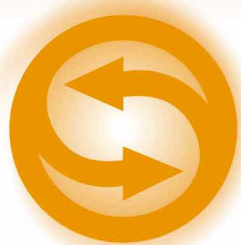


# APPLICATION NOTE

- **Permanent magnets technology advantages**
- **What's an alternator?**
- **The electronic regulator. How does it work?**
- **How to install SAPRISA alternators**



**SAPRISA**



SAPRISA

The alternator is the part responsible of supplying the required electrical current in a machine.

There are several applicable technologies and configurations depending on the system needs.

In the other hand, the regulator is the electronic equipment responsible of rectifying the AC current generated by the alternator and regulating its flux towards the system.

The SAPRISA alternators are based in permanent magnets technology, with the advantages that it means:

- Without brushes nor maintenance,
- Reduced size,
- Ideal for adverse environmental conditions (no sparks).

## The alternator

The alternator is made up of two different parts: the stator and the rotor.

The stator is the fixed part in the equipment, consisting in a series of coils wound around a magnetic core. Depending on the electrical configuration it can be wound in opposition, in double wave, in three-phase or in series.

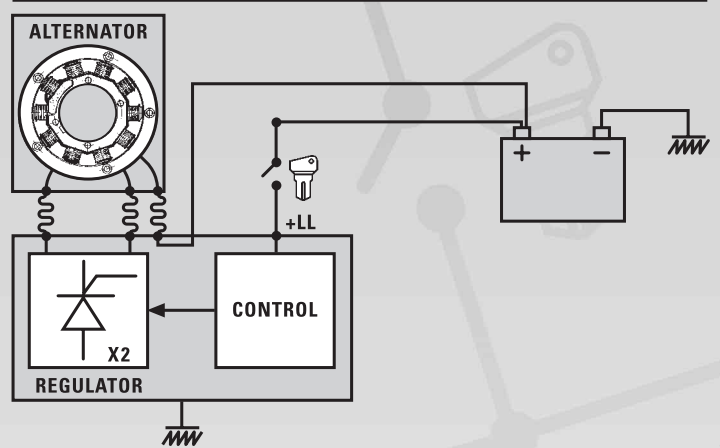
The rotor is the mobile part of the alternator. It hosts the magnets that generate the magnetic energy that, with the engine rotation, induce the electrical current through the windings.

SAPRISA products cover a wide range of requirements with different possible configurations regarding the stator winding and the mechanical structure.

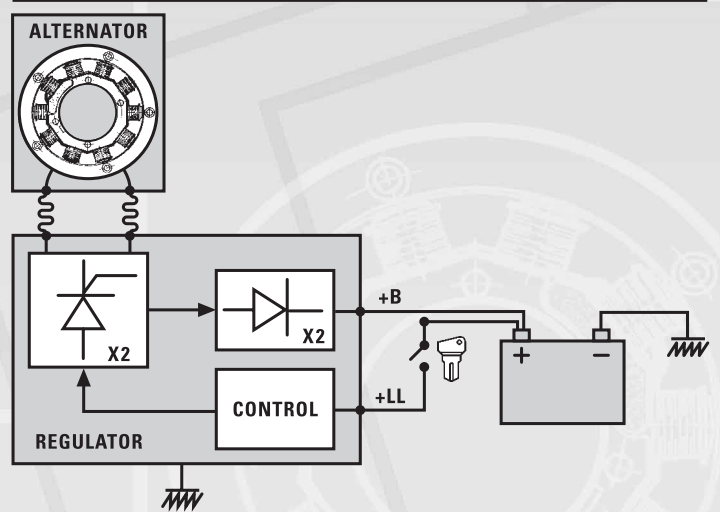
Depending on the type of winding the alternator performance will be different:

1. Opposition Installations - The coils are wined in such a way that the voltage in each one of the two groups of inductors presents opposite sign. The main advantage of this kind of alternator is that the regulation can be done with only two diodes, leading to a cost reduction of the complete equipment.
2. Double Wave Installations - The two groups of coils are connected in parallel, with the corresponding improvement from the power level point of view. In this case the regulation will require four diodes.
3. Three-phase Installations - To achieve maximum power levels the stator is wined in three groups of coils connected in a star configuration. Three-phase regulation requires 6 diodes.

