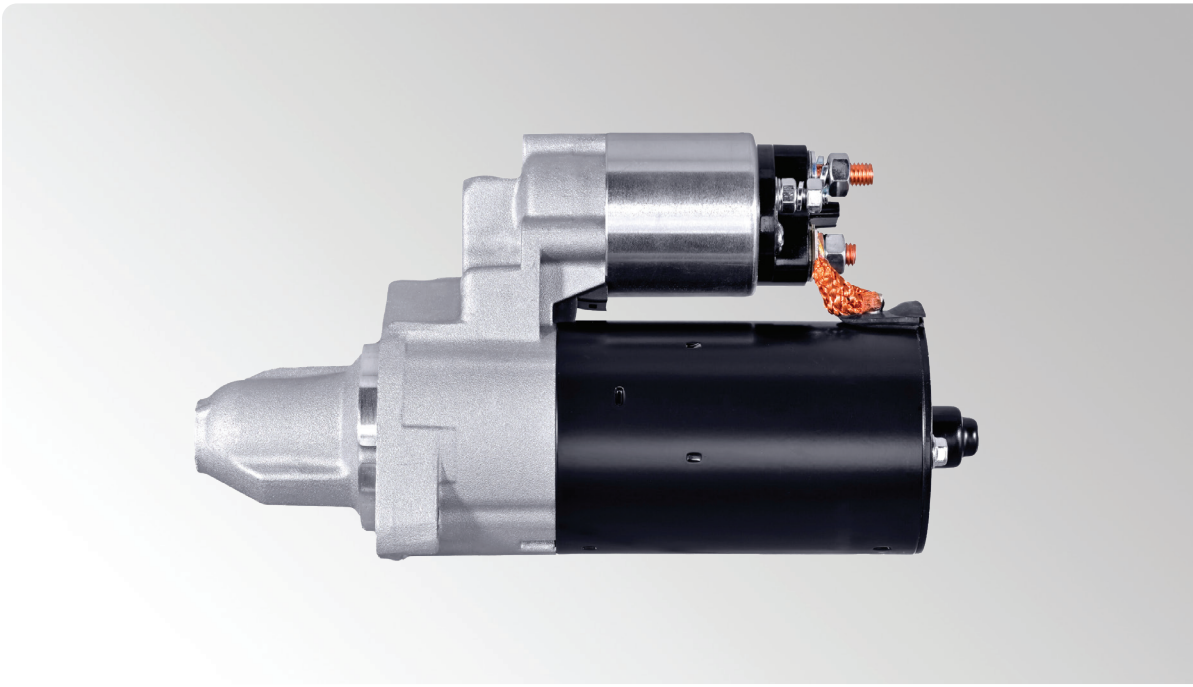


PRODUCT INFORMATION
ALTERNATORS

- → No Core Deposit: A major time-saver for workshops as there's no need to return old parts or deal with deposits, streamlining processes and improving cash flow.
- → OE-Level Quality: Built to high standards, ensuring reliability, durability, and long lifetime, backed by HELLA's quality approvals.
- → Extensive Coverage: A vast range covering most passenger cars, commercial vehicles, and specialized agricultural/construction machinery.
- → Innovative Technology: Includes advanced solutions like alternators for modern start-stop systems with brake energy regeneration.

PRODUCT FEATURES

Basics
The task of the alternator is to supply all electrical consumers within the vehicle with energy while charging the battery at the same time.

Alternators convert kinetic energy to electrical energy and ensure that a vehicle battery is charged, the vehicle electrical system remains stable and that all consumers in the vehicle are supplied with electricity. Alternators are driven via engine-side V- or V-ribbed belts, which are regularly checked for wear and may have to be replaced. An alternator freewheel decouples the belt drive from the crankshaft, with vibrations being dampened. Due to the coupling function of the alternator freewheel clutch, the torque only acts in the running direction.

