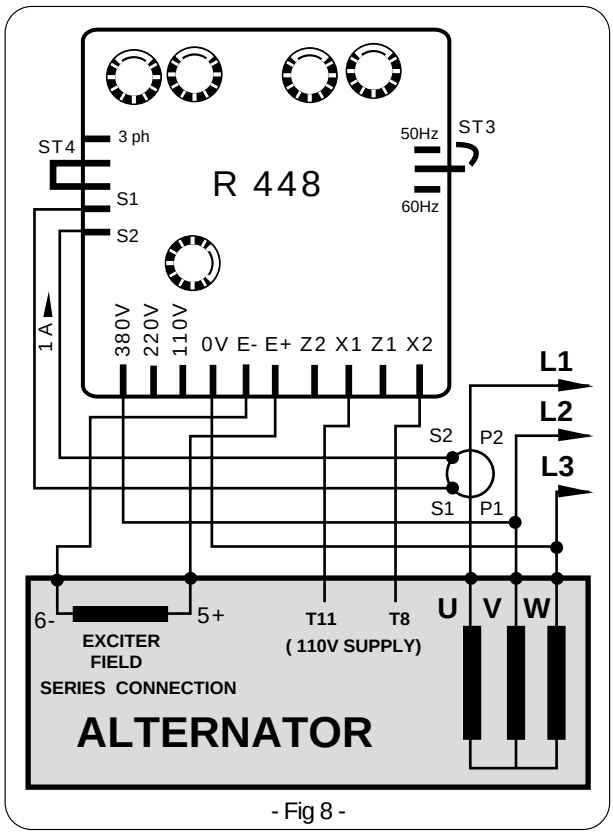


- Fig 7 -

2.3.3 - Working with A.V.R. R 448

As an option the 448 A.V.R. can replace the R 230 on shunt alternator in order to get the following functions :

- Parallel operation between alternators (with current transformer) see fig 8.
- Parallel operation with the mains (with current transformer and R 726 module).
- 3 phase detection (R 731 module).
- LAM function (integrated in the R448).



- Fig 8 -

For adjusting and fault detection refer to the section 4.5 of this manual (the function of R 438 and R 448 are the same).

2.4 - AREP field excitation system

With AREP excitation, the electronic A.V.R. **R 438** (fig 9) is powered by two auxiliary windings which are independent of the voltage detection circuit. The first winding (X1,X2) has a voltage in proportion with the output voltage of the alternator (Shunt characteristic), the second (Z1,Z2) has a voltage in proportion with the stator current (compound characteristic: Booster effect). The power supply voltage is rectified and filtered before being used by the regulator monitoring transistor. This principle ensures that regulation is not affected by distortions generated by the load.

R 438

- Fig 9 -

2.4.1 - R 438 regulator (fig 10)

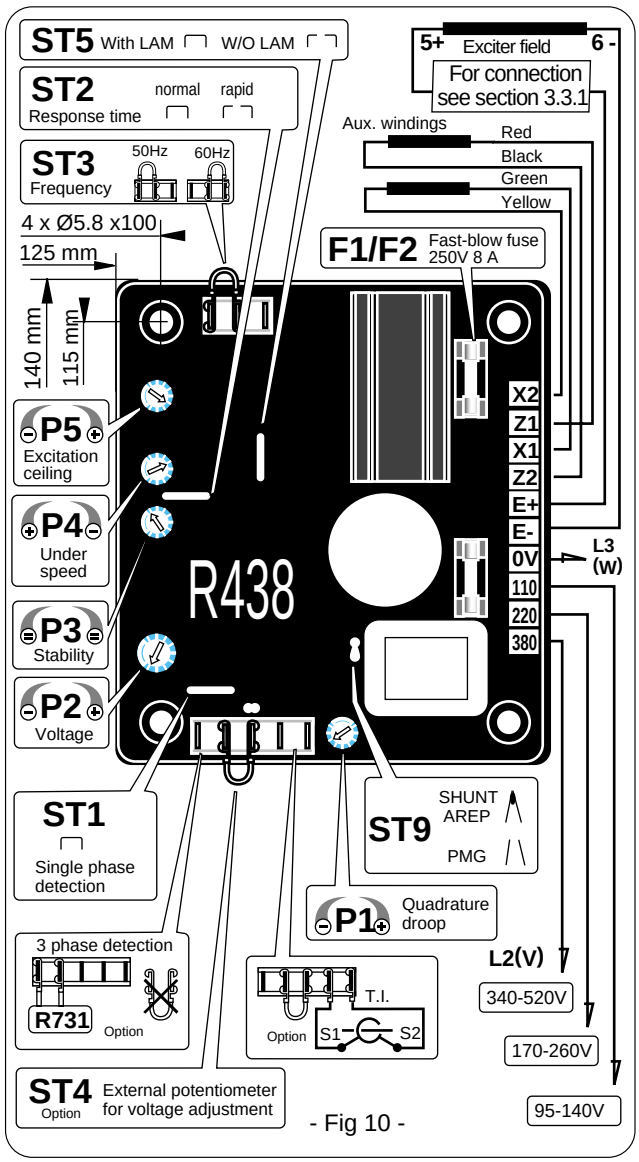
WARNING

ST9 MUST BE CLOSED FOR AREP EXCITATION

- short-circuit current = 3 x IN for 10 seconds
- standard power supply; 2 auxiliary windings
- shunt supply; max 48V - 50/60 Hz
- rated overload current: 8A - 10s
- electronic protection (overload, short-circuit opening on voltage detection): excitation ceiling current for 10 seconds then return to approx. 1A
  The alternator must be stopped (or the power switched off) in order to reset the protection.
- Fuse F1 on input side (X1, X2)
- Fuse F2 on output side (E+, E-)
- voltage detection: 5 VA isolated via transformer
  0-110 V terminals = 95 to 140 V
  0-220 V terminals = 170 to 260 V
  0-380 V terminals = 340 to 520 V
- voltage regulation ±1%
- rapid or normal response time via strap **ST2**
- voltage adjustment via potentiometer **P2**
  other voltages via step down transformer
- current detection: (parallel operation): C.T. 2.5 VA cl1, secondary 1A (Option)
- quadrature droop adjustment via potentiometer **P1**
- underspeed protection (U/f) and LAM: frequency threshold adjustable via potentiometer **P4**
- max. excitation current adjustment via **P5**: 4.5 to 10A
- 50/60 Hz selection via strap **ST3**

2.4.2 - R 438 A.V.R. options

- **Current transformer** for parallel operation
- **Remote voltage adjustment potentiometer** :
  470 Ω, 0.5 W min: adjustment range ± 5% (range limited via internal voltage potentiometer **P2**). Remove ST4 to connect the potentiometer. A 1 k Ω potentiometer can also be used to extend the adjustment range.
- **R 731** : detection of 3-phase voltage
  200 to 500 V, compatible with parallel operation. Cut ST1 to connect the module; set the voltage via the module potentiometer. (The previous version module is not compatible with parallel operation).
- **R 726 module**: 3 functions .
  P.F. φ regulation (2F) and voltage matching prior to pa ralleling with the mains (3 F).

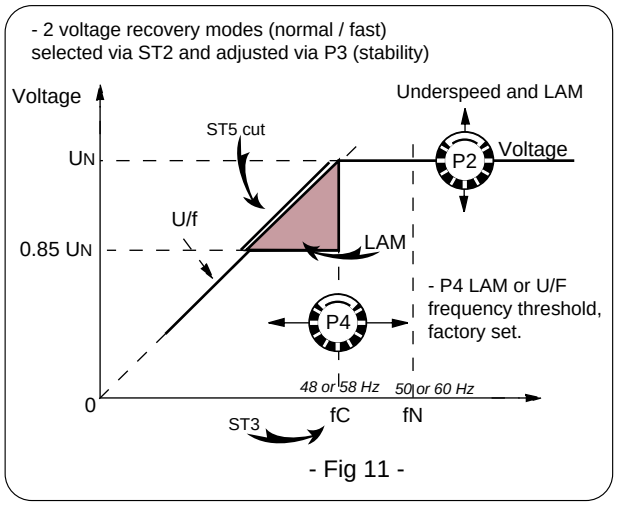


- Fig 10 -

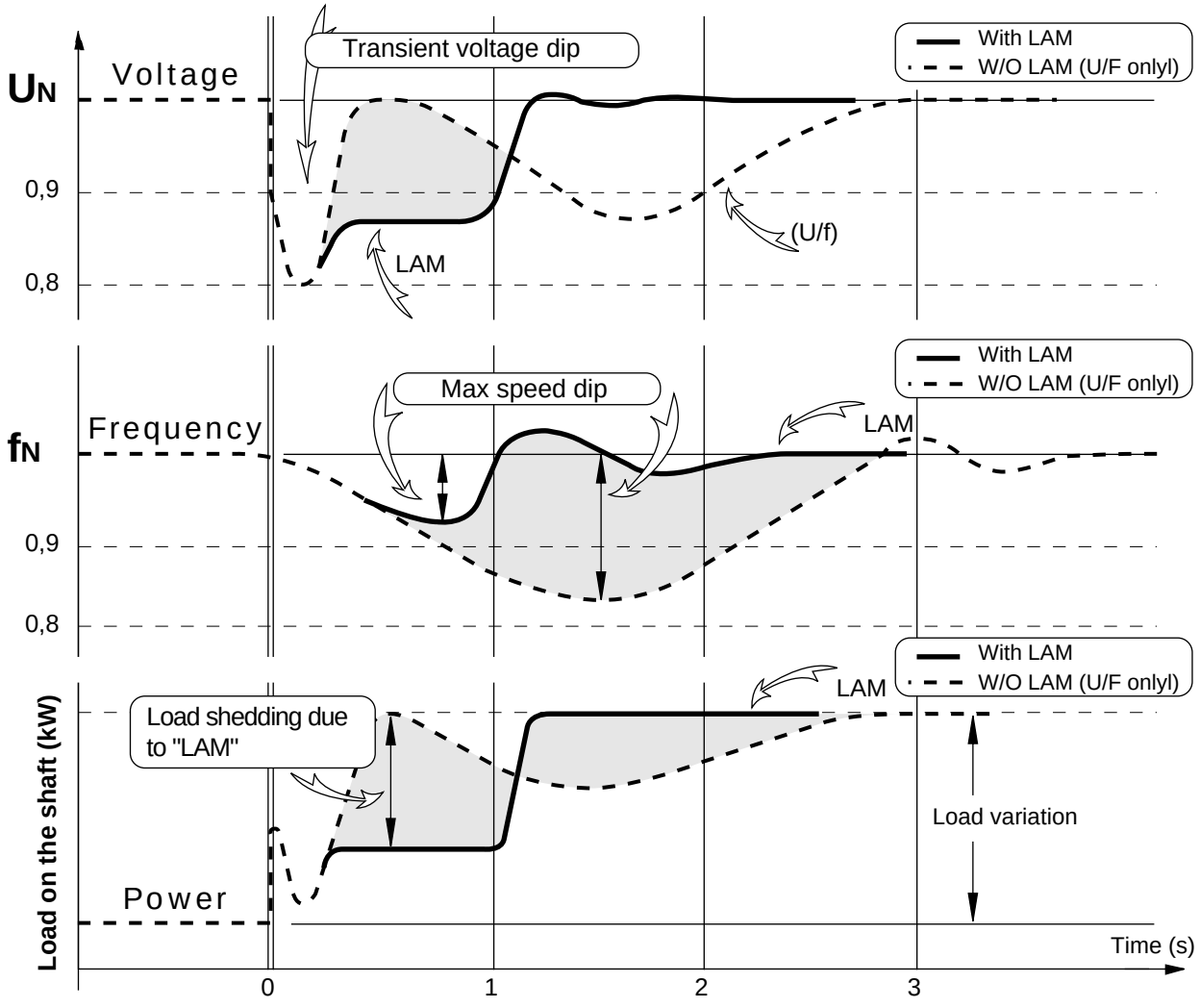
2.4.3 - LAM characteristics (Fig 11)

