Service.

Self-Study Programme 272

The Phaeton
Onboard Power Supply

Design and Function

The onboard power supply of vehicles in the early 1950s consisted of approx. 30 m of cables, some switches, lights and the ignition system.

The further development of motor vehicles required a constant increase in the number of electrical as well as electronic components.

In today's luxury performance class vehicles, the length of cable, despite networking, is approx. 3000 m, branching into approx. 1500 individual cables.

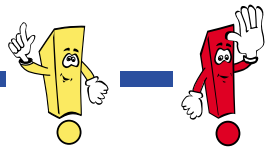
Networking connects control units with one another via databus lines. In this way, various signals can be transmitted digitally from one control unit to another. This takes place via two databus lines and eliminates the need for a separate cable for each individual signal.

This Self-Study Programme covers the design and function of the onboard power supply, that is, the power and data management of the Phaeton.

It describes new control units that control and regulate the power supply. It also describes, for example, the networking of the lighting control system as well as the CAN bus topology.

S272_073

NEW



Important Note

The self-study programme involves the design and function of new developments!
The contents are not updated.

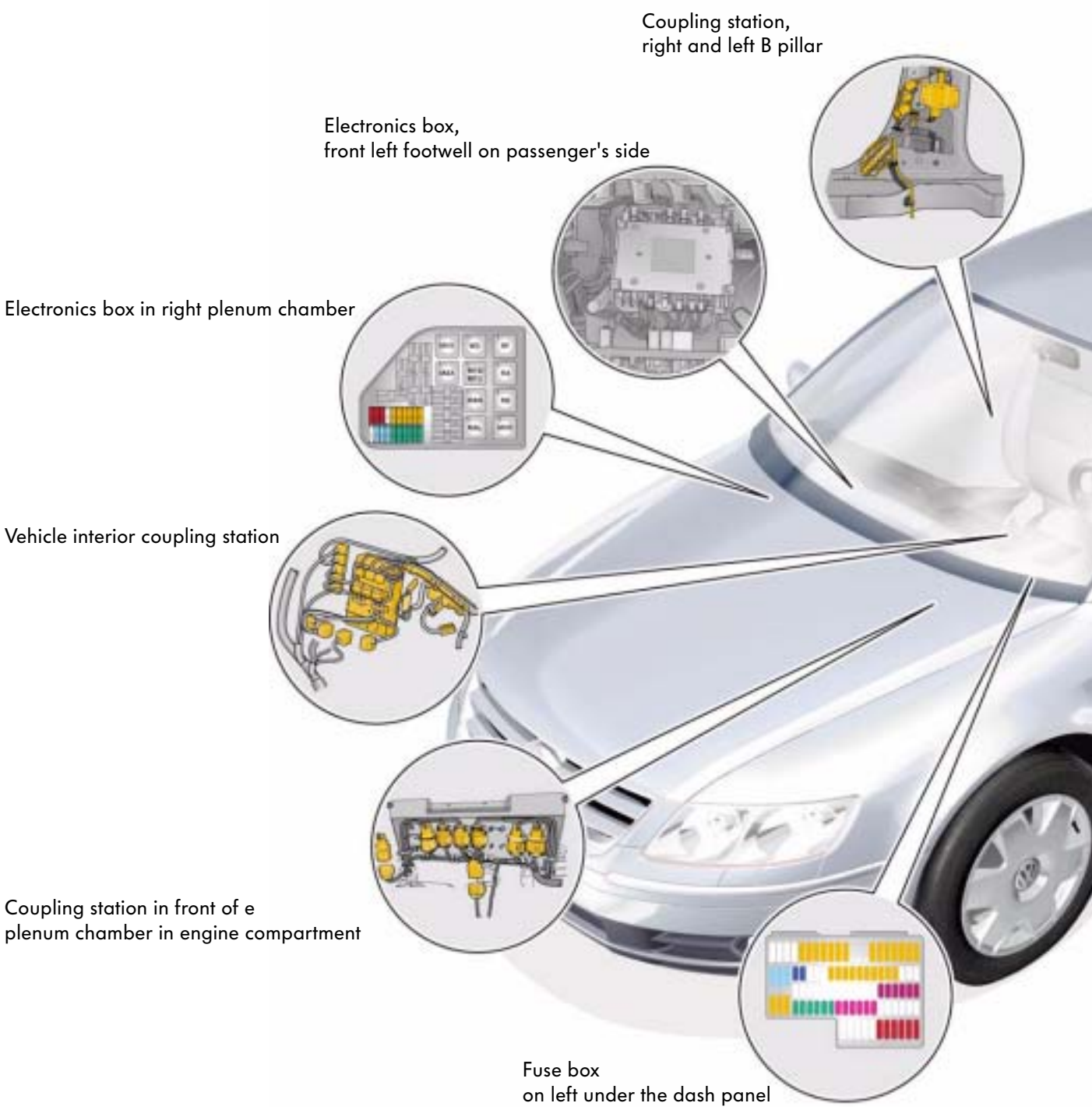
Please always refer to the relevant Service Literature for all inspection, adjustment and repair instructions.

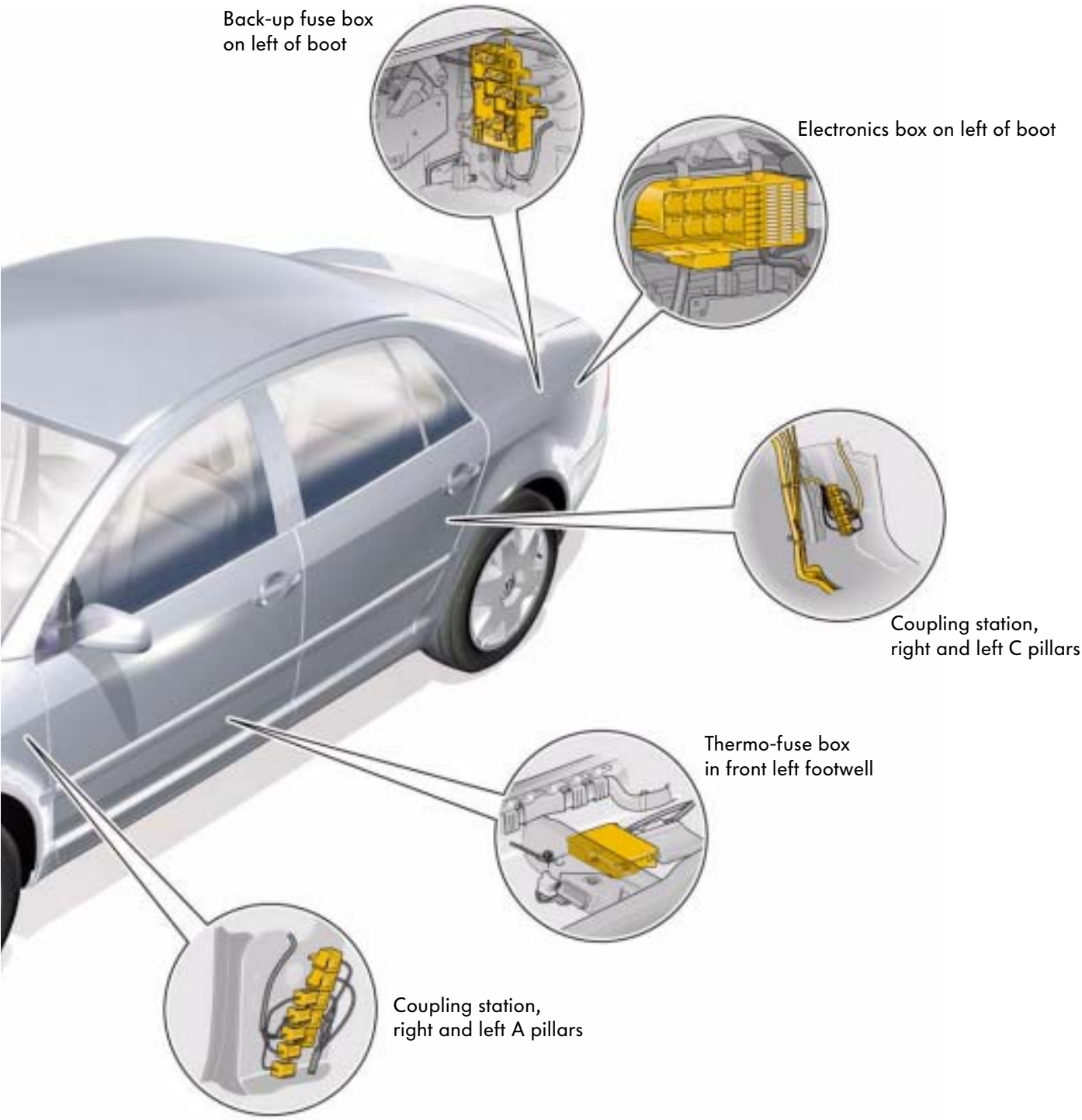
Table of contents

Introduction

Fitting locations in the onboard power supply

The onboard power supply has a decentral design. The electrical components are placed at various fitting locations in the vehicle. The following overview shows the fitting locations of the fuse boxes and coupling stations.



