

External alternator control units

As vehicle electric systems become more and more complex, simple alternator regulation is usually no longer sufficient. For this reason, some vehicle manufacturers (e.g. Ford, BMW, Mazda, Peugeot) have integrated so-called intelligent alternator control units in their charging systems.

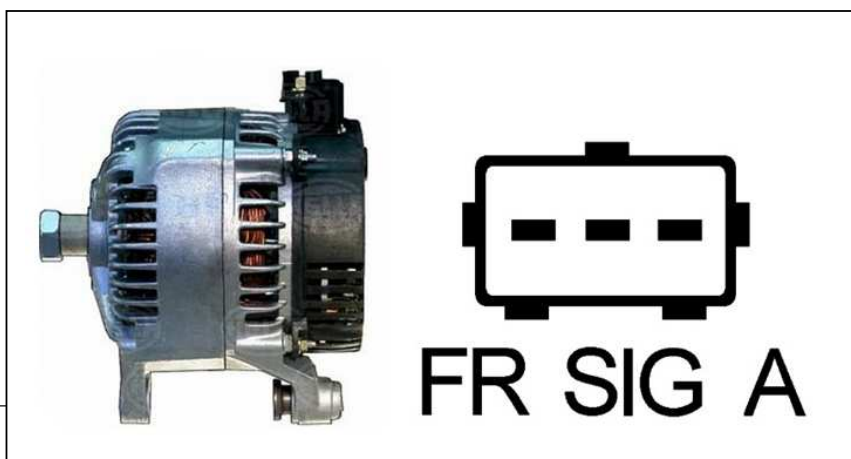
Whereas in a conventional alternator, the built-in control unit determines the alternator rated voltage, this task is taken over by the engine control unit with these new systems. The function is explained below using a system built into a Ford vehicle as an example.

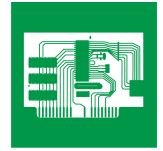
Ford “Smart Charge” alternator control

The alternator built into this system does not look significantly different than conventional alternators. In this case, there is also a voltage controller on the rear of the alternator (fig.). This controller is connected to the engine control unit (PCM) by means of two signal cables. Pulse-width modulated signals are transmitted between the alternator and PCM via these cables for communication purposes. (this

information, the PCM monitors and controls the charge voltage.

The function of the charge control lamp in the instrument cluster is controlled by PCM. For the function test, the control lamp is switched on after the ignition has been switched on, and switched off again after the engine has been providing the system function is fault-free.





Functional scope

1. Charge voltage regulation and calculation of battery temperature

Since warm batteries are more efficiently charged with low voltage and cold batteries with higher voltage, the charge voltage is adapted by the PCM depending on the battery temperature. Reference parameters for calculation of the battery temperature are intake air and coolant temperature. The battery charging current is optimised through permanent calculation of the battery temperature and adjustment of the alternator output voltage.

2. Alternator switch-off when engine started

When the engine is started, the alternator is deactivated by the PCM to reduce the torque. The alternator is only switched to the required value electronically by the PCM after the engine has been started up.

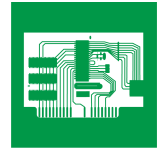
3. Increasing idling speed at low voltage and high electrical load.

When the battery charge is very low or the electrical load in idling is very high, the PCM can gradually increase the speed up to 150 rpm in order to increase the alternator performance.

4. Advance notification function for alternator load

The PCM receives information about imminent electrical load from the alternator via the signal cable, and can thus compensate the alternator torque to be expected by increased idling speed.

The PCM can guarantee greater idling stability on the basis of this information. By monitoring the vehicle electric system voltage, the PCM can change the charge current by changing the pulse-width modulated signal to the alternator.



5. Activating or deactivating electrical consumers

By linking the PCM with the central electronics module, the following consumers are activated or deactivated in the event of overvoltage or undervoltage depending on battery voltage:

- Heated windscreen
- Heated rear window
- Air-conditioning system (if appropriate)
- Auxiliary heater (if appropriate)

The low-voltage limit is around 10.3 V, the overvoltage limit around 16.0 V.

Damage caused by excessive vehicle battery charge is reduced by activating individual consumers, and at the same time the charge voltage is kept within the specification. Switching the consumers on increases the engine load and thus serves to support the control unit at the same time in the warm-up phase. If the battery voltage falls below the limit value, the consumers are deactivated again to prevent excessive discharging of the battery.

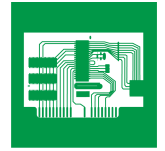
6. Diagnosis and limp-home function

The diagnosis possibility of the Smart Charge system is implemented through the engine control unit (PCM)

System faults are stored in the engine control unit and can be read out using a diagnostic unit. After the ignition has been switched on the system carries out a self-test. If a fault is detected in the “Smart Charge” system during the self-test, the charge control lamp is not switched off. The alternator is operated at a fixed charge voltage of 13.5 V if voltage regulation is not possible on account of the reason for the fault. This enables the alternator to generate enough current to supply the vehicle systems.

During driving, the charge control lamp is only switched on if the PCM detects the following faults:

- Impermissible voltage
- Internal alternator fault
- Communication fault PCM/alternator



Schematic diagram

PCM: Engine control unit

GEM: Control unit for the central electronics

a: Communication cable for consumer control (CAN)

b: Communication cable for charge control lamp (CAN)

c: Monitoring signal alternator function

d: Control signal alternator cable

