Low Voltage Alternators

Excitation and regulation systems

SHUNT - PMG - AREP

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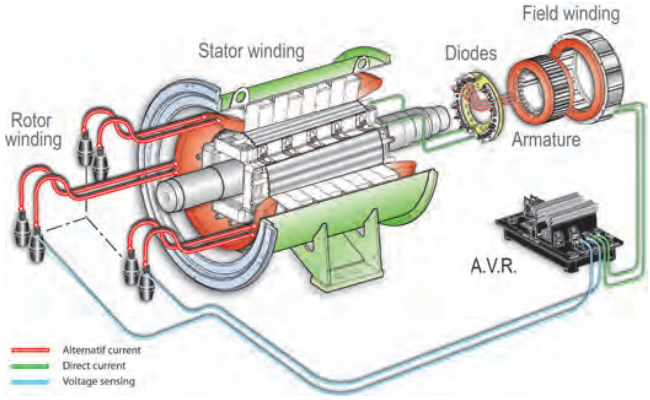
Low Volta

SHUNT excitation *for basic applications*

- The AVR power supply voltage is shunted on the alternator output terminals.
- The voltage reference is shunted on the same output terminals.
- The AVR generates and regulates the excitation current as a function of the alternator output voltage.

The SHUNT system is extremely simple in its design and is ideal for basic applications. It cannot tolerate high overloads and does not offer a short-circuit capability.

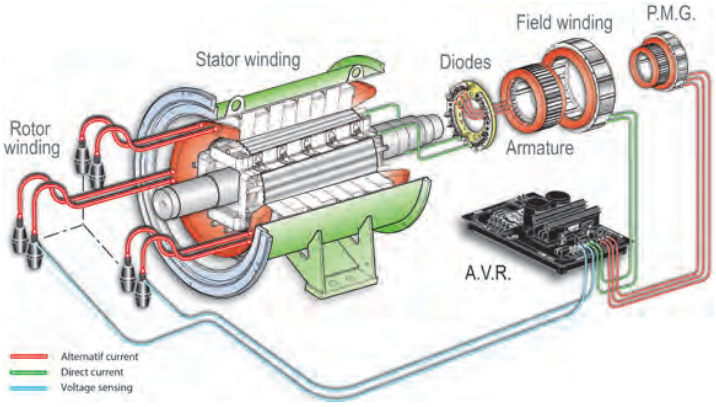


PMG excitation *for demanding applications*

The main alternator is the same design as that used with SHUNT excitation.

- The AVR power supply voltage is generated by a permanent magnet generator (PMG) which is mounted on the shaft extension behind the alternator. The PMG delivers constant voltage which is independent of the main alternator winding.
- The voltage reference is shunted on the alternator output terminals. Whatever the load, the AVR therefore delivers an excitation current suitable for this load, depending on how the voltage reference changes.

The PMG system therefore has a high overload capacity (load impact or starting electric motors) which can short-circuit (300% - 10 s) in order to provide discriminating protection: Voltage build-up is intrinsic because of the permanent magnets. It is particularly suitable for demanding applications. The PMG system improves the performance of a SHUNT system.



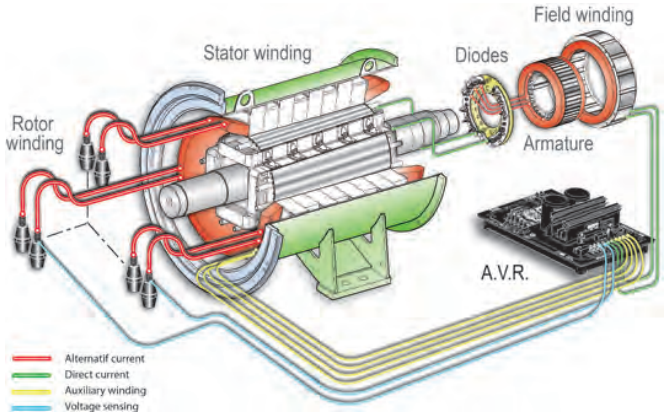
AREP excitation *for demanding applications/Patented by Leroy-Somer*

The AVR power supply voltage comes from 2 independent auxiliary windings located in the main stator:

- The voltage delivered by the first auxiliary winding H1 is proportional to the alternator output voltage (shunt characteristic).
- The voltage delivered by the second auxiliary winding H3 is proportional to the current drawn by the alternator and is a function of the applied load (compound characteristic – booster effect).
- The resulting phase-to-phase voltage supplies power to the AVR.

