

Introduction of the smart fortwo electric drive (3rd generation) Model series 451

Introduction into Service Manual



Introduction of the smart fortwo electric drive (3rd generation) Model series 451

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Dear Reader,

This Introduction into Service Manual presents the 3rd generation of the smart fortwo electric drive of model series 451.

The purpose of this brochure is to acquaint you with the technical highlights of this new vehicle in advance of its market launch. This brochure is intended to provide information for people employed in service or maintenance/repair as well as for aftersales staff. It is assumed that the reader is already familiar with the Mercedes-Benz and smart model series currently on the market.

In terms of the contents, the emphasis in this Introduction into Service Manual is on presenting new and modified components and systems.

This Introduction into Service Manual is not intended as an aid for repairs or for the diagnosis of technical problems. For such needs, more extensive information is available in the Workshop Information System (WIS) and in the Diagnosis Assistance System (DAS).

The content in WIS is updated. Therefore, the information available there reflects the latest technical status of our vehicles.

This Introduction into Service Manual presents initial information relating to the 3rd generation of the smart fortwo electric drive in model series 451 and, as such, is not stored in WIS. The contents are not maintained and there is no provision for updates.

We will publicize modifications and new features in the relevant WIS documents. The information presented in this Introduction into Service Manual may therefore differ from the more up-to-date information found in WIS.

All information relating to technical data, equipment and options is valid as of the copy deadline in February 2012 and may therefore differ from the current production configuration.

Daimler AG

Technical Information
and Workshop Equipment (GSP/OI)

Overview

Vehicle concept

The 3rd generation smart fortwo electric drive is a series produced passenger car which is solely powered by electrical means. The 3rd generation of the smart fortwo electric drive is available in right-hand and left-hand drive versions in the coupé and cabrio models.

With a new high-voltage battery, the 3rd generation of the smart fortwo electric drive makes a significant contribution to conserving fossil fuels and reducing emissions during driving operation.

With a range of roughly 150 km, the smart fortwo electric drive thus represents an ideal alternative for mobility requirements in urban areas and is a further step towards the electromobility of the future.

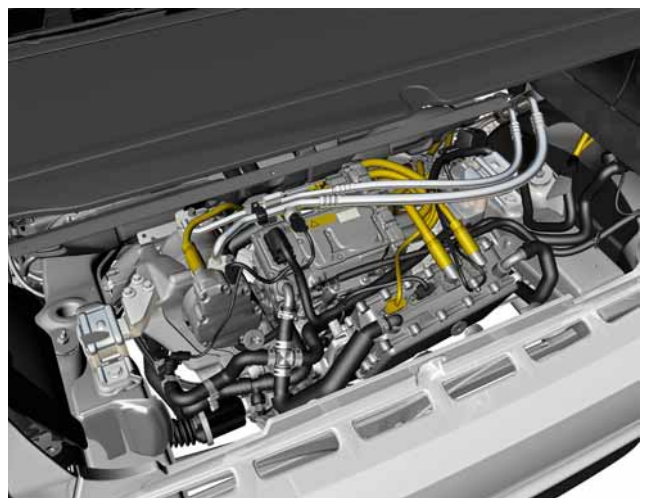
Thanks to standardised charging components, the smart fortwo electric drive can be charged at any household power outlet or on public charging infrastructure.



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Innovations

- Water-cooled 3-phase AC motor with 35 kW continuous output and 55 kW peak output
- Single stage transmission with integrated bevel gear differential
- Water-cooled high-voltage battery (lithium-ion battery) of the latest generation with high energy density
- Charging of high-voltage battery through regenerative braking
- Electrically powered refrigerant compressor for interior and battery cooling (only with code (V03) Battery cooling system)
- High-voltage PTC heater for interior heating
- Pre-heating/cooling of interior compartment (pre-conditioning)

With a maximum torque of 130 Nm and acceleration boost, the powerful electric motor provides good driving performance and responsiveness.

Due to the output characteristics of the electric motor, the smart fortwo electric drive only requires a single fixed transmission ratio. This makes gearshifting unnecessary. The motor changes its direction of rotation for reverse travel.

The high-voltage battery is installed between the axles in the underfloor instead of a fuel tank. The electric drive does not result in any space-related limitations for the smart fortwo electric drive; the interior compartment and trunk are exactly the same size as on a smart fortwo with combustion engine.

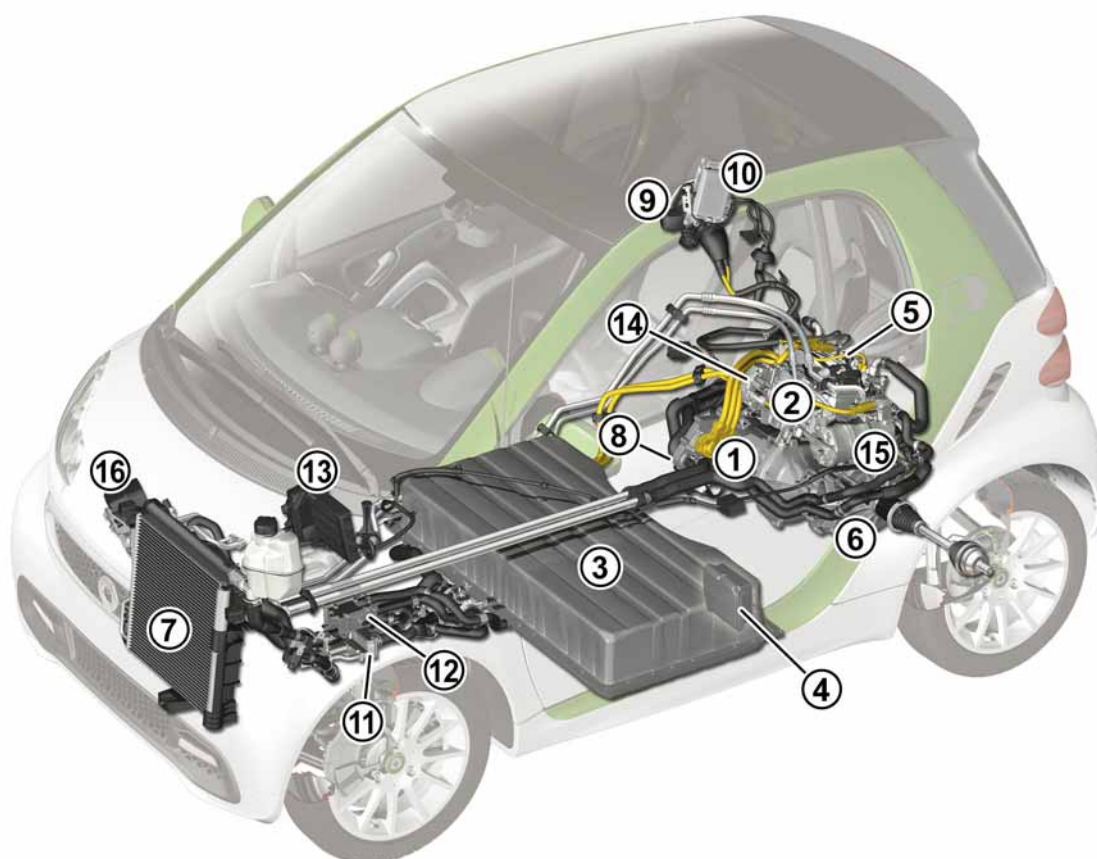


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Electric drive system of smart fortwo electric drive

Overview

Model 451	Model	Motor
smart fortwo electric drive coupé	451.390	780.993
smart fortwo electric drive cabrio	451.490	780.993



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smart fortwo electric drive coupé

- | | |
|--|--|
| 1 Electric motor | 10 Drivetrain control unit |
| 2 Power electronics control unit | 11 High-voltage battery heat exchanger (chiller) |
| 3 High-voltage battery | 12 High-voltage battery heater |
| 4 Battery management system control unit | 13 Interior high-voltage PTC heater |
| 5 On-board charger | 14 High-voltage adapter plate fuse box |
| 6 Transmission | 15 Electric refrigerant compressor |
| 7 Cooling module | 16 Electric vehicle sound generator |
| 8 Brake booster vacuum pump | |
| 9 Charger feed-in socket | |

	Unit	smart fortwo electric drive 3rd generation	smart fortwo electric drive 2nd generation	smart fortwo 52 kW gasoline engine mhd/passion
Performance				
Maximum speed	km/h	125	100	145/155 ³
Acceleration 0–100 km/h	s	11.5	26.7	13.7
Range as per NEDC	km	> 145	> 135	760 ¹ /750 ²
Range as per UDDS	miles	> 100	91	—
CO ₂ emissions	g/km	0	0	98 ¹ /100 ²
Consumption as per NEDC	kWh/100 km	13.3	18.2	—
Consumption as per NEDC	l/100 km	—	—	4.3 ¹ /4.4 ²
Consumption as per UDDS	mpg	—	—	33 ³
Dimensions				
Vehicle length	mm	2695		
Vehicle width	mm	1559		
Vehicle height	mm	1565		
Wheelbase	mm	1867		
Front track width	mm	1283		
Rear track width	mm	1385		
¹ coupé ² cabrio ³ USA 52 kW passion				

Technical data

	Unit	smart fortwo electric drive 3rd generation	smart fortwo electric drive 2nd generation	smart fortwo 52 kW gasoline engine mhd/passion
Dimensions and weights				
Curb weight (as per DIN/EPA)	kg	900 ¹ /920 ²	900 ¹ /920 ²	750 ¹ /790 ²
Curb weight (as per US Curb-Weight)	kg	950 ¹ /970 ²	945 ¹ /965 ²	835 ¹ /855 ²
Permissible gross vehicle weight	kg	1150	1120	1020/1070 ³
Maximum payload ECE	kg	250 ¹ /230 ²	220 ¹ /200 ²	270 ¹ /230 ²
Maximum payload USA	kg	190 ¹ /180 ²	205 ¹ /185 ²	235 ¹ /215 ²
Trunk capacity	l	220		
¹ coupé ² cabrio ³ USA 52 kW passion				



	Unit	smart fortwo electric drive 3rd generation	smart fortwo electric drive 2nd generation
High-voltage battery			
Design	—	Lithium-ion battery	
Max. output	kW	63	30
Continuous output	kW	42	20
Energy content	kW/h	17.6	16.5
Rated voltage/max. voltage	V	339/391	—
Rated capacity	Ah	52	—
Weight	kg	approx. 175	approx. 150
Electric motor			
Motor model designation	—	780.993	780.009
Design	—	Permanently energized 3-phase AC motor	
Max. output/continuous output	kW	55/35	30/20
Peak torque	Nm	130	120
Max. rpm		11,800	12,000
Power transmission			
Drive	—	Rear wheel drive	
Transmission	—	New single stage transmis- sion with integrated bevel gear differential	Modified single stage transmission from smart fortwo with conventional drive system
Transmission ratio	—	9.922:1	9.77:1

Maintenance

Maintenance concept

The maintenance concept mainly differs in terms of the maintenance performed on the drive system. In contrast to a vehicle driven by a combustion engine, the electric drive is largely maintenance free.

In addition to a visual inspection for damage and leaks as well as checking, refilling or replacing operating fluids and electronic battery testing, only the desiccant cartridge of the high-voltage battery has to be replaced.

Maintenance interval display

The maintenance interval display is located in the multifunction display of the instrument cluster. The maintenance interval is displayed here in the form of two wrench symbols.

The remaining time is shown in days roughly one month before a service date.

The remaining distance is displayed as of 1000 km.

Service indicator:



Service in XXX km



Service in XX days

Maintenance interval

The maintenance interval for the smart fortwo electric drive is specified as follows:

1 year or 20,000 km



Note

One special consideration is that the number of operating hours of the brake booster vacuum pump must be checked using **DAS** as part of servicing at the following intervals:

- Up to 4 years/125,000 km: every 2 years
- After 4 years/125,000 km: annually



Note

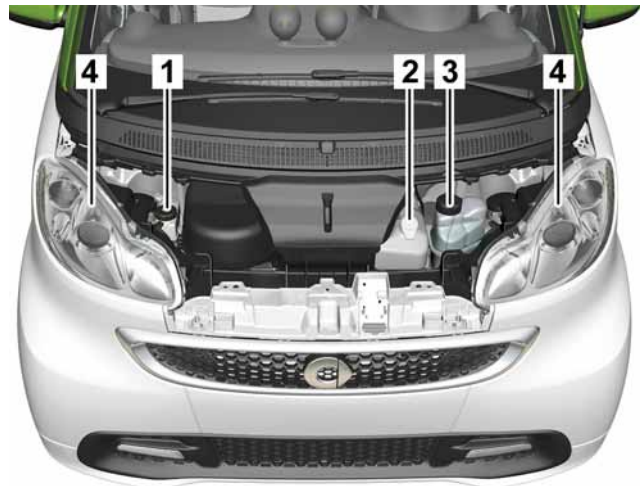
The desiccant cartridge in the high-voltage battery module must be replaced every 2 years or every 40,000 km.



Maintenance items at front

The following maintenance items are accessible via the front service flap:

- 1 Brake fluid reservoir
- 2 Windshield washer fluid reservoir
- 3 Coolant expansion reservoir
- 4 Lamp unit for bulb replacement

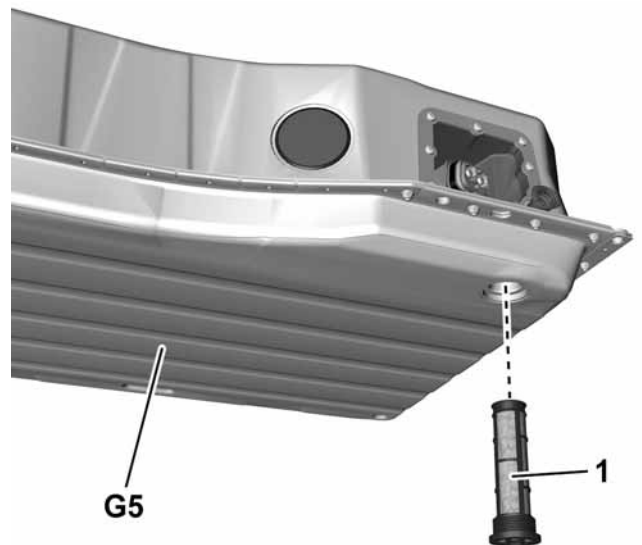


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High-voltage battery desiccant cartridge

The desiccant cartridge is located on the underside of the high-voltage battery under the connection for the high-voltage lines on the right in the direction of travel:

- 1 Desiccant cartridge
- G5 High-voltage battery



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Towing

Notes on towing

The vehicle can be towed at a maximum speed of 50 km/h for a distance of up to 50 km.

Prerequisite:

- Ignition "ON"
- Selector lever in position "N"

The vehicle must be loaded on to a suitable means of transport if one of the following events occurs:

- One or more red warning lamps (e.g. high-voltage battery, drive diagnosis, 12 V battery) lights up on the instrument cluster
- Increased or pulsating braking effect

If a fault in the high-voltage system is detected, the message "Do not tow" is also shown on the multifunction display.



Warning

If the vehicle is towed at a speed greater than 50 km/h, there is a risk that the electric drive or high-voltage battery may overheat.



Warning

If the instrument cluster display is not operational (e.g. if 12 V battery is empty), the vehicle may **not** be towed!

On-board electrical system/power supply

The power supply in the smart fortwo electric drive is provided via two separate on-board electrical systems:

- High-voltage on-board electrical system with high-voltage battery

The high-voltage battery is charged via the on-board charger when connected to an external power supply.

In deceleration mode and when braking, the high-voltage battery is charged through regenerative braking and the electric motor then operates as a generator.

- 12 V on-board electrical system with 12 V battery

The 12 V on-board electrical system is supplied with power by a DC/DC converter in the power electronics control unit. The DC/DC converter transforms the high direct voltage from the high-voltage on-board electrical system into 12 V direct voltage. The power electronics control unit thus performs the task of the alternator on a vehicle with combustion engine.

Information on the high-voltage system

General

The high-voltage system consists of several components. The individual components are connected by high-voltage-carrying electrical lines. The high-voltage on-board electrical system is a fully insulated network. Neither the positive terminal nor the negative terminal are connected to the vehicle ground.

Note

Identification of high-voltage components and high-voltage lines

Every component of the high-voltage on-board electrical system installed in the vehicle is identified by a yellow warning sticker. All electrical lines conducting high voltages are marked by a warning color (orange).



Warning sticker

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On-board electrical system/power supply



DANGER

Due to the high-voltage technology, electrical lines and components which operate under high voltage are used in the vehicle. Accordingly, work on the vehicle may only be performed by specially trained mechanics.

Special care must be taken at all areas of the vehicle which are linked to the high-voltage system e.g. parts in the engine compartment. Orange-coloured lines and their connectors conduct high-voltage and may not be damaged.

You could be seriously or fatally injured if you

- Remove covers from components which are identified with a warning sticker
- Tamper with components of the high-voltage on-board electrical system
- Open housings
- Disconnect connectors
- Touch components or orange-coloured lines of the high-voltage on-board electrical system on a vehicle involved in an accident
- Touch damaged orange-coloured lines or their damaged connectors
- Touch damaged components of the high-voltage on-board electrical system.

Do not remove covers for components of the drive system which are marked with a warning sticker.

Do not tamper with components or orange-coloured high-voltage cables of the drive system.

When performing general work, e.g. changing bulbs or checking the coolant level, ensure that

- The ignition is switched off
- The charging cable for charging the high-voltage battery is not connected.

Shutting off the high-voltage on-board electrical system

The high-voltage on-board electrical system must be able to be shut off in an accident or for servicing. For this purpose, the high voltage output of the high-voltage battery can be disconnected from the high-voltage on-board electrical system by contactors which are actuated by the battery management system control unit.

The pyrofuse and Service Disconnect plug are connected in series in the control line of the contactors.

Note

The procedure for deenergizing the system is described in the chapter "Deenergisation" as of page 48.

Service

During servicing, the control line of the contactors is physically disconnected by disconnecting the Service Disconnect plug. The high-voltage output remains permanently deactivated and can no longer be switched on by the battery management system control unit.

Accident

In the event of an accident, the high-voltage on-board electrical system can either be shut off by the high-voltage crash sensor control unit or the restraint system control unit.

Shutoff by restraint system control unit

If the restraint system control unit triggers the airbags in an accident, the pyrofuse in the control line of the contactors is also triggered. The control line is then physically disconnected. The high-voltage output remains irreversibly deactivated.

Shutoff by high-voltage crash sensor control unit

The high-voltage crash sensor control unit is located under the left-hand seat on the vehicle floor. It shuts off the high-voltage on-board electrical system in the following conditions:

- During charging: in the event of a stationary crash
- During driving operation: in the event of a rollover

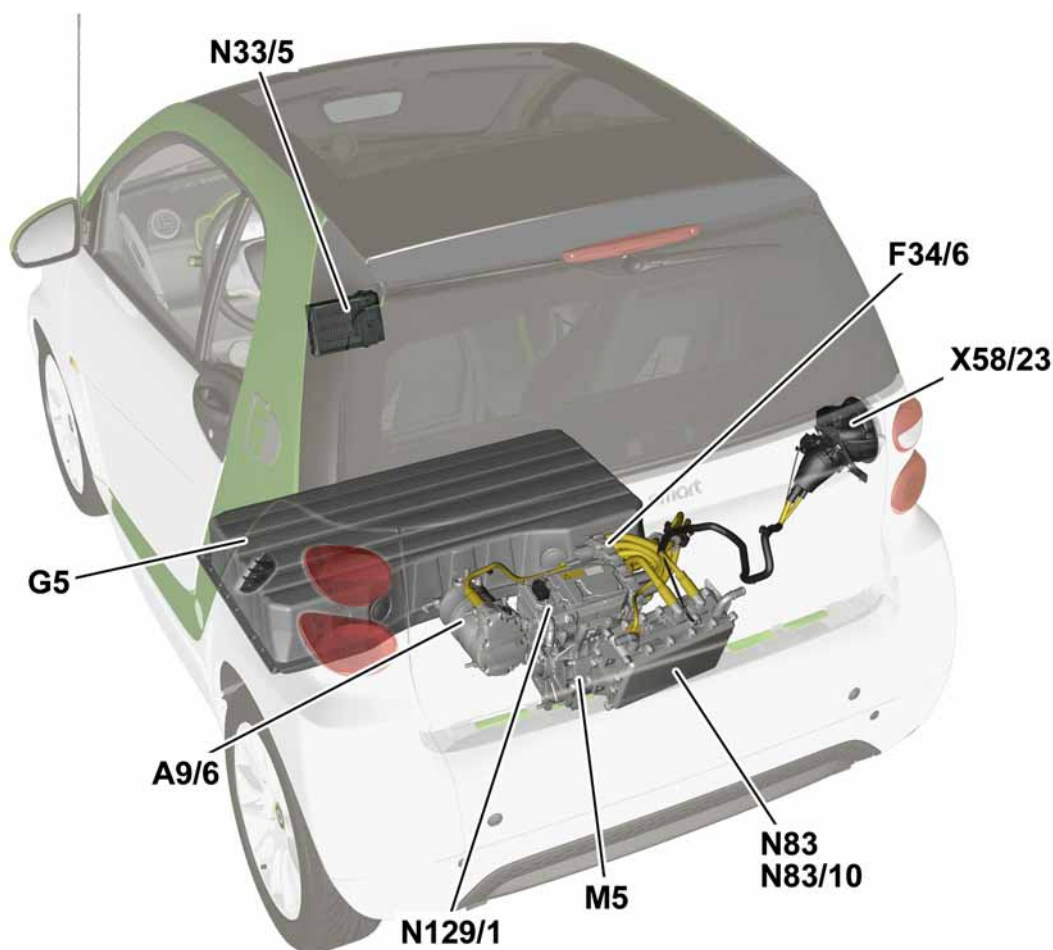
The high-voltage on-board electrical system and the high-voltage crash sensor control unit are also active during pre-conditioning on a parked vehicle. The high-voltage crash sensor control unit causes the battery management system control unit to shut off the contactors by means of a signal on the CAN bus. This shutoff of the high-voltage on-board electrical system is reversible.