The LAM system is integrated as standard in the **R 438** regulator.

- Role of the "LAM" (Load Adjustment Module):
  On load impact, the rotation speed of the generator set decreases. When it passes below the preset frequency threshold, the "LAM" causes the voltage to drop by approximately 15% and consequently the amount of active load applied is reduced by approximately 25%, until the speed reaches its rated value again. Hence the "LAM" can be used either to reduce the speed variation (frequency) and its duration for a given applied load, or to increase the applied load possible for one speed variation (turbo-charged engine). To avoid voltage oscillations, the trip threshold for the "LAM" function should be set approximately 2 Hz below the lowest frequency in steady state.
- LAM: action eliminated by cutting strap ST5



- Fig 11 -



- Fig 12 Typical effects of the "LAM" with a diesel engine -

2.5 - SHUNT + PMG field excitation system

WARNING

For PMG running, the ST9 strap must be open. (from R438 LS C)

This system is built with the fitting of a PMG (Permanent Magnet Generator) on a base SHUNT machine described on 2.3. The PMG is fitted at the rear end of the alternator and supplies a voltage to the A.V.R. R438.
The PMG provides to the AVR constant power which is independant of the main stator load. The result is the alternator has a short circuit capability and a good immunity to distortions.
By checking the voltage sensing circuit, the AVR adjust the excitation current required for maintaining the right voltage.

2.5.1 - R 438 regulator (fig 13)

WARNING

Make sure that the ST9 strap is closed for AREP but open for PMG.

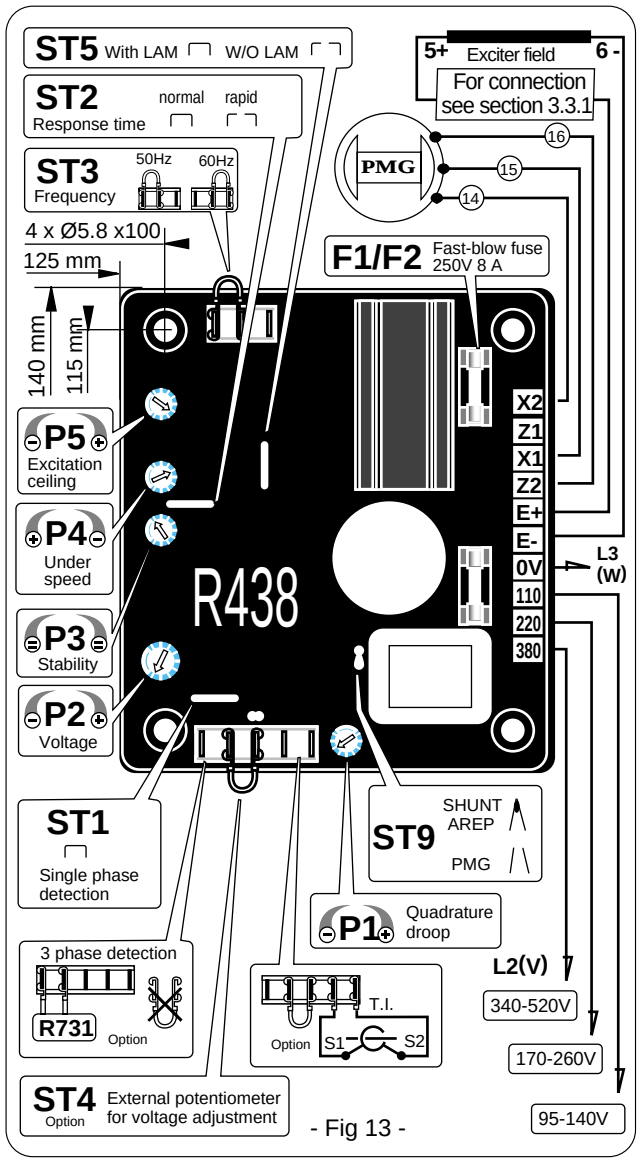
- short-circuit current = 3 x IN for 10 seconds
- standard power supply; PMG (X1, X2, Z2)
- rated overload current: 8A - 10s
- electronic protection (overload, short-circuit opening on voltage detection): excitation ceiling current for 10 seconds then return to approx. 1A
  The alternator must be stopped (or the power switched off) in order to reset the protection.
- Fuse F1 on input side (X1, X2)
- Fuse F2 on output side (E+, E-)
- voltage detection: 5 VA isolated via transformer
  0-110 V terminals = 95 to 140 V
  0-220 V terminals = 170 to 260 V
  0-380 V terminals = 340 to 520 V
- voltage regulation ±1%
- rapid or normal response time via strap **ST2**
- voltage adjustment via potentiometer **P2**
  other voltages via step down transformer
- current detection: (parallel operation): C.T. 2.5 VA cl1, secondary 1A (Option)
- quadrature droop adjustment via potentiometer **P1**
- underspeed protection (U/f) and LAM: frequency threshold adjustable via potentiometer **P4**
- max. excitation current adjustment via **P5**: 3,2 to 8A
- 50/60 Hz selection via strap **ST3**

2.5.2 - R 438 A.V.R. options

- Same as section 2.4.2.

2.5.3 - LAM characteristics

- Same as section 2.4.3.



- Fig 13 -

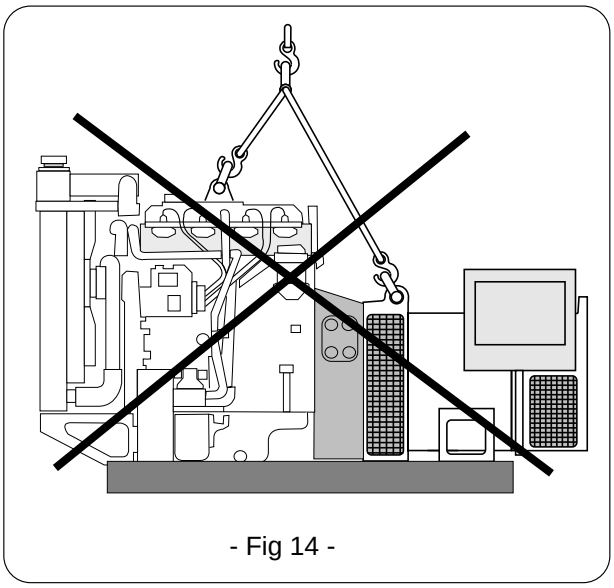
3 - INSTALLATION - COMMISSIONING

3.1 - Assembly

All mechanical handling operations must be undertaken using approved equipment.
While being handled, the machine should remain horizontal (when travelling bar removed).

3.1.1 - Handling

The generously-sized lifting rings are for handling the alternator alone. They must not be used to lift the genset. Choose a lifting system which respects the positionning of the rings (see fig 14).



- Fig 14 -

3.1.2 - Coupling

3.1.2.1 - Single bearing alternator

Before coupling to the prime mover, check that both are compatible by:

- Undertaking a torsional analysis of the transmission.
- Checking the dimensions of the flywheel and its housing, the flange, coupling discs and offset.

WARNING

When coupling the alternator to the prime mover, the holes of the coupling discs should be aligned with the flywheel holes by cranking the engine.
Do not use the alternator fan to turn the rotor.

Tighten the coupling discs screws to the recommended torque (see section 4.6.2) and check that there is lateral play on the crankshaft.

3.1.2.2 - Two-bearing alternator

- Semi-flexible coupling

  Careful alignement of the machines by measuring the concentricity and parallelism of the two parts of the coupling is recommended, the difference bet ween the teadings should not exceed the specified values (say 0.1 mm).

WARNING

This alternator has been balanced with a 1/2 key.

- Belt and pulley drive system

Check that the shafts are parallel, the pulleys aligned, and that the belt tension is correct.
The maximum permissible radial load at the middle of the shaft end is 520 da.N for a calculated service life "L10" of 20,000 hrs at 1800 min^{-1} or 3600 min^{-1} .
Note: For special belt-pulley drive systems, please consult the factory.

3.1.3 - Location

Ensure that the ambient temperature in the room where the alternator is placed cannot exceed 104° F for standard power ratings (for temperatures above 104° F, apply a derating coefficient). Fresh air, free from damp and dust, must be able to circulate freely around the air input louvres on the opposite side from the coupling. It is essential to prevent not only the recycling of hot air from the machine or engine, but also exhaust fumes.

