

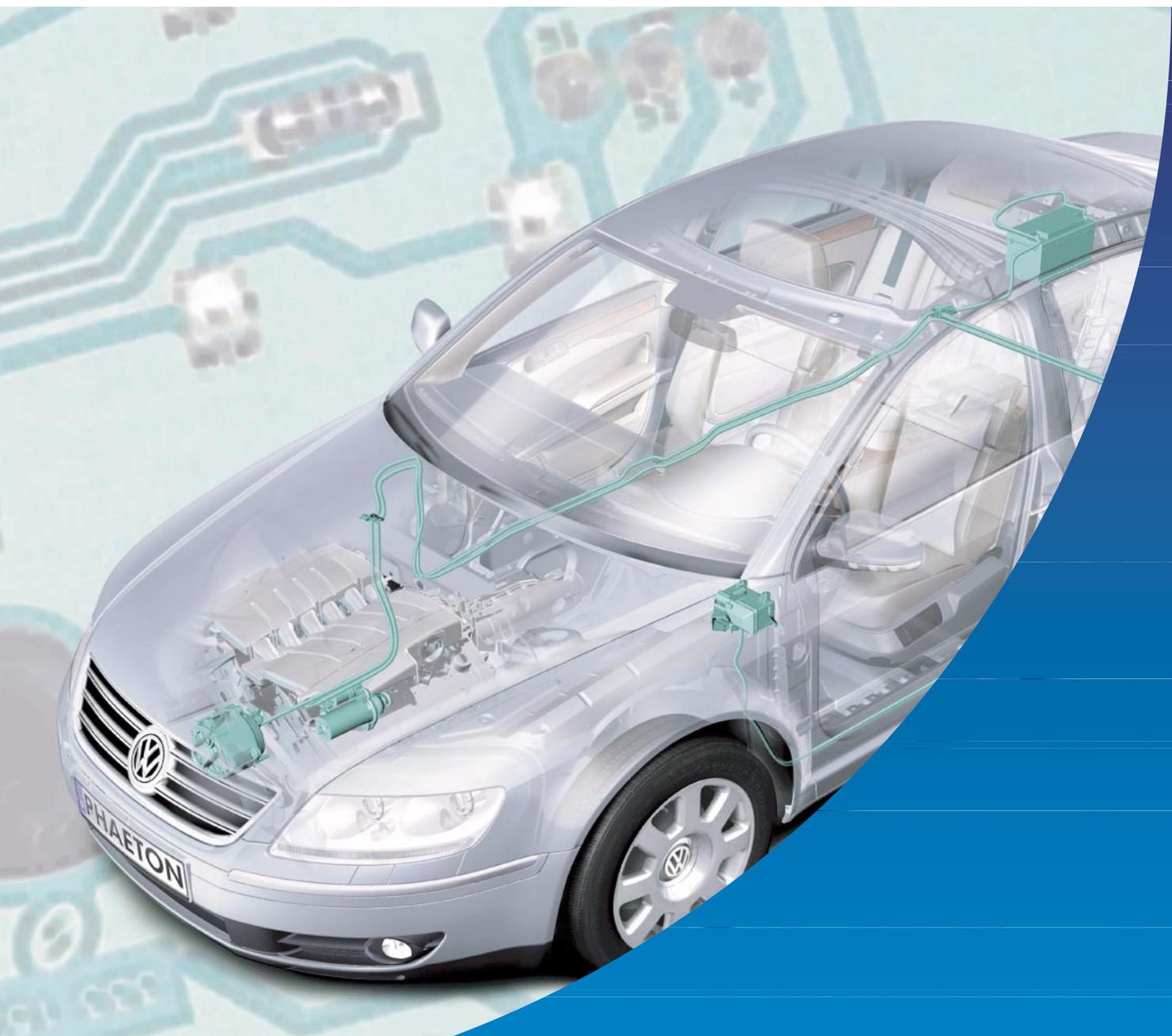
Service.



**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.

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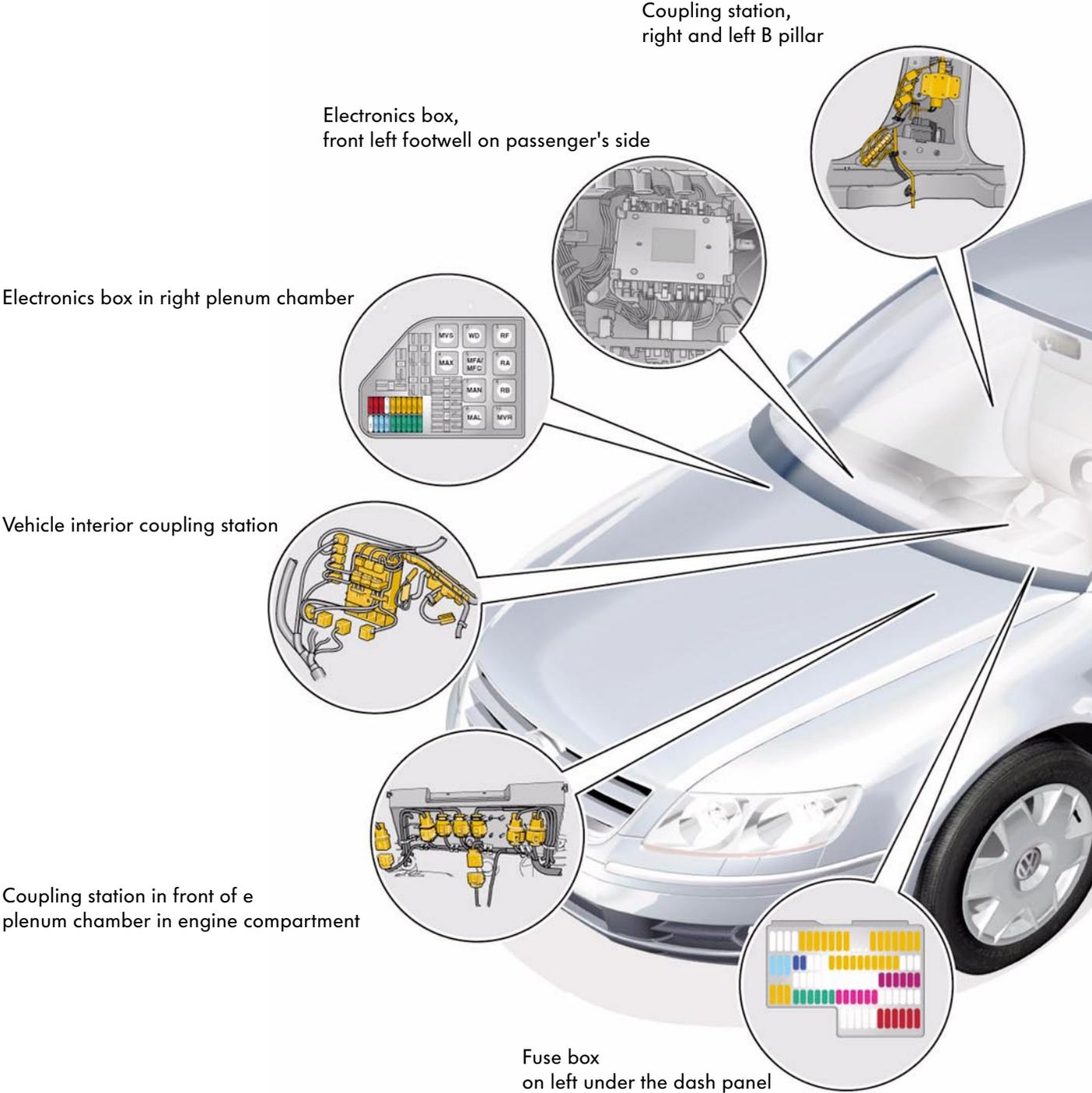


# Introduction



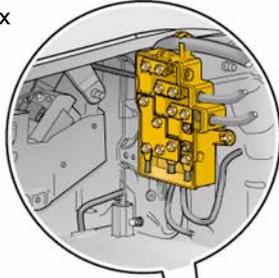
## Fitting locations in the onboard power supply

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.

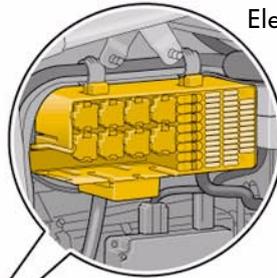




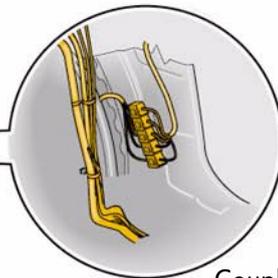
Back-up fuse box  
on left of boot



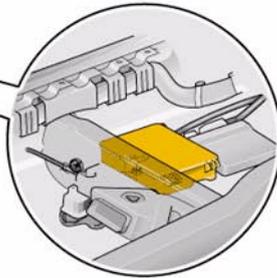
Electronics box on left of boot



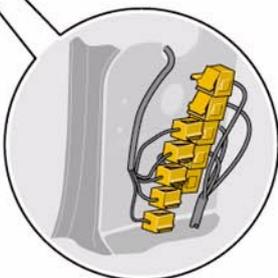
Coupling station,  
right and left C pillars