This power supply to the AVR power circuit is independent of the voltage sensing measured on the alternator output terminals. Therefore, the excitation current delivered by the AVR to the alternator exciter is independent of any voltage distortions (harmonics) due to the load.

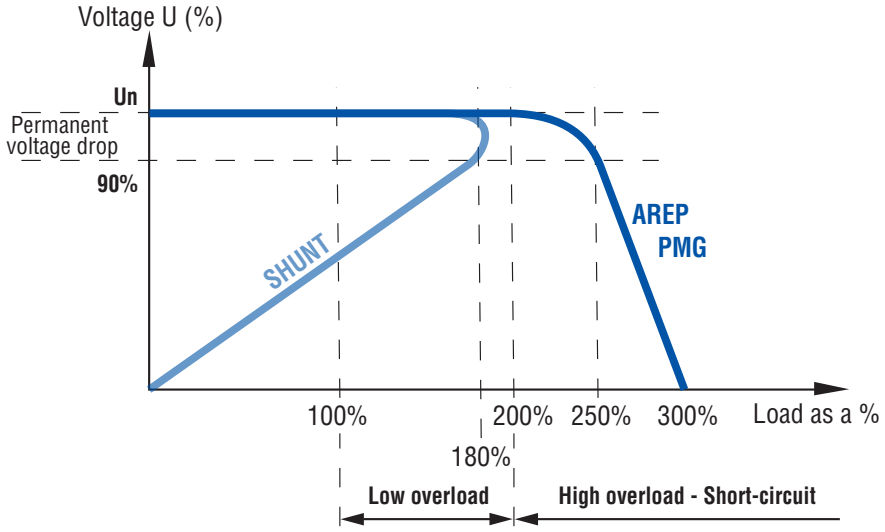
The AREP system gives the alternator a high overload capacity (load impact or starting electric motors) and a short-circuit capability (300% - 10 s) in order to provide discriminating protection: the alternator with AREP excitation is shorter than the one with PMG excitation. It is particularly suitable for demanding applications.



ge Alternators - Excitation and regulation sy

Excitation system selection chart

	SHUNT	AREP	SHUNT + PMG
Motor starting capacity	Basic	High	High
Short-circuit capability	No	300%/10 s	300%/10 s
Susceptibility to non-linear loads	Maximum	Minimum	Minimum
Number of components	Minimum	Minimum	Maximum
Possibility of conversion	Yes (PMG)	Yes (PMG)	Yes (Shunt)
Alternator length	Minimum	Minimum	Maximum
Price	€	€€	€€€
Stator design	Standard	Special	Standard
Voltage build-up	Residual magnetism (remanent)	Residual magnetism (remanent)	Permanent magnets
Applications	Basic backup Telecom	Marine, industry, construction, hospitals, banks, standard production	Marine, industry, construction, hospitals, banks, standard production
Lifetime	Optimal	Optimal	Reduced: an additional turning part



Excitation system varies depending on the type of alternator

Type of excitation	LSA alternator type range									
	40	42.3	44.3	46.3	47.2	49.3	50.2	52.3	53.1	54
SHUNT	•	•	•	•	•					
AREP	•	•	•	•	•	•	•	•	•	•
PMG		•	•	•	•	•	•	•	•	•
PMI*				option	option	option	•	•	•	•

**For better voltage build-up, permanent magnets are inserted in the the exciter poles (standard in 50.2, 52.3, 53.1 and 54).*

Analog or digital voltage AVRs depending on customer requirements

Leroy-Somer AVRs benefit from all Leroy-Somer's experience in the electronics field. They have been designed to comply with market requirements in terms of characteristics, performance, conformity with standards and reliability.

