Starters and alternators

Product competence from EUROPART

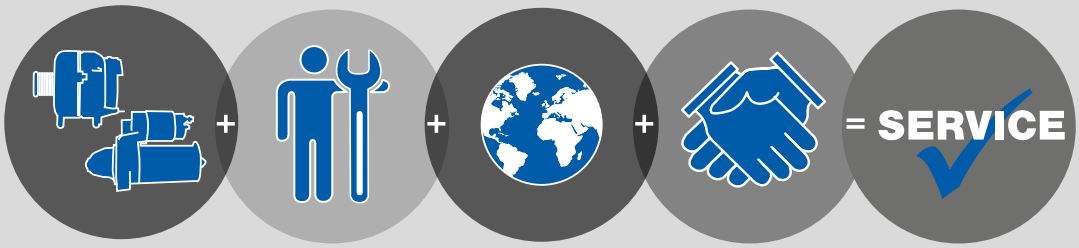
EUROPART - Europe's No. 1 for truck, trailer, van and bus spare parts!

HELLA and EUROPART are not just connected by a business relationship, but also by a strategic partnership of many years. We are a team that serves the needs of our customers. Active professional communication is the basis for this. That's why we are regularly at the EUROPART headquarters or on-site at the branches and present at in-house exhibitions. We always receive new impulses for our own developments from the conversations we have and from direct customer feedback. In this way, we are able to offer garages, freight forwarding services and municipal operations innovative lighting solutions as well as comprehensive electrical and electronic products.

HELLA and EUROPART share the same philosophy. The focus of our work is always on the customer, as well as the objective of making their work more efficient – no matter where in the world they are. The international focus connects HELLA and EUROPART and drives their collaboration. Customers definitely appreciate the result. The proof: numerous awards - among other things. That's why we are excited to continue writing this success story together with EUROPART.

Premium service from a single source

At EUROPART you profit from our high service quality and our worldwide network. Our brand partner HELLA is also at your side offering professional support and assisting you with technical inquiries.



Replacement part quality at the best price

Whether replacement, repair, conversion or retrofitting – EUROPART offers you a comprehensive assortment in collaboration with HELLA.

Focus on quality. HELLA new parts without a deposit.

- Consistent monitoring of warranties and development of improvement measures.
- High component quality requirements.
- Continuous product quality improvement.
- Release according to OE specification.

The facts

- The assortment contains over 1,200 article numbers from the areas of utility and passenger vehicles, with market coverage of over 80 % for about 35,000 vehicle types.
- All new parts without deposit are clearly identifiable based on the packaging and clear TecDoc label.

The advantages:

- Certified quality: HELLA new parts without deposit meet the high HELLA quality requirements of the HELLA competence centre.
- Easy handling: With elimination of the deposit system used parts returns are no longer required.
- 3 year guarantee: There is a 3-year warranty from purchase date October 2017 for all deposit-free HELLA starters and generators More detailed information is available on pg. 4.

New parts – full programme

Thanks to elimination of the deposit system for new parts, complicated and risky used parts returns are no longer necessary. The warranty is conveniently processed by EUROPART. The corresponding starters and generators are presented in the yellow-blue HELLA packaging with the addition "New part without deposit".

There is a three year warranty for component parts starting from purchase date October 2017. This means an extended follow-up warranty period, in addition to the legally specified warranty period. In addition to the return of the part price, the warranty also covered incurred installation and disassembly costs up to a value of 250 €. Excluded from the warranty is wear and tear as well as damage caused by improper handling of the starter and generator, and if there has been more than 150,000 km of mileage since installation upon admission of the warranty claim.

If, in accordance with applicable law, the garage customer has rights from a warranty for defects or product warranty, these remain valid independent from the warranty. In addition, each starter/ generator package comes with a sticker. It can be affixed in the service handbook or on the invoice as proof of the replacement of the starter or generator.

Why new parts without a deposit?

PREVIOUS

HELLA remanufactured assortment

Purchase of remanufactured units **with** deposit → Return of the used part → Identification and technical inspection

- Used part accepted → Deposit refund
- Used part declined → No deposit

RESOLUTION

HELLA remanufactured assortment

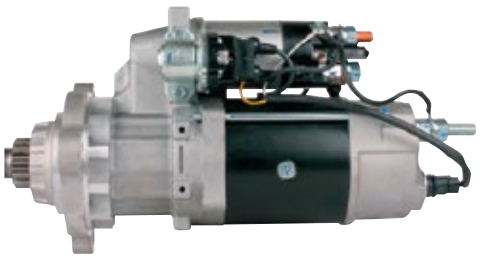
Purchase of a **new part without deposit**

- No time-consuming return process
- No deposit system
- Easy warranty processing

Warranty card – 3 year guarantee

- Is enclosed with the packaging
- Can be affixed to the invoice or service handbook
- Simple communication of the quality advantages with 3 years warranty

Starter motors



Starter motors

Foundations

Combustion engines cannot start up using their own power; they must be started with external energy. This starting procedure can be electrical, hydraulic or pneumatic.

In most cases electric motors are used in motor vehicles, generally designated as a starter or starter motor. Since high friction and compression resistance must be surmounted during the starting procedure, the direct current series-wound motor is particularly suitable as a starter motor due to its high starting torque.

The starter converts energy into kinetic energy. Diesel vehicles or vehicles with a start-stop system have a high-performance starter. In order to achieve the required torque during the start procedure, a countershaft gearbox provides the required gear reduction. The “engaging” of the starter pinion usually occurs with the aid of a magnet switch. Gasoline engines strain the battery with about 100 A during the starting procedure, while diesel engines take about 400 A. The latter is due to the high compression of compression ignition engines. In addition to the engine type, (gas, diesel), the minimum performance of a starter depends on the engine displacement, the minimum starting speed of the unit, and the required motor oil formulation (oil viscosity). A smaller starter with less performance is sufficient for modern, turbo-charged downsizing-motors with less displacement.

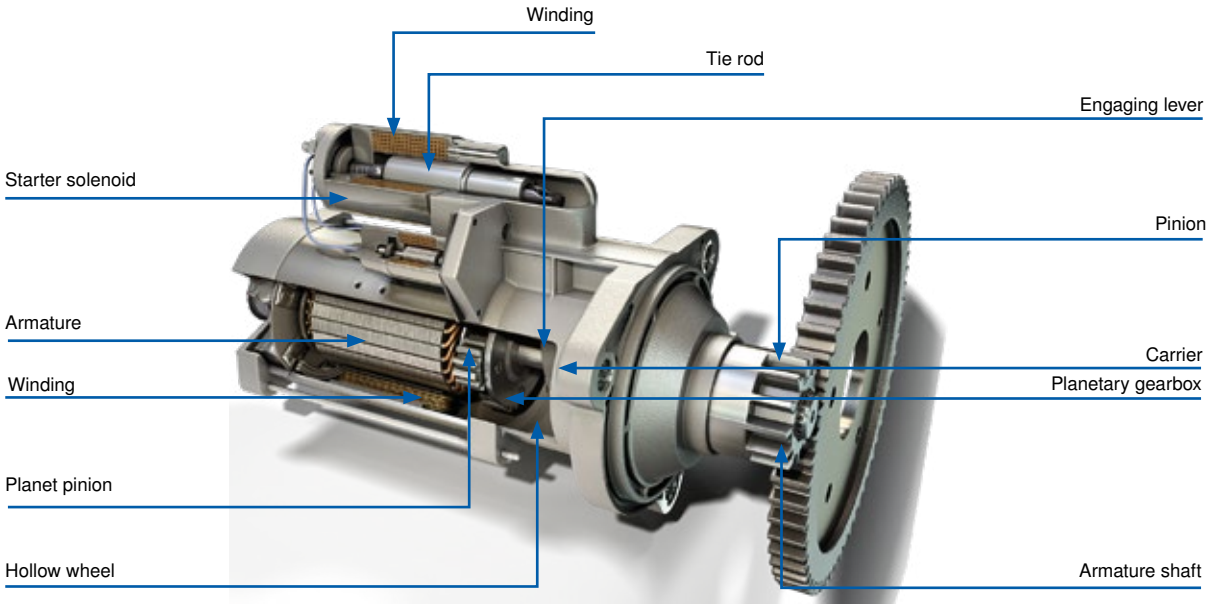
Bodywork

A starter motor is generally comprised of the following components:
- Electrical starter motor
- Starter solenoid (solenoid switch)
- Drive-end bearing with meshing drive

The electrical starter motor generally comprises of a tubular generator body wherein the pole shoes, excitation windings and permanent windings are contained. This generator body contains the electric anchor with armature winding. The starter solenoid – also referred to as the solenoid switch – is a combination of a relay and a starting motor solenoid and is mounted above in the drive-end bearing. The drive-end bearing contains the meshing drive with pinion, roller-type free-wheel, engaging lever, driver and meshing spring.