Thermo-fuse box  
in front left footwell



Coupling station,  
right and left A pillars



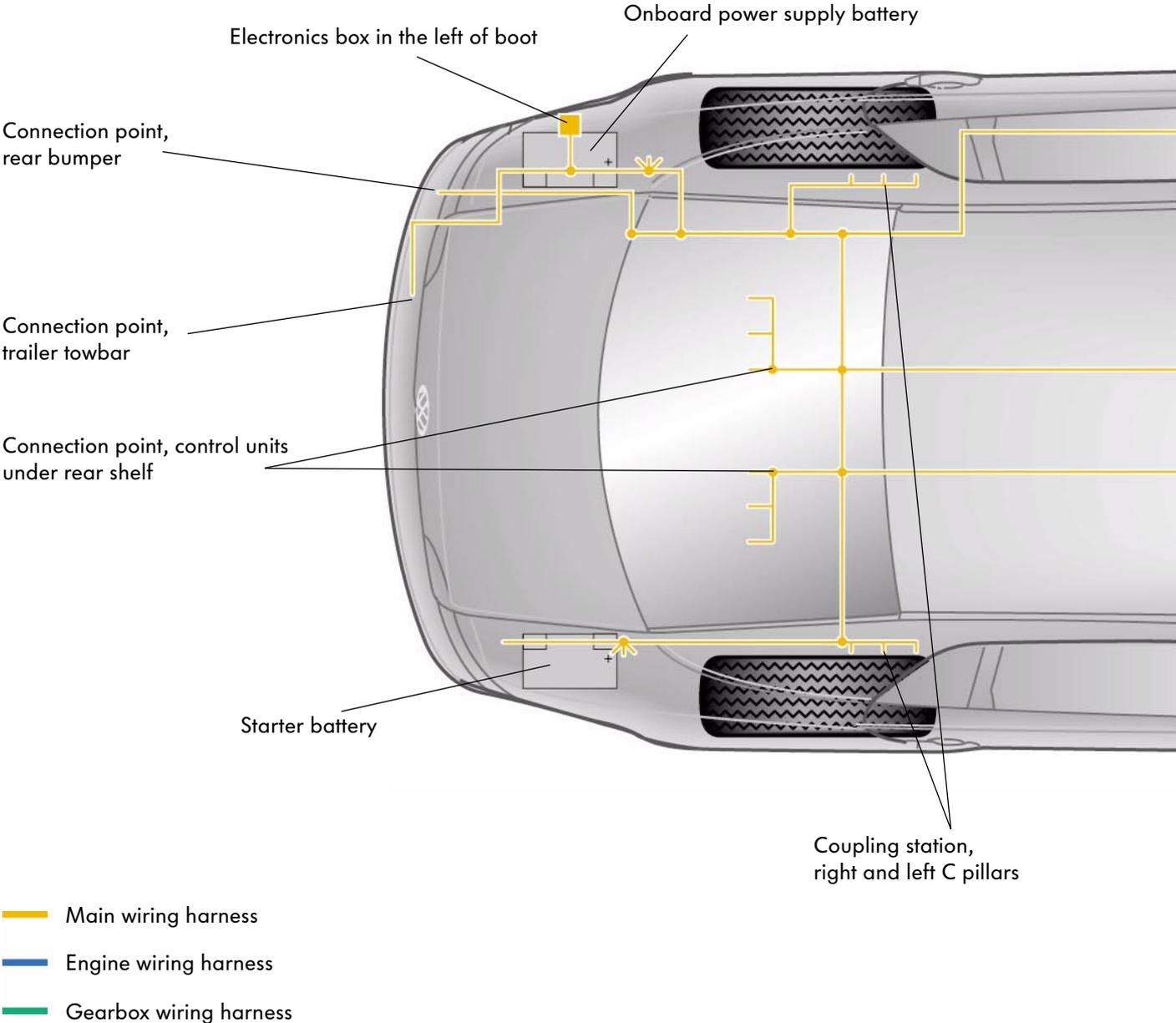
S272\_009

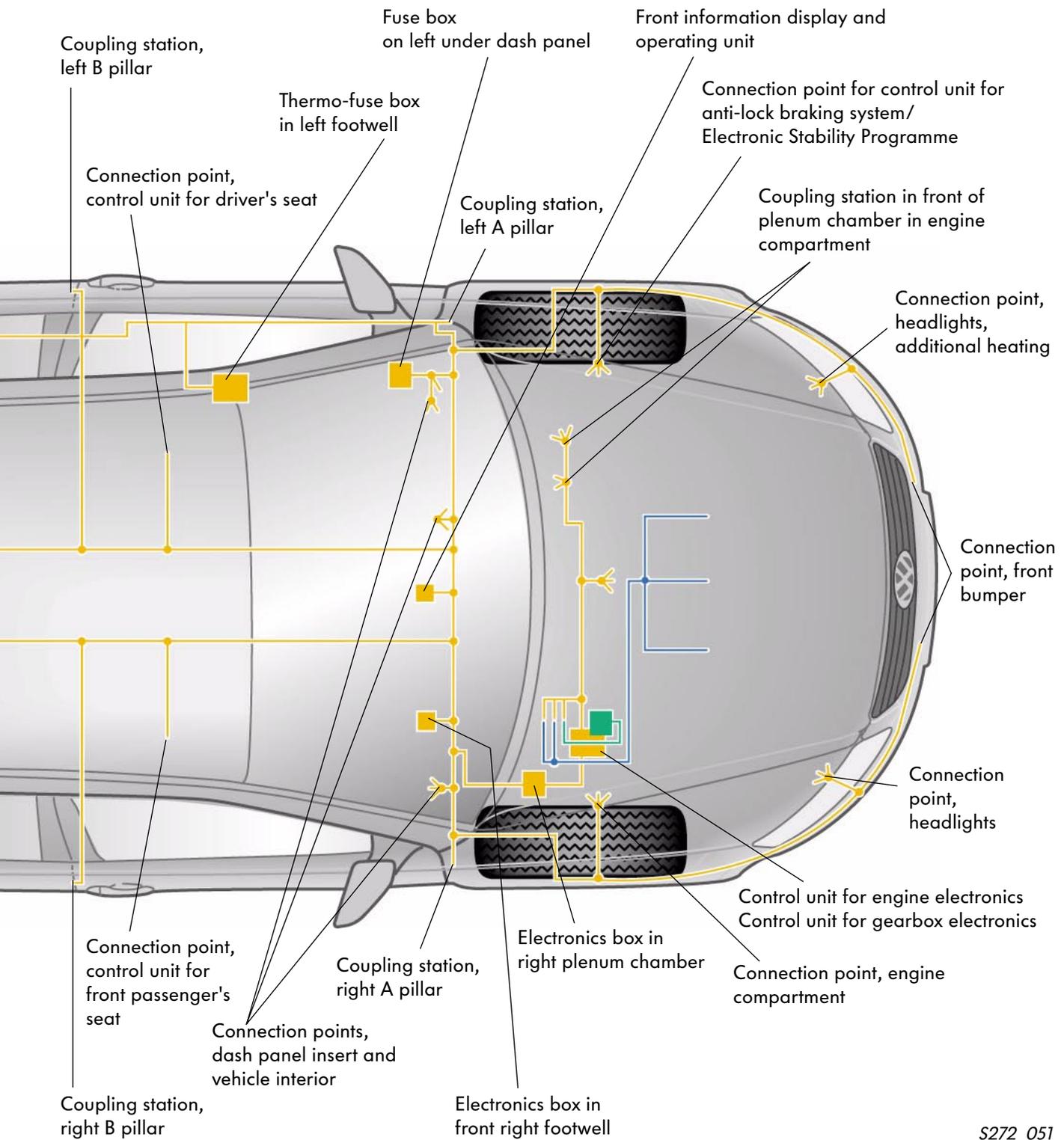
# Introduction



## 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.





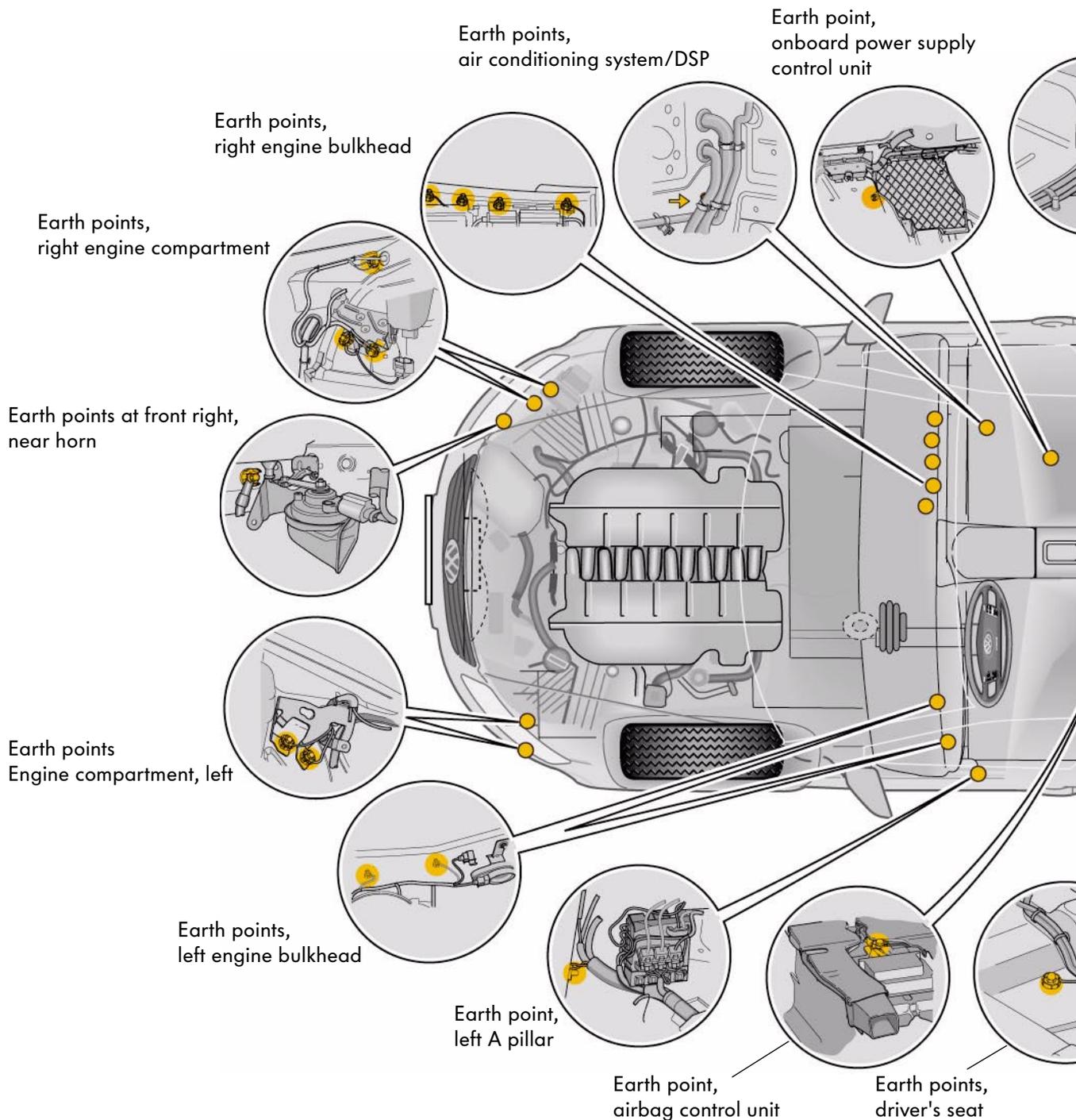
S272\_051

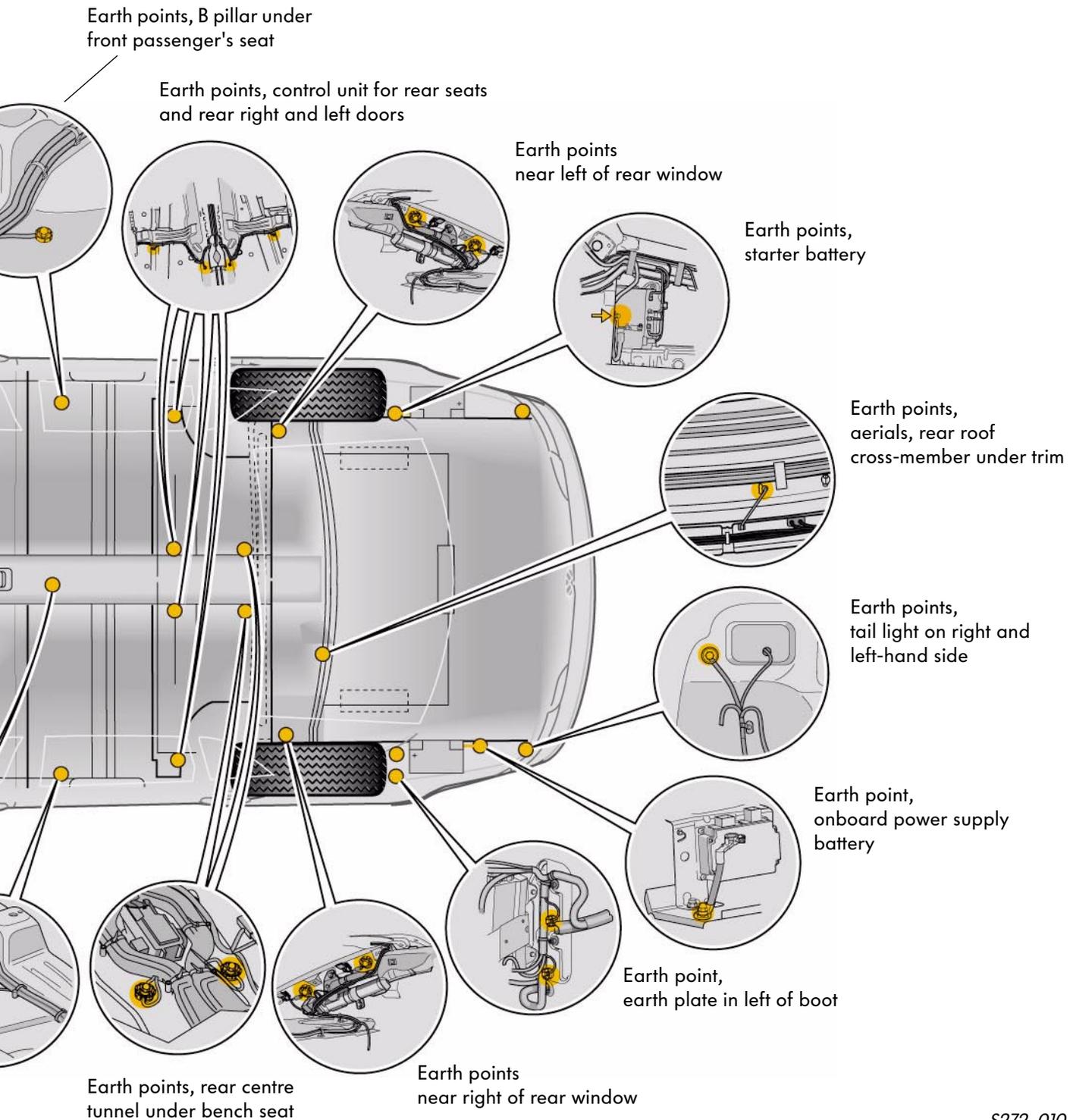
# Introduction

## 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).





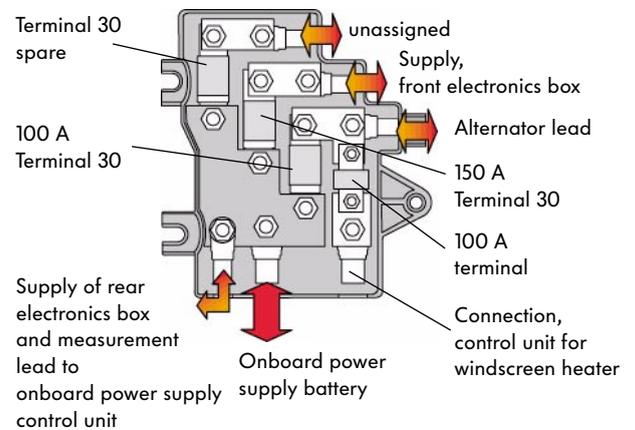
S272\_010

# 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.

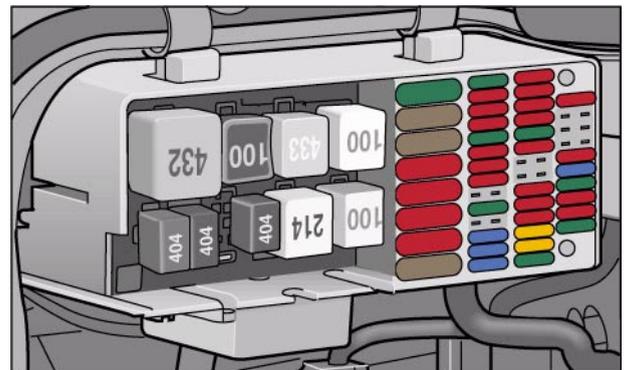


S272\_069

## 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

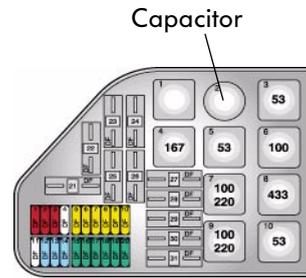


The relays fitted depend on the vehicle type. The current list of fitted relays is contained on the valid current flow diagram.

## 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

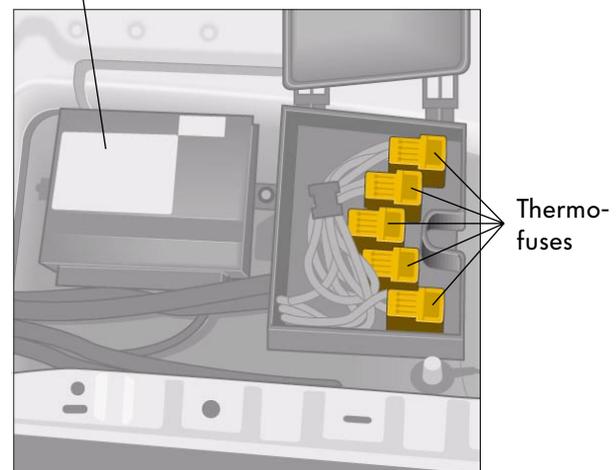


## Thermo-fuse box

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 |

### Control unit for entry and start authorisation



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.

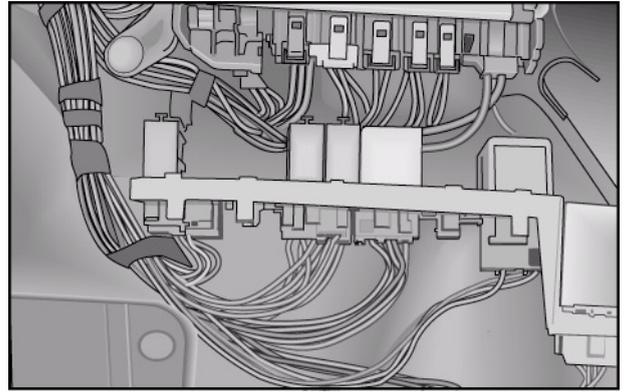
# Electrics boxes

## 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.

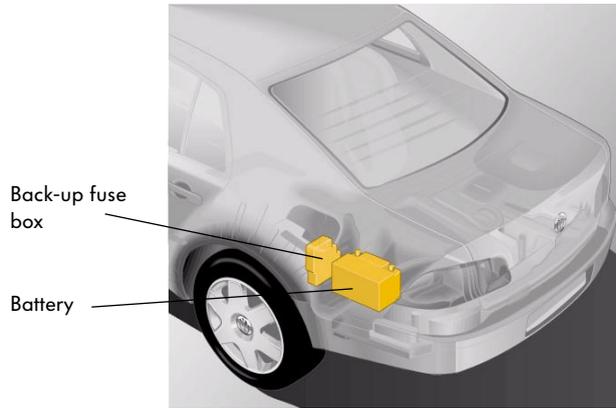
Engine	Onboard power supply battery	Starter battery
V6	75 Ah/420 A*	61 Ah/330 A**
V8	75 Ah/420 A*	61 Ah/330 A**
W12	85 Ah/480 A	61 Ah/330 A
V10 TDI	85 Ah/480 A	85 Ah/480 A

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

\*\*optional

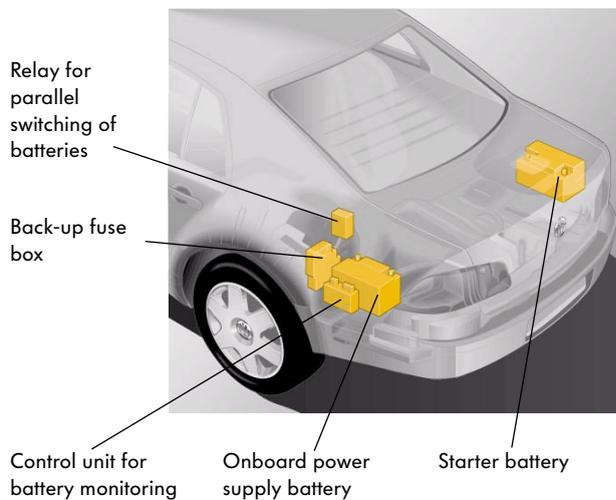


In case of vehicles with one-battery onboard power supplies, it ensures the supply of electrical energy.



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

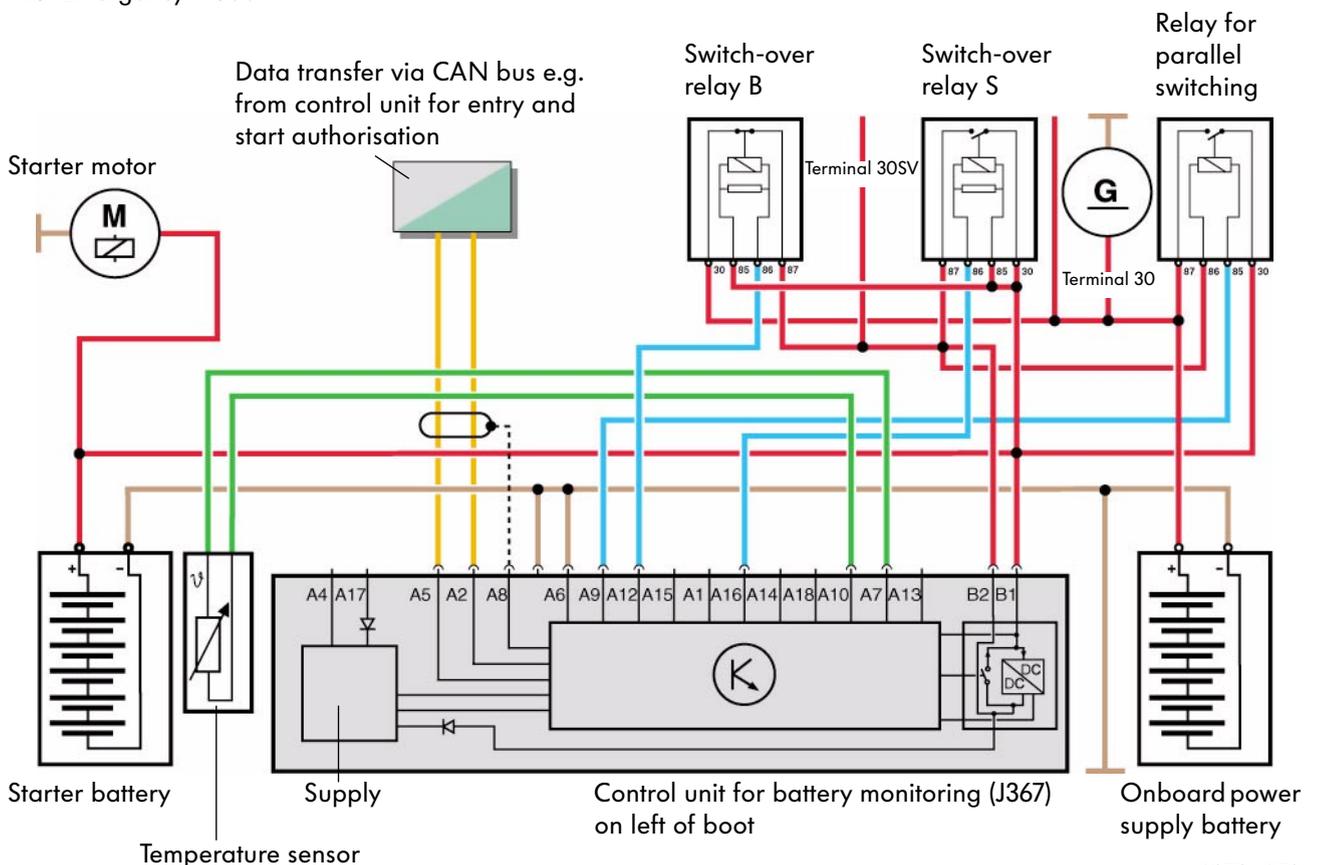
## Functional description

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.I 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.