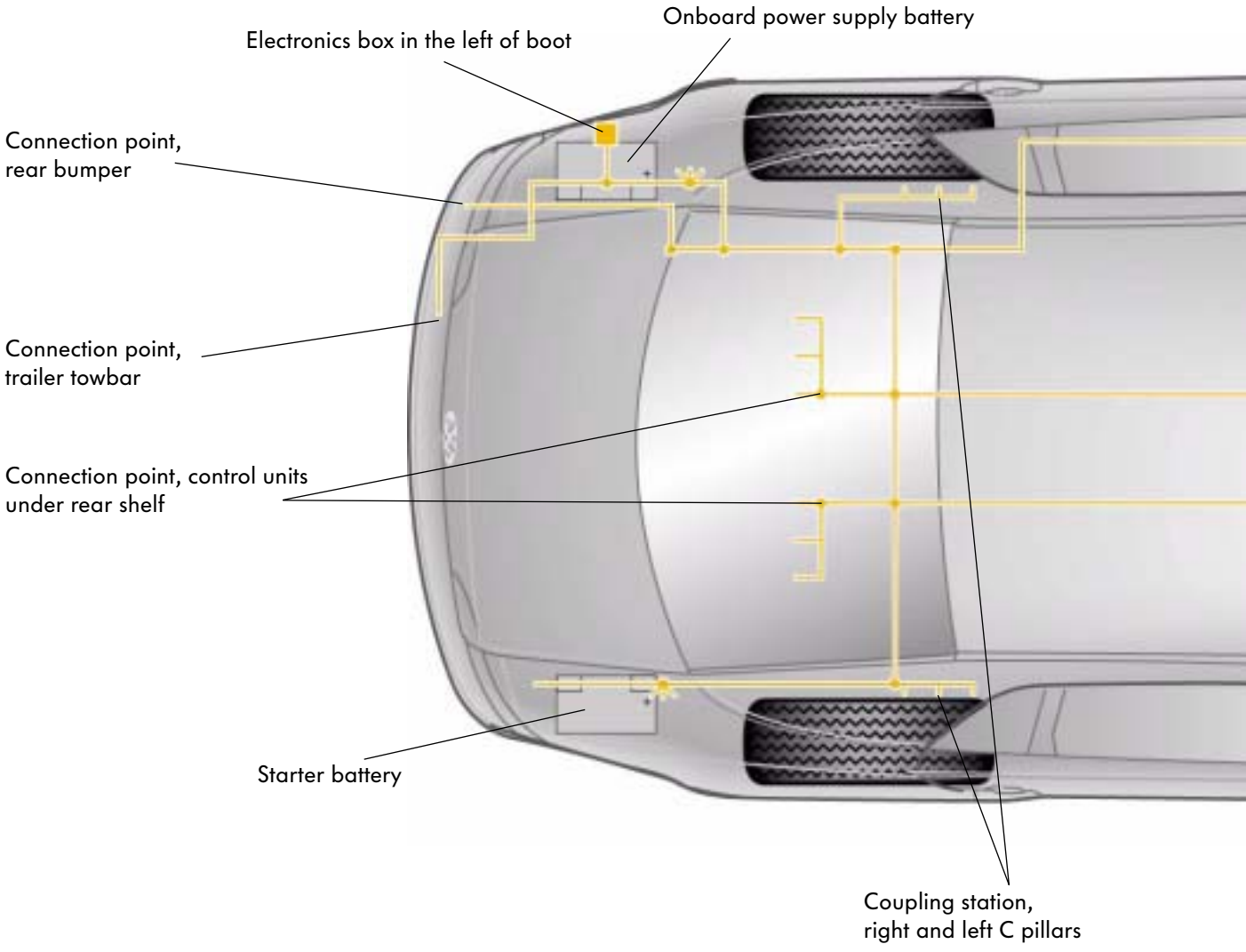

Back-up fuse box
on left of boot
Electronics box on left of boot
Coupling station,
right and left C pillars
Thermo-fuse box
in front left footwell
Coupling station,
right and left A pillars

S272_009

Introduction

Cable routing

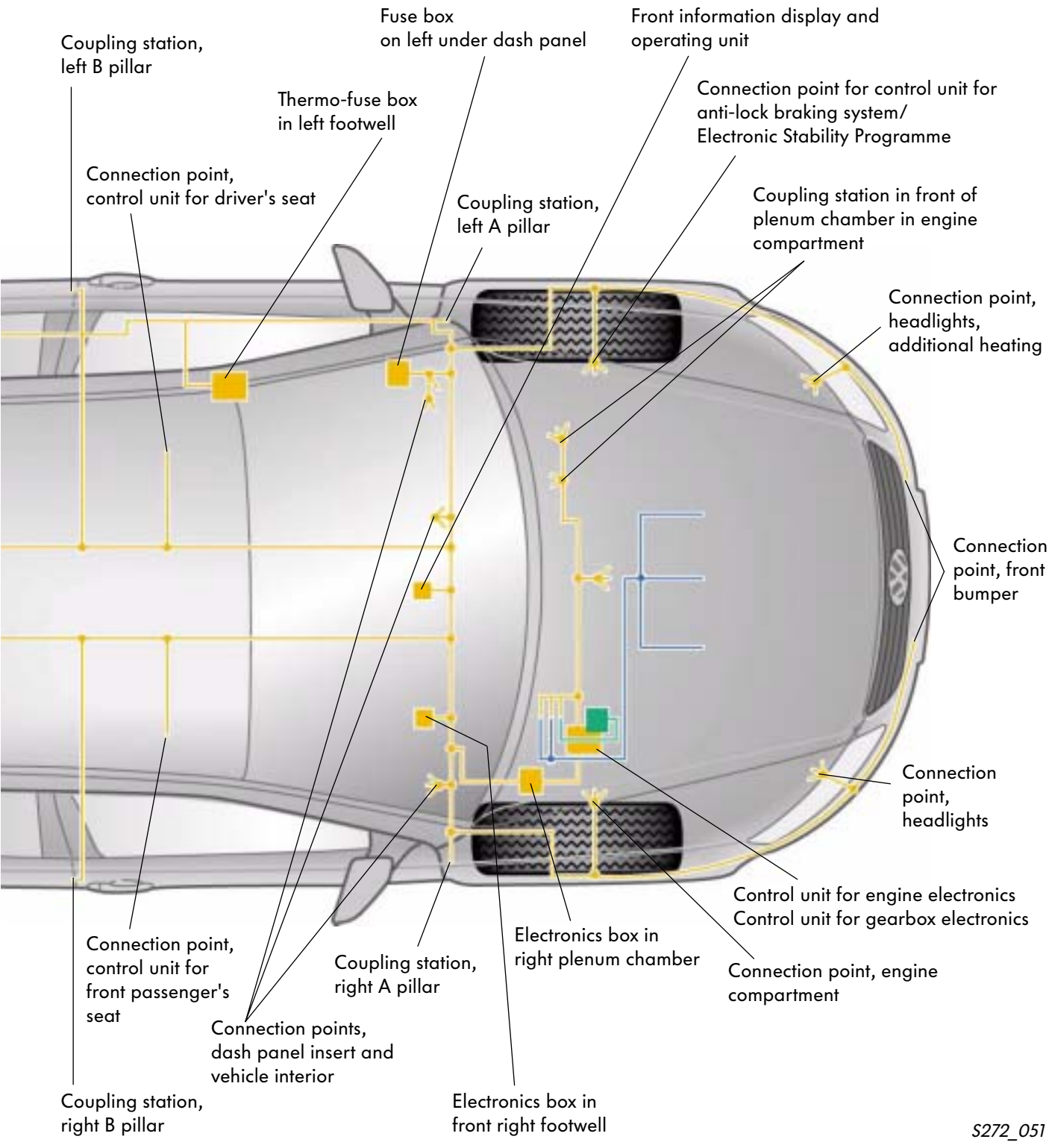
The main wiring harness runs from the battery in the boot on the driver's side to the connection points.
In the case of vehicles with a two-battery onboard power supply, the starter motor is supplied via a separate wiring harness on the right-hand side.
For protection, the wiring harnesses are laid in the floorpan area in cable ducts.



Main wiring harness

Engine wiring harness

Gearbox wiring harness

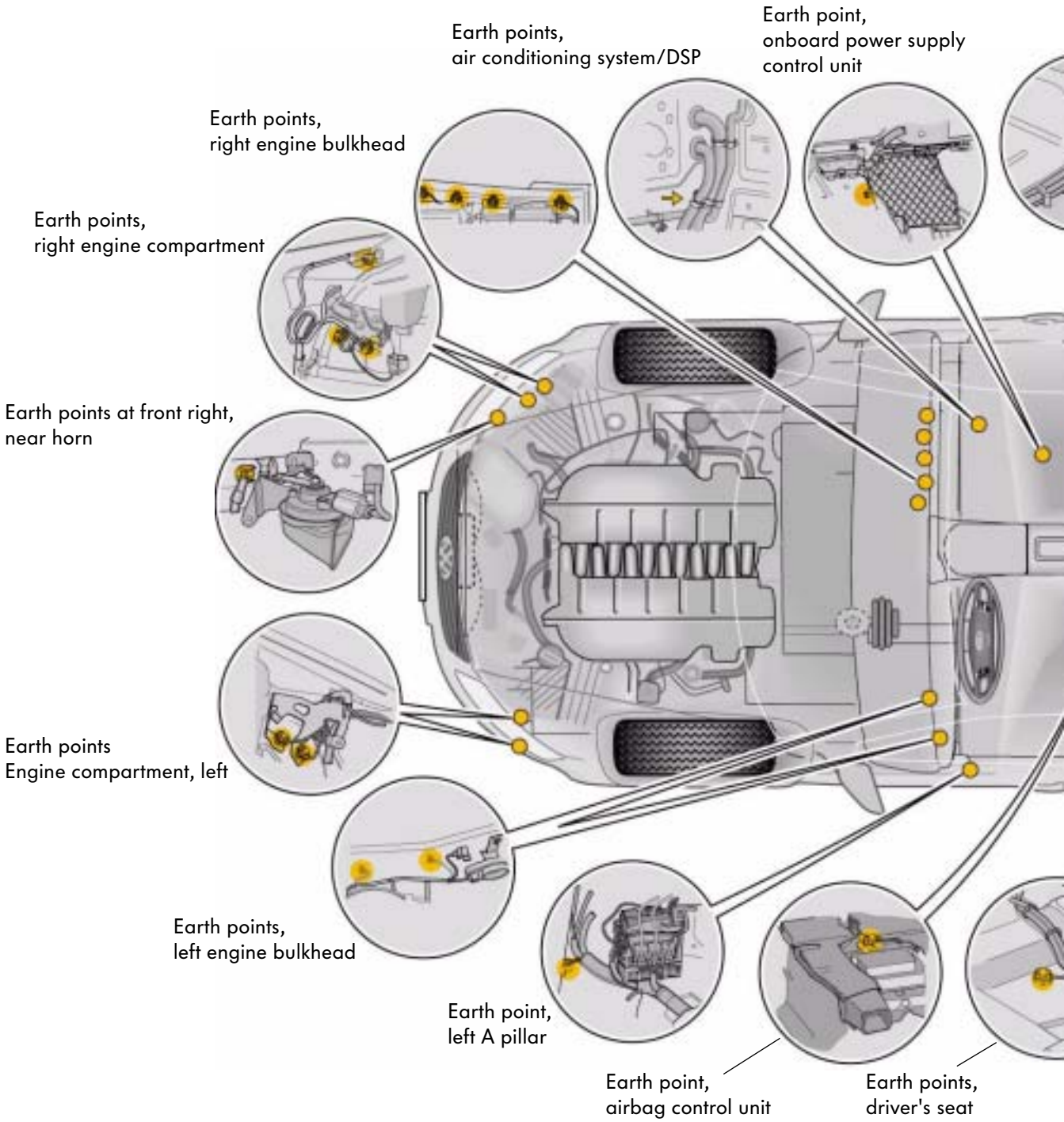

Coupling station, left B pillar
Fuse box on left under dash panel
Front information display and operating unit
Thermo-fuse box in left footwell
Connection point for control unit for anti-lock braking system/ Electronic Stability Programme
Connection point, control unit for driver's seat
Coupling station, left A pillar
Coupling station in front of plenum chamber in engine compartment
Connection point, headlights, additional heating
Connection point, front bumper
Connection point, headlights
Control unit for engine electronics
Control unit for gearbox electronics
Connection point, control unit for front passenger's seat
Coupling station, right A pillar
Electronics box in right plenum chamber
Connection point, engine compartment
Connection points, dash panel insert and vehicle interior
Coupling station, right B pillar
Electronics box in front right footwell
S272_051