The energy itself is generated between the armature and coil according to the principle of electromagnetic induction. The alternating voltage generated here is converted by a rectifier to the direct-current voltage required for the vehicle electrical system.

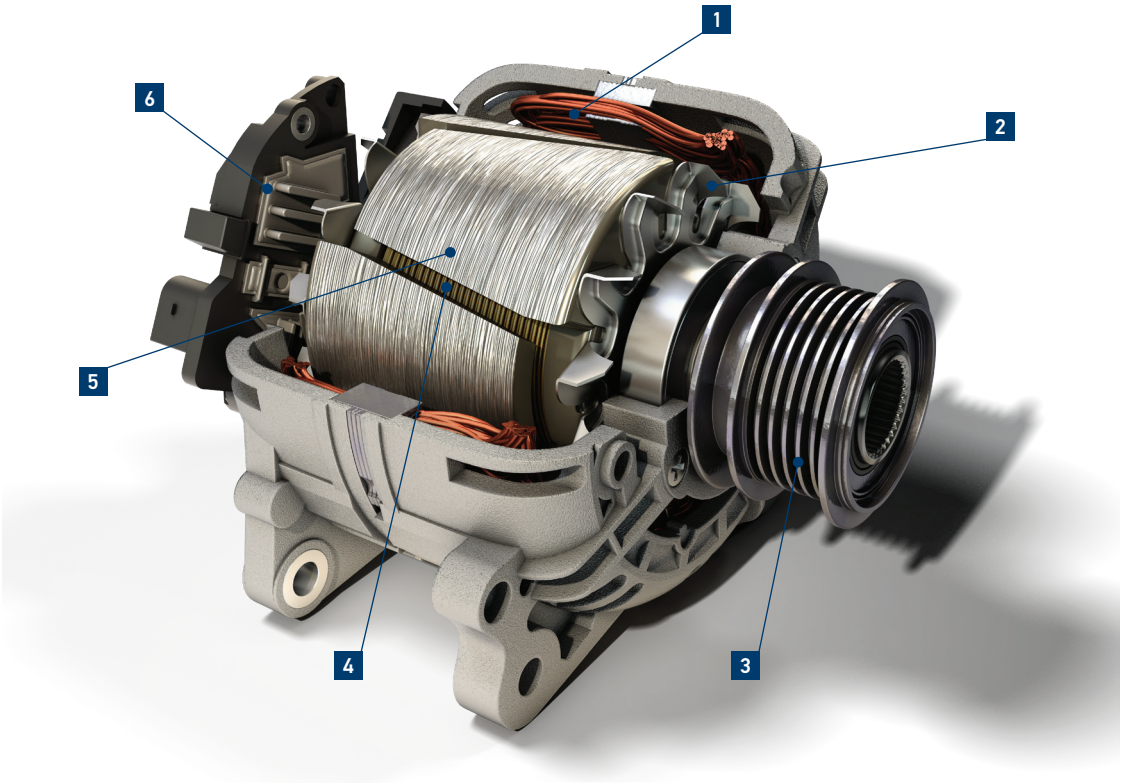
Three-phase alternators are generally installed in contemporary vehicles. The alternator power, battery capacity and the total power requirements of the vehicle's electrical system are matched to each other.

Design

The alternator is usually composed of the following components:
- → Housing
- → Anchor
- → Alternator rotor
- → Alternator regulator

The stator with three-phase winding is mounted in the alternator housing. Claw poles, excitation winding, fan and slip rings are mounted on the shaft of the alternator rotor. The pulley is mounted on the front of the external part of the shaft. The electronic control unit with carbon brush brackets is attached in the rear area of the alternator.

ALTERNATORS



1. Stator winding | 2. Fan | 3. Pulley
4. Excitation winding | 5. Claw pole rotor | 6. Regulator

How they work

Induction is used to generate electricity in the three-phase alternator. An electrical voltage is generated in the stator winding when the magnetic field within this winding changes. This change in the magnetic field is generated by the rotating alternating rotor. Alternating the north and south poles of the magnetic field generates a sinusoidal AC voltage. This alternating voltage, which is unsuitable for the electrical system in the vehicle, is converted to direct-current voltage by the rectifier. The control unit adjusts the alternator voltage to the respective operating state of the motor and to the voltage requirements of all consumers in the system.