Operating principle

The starter solenoid is activated by starting the motor via the ignition switch. The relay armature is tightened by the current flow in the pull-in and holding winding. This activates the engaging lever and pushes the driver unit with pinion and overrunning clutch against the engine flywheel's ring gear. When the pinion is completely meshed, the contact bridge in the starter solenoid closes the main circuit to the starter motor. The starter is switched on and rotates.

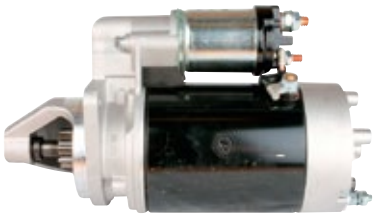


Experience the operating principle of the starter in the animation.

Starter motor

Voltage	24 V
Power	4 kW
Version	clockwise direction of rotation
Pinion teeth	9
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	89 mm

Suitable for	Order no	Comparative no
Mercedes-Benz Actros 1/2/3, Axor 1/2/3, Atego 1 (18 t), Atego 1/2, Econic 1, LK/LN2, Unimog, Zetros	**0012 586 011**	HELLA 8EA 012 586-011



Starter motor

Voltage	24 V
Power	4 kW
Version	clockwise direction of rotation
Pinion teeth	9
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	89 mm

Suitable for	Order no	Comparative no
Mercedes-Benz Unimog U1300L, LK/LN2, NG 1017	**0012 586 121**	HELLA 8EA 012 586-121

Starter motor

Voltage	24 V
Power	4 kW
Version	clockwise direction of rotation
Pinion teeth	9
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	89 mm

Suitable for	Order no	Comparative no
Mercedes-Benz MK, LK/LN2, Unimog	**0012 586 411**	HELLA 8EA 012 586-411

Starter motor

Voltage	24 V
Power	4 kW
Version	clockwise direction of rotation
Pinion teeth	11
Pinion basic position	29 mm
Flange	3-hole
Flange-∅	89 mm

Suitable for	Order no	Comparative no
MAN M2000L, M2000M, L2000, M90, SÜ	**0012 586 421**	HELLA 8EA 012 586-421

Starter motor

Voltage	24 V
Power	4 kW
Version	clockwise direction of rotation
Pinion teeth	10
Pinion basic position	28 mm
Flange	3-hole
Flange-∅	89 mm

Suitable for	Order no	Comparative no
MAN M2000L, L2000, M90	**0012 586 501**	HELLA 8EA 012 586-501

Starter motor

Voltage	24 V
Power	4 kW
Version	clockwise direction of rotation
Pinion teeth	10
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	89 mm

Suitable for	Order no	Comparative no
Iveco EuroCargo I/II/III	**0012 586 521**	HELLA 8EA 012 586-521

Starter motor

Voltage	24 V
Power	4 kW
Version	clockwise direction of rotation
Pinion teeth	9
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	89 mm

Suitable for	Order no	Comparative no
Scania R, G, P, 144, 124, 114, 94, 93	**0012 586 561**	HELLA 8EA 012 586-561

Starter motor

Voltage	24 V
Power	4 kW
Version	clockwise direction of rotation
Pinion teeth	10
Pinion basic position	29 mm
Flange	3-hole
Flange-∅	89 mm

Suitable for	Order no	Comparative no
MAN M2000L, M2000M, L2000, M90	**0012 586 581**	HELLA 8EA 012 586-581

Starter motor

Voltage	24 V
Power	4,5 kW
Version	with reduction gear, clockwise direction of rotation
Pinion teeth	10
Pinion basic position	50 mm
Flange	3-hole
Flange-∅	89 mm

Suitable for	Order no	Comparative no
Iveco Stralis II AD, Trakker II AD, EuroTrakker	**0012 586 001**	HELLA 8EA 012 586-001

Starter motor

Voltage	24 V
Power	5,4 kW
Version	clockwise direction of rotation
Pinion teeth	9
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	92 mm

Suitable for	Order no	Comparative no
MAN TGA, E2000, F2000 **Mercedes-Benz** Axor 2, SK, MK, NG	**0012 586 091**	HELLA 8EA 012 586-091

Starter motor

Voltage	24 V
Power	5,5 kW
Version	with reduction gear, clockwise direction of rotation
Pinion teeth	12
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	92 mm

Suitable for	Order no	Comparative no
Scania R, G, P, T	**0012 586 101**	HELLA 8EA 012 586-101

Starter motor

Voltage	24 V
Power	5,5 kW
Version	clockwise direction of rotation
Pinion teeth	12
Flange	3-hole

Suitable for	Order no	Comparative no
Renault Premium II, Midlum II **Volvo** FE II (2013-), FE I (2006-2013), FL III (2013-), FL II (2006-2013)	**0125 863 010**	HELLA 8EA 012 586-301

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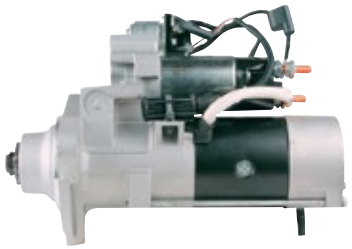
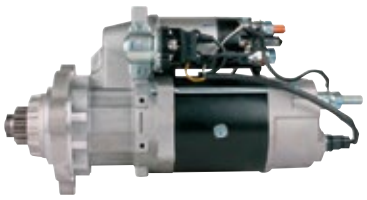


Starter motor

Voltage	24 V
Power	5,5 kW
Version	clockwise direction of rotation
Pinion teeth	12
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	92 mm

Suitable for	Order no	Comparative no
MAN TGX, TGS, TGA	**0012 586 382**	HELLA 8EA 012 586-381



Starter motor

Voltage	24 V
Power	6,2 kW
Version	clockwise direction of rotation
Pinion teeth	12
Flange	3-hole
Flange-∅	92 mm

Suitable for	Order no	Comparative no
Mercedes-Benz Actros 2/3/4, Arocs, Antos, Axor 1/2	**0012 586 231**	HELLA 8EA 012 586-231

Starter motor

Voltage	24 V
Power	6,2 kW
Version	clockwise direction of rotation
Pinion teeth	11
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	92 mm

Suitable for	Order no	Comparative no
Mercedes-Benz Actros 1/2/3, Axor 1/2	**0012 586 391**	HELLA 8EA 012 586-391

Starter motor

Voltage	24 V
Power	6,7 kW
Version	clockwise direction of rotation
Pinion teeth	11
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	92 mm

Suitable for	Order no	Comparative no
Scania 164, 124, 114	**0012 586 031**	HELLA 8EA 012 586-031

Starter with different numbers of teeth

As part of product revisions it is possible that a vehicle starter can be installed with different numbers of teeth.

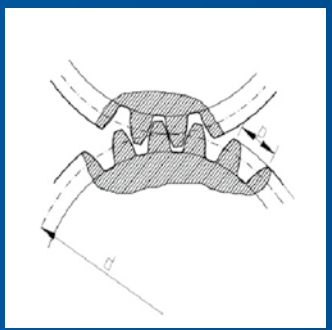
What is crucial in this context is not the number of teeth, but the displacement of the armature centre to balance the differences in the ring gear.

The displacement of the armature shaft corresponds to half a module per tooth, whereby the module is always the relation of the pitch p to the tooth Pi (p) and thereby the diameter of the pitch circle and/or working diameter results from the product of the module and number of teeth. The gear and meshing gear must always have the same module.

For instance, if a starter with 11 teeth is being replaced by one with 12, the armature shaft with a module of 2.05 is moved 1.025 mm further from the ring gear.