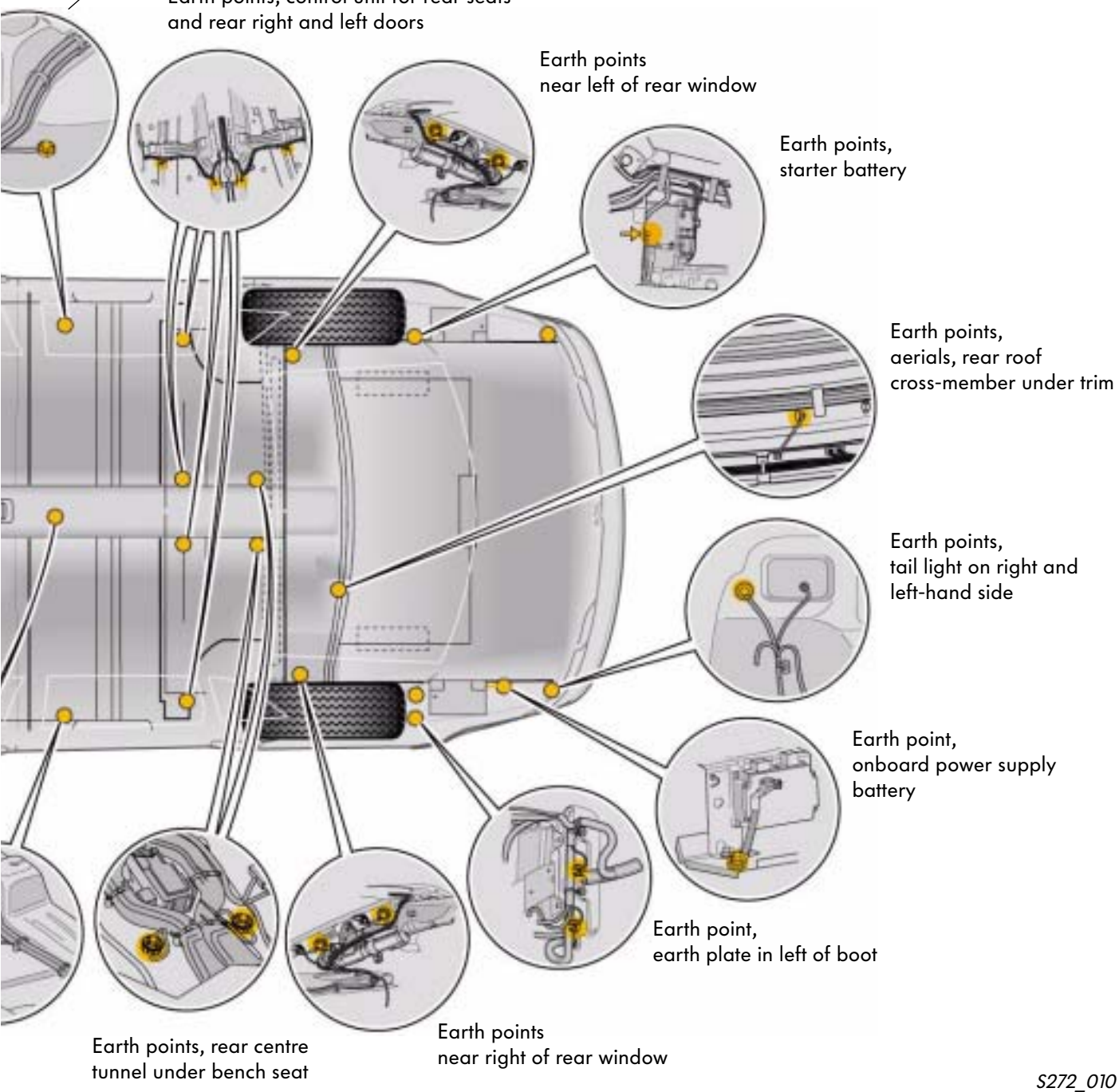
Introduction

Earth points

Specially selected locations in the vehicle serve as Earth points, as they are essential on modern vehicles with a large number of high-quality electronic control units.

The electronics are dependent on equalised earth potential to be able to work faultlessly.
Randomly selected Earth points can lead to different earth potentials and may cause malfunctions (e.g. compensating currents).




Earth points, B pillar under front passenger's seat
Earth points, control unit for rear seats and rear right and left doors
Earth points near left of rear window
Earth points, starter battery
Earth points, aerials, rear roof cross-member under trim
Earth points, tail light on right and left-hand side
Earth point, onboard power supply battery
Earth point, earth plate in left of boot
Earth points near right of rear window
Earth points, rear centre tunnel under bench seat

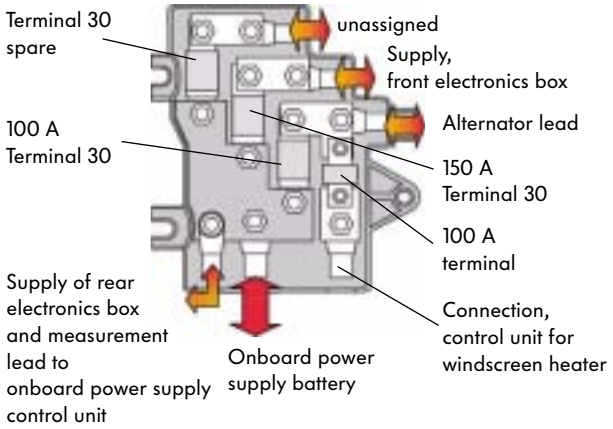
S272_010

Electrics boxes

Back-up fuse box

The back-up fuse box is located in the boot on the left. It contains the main fuses of the onboard power supply.

Moreover, the connection leads for the onboard power supply battery, the control unit for the windscreen heater (DC/DC converter), the rear and front electronics boxes, the alternator lead as well as the measurement lead for the onboard voltage come from this fuse box.

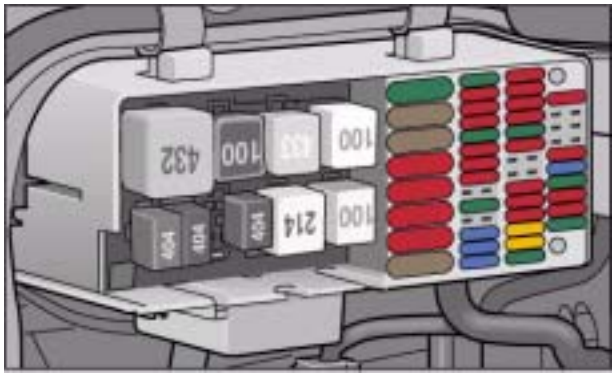


S272_069

Rear electronics box

The electronics box in the rear left of the boot contains:

- the switch-over relay for the starter battery (100),
- the switch-over relay for the onboard power supply battery (432),
- the fuel pump relay 1 (404),
- the fuel pump relay 2 (404),
- the relay for Terminal 50 (433),
- the relay 1 for the rear window heater (100),
- the relay 2 for the rear window heater (104),
- the relay for air suspension (214) and
- the relay for the tank filler flap opening (404)



S272_070

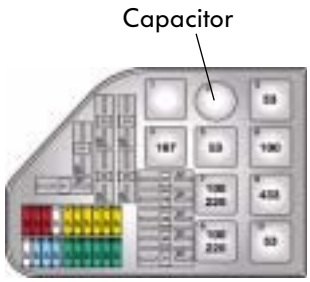
The relays fitted depend on the vehicle type. The current list of fitted relays is contained on the valid current flow diagram.

Electronics box, plenum chamber

Components

- Smoothing capacitor for onboard power supply voltage
- Main relays 1 and 2 (53 and 100)
- Terminal 75 relay (100)
- Terminal 15 relay (433)
- Secondary air pump relays 1 and 2 (100) as well as
- Power supply relay for Motronic (167)

are located in the electronics box in the front plenum chamber.

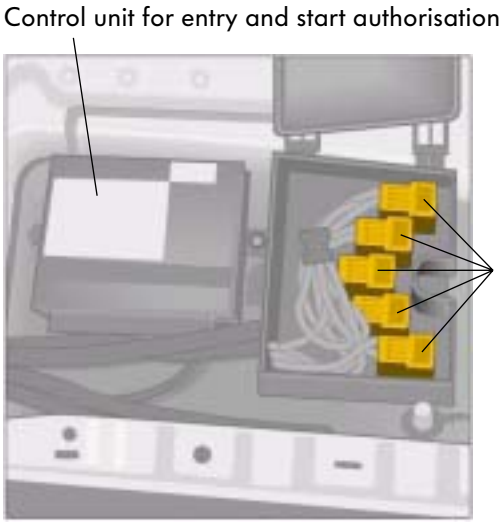


S272_071

Thermo-fuse box

The thermo-fuse box in the front left footwell contains the thermo-fuses:

- left window regulator	30 A
- right window regulator	30 A
- driver's seat control unit	30 A
- front passenger's seat control unit	30 A
- rear compartment seat control unit	30 A
- rear left PTC heating	30 A
- rear right PTC heating	30 A



S272_077

The thermo-fuses fitted depend on the vehicle type. The current list of fitted thermo-fuses are contained on the valid current flow diagram.