On-board electrical system/power supply

Overview of high-voltage components

The high-voltage on-board electrical system on the smart fortwo electric drive consists of the following high-voltage components:

- Electric drive motor
- Power electronics control unit
- High-voltage battery
- Electric refrigerant compressor
- High-voltage PTC heater
- High-voltage adapter plate fuse box
- On-board charger

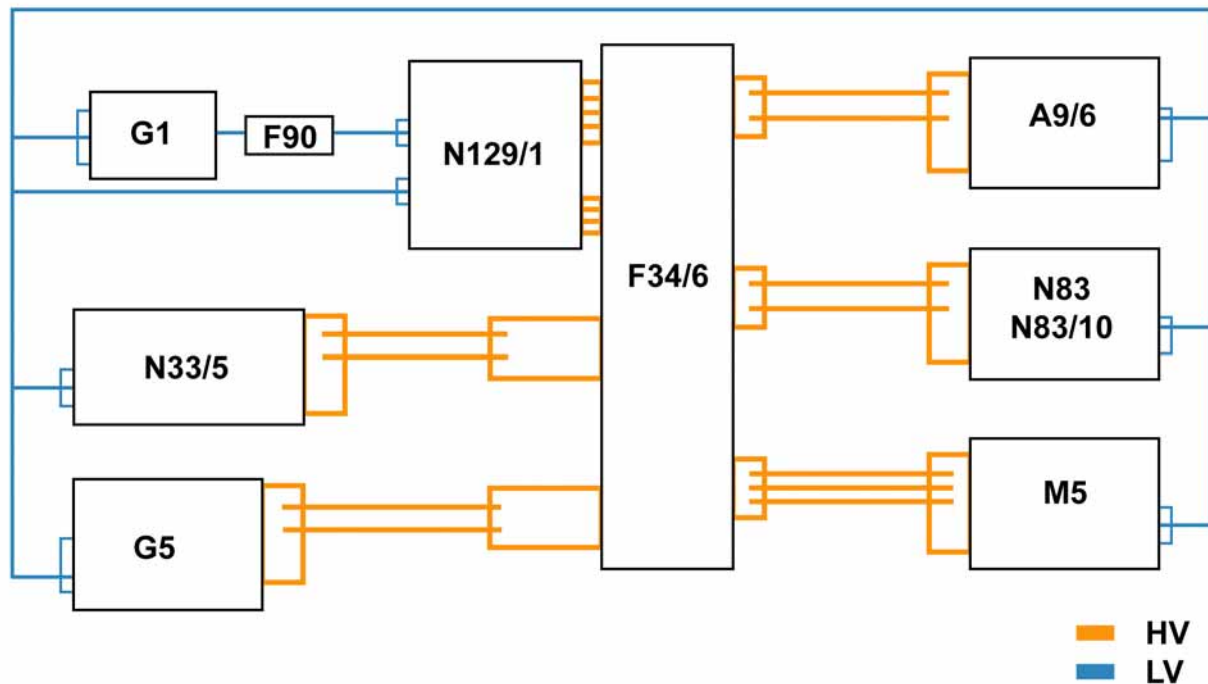


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A9/6	Electric refrigerant compressor
F34/6	High-voltage adapter plate fuse box
G5	High-voltage battery
M5	Electric drive motor
N33/5	High-voltage PTC heater

N83	On-board charger 3kW
N83/10	On-board charger 22 kW (with code (908) 22 kW on-board charger)
N129/1	Power electronics control unit
X58/23	Charger feed-in socket

Topology of high-voltage/12 V on-board electrical systems



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A9/6	Electric refrigerant compressor
F34/6	High-voltage adapter plate fuse box
F90	12 V charge line prefuse
G1	Battery (12 V)
G5	High-voltage battery
M5	Electric drive motor
N33/5	High-voltage PTC heater
N83	On-board charger 3kW
N83/10	On-board charger 22 kW (with code (908) 22 kW on-board charger)
N129/1	Power electronics control unit

HV	High-voltage
LV	Low-voltage (12 V)

On-board electrical system/power supply

General activities

Repair, maintenance and diagnosis activities on vehicles with high-voltage system may only be performed by qualified staff (the minimum qualification required is high-voltage awareness training).

Deenergization of the high-voltage system before operations are carried out on the vehicle and subsequent initial startup after the operations have been performed may only be carried out by one and the same **electrical specialist for high-voltage systems in motor vehicles (series production vehicles)**. The following preconditions must be met:

- Successful completion of the high-voltage awareness course
- Successful completion of the high-voltage qualification course
- Successful completion of the smart electric drive product training course

Working requirements

When work is performed on a high-voltage system, the system must be deenergized and the voltage-free state of the high-voltage system must be secured.

This has to happen in accordance with 5 safety rules as per DIN VDE 0105:

- Deenergize
- Secure against reactivation
- Check deenergisation at all terminals
- Ground and short circuit
- Cover or shield any adjacent current-conducting parts

The following information must be observed and complied with for operations on high-voltage systems:

- Testing equipment and aids must be checked for proper condition before use
- Cable lugs and contacts must be secured with suitable protective bags and insulating caps
- Contacts, electrical lines and electrical connectors must be checked for dirt and damage before assembly and they must be cleaned or replaced if necessary
- Screw contacts must be tightened to the specified tightening torque and (if applicable) rotation angle

On-board electrical system/power supply

Evaluation of high-voltage components

Wiring harness check:

If the chafe protection or the lines are damaged by external influences (e.g. animal bites), the lines must be replaced immediately. Repair is not permissible.

Check after an accident:

The high-voltage system must be checked for external damage and defects. If defects (e.g. loss of electrical insulation) or external damage is found on the high-voltage components or lines, they must be replaced. Repair of the high-voltage components or lines is not permissible.

Safety function after an accident:

High-voltage system shut off

- Automatic shutoff of the high-voltage battery and discharge of the high-voltage components takes place via the high-voltage crash sensor control unit:
 - During charging: in the event of a stationary crash
 - During driving operation: in the event of a rollover
- Automatic shutoff takes place via the restraint system control unit after triggering of the emergency tensioning retractors (stage 1) or the front airbags (stage 2) through simultaneous triggering of the pyrofuse.

High-voltage battery

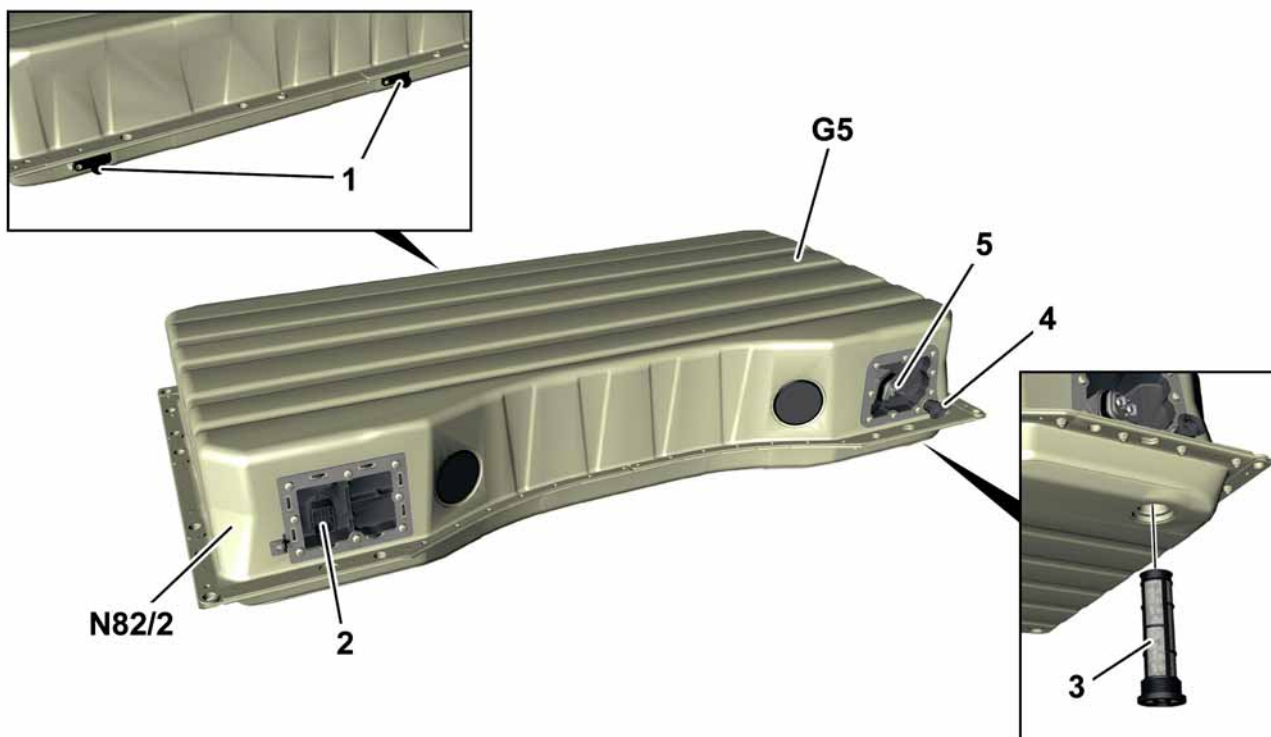
The high-voltage battery is installed under the passenger cell and consists of the following components:

- 3 modules of lithium-ion cells of the latest generation connected in series
- Electronic modules for cell monitoring
- Battery management system control unit (N82/2)
- Contactors for disconnecting/connecting the high voltage output
- High-voltage on-board electrical system connection
- 12 V on-board electrical system connection
- Cooling system
- Coolant line connections
- Desiccant cartridge
- Vent hose connection

When fully charged, the high-voltage battery supplies an output voltage of approx. 391 V. The high-voltage output can be disconnected from the high-voltage on-board electrical system by contactors actuated by the battery management system control unit. The high-voltage battery also supplies 12 V on-board electrical system with power via the DC/DC converter in the power electronics control unit.

i Note

The high-voltage battery is locked in the delivery condition and has to be enabled through initial startup in DAS.



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High-voltage battery module

- 1 Coolant line connections
- 2 12 V on-board electrical system connection
- 3 Desiccant cartridge
- 4 Vent hose connection
- 5 High-voltage on-board electrical system connection

G5 High-voltage battery
N82/2 Battery management system control unit

High-voltage battery

The permissible operating temperature of the high-voltage battery is $-25\text{ }^{\circ}\text{C}$ to $+55\text{ }^{\circ}\text{C}$.

The service life of the high-voltage battery is reduced by high temperatures.

The high-voltage battery is thus cooled by a coolant circuit under normal operating conditions.

On vehicles with code (V03) Battery cooling system there is also a heat exchanger with the refrigerant of the air conditioning system (chiller) in the coolant circuit of the high-voltage battery.

The capacity of the high-voltage battery and thus its power consumption characteristics drop off heavily at low temperatures. As a result, at temperatures below $0\text{ }^{\circ}\text{C}$ the high-voltage battery is heated during charging by a 12 V PTC heater (high-voltage battery heater) in the coolant circuit of the high-voltage battery.

The temperature of the high-voltage battery is recorded by the battery management system control unit via temperature sensors and cooling/heating mode is initiated as necessary.

In order to comply with the maximum permissible air humidity level, a desiccant cartridge is installed below the high-voltage connection at the bottom right of the high-voltage battery.

Note

The desiccant cartridge must be replaced every 2 years or every 40,000 km.

Discharged high-voltage battery

If the high-voltage battery is fully discharged, the drive system shuts off.

Note

The drive system can be briefly reactivated once by switching the ignition off and on in order to move the vehicle a few metres outside of a possible hazard area.

High-voltage battery

Information on high-voltage battery

If used according to specifications, the high-voltage battery presents no danger.

Information on safe handling

- Risk of short circuit - Avoid physical damage (pressure)
- Risk of self-ignition
Thermal load (avoid the effect of heat/welding; painting work/force drying up to max. 60 °C)
- Risk of injury due to the formation of poisonous and corrosive gases
- In addition to safety shoes, also wear personal protective equipment as per the information in the repair instructions.

General information on transport

High-voltage batteries are hazardous goods and are classified as "UN 3480 Lithium-ion battery, class 9, packaging group II" in accordance with international hazardous goods regulations. High-voltage batteries may only be transported in accordance with the applicable international and national hazardous goods regulations for the respective mode of transport. Every high-voltage battery must be checked for transport safety in the workshop. Defective or damaged high-voltage batteries must be classed as NOT safe for transport if following points apply to the transport:

- There is a possibility of dangerous exposure to heat
- The high-voltage battery can cause fires or short circuits
- Danger can occur in another way e.g. due to the release of fluid electrolyte or dangerous vapors.

Note

High-voltage batteries which are damaged during use or accident must be inspected and tested by an electrical specialist for HV systems in motor vehicles (series production vehicles). Damaged high-voltage batteries may **not** be installed in a vehicle.

Note

Shipping must be carried out/arranged by a logistics employee who is trained to deal with hazardous materials, hazardous substances and packaging.

Requirements for storage areas and containers

Used or defective high-voltage batteries with lithium-ion technology still contain a high level of electrical and chemical energy in the form of electrolytes. Since the condition of the battery is no longer monitored by the internal battery management system during storage, appropriate precautionary measures must be taken.

The storage requirements depend on the condition of the high-voltage battery as per the assessment protocol in WIS for evaluating transportability.

A distinction is made between:

- Storage of high-voltage batteries which are safe for transport/undamaged
- Storage of high-voltage batteries which are not safe for transport/damaged

and in the case of high-voltage batteries which are safe for transport/undamaged, the following distinction is made based on fire protection requirements:

- Storage with sprinkler protection and
- Storage without sprinkler protection

Storage of high-voltage batteries which are safe for transport in storage facilities with sprinkler protection

When storing high-voltage batteries in storage areas with sprinkler protection¹, the following requirements must be taken into account:

- They must be stored at a distance of 2.50 m from other stored materials. Alternatively a partition wall made of non-combustible material can be installed. The partition wall must be at least 1 m higher than the material stored adjacent to it.
- The maximum surface area of parts storage areas is 75 m²
- Maximum storage height 1.60 m, or
- Storage in protected storage racks (e.g. HHS 4 as per VdS CEA 4001)

¹ The ceiling sprinkler system must be designed as per the applicable sizing requirements for sprinkler systems (e.g. VdS CEA 4001), packaging must be taken into account

High-voltage battery

Storage of high-voltage batteries which are safe for transport in storage facilities without sprinkler protection

Due to fire protection requirements, if no sprinkler protection system is installed, high-voltage batteries should wherever possible always be stored in specially partitioned fire-resistant rooms of category F90. Alternatively, individual batteries can be stored in fire-resistant hazardous goods cabinets of category F90 as long as no other materials are stored in them. If there is no appropriate facility in the building, the batteries must be stored outside of the building at a distance of more than 5 m from other buildings or combustible materials. The following points must also be observed for storage outside the building:

- Presence of weather protection (roof) to protect against wet weather or direct sunlight
- Liquid-resistant ground surface or collecting pan
- Protection from access by unauthorised persons

Handling and storage of high-voltage batteries which are not safe for transport

High-voltage batteries which are damaged during operation or an accident may represent a hazard to their surroundings depending on the level of damage. In the event of fire or smoke formation, the fire department must be informed immediately and a safe distance must be maintained. If the risk of acute danger can be ruled out, a high-voltage battery which has been diagnosed as not safe for transport may only be removed from a vehicle after consultation with the relevant MPC/general distributor and after provision of a special container.

Until removal is carried out, the vehicle must, where possible, be parked outside by a qualified employee of the technical field service (TAD) or a qualified mechanic. It is important to ensure that any electrolyte which escapes cannot enter the soil by parking the vehicle over an impermeable floor/ground surface or a collecting pan.

High-voltage batteries which are not safe for transport are stored in a leakproof metal container which is half-filled with vermiculite (non-combustible, absorbs escaping electrolyte).

High-voltage battery

Various model-specific containers can be ordered from the GLC for all high-voltage batteries. A container for storing the high-voltage battery from BR 451 can be ordered with part number Q451BOX207680 after consultation with the MPC/general distributor.

After removal and storage in the special container, the high-voltage battery must be stored in a marked storage location outside of the building until special transport approval is received.

In this case, the following points must always be observed:

- Presence of weather protection to protect against wet weather or direct sunlight
- Liquid-resistant ground surface or collecting pan
- Protection from access by unauthorised persons
- Storage at a distance of > 5 m from buildings or combustible materials

The relevant MPC/general distributor will clarify the further procedure after consultation with the relevant product support team at GSP.

High-voltage battery

High-voltage batteries which are safe for transport

High-voltage batteries which are safe for transport may only be transported in original packaging and the high-voltage battery must be packed in the same way as it was delivered. The following minimum requirements must be observed:

- The high-voltage battery must be safeguarded against external short circuits through the use of insulating caps
- All of the openings on the high-voltage battery, particularly the coolant connections, must be sealed
- The high-voltage battery housing must be free from soiling on the outside

All requirements with regard to flawless condition of the packaging, sealing of the packaging, the identification of the packaging as per the relevant dangerous goods regulations, as well as additional requirements with regard to transport must be observed.

High-voltage batteries which are not safe for transport

A high-voltage battery is **not safe for transport** in the following circumstances:

- High-voltage battery is not diagnosis-capable
- Insulation fault
- Status of contactors is "closed" (high-voltage output energised)

Visual inspection:

- Crack in housing
- Housing deformed
- Housing tarnished
- Electrolyte leakage
- High-voltage contacts damaged

High-voltage batteries which are not safe for transport may only be transported via road or sea with an exemption from the relevant national authority and where the conditions described in the exemption are complied with in full.

Note

Shipping must be carried out/arranged by a logistics employee who is trained to deal with hazardous materials, hazardous substances and packaging.

Note

The transport of high-voltage batteries which are not safe for transport via air is forbidden under any circumstances!

All components of the smart fortwo electric drive which are involved in the charging process (on-board charger, charge socket, charging cable) have been standardised in line with future requirements in accordance with international standards (e.g. IEC62196-2). This allows for simple charging on a wide range of power grids and charging infrastructures.

Charging process:

The entire charging process is monitored. The on-board charger and the power source (charging station) communicate via a data line in the charging cable (Control Pilot, CP). In the process, the signals "ready", "not ready" and "charge" are transmitted. In the case of intelligent charging stations, digital communication also takes place via Powerline (PLC - Powerline Communication) on lines L1 and N. For this purpose, data are transferred as per the protocol specified in ISO/IEC 15118.

When charging at a household power outlet, the charging current may have to be limited in order to avoid overloading the local power grid.

The maximum permissible charging current can therefore be set via the control box on the charging cable or alternatively via the multifunction display in the vehicle.

The last selected value is retained on the multifunction display until the next change is made.

The exact charging process and the various charging options are described in the current operating instructions.

When the connector of the charging cable is plugged into the charger feed-in socket, the on-board charger wakes the control units involved in the charging process via CAN bus.

On-board charger

The on-board charger is located between the drive unit and the rear end panel and converts the alternating current of an external power supply into direct current for charging the high voltage battery. Integrated in the on-board charger is the Powerline Gateway, which is required for "Smart Charging".