For instance, if the objective is to replace a starter with 11 teeth with one featuring 12, the armature shaft with a module of 2.05 is removed further away from the ring gear by 1.025 mm. The ring circumference's point of contact at the pinion and the ring gear thus remains identical despite a different number of teeth. If a starter with a different number of teeth is thus supplied, it can be installed without any issues – provided the vehicle has been correctly assigned.

Alternator testing

The alternator supplies all electrical components in the vehicle with electricity. Alternators can become damaged by the effects of humidity, contamination with oil (e.g. in the case of alternators with flange-mounted vacuum pump) and by corrosion. Short circuiting may occur (for example, with polarity reversal when jump-starting) or bearing damage. Should the alternator lose its full functionality, the electronics will fail after a certain period – the battery will no longer be charged, and the vehicle will no longer be roadworthy. Any faults must be identified in good time in order for this not to happen. We therefore provide you with various problem descriptions and detailed solutions in the following.

Symptoms

The following symptoms may indicate a fault in the alternator:

- → Charging indicator lamp lights up
- → Starting difficulties due to insufficiently charged vehicle battery
- → Vehicle battery heats up due to overload
- → The illuminance of the headlamp fluctuates depending on the engine RPM
- → Bulbs burn out more quickly than normal

Cause of failure

An alternator malfunction can have different causes. The cause is not always due to an internal alternator fault, such as a faulty winding, rotor, rectifier or regulator. Before replacing the alternator, additional components must be considered and checked as a cause of failure.

- → Prematurely aged or faulty vehicle battery
- → Electrical connections on the alternator loose or faulty
- → V-belt or V-ribbed belt loose or faulty
- → Belt tensioner or free-running roller damaged

Important

As a rule, when performing welding work on the vehicle and when removing or installing the alternator, the battery must be disconnected.

ALTERNATOR TROUBLESHOOTING – INDIVIDUAL FAULTS

Malfunction: Charging indicator lamp flickering.

Causes	Remedy
V-belt too loose	Retighten V-belt

Malfunction: Charging indicator lamp lights up equally brightly at higher engine RPM.

Causes	Remedy
Short circuit to frame at cable D+/61	→ Rectify short circuit to frame → Replace cable
Regulator faulty	Replace regulator
→ Rectifier damaged → Short circuit in DF cable or in the rotor winding	Check alternator and repair or replace if necessary

Fault: Charging indicator lamp lights up brightly with the ignition switched on, but dims or flickers when the engine is running..

Causes	Remedy
Contact resistance in the charging current circuit or in the cable for the indicator lamp	Check cable and connections, and replace if necessary
Regulator faulty	Replace regulator
Alternator faulty	Check alternator, repair, or replace if necessary

Malfunction: Charging indicator lamp lights up when the ignition is switched on.

Causes	Remedy
Battery discharged or faulty	Charge battery, check, replace if necessary
Cables or connections damaged, loose or oxidised	Check cables and connections, attach, replace if necessary
→ Carbon brushes worn → Regulator faulty	→ Replace carbon brushes → Replace regulator
Short circuit of a positive diode	Immediately disconnect battery or B+ (otherwise discharge in situ) and repair/ replace alternator
Oxide coating on the slip rings, break in the rotor winding	Repair/replace alternator
Indicator lamp faulty	Replace indicator lamp

Troubleshooting information

Observe the following fundamental rules when performing troubleshooting on the alternator:

→ Do not disconnect, short circuit or mount battery or connection terminals when the engine is running or the alternator is in operation (voltage peaks can lead to damage)
→ Do not measure voltage or current via short circuit (voltage peaks) - use a voltmeter or ammeter

Please also refer to the technical information about "Ground (31)" on page 21.