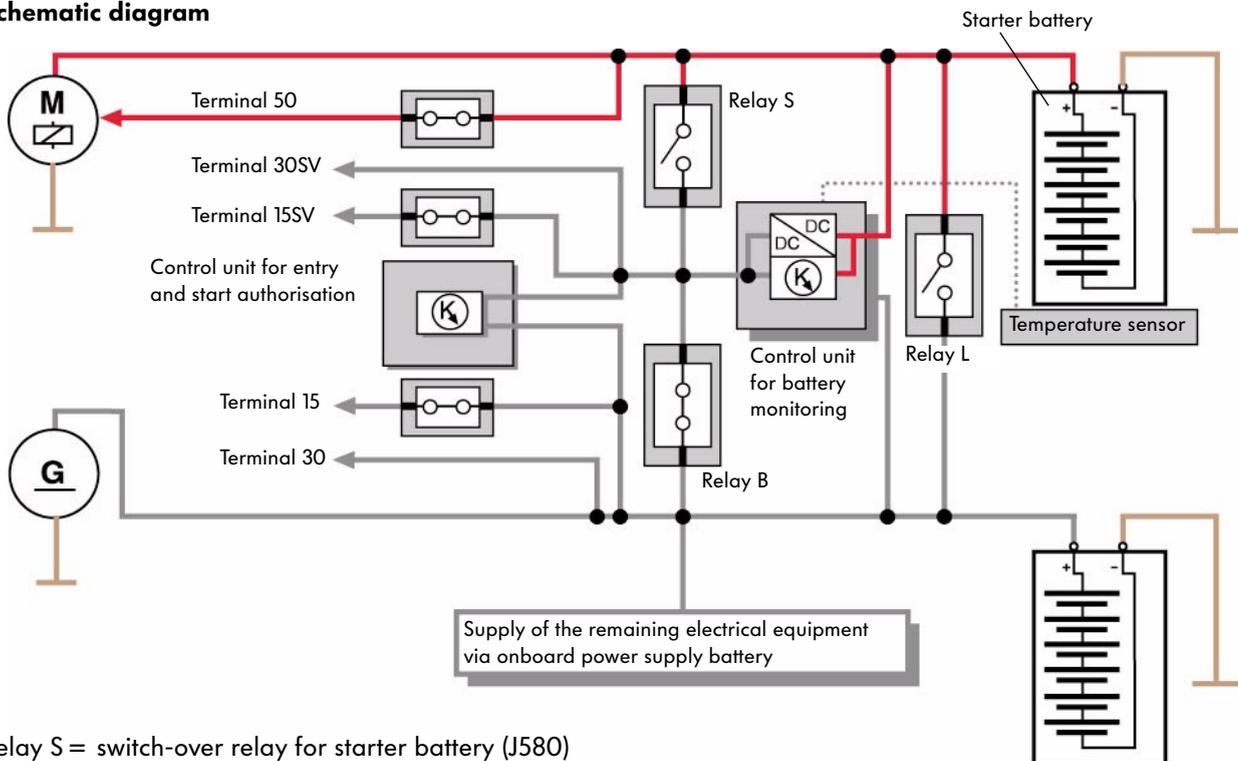
The control unit for battery monitoring is activated by the control unit for entry and start authorisation (J 518) with the signals 'Ignition key in the ignition lock' (Key-In) 'Ignition switched on' (Terminal 15) and the start signal (Terminal 50).

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

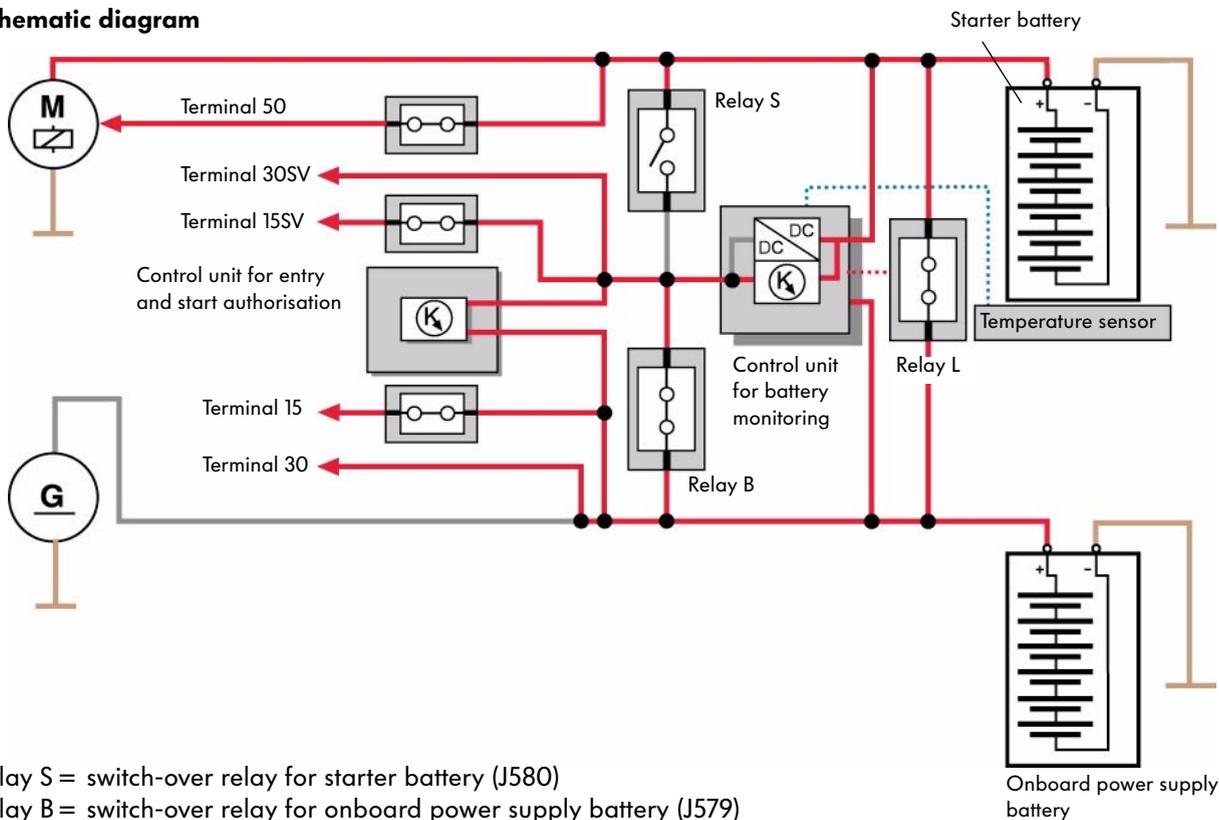
In addition to the input signals of the normal start, the battery temperature as well as the coolant temperature transmitted via the CAN bus are taken into account.

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  $< -10^{\circ}\text{C}$  and
- in the case of V10 TDI  $< 0^{\circ}\text{C}$ .

### 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.

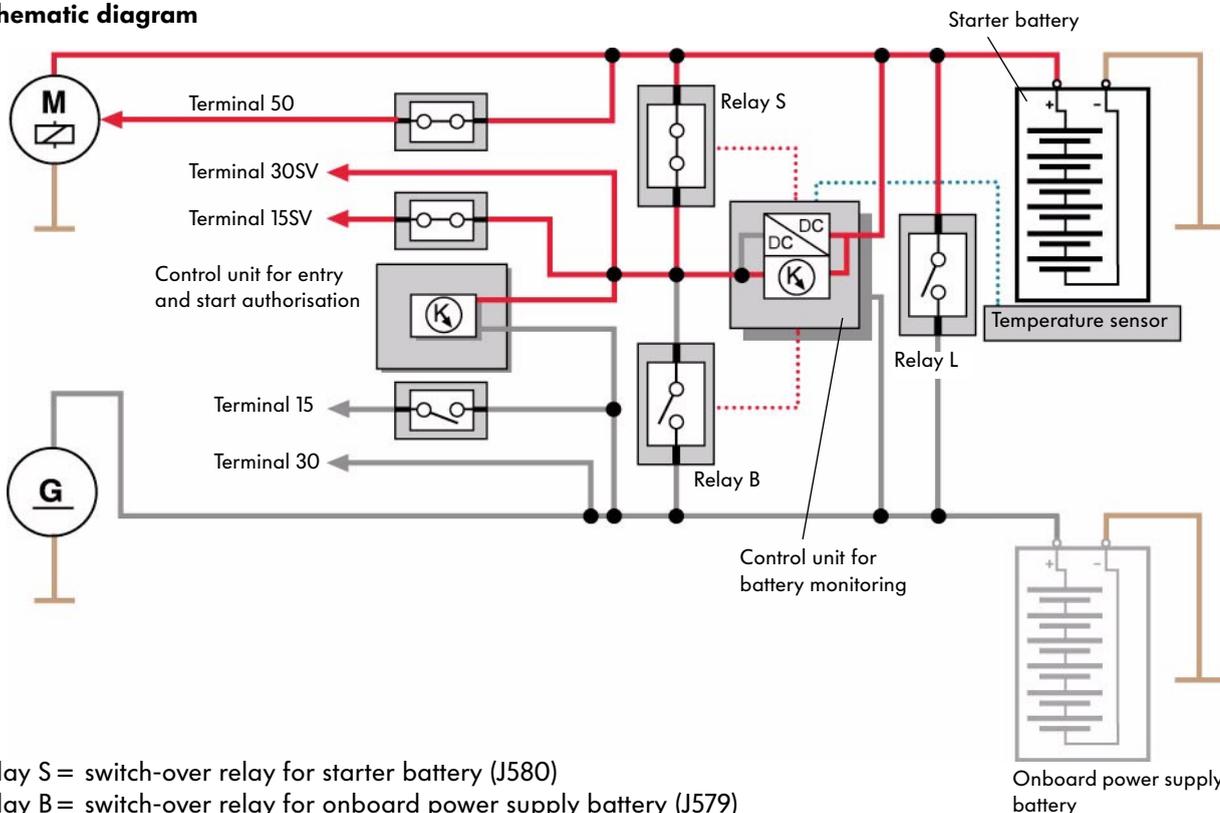
The 'Emergency operation' mode is cancelled approx. two seconds after the system detects that the engine is running.

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

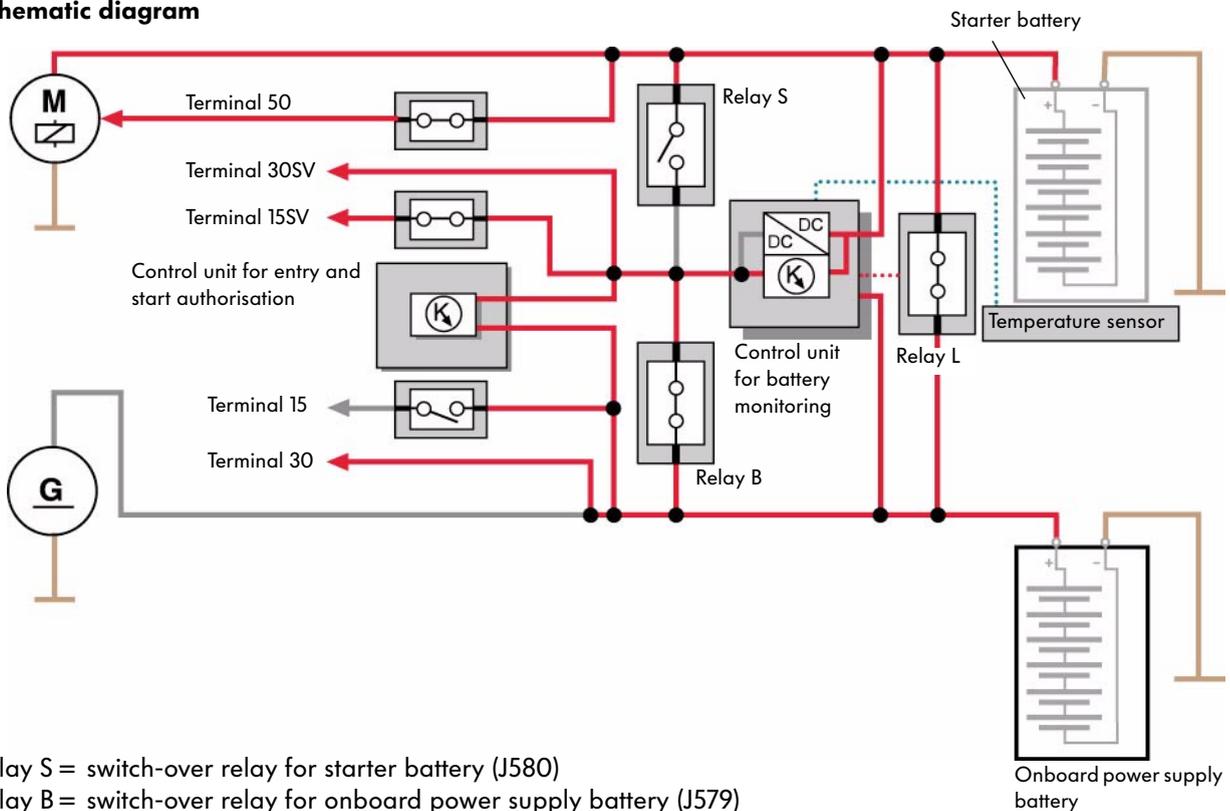
The 'Emergency start' mode is sent via the CAN bus and the PIN 'Emergency operation'.

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

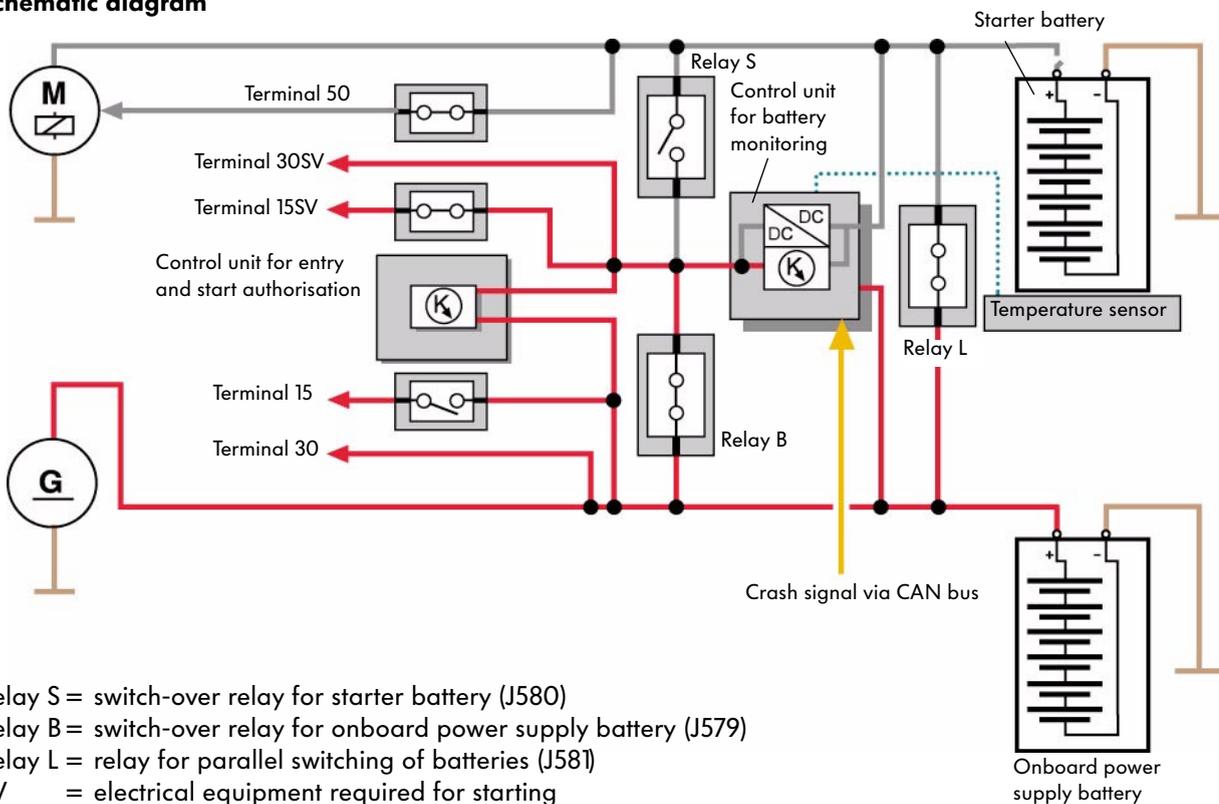
## Monitoring after a crash event

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



S272\_068



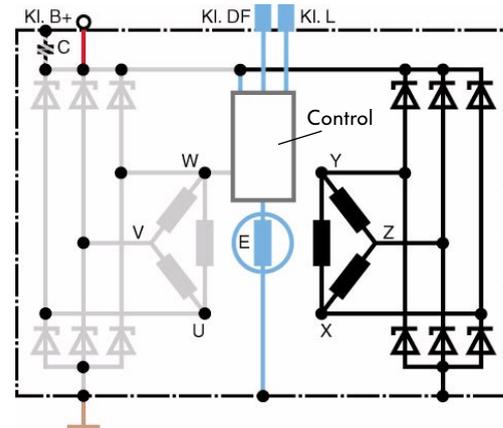
If the 'Key IN' is not present and the onboard power supply battery is discharged, no start is possible. The VAS 5051 Diagnostic Testing And Information System can be used to diagnose the control unit for battery monitoring.