3.2 - Inspection prior to first use

3.2.1 - Electrical checks

Under no circumstances should an alternator, new or otherwise, be operated if the isolation is less than 1 megohm for the stator and 100,000 ohms for the other windings.

There are two possible methods for restoring the above minimum values.
a) Dry out the machine for 24 hours in a drying oven at a temperature of approximately 230 °F.
b) Blow hot air into the air input, having made sure that the machine is rotating with the exciter field disconnected.
c) Run in short-circuit mode (disconnect the AVR)

- Short-circuit the output phases using connections capable of supporting the rated current (try not to exceed 6 A/mm2).
- Insert a clamp ammeter to monitor the current passing through the short-circuit connections.
- Connect a 48 Volt battery in series with a rheostat of approximately 10 ohms (50 Watts), to the exciter field terminals, respecting the polarity.
- Open fully all the alternator orifices.
- Run the alternator at rated speed . Adjust the exciter field current using the rheostat to obtain the rated output current in the short-circuit connections.

Note: Prolonged standstill: In order to avoid these problems, we recommend the use of space heaters, as well as turning over the machine from time to time. Space heaters are only really effective if they are working continuously while the machine is stopped.

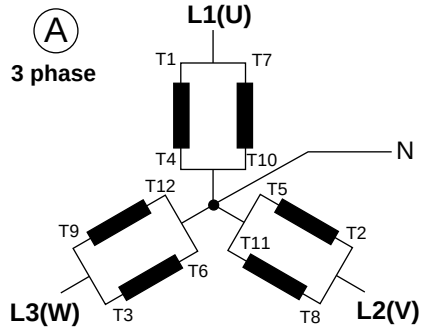
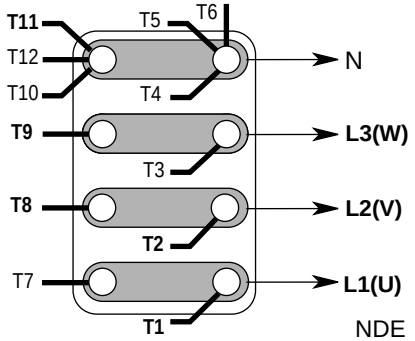
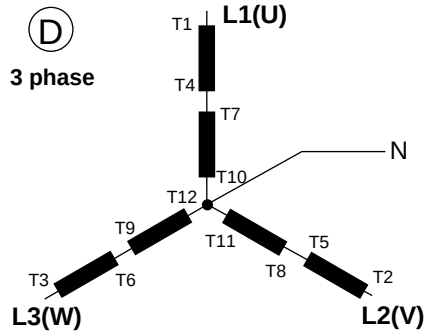
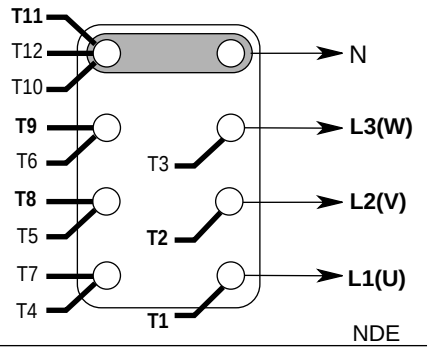
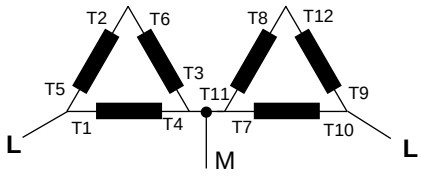
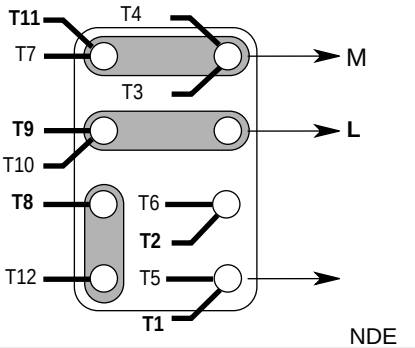
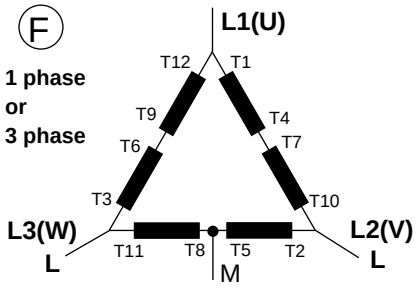
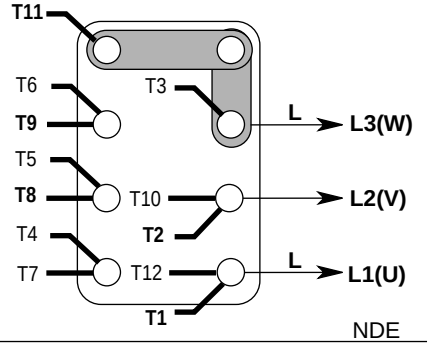
3.2.2 - Physical and visual checks

Before starting the machine for the first time, check that:
- the fixing bolts on the feet are tight
- the cooling air is drawn in freely
- the protective louvres and housing are correctly in place
- the standard direction of rotation is clockwise as seen from the shaft end (phase rotation in order 1 - 2 - 3). For anti-clockwise rotation, swap 2 and 3.
- the winding connection corresponds to the site operating voltage (see section 3.3)

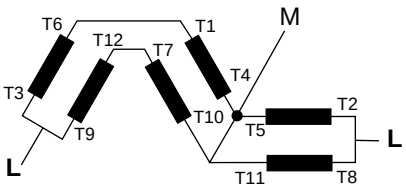
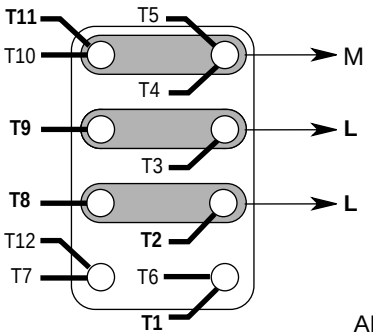
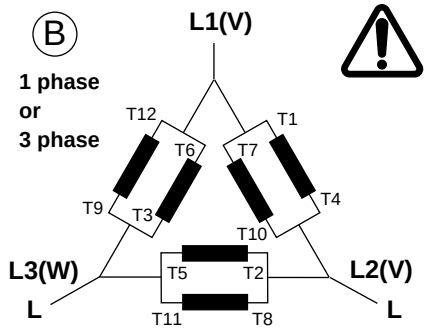
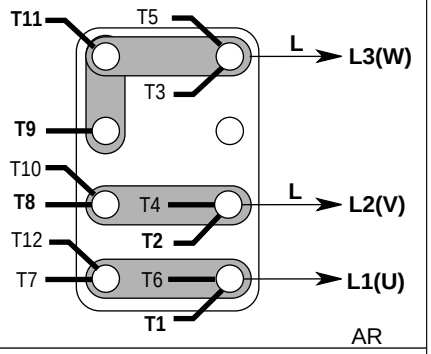
3.3 - Terminal connection diagrams

To modify the connection, change the position of the terminal cables (see fig 15 & 16). The winding code is specified on the nameplate.

Any intervention on the alternator terminals during reconnection or checks should be performed with the machine stopped.

Connection codes	L.L voltage			Factory connection
A 3 phase  	**Winding**	50 Hz	60 Hz	
	6	190 - 208	190 - 240	
	7	220 - 230	-	
	8	-	190 - 208	
	R 230 voltage detection : 0 => (T8) / 110 V => (T11) R 438 voltage detection : 0 => (T3) / 220 V => (T2)			
D 3 phase  	**Winding**	50 Hz	60 Hz	
	6	380 - 415	380 - 480	
	7	440 - 460	-	
	8	-	380 - 416	
	R 230 voltage detection : 0 => (T8) / 110 V => (T11) R 438 voltage detection : 0 => (T3) / 380 V => (T2)			
FF 1 phase  LM voltage = 1/2 LL voltage	**Winding**	50 Hz	60 Hz	
	6	220 - 240	220 - 240	
	7	250 - 260	-	
	8	200	220 - 240	
	R 230 voltage detection : 0 => (T1) / 110 V => (T4) R 438 voltage detection : 0 => (T10) / 220 V => (T1)			
F 1 phase or 3 phase  LM voltage = 1/2 LL voltage	**Winding**	50 Hz	60 Hz	
	6	220 - 240	220 - 240	
	7	250 - 260	-	
	8	200	220 - 240	
	R 230 voltage detection : 0 => (T8) / 110 V => (T11) R 438 voltage detection : 0 => (T3) / 220 V => (T2)			

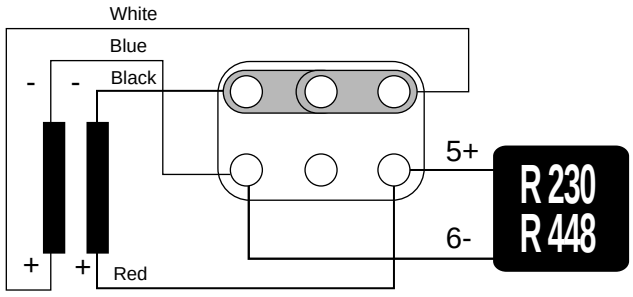
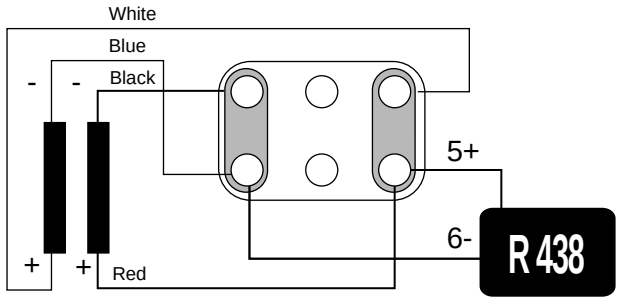
- Fig 15 -

Connection codes	L.L voltage			Factory connection
G Connection not recommended 1 PH  LM voltage = 1/2 LL voltage	**Winding**	50 Hz	60 Hz	
	6	220 - 240	220 - 240	
	7	250 - 260	-	
	8	200	220 - 240	
	R 230 voltage detection : 0 => (T8) / 110 V => (T11) R 438 voltage detection : 0 => (T3) / 220 V => (T2)			
B **1 phase or 3 phase**  	**Winding**	50 Hz	60 Hz	
	6	110 - 120	120	
	7	120 - 130	-	
	8	-	110 - 120	
	R 230 voltage detection : 0 => (T8) / 110 V => (T11) R 438 voltage detection : 0 => (T3) / 110 V => (T2)			

WARNING : Connection (B) is not possible with a standard machine in serie 3000.

