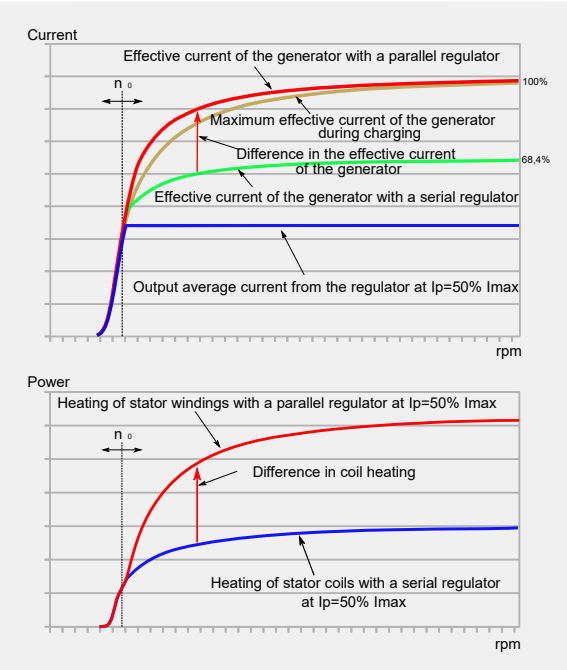
Theoretical comparison of the use of parallel and serial regulators

The question is often asked, what is the advantage of the serial thyristor-diode rectifier compared to the classic parallel (factory) regulator? It is clear that the series regulator reduces the generator current because there is no short circuit current that the parallel regulator does.

In particular, we can show how the generator current and the heating of the stator winding depend on a given consumption in the amount of 50% of the maximum current for a single-phase full-wave regulator.



In the diagram above, the output mean current (blue) is given. The series regulator produces effective current in the generator (green). The rms current of the generator and the mean output current differ in amount. Since when the possible current from the charging generator (olive) exceeds the consumption current, it flows in periodic pulses, its effective value increases the stronger the current (although the pulse width is smaller). This also affects the heating of the stator winding. It is possible that using a measuring instrument that does not calculate the effective value will show data more similar to the average output current.

The diagram below shows the heating of the coil. Blue is the serial regulator. According to the diagram, it can be seen that when the series regulator starts to pulse rectify in order to maintain the required average output current, then there is a favorable effect for the coils and for the specific consumption current, it limits the heating to half.

Unlike the series regulator, the parallel regulator in this case (the output mean current is 50% of the maximum charge current) even boosts the generator current to higher than the one the generator gives when charging (how much the red curve is higher than the olive one). This is the result of a generator short circuit when the generator supplies more current than necessary. In a short circuit, the current from the generator increases because the closing voltage is lower than when charging. This is most visible when the voltage from the generator is lower and the influence of the low closing voltage has a greater impact. At high generator voltages, the current of the generator during charging and short circuit almost meet. The coil heating diagram below shows how the parallel regulator (with 50% default consumption) heats the coils twice as much.

Conclusion:

- The use of a series regulator has a beneficial effect on **reducing the heating of the generator winding** . In this view of about 50%. The effective current in the generator

decreases by about 30% (from the red vertical arrow towards higher revolutions). Reducing consumption has a favorable effect on the engine, allowing it to accelerate faster and consume less fuel. Less heating of the generator winding reduces the risk of burnout, i.e. increases the duration.

- Reducing the heating of the stator winding also **reduces the oil temperature, and thus the engine temperature**. According to the driver's experience, the ignition of the cooling fan may be less frequent and shorter. Which means that the engine better tolerates higher air temperatures.
- The reduction of the effective current also affects **the reduced heating of the connector and wires of the generator** towards the regulator and the **reduction of the heating of the regulator itself**.
- The overall reduction in losses (reduction in the conversion of energy into heat) **reduces fuel consumption and allows more power to be transferred to the wheels.** According to an approximate calculation, a saving of 150W results in a consumption reduction of 10 euro cents per hour. The **serial regulator pays for itself**. For only 1,390 hours of driving, the investment in a series-parallel regulator (HVSP) is completely worth it.

An additional conclusion that can be seen from the diagram is that a high number of revolutions of the motor enables high effective currents and that then the winding or regulator failure is most likely. Unlike a parallel regulator, the series regulator heats less (because a smaller effective current flows through it) and can completely stop working in case of overheating (if it has a thermal sensor - all serial SPER regulators have one), and the generator winding is loaded much less.

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