Technical Tip: **On-board electronics**

Voltage regulator – precise control of the excitation current

Generators in modern vehicles have developed over the years into complex mini power plants. To ensure optimal voltage supply for the on-board electronics, precise control of the excitation current is required.

The generator, formerly also called the “dynamo,” supplies electrical consumers in the vehicle with power while the engine is running. In the past, this primarily concerned ignition, heating, or lighting, but today it is a wide range of electrical—and especially electronic—components and control units that require a stable voltage supply.

In the generator, the magnetic field required to produce electricity is generated by an electrical excitation coil. This makes it possible to keep the output voltage load constant across the entire engine speed range.

In addition to the electrical load, temperature plays a crucial role in the precise regulation of the excitation voltage. The generator’s output voltage is controlled within a temperature-dependent tolerance range—around 14 V for 12 V battery systems in passenger vehicles, and correspondingly around 28 V for 24 V electrical systems in commercial vehicles.

At colder temperatures, the voltage is regulated higher to optimally charge the vehicle battery—for example, during winter. Conversely, at higher temperatures, the voltage is regulated lower to protect the battery and prevent overcharging.

Fuel consumption and the associated emissions are also directly linked to the regulation of the generator voltage. By adjusting the excitation voltage to the current operating conditions—such as ambient temperature, engine load, electrical consumers, etc.—the power demand of the generator can be reduced to the minimum necessary, keeping additional fuel consumption as low as possible.

This requires close integration of the generator control with the engine management system to respond directly to various engine load phases. For example, the generator can be deactivated for a certain period during the start-up phase until the engine operation has stabilized. Accordingly, the generator voltage can be gradually readjusted during operation as electrical loads are switched on, allowing the engine to adapt to the additionally required torque.

In addition to purely electrical signal transmission, modern regulator modules are increasingly connected to the engine control system via digital interface protocols such as BSS or LIN. This allows specific parameters, such as engine speed, to be transmitted directly, enabling the voltage regulator to respond immediately to rapid load changes and, for example, reduce power losses by lowering the generator voltage.

As an exposed component on the generator, the regulator is subject to particular challenges. Especially in the cold season, the constant fluctuation between high operating temperatures in the engine compartment and low outside temperatures or cold splash water places great stress on it, negatively affecting the lifespan of the electronic components. During the refurbishment of a generator, the regulator can therefore be replaced or its service life extended, for example, by installing new slip rings (carbon brushes).

This practical tip was provided by:

IKA Industrie- und Kraftfahrzeugausrüstung GmbH

Humboldtstraße 8
53639
Königswinter

www.ika-germany.de
sales@ika-germany.de

Kompetenz imAbgasstrang