Fault: Battery not charging or merely insufficiently charging.

Causes	Remedy
V-belt too loose	Tighten V-belt
Cables or connections loose, damaged, oxidised	Check cables and connections between battery and alternator and the respective ground connection, replace if necessary
Battery faulty	Charge battery, check, replace if necessary
Regulator faulty	Replace regulator
→ Rectifier faulty	Check alternator, repair, or replace if necessary

TROUBLESHOOTING AT GROUND (31) – FREQUENTLY NEGLECTED

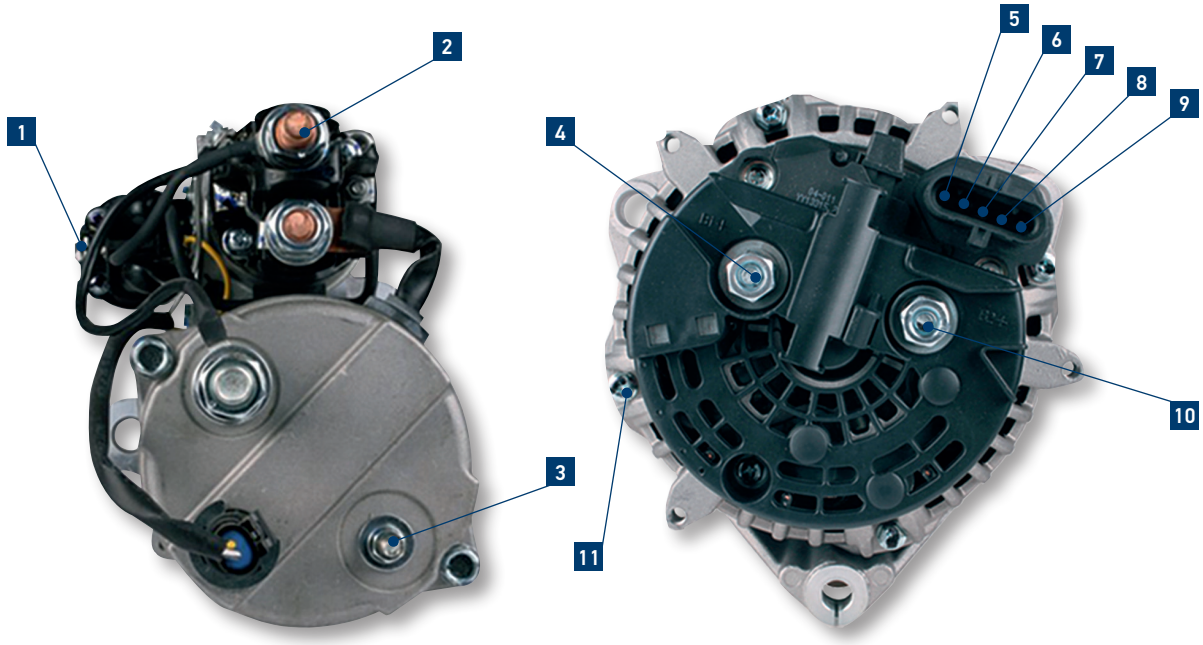
Loose or oxidised ground connections frequently lead to malfunctions at electrical or electronic components. Areas outside the vehicle interior are particularly affected, for instance alternator, starter, battery, ABS, ignition and injection system (engine electronics). However, the lighting system may also be affected. Diagnostics usually starts by checking the voltage supply. In this process, the opposite connection (ground) to the body, engine or battery is not paid enough attention. However, this connection is just as significant. Small amounts of dirt on terminals or connections can already have significant consequences.

A formation of contact resistance can lead to voltage drops or leakage currents. These may lead to malfunctions or incorrect diagnoses. For this reason, check ground connections have been securely fastened and check they are clean. The metal must be clean and free from dirt, paint and oxidation.