# 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.

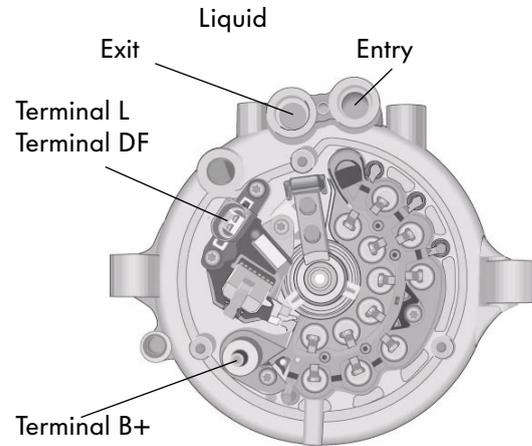
The alternator contains six instead of three stator windings, which are excited via a winding in the rotor. The drive on the V10 TDI is via an internal shaft and a gear.



S272\_025

### Legend

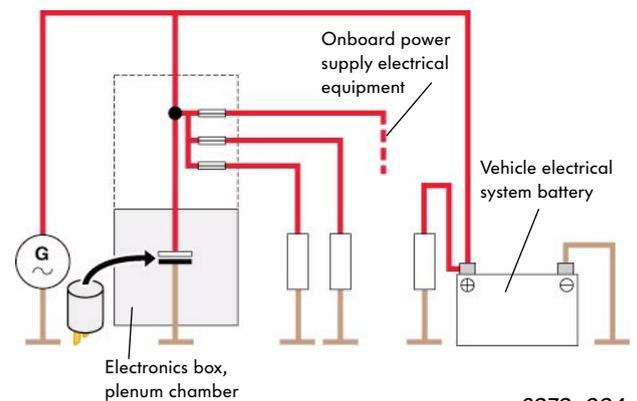
- C - Capacitor
- E - Exciter winding in the rotor
- Terminal B+ - Battery positive
- Terminal DF - Dynamo field
- Terminal L - Signal wiring for warning lamp in dash panel insert
- U, V, W, X, Y, Z - Winding ends of the generating coil



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.

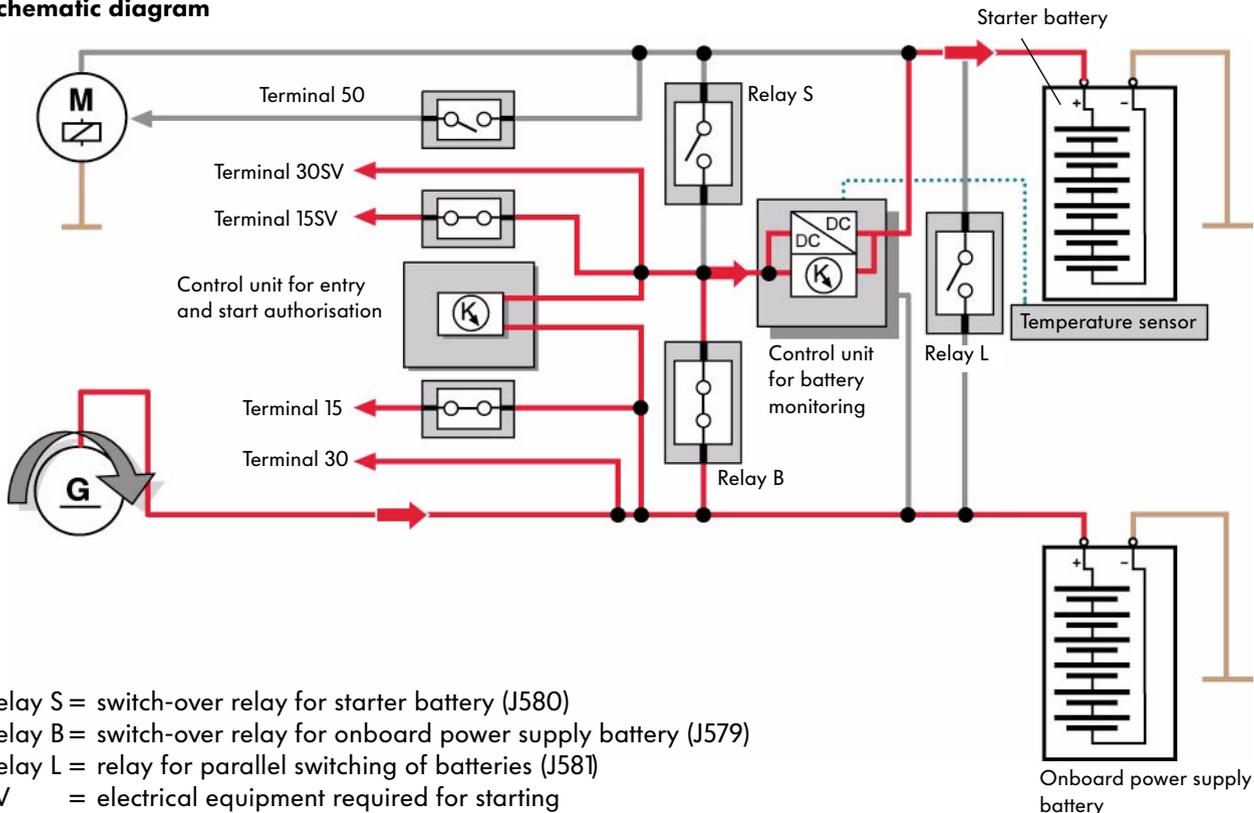
As long as the nominal charge voltage of the starter battery is lower than the current onboard power supply voltage, the charge current of the starter battery is fed via the transistor.

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



S272\_023



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

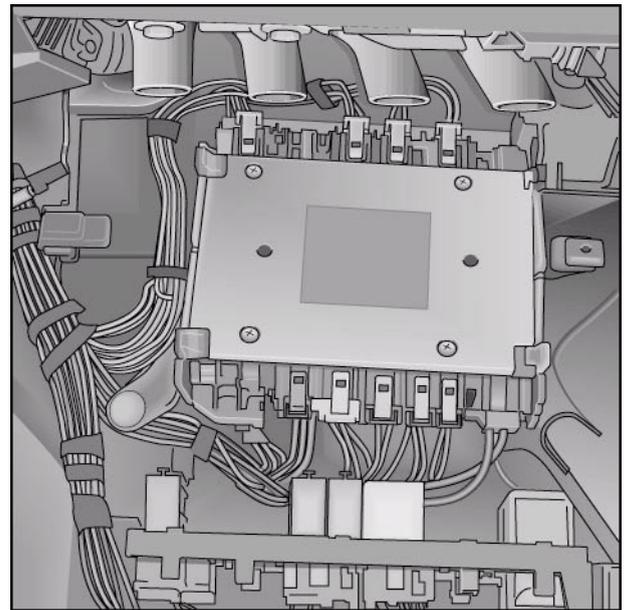
# Onboard power supply management

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

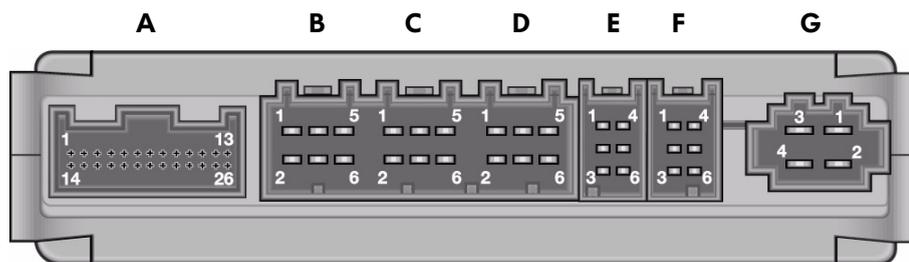
are switched by the onboard power supply control unit.



S272\_053

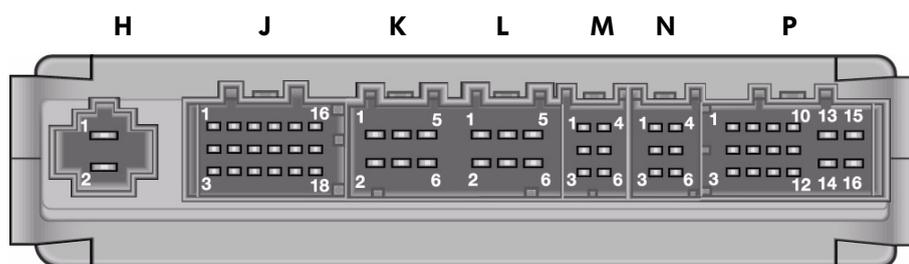
The onboard power supply control unit is located in the electronics box in the right-hand footwell.

## 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.

### 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.

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.



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

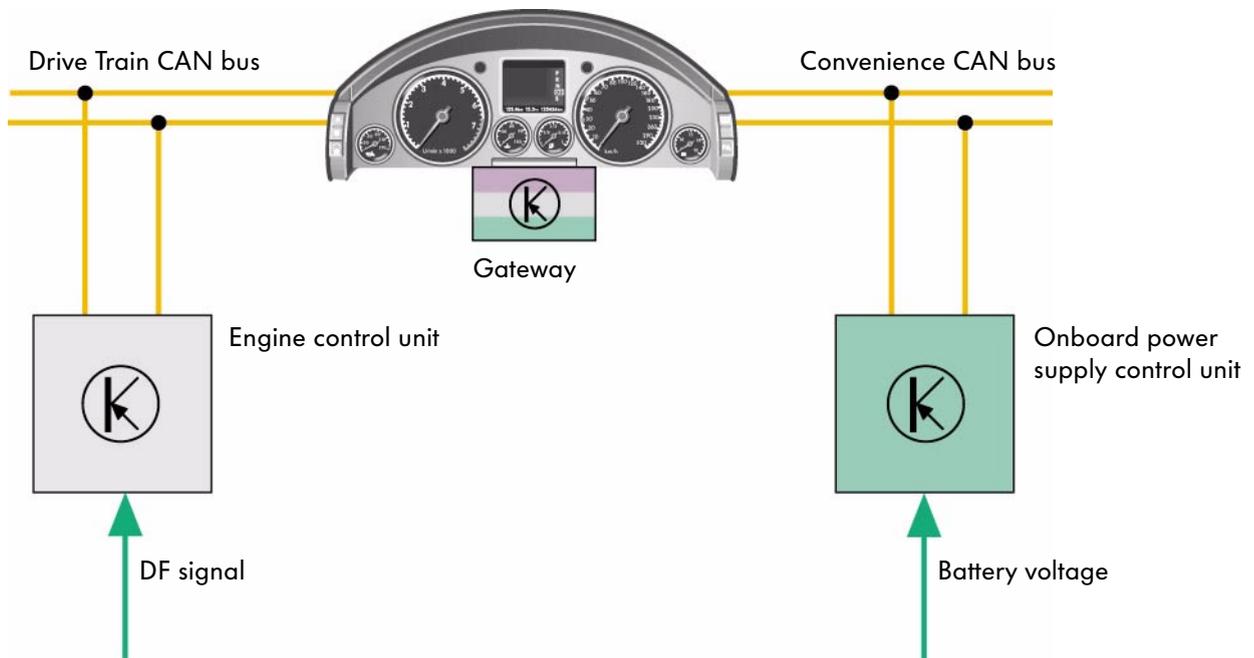
# Onboard power supply management

## 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

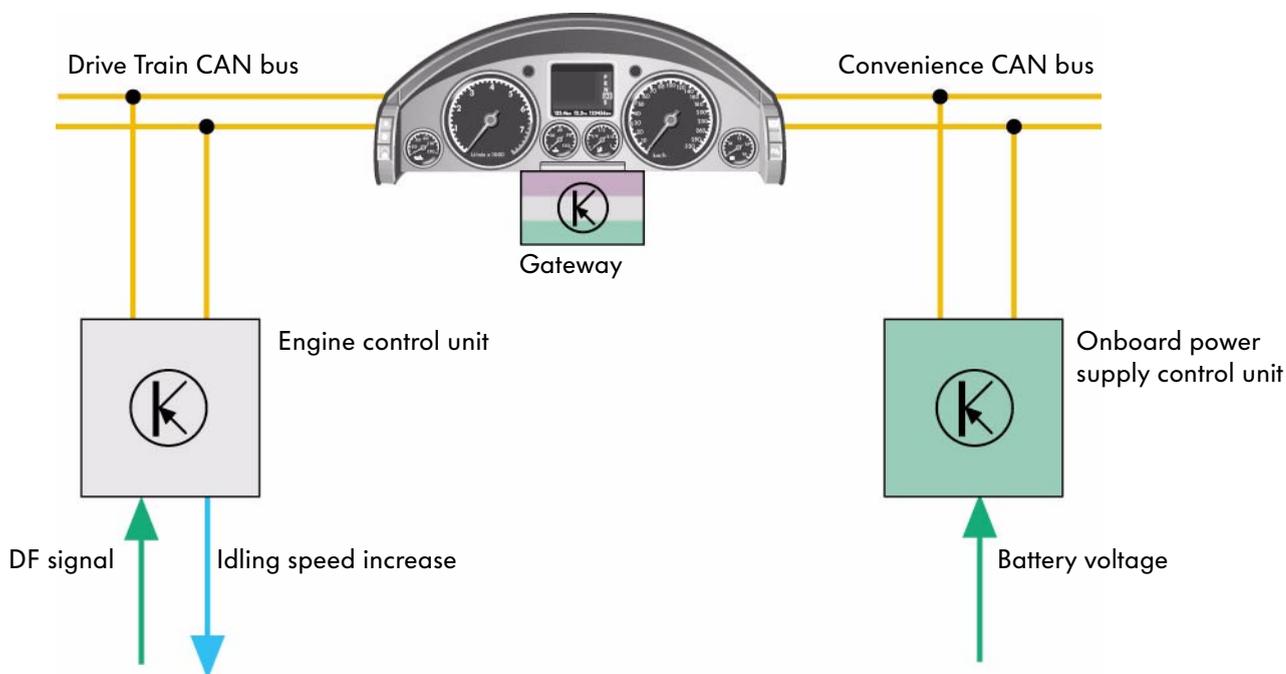


The dynamo field signal can be shown using the VAS 5051 Diagnostic Testing and Information System.

## 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.

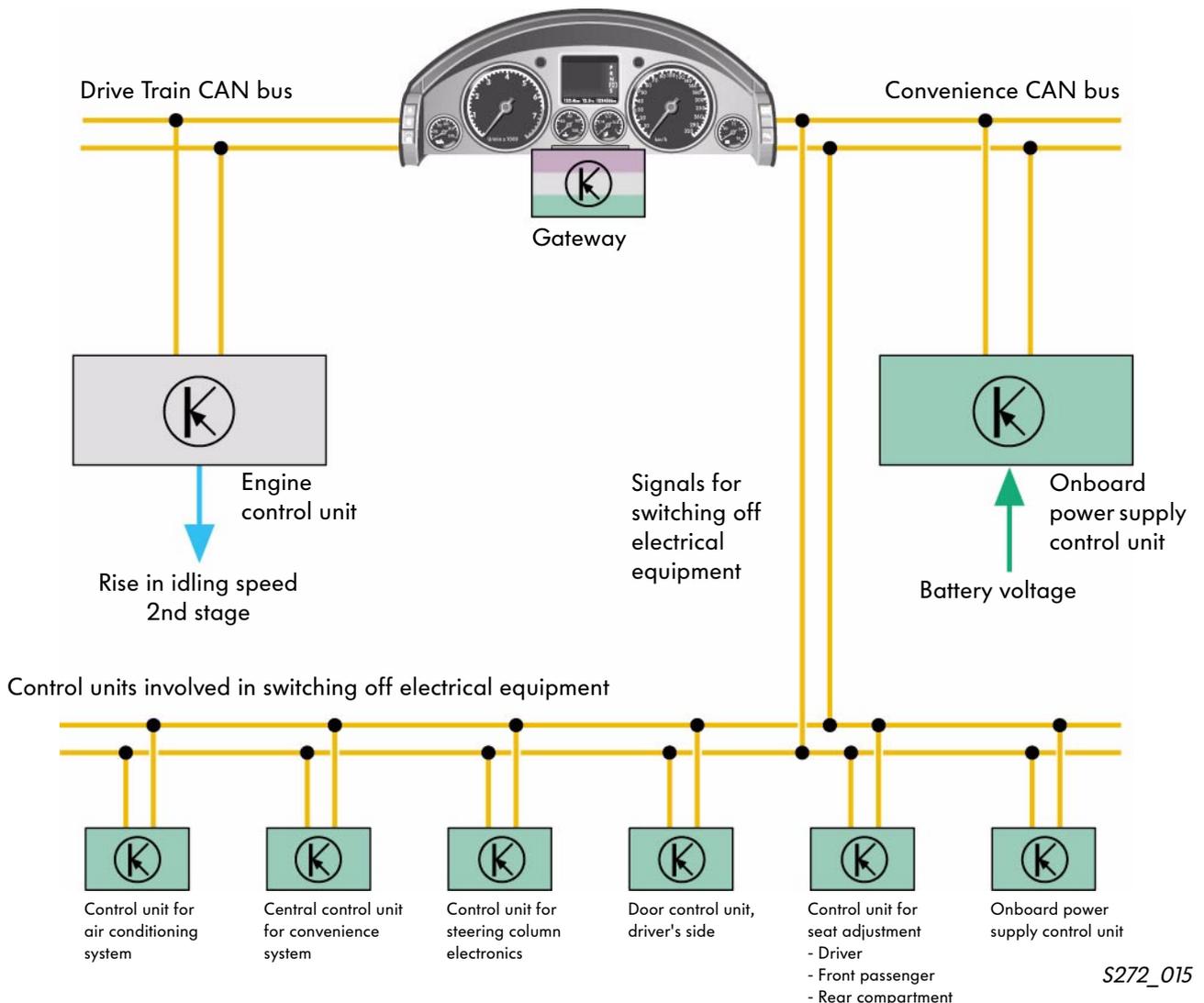
Modifying the engine speed is regulated by the engine control unit according to defined values. Fluctuations in engine speed due to fluctuating voltage values are largely suppressed by the engine control unit.