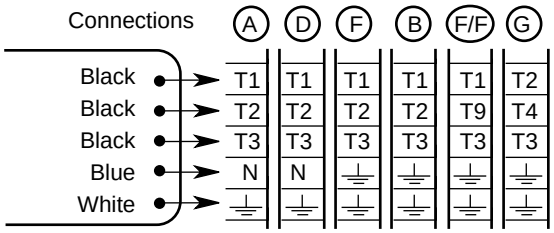
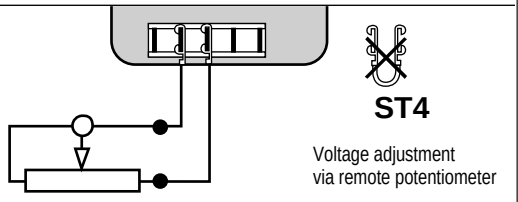
- Fig 16 -

3.3.1 - Exciter field connection (fig 17)

Series connection (SHUNT)	Parallel connection (AREP / PMG)
 	

- Fig 17 -

3.3.2 - Connection diagram for options (fig 18)

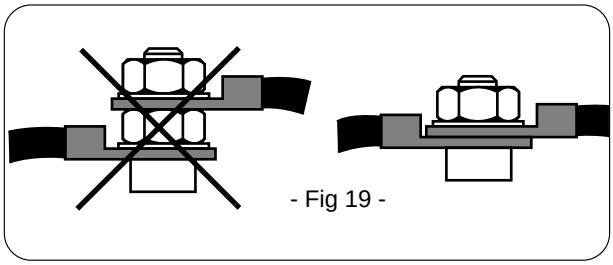
R 791 T interference suppression kit (standard for CE marking)	**Voltage potentiometer**
 	

- Fig 18 -

3.3.2 - Connection checks

Electrical installations must comply with the current legislation in force in the country of use.

Check that:
- the differential circuit-breaker conforms to legislation on protection of personnel, in force in the country of use, and has been correctly installed on the alternator power output as close as possible to the alternator. (Disconnect the blue wire of the R 791 interference suppression module linking the neutral).
- any protective devices in place have not tripped,
- if there is an external regulator, the connections between the alternator and the cubicle are made in accordance with the connection diagram.
- there is no short-circuit between phase or phase-neutral between the alternator output terminals and the generator set control cabinet (part of the circuit not protected by circuit-breakers or cubicle relays)
- the machine should be connected with the terminal lugs on top of one another as shown in the terminal connection diagrams (see fig 19).



- Fig 19 -

3.3.3 - Electrical checks on the A.V.R.

- Check that all connections have been made properly as shown in the attached connection diagram.
- Check that the frequency selection strap "ST3" is on the correct frequency setting.
- Check whether strap ST4 or the remote adjustment potentiometer have been connected.
- Optional operating modes (R 438)
- Strap ST1: cut to connect the R 731 3-phase detection module.
- Strap ST2: cut for rapid response time.
- Strap ST5: cut to suppress the function

3.4 - Commissioning

The machine can only be started up and used if the installation is in accordance with the instructions and advice defined in this manual.
The machine is tested and set at the factory. When first used with no load, make sure that the drive speed is correct and stable (see the nameplate). On application of the load, the machine should maintain its rated speed and voltage; however, in the event of abnormal operation, the machine setting can be altered (follow the adjustment procedure in section 3.5). If the machine still operates incorrectly, the cause of the malfunction must be located (see section 4.4) .

3.5 - Setting up

The various adjustments during tests must be made by a qualified engineer. Take care that the drive speed specified on the nameplate is reached before commencing adjustment. After operational testing, replace all access panels or covers.
The A.V.R. is used to make any adjustments to the machine.

3.5.1 - R 230 adjustments (Shunt system)

Initial potentiometer settings

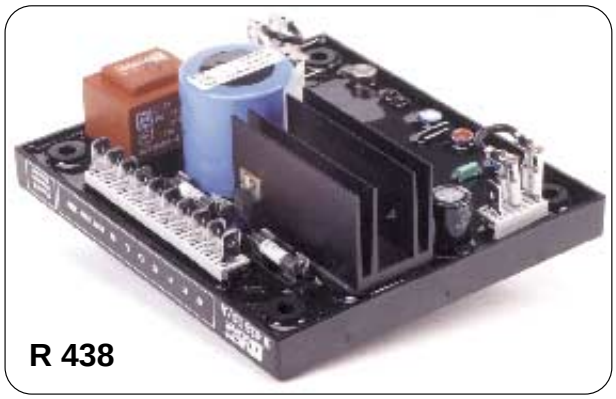
R 230

- Potentiometer **P1** (AVR voltage adjustment): fully anti clockwise.
- Remote voltage adjustment potentiometer: middle Run the alternator at its rated speed: if the voltage does not increase, the magnetic circuit should be remagnetized (see section 4.5).
- Turn the AVR voltage adjustment potentiometer **P1** slowly until the output voltage rated value is obtained.
- Adjust the stability using **P2.**
- Sealed potentiometer **P3** is factory set at 48 Hz for 50 Hz and 57.5 Hz for 60 Hz.

3.5.2 - R 438 adjustments (AREP or PMG system)

WARNING

Make sure that the ST9 strap is closed if AREP or open if PMG.



a) Initial potentiometer settings (see table below)
- remote voltage adjustment potentiometer: centre (ST4 strap removed).

Action	Factory adjust.	Pot.
Voltage minimum fully CCW	400V - 50 Hz (0 - 380 V)	
Stability	Not adjusted (middle)	
Threshold/LAM or U/F Threshold for underspeed protection U/f and LAM function	ST3 on 50 Hz (factory=48 Hz) ST3 on 60 Hz (factory=58 Hz)	
Quadrature voltage droop (Parallel operation with C.T.) - No droop fully CCW	Not adjusted (fully CCW)	
Ceiling excitation current Excitation current and short circuit current limitation, minimum fully CCW	10 A maximum	

b) Install a D.C. analogue voltmeter (needle dial) cal. 50V on terminals E+, E- and an A.C. voltmeter cal. 300 - 500 or 1000V on the alternator output terminals.

c) Make sure that the **ST3** strap is positioned on the desired frequency (50 or 60 Hz).

d) Voltage potentiometer **P2** at minimum, fully to anti-clockwise.

e) Turn the V/Hz potentiometer **P4**, fully to clockwise.

f) Stability potentiometer **P3** approximately 1/3 of travel anti-clockwise.

g) Start the engine and set its speed to a frequency of 48 Hz for 50 Hz, or 58 for 60 Hz.

h) Adjust the output voltage to the desired value using **P2**.
- rated voltage UN for solo operation (eg. 400 V)
- or UN + 2 to 4% for parallel operation with C.T. (eg. 410V -)
  If the voltage oscillates, use **P3** to make adjustments (try both directions) observing the voltage between E+ and E- (approx. 10V D.C.). The best response times are obtained at the limit of the instability. If no stable position can be obtained, try cutting or replacing the ST2 strap (normal /rapid).

i) Check LAM operation : **ST5** closed

j)Turn potentiometer **P4** slowly anti-clockwise until there is a significant voltage drop (approx. 15 %).

k) Vary the frequency (speed) of both parts between 48 or 58 Hz according to the operating frequency, and check the change in voltage previously observed (~ 15%).
l) Readjust the speed of the unit to its rated no-load value.

- Adjustments in parallel operation

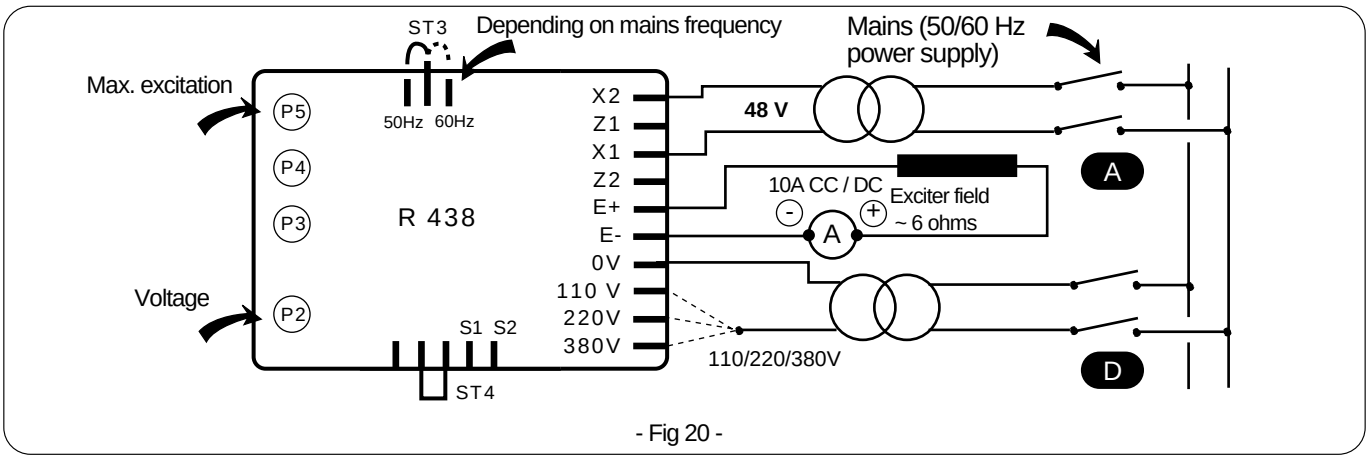
Before any intervention on the alternator, make sure that the speed quadrature droop is identical for all engine.

m) Preset for parallel operation (with C.T. connected to S1, S2 of connector J2)
- potentiometer P1 (quadrature droop) in centre position
Apply the rated load (P.F. = 0.8 inductive).
The voltage should drop by 2 to 3 %. If it increases, swap the 2 incoming wires of the C.T. secondary.

n) The no-load voltages should be identical for all the alternators intended to run in parallel.
- Couple the machines in parallel.
- By adjusting the **speed,** try to obtain **0 Kw** power exchange.
- By altering the voltage setting P2 or Rhe on one of the machines, try to cancel (or minimise) **the current** circulating between the machines.
- **From now on, do not touch the voltage settings.**

o) Apply the available load (the setting is only correct if a **reactive** load is available)
- By altering the **speed,** equalize the **KW** (or divide the rated power of the units proportionally).
- By altering the quadrature droop potentiometer **P1**, equalize or divide the **currents**.

