Multi-Function Regulators (MFR)

General

Due to ever-higher electrical power requirements, particularly efficient and powerful alternators and regulators are required. These should have the facility for consumer and battery management. For this reason, hybrid regulators are increasingly being replaced by monolithic regulators, so-called multi-function regulators.

Function

Multi-function regulators offer the following additional functions:

- Battery monitoring (sensing)
- Capacity monitoring
- Fault diagnosis
- Support of engine management
- Load control (load response)

Detailed functional description:

In the case of battery monitoring, the charging voltage of the battery is monitored via the connection “S”, which as a rule is connected directly to the battery positive terminal. The direction connection to the battery has the advantage that the voltage difference present between alternator “+” and battery “+” is taken into consideration. The charging voltage can therefore be adapted even better to the battery voltage.

With load control, it is possible to control the power of the alternator during starting and with the engine running. This means that during starting and directly after the engine starts, the alternator does not output any current. This prevents starting being prolonged due to the full power (braking moment) of the alternator. If, when driving, increased requirements, and therefore an increase of the torque on the alternator, arise, these are not passed on directly to the engine. Load control is used to increase slowly the power

output of the alternator.
The multi-function regulator also controls the pre-excitation current. After the ignition is switched on, the regulator output stage starts to cycle at the set pulse-duty factor. The alternator receives the information that the ignition is switched on via the connection terminal “L”. In relation to this, the alternator control lamp remains switched on for as long as the pre-excitation is active. Evaluation of the phase voltage is used to determine that the alternator is turning. If pre-excitation is missing, e.g. due to a defective plug-contact, excitation of the alternator is guaranteed by emergency running.
With the ignition switched off, the switching-off of quiescent current is used to reduce as far as possible the current consumption of the regulator.
If the battery-monitoring cable to battery “+” is disconnected, “emergency regulation” takes place via the “B+” connection on the alternator. To protect the regulator from overheating, the temperature is measured on the IC. If the temperature increases too much, the regulator voltage is reduced.
Connections on the multi-function regulator:
“L” = The “L” connection has several functions. The “L” connection is used to display the alternator function and faults that have occurred. The control lamp is triggered via the light output stage. Likewise, consumers, which should not be switched on until the alternator has reached full power with trouble-free operation, can be switched on in addition via a relay output stage. For this, the connection “L” makes an output current available via the relay output stage. For fault detection, all signals are constantly evaluated by the regulator, and faults arising are detected. The display of a fault takes place by switching on the control lamp by means of the light output stage.
The light and relay output stages are protected against overload and short-circuits. In relation to this, the light output stage is active during alternator pre-excitation or in the case of a detected fault. The relay output stage for additional switching-on of the consumers is active during trouble-free

alternator operation, if the lamp output stage is inactive.
“S” = The “S” connection is connected directly to battery “+” in order to measure the battery voltage as an actual value.
“DFM” = The “DFM” (DF-Monitor) connection allows the current capacity state of the alternator to be recorded. Through this, it is possible to react to certain situations, such as an increase in idle speed, or the switching-off of consumers that are not required. The signal course of “DF” can be tapped at the “DFM” connection.
“W” = At the “W” connection, there is the possibility to tap the voltage signal of an alternator phase.

Effects of failure

Failure of the multi-function regulator can have the following effects:

- Illumination of the alternator control lamp
- Discharged battery

Failure can be attributed to different causes:

- Interrupted output stage
- Overvoltage in the vehicle electric system
- Charging cable interrupted
- Battery-monitoring cable interrupted
- Fault in/on the alternator (broken drive belt, short-circuit in the excitation circuit)

Depending on the type of regulator, these faults are detected by the multi-function regulator.

Troubleshooting

The following points should be taken into consideration when troubleshooting:
Visual inspection

- Check that all cable connections and plug-contacts are laid correctly and contacted correctly.
- Check that the tension of the alternator belt is correct,

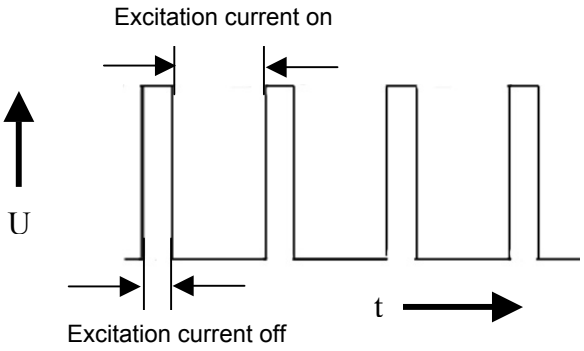
and check it for cracks.

Measuring the alternator voltage

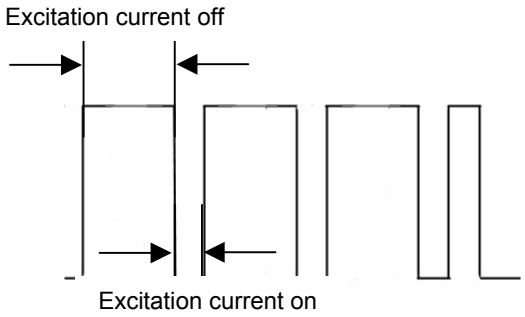
- Measurement of the alternator voltage/alternator current on the battery (observe manufacturer's data, differences between manufacturers). Carry out measurement at idle speed and increased engine speed, without and with consumers switched on in addition.

Checking the signal at the regulator connection "DFM"

- Use an oscilloscope to record the signal at the DFM connection. The signal represented reflects the pulse-duty factor of the excitation current. The pulse-duty factor must change according to the load state of the alternator.



Alternator under load



Alternator not under load