# Onboard power supply management

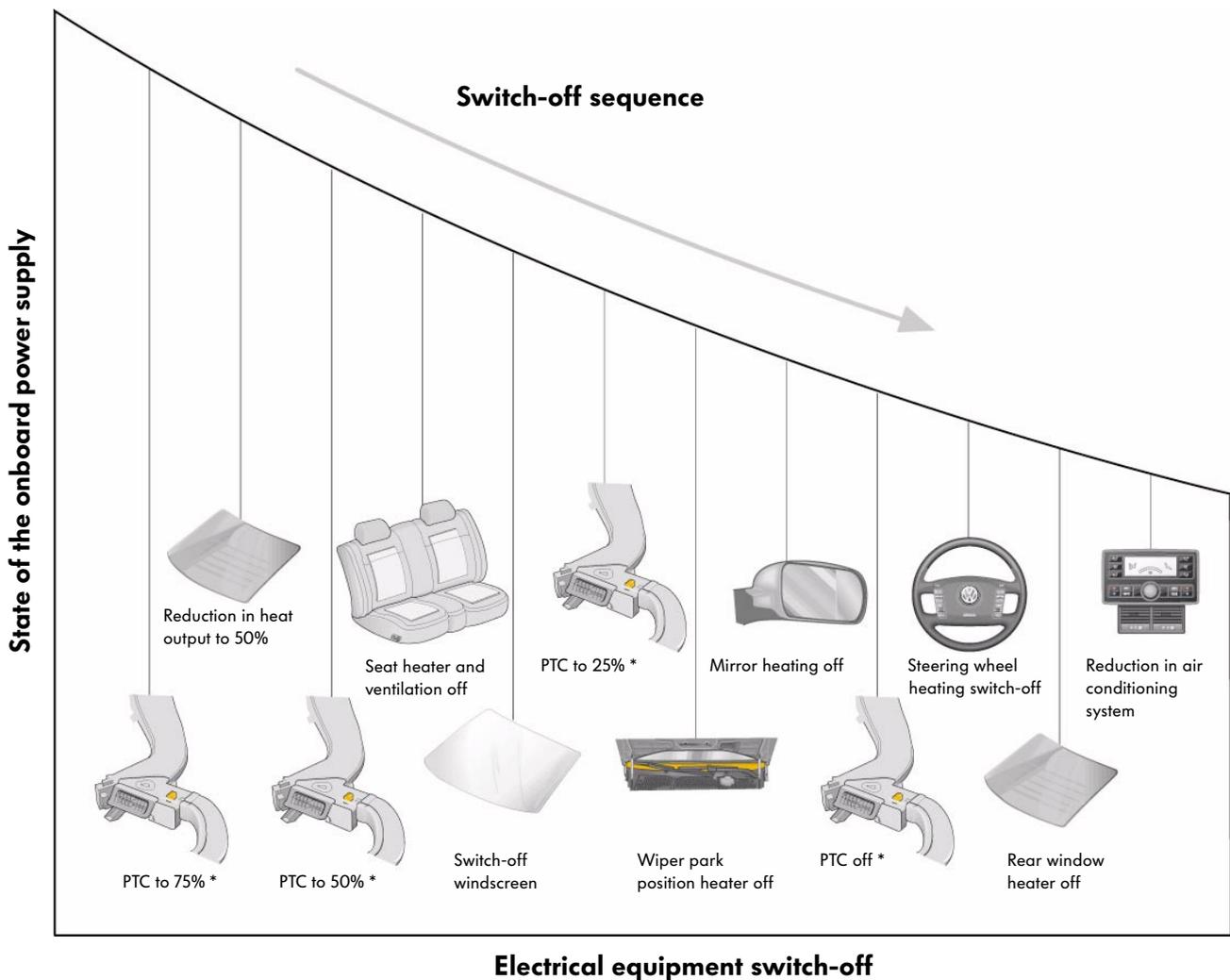
## Switching off convenience electrical equipment

With the ignition on or active alternator (engine running), the onboard power supply control is classified by the onboard power supply control unit as very critical if the voltage of the onboard power supply battery is below 12.2 volts for a certain period dependent on the electrical equipment. The result is that convenience electrical equipment is switched off by priority by its control unit. If an item of electrical equipment is not switched on, it is skipped and the next item is switched off.



If the state of the onboard power supply remains very critical after the convenience electrical equipment has been switched off, a second stage of the idle speed increase is initiated.

If this does not improve the state of the onboard power supply, the air conditioning system is also switched off.



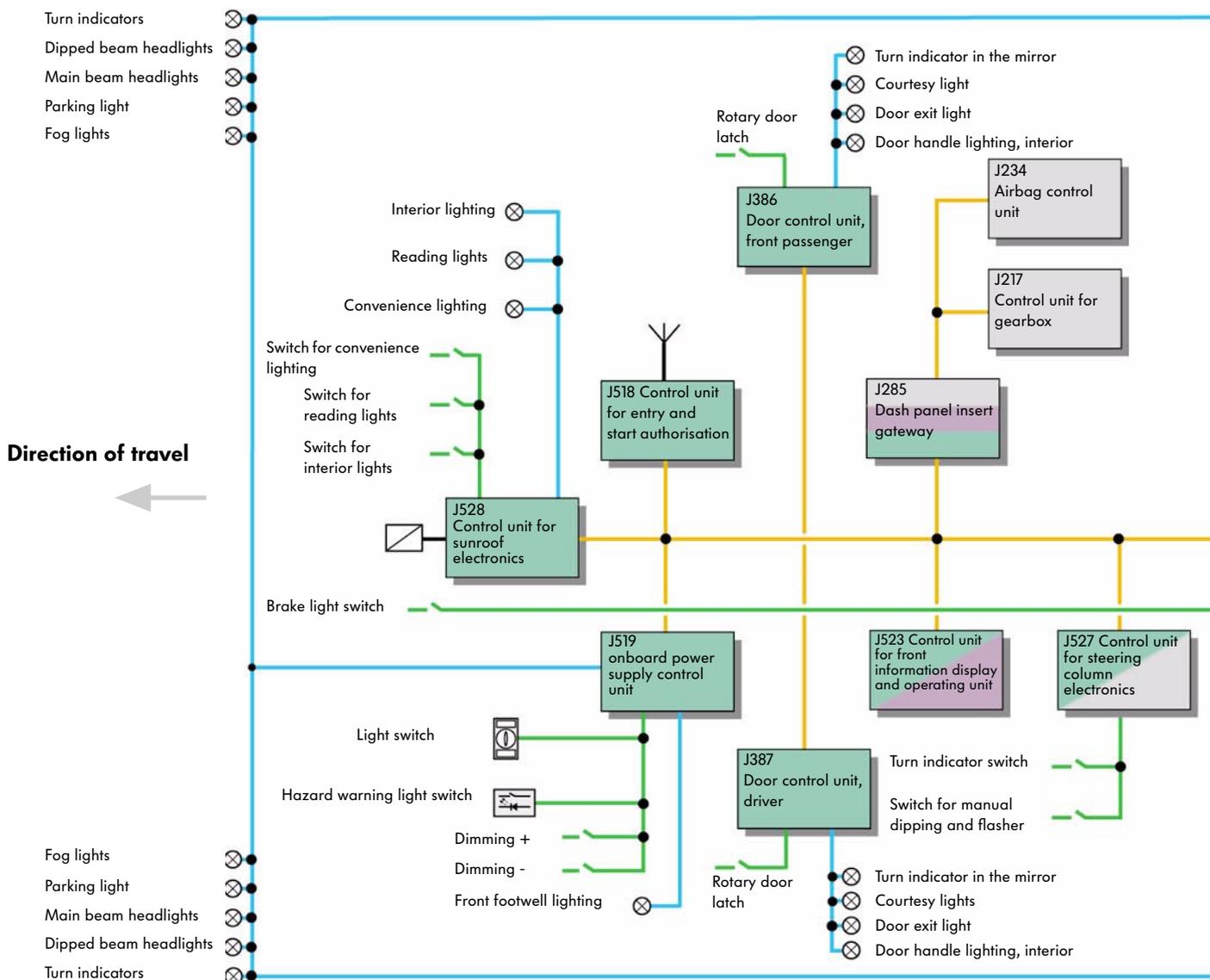
\* PTC heating element in the rear footwell flaps

# Networked functions

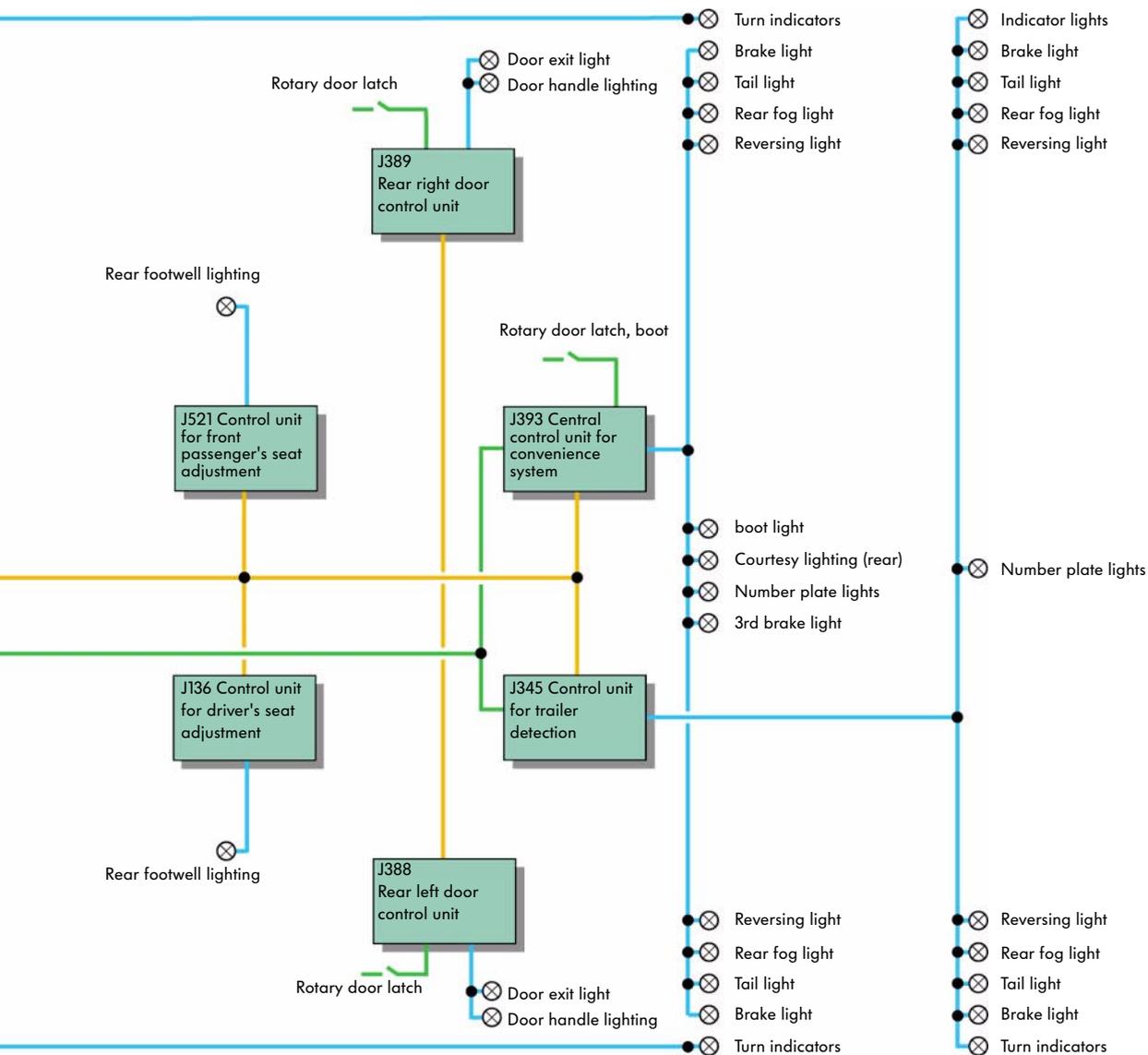
## Networking system

On today's vehicles, activation and supply of the lighting system can no longer be implemented via conventional switches, relays and cable connections. Networked functions in these vehicles handle the corresponding functions.

**Schematic diagram with control units involved in lighting control system and networking as an example**



Activation signals are sent to control units via resistance-coded switches, and these either activate the electrical equipment themselves or send the activation signal via a databus system to the control unit in charge of activation. The supply of the electrical equipment is then via the control unit in charge.



S272\_087

# Networked functions

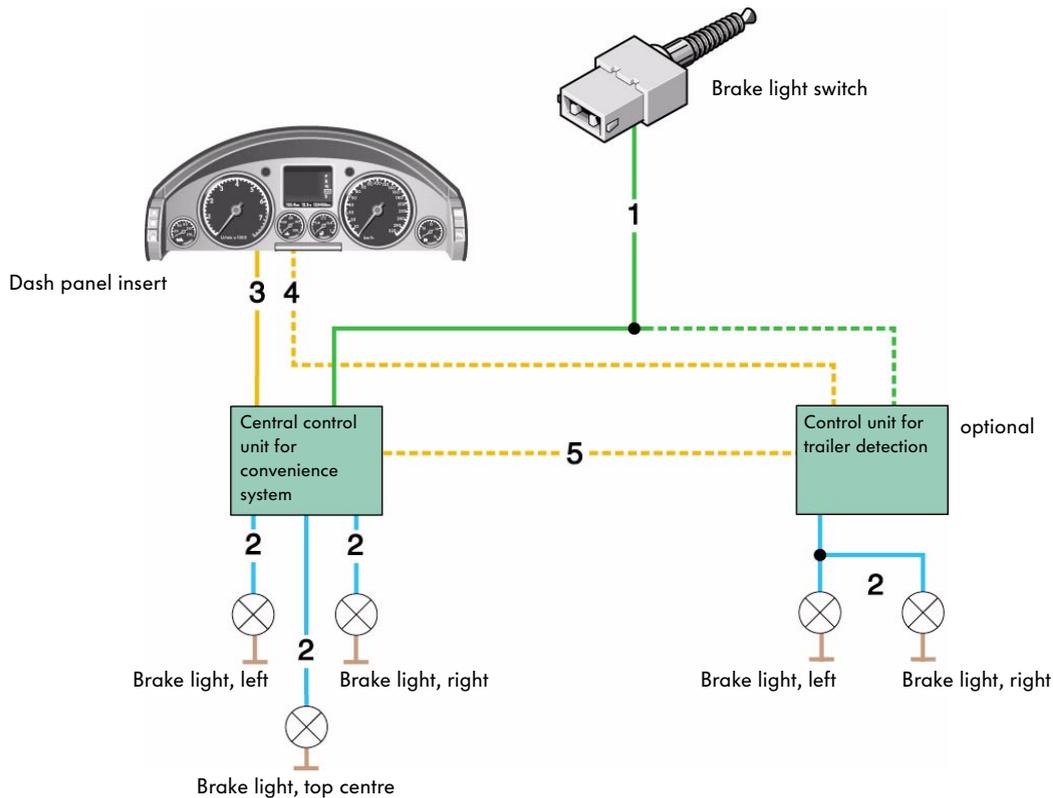
## Brake light control

### Control units involved

- Central control unit for convenience system
- Control unit for trailer detection (optional)
- Dash panel insert



By way of illustration, the CAN lines (orange) for the signals are represented individually. In reality, all the signals are sent via a CAN High and a CAN Low line.



