LEROY SOMER®

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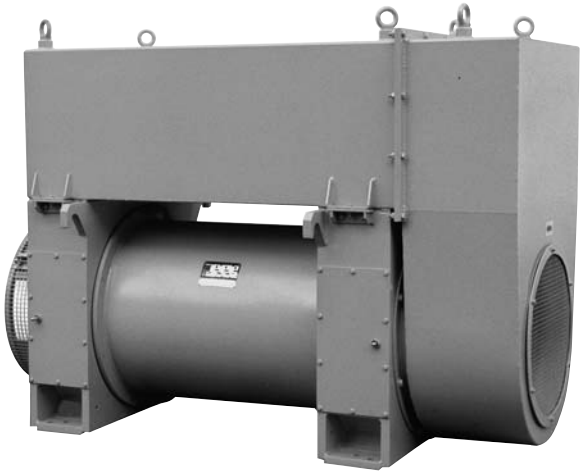
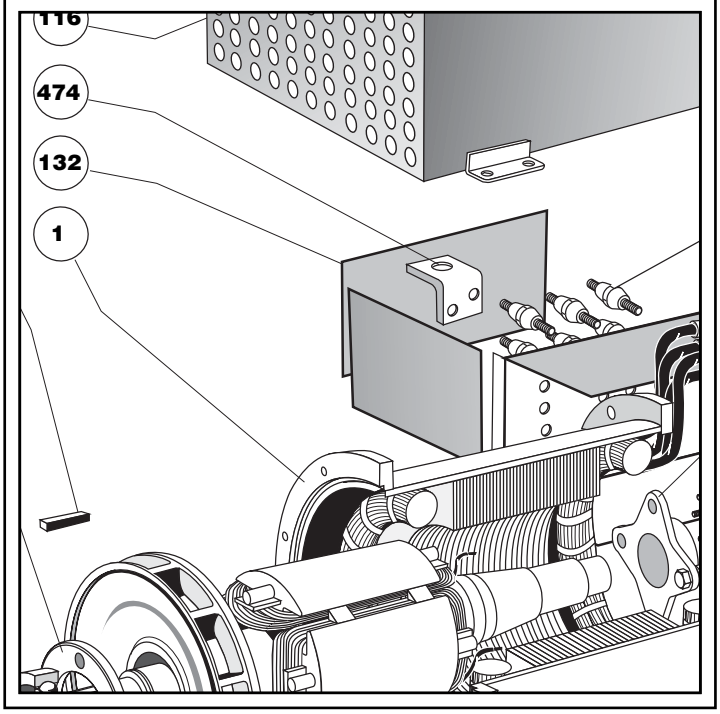


This manual is to be given to the end user



LSA R 47.1/49.1

Cooling system - AREP - 4 poles - R 448

ALTERNATORS

Installation and maintenance

LSA R 47.1/49.1 Cooling system
ALTERNATORS

This manual concerns the alternator which you have just purchased.

The latest addition to a whole new generation of alternators, this range benefits from the experience of the leading manufacturer worldwide, using advanced technology and incorporating strict quality control.

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

SAFETY MEASURES

Before using your machine for the first time, it is important to read the whole of this installation and maintenance manual.

All necessary operations and interventions on this machine must be performed by a qualified technician.

Our technical support service will be pleased to provide any additional information you may require.

The various operations described in this manual are accompanied by recommendations or symbols to alert the user to the potential risk of accidents. It is vital that you understand and take notice of the different warning symbols used.

WARNING

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

Warning symbol for general danger to personnel.

Warning symbol for electrical danger to personnel.

WARNING SYMBOLS

A set of self-adhesive stickers depicting the various warning symbols is included with this maintenance manual. They should be positioned as shown in the drawing below once the machine has been fully installed.

Note: LEROY-SOMER reserves the right to modify the characteristics of its products at any time in order to incorporate the latest technological developments. The information contained in this document may therefore be changed without notice.

LSA R 47.1/49.1 Cooling system
ALTERNATORS

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LSA R 47.1/49.1 Cooling system
ALTERNATORS
RECEIPT

1 - RECEIPT

1.1 - Standards and safety measures

Our alternators comply with most international standards and are compatible with:
- The recommendations of the
International Electrotechnical Commission
IEC 34-1, (EN 60034).
- The recommendations of the
International Standards Organisation ISO 8528.
- The European Community directive 89/336/EEC on Electromagnetic Compatibility (EMC).
- 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 carefully 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 potential risk of accidents. It is vital that you understand and take notice of the different warning symbols used.

1.2 - Inspection

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 to detect any malfunction.

1.3 - Identification

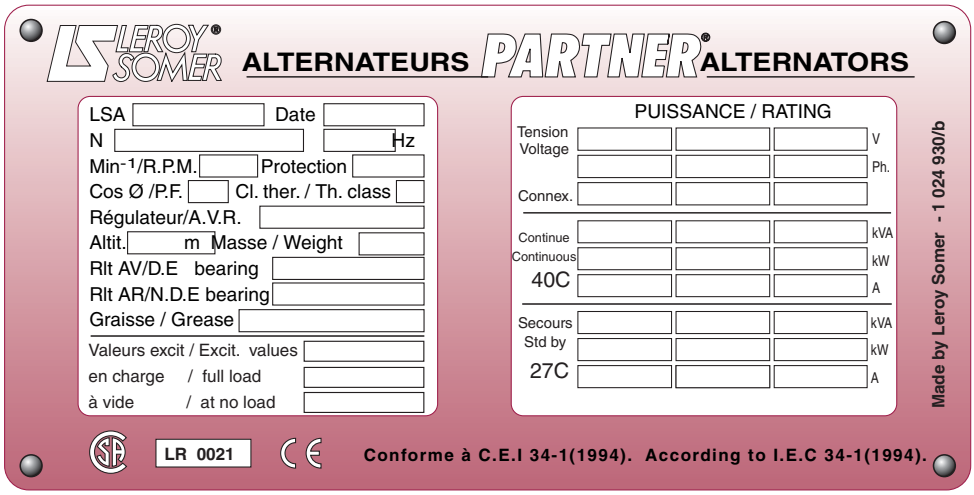
The alternator is identified by means of a nameplate glued to the frame.
Make sure that the nameplate on the machine conforms to your order.
The machine name is defined according to various criteria (see below).
Example of description: ***LSA 49.1 L6 C6/4 -***
- LSA : Name used in the PARTNER range
  M : Marine/C : Cogeneration/T : Telecommunications.
- 49.1 : Machine type
- M6 : Model
- C : Excitation system (C: AREP/J: SHUNT+ PMG/ E: COMPOUND)
- 6/4 : Winding number/number of poles

1.3.1 - Nameplate

So that you can identify your machine quickly and accurately, we suggest you write its specifications on the nameplate below.

1.4 - Storage

Prior to commissioning, 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 the risk of condensation during storage.
- If the area is affected by vibration, try to reduce the effect of these vibrations by placing the generator on a damper support (rubber disc or similar) and turn the rotor a fraction of a turn once a fortnight to avoid marking the bearing rings.