The contact point of the circumference on the pinion and the ring gear therefore remain identical despite the different number of teeth.

If therefore a starter with a deviating number of teeth is delivered, it can be readily installed – provided that the vehicle was correctly assigned.



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HELLA Tech World
Online platform for garages

- Vehicle-specific repair references
- Technical information
- Technical videos
- Responsive design

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Starter motor

Voltage	24 V
Power	5,5 kW
Version	with reduction gear, clockwise direction of rotation
Pinion teeth	12
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	110 mm

Suitable for	Order no	Comparative no
Solaris Vacanza **VDL** Bova Futura, Bova Magiq, Bova Synergy	**0012 586 531**	HELLA 8EA 012 586-531

Starter motor

Voltage	24 V
Power	5,5 kW
Version	clockwise direction of rotation
Pinion teeth	12
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	110 mm

Suitable for	Order no	Comparative no
Solaris Vacanza **VDL** Bova Magiq, Bova Synergy	**0012 586 491**	HELLA 8EA 012 586-491

Starter motor

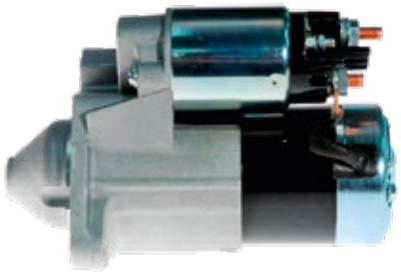
Voltage	24 V
Power	6,2 kW
Version	clockwise direction of rotation
Pinion teeth	11
Pinion basic position	48 mm
Flange	3-hole
Flange-∅	92 mm

Suitable for	Order no	Comparative no
Mercedes-Benz Citaro (O 530), Conecto (O 345), Tourismo (O 350), Travego (O 580), Touro (O 500), O 403 **Setra** S 415/416 GT, S 415/416/417 GT-HD	**0012 586 471**	HELLA 8EA 012 586-471

Starter motor

Voltage	12 V
Power	1,7 kW
Version	anti-clockwise direction of rotation
Pinion teeth	10, 11
Pinion basic position	55 mm
Flange	3-hole
Flange-∅	76 mm

Order no	Comparative no
0738 156 001	HELLA 8EA 738 156-001



Starter motor

Voltage	12 V
Power	1,4 kW
Version	clockwise direction of rotation
Pinion teeth	12
Pinion basic position	1 mm
Flange	3-hole
Flange-∅	63 mm

Suitable for	Order no	Comparative no
Nissan Kubistar, Tiida, Evalia, NV200 **Renault** Grand Modus, Modus	**0011 610 241**	HELLA 8EA 011 610-241

Starter motor

Voltage	12 V
Power	1,7 kW
Version	clockwise direction of rotation
Pinion teeth	11
Pinion basic position	-5 mm
Flange	3-hole

Suitable for	Order no	Comparative no
Citroën Jumper, Jumpy, Xsara **Fiat** Scudo, Ulysse **Peugeot** Boxer, Expert, Partner	**0011 610 071**	HELLA 8EA 011 610-071

Starter motor

Voltage	12 V
Power	2 kW
Version	clockwise direction of rotation
Pinion teeth	12/13
Pinion basic position	19 mm
Flange	2-hole
Flange-∅	89 mm

Suitable for	Order no	Comparative no
Citroën Jumper **Fiat** Ducato **Ford** Transit **Peugeot** Boxer	**0012 527 611**	HELLA 8EA 012 527-611

Starter motor

Voltage	12 V
Power	2 kW
Version	with reduction gear, clockwise direction of rotation
Pinion teeth	10
Pinion basic position	26 mm
Flange	2-hole
Flange-∅	83 mm

Suitable for	Order no	Comparative no
Mercedes-Benz Sprinter (901, 902, 903, 904), 04/2000-05/2006 Vito (638), 03/1999-07/2003, Vito, Viano (W639), 09/2003-	**0011 610 001**	HELLA 8EA 011 610-001

How does the start/stop technology affect starters?

Start/stop technology has been used successfully in vans for over 10 years. According to measurements in the New European Driving Cycle (NEDC) fuel consumption savings and emission reductions of about 8 % can be achieved thanks to this technology. In real city traffic, these savings can even be significantly higher.

Start/stop starters are designed for the associated frequent starting procedures as their service life has been increased for this specific application. The optimised design enables the starter motor to withstand frequent starts across the lifetime of the vehicle. The following measures are required for this:

- Reinforcement of the highly stressed bearing position
- Further improvements of the planetary gearbox
- Application of reinforced single-track mechanics
- Optimisation of the commutator for longer downtimes

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Starter inspection

Since a combustion motor cannot start up on its own, a functional starter, also called a starter motor, is vital for a roadworthy motor vehicle. Starters are generally maintenance-free and do their job for the entire life of a vehicle. However, if failure or functional malfunctions should occur, in many cases it is due to oxidised or faulty electrical connections, defective solenoid switches, defective electric motors or worn-out meshing drive, the drive pinion (wear or “pasting”) or the overrunning clutch. Find out everything about possible malfunctions and how you can remedy certain cases.

Symptoms

The following symptoms can indicate that the starter has a defect in the event of a faulty start attempt:

- There is no reaction when the ignition starter switch is actuated.
- The starter “clicks” put does not engage.
- You can hear the starter turning over, but the motor does not power up..

Cause of failure

The malfunction of a starter can have various causes.

- Faulty electrical connections
- Solenoid switch (starter solenoid) is tight or defective
- Electric motor is electrically defective
- Meshing drive, starter pinion or overrunning clutch is damaged

Note

Requirement for successful function is the fault-free power supply of the starter. As part of fault diagnosis, a check of the vehicle battery and the starter's excess and earthing supply must be included.

The required measuring devices and additional accessories for your garage can be found on pg. 24. An even larger selection can be found in EWOS or at your EUROPART branch. Contact us.

Electrical faults in the starter can usually be traced back to an overload.

This can become apparent by earthing and winding short circuits in the field and armature winding, but sometimes also in the coils of the controls (solenoid switch).

Carbon-brush springs and collectors are highly stressed and are more susceptible to faults than in the generator. While, for instance, jammed carbon-brush springs in the generator do not allow power to arise thereby unloading it, this leads to the formation of considerable electric arcs in the starter due to the high currents. This often destroys the collector. **A multimeter and clamp-on ammeter are required for troubleshooting. Fault sources (e.g. pinions) can also be localised through acoustic perception.**

Please also observe the technical information on “Vehicle earth (31)” on page 23.

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Starter troubleshooting – individual faults

Malfunction: The starter does not turn over when the ignition/starter switch is actuated.

Causes	Remedy
Switch on lighting (dipped headlight). Lighting is weak or does not function = ■ Cable or earth connection interrupted ■ Insufficient current flow due to loose or oxidised connections ■ Discharge battery ■ Generator defective	■ Check battery cable and connections ■ Clean battery terminals and clamps ■ Establish secure power connection between the starter, battery and vehicle earthing ■ Measure battery voltage ■ Check battery, charge, replace if necessary ■ Check generator
Solenoid switch does not pull on: Bridge clamp 30 and 50 on the starter, Starter runs/engages = ■ Ignition/starter switch defective or ■ Line interrupted	■ Replace ignition/starter switch ■ Eliminate interruption
Solenoid switch turns on: Loosen battery cable from clamp 30 in the starter and place directly on the terminal screw below terminal clamp 30. Starter picks up = ■ Solenoid switch contacts dirty or worn out	■ Clean/replace solenoid switch and contacts

Malfunction: Starter does not turn over when the battery cable is placed directly on the contact screw below terminal clamp 30, or the starter turns over too slowly and/or does not turn the motor on.

Causes	Remedy
Carbon brushes worn out	Replace carbon brushes
Clamp carbon brushes	Clean carbon brushes and brush holder guides
Springs do not have enough tension. Carbon brushes are not in contact	Replace springs
Collector is dirty	Clean collector
Collector is scored or burned	Overhaul and/or replace starter
Armature or field winding defective	Overhaul and/or replace starter

Malfunction: Starter engages and turns on. The motor only turns over jerkily or not at all.

