Excitation Systems

10 kVA - 35,000 kVA alternators

LEROY-SOMER™

Nidec

All for dreams

REGULATORS AND EXCITATION SYSTEMS ARE AT THE HEART OF INDUSTRIAL ALTERNATORS PERFORMANCE AND RELIABILITY.

At Nidec Leroy-Somer, we design, test and qualify our electronic products to meet the challenges of power generation systems. Using our experience and field expertise, we provide regulation features that help protect installations from outage and failures, and our excitation systems are optimized to provide the best performance levels for any situation.

EXCITATION SYSTEMS

We offer different excitation systems to match application requirements. An excitation system uses the alternator output to build an excitation current that is then used to power the rotating magnetic field of the rotor. This principle allows for the control of the output power.

To build excitation current, a regulator needs both a supply voltage to provide power, and a measured reference voltage at output terminals to pilot the excitation.

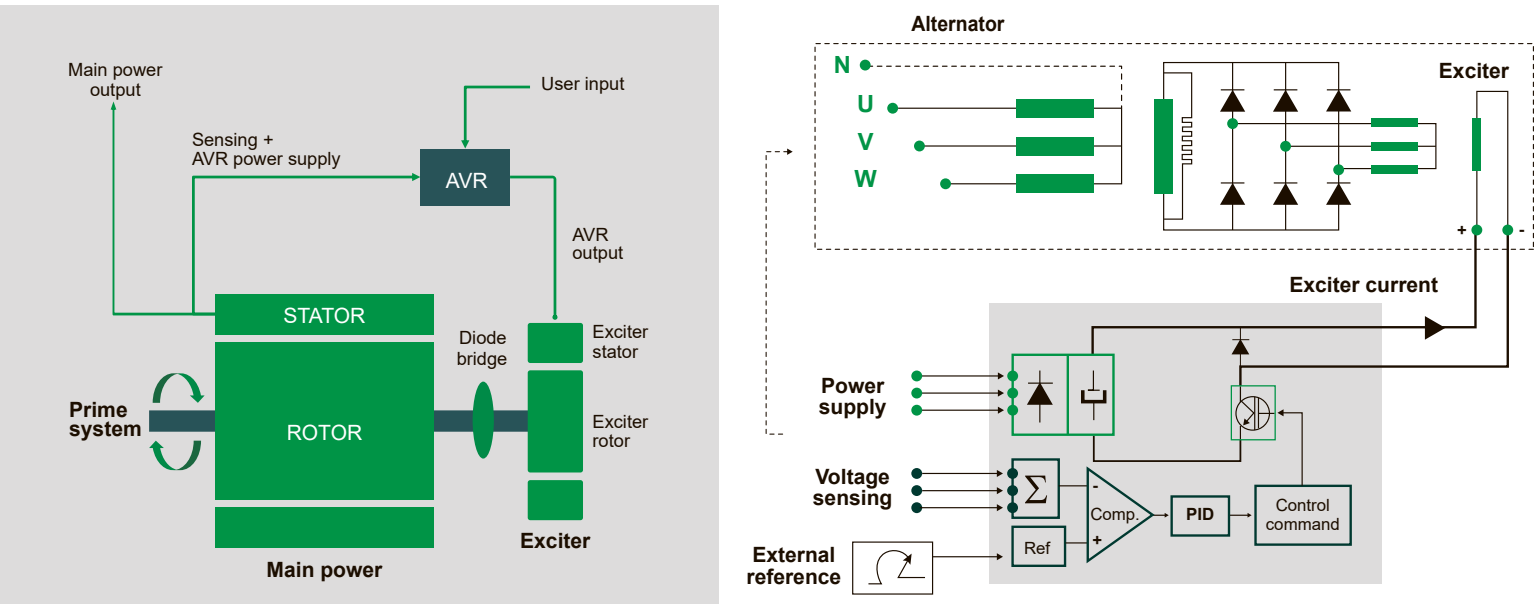


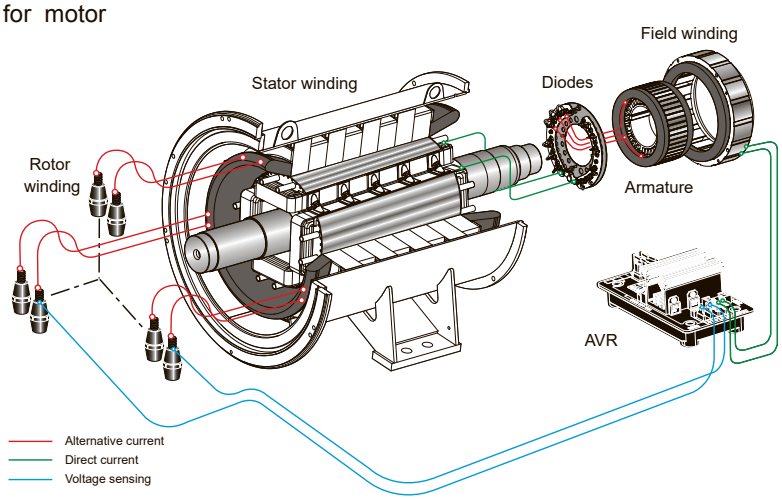
Diagram of a complete excitation system

SHUNT

In SHUNT excitation systems, the AVR power supply and voltage reference are picked 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 standard applications. AREP or PMG systems are more relevant for demanding situations where short circuit currents are anticipated (for example for motor start-up).