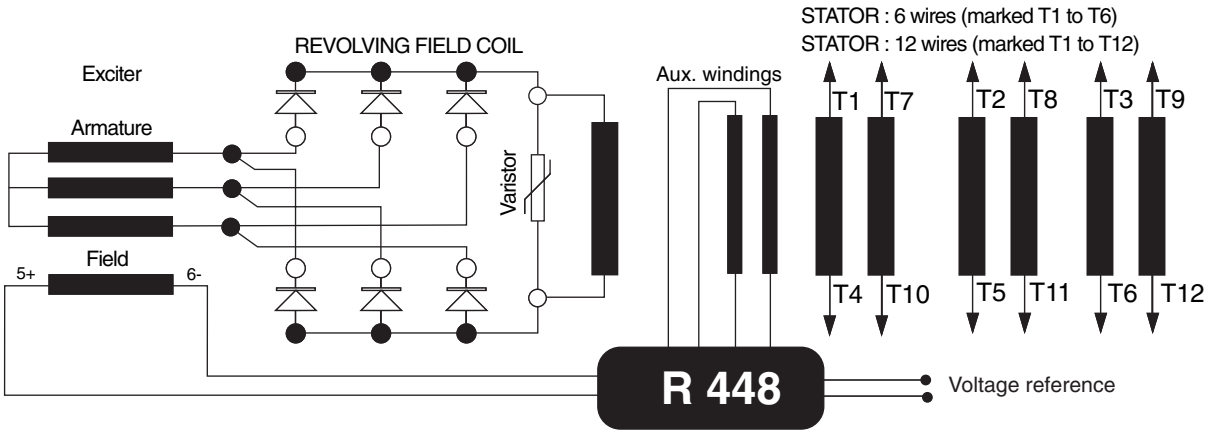
LSA R 47.1/49.1 Cooling system
ALTERNATORS
TECHNICAL CHARACTERISTICS

2 - TECHNICAL CHARACTERISTICS

2.1 - Electrical characteristics

PARTNER LSA R alternators are machines without sliprings or revolving field brushes, wound as "2/3 pitch"; 6 or 12-wire, with class H insulation and a field excitation system available in AREP version (see diagram).

AREP system with R 448



Interference suppression conforms to standard EN 55011, group 1, class B.

2.1.1 - Options

- Stator temperature detection sensors
- Space heaters
- Terminal box with connector links for mounting protection or measurement C.T.

2.2 - Mechanical characteristics

- Steel frame
- Cast iron end shields
- Greasable ball bearings
- Mounting arrangement

IM 1001 (B 34):
Two-bearing with SAE flange and standard cylindrical shaft extension
- Degree of protection: IP 54

2.2.1 - Options

To prevent excessive temperature rise caused by clogged tubes, it is advisable to monitor the stator winding with thermal sensors (PTC or PT100).
- Bearing detection sensors

LSA R 47.1/49.1 Cooling system
ALTERNATORS
TECHNICAL CHARACTERISTICS

2.3 - Excitation system

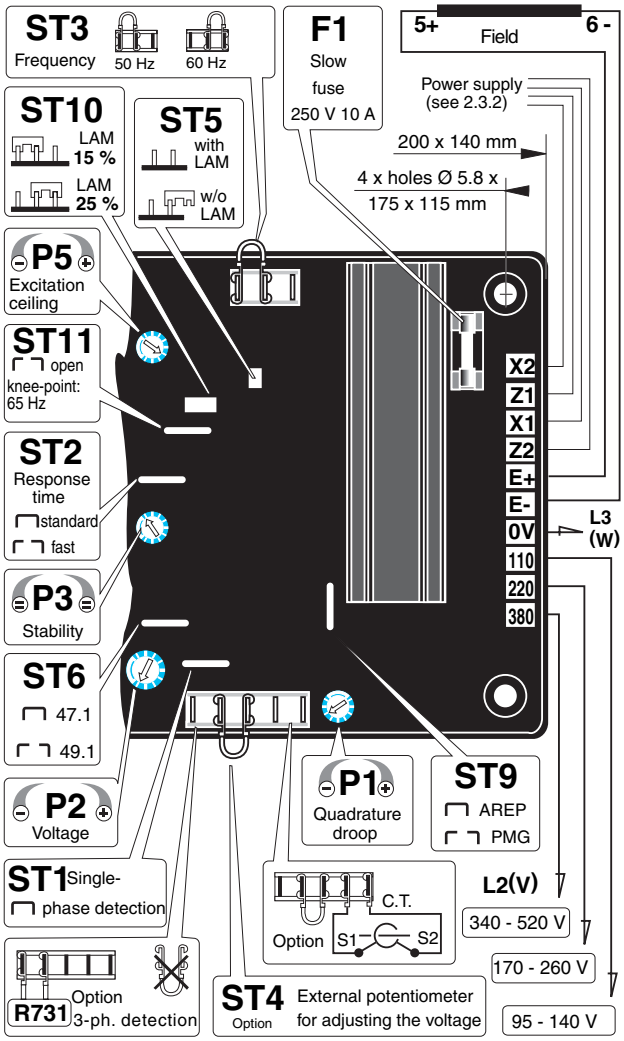
The AREP excitation system is controlled by the R 448 AVR.

With ***AREP*** excitation, the R 448 electronic AVR is powered by two auxiliary windings which are independent of the voltage match circuit. The first winding has a voltage in proportion to that of the alternator (characteristic Shunt), the second has a voltage in proportion to the stator current (compound characteristic: Booster effect). The power supply voltage is rectified and filtered before being used by the AVR monitoring transistor.

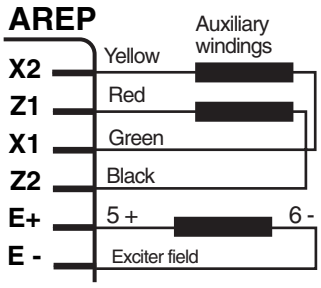
2.3.1 - R 448 AVR

- Shunt power supply: max 150 V - 50/60 Hz
- Rated overload current: 10 A - 10 s
- Electronic protection: (In the event of overload, short-circuit, loss of voltage sensing) this acts to restore the value of the excitation current to 1 A after 10 s. The alternator must be stopped (or the power switched off, see section 3.5.3) in order to reset the protection.
- Fuse: F1 on X1, X2
- Voltage sensing: 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

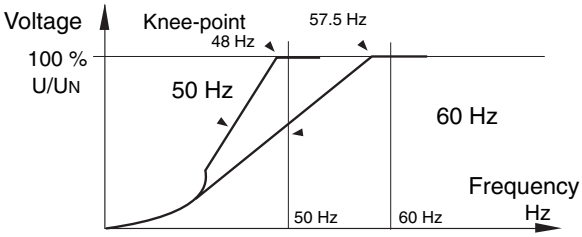
For other voltages, a transformer should be used.
- Voltage regulation ± 0.5%
- Normal or rapid response time via jumper ***ST2***
- Voltage adjustment via potentiometer ***P2*** or apply a DC voltage of ± 1 V on the terminals of the external potentiometer
- Current sensing: (Parallel operation): Input S1, S2 intended for 1 C.T. ≥ 2.5 VA cl1, secondary 1 A (optional)
- Quadrature droop adjustment via potentiometer ***P1***
- Max. excitation current adjustment via ***P5***: 4.5 to 10 A
- 50/60 Hz selection via ***ST3*** jumper
- ***ST11***: Knee-point at 65 Hz for Tractelec application and variable speed



2.3.2 - Power supply connection



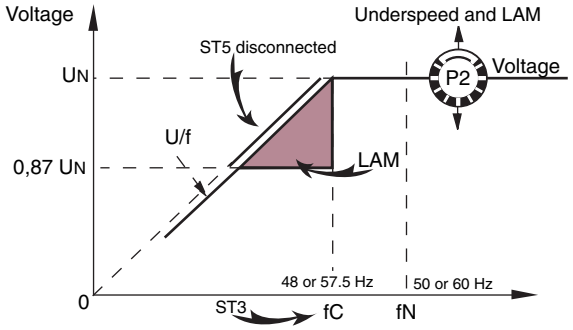
2.3.3 - Frequency compared with voltage (without LAM)



LSA R 47.1/49.1 Cooling system
ALTERNATORS
TECHNICAL CHARACTERISTICS

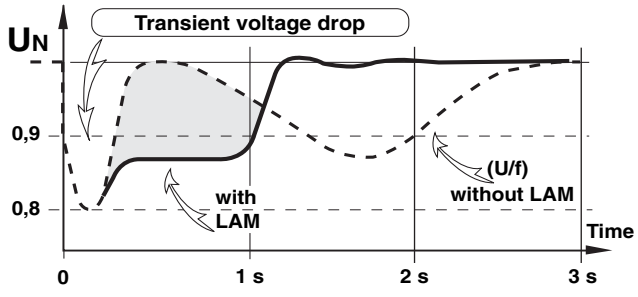
2.3.4 - LAM (Load Acceptance Module) characteristics

The LAM system is integrated in the regulator and is active as standard (ST5 with bridge). It can be deactivated by removing the ST5 bridge. It can be adjusted to 13% or 25% by means of the ST10 jumper.
- Role of the LAM (Load Acceptance Module):
On application of a load, the rotation speed of the generator set decreases. When it falls below the preset frequency threshold, the LAM causes the voltage to drop by approximately 13% or 25%. This in turn reduces the active load scale applied by approximately 25% to 45%, until the speed returns to its rated value.
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. Use of the LAM at 25% is recommended for load impacts ≥ 70% of the genset rated power.