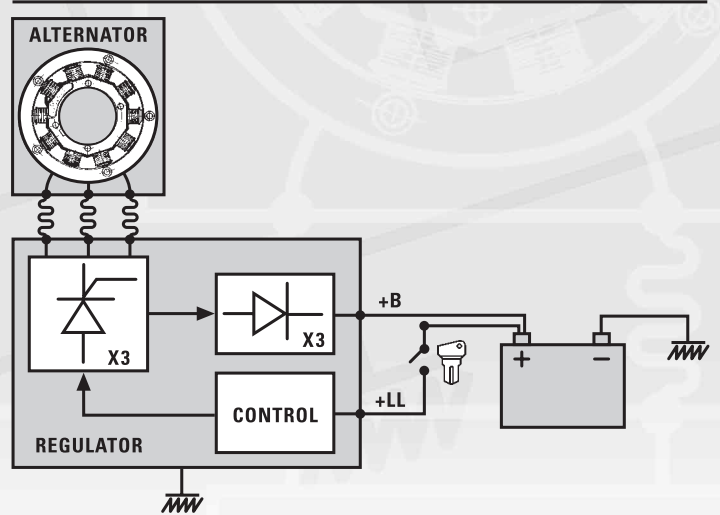
### OPS



### DO



### TRF



### AC

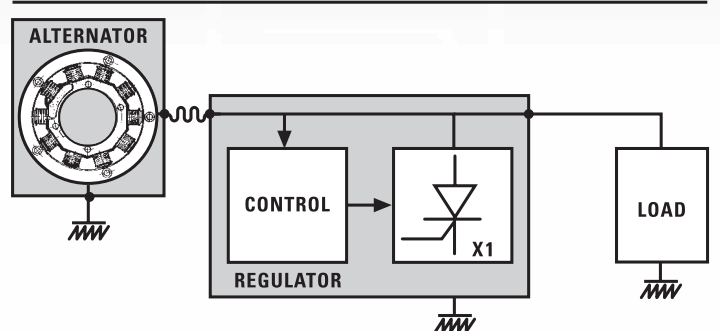


FIGURE 1



SAPRISA

4. Serial Installations - The coils are connected in series, leading to a flatter response in the curve current vs rpm. Are specially appropriated for systems with no battery.

All these electrical configurations can be implemented in 8, 10 and 12 poles alternators for flywheel applications.

A key advantage of SAPRISA alternators is its capability to satisfy several requirements with products of the same family and mechanically compatible.

Complementarily, SAPRISA PULLEY series is the best solution for compact size external alternators.

## The electronic voltage regulator

The regulator controls the energy supply according to the system demands, monitoring the voltage.

In the regulator, the device responsible of performing all these functions is the thyristor. The regulator generates a control signal that applied on the thyristor gate, controls the current through the device.

In figure 1 the block diagrams for battery charging and AC regulators are shown.

## SAPRISA regulators for battery charging

As shown in previous figures, if the voltage value in the switching key terminal ("LL") is lower than the reference voltage the thyristors switch ON, allowing the current flux from the alternator to the battery (charge). When the reference voltage is reached the thyristors switch OFF, blocking the current (regulation).

Figure 2 presents SAPRISA regulators typical behaviour under different temperature and charge conditions.