S272\_062

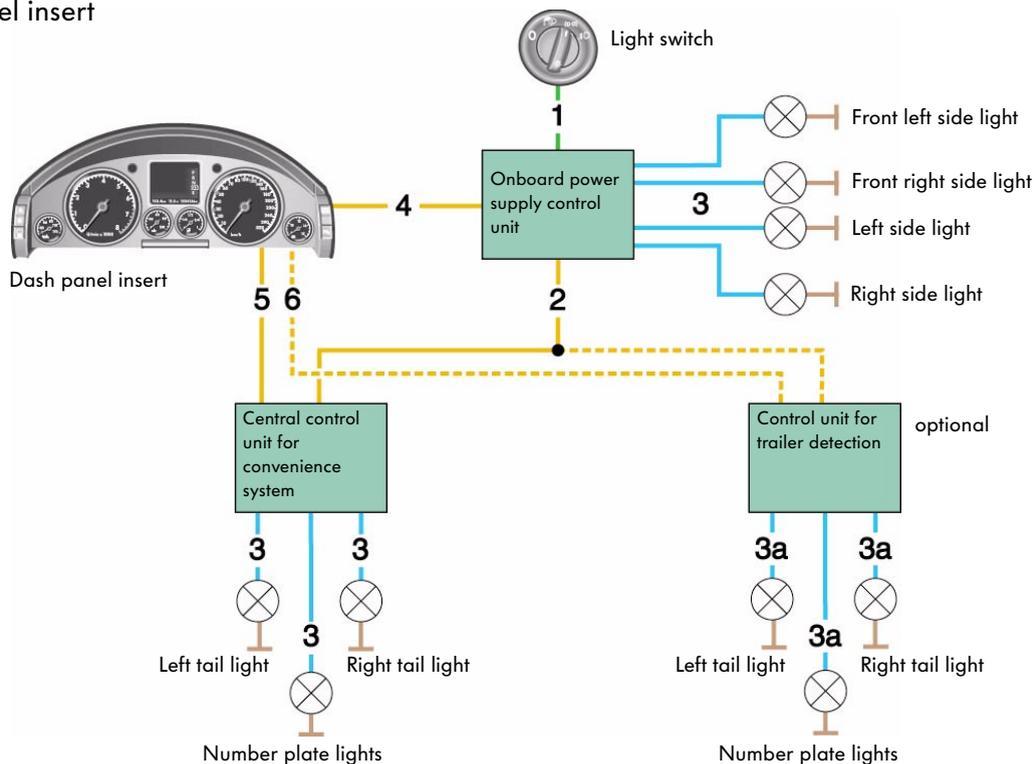
### Signals

- 1 Activation of the central control unit for the convenience system and the control unit for trailer detection via the brake light switch with an analogue voltage
- 2 Power current to the brake light from central control unit for convenience system or control unit for trailer detection
- 3 Fault message from central control unit for convenience system to the dash panel insert via Convenience CAN bus; if the brake light is defective, a fault message appears in the display
- 4 Fault message from control unit for trailer detection to the dash panel insert via Convenience CAN bus; if the brake light is defective, a fault message appears in the display
- 5 Safety signal. If the activation signal from the brake light switch to the control unit for trailer detection is missing, information is provided through the central control unit for convenience system

## Control of side lights and tail lights

### Control units involved

- Onboard power supply control unit
- Central control unit for convenience system
- Control unit for trailer detection (optional)
- Dash panel insert



S272\_045

### Signals

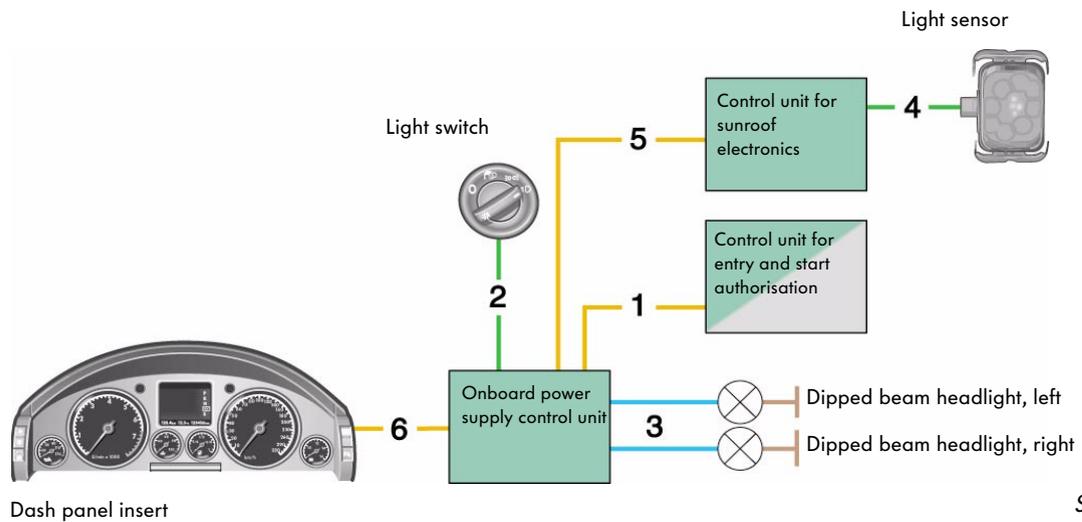
- 1 Activation of the onboard power supply control unit by the light switch with an analogue voltage
- 2 Activation signal from the onboard power supply control unit to the central control unit for convenience system and control unit for trailer detection via Convenience CAN bus
- 3 Power current to the side lights and tail lights
- 4 Fault message to the dash panel insert via Convenience CAN bus; if a side light is defective, a fault message appears in the display
- 5 Fault message to the dash panel insert via Convenience CAN bus; if a tail light is defective, a fault message appears in the display
- 6 Fault message to the dash panel insert via Convenience CAN bus; if a tail light in the trailer is defective, a fault message appears in the display

# Networked functions

## Light activation via the light switch or the automatic driving light control

### Control units involved

- Onboard power supply control unit
- Dash panel insert
- Control unit for entry and start authorisation
- Control unit for sunroof electronics



### Signals

- 1 Signal 'Ignition on' from control unit for entry and start authorisation via Convenience CAN bus
- 2 Activation of the onboard power supply control unit by the light switch with an analogue voltage signal,  $V_{bat}$  approx. 12 volts
- 3 Power current to the headlights

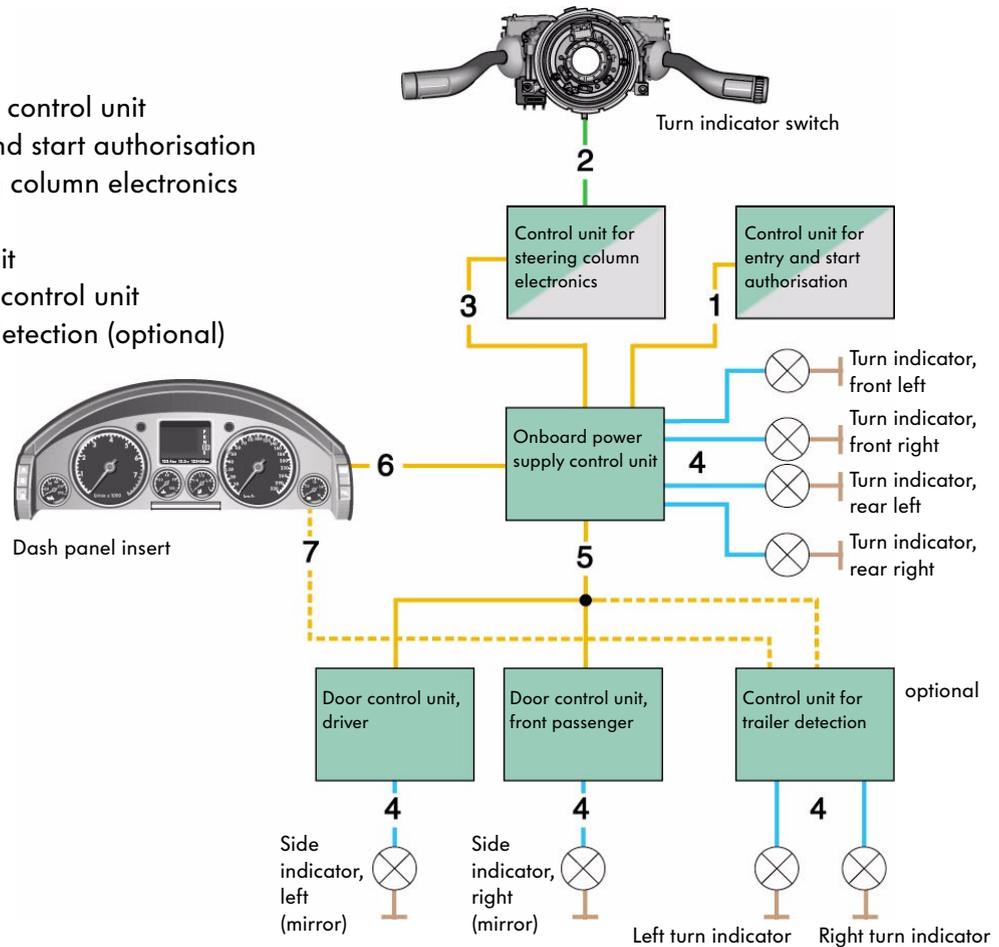
### If light sensor fitted

- 4 Analogue brightness signal from light sensor to control unit for sunroof electronics
- 5 Signal 'Switch on dipped beam headlights' via Convenience CAN bus in the case of automatic driving light control from control unit for sunroof electronics to onboard power supply control unit
- 6 Fault message to the dash panel insert via Convenience CAN bus; if dipped beam headlight is defective, a fault message appears in the display

# Control of the turn indicator

## Control units involved

- Onboard power supply control unit
- Control unit for entry and start authorisation
- Control unit for steering column electronics
- Dash panel insert
- Driver's door control unit
- Front passenger's door control unit
- Control unit for trailer detection (optional)



## Signals

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1 Signal 'Ignition on' from control unit for entry and start authorisation via Convenience CAN bus</li> <li>2 Signal 'turn indicating' from turn indicator switch into control unit for steering column electronics</li> <li>3 Signal 'turn indicating' from control unit for steering column electronics via Convenience CAN bus to onboard power supply control unit</li> <li>4 Power current to the indicator lights</li> <li>5 Signal 'turn indicating' from onboard power supply control unit via Convenience CAN bus to door control units driver/front passenger and, if present, to the control unit for trailer detection</li> </ol> | <ol style="list-style-type: none"> <li>6 Signal for activation of the indicator lamps and poss. fault messages via Convenience CAN bus from onboard power supply control unit to dash panel insert</li> <li>7 Signal for activation of the indicator lamps and poss. fault messages via Convenience CAN bus from control unit for trailer detection to dash panel insert</li> </ol> |
|--|---|

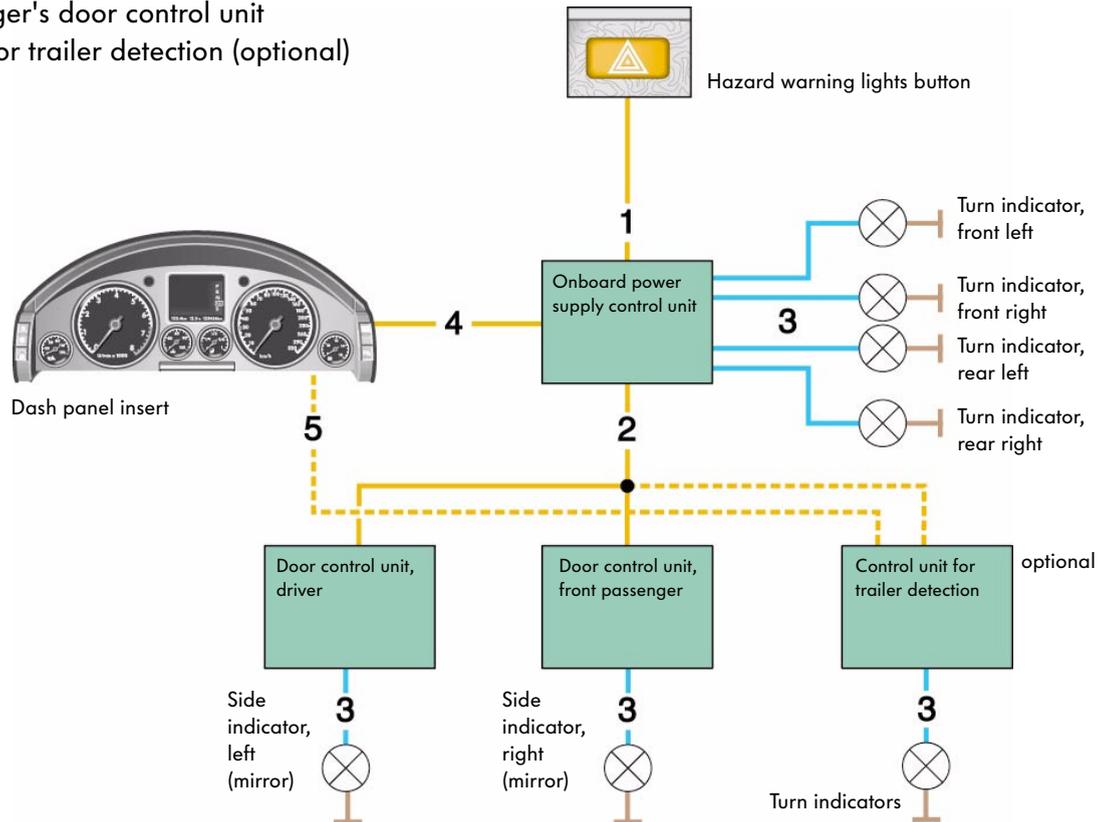
S272\_047

# Networked functions

## Hazard warning lights control

### Control units involved

- Onboard power supply control unit
- Dash panel insert
- Driver's door control unit
- Front passenger's door control unit
- Control unit for trailer detection (optional)



S272\_088

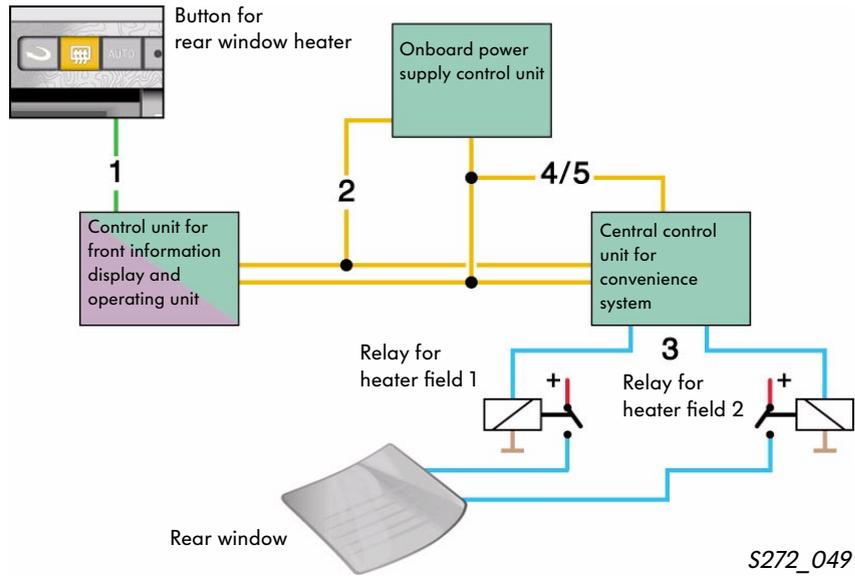
### Signals

- 1 Signal 'hazard warning lights' from hazard warning lights button to onboard power supply control unit
- 2 Signal 'hazard warning lights' from onboard power supply control unit via Convenience CAN bus to door control units driver/front passenger and, if present, to the control unit for trailer detection
- 3 Power current to the indicator lights
- 4 Signal for activation of indicator lamps and acoustic check signal and poss. fault messages via Convenience CAN bus from onboard power supply control unit to dash panel insert
- 5 Signal for activation of the indicator lamps and poss. fault messages via Convenience CAN bus from control unit for trailer detection to dash panel insert

# Control of the rear window heater

## Control units involved

- Control unit, front information display and operating unit
- Onboard power supply control unit
- Central control unit for convenience system



## Signals

- 1 Signal from rear window heater button to control unit, front information display and operating unit
- 2 Signal 'Button actuated' from control unit, front information display and operating unit to central control unit for convenience system via Convenience CAN bus
- 3 Analogue activation of the relay for heater field 1 and 2 on rear window
- 4 Signal 'Heater fields of rear window switched on' via Convenience CAN bus from central control unit for convenience system to onboard power supply control unit and control unit for front display and operating unit; indicator lamp is switched on
- 5 Signal 'Power output reduction of rear window heater' via Convenience CAN bus from onboard power supply control unit to central control unit for convenience system



The upper and lower heater fields of the rear window are activated separately. In the case of an overload of the onboard power supply control unit, the onboard power supply control unit reduces the heat output by 50%. The heater fields are activated alternately.



# Networked functions

## Control of windscreen heater

### Control units involved

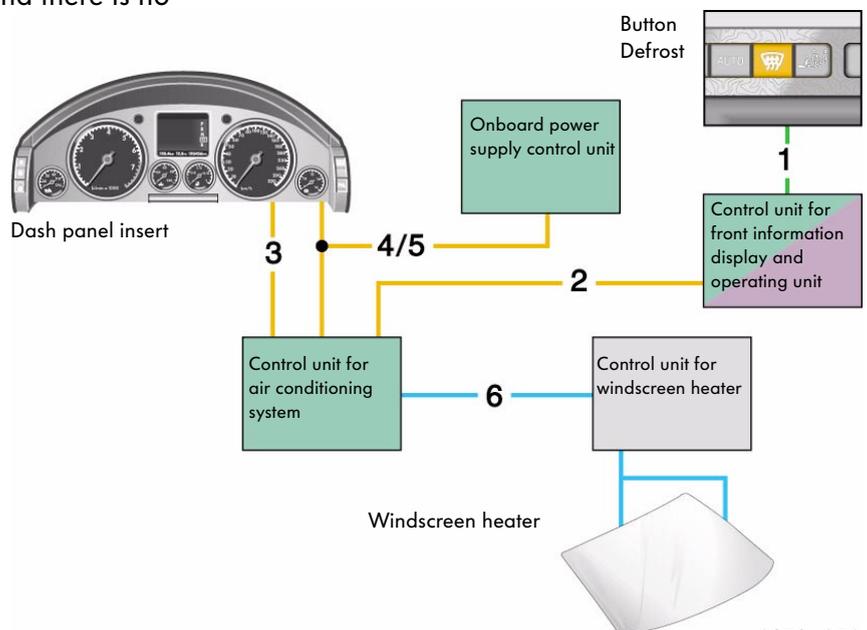
- Control unit, front information display and operating unit
- Onboard power supply control unit
- Control unit for air conditioning system
- Dash panel insert



The windscreen heater is switched on by the control unit for air conditioning system depending on the ambient temperature. The switch-on time is based on the ambient temperature:

- +5 to 0°C = 2 minutes
- 0 to -20°C = 4 minutes
- 20 to -40°C = 6 minutes

Activation via the defrost button is only possible when the engine is running, when the ambient temperature is colder than +5°C, and there is no engine load limitation.