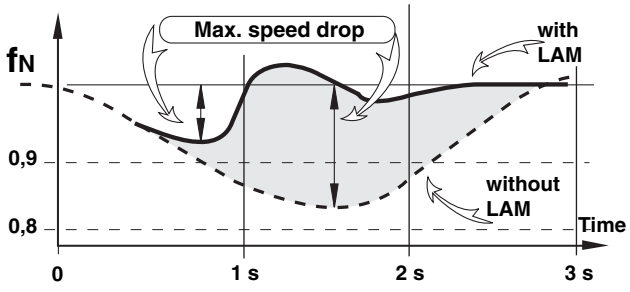


2.3.5 - Typical effects of the LAM with a diesel engine with or without a LAM (U/F only).

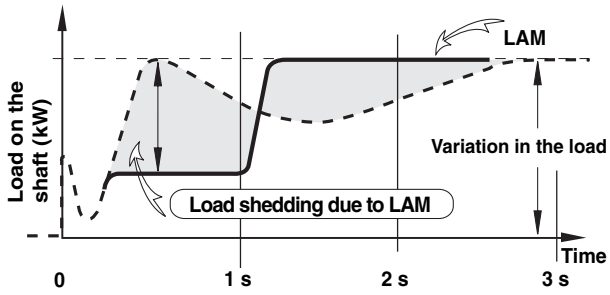
2.3.5.1 - Voltage



2.3.5.2 - Frequency

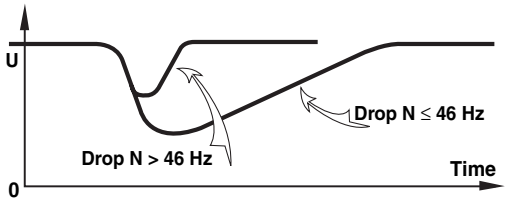


2.3.5.3 - Power



2.3.6 - Gradual voltage return function

During load impacts, the function helps the genset to return to its rated speed faster thanks to a gradual increase in voltage according to the principle:
- If the speed drops between 46 and 50 Hz, the rated voltage follows a fast gradient as it is restored.
- If the speed drops below 46 Hz, since the engine needs more help, the voltage follows a slow gradient as it returns to the reference value.



2.3.7 - R 448 AVR options

- Current transformer for parallel operation of...../ 1 A ≥ 2.5 VA CL 1 (See the diagram in this manual).
- Voltage transformer (adaptation)
- Remote voltage adjustment potentiometer:
470 Ω, 0.5 W min: Adjustment range ± 5% (range limited by internal voltage potentiometer P2). Remove ST4 to connect the potentiometer. (A 1 kΩ potentiometer can also be used to extend the adjustment range).
- R 731 module: Detection of 200 to 500 V 3-phase voltage, compatible with parallel operation. Disconnect ST1 to connect the module; set the voltage via the potentiometer.
- R 734 module: Detection of 3-phase current and voltage for parallel operation on unbalanced installations (imbalance > 15%)
- R 726 module: Regulation system changed to "4-function". (See the maintenance manual and connection diagram.)
- PF regulation φ (2F)
- Voltage matching before paralleling (3 F)
- Mains connection of alternators already running in parallel (4F)

- R 729 module: Same as R 726 with additional functions
- Detection of a diode fault
- 5/20 mA input
- Possibility of kVAR regulation

3 - INSTALLATION

3.1 - Assembly

All mechanical handling operations must be undertaken using approved equipment.
Whilst being handled, the machine must remain horizontal.

3.1.1 - Handling

The lifting rings are for handling the alternator alone. They must not be used to lift the genset. Choose a lifting system which respects the integrity and the environment of the alternators.

3.1.2 - Coupling

3.1.2.1 - single-bearing alternator

Before coupling the two machines, check that both are compatible by:
- Undertaking a torsional analysis of the transmission on both units
- 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.

3.1.2.2 - double-bearing alternator

- Semi-flexible coupling

Careful alignment of the machines is recommended, checking that the lack of concentricity and parallelism of both parts of the coupling do not exceed 0.1 mm.

WARNING

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

3.1.3 - Location

Ensure that the ambient temperature in the room where the alternator is placed cannot exceed 40°C for standard power ratings (for temperatures > 40°C, apply a derating coefficient). Fresh air, free from damp and dust, must be able to circulate freely around the air intake grilles 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 insulation is less than 1 megohm for the stator and 100,000 ohms for the other windings.

There are two possible methods for restoring these minimum values.
a) Dry out the machine for 24 hours in a drying oven at a temperature of approximately 110 °C (without the AVR).
b) Blow hot air into the air intake, having made sure that the machine is rotating with the exciter field disconnected.
c) Run in short-circuit mode (disconnect the AVR):
- Machine stopped, short-circuit the three output power terminals 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 12 V battery to the exciter field terminals, respecting the polarity, in series with a rheostat for adjusting the resistance in order to obtain an excitation current equal to the rated stator current
(e.g.: 10 Ω/50 W)
- Open fully all the alternator openings.
- Run the alternator at its rated speed, and 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.

LSA R 47.1/49.1 Cooling system
ALTERNATORS
INSTALLATION

3.2.2 - Mechanical checks

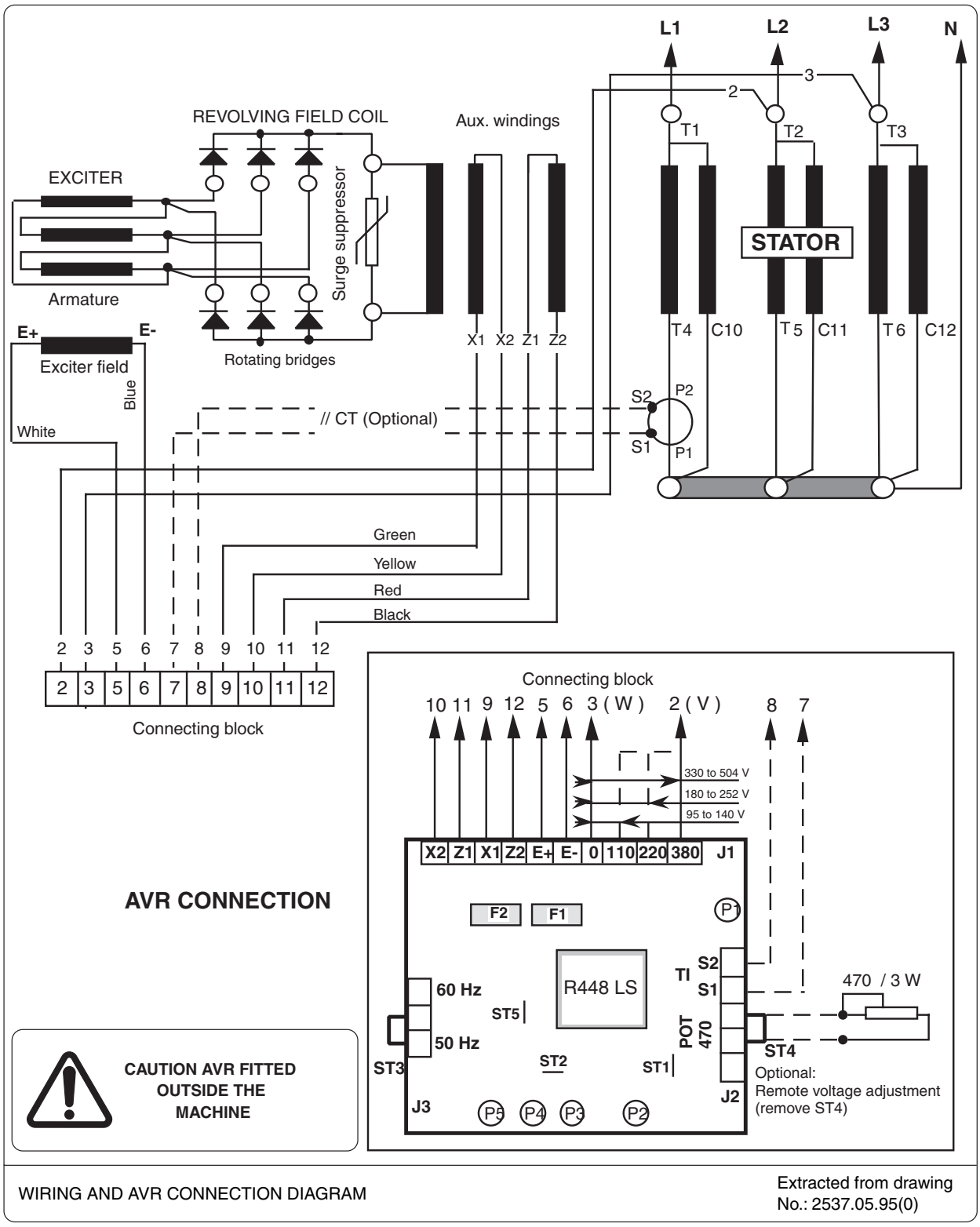
Before starting the machine for the first time, check that:
- All fixing bolts and screws are tight
- Cooling air is drawn in freely
- The protective grilles and housing are correctly in place
- The standard direction of rotation is clockwise as seen from the shaft end (phase rotation in order 1 - 2 - 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. The winding code is specified on the nameplate.