3.5.2 .2 - Max. excitation adjustment (excitation ceiling)



- Fig 20 -

- quadrature droop adjustment of the current limit, potentiometer P5 (factory setting: 7.5 A, fuse rating : 6.3A - 10 seconds) Fig 20.

The factory setting corresponds to that of the excitation current required to obtain a 3-phase short-circuit current of approximately 3 x IN at 50 Hz for industrial power, unless otherwise specified.(*)
It is possible to reduce the maximum excitation level by a static method which is safer for the alternator and the network. Disconnect power supply wires X1,X2 and Z1,Z2, and the sensing leads (0-110V-220V-380V) on the alternator.

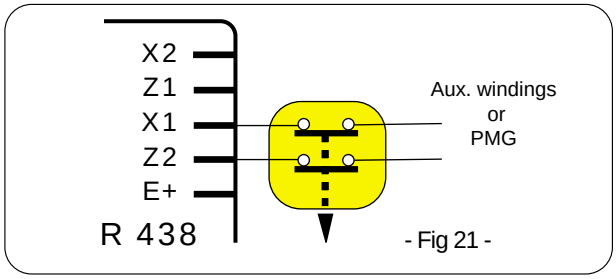
Connect the mains power supply (200-240V) as indicated (X1,X2 : 48V). Install a 10A D.C. ammeter in series with the exciter field. Turn P5 fully C.C.W. to activate the power supply. If there is no output current from the A.V.R., turn potentiometer P2 (voltage) C.W. until the ammeter indicates a stable current. Switch the power supply off, then on again, turn P5 C.W until the required max. current is obtained (no more than 8 A).

Checking the internal protection:
Open switch (D): the excitation current should increase to its preset ceiling, remain at that level for about 10 seconds and then drop to below 1A.
To reset, switch off the power supply by opening switch (A).
Note: After setting the excitation ceiling as described, adjust the voltage again (see section 3.5.2.)

(*): A short-circuit current of 3 x IN is a legal requirement in some countries so as to offer selective protection.

3.5.2 .3 - Special type of use (AREP or PMG)

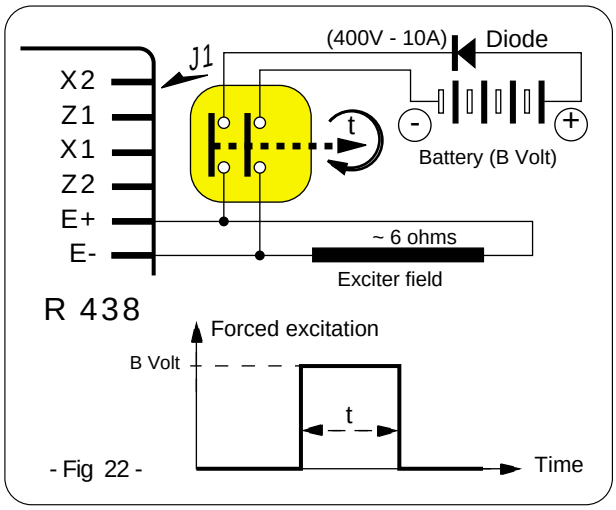
- Field de-energizing (fig 21)



- Fig 21 -

The exciter is switched off by disconnecting the AVR power supply (1 wire on each auxiliary winding) contact rating 10A - 250V A.C.
Connection is identical for resetting the AVR internal protection.

- Field forcing (fig 22)



- Fig 22 -

Applications	B volts	Time t
Guaranteed voltage build up	6 (1A)	1 - 2 s
Parallel operation, de-energized	6 (1A)	1 - 2 s
Parallel operation, at standstill	12 (2A)	5 - 10 s
Battery starting	24 (4A)	5 - 10 s
Sustained voltage on over load	24 (4A)	5 - 10 s

4 - SERVICING - MAINTENANCE

4.1 - Safety measures

Servicing or troubleshooting must be carried out strictly in accordance with instructions so as to avoid the risk of accidents and to maintain the machine in its original state.

All such operations performed on the alternator should be undertaken by personnel with training in commissioning, servicing and maintenance of electrical and mechanical components.

Before any intervention on the machine, ensure that it cannot be started by a manual or automatic system and that you have understood the operating principles of the system.

4.2 - Regular maintenance

4.2.1 - Checks after start-up

After approximately 20 hours of operation, check that all fixing screws on the machine are still tight, plus the general state of the machine and the various electrical connections in the installation.

4.2.2 - Cooling circuit

It is advisable to check that circulation of air is not reduced by partial blocking of the suction and discharge louvres: mud, fibre, grease, etc.

4.2.3 - Bearings

The bearings are greased for life: approximate life of the grease (depending on use) = 20,000 hours or 3 years. Monitor the temperature rise in the bearings, which should not exceed 60°C above the ambient temperature. Should this value be exceeded, the machine must be stopped and checks carried out.

4.2.4 Electrical servicing

- Cleaning product for the windings

WARNING

DO NOT USE: TRICHLORETHYLENE, PERCHLORETHYLENE, TRICHLOROETHANE and ANY ALKALINE PRODUCTS.

Certain strictly defined pure volatile degreasing products can be used, such as:

- Normal petrol (without additives)
- Toluene (slightly toxic); flammable
- Benzene (or benzine, toxic); flammable
- Ciclohexare (non toxic); flammable

Cleaning the stator, rotor, exciter and diode bridge

The isolating components and the impregnation system are not at risk of damage from solvents (see the list of authorised products above).

Avoid letting the cleaning product run into the slots. Apply the product with a brush, sponging frequently to avoid accumulation in the housing. Dry the winding with a dry cloth. Let any traces evaporate before reassembling the machine.

After cleaning the alternator it is essential to check the isolation of the windings (see sections 3.2. and 4.8).

4.2.5 Mechanical maintenance

WARNING

Water and/or Pressure wash are strictly prohibited. Any problems caused by such treatement are not covered by our warranty.

Degreasing : Use a brush and detergent (adapted to paint).

Dusting : Use an air gun.

If a machine is fitted with air inlet and outlet filters, in order to ensure correct ventilation, a regular cleaning of the filters must be done according to the environment conditions.

After cleaning the alternator, it is essential to check the insulation of the windings (see sections 3.2. and 4.8).

4.3 - Fault detection

If, when first commissioned, the alternator does not work normally, the source of the malfunction must be identified.

To do this, check that:

- the protective devices are fitted correctly
- all connections comply with the diagrams in the manuals supplied with the machine.
- the speed of the unit is correct (see section 1.2.2).

Repeat the operations defined in section 3.

4.4 - Mechanical defects

Fault		Action
Bearing defect	Excessive overheating of one or both bearings (temp of bearings over 176 °F)(With of without abnormal bearing noise)	- If the bearing has turned blue or if the grease has turned black , change the bearing. - Bearing race badly locked (moving in its housing) -Bracket misalignment.
Overheating	Excessive overheating of alternator frame (temperature rise of more than 104° C above ambient)	- Air flow (Inlet - outlet) partially clogged or hot air is being recycled either from alternator or prime mover - Aternator is functionning at too high a voltage (over 105 % of rated voltage on load). - Alternator overloaded.
Vibration problem	Too much vibration	Misalignment (coupling) - Defective mounting or play in coupling - Incorrect balancing of shaft (Engine - Alternator)
	Excessive vibration and humming noise coming from the alternator	Three phase alternator is single phase loaded in excess of acceptable level. - Short-circuit in the alternator stator
Abnormal noises	Alternator damaged by a significant impact which is followed by humming and vibration	- System short-circuit - Mis paralleling Possible consequences (according to the seriousness of the above faults): - Broken or damaged coupling. - Broken or bent shaft end. - Shifting and short circuit of main field rotor. - Fractured fan or coming loose on shaft. - Blown up rotating diodes, or and A.V.R.

4.5 - Electrical faults

Fault	Action	Symptoms	Cause
No voltage at no load or start up	Connect a battery of 4 to 12 volts to terminals E+ or E- respecting the polarity on the A.V.R.for 2 to 3 seconds	The alternator builds up and voltage is correct when the battery is removed	- Lack of residual magnetism
		The alternator builds up but voltage does not reach nominal value when the battery is removed	- Check the connection of the sensing leads to the A.V. R - Faulty rotating diode - Short-circuit on rotor windings
		The alternator builds up but voltage collapses when the battery is removed	- Faulty A.V.R. - Exciter windings shorted or open circuit (check winding) - Main field winding open circuit (check resistance)
Voltage too low	Check the prime mover speed	Correct speed	Check AVR connections (possible AVR failure) - Exciter field short-circuited - Rotating diode(s) burnt out - Main field rotor short-circuited - Check the resistance
		Speed too low	Increase the speed of prime mover (Do not touch the AVR voltage pot. (P2) before running at the correct speed)
Voltage too high	Adjust potentiometer voltage	No adjustment of voltage	AVR faulty
Voltage oscillations	Adjust the stability potentiometer on A.V.R.	If no effect : change recovery mode normal / rapid (ST2)	- Check speed for possible cyclic irregularity - Loose connections - Faulty A.V.R. - Speed below nominal on load (or LAM set too high)
Voltage correct on no load too low on load (*)	Run on no-load and check voltage between E+ and E-	Voltage between E+ and E- (DC) SHUNT < 20 V - AREP / PMG < 10V	- Check speed (or LAM on R 438 set too high)
		Voltage between E+ and E- SHUNT > 30 V - AREP / PMG > 15V	- Faulty rotating diodes faulty - Short-circuit in the main field. Check resistance. - Faulty exciter armature. Check resistance.
(*) **Warning**: During single-phase operation, check that the sensing wires from the AVR are connected to the correct output terminals.			
Voltage collapses during normal operation (**)	Check the AVR, the surge suppressor, the rotating diodes and replace any defective part	The output voltage does not return the rated value .	- Exciter winding open circuit - Faulty exciter armature - Faulty AVR - Main field rotor winding open circuit or short circuit
(**) **Warning**: The AVR internal protection may cut in (overload lost connection, short circuit)			