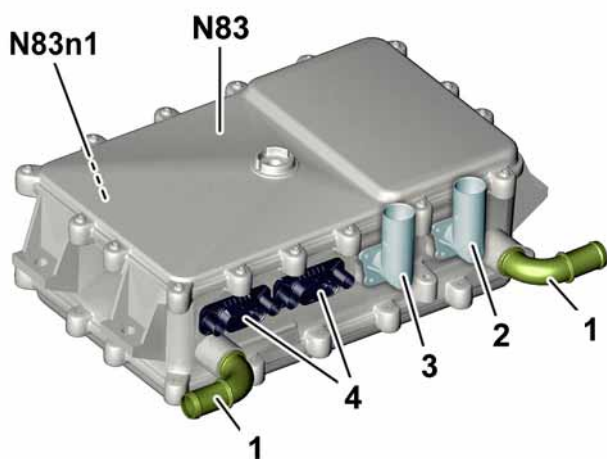
As soon as an external power supply is connected with a charging cable, the on-board charger communicates with the control box in the charging cable/charging station over a discrete control line (Control Pilot). Here, the output data of the charging infrastructure is transmitted and the power consumption of the on-board charger is adjusted accordingly. Only then does the on-board charger initiate the charging process. In the case of intelligent charging stations, additional communication takes place via the Powerline Gateway on phase L1 and the neutral wire N.

Connections:

- High-voltage output (direct voltage)
- High-voltage input (AC voltage)
- 12 V on-board electrical system
- Control system (CAN)
- Coolant lines

Since the maximum possible charging current depends on the charging cable or is determined by the charging station, the smart fortwo electric drive with both versions of the on-board charger can be charged both at a household power outlet or at a public charging station or wallbox (Smart Charging).

The control unit of the on-board charger communicates with the battery management system control unit and the drivetrain control unit over a CAN connection.



P54.10-3681-00

Onboard charger 3 kW

- | | |
|---|---|
| 1 | Coolant circuit connections |
| 2 | Charge socket high-voltage connection |
| 3 | High-voltage on-board electrical system high-voltage connection |
| 4 | 12 V on-board electrical syst./CAN connector |

N83 On-board charger 3kW

N83n1 Powerline Gateway

On-board charger

Two different on-board chargers are used in the smart fortwo electric drive:

On-board charger with 3 kW max. at 230 V (standard)

Input: 100 to 240 V_{AC}

Output: Approx. 380 V_{DC}

Charging duration at 13 A
(e.g. household power outlet):

7h (0–100% SOC) at +25 °C

Charging duration at 16 A
(e.g. charging station or wall box):

6 h (0–100% SOC) at +25 °C

On-board charger 22 kW with 3 x 400 V/32 A (with code (908) 22 kW on-board charger)

Input: 3 x 400 V_{AC}

Output: Approx. 380 V_{DC}

Charging duration:

1h (0–100% SOC) at +25 °C

On-board charger

Powerline Gateway (PLGW)

The Powerline Gateway is integrated in the on-board charger for communication via the power lines (PLC – Powerline Communication). This can connect the vehicle both to an intelligent charging station and to the Daimler Vehicle Backend (via Internet). PLC as per the Homeplug AV-Standard is used here. Communication takes place via phase L1 and the neutral wire N.

The Powerline Gateway can establish a connection to the Daimler Vehicle Backend and provide vehicle data for the Vehicle Homepage. To do so, the vehicle must be connected to the Internet via Powerline Communication.

The customer requires a commercially available Powerline socket adapter based on the "Home-Plug AV" standard for this purpose. This must be equipped with an encryption button in order to be able to configure it for communication with the vehicle. The adapter is connected to the power grid and the Internet connection of the customer e.g. by connection to their DSL router.

Configuration of the PLGW is initiated by entering the appropriate information on the instrument cluster and completed by pressing the encryption button on the Powerline socket adapter.

If the customer already has a Powerline networked installed, the vehicle can also be integrated into this network.



Note

Powerline Communication (PLC) is a generic term for the transmission of data over power lines. Here, current-conducting lines are used simultaneously both for power supply purposes and for data transfer.

Smart Charging

The PLGW is used to integrate the smart fortwo electric drive into intelligent charging infrastructure. This means that the charging process of the vehicle is adjusted to the power quantity available in the grid e.g. in order to make optimal use of power from renewable sources.

For this purpose, information about the power quantity available and its cost is transmitted to the vehicle via the charging cable. A charging profile is created based on this data, which ensures that the battery is fully charged by the set departure time but at the lowest cost.

Another functionality of Smart Charging is Plug&Charge.

Plug&Charge

Plug&Charge refers to the automatic authentication of a vehicle when the charging cable is plugged into an intelligent charging station. An electronic certificate is stored in the PLGW for this purpose. This means that the customer does not require any additional authentication via PIN, RFID card etc.

When the vehicle is connected to an intelligent charging station, the vehicle is recognised and invoicing by the power supplier takes place automatically.

The owner of the vehicle receives the electronic certificate (Plug&Charge certificate) from their power supply when the contract is signed.

There are two ways of installing the certificate in the vehicle:

- Via the smart Vehicle Homepage (connected services)
- Via diagnosis service in the workshop: the vehicle owner brings the Plug&Charge certificate + personal password to the workshop on a USB stick. After the customer enters the password, the file is decrypted with the certificate. The certificate is then installed via Star Diagnosis by a service employee.

Two other electronic certificates are installed in the vehicle ex factory:

- Root certificate
- Provisioning certificate

The certificates can be updated in the workshop using Star Diagnosis if they become invalid or require an update.

The **root certificate** applies across different power suppliers and is required in order to check a public charging station for "authenticity". This prevents communication with unauthorised partners.

The vehicle-specific **provisioning certificate** contains an individual identification number (PCID). The vehicle owner needs this PCID in order to be able to conclude a Plug&Charge power supply contract. It is handed out to the customer when the vehicle is handed over.

If necessary, the workshop can print out this PCID for the customer at any time (e.g. in the event of loss or change of owner).



Note

Before installing the Plug&Charge certificate, it is necessary to ensure that the Plug&Charge certificate file has been decrypted by the customer with their password.

Vehicle Homepage

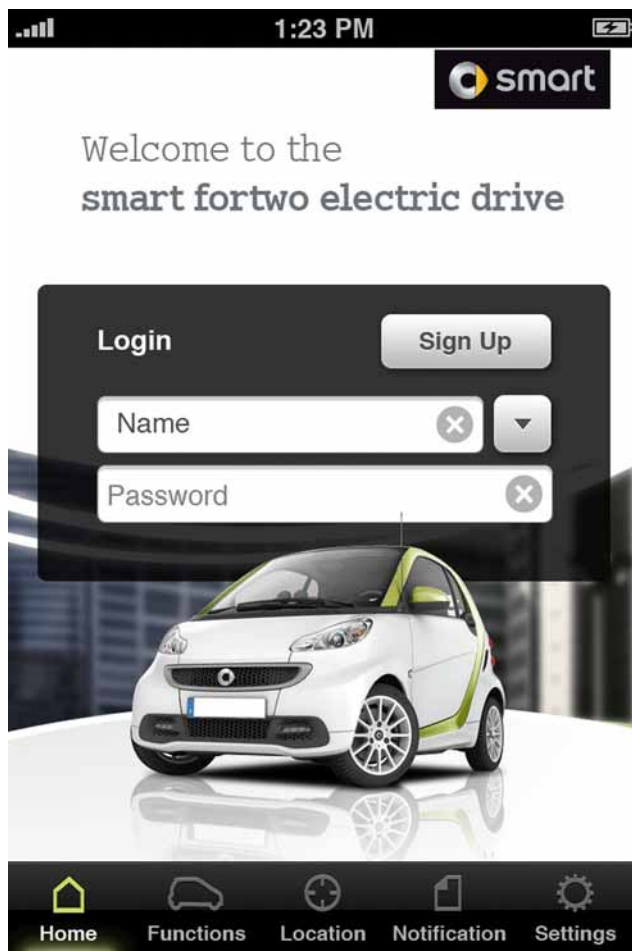
Data transfer via the Powerline Gateway makes the "Vehicle Homepage" function possible. The vehicle must be connected to the Internet via an intelligent charging post or a Powerline socket adapter for this purpose.

The Vehicle Homepage allows various functions of the vehicle to be remotely controlled using a modern smartphone or PC. For example, pre-conditioning can be activated remotely or a new departure time can be set.

It is also possible to query the current charge level of the high-voltage battery, the estimated range or the charging time.

The Plug&Charge function (see on-board charger) can also be configured via the Vehicle Homepage e.g. the Plug&Charge certificate from a power supplier can be installed on the on-board charger via the Vehicle Homepage.

The customer requires a Vehicle Verification Code to use the Vehicle Homepage. This is required to create an account.



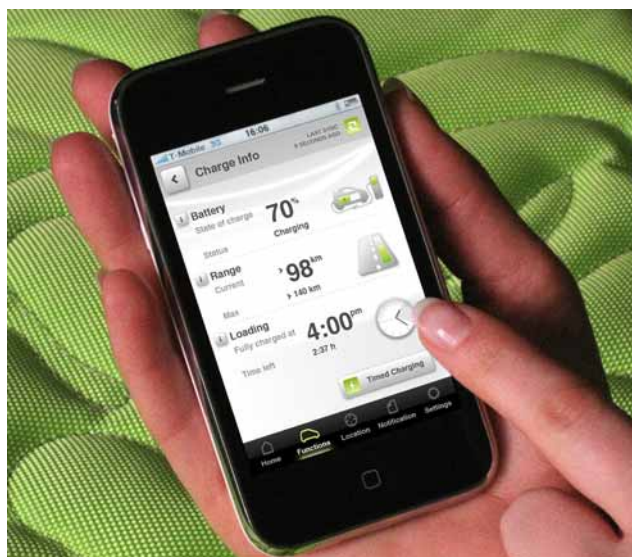
Vehicle Homepage

P82.87-8523-00

Note

The Vehicle Homepage can be accessed at any time using a smartphone or PC with the corresponding access authorisation.

However, connection to the vehicle is only possible when the vehicle is connected to the Internet via an intelligent charging post or a Powerline socket adapter.



Smartphone Application ("App")

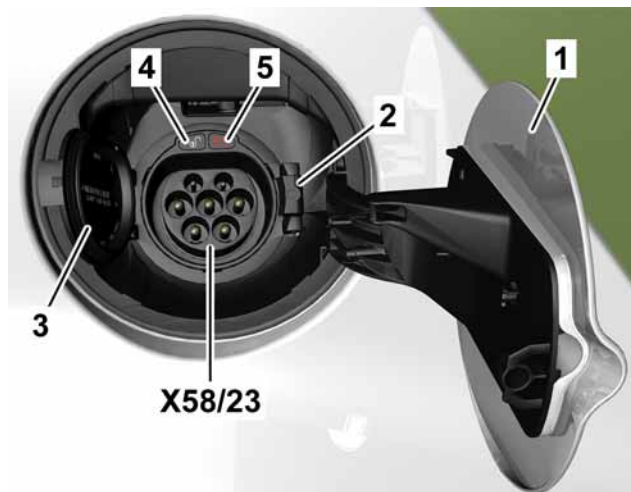
P82.87-8524-00

Charger feed-in socket

The charger feed-in socket (charge socket) is located on the right rear B-pillar under a flap. The socket is fitted with a folding protective cover. Different versions are installed depending on the national version of the vehicle (ECE, USA/Canada).

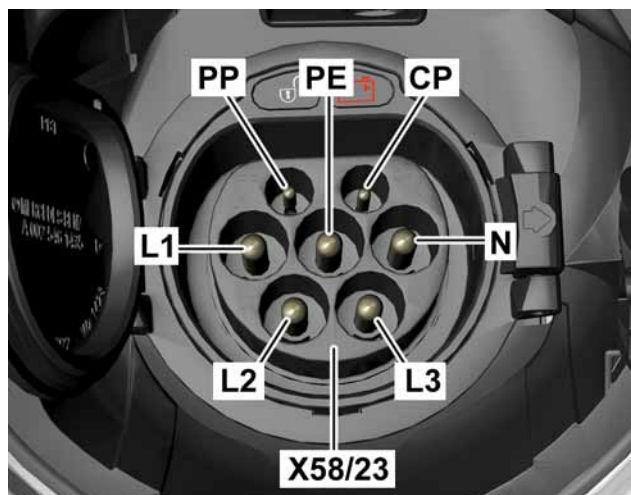
ECE version

The 7-pin socket has 5 high-voltage contacts (L1, L2, L3, N and PE) for the alternating voltage feed and 2 signal contacts for Control Pilot (CP) and Proximity (PP). The CP contact is used for data exchange with the charging station and the PP contact allows the vehicle to detect when the charging cable is plugged in. On vehicles with the 3 kW on-board charger, only high-voltage contacts L1, N and PE are used. There are 2 indicator lamps above the socket which indicate locking of the charging connector and the status of the charging process.



P54.10-3678-00

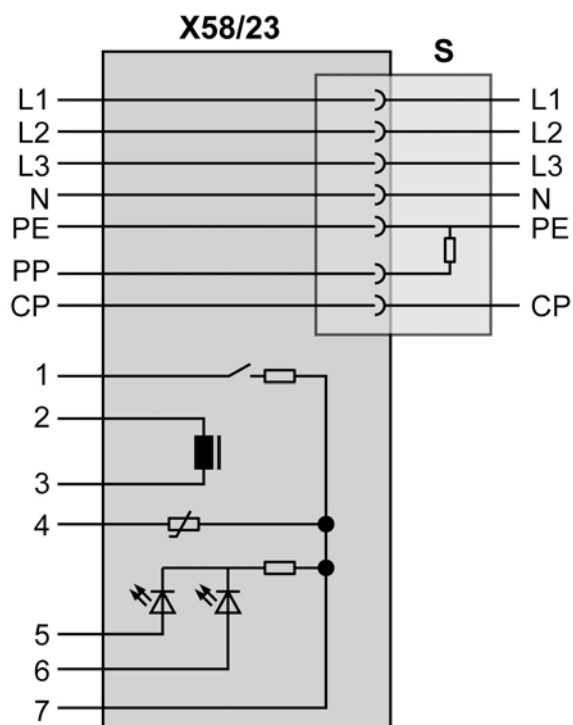
- 1 Tank cap
- 2 Protective cap release
- 3 Charger feed-in socket protective cap
- 4 Charging cable inserted indicator lamp
- 5 Charging status indicator lamp
- X58/23 Charger feed-in socket



P54.10-3679-00

- CP Control Pilot
- L1 Phase L1
- L2 Phase L2 (22 kW on-board charger only)
- L3 Phase L3 (22 kW on-board charger only)
- N Neutral wire
- PE Protective Earth
- PP Proximity
- X58/23 Charger feed-in socket

Charger feed-in socket



P54.10-3721-00

Block diagram

- 1 Locking status
- 2 Lock
- 3 Release
- 4 Temperature sensor
- 5 Charging cable indicator lamp
- 6 Charging status indicator lamp
- 7 Ground

- CP Control Pilot
- L1 Phase L1
- L2 Phase L2 (22 kW on-board charger only)
- L3 Phase L3 (22 kW on-board charger only)
- N Neutral wire
- PE Protective Earth
- PP Proximity
- S Charging cable connector
- X58/23 Charger feed-in socket

Indicator lamp

Lights up	When no charging cable is connected, it can be connected. When a charging cable is connected, it can be removed.
-----------	--

Flashes	Charging cable connector not plugged incorrectly or deformed. Lock or position sensor in charge socket defective.
---------	--

Indicator lamp

Flashes orange	The connection between the vehicle and power supply is being established before charging.
----------------	---

Lights up orange	The vehicle is ready for charging.
------------------	------------------------------------

Flashes green	The high-voltage battery is being charged.
---------------	--

Lights up green	The high-voltage battery is fully charged.
-----------------	--

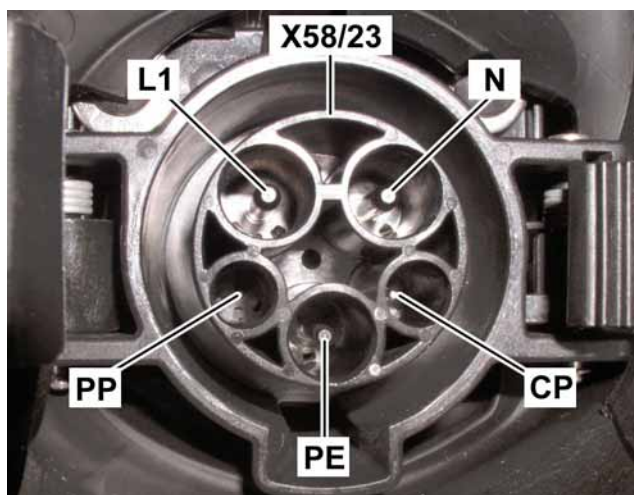
Flashes red rapidly	A fault occurred during charging.
---------------------	-----------------------------------

Charger feed-in socket

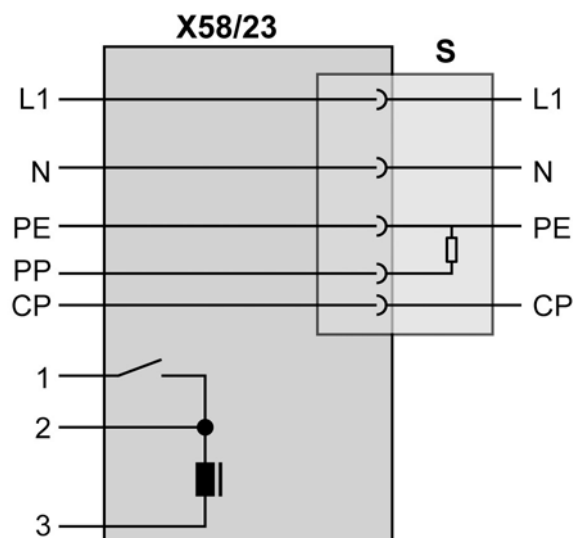
USA/Canada

The 5-pin socket has 3 high-voltage contacts for the alternating voltage feed and 2 signal contacts for CP and Proximity.

The CP contact is used for data exchange with the charging station and the PP contact allows the vehicle to detect when the charging cable is plugged in.



P54.10-3720-00



P54.10-3722-00

Block diagram

- 1 Locking status
- 2 Lock
- 3 Release

- CP Control Pilot
- L1 Phase L1
- N Neutral wire
- PE Protective Earth
- PP Proximity
- S Charging cable connector
- X58/23 Charger feed-in socket

- CP Control Pilot
- L1 Phase L1
- N Neutral wire
- PE Protective Earth
- PP Proximity

X58/23 Charger feed-in socket

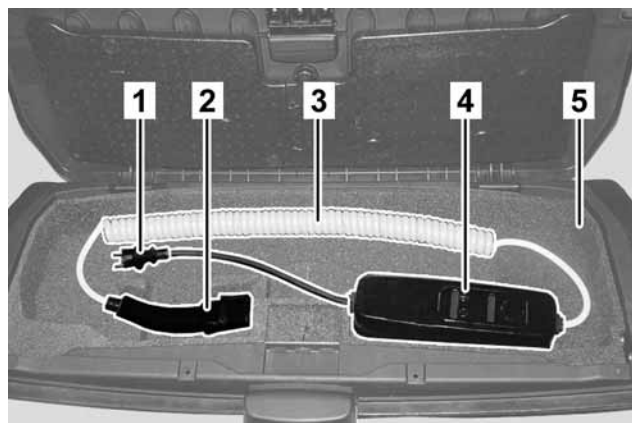
Charging cable

Depending on the on-board charger installed, different country-specific charging cable versions are available:

Charging cable for charging at a household power outlet (standard with on-board charger 3 kW)

A 7-pin charge coupling (ECE) as per IEC62196-2 is installed at the vehicle end and a country-specific grounding contact plug is installed at the power outlet end, e.g. Schuko, BS 1363. Monitoring and communication with the on-board charger takes place via a control box in the charging cable. When the mains plug is plugged in, the control box checks whether mains voltage and the protective earth conductor are present and transmits the available charging current to the on-board charger via the CP contact.

In order to avoid overload situations, the charging current can be adjusted to the circumstances of the local power grid using a button on the control box of the charging cable. The charging connector is locked at the vehicle end during the charging process.