3.3.1 - Standard terminal connection: 6-wire

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



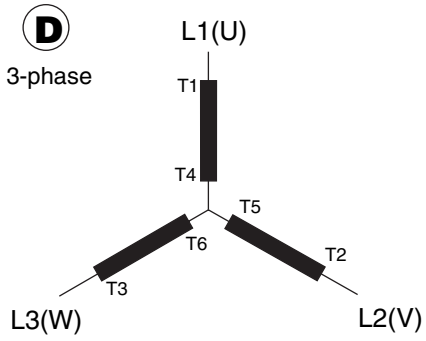
WIRING AND AVR CONNECTION DIAGRAM

Extracted from drawing No.: 2537.05.95(0)

LSA R 47.1/49.1 Cooling system
ALTERNATORS
INSTALLATION

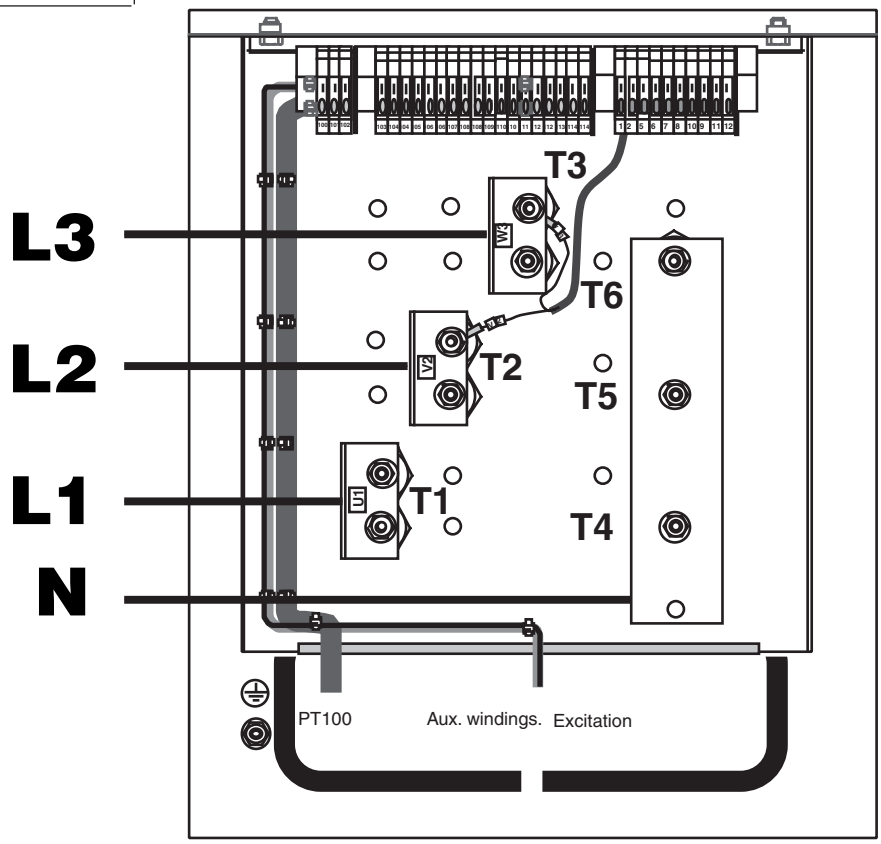
3.3.2 - Internal coupling diagram

Connection code



Voltage L.L		
Winding	50 Hz	60 Hz
6 S	380 - 415	440 - 480

AVR terminals : 0. 380 V



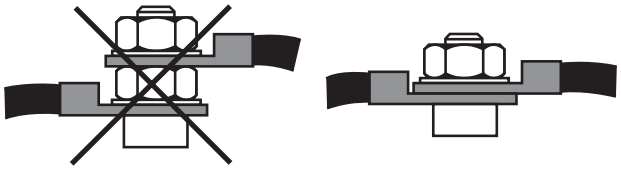
Factory connection

WIRING AND AVR CONNECTION DIAGRAM

Extracted from drawing
No.: LSA471.6.059

3.3.3 - Connection checks

Electrical installations must comply with the current legislation in force in the country of use.
Check that:
- The residual 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. (In this case, disconnect the wire of the interference suppression module linking the neutral).
- Any protection devices in place have not been tripped.
- If there is an external AVR, the connections between the alternator and the cabinet are made in accordance with the connection diagram.
- There is no short-circuit phase-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 relays in the cabinet).
- The machine has been connected with the busbar separating the terminals as shown in the terminal connection diagram.



3.3.4 - Electrical checks on the AVR

- Check that all connections have been made properly as shown in the attached wiring diagram.
- Check that the "ST3" frequency selection jumper is on the correct frequency setting.
- Check whether the ST4 jumper or the remote adjustment potentiometer have been connected.
- Optional operating modes
  • ST1 jumper: Disconnected to connect the R 731 3-phase sensing module
  • ST2 jumper: Disconnected if rapid response time is being used
  • ST5 jumper: Open to suppress the LAM function
  • ST9 jumper: Closed with AREP, open with PMG

3.4 - Commissioning

The machine can only be started up and used if the installation is in accordance with the regulations and instructions defined in this manual.
The machine is tested and set up 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 achieve 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 - Settings

The various adjustments during tests must be made by a qualified engineer.

WARNING

Ensure that the drive speed specified on the nameplate is reached before commencing adjustment

1500 rpm/50Hz or 1800 rpm/60 Hz

Do not try to set the voltage if the frequency or speed is not correct (risk of irreparable rotor damage).
The only possible adjustments to the machine should be made on the AVR.

After operational testing, replace all access panels or covers.

3.5.1 - R 448 settings

WARNING

Before any intervention on the AVR, make sure that the ST9 jumper is closed with AREP excitation and disconnected with PMG excitation.

LSA R 47.1/49.1 Cooling system
ALTERNATORS
INSTALLATION

a) Initial potentiometer settings (see table below)
- Remote voltage adjustment potentiometer: centre (ST4 jumper removed)

Action	Factory setting	Pot.
Voltage minimum fully anti-clockwise	400 V - 50 Hz (Input 0 - 380 V)	
Stability	Not set (center position)	
Voltage quadrature droop (// operation with C.T.) - 0 quadrature droop fully anti-clockwise.	Not set (fully anti-clockwise)	
Excitation ceiling Limit of excitation and short-circuit current, minimum fully anti-clockwise.	10 A maximum	

Stability adjustments in standalone operation

b) Install a DC analogue voltmeter (needle dial) cal. 100 V on terminals E+, E- and an AC voltmeter cal 300 - 500 or 1000 V on the alternator output terminals.