Causes	Remedy
Discharge battery	Charge, check battery
Defective passage of current due to loose or oxidised connections	Clean and tighten battery terminals and connections
Clamp carbon brushes	Clean carbon brushes and brush holder guides
Carbon brushes worn out	Replace carbon brushes
Collector is dirty	Clean collector
Collector is scored or burned	Overhaul and/or replace starter
Armature or field winding defective	Overhaul and/or replace starter

Malfunction: Drive pinion does not disengage. Starter engages and turns on. The motor only turns over in bursts or not at all.

Causes	Remedy
Drive pinion defective	Replace drive pinion
Ring gear defective on flywheel	Rework ring gear, replace if necessary

Malfunction: Drive pinion does not disengage.

Causes	Remedy
Pinion or coarse thread dirty and/or damaged	Overhaul starter, replace if necessary
Solenoid switch defective	Replace solenoid switch
Return spring worn out or broken	Replace return spring

Malfunction: Starter continues to run after letting go of ignition/starter switch

Causes	Remedy
Ignition/starter switch or relay defective	Turn motor off immediately! Check switch and relay, replace if necessary

Alternators, generators

Alternators, generators

Foundations

The task of the generator, also known as a dynamo, is to supply all electrical consumers in the vehicle with energy while charging the battery at the same time.

Generators convert kinetic energy into electric energy and ensure the battery is charged, stable vehicle electrics and supply all consumers in the vehicle. Generators are powered with the aid of motor V-belts or ribbed V-belts, which must be checked regularly for wear and replaced if necessary. A generator overrunning clutch ensures decoupling of the belt drive from the crankshaft, vibrations are absorbed. Due to the coupling function of the generator overrunning clutch, the torque only functions in the running direction.

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

Three-phase alternating-current generators are generally installed in modern vehicles. Generator output, battery capacity and the overall required output of the electrical vehicle system are coordinated with each other.

Bodywork

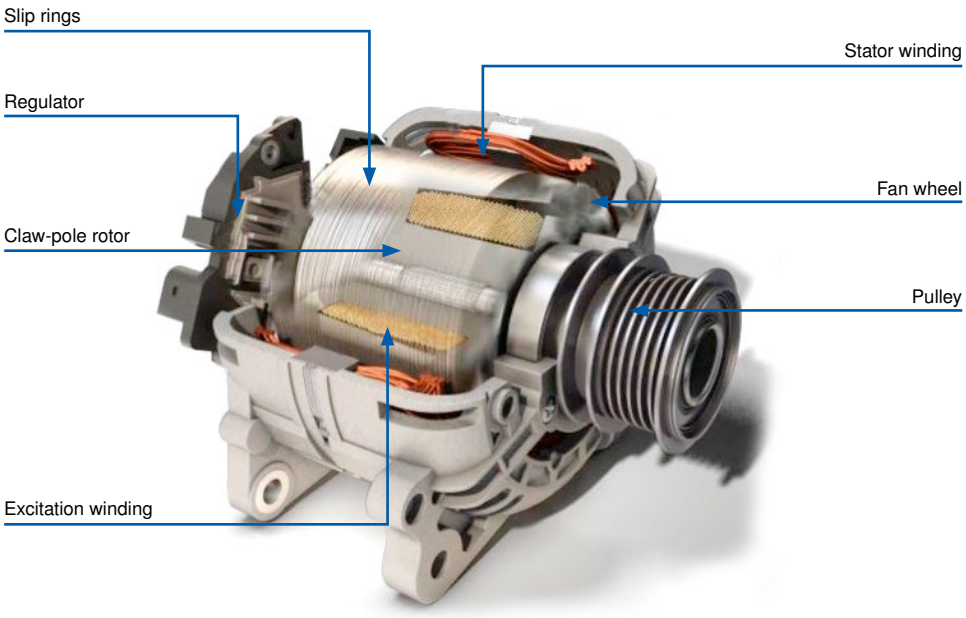
The generator is generally comprised of the following components:

- Casing
- Stator
- Generator rotor
- Generator regulator

The stator is mounted with three-phase winding inside the generator casing. The claw pole, excitation winding, fan and slip rings are found on the shaft of the rotating generator rotor. The belt pulley is mounted on the front outside part of the shaft. The electronic regulator is fastened with carbon brush holder in the back area of the generator.

Operating principle

Voltage in the alternator is generated on the principle of induction. An electric current is generated in the stator winding when the magnetic field changes within this winding. The magnetic field change is generated by the rotating generator rotor. Sinus-shaped alternating-current voltage arises from the changing magnetic field with north and south poles. This alternating-current voltage, which is unsuitable for the motor vehicle's electrical system, is converted into direct-current voltage via the rectifier. The regulator adjusts the generator voltage to the respective operating condition of the motor and the voltage requirement of all consumers in the system.



Experience the operating principle of the generator in the animation.

Alternator

Voltage	24 V
Charging current	35 A
Version	without belt pulley

Suitable for	Order no	Comparative no
MAN E2000, F2000, M2000M/L, L2000, F90, M90 **Mercedes-Benz** SK, MK, LK/LN2, Unimog	**0012 584 501**	HELLA 8EL 012 584-501

Alternator

Voltage	24 V
Charging current	55 A
Version	without belt pulley

Suitable for	Order no	Comparative no
MAN TGA, F2000, M200M/L, L2000	**0012 584 091**	HELLA 8EL 012 584-091

Alternator

Voltage	24 V
Charging current	55 A
Version	without belt pulley

Suitable for	Order no	Comparative no
DAF 95, 95XF, CF85, 85CF, 75CF, 65CF, 85, 75, 65, LF55 **MAN** F2000, M2000M/L, L2000, E2000, F90, L90, G90 **Mercedes-Benz** SK, MK, LK/LN2, Unimog	**0012 584 081**	HELLA 8EL 012 584-081

Alternator

Voltage	24 V
Charging current	65 A
Version	without belt pulley

Suitable for	Order no	Comparative no
Scania R, G, P, T, 94, 114, 124, 144, 164, 93, 113, 143	**0012 584 111**	HELLA 8EL 012 584-111

Alternator

Voltage	24 V
Charging current	80 A
Version	with ribbed V-belt pulley
Number of ribs	8
Pulley ∅	72 mm

Suitable for	Order no	Comparative no
Scania R, G, P	**0012 584 061**	HELLA 8EL 012 584-061

Alternator

Voltage	24 V
Charging current	80 A
Version	clockwise rotation, with belt pulley
Flange	3-hole

Suitable for	Order no	Comparative no
Mercedes-Benz Actros 1, Axor 1/2/3, Atego 1 (18 t), Atego 1/2/3, Unimog, LK/LN2	**0012 584 011**	HELLA 8EL 012 584-011

Alternator

Voltage	24 V
Charging current	50 A
Version	without belt pulley
Flange	2-hole

Suitable for	Order no	Comparative no
Volvo FH II (-2005), FH16 III (2012-), FH16 (2003-/2009-), FM II (2001-2006/2005-), FM7 (1998-2001), FM9 (2001-2005), FM10 (1999-2001)	**0012 584 211**	HELLA 8EL 012 584-211

Generator sizes

The nominal voltage is standardised battery voltage (6 V,12 V, 24 V).
The generator voltage, however, is the voltage with which the generator is generally operated (7 V, 14 V, 28 V).