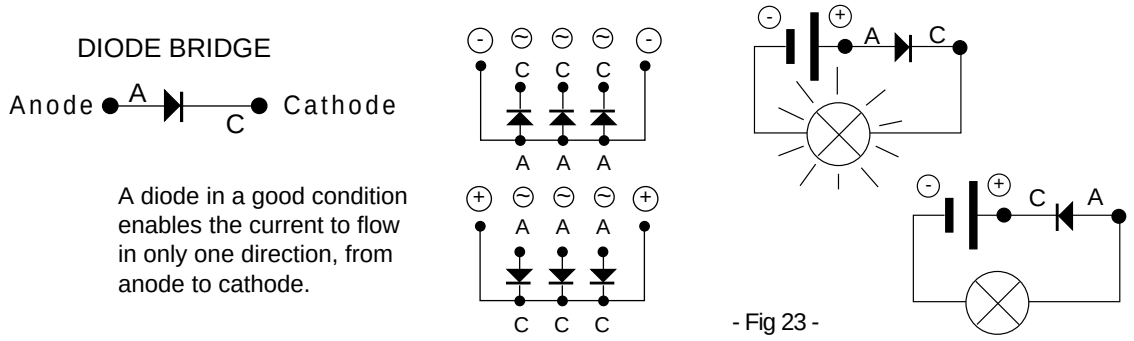
4.5.1 - Checking the windings

You can check the winding insulation making a high voltage test. In this case, you must disconnect all AVR wires.

WARNING

Damages occuring to avr in such conditions will not be taken into account in a warranty claim.

4.5.2 - Checking the diode bridge (Fig 23)



- Fig 23 -

4.5.3 - Checking the windings and rotating diodes using separate excitation

During this procedure, make sure that the alternator is disconnected from any external load and inspect the terminal box to check that the connections are fully tightened.

1) Stop the unit, disconnect and isolate the AVR wires.
2) There are are two ways of carrying out a separate excitation (see fig 24.).

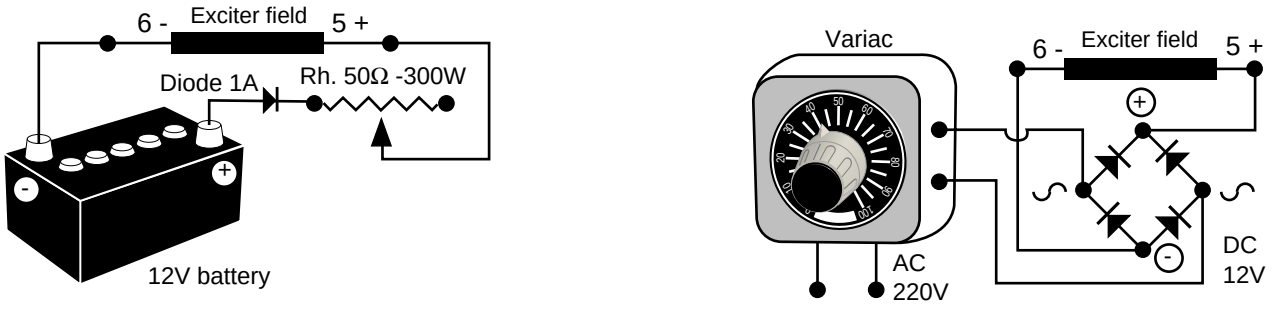
Assembly A: Connect a 12 V battery in series with a rheostat of approximately 50 ohms - 300 W and a diode on both exciter field wires (5+) and (6-).

Assembly B: Connect a "Variac" variable power supply and a diode bridge on both exciter field wires (5+) and (6-).
These two systems should have characteristics which are compatible with the exciter field excitation power of the machine (see the nameplate).

3) Run the unit at its rated speed.

4) Gradually increase the exciter field current by adjusting the rheostat or the variac and measure the output voltages on L1 - L2 - L3, checking the excitation voltage and current at no load and at full load (see machine nameplate or ask for the factory test report).

When the output voltage is at its rated value and balanced within 1%, for the rated excitation level and rated speed, then the machine is in good working order.
The fault must therefore come from the A.V.R. or its associated wiring (i.e. sensing, auxiliary windings)

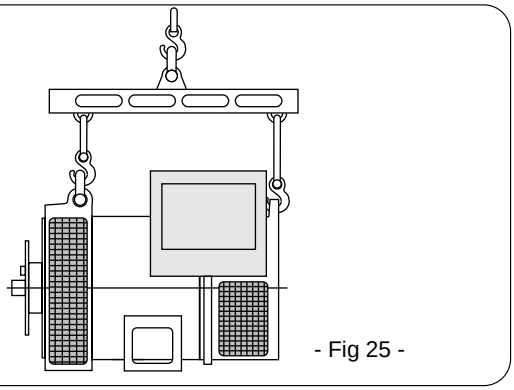


ASSEMBLY A - Fig 24 - ASSEMBLY B

4.6 - Dismantling, reassembly (see section 5.5.1. & 5.5.2.)

During the warranty period, this operation should only be carried out in a LEROY SOMER approved workshop or in our factory, otherwise the warranty may be invalidated.

The machine must be horizontal when handled (when travelling bar removed). See fig 25.



- Fig 25 -

4.6.1 - Tools required

To fully dismantle the machine, we recommend you have the tools listed below:

- 1 : ratchet spanner + extension
- 1 : torque wrench
- 1 : 7 mm / 8 mm / 10 mm / 12 mm flat spanner
- 1 : 8 mm / 10 mm / 13 mm / 16 mm / 18 mm / 21 mm / 22 mm / 24 mm socket
- 1 : 5 mm / 6 mm / 10 mm / 14 mm Allen key
- 1 : TORX T20 bit
- 1 : TORX T30 bit
- 1 : puller (U35)
- 1 : puller (U32/350)

4.6.2 - Screw tightening torque

Identification	screw Ø	Torque N.m
Field term. block screw	M4	4 Nm
Field screw	M6	10 Nm
Diode bridge screw	M6	5 Nm
Diode nut	M5	4 Nm
Assembly rod 2000	M 12	57 Nm
Assembly rod 3000	M 14	90 Nm
Earthing screw	M6	5 Nm
Discs/shaft screw 2000	M 12	110 Nm
Discs/shaft screw 3000	M 16	250 Nm
Fan screw 3000	M6	5 Nm
Louvre screw	M6	5 Nm
Cover screw	M6	5 Nm
Terminal plate screw	M10	20Nm

4.6.3 - Accessing connections and the regulation system

The terminals are accessed by removing the terminal box lid [48].

To access the adjustment potentiometers on the AVR, the side plate should be removed [367].

4.6.4 - Accessing, checking and replacing diodes

4.6.4.1- Dismantling

- Remove the air intake louvre [51].
- Remove the surge suppressor [347].
- Remove the 4 fixing screws from the diode bridges on the armature.
- Disconnect the diodes.
- Check the 6 diodes using either an ohmmeter or a battery lamp (see section 4.5.1).

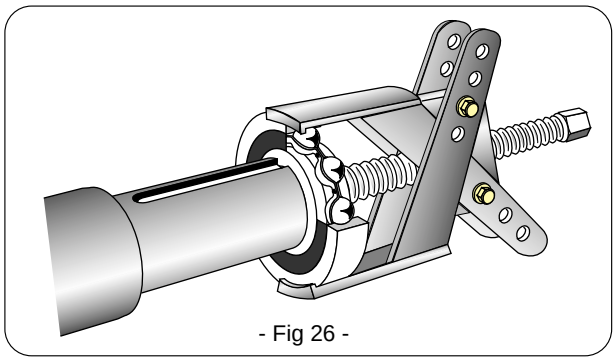
4.6.4.2 - Reassembly

- Replace the diodes, respecting the polarity (see section 4.5.1). Replace the surge suppressor [347].
- Refit the air intake louvre [51].
- Replace the terminal box lid [48].

4.6.5 - Replacing the NDE bearing on a single-bearing machine

4.6.5.1- Dismantling

- Remove the terminal box lid [48].
- Remove the air intake louvre [51].
- Unscrew the fixing clamps on the power output cables, disconnect E+, E- on the exciter and R 791 module.
- Remove the 4 nuts on the tie rods.
- Remove the NDE bracket [36] using an extractor: eg. U.32 - 350 ..
- Remove the bearing [70] using a puller.(See fig 26)

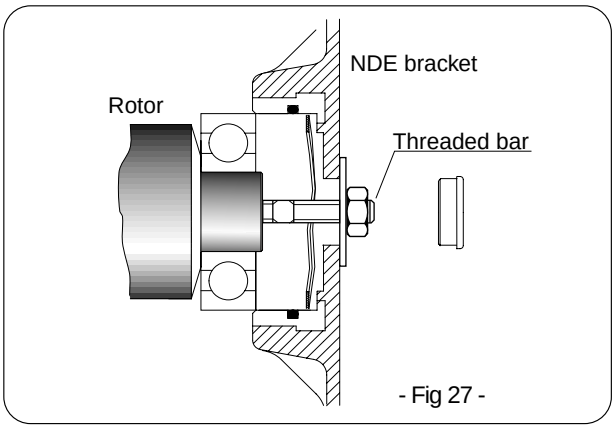


- Fig 26 -

4.6.5.2- Reassembly

- Heat the inner slipring of a new bearing by induction or in a drying oven at 80 °C (do not use an oil bath) and fit it to the machine.
- Place the preloading wavy washer [79] in the flange and fit a new O ring seal [349].
  Refit the NDE bracket (see fig 27) and pass the bundle of wires between the top bars of the flange.
- Replace the fixing clamps on the cables and the R 791 module.

- Refit the air intake louvre [51].
- Replace the terminal box lid [48].