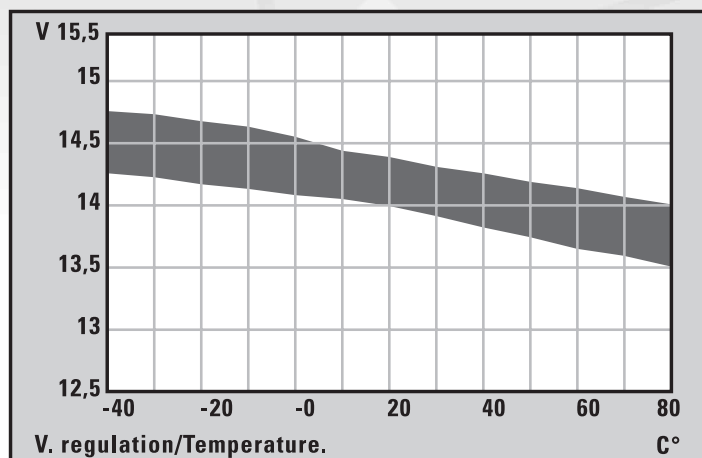


FIGURE 2-A

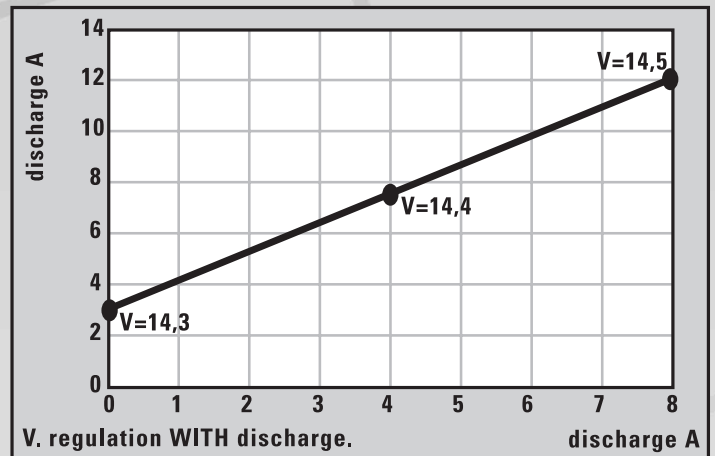


FIGURE 2-B

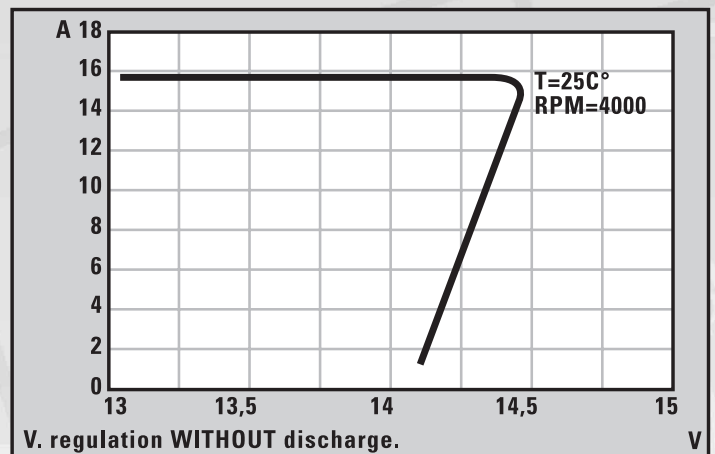


FIGURE 2-C

## Battery charge warning light

The SAPRISA regulators offer the option of the alternator charge warning light.

The circuit that generates the signal is presented in figure 3.

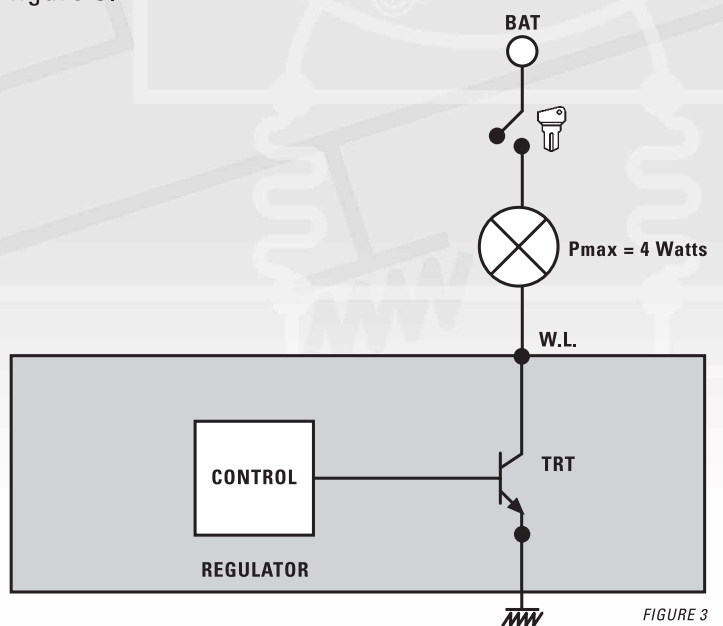


FIGURE 3

The transistor is switched ON by means of a control circuit when the charging current to the battery is lower than a reference value. The plot in figure 4



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## PERMANENT MAGNETS ALTERNATORS

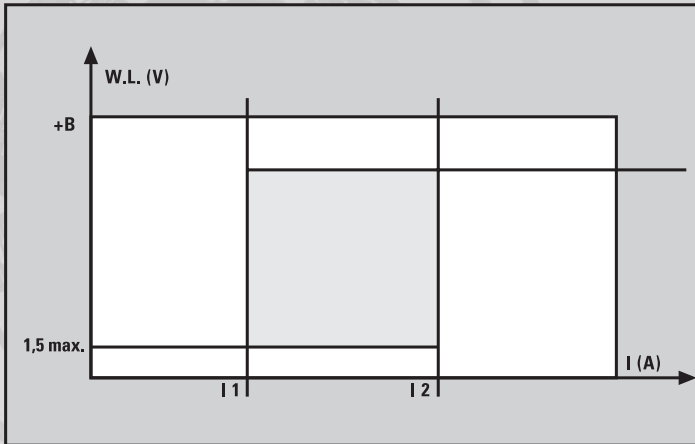


FIGURE 4

presents the circuit response with respect to the charging current. It must be taken into account that this plot depends on the alternator model, battery charge level,... Therefore, it is not recommended to use this signal to control automatism.