### Signals

- 1 Signal 'Windscreen heater on' with manual operation
- 2 Forwarding of signal 'Windscreen heater on' in the case of manual operation from control unit for front display and operating unit for information to control unit for air conditioning system via Convenience CAN bus
- 3 Signal 'Engine speed > 0 rpm' from dash panel insert to control unit for air conditioning system via Convenience CAN bus
- 4 Signal 'Switch-off windscreen heater' in the case of load limitation from onboard power supply control unit via Convenience CAN bus
- 5 Signal 'Windscreen heater on' from control unit for air conditioning system to dash panel insert as well as information signal 'Windscreen heater on' from control unit for air conditioning system to onboard power supply control unit via Convenience CAN bus
- 6 Activation to control unit for windscreen heater to switch on the windscreen heater

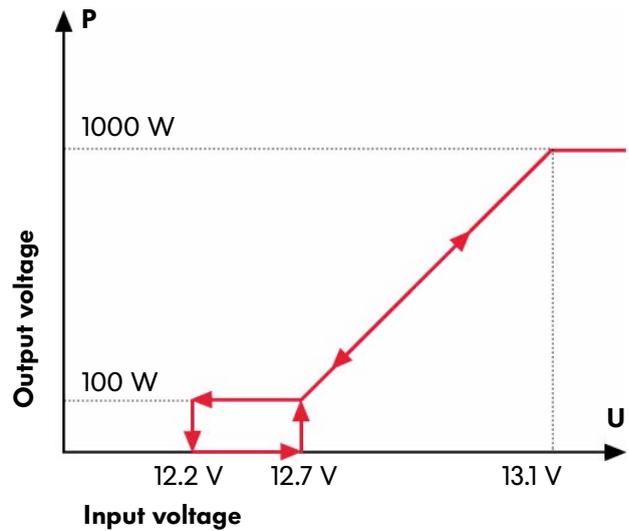
S272\_050

# Control unit for windscreen heating

In order to enhance convenience and safety (fogged or iced windows), a heated windscreen is used.

The windscreen is heated by means of an integrated metal foil. Due to the necessary electrical power output of approx. 1000 watts, as a result of the foil resistance, a voltage is required that exceeds the onboard power supply voltage of 12 volts.

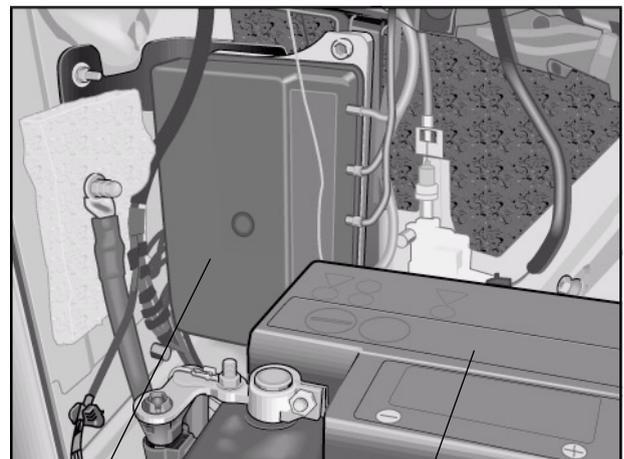
This voltage is provided by the control unit for the windscreen heater (DC/DC converter). Depending on the input voltage, an output voltage of up to 42 volts DC and power output of up to 1000 watts is provided.



S272\_089

A crack in the windscreen or a short circuit is detected by the control unit. The windscreen is then not heated.

The control unit for the windscreen heater is located in the rear right of the boot.



S272\_094

Control unit for  
windscreen heater

Starter battery



# Switches

## Resistance-coded switches

Switches serve to switch electrical components and functions on and off.

In the case of conventional switches, one cable connection per switch function is required.

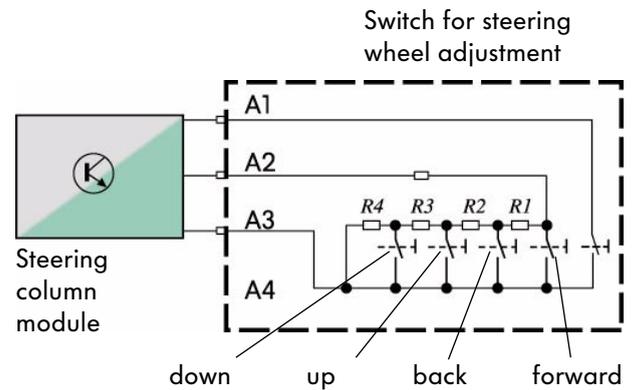
Resistance-coded switches need a considerably lower number of cable connections.

### Functional example

#### Switch for steering wheel adjustment

##### Switch open

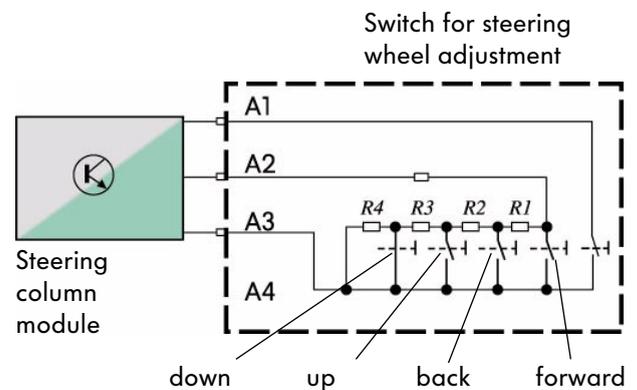
If all the switches are open, no signal is transmitted to the steering column module.



S272\_064

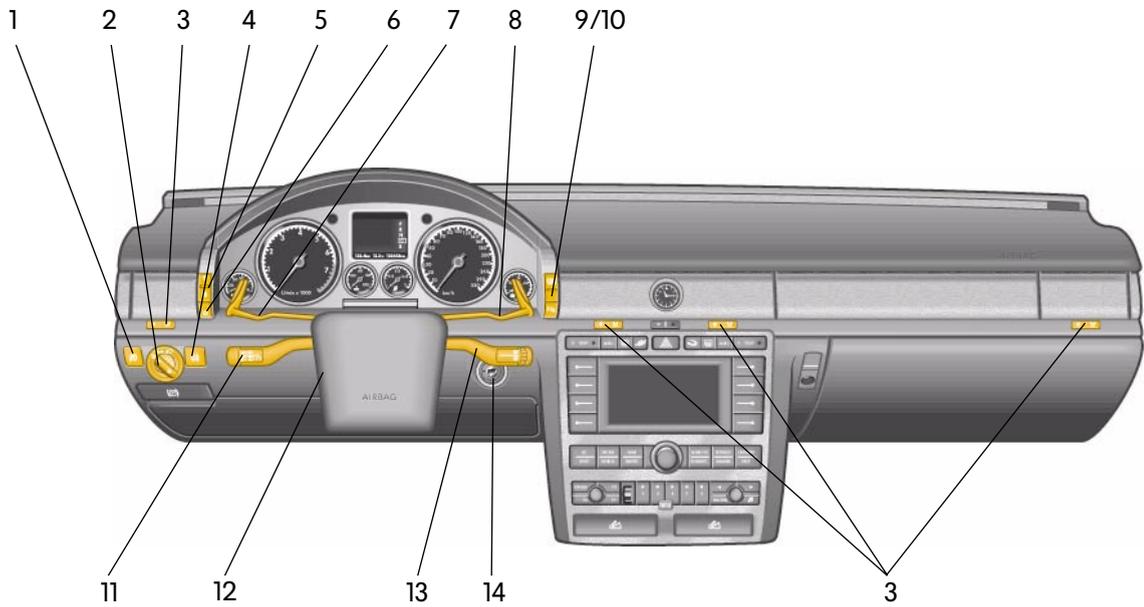
##### Switch 'down' is actuated

Via contact A2, the steering column module transmits a voltage signal to the switch. This voltage signal is changed by resistance R4. As the resistances R1, R2, R3 and R4 are different, the control unit recognises the switch position.



S272\_065

## Dash panel



S272\_026

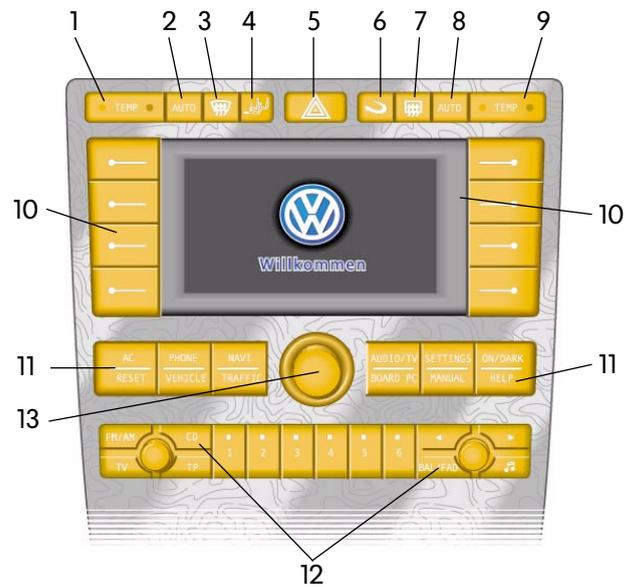
- |                        |   |
|------------------------|---|
| 1 Fog light, optional  | 9 Turn off parking aid                      |
| 2 Rotary light switch  | 10 Rear roller blind up/down                |
| 3 Vent flow restrictor | 11 Turn indicators and main beam headlights |
| 4 Rear fog light       | 12 Steering wheel adjustment                |
| 5 Instrument lighting  | 13 Wipers                                   |
| 6 Reset trip recorder  | 14 Electronic ignition lock                 |
| 7 Tiptronic -          |   |
| 8 Tiptronic +          |   |



# Switches

## Front information display and operating unit

- 1 Air conditioning temperature, driver's side
- 2 Automatic air conditioning, driver's side
- 3 Windscreen defrost
- 4 Air conditioning toggle Quattro/Mono
- 5 Hazard warning light switch
- 6 Air conditioning air recirculation
- 7 Rear window heater
- 8 Automatic air conditioning, front passenger's side
- 9 Air conditioning temperature, front passenger's side
- 10 Softkeys for menu control
- 11 Switch-over menu on screen
- 12 Radio operating keys
- 13 Rotary/push knob



S272\_039

## Multi-function steering wheel

- 1 APC or CCS On/Off
- 2 APC Distance +/-
- 3 APC or CCS Cancel
- 4 Key lighting On/Off (on the back)
- 5 APC or CCS -
- 6 APC or CCS Set
- 7 APC or CCS Resume
- 8 APC or CCS +
- 9 Volume +
- 10 Answer telephone call
- 11 Navigation announcement
- 12 Volume -
- 13 Menu selection, forward
- 14 List selection
- 15 Menu selection, backward



S272\_027

## Driver's door

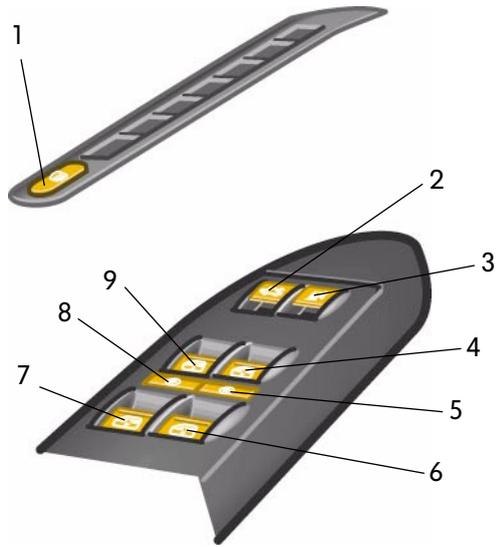
- 1 Locking/unlocking doors (in driver's and front passenger's door)



S272\_031

### Driver's door

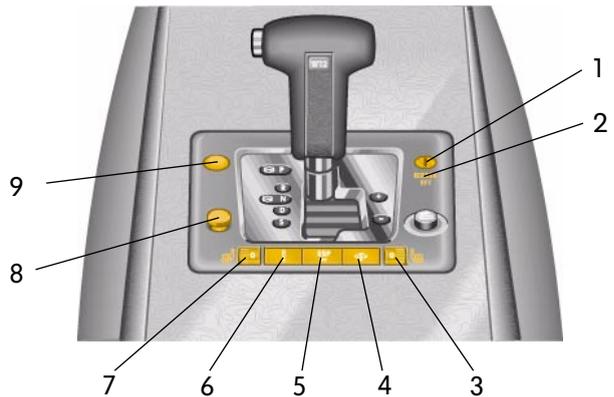
- 1 Defroster vent, driver's door
- 2 Bootlid open
- 3 Tank filler flap release
- 4 Front right window regulator
- 5 Right child-proof lock
- 6 Rear right window regulator
- 7 Rear left window regulator
- 8 Left child-proof lock
- 9 Front left window regulator



S272\_030

### Centre console

- 1 Deactivation, front passenger's airbag
- 2 Indicator lamp, deactivation front passenger's airbag
- 3 Seat heater and ventilation, front passenger (optional)
- 4 Damper setting
- 5 ESP switch
- 6 Air suspension adjustment
- 7 Seat heater and ventilation, driver, and steering wheel heating (optional)
- 8 Mirror adjustment, mirror heating, optional mirror folding function
- 9 Ignition and starting engine, optional

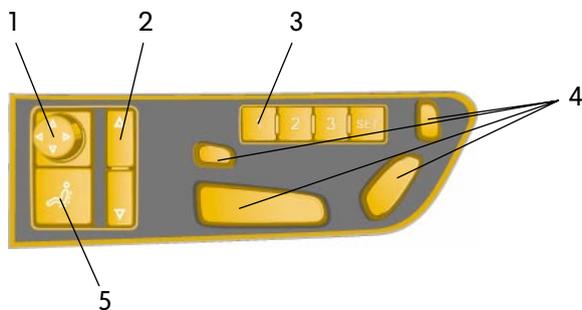


S272\_038



### Driver's and front passenger's seat

- 1 4-way adjustment lumbar support
- 2 Belt height adjustment
- 3 Position memory of seats (3 positions, 1 set)
- 4 Seat adjustment
- 5 Massage On/Off

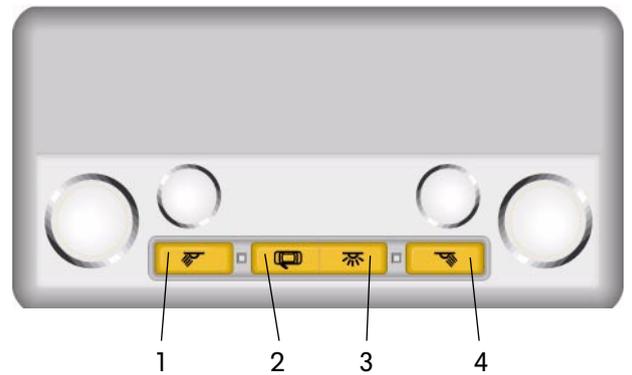


S272\_029

# Switches

## Rear roof module

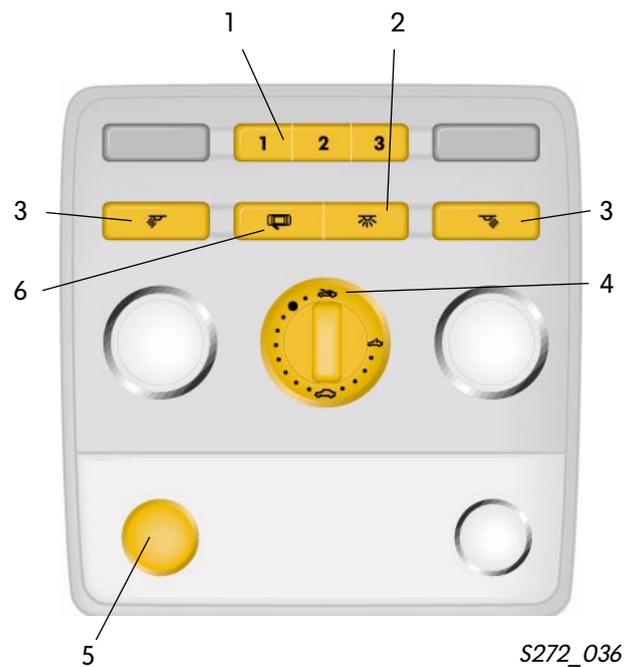
- 1 Rear left reading light On/Off
- 2 Interior light via door contact On/Off
- 3 Interior light On/Off
- 4 Rear right reading light On/Off



S272\_037

## Front roof module

- 1 Trigger for programmed remote control (e.g. open garage door)
- 2 Interior light On/Off
- 3 Reading light On/Off
- 4 Control of sliding/tilting roof
- 5 Hands-free microphone for driver (car phone and voice operation)
- 6 Interior light via door contact On/Off