- Fig 27 -

4.6.6 - Replacing the bearings on a two-bearing machine

4.6.6.1 - Dismantling

- Uncouple the alternator from the prime mover.
- Remove the 8 assembly screws.
- Remove the DE flange [30].
- Remove the NDE bracket (see section 4.6.4.1).
- Remove both bearings [60] and [70] using a puller.

4.6.6.2 - Reassembly

- Fit new bearings after heating them by induction or in a drying oven at 80 °C (do not use an oil bath).
- Check that both the preloading wavy washer [79] and new O ring seal have been fitted [349] on the NDE bracket [36].
- Replace the DE flange [30], and tighten the 4 fixing screws.
- Check that the whole machine is correctly assembled and that all screws are fully tightened.

4.6.7 - Accessing the main field and stator

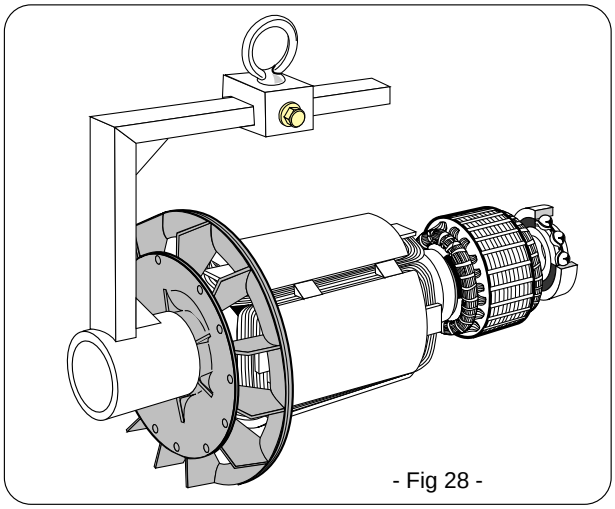
4.6.7.1 - Dismantling

Follow the procedure for dismantling bearings (see sections 4.6.5.1 and 4.6.6.1)

- Remove the coupling discs (single-bearing machine) or the DE flange (two-bearing machine) and insert a tu be of the corresponding diameter on the shaft end or a support made according to fig 28.

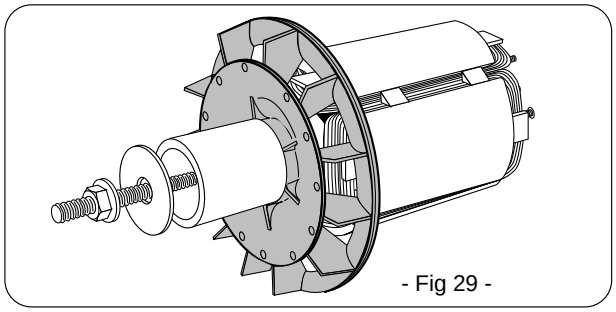
- Rest the rotor on one of its poles, then slide it out. Use the tube as a lever arm to assist dismantling.
- After extraction, be careful with the fan. It is necessary to replace the fan in case of disassembling.

NOTE: If intervention is required on the main field (rewinding, replacement of components), the rotor assembly must be rebalanced.


- Fig 28 -

4.6.7.2 - Reassembly

- Follow the dismantling procedure in reverse order. Take care not to knock the windings when refitting the rotor in the stator.
- If you replace the fan, respect the assembly guide (fig 29). Use a tube and a screw.


- Fig 29 -

Follow the procedure for reassembling the bearings (see section 4.6.5.2 and 4.6.6.2).

After final adjustments, the access panels or cover should be refitted.

4.7 -Installation and maintenance of PMG

The PMG reference for 2000 and 3000 series is PMG 1

4.7.1 Mechanical fitting

It is pointing out the following :

- A adaptation shaft (centring of the rotor PMG on alternator shaft.
- A tie rod with screw and washer.
- A rotor with 16 magnets.
- The housing stator set + the plastic tube.
- The end plate with 4 CBLXS M5 screws.
- The fixation of this set with 4 HM6 screws.

The PMG mechanical assembly order is as follows :

1) Remove the end plate [297] and the plastic obturator of the bracket and top box.
2) Assemble the housing stator set [290] by tightening the 4 HM6 screws (Torque : 8,3 Nm).
3) Put "Loctite" on the screw [295] and tighten it in the shaft.
4) Put the rotor with magnets on the adaptation shaft and assemble the set using the two M10 holes in order to lodge two threaded rods to guide the rotor when inserting in the stator (mind the magnetic attraction strength.
5) Put the end washer [296]
6) Block the set with the nut M10 (Torque : 30 Nm) .
7) Put the end plate [297] and tighten the screws CBLX 5 M5 (Torque : 5 Nm)
8) Link up the plastic tube to the top box using the end link
9) Connect the PMG leads to the AVR (see section 2.5 and 4.7.2).

4.7.2 Electrical connection

In case of a new connection in order to upgrade a shunt machine,

- Disconnect the wires of R 230A.
- Dismount the R 230 A.
- Remove the voltage sensing wires 2 & 3 from terminals T8 and T11 and connect them on terminal T2 (wire 2) and T3 (wire 3).
- Fit the AVR plate (2 screws HM6 tightened at 10 N.m)
- Be sure that the ST9 strap is open.
- Connect the 3 PMG wires (14/15/16), the 2 exciter field wires (5/6) avel the 2 voltage sensing wires (2/3) into the AVR according the wiring diagram enclosed with the PMG. Change the connection of the connecting located on the back panel of the terminal box (cf. fig 17 p 11).

Typical electrical values of the PMG
Stator resistance phase to phase 20°C : 0,7 Ω
Voltage at no load : 73 V

4.8 - Electrical characteristics table

Alternator - 4 pole - 50/60 Hz - No. 6 standard winding. (400V- 50 Hz for the excitation values)
The voltage and current values are given for no-load operation and operation at rated load with separate field excitation. All values are given at ± 10% (for exact values, consult the test report) and are subject to change without prior warning.

SHUNT 2000 :resistances at 20°C (Ω)

2014	B	D	H	J
L/N stator	0,155	0,128	0,0836	0,0631
Rotor	1,35	1,41	1,76	1,96
Field	19,5	19,5	19,5	19,5
Armature	0,23	0,23	0,23	0,23

SHUNT 2000 : field excitation current i exc (A)
Symbols : "i exc": excitation current of the exciter field.

2014	B	D	H	J
No-load	0,5	0,5	0,4	0,5
At rated load	1,6	1,7	1,5	1,6

For 60Hz machines the "i exc" values are approximately 5 to 10 % less.

AREP 2000 :resistances at 20°C (Ω)

2024	B	D	H	J
L/N stator	0,155	0,128	0,0836	0,0631
Rotor	1,35	1,41	1,76	1,96
Auxil. wind. X1, X2	0,32	0,29	0,26	0,21
Auxil. wind. Z1, Z2	0,52	0,5	0,44	0,4
Field	4,9	4,9	4,9	4,9
Armature	0,23	0,23	0,23	0,23

AREP or PMG 2000 : field excitation current i exc (A)
Symbols : "i exc": excitation current of the exciter field.

2024	B	D	H	J
No-load	1	1	0,9	1
At rated load	3,2	3,4	3	3,2

For 60Hz machines the "i exc" values are approximately 5 to 10 % less.

SHUNT 3000 :resistances at 20°C (Ω)

3014	B	F	H
L/N stator	0,55	0,0235	0,0186
Rotor	2,37	3,32	3,66
Field	19,5	19,5	19,5
Armature	0,5	0,5	0,5

SHUNT 3000 : field excitation current i exc (A)
Symbols : "i exc": excitation current of the exciter field.

3014	B	F	H
No-load	0,5	0,6	0,6
At rated load	2	1,9	2

For 60Hz machines the "i exc" values are approximately 5 to 10 % less.

AREP or PMG 3000 :resistances at 20°C (Ω)

3024	B	F	H
L/N stator	0,055	0,0235	0,0186
Rotor	2,37	3,32	3,66
Auxil. wind. X1, X2	0,28	0,17	0,16
Auxil. wind. Z1, Z2	0,44	0,28	0,21
Field	4,9	4,9	4,9
Armature	0,5	0,5	0,5

AREP 3000 : field excitation current i exc (A)
Symbols : "i exc": excitation current of the exciter field.

3024	B	F	H
No-load	1	1,15	1,2
At rated load	4	3,7	4

For 60Hz machines the "i exc" values are approximately 5 to 10 % less.

5 - SPARE PARTS

5.1 - First maintenance parts

Emergency repair kits are available as an option.
They contain the following items:

No.	Description	Qty	L 2000	Part number	L 3000	Part number
	Emergency Kit (Shunt)	1		922-216		922-218
198	Voltage regulator (AVR)	1	R 230	922-197	R 230	922-197
343	Diode bridge assembly	1	LSA 432 9 03/04	922-230	LSA 432 9 03/04	922-230
347	Surge suppressor	1	LSA 432 1 13	922-231	LSA 432 1 13	922-231
	AVR fuse	2	250 V - 8 A / slow	922-222	250 V - 8 A / slow	922-222
	Emergency Kit (AREP/MPG)			922-217		922-219
198	Voltage regulator (AVR)	1	R 438	922-045	R 438	922-045
343	Diode bridge assembly	1	LSA 432 9 03/04	922-230	LSA 432 9 03/04	922-230
347	Surge suppressor	1	LSA 432 1 13	922-231	LSA 432 1 13	922-231
	AVR fuse	2	250 V - 8 A / slow	922-222	250 V - 8 A / slow	922-222
	Other parts					
60	D.E. bearing	1	6312 2RS/C3		6315 2RS/C3	
70	N.D.E. bearing	1	6307 2RS/C3	922-111	6309 2RS/C3	922-232

5.2 - Technical support service

Our technical support service will be happy to provide any information you require.

When ordering spare parts, you should indicate the complete machine type, its serial number and the information indicated on the nameplate.