P54.10-3715-00

Charging cable, stowage compartment in liftgate

- 1 Mains plug
- 2 Charge coupling, 7-pin
- 3 Cable
- 4 Control box
- 5 Liftgate stowage compartment

The charging cable can be stowed in the vehicle as follows:

- **cabrio:**
In a box, which is available as an accessory, or in the stowage compartment in the liftgate if the space is available. In this case, the side supports of the soft top system cannot be stowed there.
- **coupé:**
In the stowage compartment of the liftgate

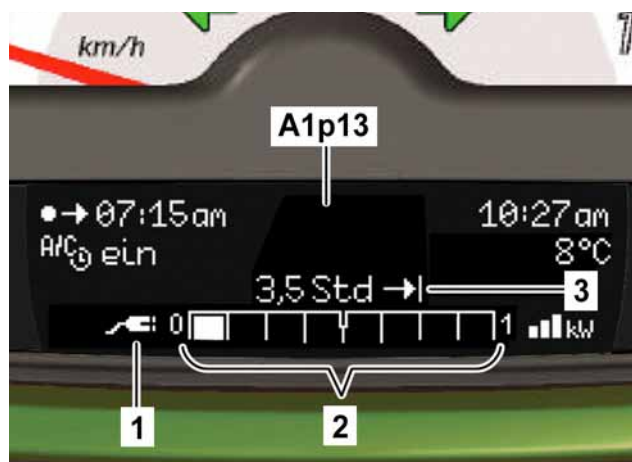
Note

The mains plug of the charging cable must be plugged directly into a suitable power outlet. No extension cords may be used (increased line resistance).

Charging cable

When the charging connector is connected to the power outlet, this is shown on the multifunction display with a connector symbol.

In addition, the charging progress (bar indicator) and the expected charging duration are displayed in the ignition key position "Circuit 15 On".



P54.33-2145-00

A1p13 Multifunction display

- 1 Connector symbol
- 2 Charging progress
- 3 Charging duration

i Note

The vehicle cannot be started during the charging process.

Charging cable for charging at public charging stations

A 7-pin charge coupling as per IEC62196-2 is installed at the vehicle end and a 7-pin charge connector as per IEC62196-2 is installed at the power outlet end. The operating parameters are exchanged between the on-board charger and the charging station via a data line in the charging cable (Control Pilot, CP). The charge connectors are locked at the vehicle end and the charging station end during the charging process.

Regenerative braking

In deceleration mode and when braking, the high-voltage battery is charged through regenerative braking and the electric motor then operates as a generator.

Regenerative braking in deceleration mode:

During regenerative braking in deceleration mode, the vehicle is braked in a similar way to a vehicle with combustion engine.

The level of regenerative braking in deceleration mode can be adjusted using the steering wheel shift paddles as a special equipment option:

Stage 0: No regenerative braking, the vehicle retains the maximum possible amount of kinetic energy.

Stage 1: Normal driving, default setting (standard)

Stage 2: For sporty driving. The brake pedal has to be used less because the level of deceleration is higher than in stage 1.

The level of regenerative braking is indicated on the right additional instrument

Regenerative braking:

If the brake pedal is actuated, the regenerative braking level is increased further.

Power electronics control unit

The power electronics control unit is installed on the electric drive motor and is connected directly to the high-voltage adapter plate fuse box and the coolant circuit. It has the following tasks:

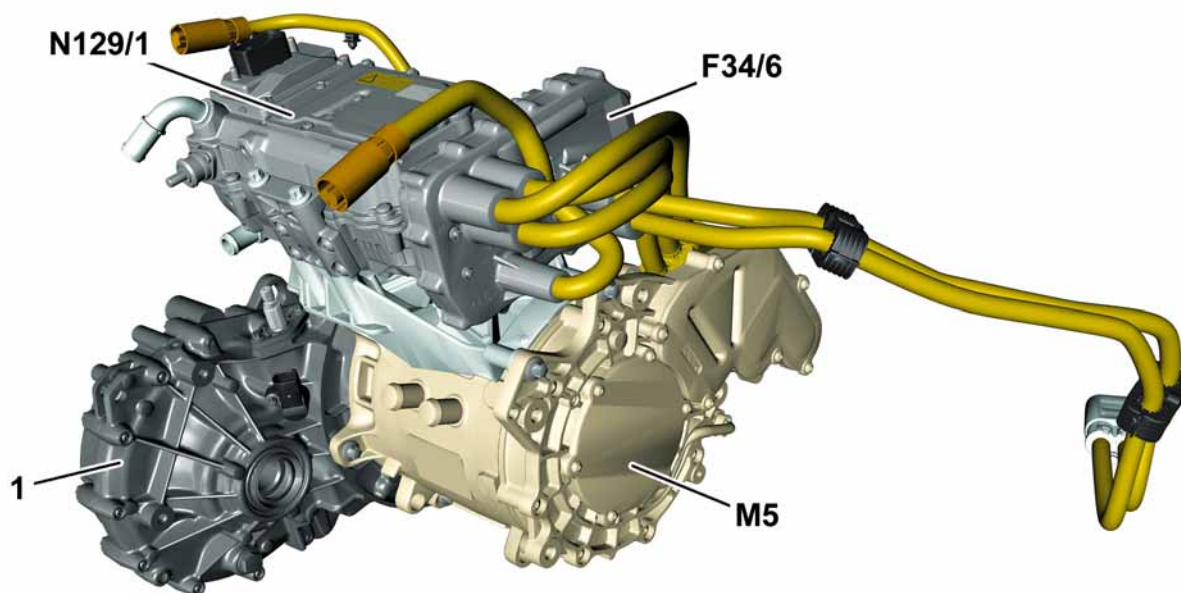
Power supply and control of electric drive motor

The inverter in the power electronics control unit generates the 3-phase alternating voltage for operating the electric motor from the direct voltage of the high-voltage battery. In the process, the power electronics control unit records the rpm, rotor position and temperature of the electric motor.

If the electric motor is operated as a generator in deceleration mode, the power electronics control unit converts the induced alternating voltage into direct voltage and uses it to supply the high-voltage on-board electrical system.

DC/DC converter

The DC/DC converter in the power electronics control unit generates the 12 V direct voltage for the 12 V on-board electrical system from the direct voltage of the high-voltage battery. It charges the 12 V battery directly and thus performs the function of the alternator on a vehicle with combustion engine.



P08.10-2052-00

Electric drive system

1 Transmission

F34/6 High-voltage adapter plate fuse box

M5 Electric drive motor

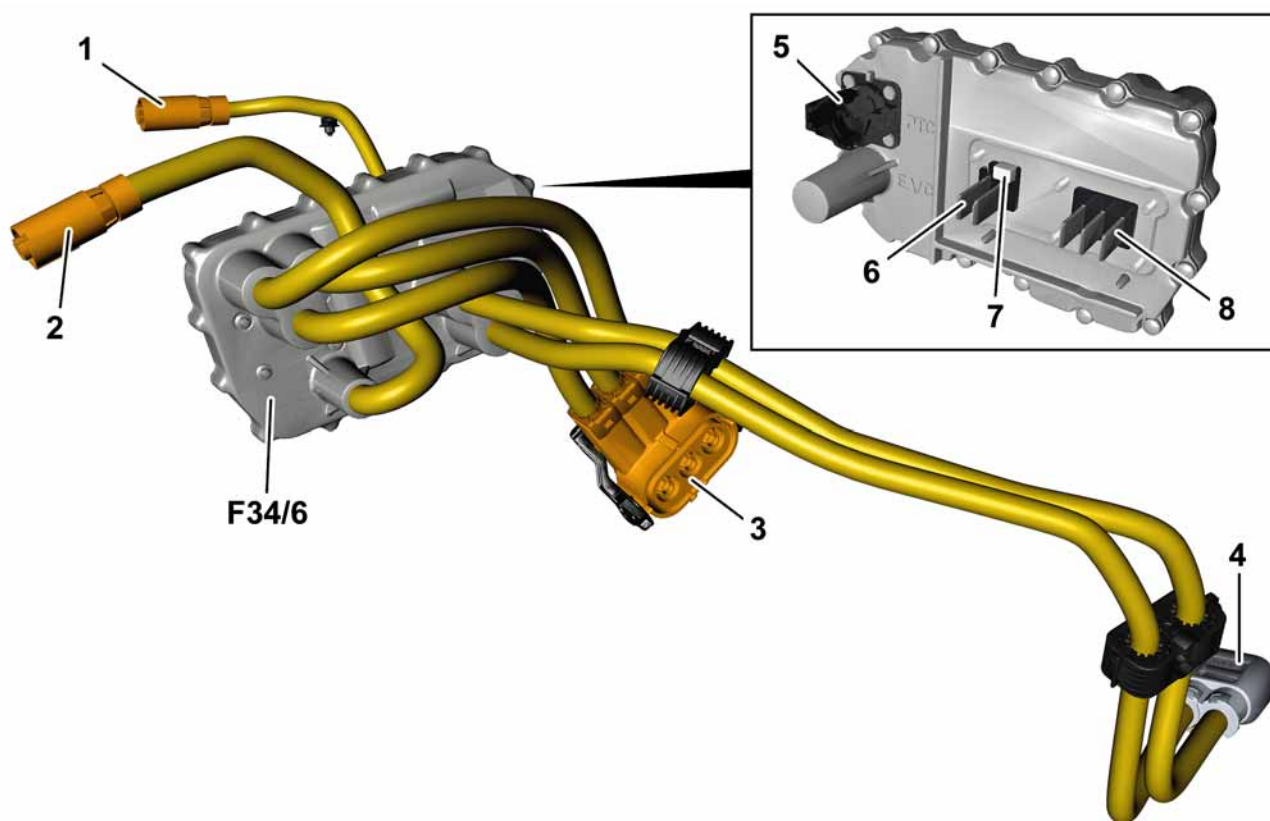
N129/1 Power electronics control unit

High-voltage adapter plate fuse box

The high-voltage adapter plate fuse box is installed on the power electronics control unit above the electric motor. The adapter plate serves as a connecting element between the high-voltage lines and the power electronics control unit.

It supplies high-voltage electrical consumers from a central location and protects the corresponding line cross-sections to the on-board charger, the high-voltage PTC heater and the electric refrigerant compressor with high-voltage fuses.

There are three fuses in the high-voltage adapter plate fuse box to protect the high-voltage on-board electrical system. The high-voltage fuses are not accessible and thus not exchangeable.

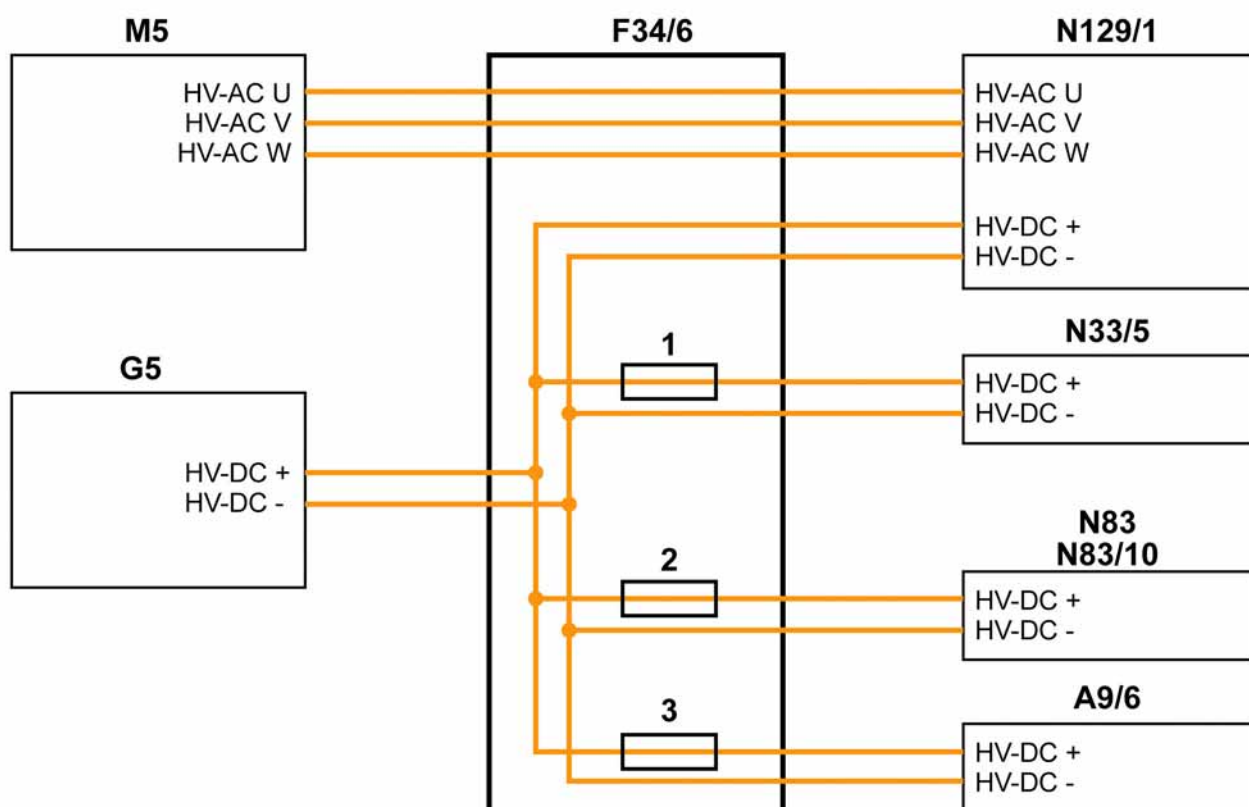


P54.10-3684-00

- 1 Electric refrigerant compressor connector
- 2 On-board charger connector
- 3 Electric drive motor connector
- 4 High-voltage battery connector
- 5 High-voltage PTC heater connector
- 6 Power electronics control unit connector

- 7 High-voltage interlock connector
- 8 Electric drive motor power supply feed connector

F34/6 High-voltage adapter plate fuse box



P54.15-3497-00

Block diagram of high-voltage fuses

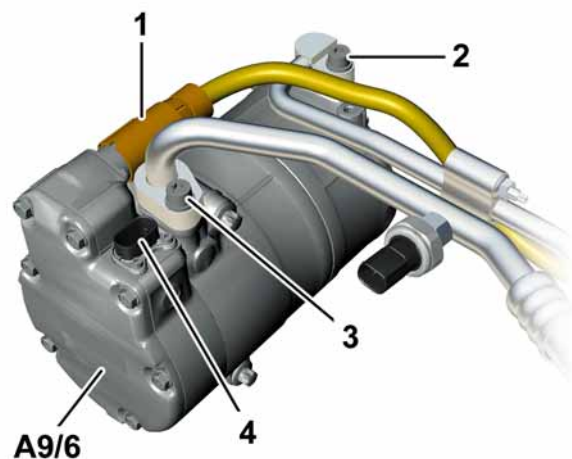
- | | | | |
|---|---|--------|--|
| 1 | High-voltage PTC heater fuse (40 A) | A9/6 | Electric refrigerant compressor |
| 2 | 3 kW on-board charger fuse (40 A) or
22 kW on-board charger fuse (100 A) | F34/6 | High-voltage adapter plate fuse box |
| 3 | Electric refrigerant compressor fuse (40 A) | G5 | High-voltage battery |
| | | M5 | Electric drive motor |
| | | N33/5 | High-voltage PTC heater |
| | | N83 | On-board charger 3kW |
| | | N83/10 | On-board charger 22 kW
(with code (908) 22 kW on-board charger) |
| | | N129/1 | Power electronics control unit |

Electric refrigerant compressor

The drive system for the refrigerant compressor has to be kept separate from the drive motor so that sufficient cooling output can be provided when the vehicle and the electric motor are stationary. This ensures that the high-voltage battery can be cooled independently and climate control for the vehicle interior can operate independently. This is achieved by means of an electrically driven refrigerant compressor.

The electric refrigerant compressor is a high-voltage component and contains an inverter for powering a spiral compressor, which is driven by an electric motor, as well as an integrated control unit. The control unit of the electric refrigerant compressor regulates the speed of the electric motor to the value set by the heater/AC operating unit. The control unit communicates with the drivetrain control unit via LIN. This only acts as a router for the CAN signals from the heater/AC operating unit in this case.

On vehicles with code (V03) Battery cooling system, the electric motor is also regulated depending on the cooling output request of the high-voltage battery.



P83.55-2216-00

- 1 High-voltage connection
- 2 Pressure line
- 3 Intake line
- 4 12 V on-board electrical system/LIN connector
- A9/6 Electric refrigerant compressor

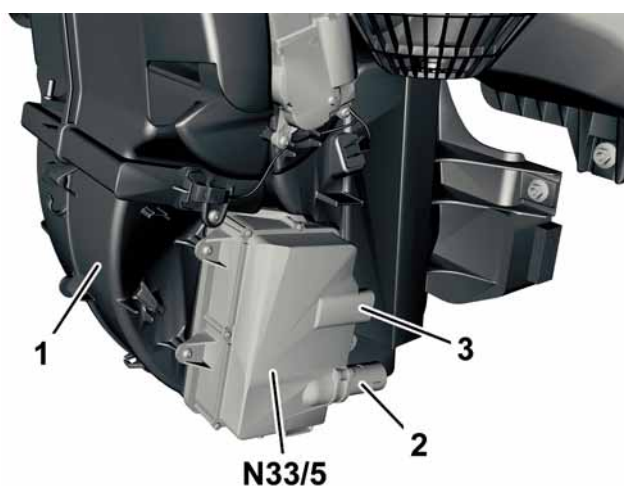
High-voltage PTC heater

The high-voltage PTC heater consists of a heating element with PTC ceramic modules, corrugated fins and a control unit with control electronics. In the PTC ceramic modules, the regulated current from the control electronics is converted into heat. Aluminium fins are in direct contact with the PTC ceramic modules and transfer the heat to the air.

For better control, the surface area of the high-voltage PTC heater is divided into 4 independently controllable sections.

The control unit of the high-voltage PTC heater receives the output request for the individual PTC sections from the drivetrain control unit and actuates the individual output stages of the power electronics via PWM signals.

In order to maintain a uniform load on the on-board electrical system, the stages are operated with a PWM offset.



P83.70-5432-00

- 1 Air conditioner housing
- 2 High-voltage connection
- 3 On-board electrical system/CAN connector
- N33/5 High-voltage PTC heater

High-voltage interlock

The interlock loop is used to protect people from faults in the high-voltage on-board electrical system. The interlock loop detects an open connector circuit in the high-voltage on-board electrical system.

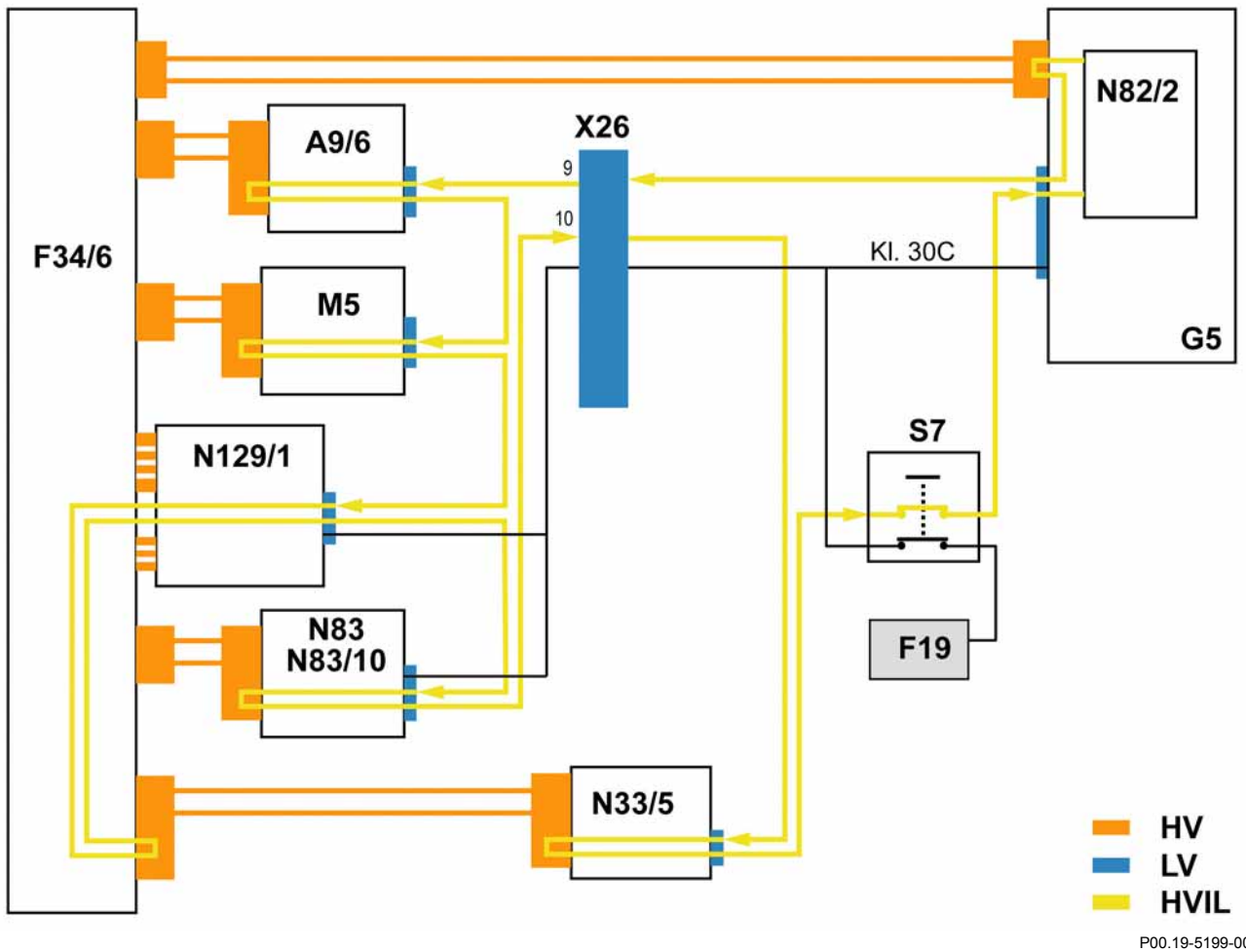
The interlock signal is generated in the battery management system control unit and passes in a loop via the following components:

- High-voltage battery
- On-board charger
- High-voltage PTC heater
- Electric refrigerant compressor
- Power electronics control unit
- High-voltage adapter plate fuse box
- Electric drive motor
- Service Disconnect
- Interior/engine connector

If the signal loop is interrupted, e.g. by disconnecting a high-voltage or 12 V connector, this causes the contactors in the high-voltage battery module to open and the high-voltage on-board electrical system to shut down. Since capacitors are also present in the high-voltage components, the high-voltage on-board electrical system is not immediately rendered voltage-free once the contactor is opened. For this reason, an active discharge function is incorporated in the high-voltage components. This discharges the high-voltage on-board electrical system to voltages below 60 V in less than 5 s.