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

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

e) Stability potentiometer P3 at around 1/3 of the anti-clockwise limit.

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

g) Set the output voltage to the desired value using P2.
- Rated voltage UN for solo operation (e.g. 400 V)
- Or UN + 2 to 4% for parallel operation with C.T. (e.g. 410 V -)
If the voltage oscillates, use P3 to make adjustments (try both directions) observing the voltage between E+ and E- (approx. 10 V DC). The best response times are obtained at the limit of the instability. If no stable position can be obtained, try disconnecting or replacing the ST2 jumper (normal/fast).

h) Check LAM operation: ST5 closed

i) Vary the frequency (speed) around 48 or 58 Hz according to the operating frequency, and check the change in voltage from that observed previously (~ 15%).

j) Readjust the speed of the genset to its rated no-load value.

Adjustments in parallel operation

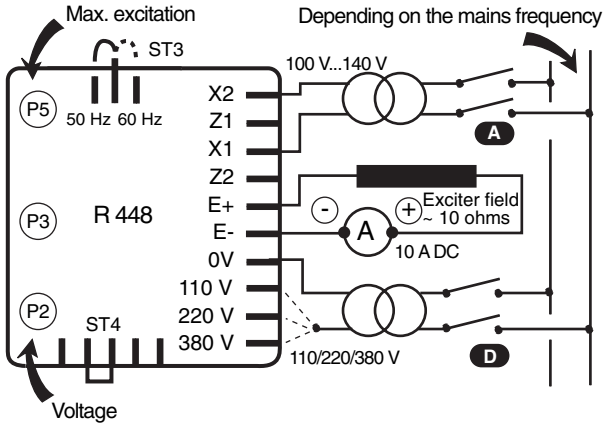
Before any intervention on the alternator, make sure that the speed droop is identical for all engines.

k) Preset for parallel operation (with C.T. connected to S1, S2)
- Potentiometer P1 (quadrature droop) in centre position.
Apply the rated load (cos Ø = 0.8 inductive).
The voltage should drop by 2 to 3%. If it increases, check that neither V and W nor S1 and S2 have been reversed.

l) 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 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.

m) Apply the available load (the setting is only correct if a reactive load is available)
- By altering the speed, match the kW (or divide the rated power of the units proportionally)
- By altering the quadrature droop potentiometer P1, match or divide the currents

3.5.2 - Max. excitation setting (excitation ceiling)



- Static adjustment of the current limit, potentiometer P5 (fuse rating: 8 A - 10 seconds).
The maximum factory setting corresponds to that of the excitation current required to obtain a 3-phase short-circuit current of approximately 3 IN at 50 Hz for industrial power, unless otherwise specified (*).
A static method can be used to reduce this value or adapt the Isc to the actual operating power (derated machine), which is safer for the alternator and the installation.
- Disconnect power supply wires X1,X2 and Z1,Z2, and the voltage reference (0-110V-220V-380V) on the alternator.
Connect the mains power supply using a transformer (200 - 240 V) as indicated (X1,X2): 120 V).
- Apply the corresponding voltage to the voltage reference input used.

- Supply the AVR with a voltage of 120 V max. on the X1, X2 input.
- Install a 10 A DC ammeter in series with the exciter field.
- Turn P5 fully anti-clockwise and activate the power supply. If there is no output current from the AVR, turn potentiometer P2 (voltage) to the right until the ammeter indicates a stable current.
- Switch the power supply off, then on again, turn P5 to the right until the required max. current is obtained (no more than 10 A).

Checking the internal protection:
Open switch (D): The excitation current should increase to its preset ceiling, remain at that level for ≥ 1 second in AREP or 10 seconds in PMG and then drop to < 1 A.
To reset, switch off the power supply by opening switch (A).
Reconnect the AVR to the alternator and adjust the reference voltage via P2 to obtain the rated voltage.

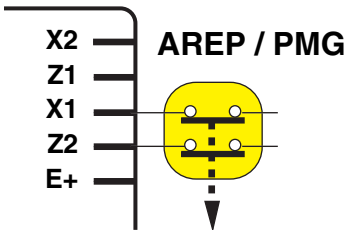
(*): In some countries it is a legal requirement to have a short-circuit current, so as to offer discriminating protection.

3.5.3 - Special type of use

WARNING

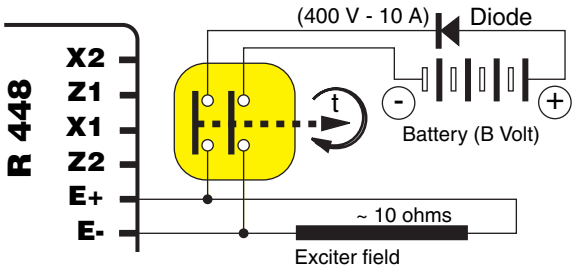
The excitation circuit E+, E- must not be left open when the machine is running: this will damage the AVR.

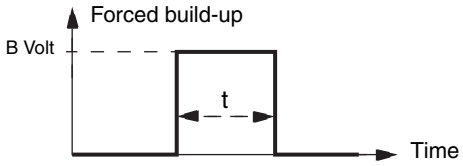
3.5.3.1 - Field weakening



The exciter is switched off by disconnecting the AVR power supply (1 wire on each auxiliary winding) - contact rating 16 A - 250 V AC.
Connection is identical for resetting the AVR internal protection.

3.5.3.2 - - Forced build-up





Applications	*B Volt*	*Time t*
Guaranteed voltage build-up	12 (1 A)	1 - 2 s
Parallel operation, de-energized	12 (1 A)	1 - 2 s
Parallel operation, at standstill	24 (2 A)	5 - 10 s
Frequency starting	48 (4 A)	5 - 10 s
Sustained voltage on overload	48 (4 A)	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 trained in the 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 - Routine 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 - Heat exchanger

4.2.2.1 - Primary circuit (hot air)

The air to be cooled flows through the machine and the heat exchanger in a closed circuit. Air circulation is normally provided by a fan fitted on the machine shaft and situated near the front bearing. In certain special cases (variable speed, etc.) the air circulation may be provided by an electric fan fitted on the heat exchanger casing.

4.2.2.2 - Secondary circuit (cold air)

The air used is normally ambient air. Circulation through the tubes is provided either by a turbine mounted out-board at the rear of the machine on an extension shaft or by an electric fan mounted on the heat exchanger.

4.2.2.3 - Performance

The heat exchanger performance that we guarantee is that for which it was designed on the basis of the conditions laid down in the specifications (ambient temperature, power to be dissipated, environmental conditions, pressure losses, etc.).

4.2.3 - Heat exchanger construction

The heat exchanger casing is made from sheet steel, and the radiator normally consists of aluminium alloy or steel tubes. The tube ends are fixed into steel plates.

4.2.4 - Heat exchanger maintenance

If the unit is operating in a clean atmosphere it can remain in service for several years without maintenance. If on the other hand the atmosphere is dirty (dust, sand, greasy vapours, etc.) the tubes should be cleaned regularly. Dirty tubes cause a reduction in heat exchanger performance with a consequent rise in the temperature of the machine. Monitoring of the machine temperature gives a good guide as to the condition of the heat exchanger.

4.2.5 - Bearings

The bearings are greasable. It is advisable to lubricate the machine during operation. The lubrication characteristics are given in the table below.

Type of alternator	***47.1***	***47.1***	***49.1***	***49.1***
Bearings	6318 C3	6315 C3	6322 C3	6320 C3
Quantity of grease: gr or cm^3	40	30	50	60
Regreasing interval	3500	4500	4500	4500

Lubrication intervals are given for grease type
LITHIUM - standard - NLGI 3.
In the factory, the grease used for lubrication is:
ESSO UNIREX N3.

Before using another grease, check for compatibility with the original one. 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.

4.2.6 - Electrical servicing

Cleaning product for the windings

WARNING

Do not use: Trichlorethylene, perchlorethylene, trichloroethane or any alkaline products.