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Alternator

Voltage	28 V
Charging current	80 A
Version	without belt pulley

Suitable for	Order no	Comparative no
MAN TGX, TGS, TGA, TGM, TGL	**0012 584 251**	HELLA 8EL 012 584-251

Alternator

Voltage	24 V
Charging current	90 A
Version	without belt pulley
Number of ribs	12
Pulley ∅	69 mm

Suitable for	Order no	Comparative no
Iveco Stralis I/II, EuroStar, EuroTech, EuroTrakker, Trakker I/II	**0012 584 001**	HELLA 8EL 012 584-001

Alternator

Voltage	24 V
Charging current	90 A
Version	without belt pulley

Suitable for	Order no	Comparative no
MAN TGA, F2000, M2000M/L, L2000, E2000	**0012 584 071**	HELLA 8EL 012 584-071

Alternator

Voltage	24 V
Charging current	80 A
Version	clockwise rotation, with belt pulley
Flange	3-hole

Suitable for	Order no	Comparative no
Mercedes-Benz Actros 1/2/3, Arocs, Axor 1/2, Atego 1/2/3, Econic 1, Unimog, Zetros, LK/LN2	**0012 584 121**	HELLA 8EL 012 584-121

Alternator

Voltage	24 V
Charging current	100 A
Version	clockwise rotation, with belt pulley
Flange	3-hole

Suitable for	Order no	Comparative no
Mercedes-Benz Actros 1/2/3, Axor 1/2, Atego 1/2, Econic 1, Unimog, Zetros	**0012 584 151**	HELLA 8EL 012 584-151

Alternator

Voltage	24 V
Charging current	100 A
Version	with ribbed V-belt pulley
Number of ribs	8
Pulley ∅	71 mm

Suitable for	Order no	Comparative no
Scania R 730, R 620, R 580, R 560, R 520, R 500, R 490, R 480, R 470, R 460, R 450, R 440, R 420, R 410, R 400, R 380, R 370, R 360, R 340, R 320, R 310, R 270, R 230, G 620, G 490, G 480, G 470, G 460, G 450, G 440, G 420, G 410, G 400, G 380, G 370, G 360, G 340, G 320, G 310, G 280, G 270, G 250, G 230, P 500, P 480, P 470, P 460, P 450, P 440, P 420, P 410, P 400, P 380, P 370, P 360, P 340, P 320, P 310, P 280, P 270, P 250, P 230, T 580, T 500, T 470, T 420, T 380, T 340, 164, 124, 114, 94	**0012 584 161**	HELLA 8EL 012 584-161

Alternator

Voltage	24 V
Charging current	100 A
Version	without belt pulley

Suitable for	Order no	Comparative no
Mercedes-Benz Actros 1/2/3, Axor 1/2, Atego 1/2, Econic, Unimog, Zetros	**0012 584 191**	HELLA 8EL 012 584-191

Alternator

Voltage	24 V
Charging current	110 A
Version	without belt pulley

Suitable for	Order no	Comparative no
MAN TGX, TGS, TGA, TGM, TGL	**0012 584 241**	HELLA 8EL 012 584-241

Alternator

Voltage	24 V
Charging current	120 A
Version	without belt pulley

Suitable for	Order no	Comparative no
MAN TGX, TGS, TGA	**0012 584 461**	HELLA 8EL 012 584-461

Alternator

Voltage	24 V
Charging current	110 A
Version	With connection for tachometer
Flange	2-hole

Suitable for	Order no	Comparative no
Renault Magnum II/III, Kerax **Volvo** FH II (2005-2013), FM II (2005-2013)	**0012 584 271**	HELLA 8EL 012 584-271

Alternator

Voltage 24 V
Charging current 80 A
Version without belt pulley

Suitable for	Order no	Comparative no
Solaris Vacanza **VDL** Bova Futura, Bova Maqig	**0012 584 301**	HELLA 8EL 012 584-301

Alternator

Voltage 24 V
Charging current 80 A
Version without belt pulley

Suitable for	Order no	Comparative no
Solaris Vacanza **VDL** Bova Magiq, Bova Synergy	**0012 584 321**	HELLA 8EL 012 584-321

Alternator

Voltage 24 V
Charging current 100 A
Version without belt pulley

Suitable for	Order no	Comparative no
Solaris Vacanza **VDL** Bova Futura, Bova Maqig, Bova Synergy	**0012 584 481**	HELLA 8EL 012 584-481

Alternator

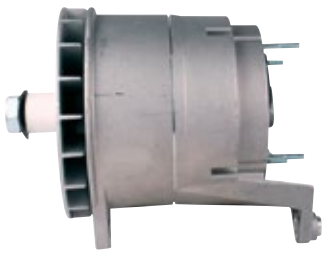
Voltage 24 V
Charging current 110 A
Version with ribbed V-belt pulley
Number of ribs 7
Pulley ∅ 86 mm

Suitable for	Order no	Comparative no
Solaris Vacanza **VDL** Bova Maqig, Bova Synergy	**0012 584 331**	HELLA 8EL 012 584-331

Alternator

Voltage 24 V
Charging current 140 A
Version without belt pulley

Suitable for	Order no	Comparative no
MAN Lion's Coach (A13), Lion's Comfort (A02), Lion's Star (A03/ R02/R03), EL (A12), EM, NG (A11/A23), NL (A10/A21), NM, NÜ (A20), SÜ, ÜL (R12/R13/R14) **Neoplan** Cityliner (N 1216), Tourliner (N 2216)	**0012 584 261**	HELLA 8EL 012 584-261



Alternator

Voltage 24 V
Charging current 140 A
Version without belt pulley
Flange 2-hole

Suitable for	Order no	Comparative no
Mercedes-Benz Citaro I (O 530), Conecto I (O 345), Integro I (O 550), Tourino (O 510), Tourismo I (O 350), Travego I (O 580), O 402, O 403, O 404, O 405, O 407, O 408	**0012 584 361**	HELLA 8EL 012 584-361

Alternator

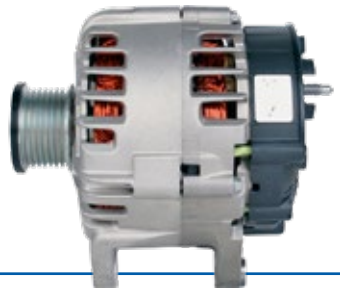
Voltage	24 V
Charging current	140 A
Version	without belt pulley
Flange	2-hole

Suitable for	Order no	Comparative no
Mercedes-Benz Citaro I (O 530), Cito (O 520), Conecto I (O 345), O 403, Tourino (O 510), Tourismo (O 350) **Setra** S 415 GT, S 415/416/417 GT-HD	**0012 584 411**	HELLA 8EL 012 584-411

Alternator

Voltage	12 V
Charging current	90 A
Version	With overrunning clutch pulley
Number of ribs	6
Pulley ∅	56 mm

Suitable for	Order no	Comparative no
VW T5, Crafter	**0011 710 381**	HELLA 8EL 011 710-381



Alternator

Voltage	12 V
Charging current	150 A
Version	With overrunning clutch pulley
Number of ribs	7
Pulley ∅	49 mm

Suitable for	Order no	Comparative no
Nissan Primastar **Opel** Vivaro **Renault** Trafic II	**0012 426 051**	HELLA 8EL 012 426-051

Alternator

Voltage	12 V
Charging current	85 A
Version	With overrunning clutch pulley
Number of ribs	7
Pulley ∅	58 mm

Suitable for	Order no	Comparative no
Toyota Hiace IV, Hilux VII	**0011 711 331**	HELLA 8EL 011 711-331

Clutch pulley in generators

Features
- two-sided closed version to counteract dust entry
- specially developed for alternating-current generators

Advantages
- optimum adjustment to the shaft
- no damage to the casing
- noise-optimised

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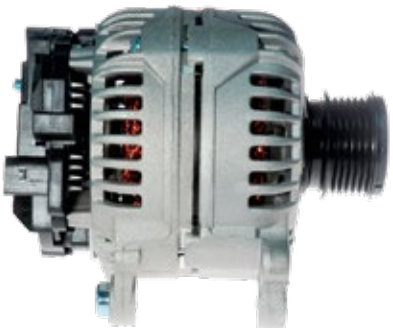

Alternator

Voltage	12 V
Charging current	140 A
Version	With overrunning clutch pulley
Pulley ∅	56 mm

Suitable for	Order no	Comparative no
VW T5, Crafter	**0011 710 791**	HELLA 8EL 011 710-791

Alternator

Voltage	12 V
Charging current	180 A
Version	with freewheel pulley
Number of ribs	6
Pulley ∅	50 mm

Suitable for	Order no	Comparative no
Mercedes-Benz Sprinter (906), 06/2006-, OM 646.984/985/986/989/990 Vito (W639), 09/2003-, OM 646.981/982/983 Viano (W639)	**0012 430 201**	HELLA 8EL 012 430-201

The required measuring devices and additional accessories for your garage can be found on pg. 24. An even larger selection can be found in EWOS or at your EUROPART branch. Contact us.