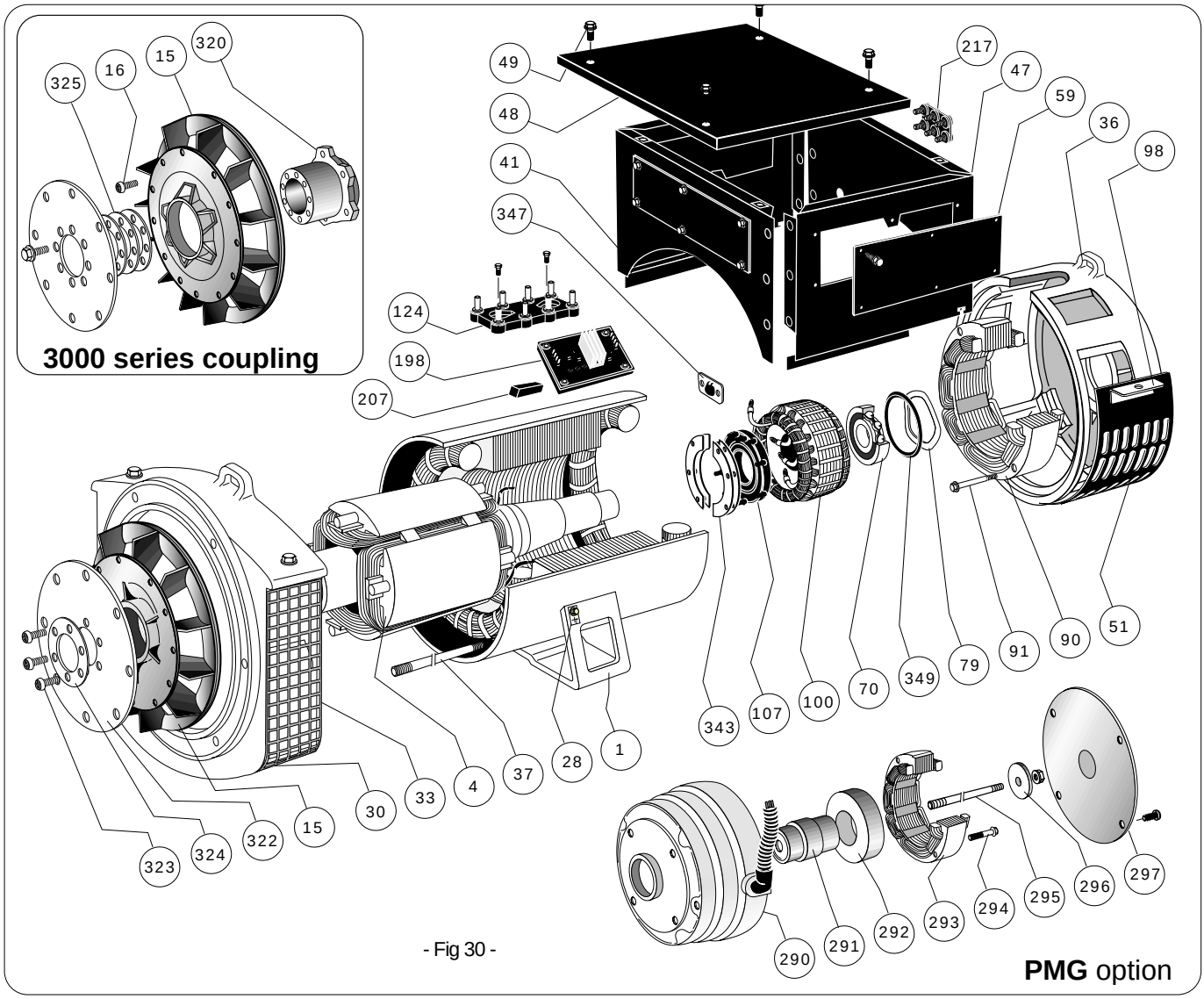
Address your enquiry to your usual contact.

WARNING

Part numbers should be identified from the exploded views and their description in the parts list.
Our extensive network of "service stations" can dispatch the necessary parts without delay.
To ensure correct operation and the safety of our machines, we recommend the use of original manufacture spare parts.
In the event of failure to comply with this advice, the manufacturer cannot be held responsible for any damage.

5.3 - Exploded view, parts list.

5.3.1 - Single bearing (fig 30)

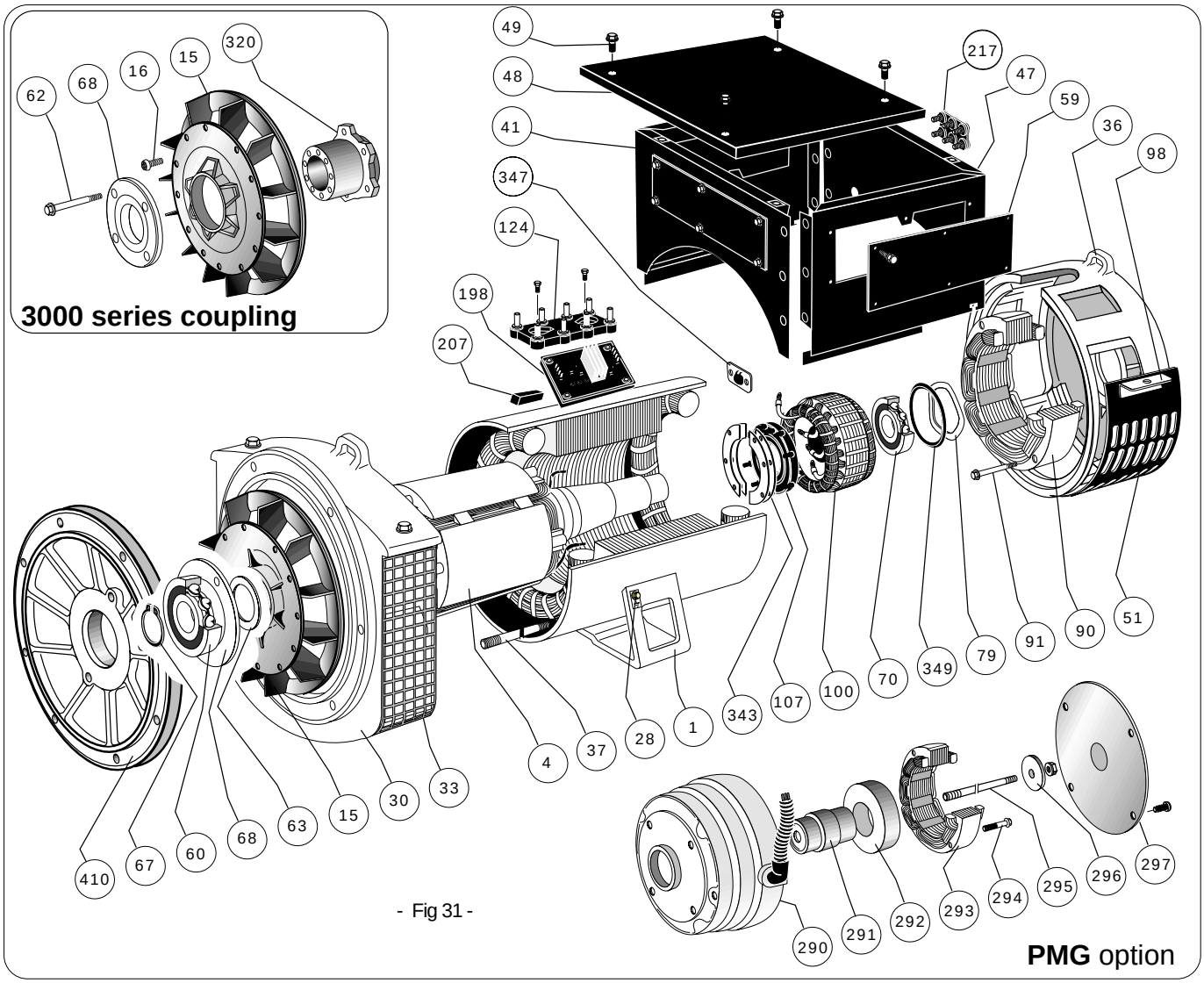


- Fig 30 -

PMG option

No.	Nbr.	Description	No.	Nbr.	Description
1	1	Stator assembly	107	1	Support diode assembly
4	1	Rotor assembly	124	1	Terminal plate
15	1	Fan	198	1	Regulator (AVR)
16	6	Fan fixing screw	207	1	Rubber
28	1	Earth terminal	217	1	Auxiliary terminal plate
30	1	DE flange	290	1	Housing
33	1	Air outlet louvre	291	1	Adaptation shaft
36	1	N.D.E. bracket	292	1	Rotor magnets
37	4	Tie rod	293	1	Stator
41	1	D.E. terminal box	294	2	Fixing screw
47	1	N.D.E. terminal box	295	1	Tie rod
48	1	Terminal box lid	296	1	Washer + nut
49	20	Terminal box fixing screw	297	1	End plate
51	1	Air intake louvre	320	1	Hub
59	3	Inspection door	322	1	Coupling disc
70	1	NDE bearing	323	-	Fixing screw
79	1	Preloading wavy washer	324	1	Clamping washer
90	1	Wound exciter field	325	-	Spacer shim
91	4	Field fixing screw	343	1	Diode bridge assembly
98	3	Corner plate	347	1	Surge suppressor
100	1	Exciter armature	349	1	O ring seal

5.3.2 - Two bearing (fig 31)



No.	Nbr.	Description	No.	Nbr.	Description
1	1	Stator assembly	90	1	Wound exciter field
4	1	Rotor assembly	91	4	Field fixing screw
15	1	Fan	100	1	Exciter armature
16	6	Fan fixing screw	107	1	Rotating diode support
28	1	Earth terminal	124	1	Terminal plate
30	1	DE flange	198	1	Regulator (AVR)
33	1	Air outlet louvre	207	1	Rubber
36	1	N.D.E. bracket	217	1	Auxiliary terminal plate
37	4	Tie rod	290	1	Housing
41	1	D.E. terminal box	291	1	Adaptation shaft
47	1	N.D.E. terminal box	292	1	Rotor magnets
48	1	Terminal box lid	293	1	Stator
49	20	Terminal box fixing screw	294	2	Fixing screw
51	1	Air intake louvre	295	1	Tie rod
59	3	Inspection door	296	1	Washer + nut
60	1	DE bearing	297	1	End plate
62	2 or 4	Cap fixing screw	320	1	Hub
63	1	Washer	343	1	Diode bridge assembly
67	1	Circlips	347	1	Surge suppressor
68	1	Bearing cap	349	1	O ring seal
70	1	NDE bearing	410	1	DE flange
79	1	Preloading wavy washer