Special contact sprays are available for protection. Also check the cable ends secured to the connectors and cable ends. These may have come loose as a result of temperature fluctuations and vibrations. Water that has penetrated the cables may cause internal corrosion and thus associated malfunctions. Measuring the resistance using a multimeter also forms part of the test scope as does measuring the voltage drop (if possible under load). The following overview provides some starting points for cable resistance, cross sections, maximum continuous current and voltage drops:

Cable cross section in mm²	**Max. Resistance/m (20 °C) mΩ/m**	**Permissible continuous current A**
1 1.5 2.5 46 10 16 25 35 50 70 95 120	18.5 12.7 7.6 4.71 3.14 1.82 1.16 0.743 0.527 0.368 0.259 0.196 0.153	10 20 25 35 50 65 85 120 160 200 250 300 350
Maximum permissible Starter	Voltage drop in Alternator	12 Volt vehicle electrical system (example) Lighting
→ Starter housing to body and/or to engine block: 0.1 V → Negative battery terminal to body and/or to engine block: 0.2 V → Negative battery terminal to starter housing: 0.3 V → Positive battery terminal to starter's main power connection: 0.5 V → Starter's main power connection under load (when starting): 3.5 V → Ignition switch to starter's control current connection: 1.5 V	→ Alternator housing to body and/or to engine block: 0.1 V → Negative battery terminal to body and/or to engine block: 0.2 V → Negative battery terminal to alternator housing: 0.3 V → Positive battery housing to alternator's main power connection: 0.4 V	Voltage drop at positive cable and (in overall circuit): → From light switch at terminal 30 to bulb < 15 W: 0.1 V (0.6 V) → From light switch at terminal 30 to bulb > 15 W: 0.5 V (0.9 V) → From light switch at terminal 30 to headlamps: 0.3 V (0.6 V)

ALTERNATORS



1. Terminal 50c (15/15a) | 2. Terminal 30 (B+) | 3. Terminal 31(B-) | 4. Terminal B+ (B1+) | 5. Connection W
6. Connection/terminal L | 7. Connection/terminal 15 | 8. Connection/terminal S (Sense) | 9. Connection/terminal DFM
10. Terminal B2+ (auxiliary connection) | 11. Terminal 31 (B-) (directly via the housing/vehicle chassis)

DIN 72552 terminal designations

The objective of the standard for electrical systems in motor vehicles is to eradicate connection errors of cables to devices as much as possible, most of all during repair work and when installing spare parts. The terminal and cable designations may deviate from each other because devices with different terminal designations may have been connected to both ends of a cable. For this reason, the designations must not be attached to the cables. Multiple plug connectors for which designations as part of DIN 72552 are no longer sufficient are assigned serial numbers or designations with letters for which the standard has not specified specific functions.

Battery

15	Positive battery terminal via switch, ignition lock, fuse
30	Direct input from positive battery terminal
30a	12/24 V battery changeover relay, input from battery 2 positive
31	Vehicle ground, negative battery terminal
31a	Return cable to second battery negative, 12/24 V changeover relay
31b	Return cable to negative battery terminal or to ground via switch
31c	Return cable to first battery negative, 12/24 V changeover relay

Alternator, alternator regulator

61	Charge controller from alternator
B+	Positive battery terminal
B-	Negative battery terminal
D+	Positive dynamo terminal
D-	Negative dynamo terminal
DF	Dynamo field
DF1	Dynamo field 1
DF2	Dynamo field 2
U, V, W	Three-phase current terminals

Starter

45	Separate starting relay, output, starter: input (principal current)
45a	2-starter parallel operation, starting relay for engagement current, output starter 1
45b	2-starter parallel operation, starting relay for engagement current, output starter 2
48	Terminal on starter and on starting repeat relay
50	Starter, start control direct
50a	Batter changeover relay, output for starter control
50b	Starter control, parallel operation of 2 starters with downstream control
50c	Input in starting relay for starter 1
50d	Input in starting relay for starter 2
50e	Start lock relay input
50f	Start lock relay output
50g	Starting repeat relay input

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