If the interlock signal is interrupted during driving operation, the high-voltage on-board electrical system is only shut off the next time the vehicle is stopped when the selector lever is moved to position "P" with the vehicle at a standstill or the vehicle key is turned to position "Off".

Topology of high-voltage interlock



A9/6	Electric refrigerant compressor
F34/6	High-voltage adapter plate fuse box
F19	Pyrofuse
G5	High-voltage battery
M5	Electric drive motor
N33/5	High-voltage PTC heater
N82/2	Battery management system control unit
N83	On-board charger 3kW
N83/10	On-board charger 22 kW (with code (908) 22 kW on-board charger)
N129/1	Power electronics control unit
S7	Service Disconnect
X26	Interior/engine connector

HV	High-voltage
LV	Low-voltage (12 V)
HVIL	High-voltage interlock loop

Deenergisation

To allow repair and service operations to be performed without any risk of electric shock, the high-voltage on-board electrical system must be deenergized and protected against reactivation.

The deenergization and restart must be documented in a vehicle power disable event log and vehicle initial startup log. The logs must be stored with the vehicle repair documents.

The high-voltage on-board electrical system is deenergised via vehicle diagnosis (DAS). Pulling out the Service Disconnect plug underneath the instrument panel in the left footwell physically interrupts the actuation of the contactors of the high-voltage battery. The empty slot is protected against reinsertion by a lock.

Note

When a high-voltage on-board electrical system has been deenergised, only the repair and maintenance operations which made the deenergisation necessary should be performed.

All high-voltage relevant repairs and maintenance operations should be designed as separate procedures so that the vehicle is not put in a condition which could affect restarting of the high-voltage on-board electrical system because multiple operations are in progress simultaneously.



P54.25-8975-00

S7 Service Disconnect
N10/10 SAM control unit

Diagnose-Assistenz-System

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FIN	WME451490xxxxxxx	Baureihe/muster	451.490
Auftrags-Nummer	Kennzeichen		

Hochvolt-Bordnetz-Freischaltungsprotokoll

Allgemeine Daten			
Manuelle Benutzereingaben			
Werkstattname			
Landes- und Betriebsnummer			
Name der Kontaktperson			
Telefonnummer mit Landesvorwahl			
Faxnummer mit Landesvorwahl			
E-Mail-Adresse			
Reparaturauftragsnummer			
Kundenbeanstandung			
STAR DIAGNOSIS-Information			
Identifikation / LanID (Variante)	CMTCL074681 (Author)	Diagnose-Multiplexer-Variante	PART_T (SN: 025584), D_OBDII
DAS-Software-Version	03/2012 (2011-11-28) (Deutsch)	Info über Diagnose-Multiplexer	03.02.08, -, 1.43, 01.12.00
Fahrzeugdaten			

Diagnose-Assistenz-System

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FIN	WME451490xxxxxxx	Baureihe/muster	451.490
Auftrags-Nummer	Kennzeichen		

Hochvolt-Bordnetz-Inbetriebnahme-Protokoll

Allgemeine Daten			
Manuelle Benutzereingaben			
Werkstattname			
Landes- und Betriebsnummer			
Name der Kontaktperson			
Telefonnummer mit Landesvorwahl			
Faxnummer mit Landesvorwahl			
E-Mail-Adresse			
Reparaturauftragsnummer			
Kundenbeanstandung			
STAR DIAGNOSIS-Information			
Identifikation / LanID (Variante)	CMTCL074681 (Author)	Diagnose-Multiplexer-Variante	PART_T (SN: 025584), D_OBDII

DAS form, power disable event log (extract)

DAS form, initial startup log (extract)

Deenergisation

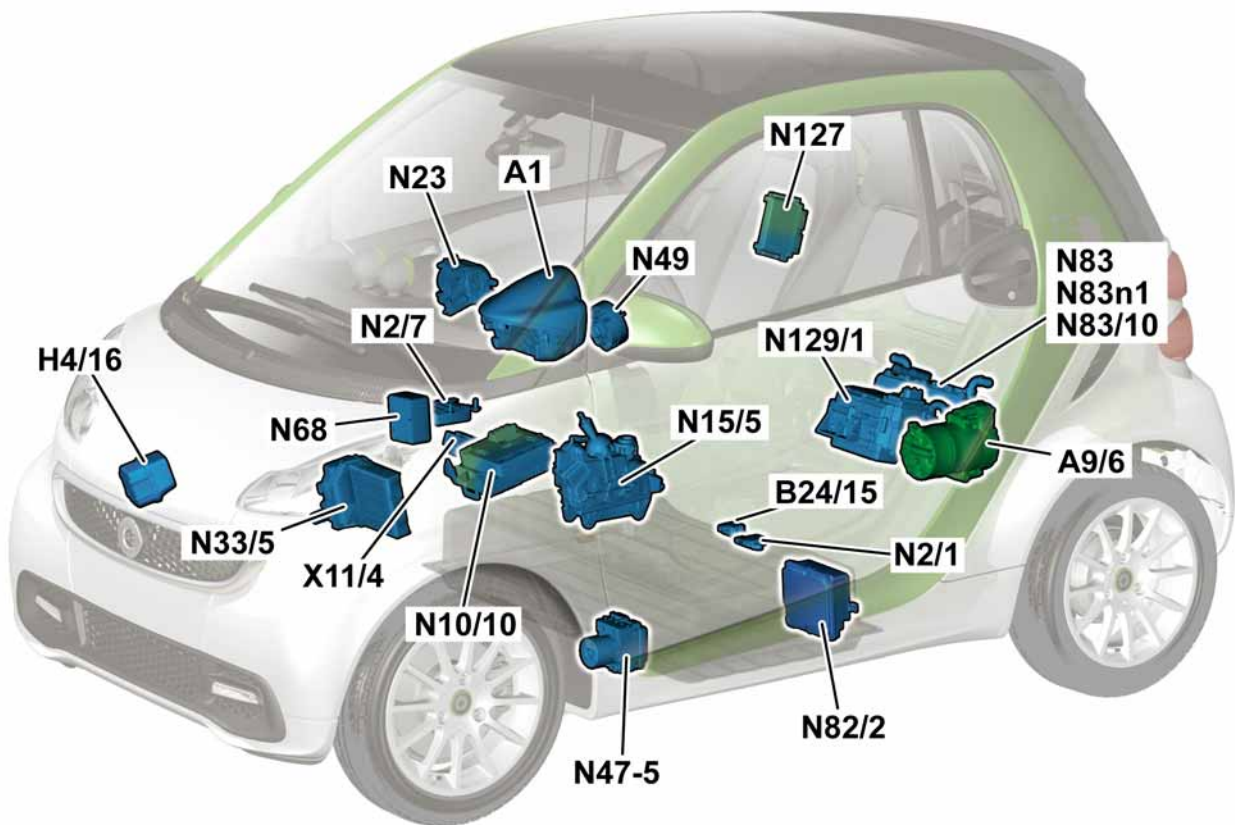
Deenergisation matrix for operations where deenergisation is required

	Yes	No
Underside of vehicle		
Remove/install electric motor with power electronics	X	
Remove/install transmission	X	
Remove/install integral support	X	
Remove/install axle tube	X	
Remove/install drive system coolant pump		X
Remove/install high-voltage battery coolant pumps		X
Remove/install A/C condenser		X
Remove/install pedals		X
Remove/install ESP control unit		X
Remove/install ESP hydraulic unit		X
Remove/install electric steering		X
Remove/install high-voltage battery	X	
Remove/install vacuum pump		X
Remove/install refrigerant compressor	X	
Remove/install high-voltage adapter plate fuse box	X	

	Yes	No
Underside of vehicle		
Remove/install on-board charger	X	
High-voltage lines	X	
Remove/install front axle		X
Remove/install front suspension		X
Outside of vehicle		
Remove/install CBS parts		X
Remove/install soft top/roof		X
Remove/install windshield		X
Remove/install rear-end door upper section (coupé)		X
Remove/install rear-end door lower section		X
Remove/install front exterior lights		X
Remove/install rear exterior lights		X
Remove/install wiper blades		X
Remove/install charger feed-in socket (charge socket)	X	

Deenergisation

	Yes	No
Wheels, brakes		
Remove/install wheels/tires		X
Remove/install front service brake		X
Remove/install rear service brake		X
Vehicle interior		
12 V battery	X	
Remove/install restraint systems	X	
Remove/install floor covering		X
Remove/install instrument cluster		X
Remove/install instrument panel		X
Multifunction control lever		X
Remove/install driver/passenger seat		X
Remove/install interior high-voltage lines	X	
Remove/install air distribution box	X	

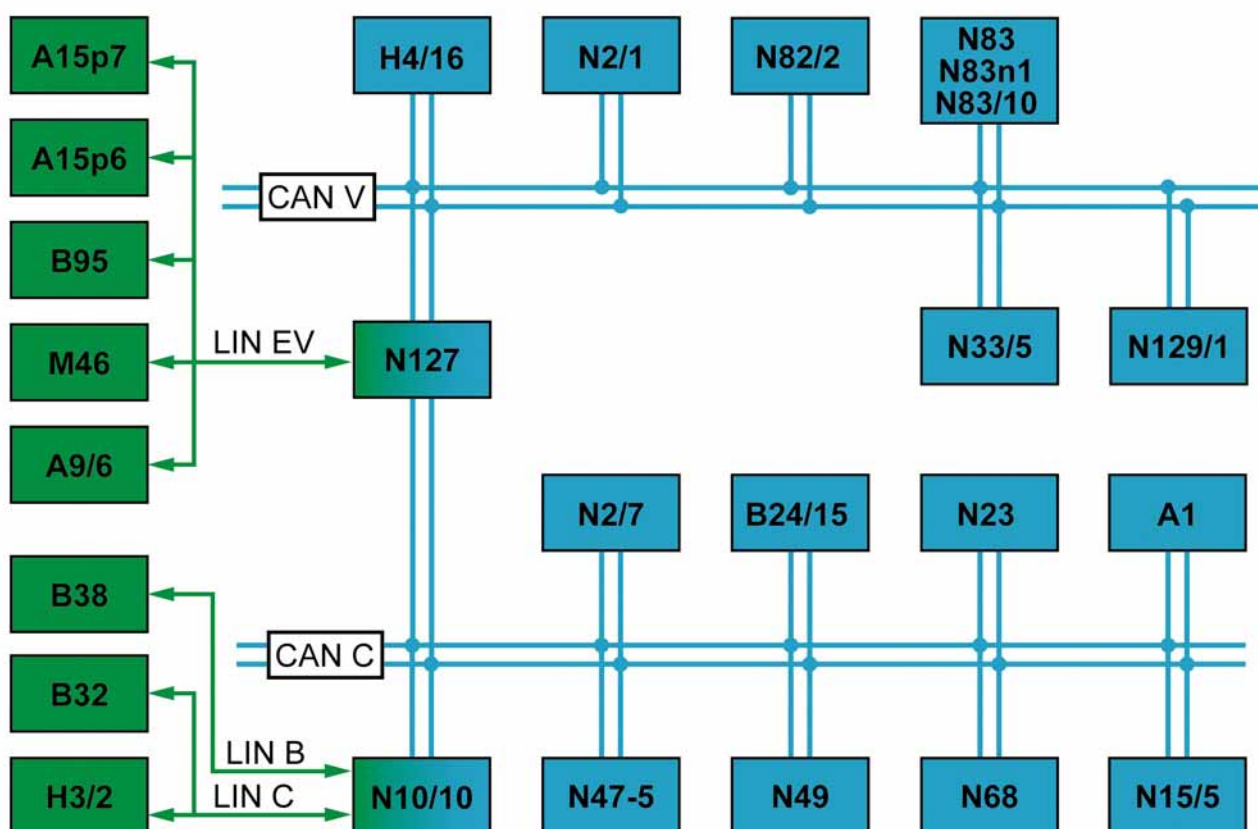


P00.19-5201-00

Overall network (ECE version)

A1	Instrument cluster	N33/5	High-voltage PTC heater
A9/6	Electric refrigerant compressor	N47-5	ESP control unit
B24/15	Yaw rate and lateral acceleration sensor	N49	Steering angle sensor
H4/16	Electric vehicle sound generator	N68	Power steering control unit
N2/1	High-voltage crash sensor control unit	N82/2	Battery management system control unit
N2/7	Restraint systems control unit	N83	On-board charger 3kW
N10/10	SAM control unit	N83n1	Powerline Gateway control unit
N15/5	Electronic selector lever module	N83/10	On-board charger 22 kW (with code (908) 22 kW on-board charger)
N23	Heater/AC operating unit	N127	Drivetrain control unit
		N129/1	Power electronics control unit
		X11/4	Data link connector

Overall network



P00.19-5204-00

Block diagram of overall network (ECE version)

A1	Instrument cluster	N33/5	High-voltage PTC heater
A15p6	High-voltage battery power flow	N47-5	ESP control unit
A15p7	High-voltage battery state of charge (SOC) indicator	N49	Steering angle sensor
A9/6	Electric refrigerant compressor	N68	Power steering control unit
B24/15	Yaw rate and lateral acceleration sensor	N82/2	Battery management system control unit
B32	Microwave sensor (with code (V01) Anti-theft alarm system)	N83	On-board charger 3kW
B38	Rain sensor/light sensor (with code (V54) Rain sensor/light sensor or code (V62) Rain sensor (car2go))	N83n1	Powerline Gateway control unit
B95	Battery sensor	N83/10	On-board charger 22 kW (with code (908) 22 kW on-board charger)
H3/2	Alarm siren with inclination sensor (with code (V01) Anti-theft alarm system)	N127	Drivetrain control unit
H4/16	Electric vehicle sound generator	N129/1	Power electronics control unit
M46	Electric drive and on-board charger coolant pump	X11/4	Data link connector
N2/1	High-voltage crash sensor control unit	CAN C	Engine compartment CAN
N2/7	Restraint systems control unit	CAN V	Electric vehicle CAN
N10/10	SAM control unit	LIN EV	Electric vehicle LIN
N15/5	Electronic selector lever module	LIN B	Interior LIN 1 (with code (V54) Rain sensor/light sensor or code (V62) Rain sensor (car2go))
N23	Heater/AC operating unit	LIN C	Interior LIN 2 (with Code (V01) Anti-theft alarm system)

General

The network architecture allows external access to the individual control units of the CAN bus systems.

The vehicle and all of its equipment features can be identified using Star Diagnosis. This enables accurate fault evaluation and rectification and the analysis of vehicle-specific values and parameters.

Diagnosis Assistance System (DAS)

The data link connector (X11/4) is located in the vehicle interior on the underside of the instrument panel on the driver side.

Diagnosis-capable control units:

- Instrument cluster (A1)
- High-voltage crash sensor control unit (N2/1)
- Restraint systems control unit (N2/7)
- SAM control unit (N10/10)
- Electronic selector lever module (N15/5)
- Heater/AC operating unit (N23)
- ESP control unit (N47-5)
- Power steering control unit (N68)
- Battery management system control unit (N82/2)
- On-board charger 3 kW (N83)
- Powerline Gateway control unit (N83n1)
- On-board charger 22 kW (N83/10)
(with code (908) 22 kW on-board charger)
- Drivetrain control unit (N127)
- Power electronics control unit (N129/1)



P54.22-2062-00

X11/4 Data link connector

SAM control unit

All fuses are housed on the SAM control unit.

Exceptions:

- In the high-voltage adapter plate fuse box:
 - High-voltage fuses
- Fuse holder in battery recess (12 V battery):
 - F 10/1 (40 A) Vacuum pump fuse
 - F 10/3 (60 A) High-voltage battery heater fuse
- In circuit 30 line to SAM:
 - F 91 (125 A) SAM prefuse

Fuses 1–31 and reserve fuses R1–R9 are located on the front of the SAM control unit, fuses 32–35 are on the back.

The SAM control unit is linked with the engine compartment CAN (CAN C) in order to exchange data. It communicates with the following components:

- Instrument cluster
- ESP control unit
- Restraint systems control unit
- Heater/AC operating unit
- Power steering control unit
- Yaw rate and lateral acceleration sensor
- Drivetrain control unit
- Steering angle sensor
- Vehicle diagnosis/DAS datalink connector

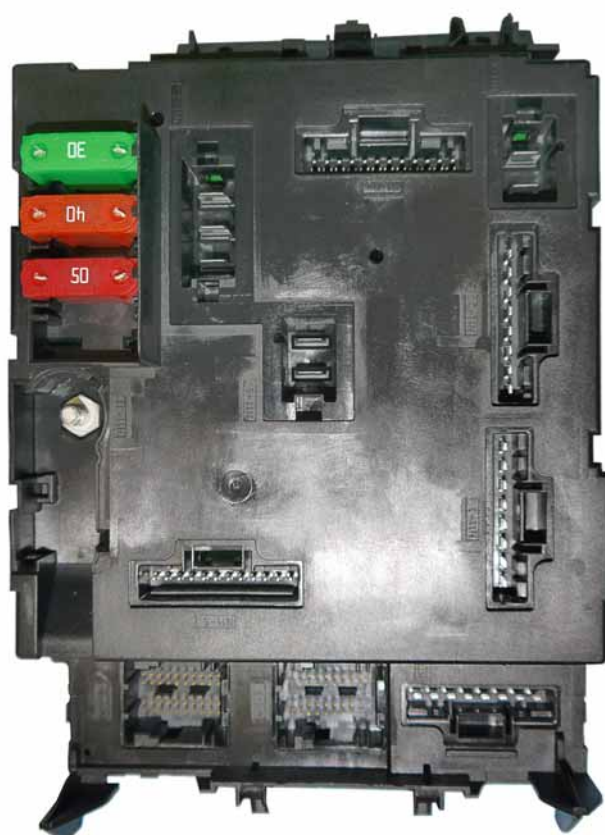
The SAM control unit communicates via LIN with

- Microwave sensor (interior/ATA)
- Rain sensor/light sensor
- Alarm siren with inclination sensor



Front of SAM control unit

P54.21-3283-00



Back of SAM control unit

P54.21-3284-00

Fuse assignment			
Fuse	Designation	Amps	Color
2	Front windshield wipers	25 A	White
3	Power windows	20 A	Yellow
4	Engine components, interior blower motor	25 A	White
5	LED daytime running lights, front fog lamps	10 A	Red
6	Right standing light/taillight, license plate illumination	7.5 A	Brown
7	Left standing light/taillight	7.5 A	Brown
8	Engine components, stationary air conditioner	25 A	White
9	Engine components, brake system, ESM	7.5 A	Brown
10	Engine components, electric expansion valve (battery) Coolant pump 1 and 2	15 A	Blue
11	ESP control unit	25 A	White
12	Left multifunction control lever functions, switch panel functions, data link connector, mirror heater, ATA, rain sensor/light sensor (LHD only), additional instruments, central locking, instrument cluster, TPM (USA only), brake/turn signal light switching (USA only)	10 A	Red
15	Electric drive safety circuit, pyrofuse	15 A	Blue
17	Rear windshield wiper (coupé only)	15 A	Blue
18	ESP control unit, EPS control unit, restraint system, Airbag On/Off indicator lamp, turn rate sensor, steering angle sensor	10 A	Red