Generator inspection

The generator, also called a dynamo, supplies all electrical components of the vehicle with electricity. Generators can be damaged by the effects of moisture, oil wetting (for example with generators with flange-mounted vacuum pumps) as well as by corrosion. This can result in short circuiting (for example in the event of reverse polarity during external jump-starting) or bearing damage. If it is no longer functional, the electronics will fail after a while – the battery will no longer charge, the vehicle is no longer roadworthy. To ensure that it doesn't progress that far, a defect should be detected early on. Below we provide you with various descriptions of problems and extensive possible solution approaches.

Symptoms

The following symptoms can indicate a generator defect:

– Battery charge indicator lamp is illuminated
– Difficulty starting up due to insufficiently charged vehicle battery
– Vehicle battery is hot due to over-charging
– The illumination strength of the headlights fluctuates in relation to the motor speed
– Bulbs burn out in short intervals

Cause of failure

The failure of a generator can have various causes. The cause cannot always be traced back to an internal generator defect, such as defective winding, armature, rectifier or regulator. Before the generator is replaced, additional components should be considered as malfunction causes and checked.

– Outdated or defective vehicle batteries
– Electrical connections on the generator are loose or defective
– V-belt or ribbed V-belt loose or defective
– Belt tensioner or roller-type free-wheel defective

Note

As a general rule, the battery must be disconnected during welding work on the vehicle and when dismounting and/or installing the generator!

During troubleshooting of generators the following guidelines must be adhered to:

- Do not separate, short-circuit or install battery or terminal clamps when the motor is running or the generator is powered (voltage peaks can cause damage).
- Never conduct voltage and power measurements via short circuit (voltage peaks), instead use a voltmeter or ammeter.

Please also observe the technical information on "Vehicle earth (31)" on page 23.

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Generator troubleshooting – individual faults

Malfunction: Battery charge indicator lamp flickers.

Causes	Remedy
V-belt too loose	Retighten V-belt
Set-up of contacts is incorrect or regulator resistance is burnt-out (Only for contact regulators!)	Align contacts, renew resistance and/or regulator

Malfunction: Battery charge indicator lamp is consistently bright at higher speeds.

Causes	Remedy
Line D+/61 has a short to earth	■ Remedy short to earth ■ Replace line
Regulator defective	Switch-out regulator
■ Rectifier is defective ■ Collector is dirty ■ Short circuit in line DF or rotor winding	Inspect generator and repair, replace if necessary

Malfunction: Battery charge indicator lamp is bright when ignition is switched on, but becomes dark or glowing when the motor is running.

Causes	Remedy
Transition resistance in the charging circuit or in the line to indicator lamp	Check line and connections, replace if necessary
Regulator defective	Switch-out regulator
Generator defective	Inspect and repair generator, replace if necessary

Malfunction: Battery charge indicator lamp does not light up when ignition is switched on.

Causes	Remedy
Battery discharged or defective	Charge battery, check, replace if necessary
Lines or connections damaged, loose or oxidised	Check lines and connections, tighten, replace if necessary
■ Carbon brushes worn out ■ Regulator defective	■ Carbon brushes ■ Replace regulator
Short circuit of a positive diode	Immediately disconnect battery or B+ (otherwise discharge in stand) and repair/ replace generator
Oxide layer on the slip rings, interruption of rotor winding	Repair/replace generator
Indicator lamp defective	Replace indicator lamp

Malfunction: Battery does not charge or only charges insufficiently

Causes	Remedy
V-belt too loose	Tighten V-belt
Lines or connections loose, damaged, oxidised	Check lines and connections between the battery and generator and/or respective earth connection, replace if necessary
Battery defective	Charge battery, check, replace if necessary
Regulator defective	Switch-out regulator
■ Collector is dirty ■ Rectifier defective	Inspect and repair generator, replace if necessary

Regulator

Multi-function regulator (MFR)

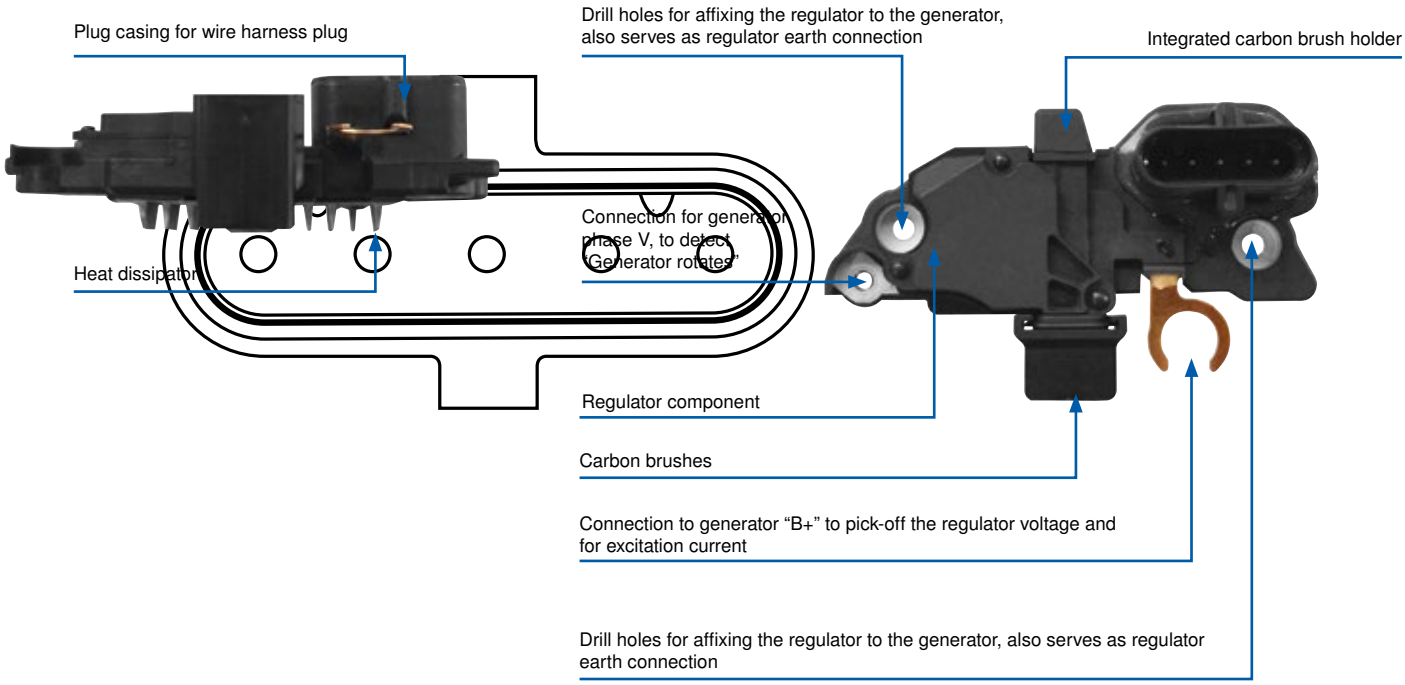
General

Due to the increasing electrical output requirement, especially efficient and high-performance generators and regulators are required. They should have the option of having consumer and battery management. For this reason, hybrid regulators are being increasingly replaced by transistor regulators (1-chip regulator) with new functions, known as multi-function regulators.

Operating principle

Multi-function regulators offer the following additional functions:

- Battery monitoring (sensing)
- Capacity monitoring
- Fault diagnosis
- Supporting motor management
- Load response



Connection W

The connection "W" enables pick-off of the generator phase's voltage signal. The output signal is decoupled from the actual generator phase and is guided outwards via a push-pull output stage.

Connection L

Depending on the generator's operating state and the vehicle electrical system, connection "L" controls:

- the display elements of located faults via the lamp output stage or
- the switching of consumers via the relay output stage during fault-free generator operation.

Depending on the operating mode, current flows in and out of the regulator via connection L.

Connection clamp 15 (utility vehicles only)

Current flows into the regulator via connection "15", which detects the state "driving switch On" during exceedance of the defined threshold value and controls the pre-excitation of the generator.

When certain voltage values are exceeded, the running generator can be re-energised, which is used for dangerous goods transportation vehicles.