The SHUNT excitation system can also be completed by a booster system for larger installations to allow for short circuit capability. In this situation, current transformers are added in the terminal box to increase supply voltage range. This solution is not always possible and adds an extra cost due to the transformers purchase & installation.

COMPACT ECONOMIC



AREP+

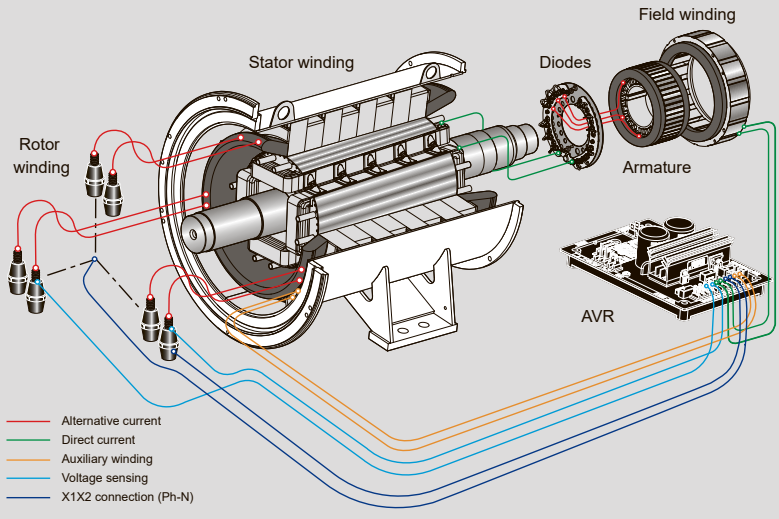
The AREP+ system uses the output voltage of the main stator as supply voltage and a single auxiliary winding inserted in selected slots of the main stator for booster effect. The combination of these two sources is then used to power the regulator, thus combining the power of a traditional SHUNT system with the reliability and control level of an AREP system. Under the same conditions, more power is taken to supply the regulator, which improves the excitation capabilities.

The AREP+ system improves the electrical performance of equipped machines, especially during transient short circuit, load shedding or load impact phases.

As a result, the starting kVA performances are improved by up to 30% depending on generator model (vs a standard AREP system). This level of performance is decisive when generators are used to start electric motors.

COMPACT SHORT CIRCUIT

TRANSIENT



AREP

In AREP excitation systems, the AVR power supply comes from two separate auxiliary windings. 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 (booster effect).