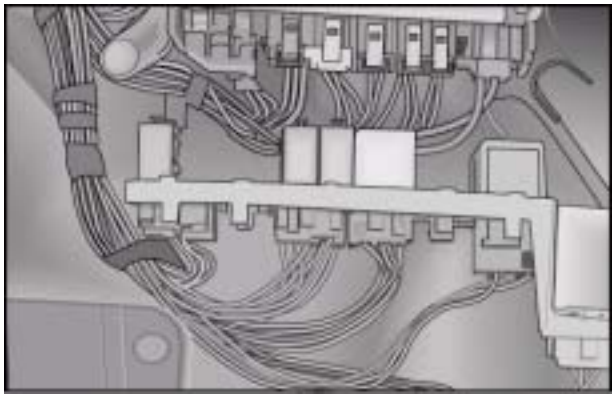
Electrics boxes

Relay holder, right footwell

The relay holder is located in the footwell on the front passenger's side.

It contains the:

- water pump relay (404)
- vacuum pump relay (404)
- relay for heated wiper park position (404)
- relay for enable seat heating (404)
- sunroof relay (79)
- terminal 15SV relay (100)
- headlight washer system relay (53)
- relay for control unit for Servotronic (631)
- relay for airbag warning lamp (464)



S272_085

Power management

In order to ensure sufficient power supply of the electrical equipment and the starter motor, a

- one-battery onboard power supply

as well as a

- two-battery onboard power supply

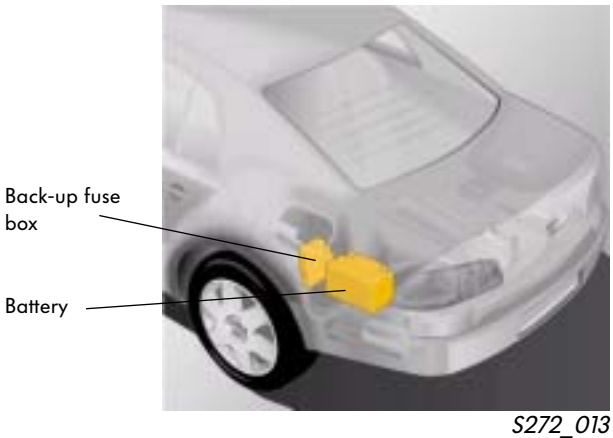
are used.

Engine	Onboard power supply battery	Starter battery
V6	75 Ah/420 A*	61 Ah/330 A**
V8	75 Ah/420 A*	61 Ah/330 A**
W12	85 Ah/480 A	61 Ah/330 A
V10 TDI	85 Ah/480 A	85 Ah/480 A

*currently still 85 Ah/450 A
The 75 Ah/420 A battery
will be deployed later.

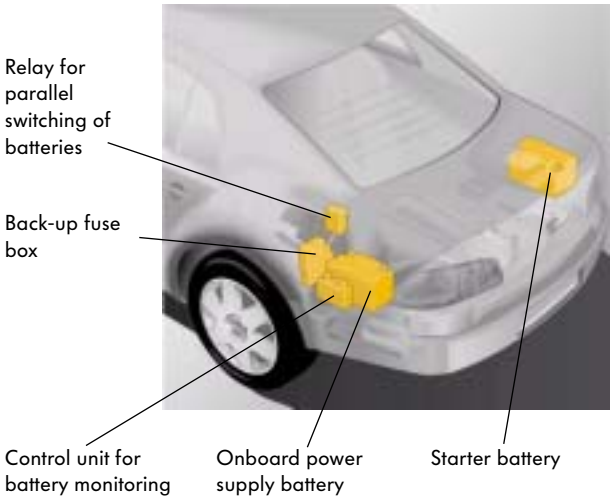
**optional

In case of vehicles with one-battery onboard power supplies, it ensures the supply of electrical energy.



S272_013

Vehicles with two-battery onboard power supplies have a starter battery and an onboard power supply battery. In normal operation, the starter battery supplies the starter motor during the starting cycle and the onboard power supply battery supplies the electrical equipment. If one of the batteries does not have sufficient power, it is supported by the other. Support is controlled by the control unit for battery monitoring.



S272_012

Energy management

To ensure the power supply for the electrical equipment on the W12 and V10 TDI, the two-battery onboard power supply is used; for all other versions, it is available as an option.

Components

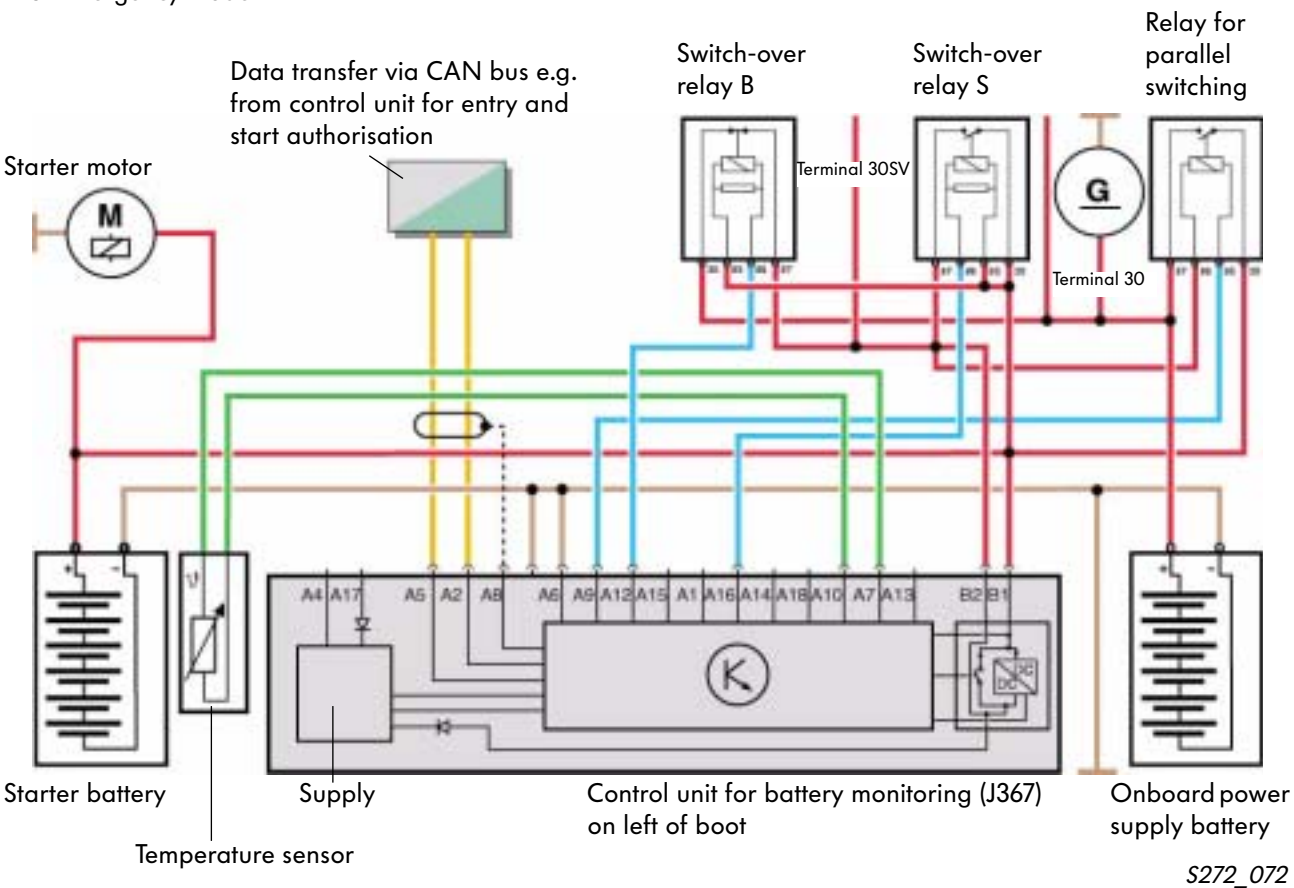
- Starter battery
- Onboard power supply battery
- Relay for parallel switching of batteries
- switch-over relay for starter battery
- switch-over relay for onboard power supply battery
- Control unit for battery monitoring
- Temperature sensor for starter battery

Functional description

Normally, the starter battery supplies the starting circuit of the engine. The onboard power supply battery supplies the 12-volt onboard power supply; in the case of a cold start, it is supported by the starter battery.

The circuit of the starter motor and onboard power supply electrical circuit are controlled by the control unit for battery monitoring (J367). This controls the charge of the starter battery and safely ensures supply of the electrical equipment required to start the car.

A1 T. 50
A4 Key-In
A14 Terminal 15
A15 Emergency mode
A17 T. 30
A18 T.l 15SV



S272_072

Starting modes

In order to ensure sufficient power supply to both electrical circuits, different operating modes are implemented by the control unit for battery monitoring.

Electrical equipment required to start the car:

- Engine control unit
- Fuel pump
- Control unit for entry and start authorisation
- Dash panel insert
- Airbag control unit (for safety reasons)

Normal start

The onboard power supply and starter battery are charged.