SAM control unit

Fuse assignment			
Fuse	Designation	Amps	Color
19	Drivetrain control unit, TPM control unit (USA only), data link connector, drive components	7.5 A	Brown
20	Heater/AC operating unit, outside mirror adjustment, washer fluid pump, radio systems, seat heaters, backup lamp (except USA), right multifunction control lever functions, cabrio soft top operation	10 A	Red
21	12 V socket (cigarette lighter)	15 A	Blue
22	Left low beam	7.5 A	Brown
23	Right low beam	7.5 A	Brown
24	Brake lights (except USA), backup lamps (USA only), rear fog lamp (except USA)	15 A	Blue
25	Right high beam	7.5 A	Brown
26	Left high beam	7.5 A	Brown
27	Engine components	7.5 A	Brown
28	Rear window heater (coupé)	40 A	Orange
29	Electric power soft top (cabrio)	30 A	Green
30	Front radiator fan motor	40 A	Orange
31	Horn, central locking	20 A	Yellow
33	Ignition/starter switch	50 A	Red
34	ESP control unit	40 A	Orange

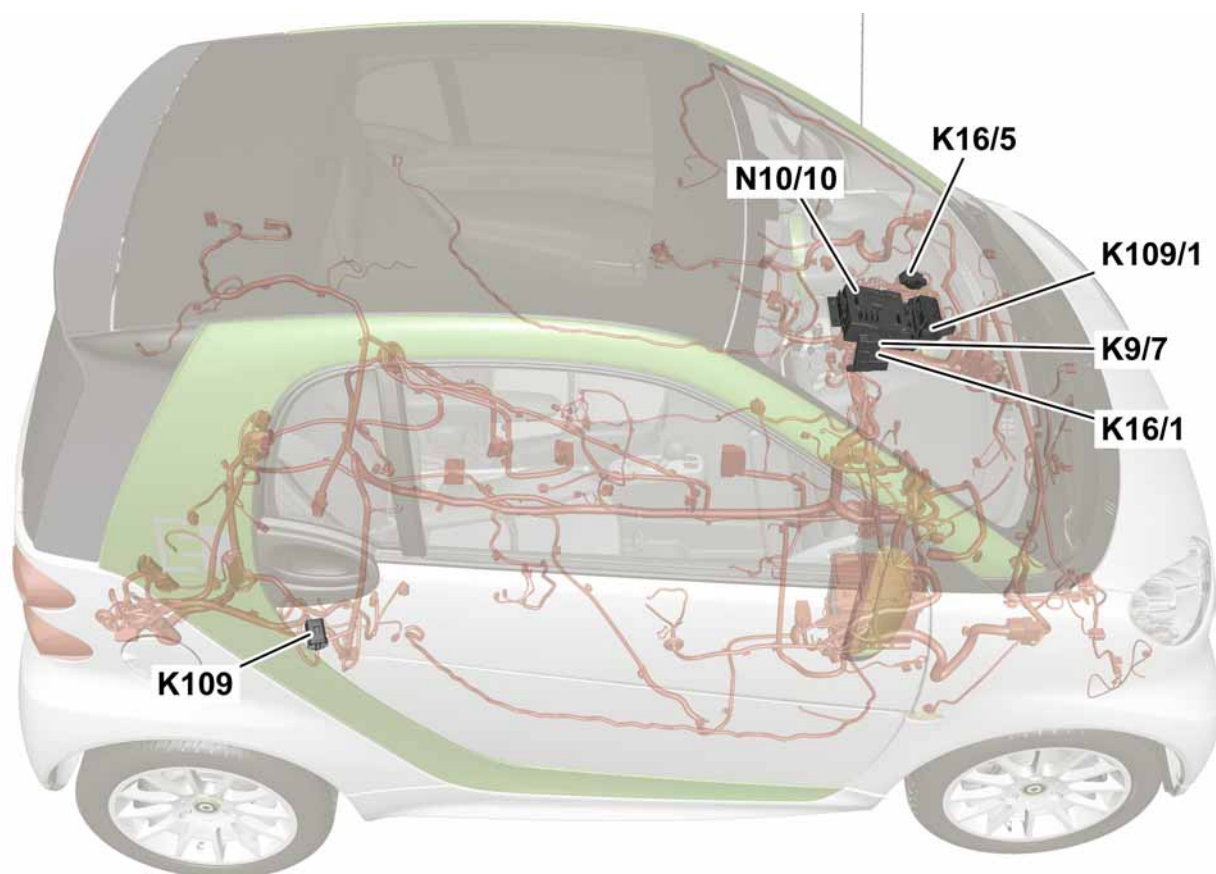
Fuse assignment			
Fuse	Designation	Amps	Color
35	EPS control unit (power steering)	30 A	Green
R1	Mirror heater	7.5 A	Brown
R2	Brake lights (USA only)	7.5 A	Brown
R4	TPM (USA only)	7.5 A	Brown
R5	Engine components: on-board charger, electric refrigerant compressor, coolant pump (power electronics/electric drive motor/on-board charger), high-voltage PTC heater	10 A	Red
R6	Radio systems, subwoofer (standard sound), soft top	15 A	Blue
R7	Interior lights	5 A	Light brown/beige
R8	Premium sound amplifier	20 A	Yellow
R9	Heated seats control unit	25 A	White

SAM control unit

Relays

The following relays for the smart fortwo electric drive are located on the SAM and in relay holders on branch-off lines of the wiring harness:

- Fan stage switching changeover relay (K9/7) (cooling fan stage 1 + 2)
- Circuit 15/30 stationary air conditioner relay (K16/1) (2 micro-relays on one holder)
- 12 V PTC heater booster relay (K16/5)
- Relay for brake vacuum pump (+) (K109)
- Relay for brake vacuum pump (-) (K109/1)



P54.15-3498-00

Relay arrangement

K9/7 Fan stage switching changeover relay
 K16/1 Circuit 15/30 stationary air conditioner relay
 K16/5 12 V PTC heater booster relay

K109 Relay for brake vacuum pump (+)
 K109/1 Relay for brake vacuum pump (-)
 N10/10 SAM control unit

General

The brake system is largely the same as the brake system of the smart fortwo with combustion engine in terms of its design and operation.

A new feature is the electric vacuum pump, which is actuated by the drivetrain control unit.

Using two redundant differential pressure sensors in the vacuum line, the drivetrain control unit measures the pressure differential between the vacuum in the vacuum line and the atmospheric pressure. Depending on the vehicle speed, the drivetrain control unit actuates the brake booster vacuum pump directly via the relays.

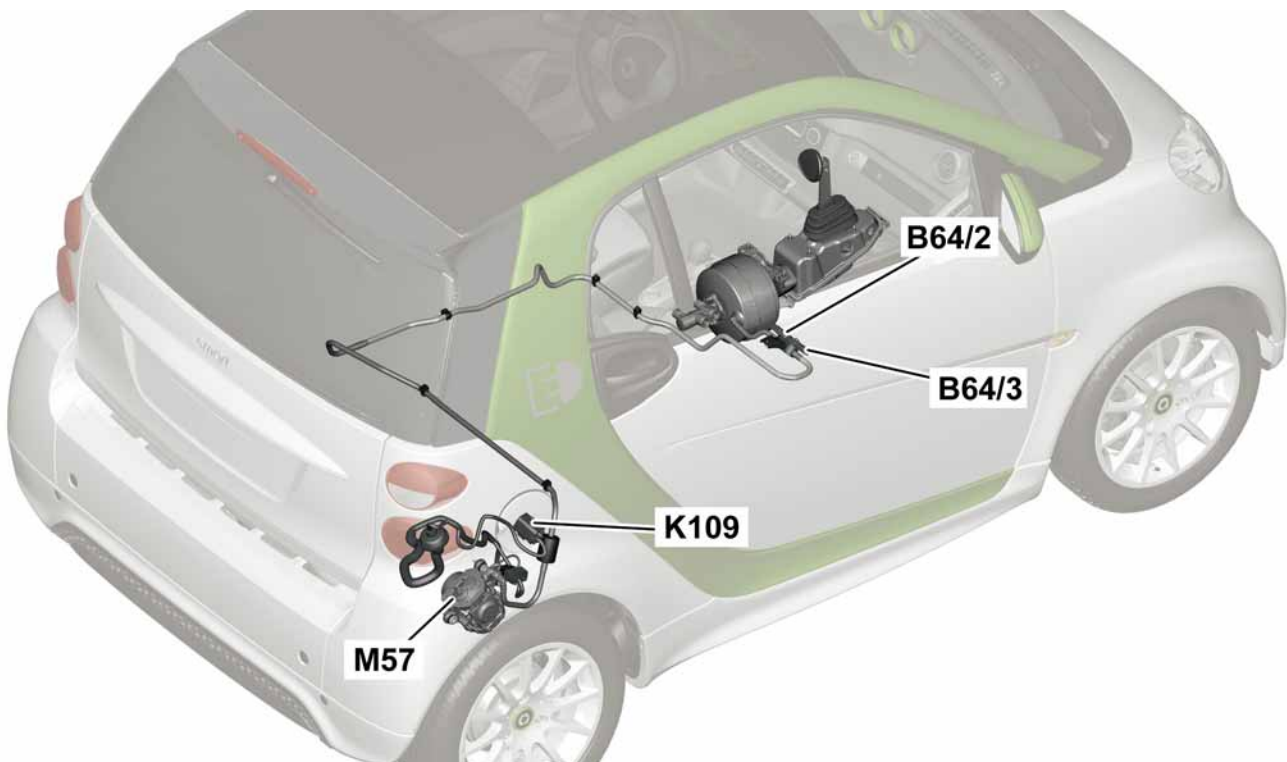
A check valve integrated in the vacuum pump, prevents the vacuum from being released when the pump is switched off.

Note

The number of operating hours of the vacuum pump must be determined using **DAS** at the following intervals:

- Up to 4 years/125,000 km: every 2 years
- After 4 years/125,000 km: annually

The brake booster vacuum pump must be replaced after 1200 operating hours. If replacement is required, this is indicated by the drivetrain control unit.



P42.10-2902-00

B64/2 Brake vacuum sensor 1
B64/3 Brake vacuum sensor 2

K109 Relay for brake vacuum pump (+)
M57 Brake booster vacuum pump

Sound generator

Since the electric drive system of the smart fortwo electric drive is very quiet, especially at low speeds, there is a risk that the vehicle may not be noticed or may only be noticed very late by other road users, particularly pedestrians. For this reason, a sound generator is offered as special equipment for the smart fortwo electric drive.

The sound generator is located at the front under the service flap and generates a speed-dependent noise at up to approx. 30 km/h.

The sound generator consists of a control unit, an audio output stage and a speaker. The sound generator is actuated by the drivetrain control unit via the CAN bus.



P82.62-3826-00

H4/16 Electric vehicle sound generator

Motor description

The smart fortwo electric drive is driven by a permanently energized 3-phase AC motor with 35 kW continuous output and 55 kW peak output.

An inverter in the power electronics control unit converts the direct voltage of the high-voltage battery into 3-phase alternating voltage for operating the electric motor. The rpm of the motor is determined by the frequency and the torque via the PWM duty cycle of the AC voltage.

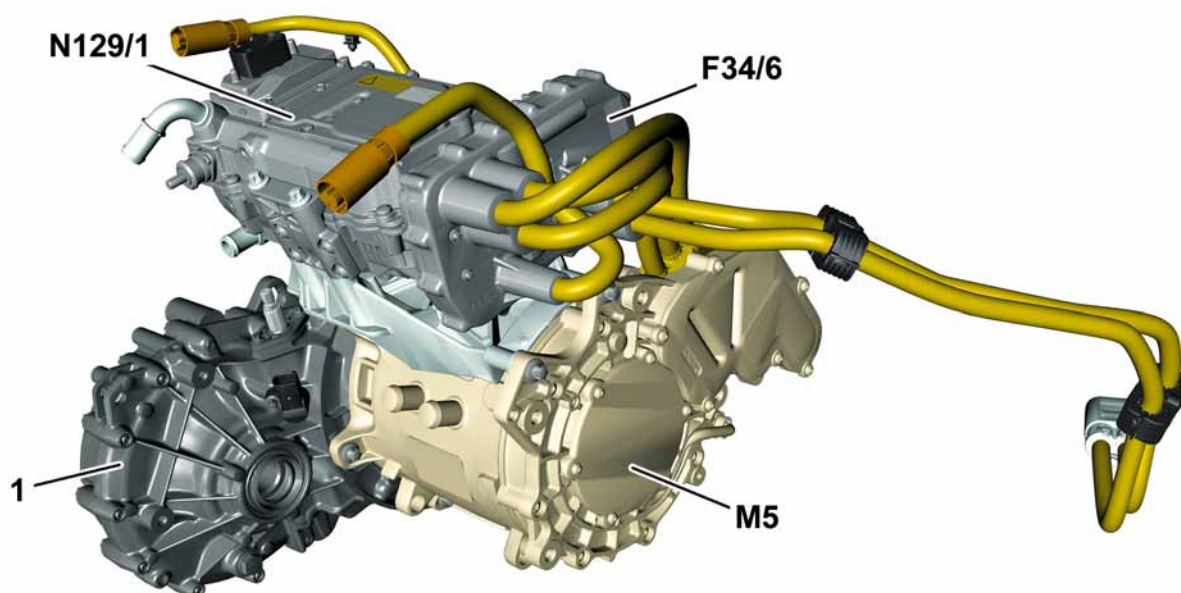
The power electronics control unit is connected directly to the high-voltage adapter plate fuse box. The electric motor is connected to the high-voltage adapter plate fuse box via 3 high-voltage lines. The operating parameters such as rotor position, rpm and motor temperature are transmitted to the power electronics control unit over another connector.

The direction of rotation of the electric drive motor is reversed for reverse travel.

In deceleration mode, the electric drive motor operates as a generator (regenerative braking). In this case, the voltage generated by the motor is fed to the high-voltage on-board electrical system via the power electronics control unit.

The efficiency of the power electronics and electric motor depends on the operating temperature.

The power electronics control unit and electric drive motor are cooled by a coolant circuit. At a coolant temperature between 80 °C and 90 °C, measured by the power electronics control unit, the output is reduced by the power electronics control unit down to 0 kW on a linear basis.



P08.10-2052-00

Electric drive system

1	Transmission	M5	Electric drive motor
F34/6	High-voltage adapter plate fuse box	N129/1	Power electronics control unit

Transmission description

The smart fortwo electric drive uses a newly developed single stage transmission with bevel gear differential and park pawl.

The drive system has a permanent gear ratio of 9.922:1. The new transmission allows the use of standard drive shafts.

Reverse gear:

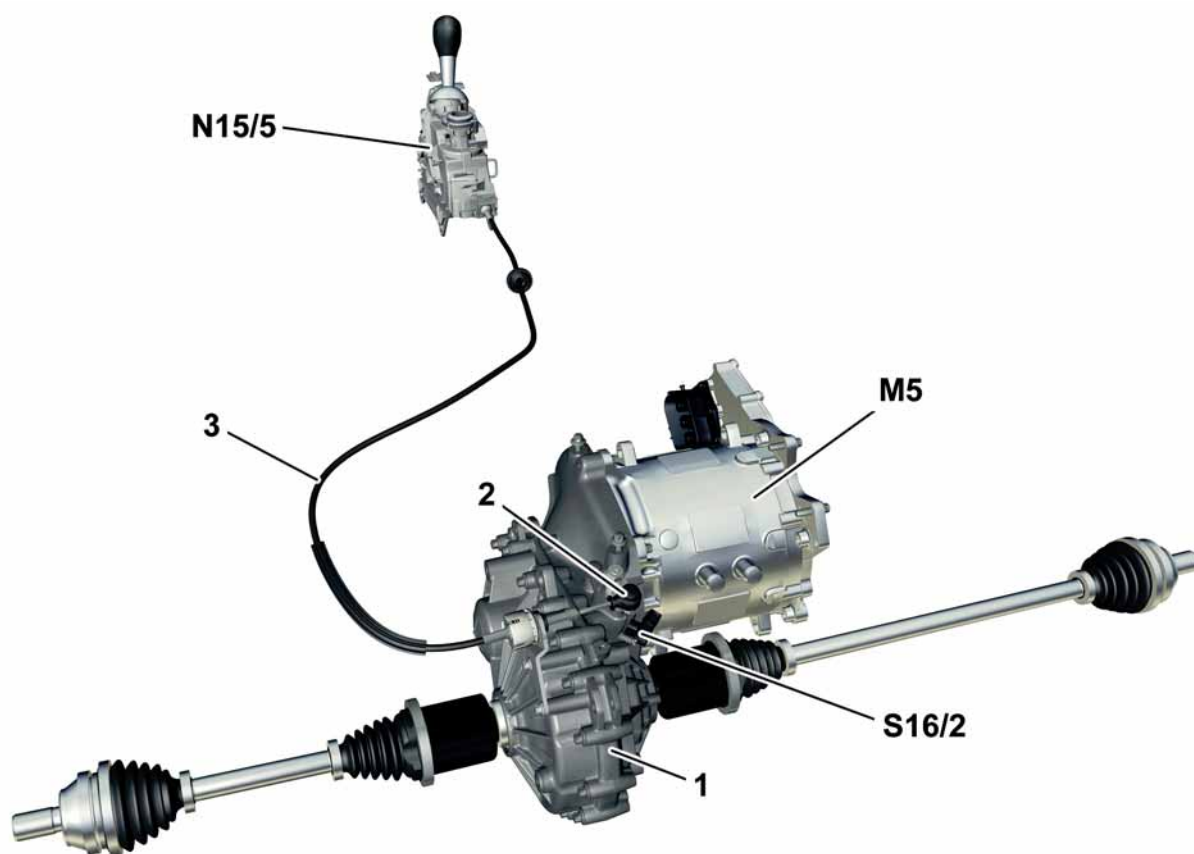
The direction of rotation of the electric drive motor is reversed for reverse travel.

Selector lever

The system is operated via the electronic selector lever module.

The mechanical park pawl is engaged in the transmission in position "P" via a cable.

The drivetrain control unit reads in the status of the park pawl via the park pawl switch.



P26.60-2482-00

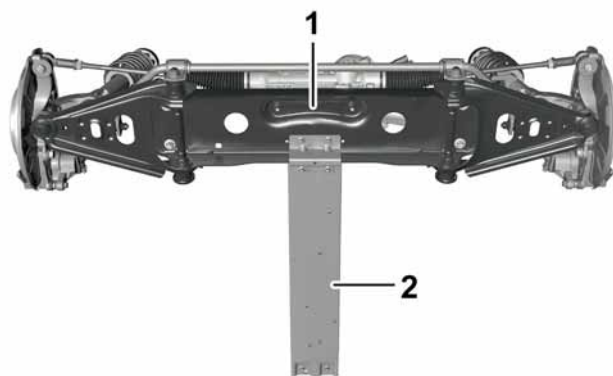
- 1 Transmission
- 2 Park pawl
- 3 Park pawl cable

- M5 Electric drive motor
- N15/5 Electronic selector lever module
- S16/2 Park pawl switch

Axles and suspension

Due to the greater vehicle weight, modified springs are used at the front and rear axle.

On the front axle, the crossmember for holding the supporting strut for the high-voltage battery was modified.



P33.00-2122-00

- 1 Front axle crossmember
- 2 High-voltage battery supporting strut



P00.00-4820-00

Suspension and steering

Wheels, tires and brakes

	Front wheel	Front tire	Rear wheel	Rear tire
Light alloy wheels (cast aluminum)				
Standard	4.5 Jx 15 H2 ET23.5	155/60 R15 74 T	5.5 Jx 15 H2 ET22	175/55 R15 77 T
Spare wheel	TIREFIT tire sealant			

Brake system	Front axle	Rear axle
Brake type	Disk brake 1-piston floating caliper	Drum brake 2-piston simplex
Disk diameter	280 mm	—
Drum diameter	—	203 mm
Disk thickness	9.7 mm	—
Drum width	—	30 mm

The smart fortwo electric drive has 2 cooling systems. Climate control of the interior compartment is performed by a refrigerant circuit and cooling of the drivetrain components is performed by a coolant circuit. On vehicles with code (V03) Battery cooling system, the coolant for the high-voltage battery can additionally be cooled by the air conditioning system via a refrigerant/coolant heat exchanger (chiller).

Interior cooling system

As on vehicles with a combustion engine, the interior is cooled via the refrigerant circuit with the following components:

- Electric refrigerant compressor
- Condenser
- Expansion valve
- Evaporator

On vehicles with code (V03) Battery cooling system, the expansion valve can also be shut off electrically. There is an additional electrical expansion valve (battery) on the chiller.

Drivetrain component cooling system

Cooling of the drivetrain components is performed by a coolant circuit. The following components are cooled:

- Electric drive motor
- Power electronics control unit
- High-voltage battery
- On-board charger

The cooling module, consisting of a cooler, coolant expansion reservoir and condenser, is the same as that of the smart with combustion engine.