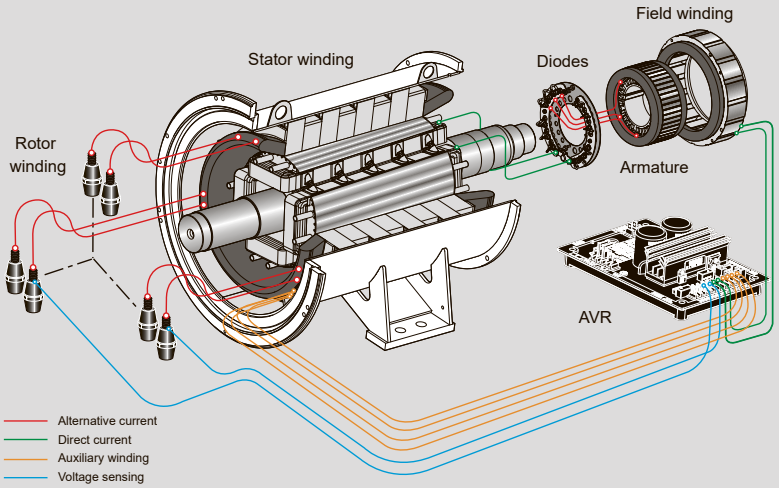
The power supply to the AVR power circuit is independent from the voltage sensing measured on the alternator output terminals.

Therefore, the excitation current delivered by the AVR to the alternator exciter is not affected by any voltage distortions (harmonics) due to the load. The AREP system gives the alternator a high short circuit capability for LSA range: 300% - 10 s.

COMPACT

SHORT CIRCUIT

TRANSIENT



PMG

In PMG excitation systems, the AVR power supply voltage is generated by a permanent magnet generator (PMG) that is mounted on the shaft extension at the non-drive end of the alternator. The PMG delivers a constant voltage, regardless of the main alternator winding. PMG systems have high overload and short circuit (for LSA range: 300% - 10 s) capacities.

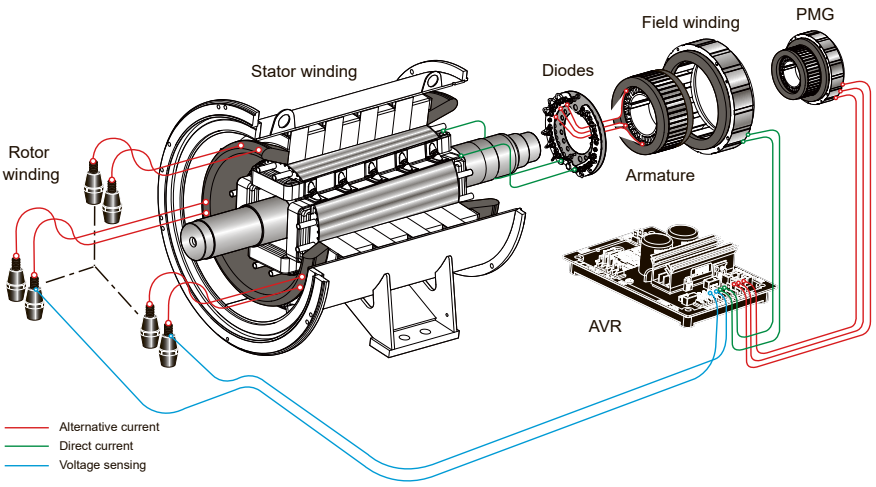
The permanent magnets used in the PMG ensure enough remanent magnetism and secure the system startup, even after long shut-down periods. Because it is external to the alternator system, a PMG can be installed on an existing machine (SHUNT or AREP) when required.

As an alternative to PMG, the SHUNT, AREP or AREP+ systems can be completed with permanent magnets inserts (PMI). In this case, permanent magnets are mounted on the exciter stator poles.