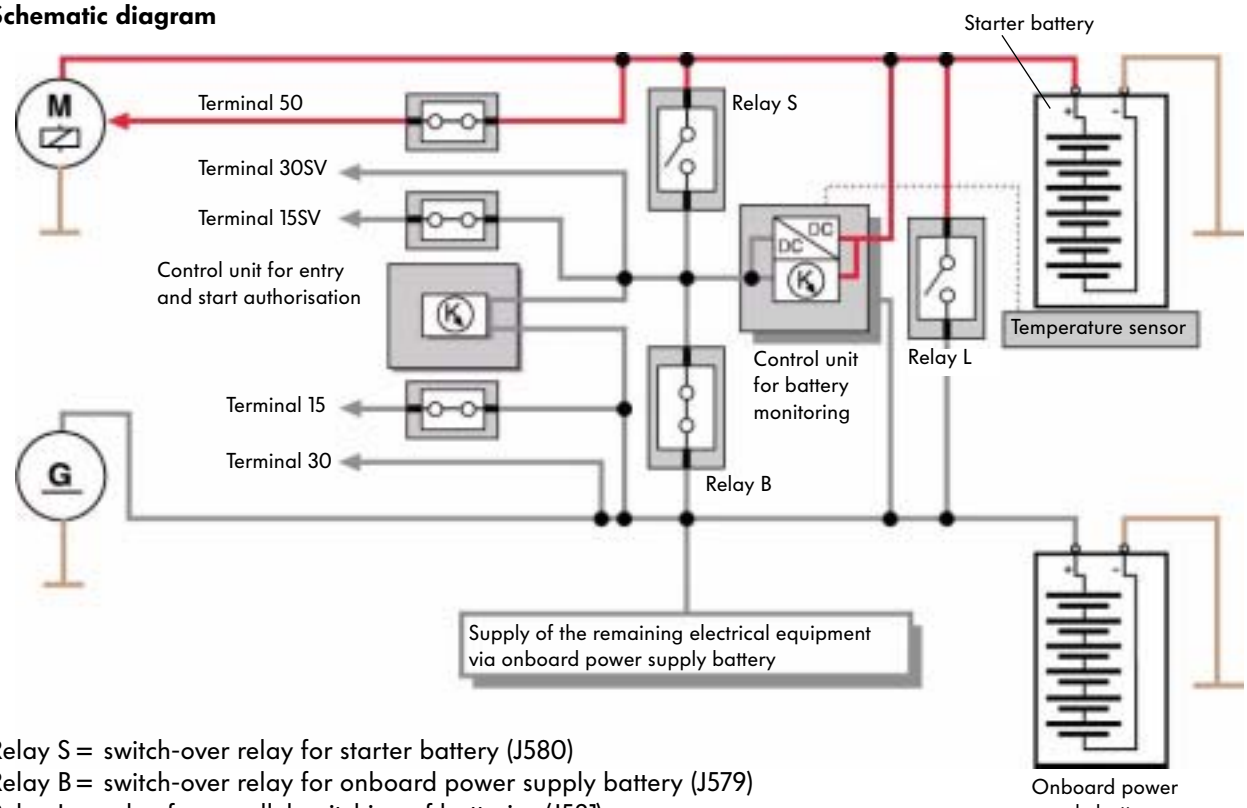
The starter and onboard power supply electrical circuits are separate.

The control unit for battery monitoring is activated by the control unit for entry and start authorisation (J 518) with the signals 'Ignition key in the ignition lock' (Key-In) 'Ignition switched on' (Terminal 15) and the start signal (Terminal 50).

The switch-over relay onboard power supply battery (relay B) is closed; the electrical equipment required for starting is supplied via the onboard power supply battery.

The starter battery supplies the starter motor.

Schematic diagram



Relay S = switch-over relay for starter battery (J580)
Relay B = switch-over relay for onboard power supply battery (J579)
Relay L = relay for parallel switching of batteries (J581)
SV = electrical equipment required for starting

S272_019

Power management

Cold start

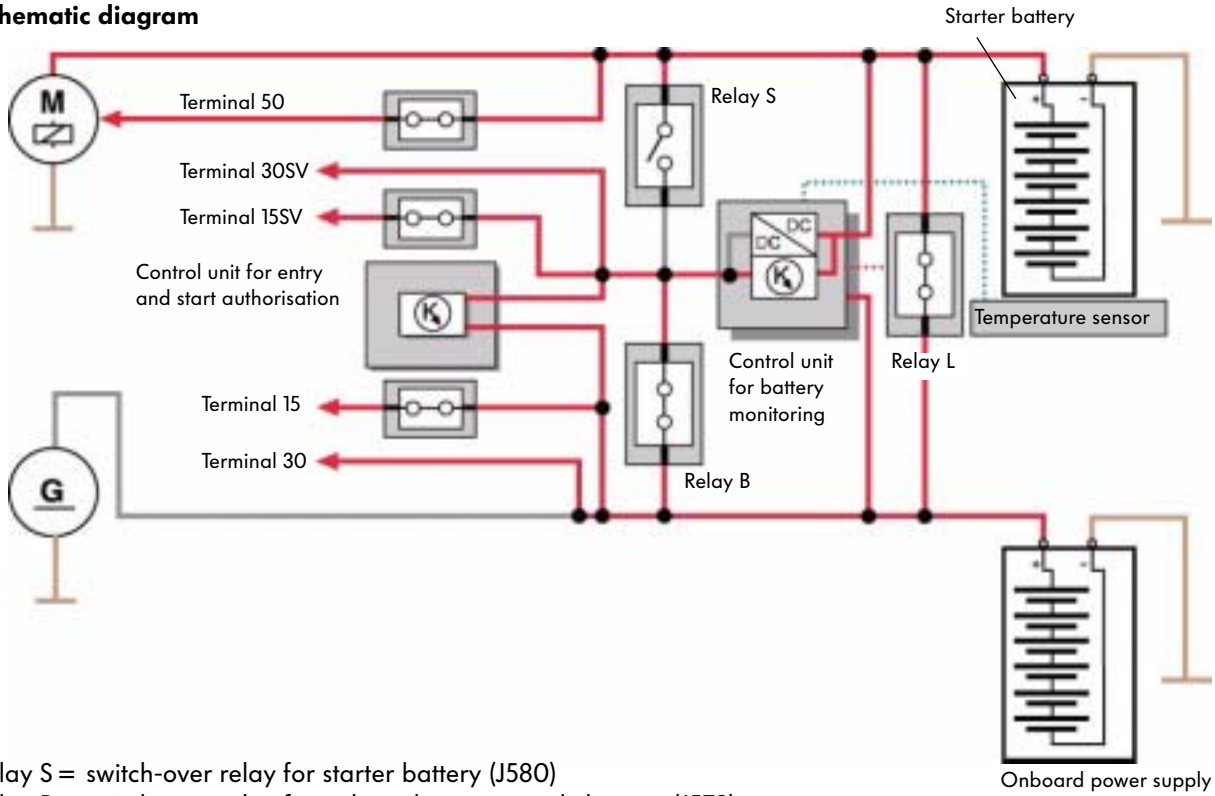
In addition to the input signals of the normal start, the battery temperature as well as the coolant temperature transmitted via the CAN bus are taken into account.

The switch-over relay onboard power supply battery is closed; the control unit for battery monitoring activates the relay for parallel switching. Activation closes the relay for parallel switching and both batteries are switched in parallel.

Parallel switching is temperature-dependent:

- in the case of petrol engines < -10°C and
- in the case of V10 TDI < 0°C.

Schematic diagram



Relay S = switch-over relay for starter battery (J580)
Relay B = switch-over relay for onboard power supply battery (J579)
Relay L = relay for parallel switching of batteries (J581)
SV = electrical equipment required for starting

S272_020

The starting cycle in the case of discharged onboard power supply battery

With Terminal 15SV switched on, the 'Emergency start' mode is sent via the CAN bus and the PIN 'Emergency operation' if the voltage of the onboard power supply battery is less than 11 V.

Terminal 30SV is connected via the switch-over relay starter battery to the starter battery as soon as the ignition key is inserted in the ignition lock.

When the ignition is turned on, the Drive Train CAN bus goes to partial operation. Only control units required for starting take part in the communication.

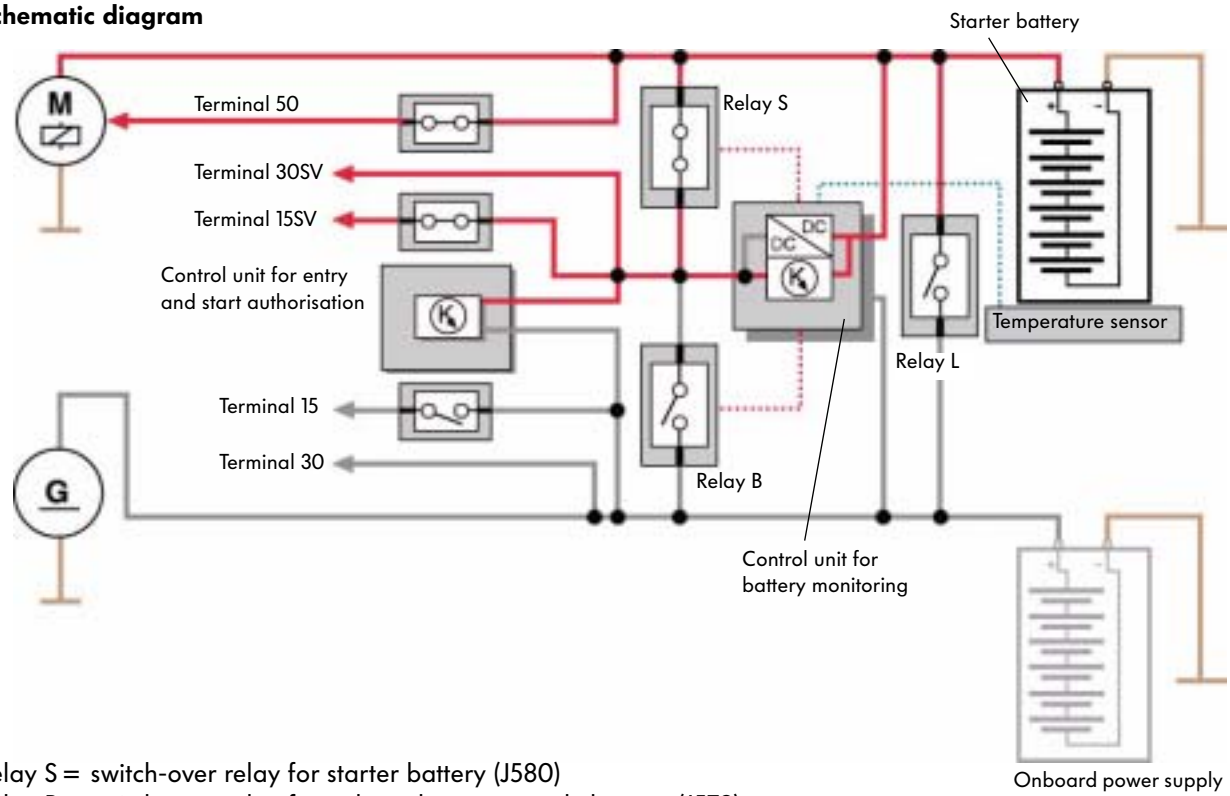
After the engine starts, heating equipment involved in the convenience system is switched off for two to five minutes.