Certain strictly defined pure volatile degreasing agents can be used, such as:
- Normal petrol (without additives); inflammable
- Toluene (slightly toxic); inflammable
- Benzene (or benzene, toxic); inflammable
- Ciclohexare (non toxic); inflammable

Cleaning of the stator, rotor, exciter and diode bridge

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

4.2.7 - Mechanical servicing

WARNING

Cleaning the machine using water or a high-pressure washer is strictly prohibited.
Any problems arising from such treatment are not covered by our warranty.
The machine should be cleaned with a degreasing agent, applied using a brush. Check that the degreasing agent will not affect the paint.
Compressed air should used to remove any dust.
If filters have been added to the machine after manufacture and do not have thermal protection, the service personnel should replace the air filters periodically and systematically, as often as is necessary (every day in very dusty atmospheres).
After cleaning the alternator, it is essential to check the winding insulation (see sections 3.2 and 4.8.).

4.3 - Fault detection

If, when commissioned, the alternator does not work normally, the source of the malfunction must be identified. To do this, check that:
- The protection devices are fitted correctly
- The connections comply with the diagrams in the manuals supplied with the machine
- The speed of the unit is correct (see nameplate)

Repeat the operations defined in section 3.

4.4 - Mechanical defects

Fault		Possible causes
Bearing	Excessive overheating of one or both bearings (temperature > 80°C on the bearing retainers with or without abnormal noise)	- End shields misaligned (flanges not properly fitted) - Free axial bearing If the bearing has turned blue or if the grease has turned black, change the bearing.
Temperature abnormal	Excessive temperature rise in the alternator housing (more than 40°C above the ambient temperature)	- Air flow (intake-outlet) partially clogged or hot air is being recycled from the alternator or engine - Alternator operating at too high a voltage (> 105% of Un on load) - Alternator overloaded
Vibration	Excessive vibration	- Misalignment (coupling) - Defective mounting or play in coupling - Rotor balancing fault
	Excessive vibration and humming noise coming from the machine	- Alternator operating in single-phase mode (single-phase load or faulty contactor or installation fault) - Stator short-circuit
Abnormal noise	Alternator damaged by a significant impact, followed by humming and vibration	- System short-circuit - Mis-paralleling Possible consequences - Broken or damaged coupling - Broken or bent shaft end - Shifting and short-circuit of revolving field winding - Fan fractured or coming loose on shaft - Irreparable damage to rotating diodes or AVR

4.5 - Electrical faults

Fault	Action	Effect	Check/Cause
No voltage at no load on start-up	Connect a new battery of 4 to 12 V to terminals E- and E+, respecting the polarity, for 2 to 3 seconds	The alternator builds up and its voltage is still correct when the battery is removed.	- Lack of residual magnetism
		The alternator builds up but its voltage does not reach the rated value when the battery is removed.	- Check the connection of the voltage reference to the AVR - Faulty diodes - Armature short-circuit
		The alternator builds up but its voltage disappears when the battery is removed	- Faulty AVR - Field windings disconnected - Main field winding open circuit - check the resistance
Voltage too low	Check the drive speed	Correct speed	Check the AVR connections (AVR may be faulty) - Field windings short-circuited - Rotating diodes burnt out - Main field winding short-circuited - Check the resistance
		Speed too low	Increase the drive speed (Do not touch the AVR voltage pot. (P2) before running at the correct speed.)
Voltage too high	Adjust AVR voltage potentiometer	Adjustment ineffective	- Faulty AVR - 1 faulty diode
Voltage oscillations	Adjust AVR stability potentiometer	If no effect: try normal/fast recovery modes (ST2)	- Check the speed: possibility of cyclic irregularity - Loose connections - Faulty AVR - Speed too low when on load (or LAM set too high)
Voltage correct at no load and too low when on load (*)	Run at no load and check the voltage between E+ and E- on the AVR	Voltage between E+ and E- AREP < 10 V	- Check the speed (or LAM set too high)
		Voltage between E+ and E- AREP > 15 V	- Faulty rotating diodes - Short-circuit in the revolving field coil. Check the resistance- Faulty exciter armature
(*) Caution: For single-phase operation, check that the sensing wires coming from the AVR are correctly connected to the operating terminals			
Voltage disappears during operation (**)	Check the AVR, the surge suppressor, the rotating diodes, and replace any defective components	The voltage does not return to the rated value	- Exciter winding open circuit - Faulty exciter armature - Faulty AVR - Revolving field coil open circuit or short-circuited
(**) Caution: Internal protection may be activated (overload, open circuit, short-circuit)			

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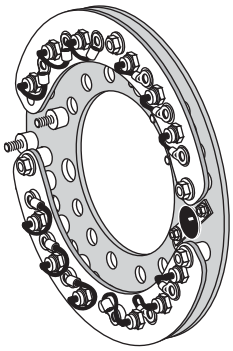
4.5.1 - Checking the winding

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

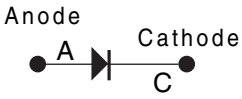
WARNING

Damage caused to the AVR in such conditions is not covered by our warranty.

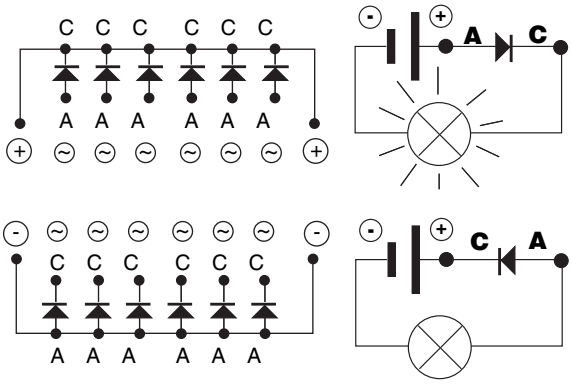
4.5.2 - Checking the diode bridge



DIODE BRIDGE



A diode in good working order should allow the current to flow only in the anode-to-cathode direction.



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.

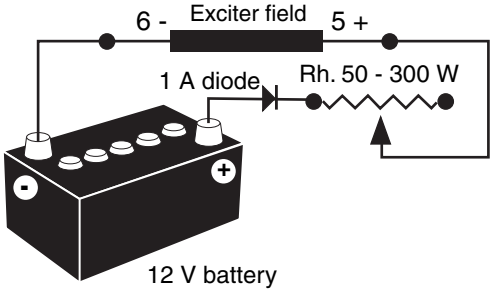
1) Stop the unit, disconnect and isolate the AVR wires.

2) There are two ways of creating an assembly with separate excitation.

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-).

CAUTION: Adapt the diode to the rated excitation current of the alternator (see nameplate).

ASSEMBLY A



Assembly B: Connect a “Variac” variable power supply and a diode bridge on both exciter field wires (5+) and (6-).

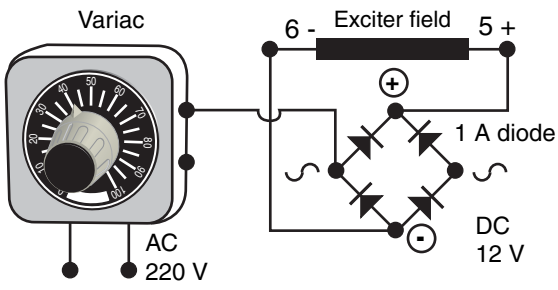
Both these systems should have characteristics which are compatible with the field excitation power of the machine (see the nameplate).

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 on load (see the 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, the machine is in good working order. The fault therefore comes from the AVR or its associated wiring (i.e. sensing, auxiliary windings).