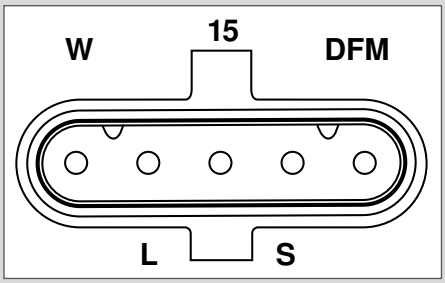
Connection S (sense)

The voltage is directly measured on "B+" of the battery as an actual value via connection "S". A possible voltage difference between "B+" and battery "+" is excluded thereby and optimisation of the charging voltage of the starter battery is performed.

Depending on the regulator type, there is a fault display in the event of an interruption of the sense line.

Connection DFM

The connection DFM emits a DFM signal (DF-monitor) that reflects the generator's utilisation rate and initiates suitable measures, such as increasing the idle speed and reducing output by switching off negligible consumers.



Generator regulator

Version negative regulating
Suitable for Slip ring ∅ 28 mm


1


2


3

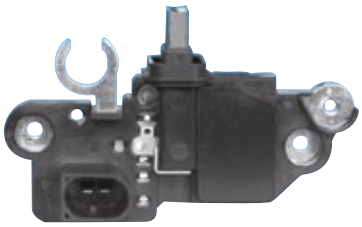
Scope of supply
with gasket

Voltage	Fig.	Order no	Comparative no
28 V	1	**0004 246 561**	HELLA 5DR 004 246-021
28,1 V	2	**0004 246 711**	HELLA 5DR 004 246-711
28,5 V	3	**0004 246 571**	HELLA 5DR 004 246-571

Generator regulator

Version Multi-function, positive regulating
Voltage 28,3 V
Suitable for Slip ring ∅ 14 mm

Suitable for	Order no	Comparative no
Mercedes-Benz Actros 2/3	**0009 728 441**	HELLA 5DR 009 728-441



Generator regulator

Version Multi-function, positive regulating
Voltage 14,5 V
Suitable for Slip ring ∅ 14 mm

Suitable for	Order no	Comparative no
VW Transporter T5, 1.9 TDI AXC/AXB, 04/2003-11/2009	**0009 728 021**	HELLA 5DR 009 728-021

Defects

Impact in the event of failure

Failure of the multi-function regulator can have the following effects:
- Illumination of the generator control light
- Discharged battery

Cause of failure can be traced back to various causes:
- Interrupted output stage
- Overvoltage in vehicle electrical system
- Charging cable interrupted
- Battery monitoring line interrupted
- Fault in/on the generator (torn drive pinion, short circuit in excitation circuit, ...)

These faults are detected by the multi-function regulator depending on the regulator type.

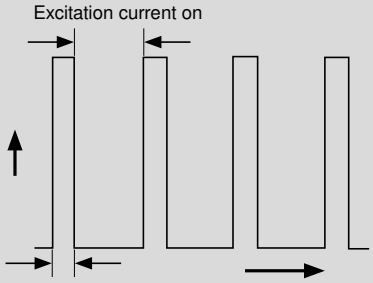
Troubleshooting

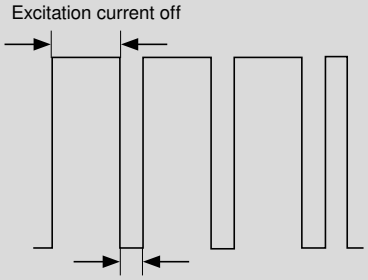
The following aspects should be considered when troubleshooting:

Visual inspection
- Check all cable connections and plug contacts for correct installation and contacting.
- Check generator drive belt for correct tension or possible tear.

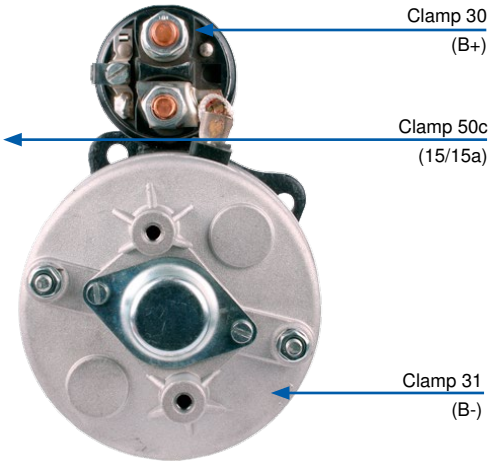
Measuring the generator voltage
- Measuring the generator voltage/current on the battery (observe manufacturer specifications, differences between manufacturers). Measure at idle speed and increase motor speed, without and with connected consumers.

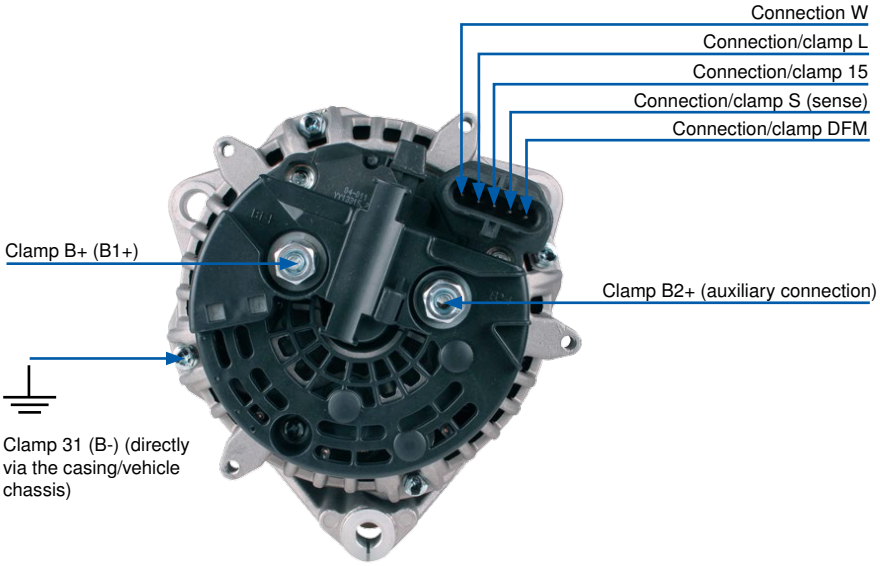
Check the signal on the regulator connector "DFM"
- Pick-up signal with oscilloscope at the DFM connection. The depicted signal mirrors the duty factor of the excitation current. The duty factor must change depending on the generator's load status.





Clamp designations DIN 72552





Clamp designations DIN 72552

The objective of the norm for electrical systems in motor vehicles is, inasmuch is possible the error-free connection of all lines to devices, especially during repairs and replacement parts installations. The clamp and line designations can deviate from one another, since devices with different clamp designations can be connected at both ends of a line. Therefore they do not need to be affixed to the lines. Multiple plug connections where the designation as per DIN 72552 is no longer sufficient, receive consecutive number or letter designations that do not have a function allocation defined by the norm.

Battery

15	Battery plus via switch, ignition switch, fuse
30	Entry from battery plus direct
30a	Battery changeover relay 12/24 V, entry from battery 2 plus
31	Vehicle earth, battery minus
31a	Return line to 2. Battery minus, changeover relay 12/24 V
31b	Return lines to battery minus or on vehicle earth via switch
31c	Return line to 1. Battery minus, changeover relay 12/24 V

Generator, generator regulator

61	Generator's battery charge indicator
B+	Battery Plus
B-	Battery Minus
D+	Dynamo Plus
D-	Dynamo Minus
DF	Dynamo Field
DF1	Dynamo Field 1
DF2	Dynamo Field 2
U, V, W	Three-phase alternating current clamps

Starter motors

45	Separate start relay, exit, starter: Entry (main current)
45a	2-Starter parallel operation, start relay for starter current, exit starter 1
45b	2-Starter parallel operation, start relay for starter current, exit starter 2
48	Clamp on starter and on start-repeating relay
50	Starter, starter control direct
50a	Battery changeover relay, exit for starter control
50b	Starter control, parallel operation of 2 starters in sequence control
50c	Entry in start relay for starter 1
50d	Entry in start relay for starter 2
50e	Start-locking relay entry
50f	Start-locking relay exit
50g	Start-repeating relay entry