The 'Emergency operation' mode is cancelled approx. two seconds after the system detects that the engine is running.

Until there is sufficient charge voltage in the onboard power supply battery, the onboard power supply is supplied from the starter battery by means of parallel switching via the relay for parallel switching.

In the case of diesel engines, the connection to the starter battery is made when Terminal15SV it is switched to enable the glow phase.

Schematic diagram



Relay S = switch-over relay for starter battery (J580)
Relay B = switch-over relay for onboard power supply battery (J579)
Relay L = relay for parallel switching of batteries (J581)
SV = electrical equipment required for starting

S272_021

Energy management

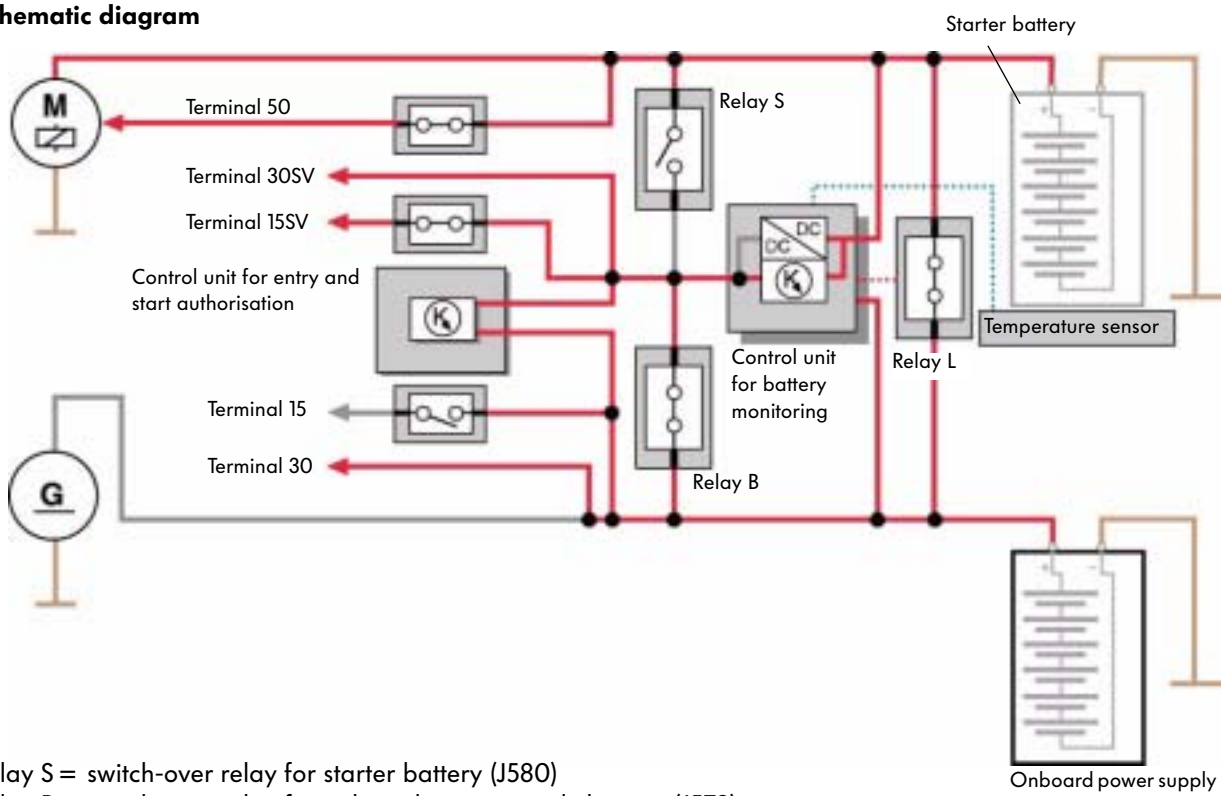
Starting cycle in the case of discharged starter battery

The 'Emergency start' mode is sent via the CAN bus and the PIN 'Emergency operation'.

Terminal 30SV remains connected to the onboard power supply battery via the switch-over relay for onboard power supply battery.

Both batteries are switched in parallel via the relay for parallel switching when the start (Terminal 50) is initiated.

Schematic diagram



Relay S = switch-over relay for starter battery (J580)
Relay B = switch-over relay for onboard power supply battery (J579)
Relay L = relay for parallel switching of batteries (J581)
SV = electrical equipment required for starting

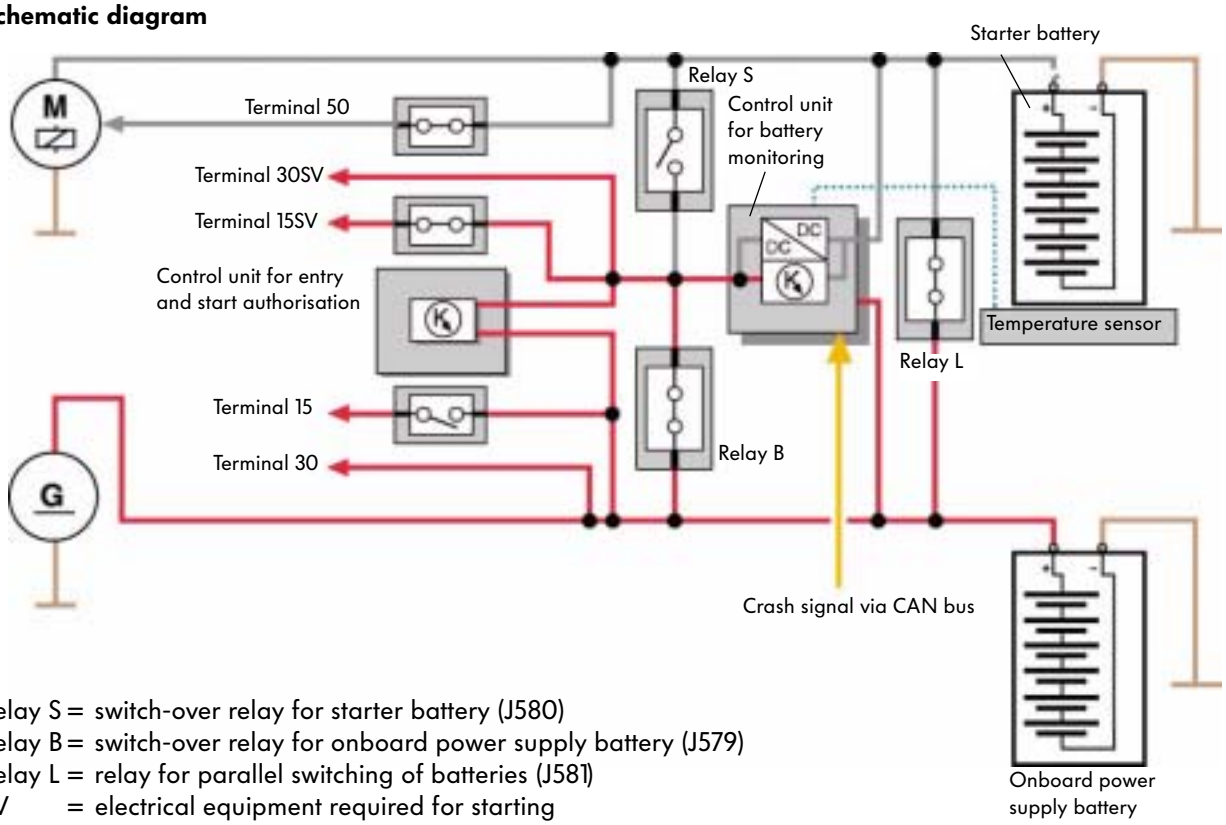
S272_022

Monitoring after a crash event

In the case of a crash event, the control unit for battery monitoring receives a crash signal via the CAN bus. This cancels the charge operation of the starter battery. This signal remains stored until it is reset by the VAS 5051 Diagnostic Testing and Information System. Every time the ignition is switched on, the lead to the starter motor is tested for short circuits.

If a short circuit is detected, it prevents a starting cycle from initiating.

Schematic diagram



Relay S = switch-over relay for starter battery (J580)
Relay B = switch-over relay for onboard power supply battery (J579)
Relay L = relay for parallel switching of batteries (J581)
SV = electrical equipment required for starting

S272_068

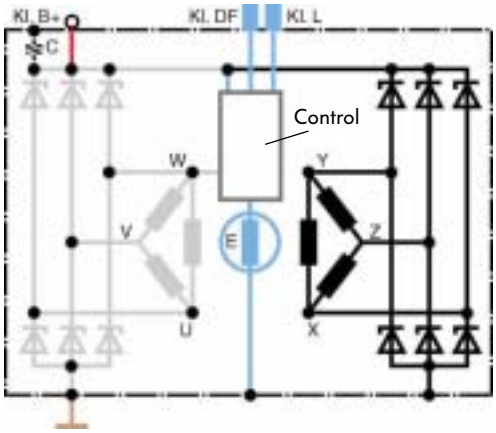
If the 'Key IN' is not present and the onboard power supply battery is discharged, no start is possible. The VAS 5051 Diagnostic Testing And Information System can be used to diagnose the control unit for battery monitoring.

Energy management

Alternator

A liquid-cooled alternator with 190 Amperes is fitted. Its maximum current in the short term can be up to 300 Amperes.

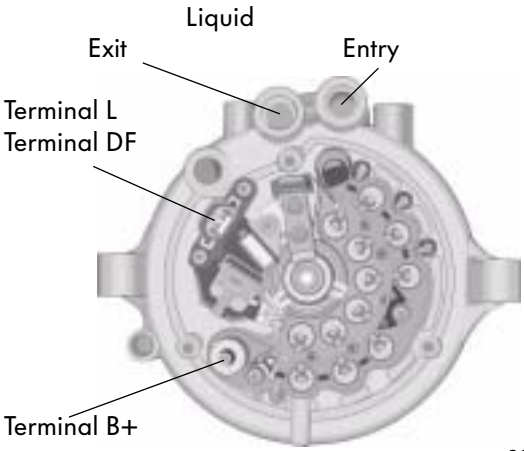
The alternator contains six instead of three stator windings, which are excited via a winding in the rotor. The drive on the V10 TDI is via an internal shaft and a gear.