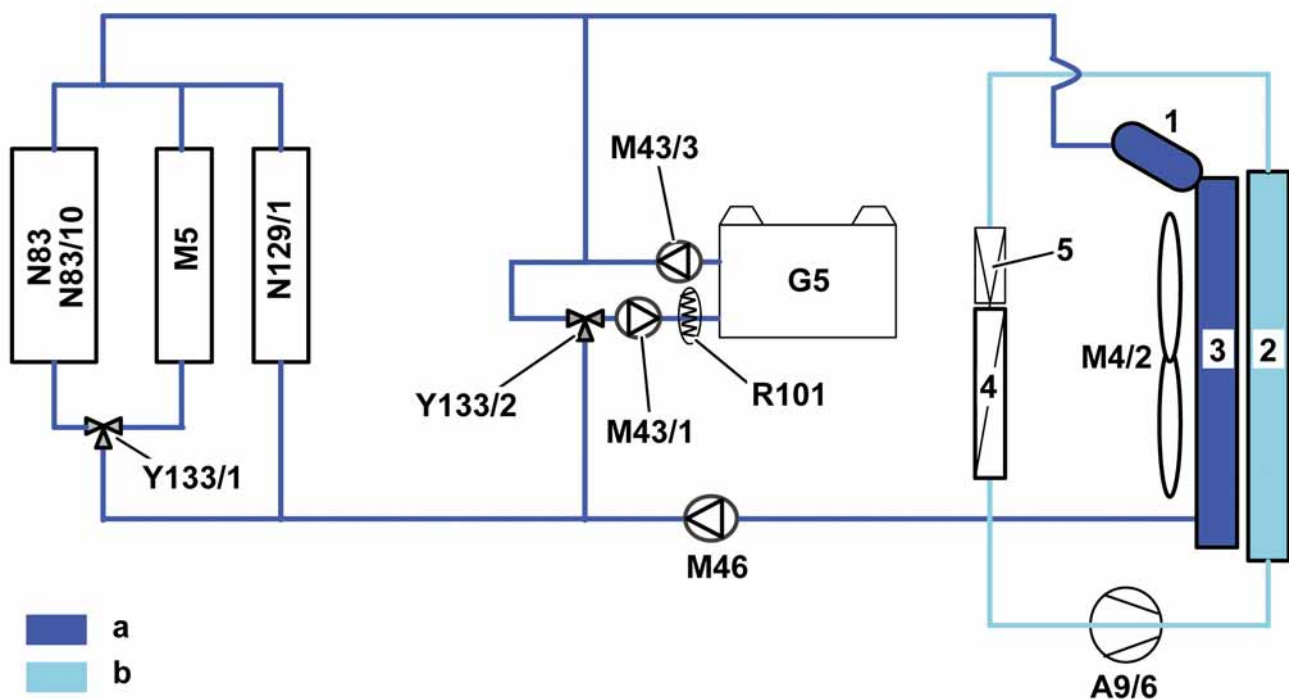
The drivetrain control unit records the values from the temperature sensors in the components involved and controls the coolant fan motor and electrical coolant pump according to requirements.

The coolant (glycol/water mixture) is pumped from the cooler to the drivetrain components by the electric coolant pump. From there, it returns to the coolant expansion reservoir.

The coolant fan motor can be operated in two stages. It is switched via the fan stage switching relay and fan control series resistor by the drivetrain control unit.

Cooling system overview

Cooling system without code (V03) Battery cooling system

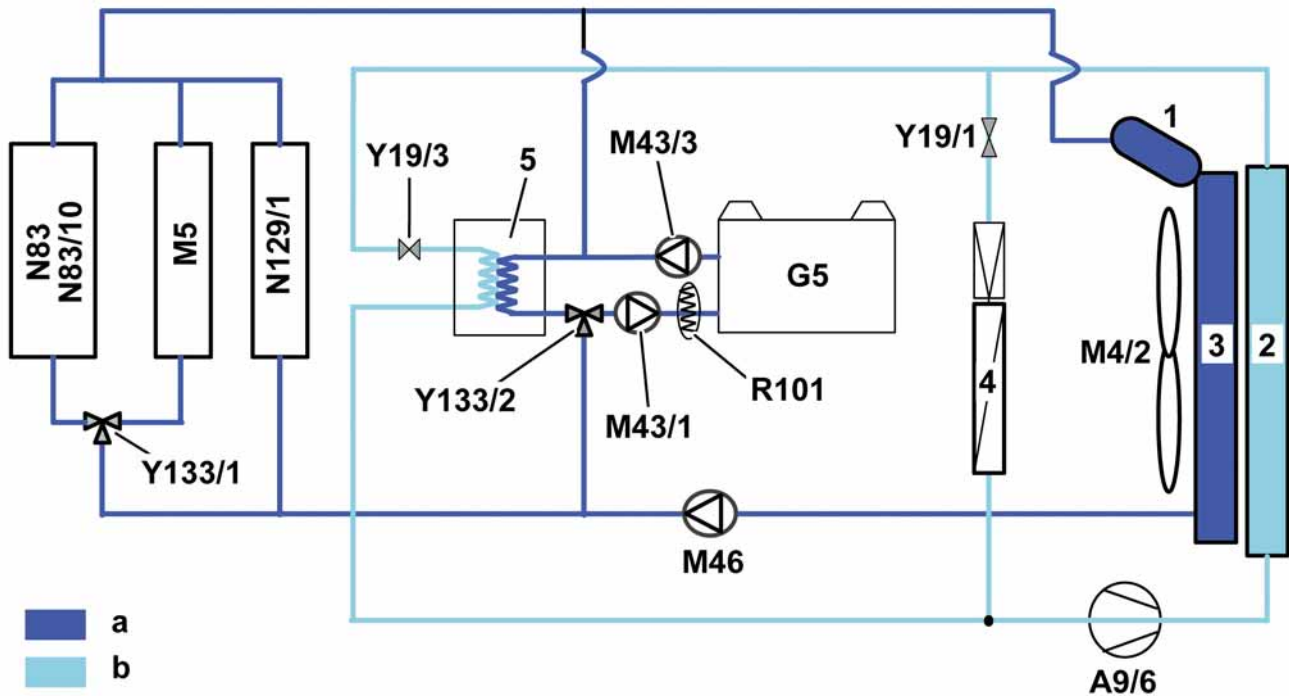


P20.00-2442-00

Coolant/refrigerant circuit (schematic)

A9/6	Electric refrigerant compressor	1	Expansion reservoir
G5	High-voltage battery	2	Condenser
M4/2	Coolant fan motor	3	Cooler
M5	Electric drive motor	4	Evaporator
M43/1	Coolant pump 1 (feed)	5	Expansion valve
M43/3	Coolant pump 2 (return)	a	Coolant circuit
M46	Electric drive and on-board charger coolant pump	b	Refrigerant circuit
N83	On-board charger 3kW		
N83/10	On-board charger 22 kW (with code (908) 22 kW on-board charger)		
N129/1	Power electronics control unit		
R101	High-voltage battery heater		
Y133/1	Drive system coolant pump switchover valve		
Y133/2	High-voltage battery coolant pump switchover valve		

Cooling system with code (V03) Battery cooling system

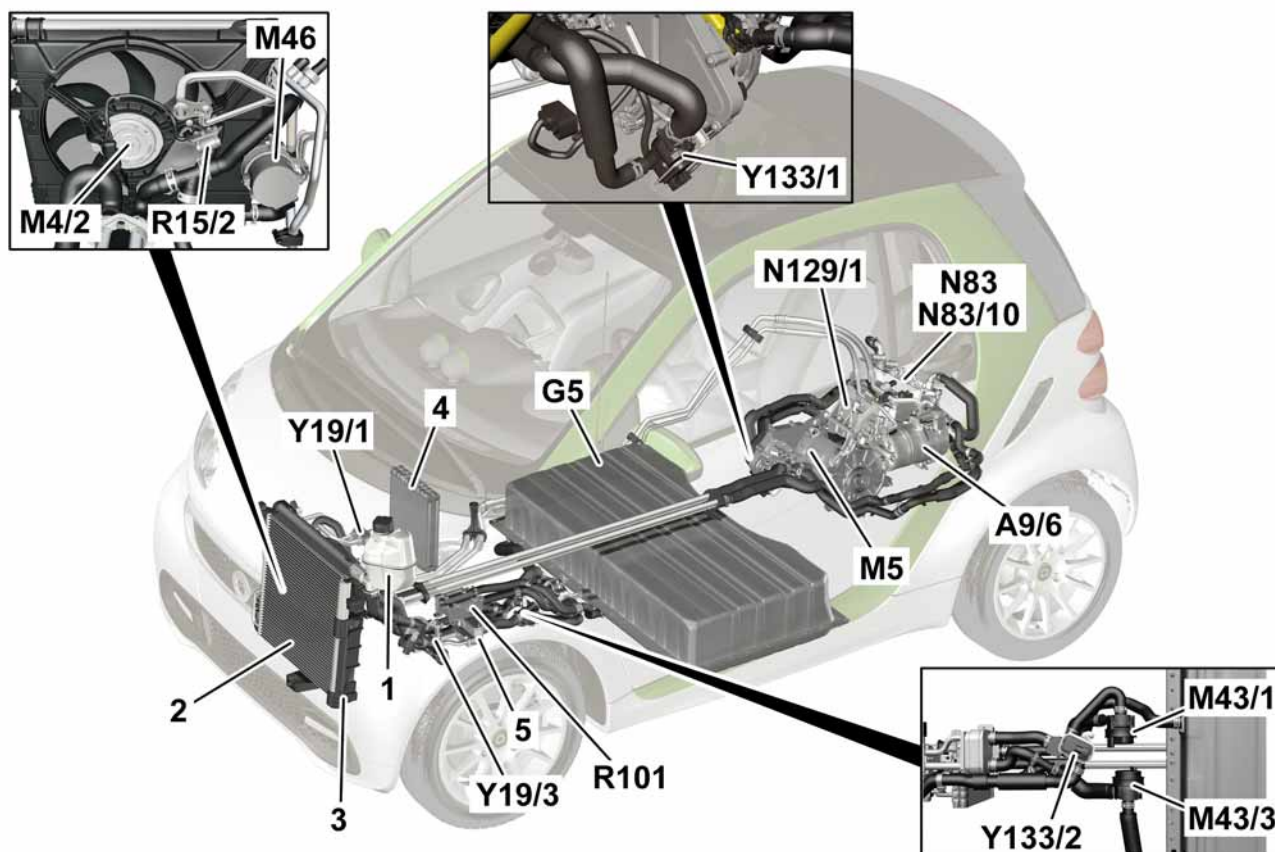


P20.00-2437-00

Coolant/refrigerant circuit (schematic)

A9/6	Electric refrigerant compressor	1	Expansion reservoir
G5	High-voltage battery	2	Condenser
M4/2	Coolant fan motor	3	Cooler
M5	Electric drive motor	4	Evaporator
M43/1	Coolant pump 1 (feed)	5	Chiller
M43/3	Coolant pump 2 (return)	a	Coolant circuit
M46	Electric drive and on-board charger coolant pump	b	Refrigerant circuit
N83	On-board charger 3kW		
N83/10	On-board charger 22 kW (with code (908) 22 kW on-board charger)		
N129/1	Power electronics control unit		
R101	High-voltage battery heater		
Y19/1	Electric expansion valve (interior)		
Y19/3	Electric expansion valve (battery)		
Y133/1	Drive system coolant pump switchover valve		
Y133/2	High-voltage battery coolant pump switchover valve		

Cooling system components



P20.00-2443-00

Cooling system with code (V03) Battery cooling system

A9/6	Electric refrigerant compressor
G5	High-voltage battery
M4/2	Coolant fan motor
M5	Electric drive motor
M43/1	Coolant pump 1 (feed)
M43/3	Coolant pump 2 (return)
M46	Electric drive and on-board charger coolant pump
N83	On-board charger 3kW
N83/10	On-board charger 22 kW (with code (908) 22 kW on-board charger)
N129/1	Power electronics control unit
R15/2	Fan control series resistor (2-stage)
R101	High-voltage battery heater
Y19/1	Electric expansion valve (interior)
Y19/3	Electric expansion valve (battery)
Y133/1	Drive system coolant pump switchover valve
Y133/2	High-voltage battery coolant pump switchover valve

- 1 Expansion reservoir
- 2 Condenser
- 3 Cooler
- 4 Evaporator
- 5 Chiller

High-voltage battery cooling system

High-voltage battery cooling system

Since the optimal operating conditions of the high-voltage battery are bound by tight temperature limits, the battery management system control unit can decouple the coolant circuit of the high-voltage battery from the rest of the cooling circuit via an electromotive water valve if necessary.

The cooling circuit of the high-voltage battery then consists of:

- 2 coolant pumps
- High-voltage battery heater
- Chiller (only with code (V03) Battery cooling system)
- Electric expansion valve (only with code (V03) Battery cooling system)
- Electromotive water valve (coolant pump switchover valve)

The chiller is only installed on vehicles with code (V03) Battery cooling system. It is a refrigerant/coolant heat exchanger which is connected to the refrigerant circuit of the air conditioning and the cooling circuit of the high-voltage battery. The electric expansion valves of the chiller and of the evaporator for interior cooling can be actuated by the battery management system control unit.

The high-voltage battery can thus be cooled independently of the interior climate control.



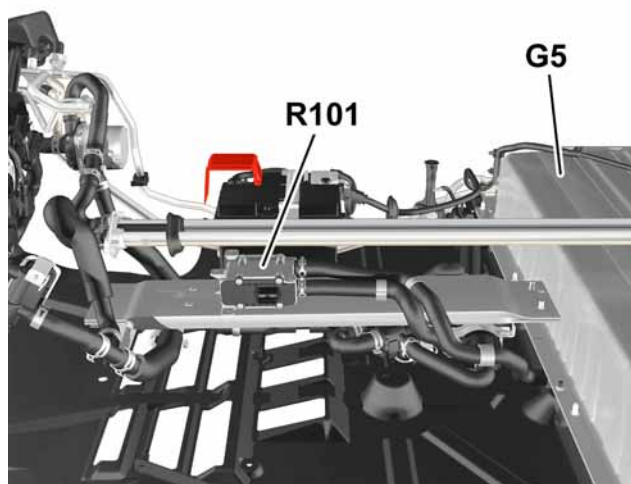
Note

In the smart fortwo electric drive, R134a is used as refrigerant and ND8 is used as refrigerant oil, including for service.

High-voltage battery heater

Since the capacity of the high-voltage battery drops at low temperatures, the high-voltage battery can be heated by the high-voltage battery heater during the charging process at temperatures below 0°C.

The high-voltage battery heater is located in the cooling circuit of the high-voltage battery, is supplied with power by the 12 V on-board electrical system and actuated by the drivetrain control unit.



P54.10-3703-00

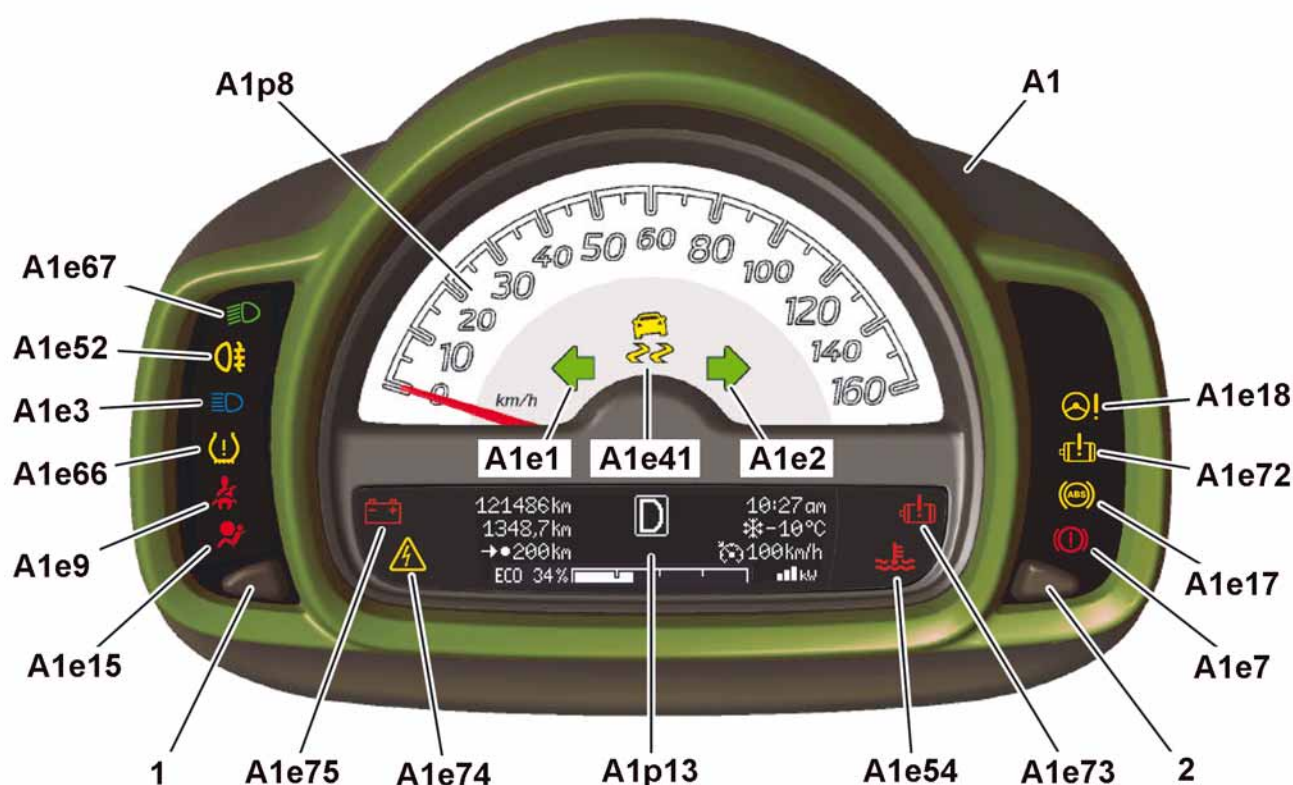
- G5 High-voltage battery
R101 High-voltage battery heater

Instrument cluster

The instrument cluster is based on the High-Line instrument cluster of the facelifted smart fortwo.

It has been supplemented with the following electric vehicle-specific indicators:

- Drive system diagnosis indicator lamp
- Drive system diagnosis warning lamp
- High-voltage system warning lamp
- Electric steering indicator lamp



P54.33-2054-00

- 1 Left button, select multiple display / set clock
- 2 Right button, instrument illumination / set clock
- A1 Instrument cluster
- A1e1 Left turn signal indicator lamp
- A1e2 Right turn signal indicator lamp
- A1e3 High beam indicator lamp
- A1e7 Brake fluid and parking brake warning lamp
- A1e9 Seat belt warning lamp

- A1e15 Airbag indicator and warning lamp
- A1e17 ABS indicator lamp
- A1e18 Electric steering indicator lamp
- A1e41 ESP warning lamp
- A1e52 Rear fog light indicator lamp
- A1e54 Coolant temperature warning lamp
- A1e66 Tire pressure monitor warning lamp
- A1e67 Low beam indicator lamp
- A1e72 Drive system diagnosis indicator lamp
- A1e73 Drive system diagnosis warning lamp
- A1e74 High-voltage system warning lamp
- A1e75 12 V battery warning lamp
- A1p8 Electronic speedometer
- A1p13 Multifunction display

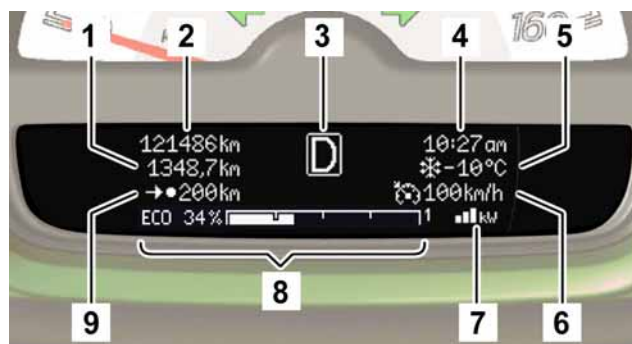
Multifunction display

The multifunction display provides information about variable changes in the vehicle, its surroundings and the route. This includes:

- Outside temperature with black ice warning
- Main odometer
- Trip odometer
- Gear indicator P-R-N-D
- Maintenance interval display

The smart fortwo electric drive also includes the following new indicators:

- Available power of electric drive motor
- Remaining charging time
- Remaining range
- ECO indicator
- Time



P54.33-2053-00

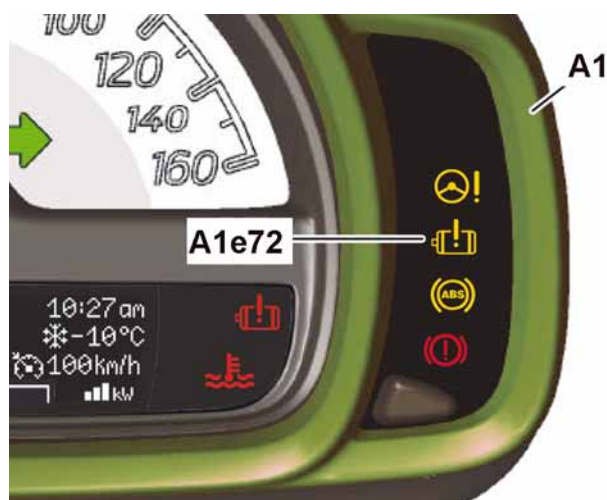
Multifunction display

- 1 Trip odometer/pre-conditioning ON
- 2 Total distance/pre-conditioning departure time
- 3 Gear indicator/trip computer/messages
- 4 Time
- 5 Outside temperature with black ice warning
- 6 Cruise control
- 7 Available power
- 8 ECO indicator
- 9 Remaining range

Limp-home mode

The limp-home function with power reduction is activated if one of the following events occurs:

- Faults in the 12 V on-board electrical system
- Accelerator pedal malfunction
- Faults in battery management system and malfunction of high-voltage battery coolant pump
- The drive system diagnosis indicator lamp comes on in the instrument cluster.