Fault source vehicle earth (31) – usually neglected

Loose or oxidised earthing connections always lead to malfunctions of electric and electronic components. Particularly affected are areas that are outside of the vehicle interior, such as generator, starter, battery, ABS, ignition and injection system (engine electronics). However, the lighting system can also be affected. The diagnosis generally begins by checking the power supply. In so doing, the opposing connection (vehicle earth) to the body, the motor or the battery are given less attention. Yet this is just as important. Even low levels of dirt on the connections or coupling can have considerable consequences. The formation of transition resistance can lead to voltage drops and creeping current. These lead to malfunctions and false diagnoses. This is why earth connections must be checked to ensure secure fit and cleanliness. They should be metallic bright and free from dirt, paint and oxidation. There are special contact sprays for protection. Furthermore, the cable ends attached to the plugs and lugs should be checked. These may have loosened from temperature fluctuations and vibrations. Water that has penetrated into the cable can lead to “interior corrosion” and related malfunctions. A resistance check with a multimeter is as much a part of the scope of inspection as measuring the voltage drop is (ideally under load). The following overview provides several reference points about conductor resistance, cross-sections, max. permanent current and voltage drops:

Conductor cross-section mm²	Max. resistance/m (20 °C) mO/m	Permissible constant current A
1	18,5	10
1,5	12,7	20
2,5	7,6	25
4	4,71	35
6	3,14	50
10	1,82	65
16	1,16	85
25	0,743	120
35	0,527	160
50	0,368	200
70	0,259	250
95	0,196	300
120	0,153	350

Maximum permitted	Voltage drops in	12 volt vehicle electrical system (example)
Starter motors	Alternator	Lighting
Starter casing to the body and/or motor block: 0.1 V	Generator casing to the body and/or motor block: 0.1 V	U-loss on the plus wire and (in the entire circuit):
Battery minus to the body and/or motor block: 0.2 V	Battery minus to the body and/or motor block: 0.2 V	from light switch clamp 30 to bulb < 15 W: 0.1 V (0.6 V)
Battery minus to the starter casing: 0.3 V	Battery minus to the generator casing: 0.3 V	from light switch clamp 30 to bulb > 15 W: 0.5 V (0.9 V)
Battery plus to the main current connection starter: 0.5 V	Battery plus to the main current connection generator: 0.4 V	from light switch clamp 30 to headlight: 0.3 V (0.6 V)
Main current connection starter under load (when starting): 3.5 V		
Ignition/starter switch to the control circuit connector starter: 1.5 V		

Workshop Equipment

Our assistance for your workshop

According to breakdown statistics, the number one cause of breakdowns is still electrical faults (batteries, starter, generator).

We assist you in handling the ever-increasing vehicle electronics and the growing challenges that come with it.

EUROPART's selection of diagnosis and service devices assists workshops - from traditional maintenance service to high-tech operation. The wide spectrum includes vehicle diagnostics systems, precise and reliable configuration and measuring devices, such as multimeter and oscilloscope, as well as our professional battery service.

Assistance in detail:
EUROPART offers the workshop a complete solution from a single source. Not only does it include vehicle data, diagnostics software and tools, but also a direct link to technical data and control unit diagnosis.

Please speak with your branch about individualised options for device financing.

Battery charger

EP122450A

professional charger for 12 and 24 V batteries, polarity reversal protection, multi-level charging process, built-in ventilator protects against overheating, supply mode, with boost function to remove sulphate.

Voltage	230 V
Charge voltage	12/24 V
Charge current, max.	25 A
Length x width x height	305 x 135 x 70 mm
Weight	2220 g
Protection class	IP44

Battery capacity 12 V: 50-450 Ah (charging), 50-500 Ah (maintenance)
Battery capacity 24 V: 25-230 Ah (charging), 25-230 Ah (maintenance)

Application range
for all standard vehicle batteries (WET/MF/GEL/EFB/AGM/Ca-Ca)

Scope of supply
equipped with brackets and eyelets

Order no
9539 111 640

Battery tester

usage without battery disassembly, with reverse polarity protection and illuminated display, reliable information about the battery level at the push of a button, checks battery charge in V, cold-start system, current in A of 0.01-700 charge level in %

Version	digital
Protection class	IP54

Application range
For acid batteries, EFB batteries, AGM batteries, gel batteries, also for deeply discharged batteries > 8 V usable

Order no
9009 734 041

Battery tester

T11, with integrated thermal printer

reinforced casing shell, rubberised anti-scratch plastic coating, graphic display with touchscreen for easy operation, connection to PC possible with USB cable, enables saving or digital sending of data, customer information - such as VIN-number, registration number, battery type etc. - can be entered and printed on request, memory function stores up to 70 readout data sets, maintenance-free, functions without internal battery, grounding test (only 12 V), internal battery resistor test (12 V), starter test (12 V and 24 V), generator test (12 V and 24 V)

Voltage	12/24 V
Operating temperature	0-50 °C

Application range
EFB (Enhanced Flooded Battery), AGM (Absorbent Glass Mat), 6/12 V starter battery (lead acid, gel and fibrous-mat batteries/AGM)

	Order no
	9539 640 020

Accessories

Description	Order no
Printer paper roll for battery tester T11	**9539 640 024**

Diagnosis unit

NAVIGATOR TXTs

Truck identification by VIN or engine code, automatic fault-memory scan of all common systems, read and delete fault-memory entries and display fault code descriptions, query technical notifications and data, electrical circuit board with component layout, optional access to the TEXA database via Google® search function, query status messages and parameters, implement settings and coding, control of actuators, parametrisation and initialisation of ABS and EBS systems, wireless Bluetooth communication with the diagnostic interface, expansion through measurement technology module, software integration available for cars, motorcycles, agricultural and construction machinery as well as marine, automatic update function

Cortex M3 Processor, 8 Mbit SRAM, 1 GB NAND-flash memory, power supply 8 to 32 V, typical current consumption at 12 V-0.25 A/24-0,18A, Bluetooth Class 1 with 30 m range, Pass-THRU capable as per SAE J2534

Scope of supply
Diagnostic interface NAVIGATOR TXTs, Diagnostic software IDC5 Truck Plus, USB Hardware key, TEXPACK Truck update contract for 12 months, TEXINFO Call Centre diagnostic assistance by telephone for 12 months, TEXINFO technical notification access for 12 months, TEXINFO Google® search function access for 12 months, UBS-connection cable, EOBD cable, supporting strap for navigator, storage case, operating instructions

	Order no
	9539 003 639

Accessories

Description	Order no
Laptop	**9189 945 090**

TEXA

Oscilloscope

Uniprobe Truck

Module for measuring electrical quantities with USB connection or Bluetooth, the measurements available are multimeter, battery efficiency test and starter/generator circuits (2nd generation), physical/electrical control of CAN networks (2nd generation), high voltage test, integrated ignition coils, misfire and traditional pressure tests, signal generator.

Version 4-channel oscilloscope

Scope of supply
Strap, manual and software
Ampere clamp BICOR3
- 10 mV/A from 0 to 200 A
- 1 mV/A from 0 to 1200 A

absolutely vital for testing the starting and charging systems on vans and commercial vehicles
Ampere clamp BICOR4
- 1 V/A from 0 to 3 A
- 0.1 V/A from 0 to 30 A

absolutely vital for all lost current tests

Order no
9539 003 363

PREMIUM-WERKZEUGE
KS TOOLS
PREMIUM TOOLS

Digital multimeter

with basic measurement functions, set of measurement cables with test probes (red/black), central rotary switch, 3 1/2 figure display, state of charge indicator in display, with stand, in protective rubber holster

Version	continuous current, DC and AC voltage, resistance, diode check (with acoustic signal), transistor check, continuity test (with acoustic signal), data hold function
Operating temperature	0 to +40 °C
Overall length	138 mm
Width	69 mm
Depth	31 mm

fuse protection S1 (fine current) 200 mA/250 V
AC voltage 600 V
DC voltage 600 V
Direct current 10 A
Storage temperature -10 to +50 °C
Temperature for measuring accuracy 23 ± 5 °C

Order no
9501 501 495

The technical information and tips for use in practice were compiled in order to professionally support motor vehicle garages in their work. The information provided here should only be used by appropriately trained qualified staff.

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