RETROFIT

SHORT CIRCUIT

TRANSIENT

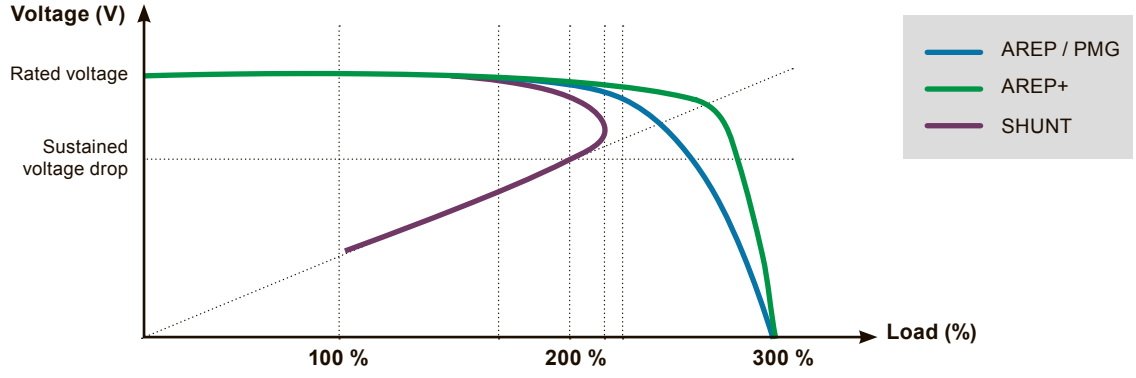


EXCITATION SYSTEMS COMPARISON

	SHUNT	AREP+	AREP	PMG
Transient performances		~	~	~
Short circuit performances		⚡	⚡	⚡
Non-linear loads		*	*	*
Voltage build-up	Residual	Residual	Residual	Perm. Magnets
Footprint	Small	Small	Small	Important
Conversion	To PMG	To PMG	To PMG	To SHUNT / AREP
Cost	$	$$	$$	$$

EXCITATION SYSTEMS SHORT CIRCUIT PERFORMANCES COMPARISON

The graph below illustrates the compared performance of SHUNT, AREP, AREP+ and PMG excitation systems in short circuit current situations.



AVR RANGE & FEATURES

AVR MODEL	D350	D550	D700	R120	R150	R180	R220	R250
Technology		Digital				Analog		
SHUNT	✓	✓	✓	✓	✓		✓	✓
AREP / AREP+	✓	✓	✓			✓		
PMG	✓	✓	✓			✓		
Rated excitation current (A, 55°C)	5	8	20	4	6	6	3.2	5
Regulation accuracy (+/- %)	0.25	0.25	0.25	1	0.8	0.5	0.5	0.5
Voltage setting range (+/-%)	30	30	30	10	10	5	5	5
Paralleling between gensets (droop)	✓	✓	✓		✓	✓		
Three-phase sensing	✓	✓	✓					
LAM	✓	✓	✓					✓
Over-excitation limitation	✓	✓	✓	✓	✓			
Short circuit current limitation	✓	✓	✓					
Grid paralleling (PF / kVAr)		✓	✓					

OUR RANGE OF PRODUCTS

LSA RANGE

	LSA 40	LSA 42.3	LSA 44.3	LSA 46.3	LSA 47.3	LSA 49.3	LSA 50.2
SHUNT	R220			R250		-	-
AREP / PMG	D350						

	LSA 52.3	LSA 53.2	LSA 54.2	LSA 56	LSA 58	LSA 60	LSA 62
SHUNT	D550			D700			
AREP / PMG							

TAL RANGE

	TAL 040	TAL 042	TAL 044	TAL 046	TAL 0473	TAL 049
SHUNT	R120			R150		
AREP+ / PMG	R180					


R120


R150


R180


D350


D550


D700

The regulator model can change according to specific options (UL, remote potentiometer, 1-phase) or specific requirements. Please consult our catalogs & rating tables for details.

REGULATION FEATURES

PID

PID is the regulation system function which combines different rules (Proportional, Integral, Derivative) to stabilize the current produced by the alternator. Tuning this function allows to optimize the response time of the system to reach the voltage set point, or to stabilize it quickly in case of fluctuations. It is an essential component of any regulation system.

U/f function

U/f is a function designed to handle underspeed situations. It allows to adapt the alternator voltage according to the rotation speed of the prime mover. If the system speed is lower than the nominal speed, the alternator voltage is reduced. This prevents saturation in the excitation system and protects the alternator rotor from any damage.