P54.33-2055-00

- A1 Instrument cluster
A1e72 Drive system diagnosis indicator lamp

Additional instruments

Additional instruments

The function of the two additional instruments on the center of the instrument panel has been modified: The additional instruments are actuated by the drivetrain control unit via LIN EV.

The right additional instrument (Powermeter) shows the power flow of the high-voltage battery and has the following functions:

- Rest condition = OFF
- Level of regenerative braking (Charge)
- Power use (0 - 100%)



P54.33-2051-00

Right additional instrument

A15p6 High-voltage battery energy flow

The left additional instrument shows the high-voltage battery state of charge (SOC)



P54.33-2052-00

Left additional instrument

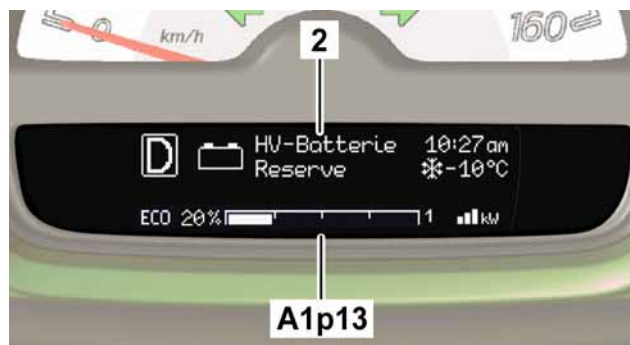
A15p7 High-voltage battery state of charge (SOC) indicator

Additional instruments

Display of state of charge of high-voltage battery on multifunction display

When the remaining charge level of the battery is 20%, the text message "HV battery reserve" appears.

When this is acknowledged by pressing the "OK" button on the right multifunction control lever, the remaining range is displayed again.

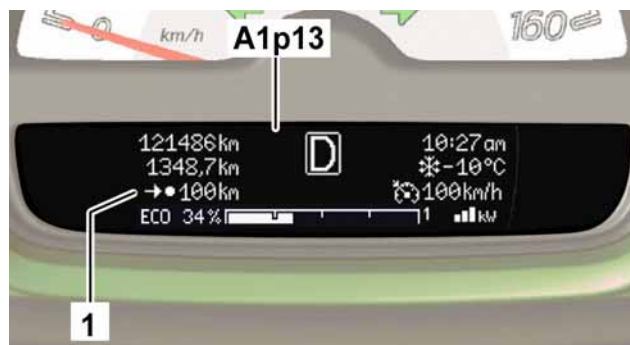


P54.33-2158-00

2 "HV battery reserve" indicator

A1p13 Multifunction display

The remaining range is displayed on the multifunction display down to a battery charge level of 10%.



P54.33-2157-00

1 Remaining range indicator

A1p13 Multifunction display

When the remaining charge level of the battery is 10%, the text message "HV battery reserve" appears again. After this, "Low Battery" is displayed permanently on the multifunction display instead of the remaining range indicator.

As of 5% SOC, a warning tone sounds and the power display on the multifunction display starts to flash.



P54.33-2159-00

3 "Low Battery" indicator

A1p13 Multifunction display

Climate control

Heating

A high-voltage PTC heater with 4 kW output is used instead of a heater heat exchanger through which coolant flows as is the case on vehicles with a combustion engine.

The heater is controlled using the heater/AC operating unit via CAN based on the selected interior target temperature and ambient temperature.

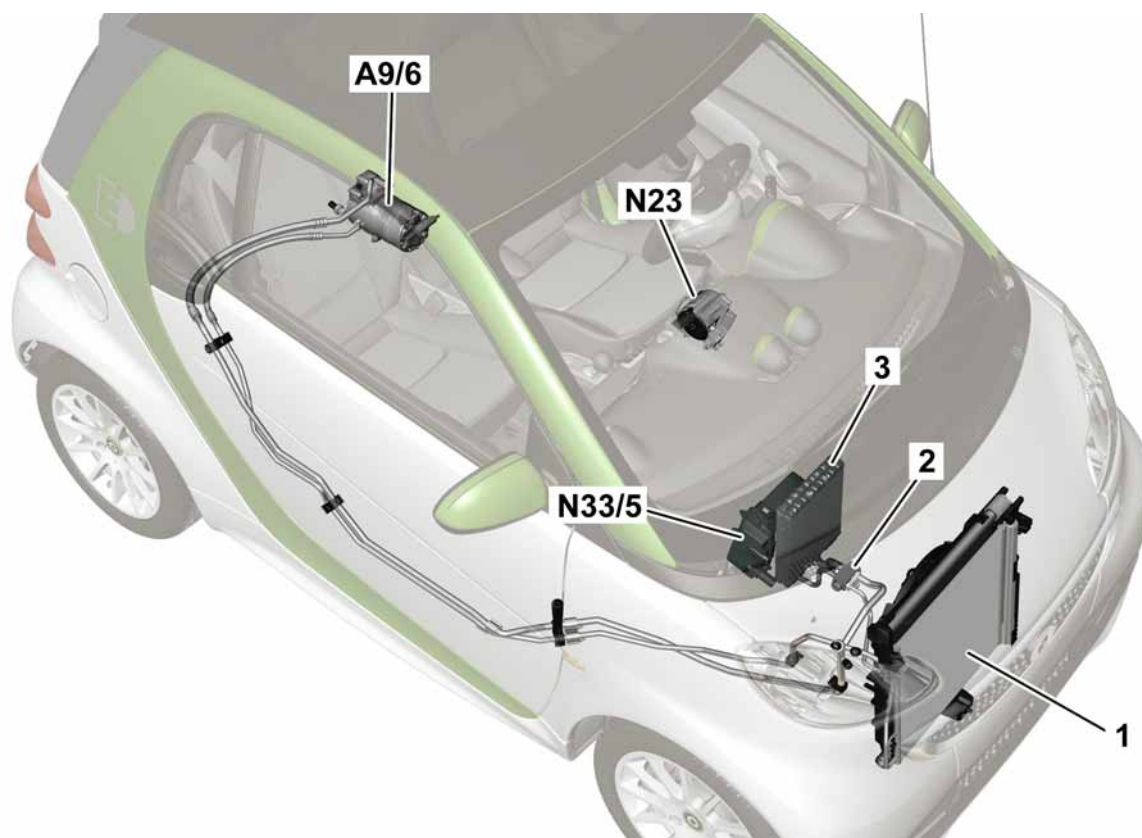
The high-voltage PTC heater is supplied with power by the high-voltage adapter plate fuse box.

Air conditioning

As on a smart with conventional drive system, it is controlled via the heater/AC operating unit.

The design of the system differs in the following aspects:

- Electrically driven refrigerant compressor
- Thermostatic expansion valve on interior evaporator with electromagnetic shutoff function (only with code (V03) Battery cooling system)
- Additional branch to chiller in refrigerant circuit (only with code (V03) Battery cooling system)



P83.30-4835-00

- 1 Condenser
- 2 Expansion valve
- 3 Evaporator

- A9/6 Electric refrigerant compressor
N23 Heater/AC operating unit
N33/5 High-voltage PTC heater

Heater/AC operating unit

The heater/AC operating unit is located at the top of the center console. The interior temperature sensor is located under the temperature selector wheel.

When the desired temperature is set, the request for heating or cooling is transmitted to the drivetrain control unit via CAN C. This forwards the output values requested by the heater/AC operating unit for the high-voltage PTC heater or the requested rpm for the electric refrigerant compressor to the corresponding components.

Heating:

Climate control takes place via the heater/AC operating unit. This communicates with the control unit in the high-voltage PTC heater via CAN C. The control unit in the high-voltage PTC heater activates the output stages in accordance with the requested heat output.

Cooling:

The drivetrain control unit communicates with the control unit in the electrically driven high-voltage refrigerant compressor via LIN. The control unit of the electric refrigerant compressor regulates the speed to the value set by the heater/AC operating unit.

On vehicles with code (V03) Battery cooling system, the electric motor is also regulated depending on the cooling output request of the high-voltage battery. These vehicles (for hot countries) have an additional coolant/refrigerant heat exchanger (chiller) in the refrigerant circuit for cooling the high-voltage battery.

These vehicles are equipped with electrically switchable expansion valves in order to allow the interior and battery cooling systems to be activated independently.

Cooling of the high-voltage battery is controlled by the battery management system control unit.

Climate control

Pre-conditioning

As a special comfort feature, the vehicle interior of the smart fortwo electric drive can be pre-heated or pre-cooled. The pre-conditioning function can be set using the multifunction display.

Requirements:

- Charging cable plugged in and connected to external power supply
- Charge level of high-voltage battery (SOC) at least 30%
- Temperature in interior below 18 °C or above 24 °C

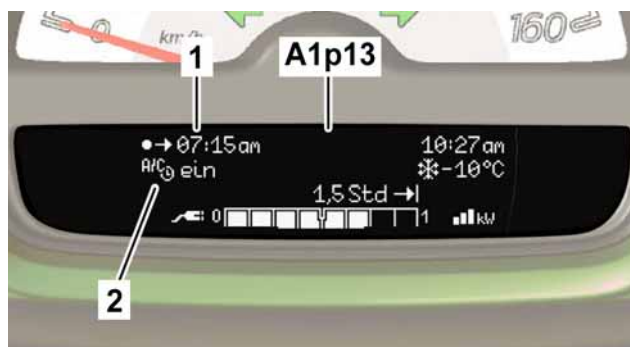
Pre-conditioning starts 35 minutes before departure at the earliest and is maintained for a maximum of 5 minutes after the programmed departure time. The actual start of pre-conditioning depends on the ambient temperature and the temperature in the vehicle interior.

The high-voltage PTC heater is switched on at interior temperatures below 18 °C. The heat output is adjusted so that an interior temperature of 18 °C is reached 5 minutes before the programmed departure time.

The electric refrigerant compressor is switched on at interior temperatures above 24 °C. The cooling output is adjusted so that an interior temperature of 24 °C is reached 5 minutes before the programmed departure time.

The blower is always operated at stage 2 in this case. The temperature preselected on the heater/AC operating unit has no influence on pre-conditioning.

The air distribution cannot be influenced by pre-conditioning. The customer must set the air distribution to the desired direction when the vehicle is parked.



P54.33-2156-00

- 1 Departure time
- 2 A/C On indicator

A1p13 Multifunction display

i Note

Pre-conditioning can also be activated and programmed via the "Vehicle Homepage" function using a smartphone with corresponding application ("App") or a PC.

Bodyshell structure

The bodyshell structure has been taken over from the series production vehicles unchanged.

A High-strength steels:

These areas consist of high-strength, micro-alloyed steels. Resistance spot welding can easily be carried out in these areas. However, metal active gas (MAG) welding can only be performed in approved areas.

B Soft deep-drawing steels:

In these areas, all the usual welding methods can be used.



P60.00-2875-00

Bodyshell material overview

- A High-strength steels
- B Soft deep-drawing steels

Body

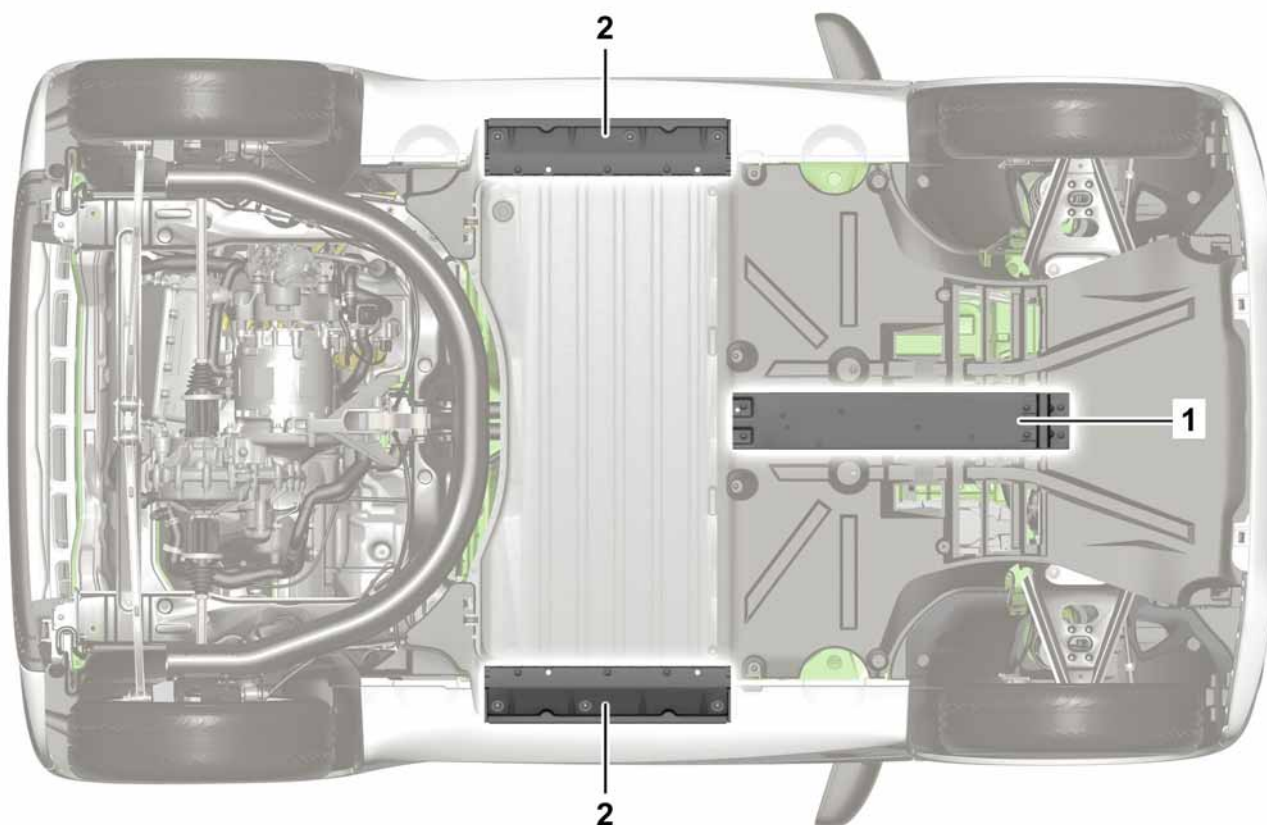
Underfloor

Reinforcements

The reinforcements for the high-voltage battery are located in the area of the underfloor.

Underfloor paneling

A continuous underfloor panel made of plastic is installed in the front area from the bumper up to the high-voltage battery. This has the effect, for example, of significantly reducing the ingress of dirt and corrosive materials.



P60.00-2945-00

- 1 High-voltage battery supporting strut
- 2 Reinforcement for protection against side crashes

Chassis

If damage to the chassis has occurred or is suspected, a wheel alignment check is recommended for quick diagnosis of the damage. The wheel alignment data for the series production vehicle with combustion engine apply.

In order to prevent false measurement results, undamaged wheels must be mounted on the vehicle before the wheel alignment check. In particular, the four bolting points (front axle carrier/frame-type integral support) to the body must be checked for displacement.

If there is any type of deformation on the front or rear axle, it must be replaced. For this reason, these components must be visually inspected with care for cracks and deformation.

In order to check for frame damage, electronic body measurement systems can be used for diagnostic purposes e.g.

- "Contact" (CAR BENCH)
- "NAJA" (Celette)
- "Shark" (Blackhawk)

High-voltage system

If the vehicle suffers significant damage due to external force, the high-voltage system must be checked to determine whether it is deenergised. Work on the vehicle may only be carried out by an **"Electrical specialist for HV systems in motor vehicles (series production vehicles)"**.

If it is not possible to definitively determine that the high-voltage system is deenergized, e.g. due to mechanical damage, no further work may be performed on the high-voltage system.

Once the power has been disconnected, the high-voltage system must be checked for external damage and defects. Damaged or defective high-voltage components, cooling systems or lines must be replaced.

Repairing the high-voltage components is not permissible.

When inspecting high-voltage components, personal protective equipment must always be worn (safety glasses, electrical gloves etc.).

Notes on supplemental restraint system

Airbag or emergency tensioning retractor units

Before performing work on the airbag or emergency tensioning retractor units, which requires intervention in their electric circuits (e.g. disassembly), the high-voltage system must always be deenergized.

The vehicle may only be deenergised by an "Electrical specialist for HV systems in motor vehicles (series production vehicles)".

Note

Airbag or emergency tensioning retractor units which have been dropped from a height of over 0.5 m must be replaced.

Do not allow airbag or emergency tensioning retractor units to come into contact with grease, oil or cleaning agents.

To allow emergency tensioning retractor units to be installed without damage or soiling, they are fitted with a PVC protective hose. After installation, these protective components can be removed. No sharp-edged tools may be used for removal to prevent damaging the belt strap.

Body

Depending on the extent of the damage, sheet metal damage can be repaired in various ways:

- Remove dents from sheet metal part(s)
- Partially replace sheet metal part(s)
- Completely replace sheet metal part(s)

Only the cutting areas are specified for sectional repairs (also "replacement part repairs"). This gives the service operation some leeway when adjusting the section to the respective damage profile. Cuts should always be made at the narrowest point and along the shortest distance.

Sectional repairs on the front longitudinal member are only permissible in front of the axle mount. The dull repair weld seams on the front longitudinal member repair section may not be ground smooth for strength-related reasons.

Before and after body repairs, the fault memory must be read out and any faults present must be documented.

After repairs to the body or body connections (e.g. suspension), the steering angle sensor (ESP) must be reparameterized.

Welding

Welding may only be performed on the vehicle after the high-voltage battery has been deenergised.

The high-voltage battery should be protected from the influence of thermal energy.

Before welding, a voltage monitor can be attached to the 12 V battery. This protects electronic systems and components from brief voltage peaks (overvoltage) caused by the welding equipment. The 12 V battery does not then have to be disconnected.

The decision as to whether a voltage monitor is used or the 12 V battery is disconnected depends on the extent of the damage.

Post-repair refinishing

The following measures must be observed before and during painting work:

- The preparation of paints produces vapors which combust in an explosion if ignited.
- Good ventilation must be provided before and during painting work.
- A dry temperature (or object temperature) of 60 °C may not be exceeded.

Electrical system

68-pin adapter cable

Use	For checking lines on drivetrain control unit.
MB number	W 451 589 07 63 00
FG	54
Set	B
Note	Only in combination with test box W 000 589 00 21 00



P58.20-2388-00

Abbreviations

ABS

Antilock Brake System

AC

Alternating Current

ATA

Antitheft alarm system

BMS

Battery Management System

CAN

Controller Area Network

CBS

Customized Bodypanel System

CP

Control Pilot

DAS

Diagnosis Assistance System

DC

Direct Current

DSL

Digital Subscriber Line

EPS

Electronic Power Steering

ESM

Electronic selector lever module

ESP

Electronic Stability Program

HV

High Voltage

HVIL

High Voltage Interlock Loop

LED

Light Emitting Diode

LIN

Local Interconnect Network

LHD

Left-Hand Drive

LV

Low Voltage

MAG

Metal Active Gas

Abbreviations

NEDC

New European Driving Cycle

PIN

Personal Identification Number

PLC

Powerline Communication

PLGW

Powerline Gateway

PP

Proximity

PTC

Positive Temperature Coefficient

PWM

Pulse Width Modulation

RFID

Radio Frequency Identification

SAM

Signal acquisition and actuation module

SRS

Supplemental Restraint System

SOC

State of Charge

TPM

Tire Pressure Monitor

WIS

Workshop Information System

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