Their main characteristics are as follows:

- Simple, user-friendly user interfaces
- Power switching transistor offers an optimum response to interference generated by distorting loads
- Voltage regulation ±0.5% in steady state with rapid response time (< 500 ms)
- Optimised mechanical design for resistance to vibration and harsh environments, with coated electronic circuits
- Conformity with IEC 60034-1 and UL 508

Analog AVRs with digital regulation function

R200 range for SHUNT excitation: simplicity itself

- Single-phase voltage sensing
- Underspeed protection by U/f (R220) or U/f and LAM (R250) function

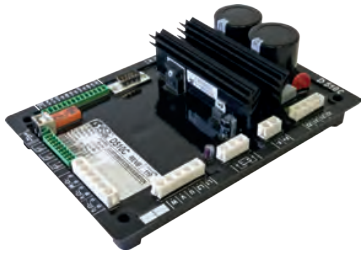
R400 range for SHUNT, PMG and AREP excitation types: performance

- Single-phase voltage sensing
- Excitation ceiling setting
- Underspeed protection by U/f and LAM function
- Parallel operation between alternators with CT
- Parallel operation with the mains with CT and R726 module
- Three-phase sensing in R450T version or with R731 module
- Overload protection with R450 version

Digital AVRs

D500 range for SHUNT, PMG and AREP excitation types: performance - communication

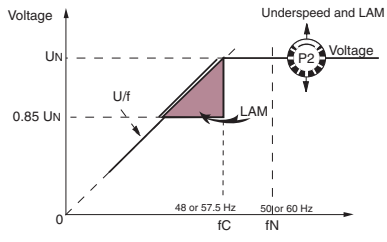
- EASYREG™ parameter-setting and supervision program with user-friendly interface
- Single-phase or three-phase voltage sensing
- Adjustable underspeed protection by adjustable U/f and LAM function
- Stator overvoltage protection
- Built-in parallel operation between alternators and with the mains
- Communication : USB serial, proprietary CAN, J1939 CAN
- Diodes detection fault



Systems that help take account of load impact/load shedding are built into Leroy-Somer AVRs

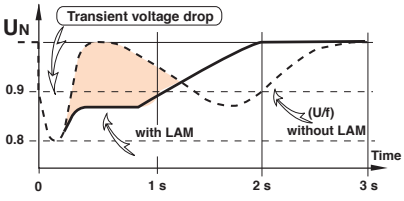
U/f function

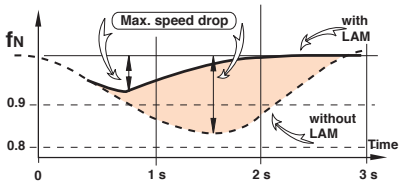
- Load impacts taken into account
- Instant response from the AVR below the underspeed threshold
- Gradual voltage return to rated voltage

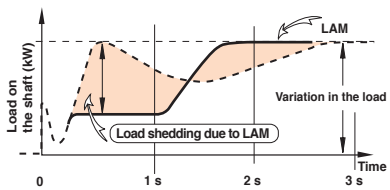


LAM function

- Load Acceptance Module
- Reduction in voltage drop and duration of speed variation of the diesel engine
- Possible increase in the applied load for the same speed variation
- Adaptive tuning LAM for load impacts > 60%







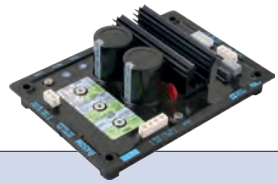
Comparison of U/f and LAM system performance

Excitation and Regulation matched for optimised performance

AVRs for SHUNT excitation

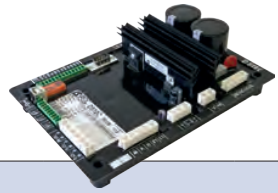
Type of AVR	LSA alternator type range									
	40	42.3	44.3	46.3	47.2	49.3	50.2	52.3	53.1	54
R220	•	•								
R250			•	•	•					
R450**		option	option	option	option					
Digital D510C***	option*	option	option	option	option					

AVRs for PMG excitation



Type of AVR	LSA alternator type range									
	40	42.3	44.3	46.3	47.2	49.3	50.2	52.3	53.1	54
R438	•	•	•							
R450**			option	•	•	•	•			
R449								•	•	•
Digital D510C***	option*	option	option	option	option	option	option	option	option	option

AVRs for AREP excitation



Type of AVR	LSA alternator type range									
	40	42.3	44.3	46.3	47.2	49.3	50.2	52.3	53.1	54
R438	•	•	•							
R450**			option	•	•	•	•			
R449								•	•	•
Digital D510C***	option*	option	option	option	option	option	option	option	option	option

*mounted externally
** R450T optional for three-phase sensing
*** parallel operation with mains included

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