LAM function

The LAM (Load Acceptance Module) is a function that adapts the alternator voltage according to the rotation speed of the prime mover. It is triggered in the event of a load impact. The LAM considerably reduces the alternator voltage which results in decreased power demand on the prime mover.

As the speed climbs back to normal, the alternator voltage re-established.

Three-phase sensing

The regulator needs voltage measurement in order to maintain the voltage on the alternator output terminals. Three phases sensing means that voltage detection and measurement is done on all three phases of the alternator, which allows to regulate the average voltage. This means that regulation is more precise and safer.

Short circuit current limitation

The short circuit current limitation is triggered during short circuits. It is adjusted on the regulator and allows to limit the delivered current during 10 seconds maximum. This prevents the alternator from getting damaged by a too strong current.

Active & Reactive reverse power alarm

These functions are only possible if you use a D550 or a D700 regulator. A wired current transformer is necessary to calculate the active and reactive powers. In this case, the regulator will be able to control it.

The active reverse power occurs on the machines paralleled with other machines or a network. The active power on the alternator's output terminals must always be positive. A negative power means that the alternator starts to act as an electric motor, which can fatally damage the prime mover. The active reverse power allows to disconnect the alternator from the network to avoid the failure.

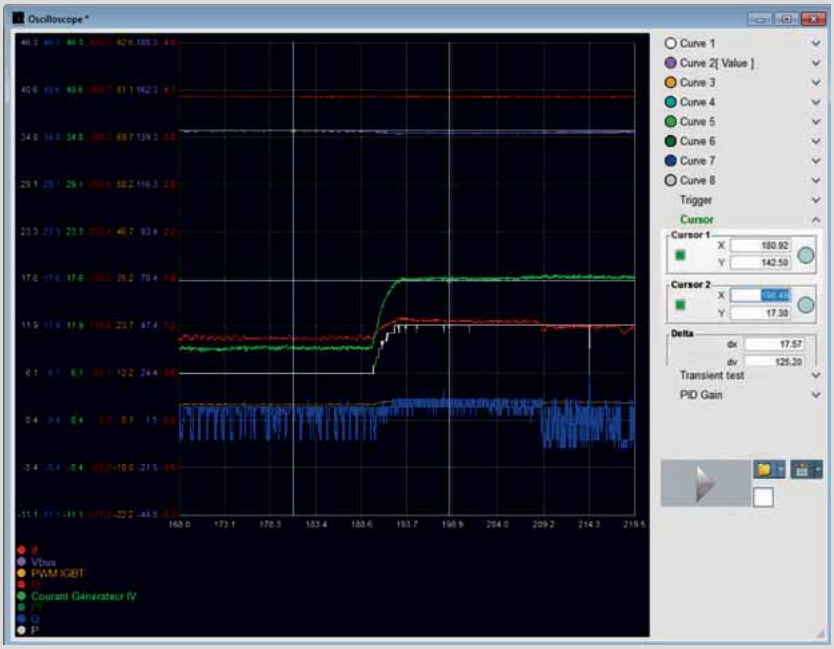
An absorption of reactive power deenergizes the alternator and thus reduces the magnetic flux between the rotor and the stator. Too much absorption may cause pole slipping, which can severely damage not only the alternator, but also the mechanical coupling with the drive system. The reverse reactive power alert will also disconnect the alternator from the network in this situation.

EASYREG ADVANCED

EasyReg Advanced is the dedicated software to configure and monitor our digital Automatic Voltage Regulators (AVR). It is compatible with the D350, D550 and D700.

EasyReg Advanced includes a complete set of tools:

- Step-by-step configuration of the alternator parameters, regulation modes, limits, wiring, PID, I/O and protection devices
- Monitoring and analysis tools, including an oscilloscope, a monitoring panel, and harmonic analysis
- Grid code protection parameters definition and synchronization parameters for grid paralleling



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4124 en - 2022.06 / i