It must be highlighted the following points:

- The warning light bulb cannot exceed 4 W power consumption,
- The circuit is protected against short circuits and voltage peaks.

### Regulator "W" terminal

Another option of SAPRISA regulators is the frequency signal terminal ("W") to drive tachometers or

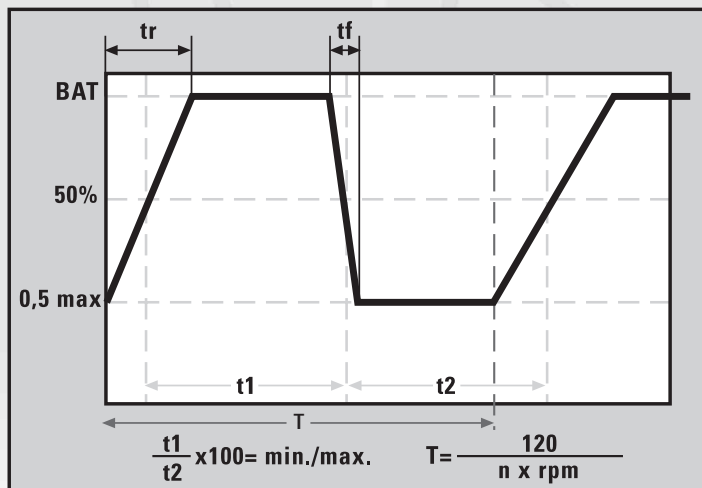


FIGURE 5

automatism (See SAPRISA control panels and instrumentation). When open circuited the "W" terminal voltage presents a wave form as per figure 5.

The signal frequency is proportional to the engine speed according to the expression in figure 5, where n is the number of poles and rpm is the engine speed.

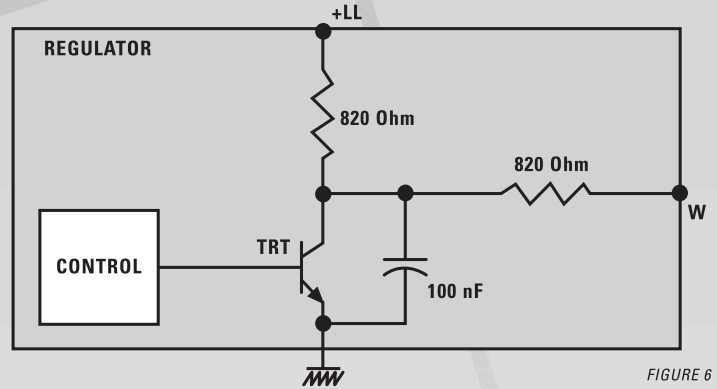


FIGURE 6

The circuit responsible of generating such a signal is shown in figure 6.

### SAPRISA AC regulators

These regulators, used with some kind of alternators, permit having installations (i.e: bulbs) with regulated voltage and without battery.

### Installation main characteristics

This kind of system particular working characteristics make advisable to take into account a series of aspects:

- The alternator terminals voltage depends very much on the alternator type and its working mode, existing the possibility of presenting peak voltages higher than 100 V.
- Switching key terminal ("LL") voltage must correspond to the battery voltage. If there is a voltage fall between both points due to any bad contact or connection, there will be an improper regulation that could cause a battery overvoltage.
- If the regulator is mounted with the case ground isolated, a connection with a proper section wire is required. It must be remarked that the current through the negative terminal is the same than through the positive one and, therefore, the wire sections of both connections must be appropriated.

### Installation cautions

Although SAPRISA regulators are characterised by its roughness and protections, some installation cautions are advisable:

- To guarantee proper wiring, the use of SAPRISA connectors is recommended.
- In case of battery bad conditions, system overvoltages can be detected.
- In case of disconnecting the battery with the engine ON, the installation could be damaged.
- To guarantee a proper thermal dissipation, the regulator must be mounted on a metallic, flat surface, assuring that the temperature in the regulator thermal control point ("T" in SAPRISA drawings) is lower than 75°C.