S272_025

Legend

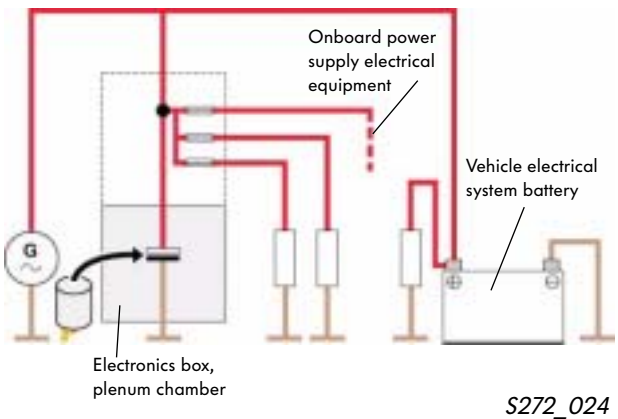
C	-	Capacitor
E	-	Exciter winding in the rotor
Terminal B+	-	Battery positive
Terminal DF	-	Dynamo field
Terminal L	-	Signal wiring for warning lamp in dash panel insert
U, V, W, X, Y, Z	-	Winding ends of the generating coil



S272_080

Smoothing capacitor for the onboard power supply voltage

The onboard power supply battery is located in the boot. The length of the charge lead from the alternator to the battery is approx. 6 m. The capacitor has the task of reducing the voltage ripple on the charge lead in the vicinity of the alternator. Smoothing the charge current and charge voltage on the charge lead reduces electrical and acoustic faults. The supply for the high-current electrical equipment, where high voltage ripples can occur, is tapped in the plenum chamber.



S272_024

Charge process of the starter battery

The charging process of the starter battery can take place in two operating modes:

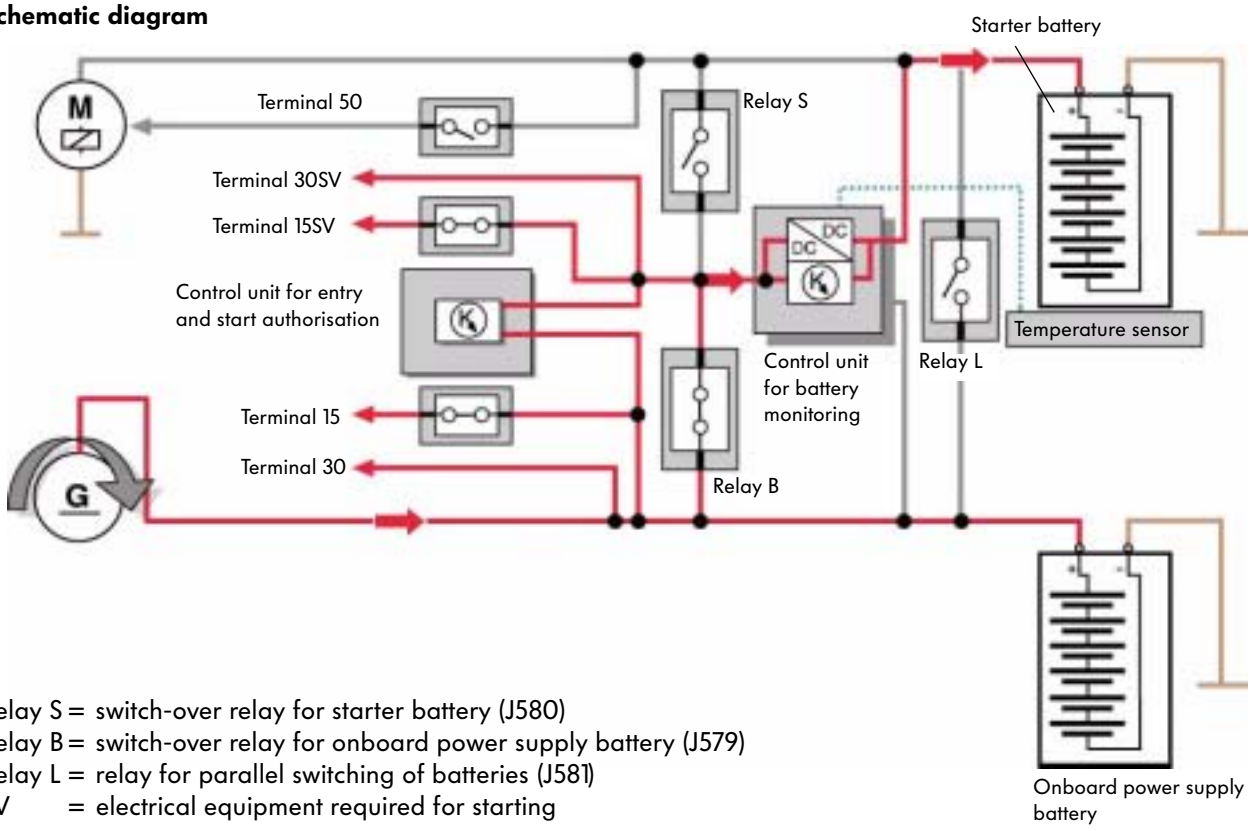
- through the transistor
  or
- the DC/DC converter in the control unit for battery monitoring.

As long as the nominal charge voltage of the starter battery is lower than the current onboard power supply voltage, the charge current of the starter battery is fed via the transistor.

If the onboard power supply voltage is below the nominal value of the charge voltage, the charge current is fed via the DC/DC converter. The charge time is monitored by the control unit for battery monitoring. If the starter battery does not reach its voltage value within the prescribed parameter, the charging process is cancelled and disabled. This means that a defective battery is not continuously charged.

A fault is entered in the fault memory: charge monitoring for starter battery - upper limit value exceeded.

Schematic diagram



Relay S = switch-over relay for starter battery (J580)
Relay B = switch-over relay for onboard power supply battery (J579)
Relay L = relay for parallel switching of batteries (J581)
SV = electrical equipment required for starting

S272_023

The control unit for battery monitoring has diagnostic capability with the VAS 5051 Diagnostic Testing and Information System.

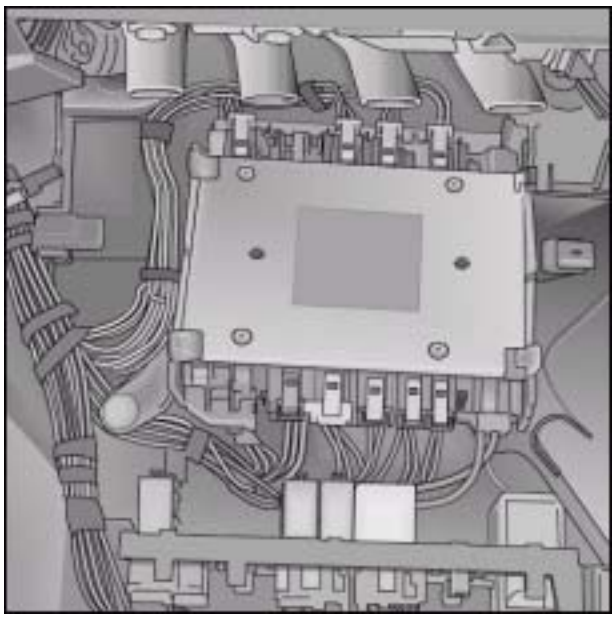
Onboard power supply management

The onboard power supply control unit (J519) pools various functions in the vehicle.

The various functions that until now were enabled via switches and relays

- Parking lights
- Dipped beam headlights
- Side lights
- Turn indicators
- Main beam headlights
- Fog lights
- Footwell lights
- Terminal 58 d
- Indicator lamp for hazard warning lights
- Relay for headlight washer system
- Relay for heating wiper park position
- Fuel pump feed and
- Horn

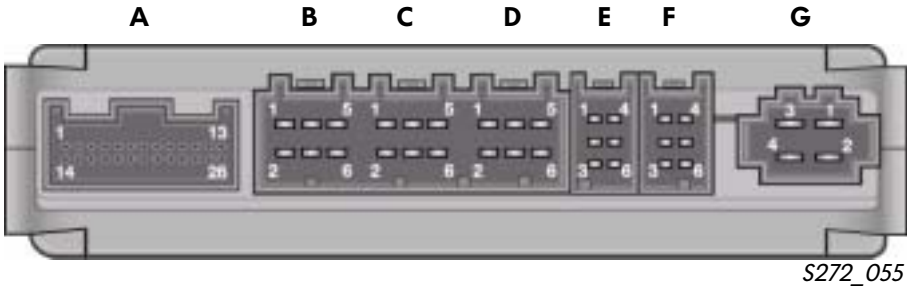
are switched by the onboard power supply control unit.



S272_053

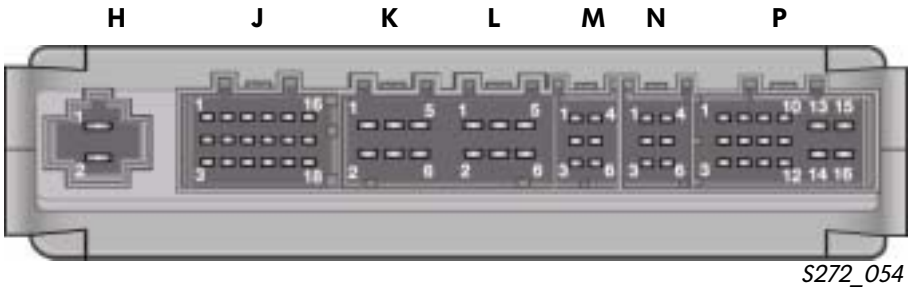
The onboard power supply control unit is located in the electronics box in the right-hand footwell.