ASSEMBLY B



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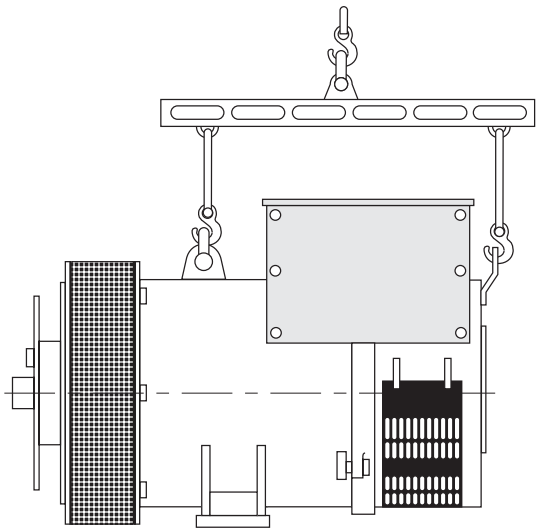
4.6 - Dismantling, reassembly

During the warranty period, this operation should only be carried out in an approved workshop or in our factory, otherwise the warranty may be invalidated.
Whilst being handled, the machine must remain horizontal.



4.6.1 - Tools required

To fully dismantle the machine, we recommend using the tools listed below:
- 1 ratchet spanner + extension
- 1 torque wrench
- 1 set of flat spanners: 8 mm, 10 mm, 18 mm
- 1 socket set: 8, 10, 13, 16, 18, 21, 24, 30 mm
- 1 puller (U35)/(U32/350)

4.6.2 - Screw tightening torque

IDENTIFICATION	Screw Ø	Torque N.m
Field screw	M6	8.3
Diode/star bridge	M6	10
Diode nut	M6	3
Flange/frame screw	M14	110
NDE shield/frame screw	M14	110
Discs/hub screw	M20	340
Earth screw	M12	35
Grille screws	M6	4
Cover screws	M6	5
Stator connection nut	M12	35

4.6.3 - Dismantling - Reassembly

4.6.3.1 - Access to diodes
- Remove the access panels (140).
- Disconnect the diodes.
- Disconnect the diodes using an ohmmeter or a battery lamp (see section 5 - 4)

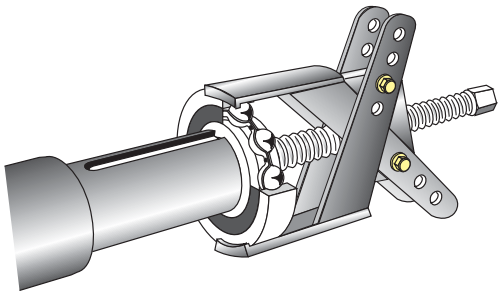
If the diodes are faulty:
- Remove the surge suppressor (347).
- Remove the 6 "H" mounting nuts for the diode bridges on the support.
- Change the fitted caps, respecting the polarity.

4.6.4 - Access to connections and the regulation system

Access by removing the terminal box lid (132).

4.6.5 - Replacing the NDE bearing

- Remove the terminal box lid (132).
- Disconnect the exciter (+ and -).
- Remove the air intake grille (50).
- Remove the cooling fan (118).
- Remove the cooling fan cover (117).
- Remove the "O" ring (249).
- Take out the inner bearing retainer screws (78).
- Remove the NDE shield (82).
- Take out the antifriction bearing (70) using a puller with a central screw (see drawing below).



- Change the "O" ring seal (349).
- Fit the new antifriction bearing after heating it by induction to approximately 80°C.

WARNING

REPLACE THE DISMANTLED BEARING WITH A NEW ONE.

4.6.6 - Replacing the DE bearing

- Remove the "O" ring (247).
- Remove the inner bearing retainer screws (68).
- Remove the DE shield (410).
- Remove the circlips (284).
- Remove the ball bearing (60) using a puller with a central screw.
- Fit the new bearing after heating it by induction to approximately 80°C.

WARNING

REPLACE THE DISMANTLED BEARING WITH A NEW ONE.

4.6.7 - Complete dismantling

-Remove the NDE bearing following the instructions in section 4.6.5.
- Remove the DE bearing following the instructions in section 4.6.6.
- Remove the access plates (140).
- Remove the grease tubes (77).
- Remove the cooling tube casing (116).
- Remove the DE base (30).
- Support the DE rotor (4) with a strap or with a support.
- Knock lightly on the shaft end on the opposite side from the coupling using a small mallet.
- Move the strap as the rotor moves in order to distribute the weight over it.

4.6.8 - Complete reassembly

- Place the "O" ring seal (349) and the preloading wavy washer (79) in the bearing seat (36).
- Mount and secure the NDE shield (82) on the NDE base (36).
- Mount the rotor (4) in the stator (1).
- Mount and secure the DE base (30).
- Refit the cooling tube casing (116).
- Refit the DE and NDE tubes (77) in the inner bearing retainers.
- Refit the access plates (140).
- Refit and secure the DE shield (410).
- Secure the inner bearing retainer (68).
- Refit the "O" ring (247).
- Refit the "O" ring (249).
- Refit and secure the fan cover (117).
- Refit the fan (118).
- Refit the air intake grille (51).
- Reconnect the exciter and close the terminal box.

4.7 - Table of characteristics

Table of average values.
Alternator - 4 poles - 50 Hz - Standard winding No. 6.
(400 V 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 to within ± 10% and may be changed without prior notification (for exact values, consult the test report).

4.7.1 - Resistances of main windings at 20°C (Ω)

Average values for 6S winding - (6 wires))

LSA 47.1	L/N stator	Rotor	Exciter	Armature
L4	0.0108	0.79	10.6	0.13
L6	0.0083	0.84	10.6	0.13

Average values for 6S winding - (12 wires)

LSA 49.1	L/N STATOR	ROTOR	Exciter	Armature
L2	0.0055	0.3	0.08	12
L4	0.0037	0.33	0.08	12
L6	0.0029	0.38	0.08	12
L7	0.0029	0.38	0.08	12

4.7.2 - Field excitation current i exc (A)

LSA 47.1	No load	At rated load
L4	0.9	3.8
L6	0.9	3.8

4.7.3 - Field excitation current i exc (A)

LSA 49.1	No load	At rated load
L2	0.8	3.7
L4	0.85	3.4
L6	0.9	3.3
L7	0.9	3.5

4.7.4 - Voltage of auxiliary windings at no load

LSA 49.1	X1, X2	Z1, Z2
50 Hz	70 V	10 V
60 Hz	85 V	12 V

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

5 - SPARE PARTS

5.1 - First maintenance parts

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

Ref.	Description	Reference LSA 47.1	Code
198	Voltage regulator (AVR)	R 448	***AEM 110 RE 005***
343	Diode assembly	LSA 471.9.07/08	***ADE 471 EQ 007*** ***ADE 471 EQ 008***
347	Surge suppressor: 250 V	LSA 461.9.01	***PEL 250 EC 002***
	Slow-blow fuse of the AVR	250 V - 10 A	***PEL 010 FA 004***
	Other spare parts		
60	Drive end bearing	6318 - C3	***RLT 090 OU 030***
70	Non drive end bearing	6315 - C3	***RLT 075 OU 030***
418	Filter element (optional)		

Ref.	Description	Reference LSA 49.1	Code
198	Voltage regulator (AVR)	R 448	***AEM 110 RE 005***
343	Diode assembly	LSA 491.9.12/13	***ADE 491 EQ 012*** ***ADE 491 EQ 013***
347	Surge suppressor: 250 V	Z 220 LP/2	***PEL 250 EC 002***
	Slow-blow fuse of the AVR	250 V - 10 A	***PEL 010 FA 004***
	Other spare parts		
60	Drive end bearing	6322 - C3	***RLT 110 OR 030***
70	Non drive end bearing	6320 - C3	***RLT 100 OR 030***
418	Filter element (optional)		

5.2 - Technical support service

Our technical support service will be pleased to provide any additional information you may require.

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

Address your enquiry to your usual contact, or to:

MOTEURS LEROY-SOMER
Usine de Sillac/Alternateurs
16015 ANGOULEME CEDEX - FRANCE
Tel.: (33) 05.45.64.45.64
Technical Support Service: (33) 05.45.64.43.69
(33) 05.45.64.43.67
Fax: (33) 05.45.64.43.24

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

5.3 - Accessories

5.3.1 - Temperature sensors with thermistors

These are thermistor triplets with a positive temperature coefficient installed in the stator winding (1 per phase). There can be a maximum of 2 triplets in the winding (at 2 levels: warning and trip) and 1 or 2 thermistors in the shields.
These sensors must be linked to adapted sensing relays (supplied optionally).
Cold resistance of cold thermistor sensors:
100 to 250 Ω per sensor.