Front of device connector



S272_055

Back of device connector



S272_054

Supply voltage

Signal	Input from	Output to
Voltage of onboard power supply battery	Onboard power supply battery +	
Voltage of starter battery	Starter battery +	
Voltage of starter battery	Starter battery -	
Voltage of onboard power supply battery	Onboard power supply battery -	
Terminal 15	Control unit for entry and start authorisation	

CAN bus signals

Signal	Input from	Output to
Convenience CAN High	Convenience CAN bus	Convenience CAN bus
Convenience CAN Low	Convenience CAN bus	Convenience CAN bus

Input signals

Signal	Input from	Output to
Hazard warning lights	Button for hazard warning lights	
Fog lights	Button for fog lights	
Automatic lights	Light switch	
Mirror heating	Switch for door mirror	
Dimming	Increase dimmer +	
Dimming	Reduce dimmer -	
Fault fibre-optic cable	Headlight, right	
Mirror adjustment	Switch for door mirror	
Fold-in mirror	Switch for door mirror	
Bonnet opened	Switch for bonnet	
Side lights	Light switch	
Rear fog light	Light switch	
Dipped beam headlights	Light switch	
Reversing light	Switch for reversing light	
Mirror adjustment	GND switch for door mirror	
Fog lights	Terminal 30 fuse box	
Low-beam and main beam headlight, left	Terminal 30 fuse box	

Onboard power supply management

Input signal (continued)

Signal	Input from	Output to
Low-beam and main beam headlight, left	Terminal 30 fuse box	
Flashing light, left side light	Terminal 30 fuse box	
Low-beam and main beam headlight, right	Terminal 30 fuse box	
Flashing light, right side light	Terminal 30 fuse box	
Horn	Terminal 30 fuse box	
Wake up running gear	Running gear control	
Footwell lights	Terminal 58d	
Headlight washer system	Terminal 30 fuse box	

Output signals

Signal	Input from	Output to
Fog lights		Fog lights
Footwell lighting		Footwell lights
Instrument lighting		Terminal 58d Instrument
Turn signal, left		Headlight, left
Main beam headlight, left		Headlight, left
Dipped beam headlight, left		Headlight, left
Parking light, left		Headlight, left
Main beam headlight, right		Headlight, right
Dipped beam headlight, right		Headlight, right
Turn indicator, right		Headlight, right
Parking light, right		Headlight, right
Horn		Horn
Check of hazard warning lights		Indicator lamp
Heating		Wiper storage relay
Headlight washer system		HWS pump
Supply line, fuel pump		Fuel pump relay
Enable seat heater		Relay (only in the case of veh. without seat memory control unit)
Headlight cleaning system		Pop-up washer jet motor, right
Headlight washer system		Pop-up washer jet motor, left
Voltage supply +		Terminal 30a

Special features of the lighting control system

Turn indicators

The following turn indicator controls are possible:

- Turn indication
- Hazard warning lights
- Crash indication
- Flashing on locking and activating the anti-theft alarm system as well as panic flashing (USA only)

The onboard power supply control unit also controls the onboard power supply management so that sufficient electrical energy is available continuously.

The onboard power supply management switches off electrical equipment if the battery voltage of the onboard power supply battery falls below a defined value.

These operating modes are arranged by priority:

1 Crash indication

2 Hazard warning lights

3 Turn indication

4 Special functions, e.g. anti-theft alarm system

With this arrangement, a flashing function can be activated although another has not been deactivated.

Side lights and driving lights

Emergency function

An additional circuit in the onboard power supply control unit ensures that the side lights and dipped beam headlights are also switched on in the case of a defect in the onboard power supply control unit.

If a turn indicator light fails, the rate of the indicator lamp is doubled to signal the failure. The indicator lights continue to work at the normal rate. With the hazard warning lights, the indicator lamp flashes at the normal rate.

Via the VAS 5051 Diagnostic Testing And Information System, the onboard power supply control unit has diagnostic capability.

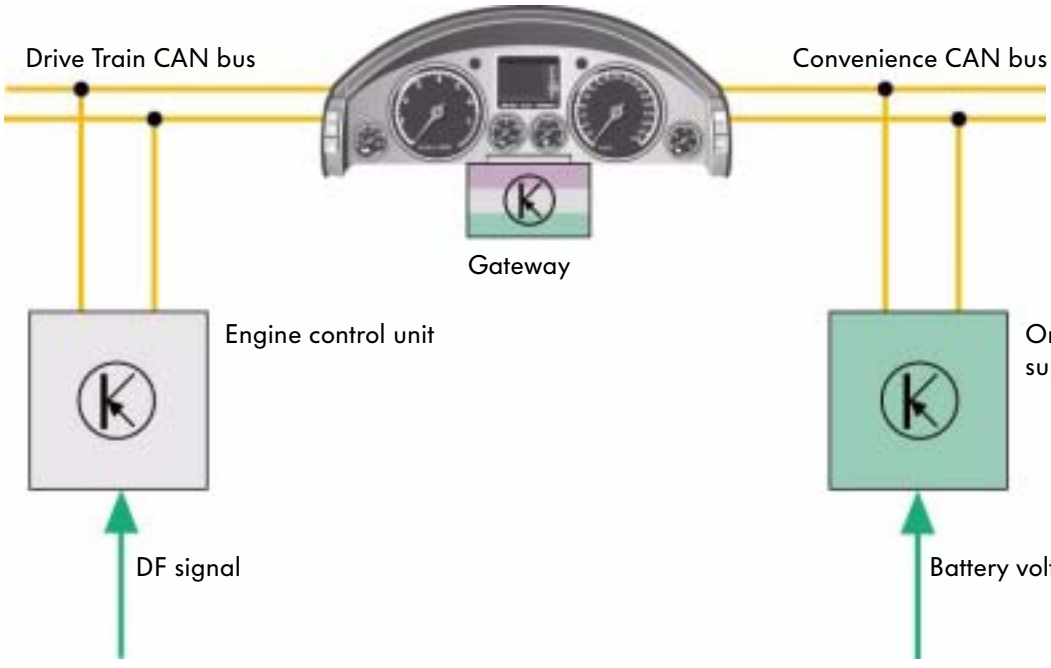
Onboard power supply management

Monitoring the onboard power supply voltage

The onboard power supply control unit monitors the charge state of the onboard power supply battery to avoid excessive discharge.

From the alternator (Terminal DF), the engine control unit receives the pulse-width modulated (PWM) information regarding the capacity utilisation of the alternator. This information reaches the Convenience CAN bus via the Drive Train CAN bus and the gateway in the dash panel insert. The onboard power supply control unit evaluates the state of the onboard power supply voltage by comparing the DF signal and the onboard power supply voltage.

If a critical state of the onboard power supply is detected, the idling speed is increased; in very critical states, convenience electrical equipment is switched off.



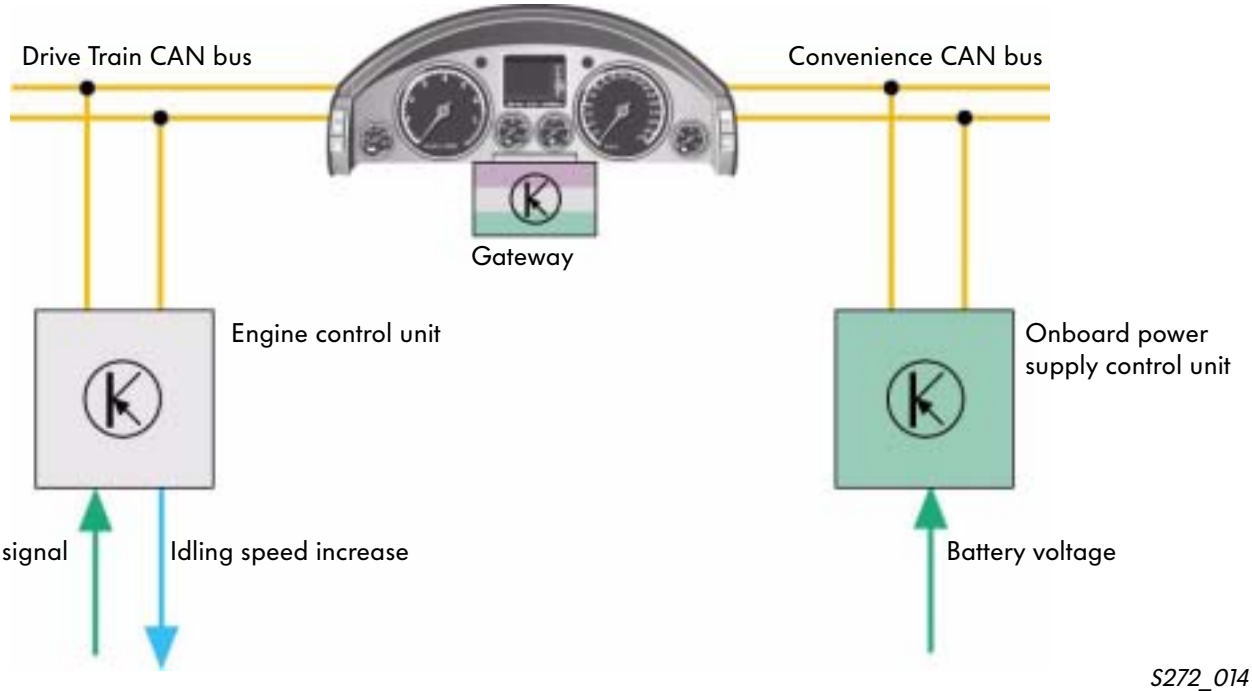
S272_018

The dynamo field signal can be shown using the VAS 5051 Diagnostic Testing and Information System.

Raising the idling speed

If the voltage of the onboard power supply battery falls below 12.7 volts for longer than 10 seconds, the state of the onboard power supply is classified as critical and the idling speed is raised. The signal for requesting a rise is sent by the onboard power supply control unit via the Convenience CAN bus, the gateway and the Drive Train CAN bus to the engine control unit.

The idling speed is raised when the automatic gearbox is in positions 'P' or 'N'. It remains at the increased level if - on transition to vehicle operation - the engine speed was higher beforehand.



S272_014

The value of the speed increase varies from one engine variant to the next.

If the voltage is constantly higher than 12.7 volts for at least two seconds, the state of the onboard power supply is detected as uncritical and the request to raise the idling speed is cancelled.

Modifying the engine speed is regulated by the engine control unit according to defined values. Fluctuations in engine speed due to fluctuating voltage values are largely suppressed by the engine control unit.