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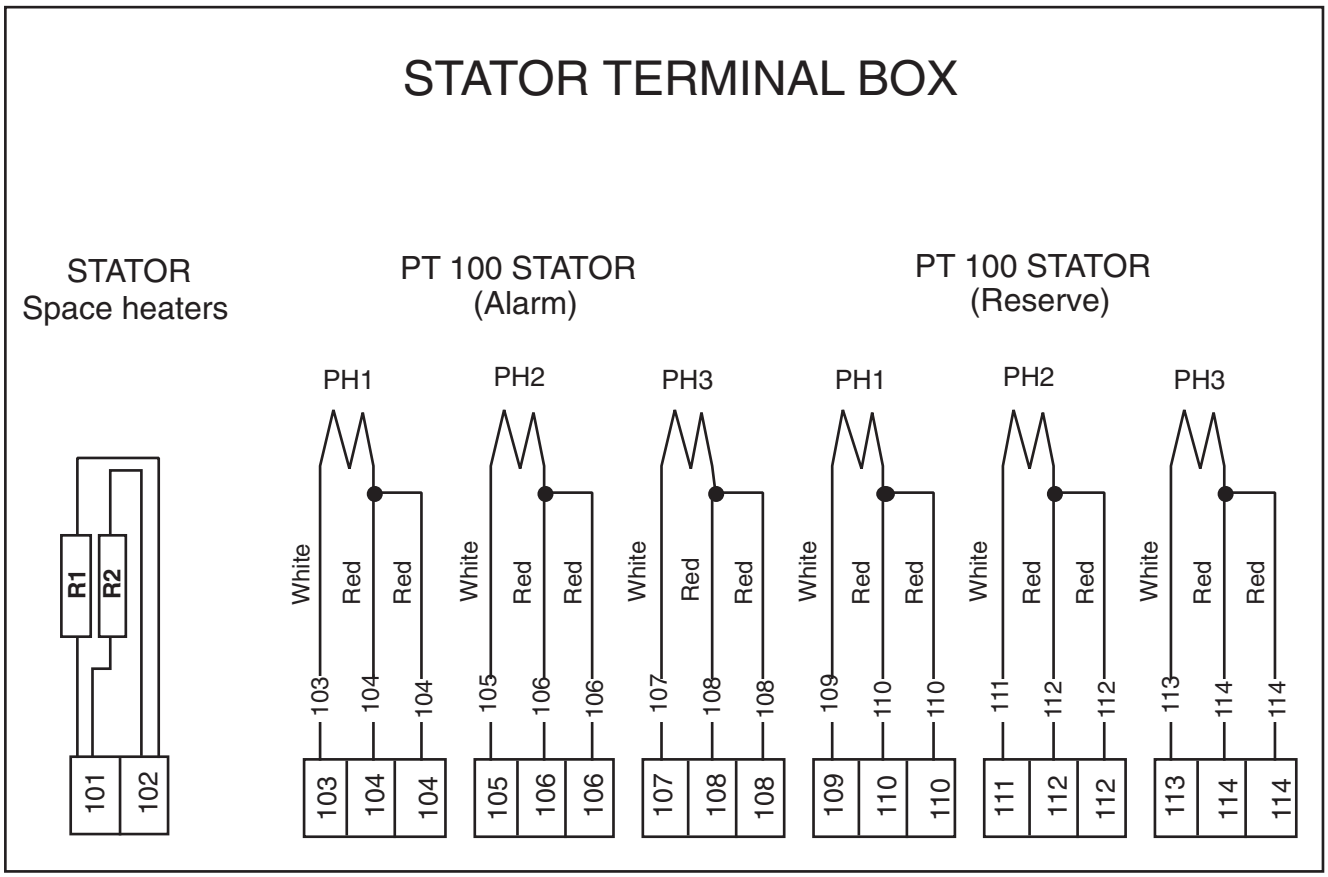
5.3.2 - Protection



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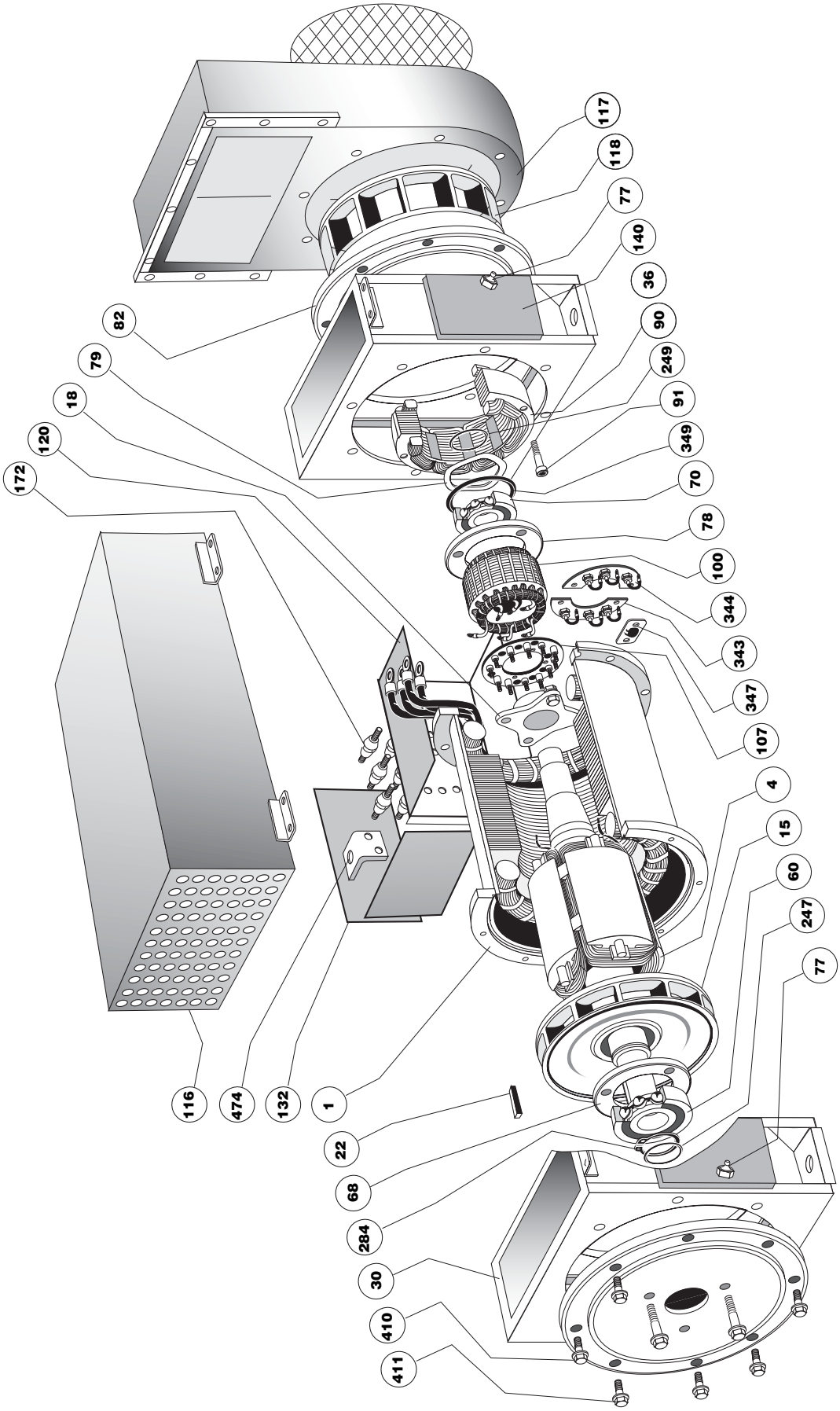
5.4 - Exploded view



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ALTERNATORS

LEROY-SOMER 16015 ANGOULÊME CEDEX - FRANCE

RCS ANGOULÊME N° B 671 820 223
S.A. au capital de 62 779 000 €

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