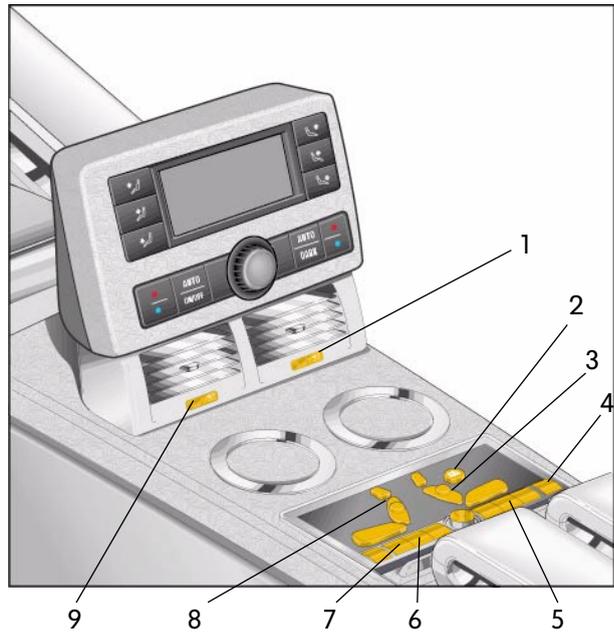


S272\_036



### Operating elements on the console in the rear

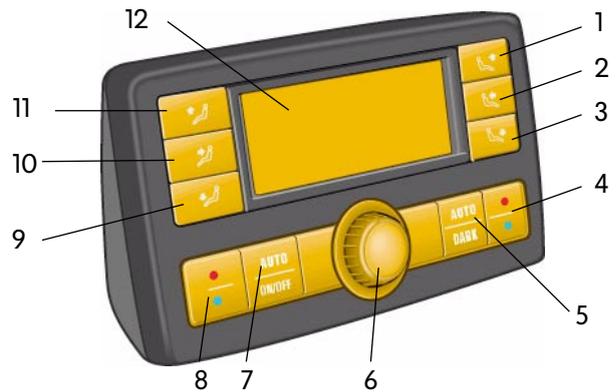
- 1 Vent flow restriction, centre rear right
- 2 Switch-over to seat control, front passenger's seat
- 3 Rear right seat setting
- 4 Rear right seat heater and ventilation
- 5 Rear right seat memory (2/3 positions and massage at 2 positions)
- 6 Rear left seat memory (2/3 positions and massage at 2 positions)
- 7 Rear left seat heater and ventilation
- 8 Rear left seat setting
- 9 Vent flow restriction, centre rear left



S272\_032

### Rear air conditioner/Climatronic operating and display unit (four-seater)

- 1 Rear right head vent
- 2 Rear right body vent
- 3 Rear right foot vent
- 4 Rear right manual temperature control
- 5 Rear right automatic control
- 6 Fan +/-
- 7 Rear left automatic control
- 8 Rear left manual temperature control
- 9 Rear left foot vent
- 10 Rear left body vent
- 11 Rear left head vent
- 12 Display



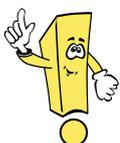
S272\_033



As regards operation of a retrofitted version, please consult the manual.

### Rear doors

- 1 Locking/unlocking doors



New!



S272\_035

# Dash panel insert

The dash panel insert is designed as a premium version with a 5" colour TFT screen (thin-film transistor) and a highline version with a 3" monochrome dot-matrix screen.



The top-of-the-range dash panel insert has the following functions:

## Analogue displays

- Speed (country-specific in kph, mph + kph, kph + mph)
- Engine speed
- Fuel gauge
- Coolant temperature (country-specific in °C/°F)
- Oil temperature (country-specific in °C/°F)
- Onboard power supply voltage (V)
- Odometer display (total distance driven, trip counter)

## 5" colour TFT screen

- The on-board computer can be switched to country-specific units
- Driving time
- Distance
- Average speed
- Average consumption
- Momentary consumption
- Ambient temperature/ice warning
- Remaining distance
- Maintenance due indicator
- Gear selection for automatic
- Alarm indications with pictograms
- Navigation/radio data
- APC displays
- Tyre pressure warning
- Lamp failure display

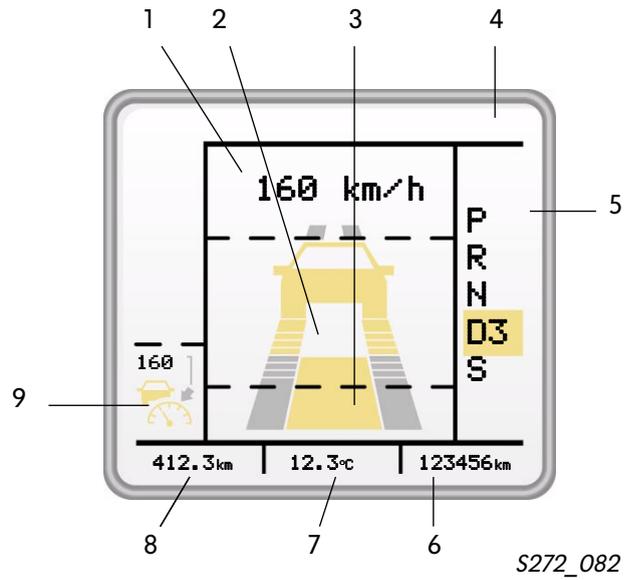
## Highline dash panel insert

- a 3" monochrome dot-matrix screen
- a clock with LC display in the rev counter
- a total distance driven and trip counter with LC display in the speedometer



## Layout of the display

- 1 Audio part display  
Warnings
- 2 Multi-function display  
Warnings  
Automatic proximity control main screen  
Voice input  
Navigation main screen  
Car phone  
Telematics  
Audio
- 3 Buttons of the multi-function steering wheel that can be activated  
APC part screen  
Audio list  
Car phone list  
Navigation: current road  
Warnings
- 4 Marker for warnings
- 5 Gear selection display
- 6 Total distance driven
- 7 Ambient temperature
- 8 Trip counter
- 9 Red symbol for APC



S272\_082

The display areas 1, 2 and 3 are assigned according to the priority of the displays to be shown.

### High, red warnings:

- Danger or cars down

### Medium, amber warnings:

- Messages

### Low:

- Information



# Dash panel insert

## Existing driver information

Driver information	Analogue display	Symbols	Text messages
ABS			
APC displays			e.g. APC defective
Airbag displays			e.g. airbag fault
Ambient temperature		12.3°C	
Onboard power supply voltage			Electrics: electrical equipment switch-off
Lack of brake fluid			e.g. brake fluid, stop vehicle!
Brake fault, EBD fault			e.g. brake fault, stop vehicle!
Brake wear			Check brake pads
Damper function			e.g. Sport
Damper fault			Fault
Dynamic oil warning			Oil pressure, engine off!
Engine speed			
EPC		EPC	
Ice warning			
ESP/TCS displays			
Turn indicator check, trailer			
Turn indicator check, left/right			
Main beam headlights			
Handbrake			Release handbrake!
Total distance driven		123456 km	
Speed			
Light bulb failure			e.g. check rear fog light
Light bulb failure, brake light			Please check brake light
ID sender 'Battery warning'			Key battery empty
ID sender not authorised (immobiliser)			Key not authorised
ID sender not detected			e.g. system fault, workshop!
Fuel gauge			
Lack of coolant			Lack of coolant
Coolant temperature			
Coolant overheating			Coolant overheating



Driver information	Analogue display	Symbols	Text messages
Charge control			Alternator, workshop
Steering wheel cannot be locked			Please move steering wheel
Steering wheel locked			Locking: press start/ stop for longer period
Steering defective			Steering defective, workshop
Headlight range control failure			Check headlight range control
Light warning			e.g. switch on side lights
Bonnet, doors, bootlid open, child-proof lock			
Fog lights			
Rear fog light			
Self-levelling function			e.g. vehicle lowering
Level, fault			Fault
Emergency start			Please start engine
EOBD			e.g. engine fault
Oil temperature			
Oil level too low			Check oil level
Oil level sensor defective			Oil sensor fault, workshop!
Tyre pressure control displays			e.g. tyre pressure control off
Key warning			Key not found
Shift lock			Press brake
Seat belt, driver			Driver: fasten seat belt
Trip counter		123.4km	
Fuel warning			Please refuel
Gear selection display		D3	
Place selector lever in position 'P'			Place selector lever in position 'P'
Service due indicators			e.g. Service now
Washer fluid level			Add washer fluid

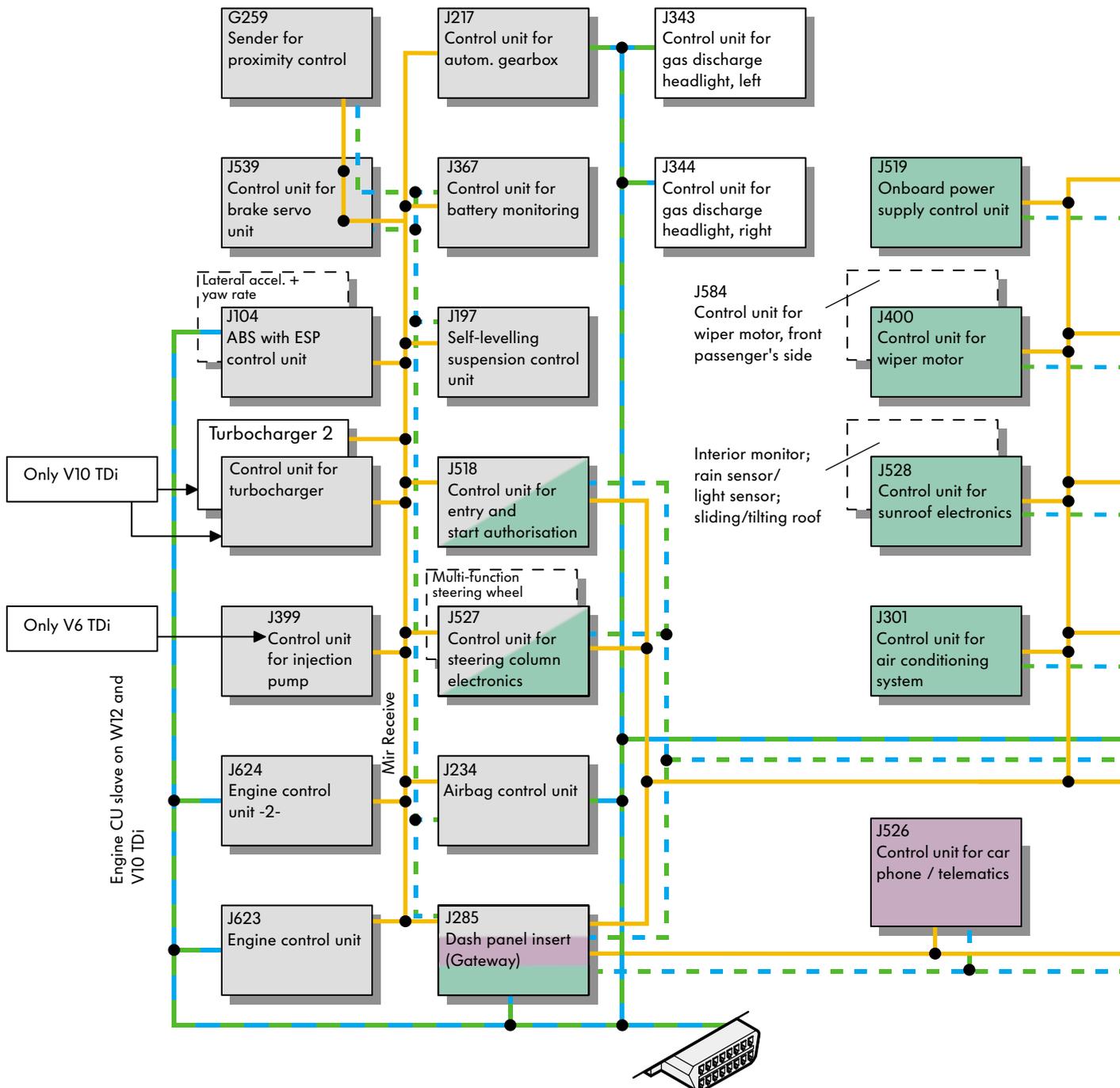


# Networking

## Databus topology

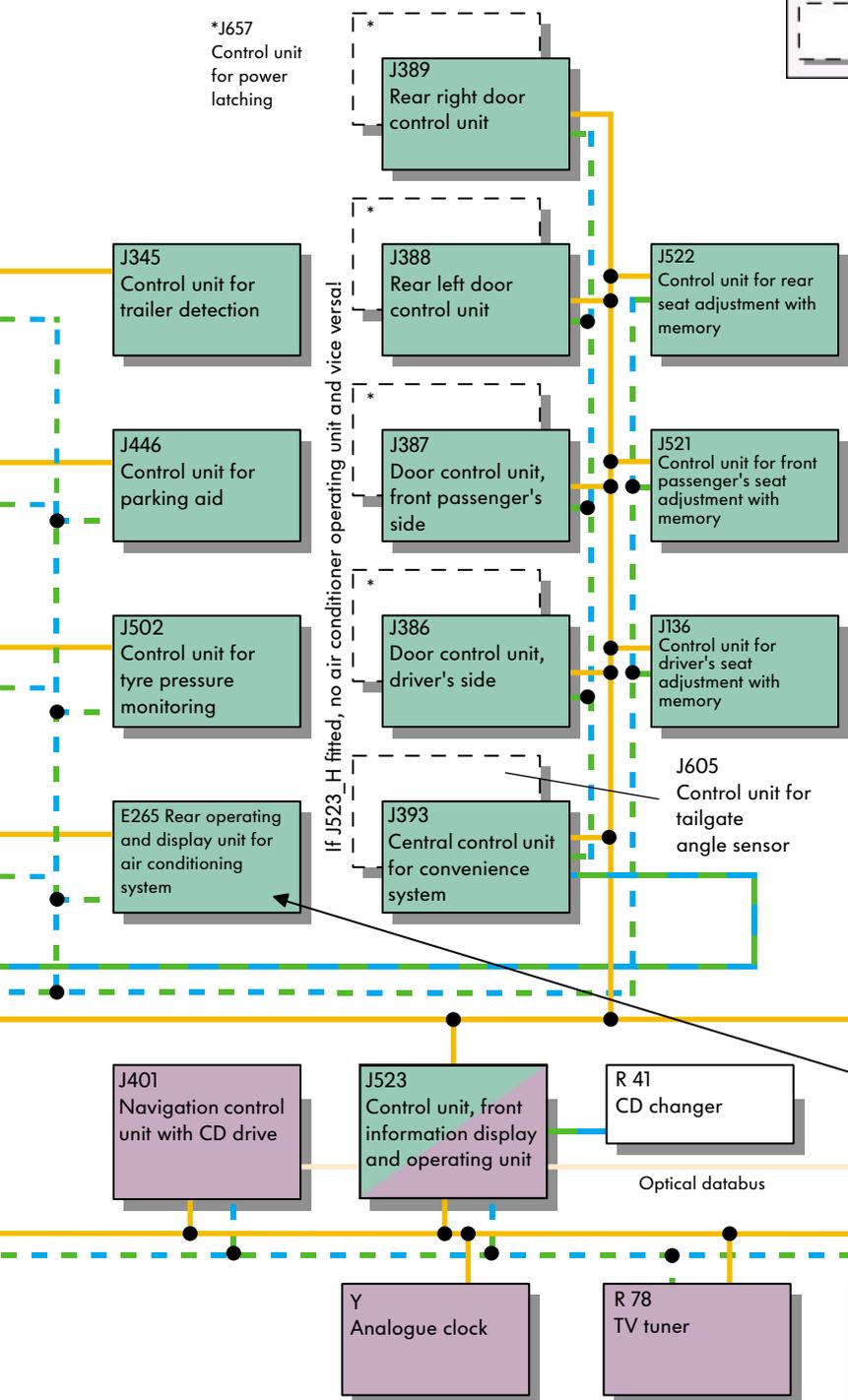
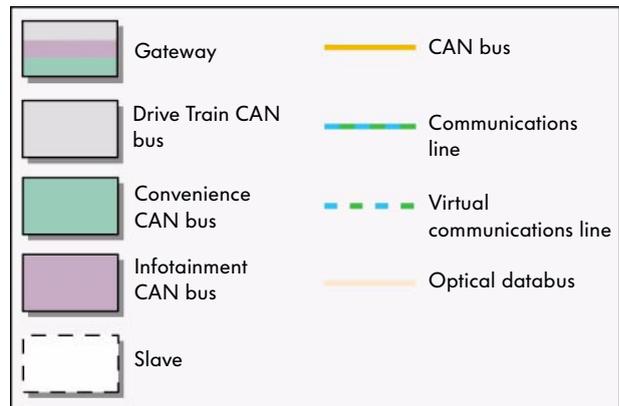
The databus system has been expanded to a great extent. It has three subsystems, the

- Drive Train CAN bus,
- Convenience CAN bus,
- Infotainment CAN bus.



## Diagnosis via the databus

The diagnosis via the communications line only takes place now in the case of a few control units in the Drive Train CAN bus subsystem, the gas discharge headlights and in the central control unit for the convenience system.



All other control units, except for the analogue clock, the control units for turbochargers 1 and 2, the injection pump and the control unit for trailer detection have a virtual communications line. Diagnosis is performed via the bus system. The control units send their diagnostic data via the gateway in the dash panel insert to the diagnostic testing and information system. In the case of a defective dash panel insert, no diagnosis of control units is possible using the virtual communications line.



The control unit for trailer detection as well as the analogue clock do not have self-diagnostic capability.

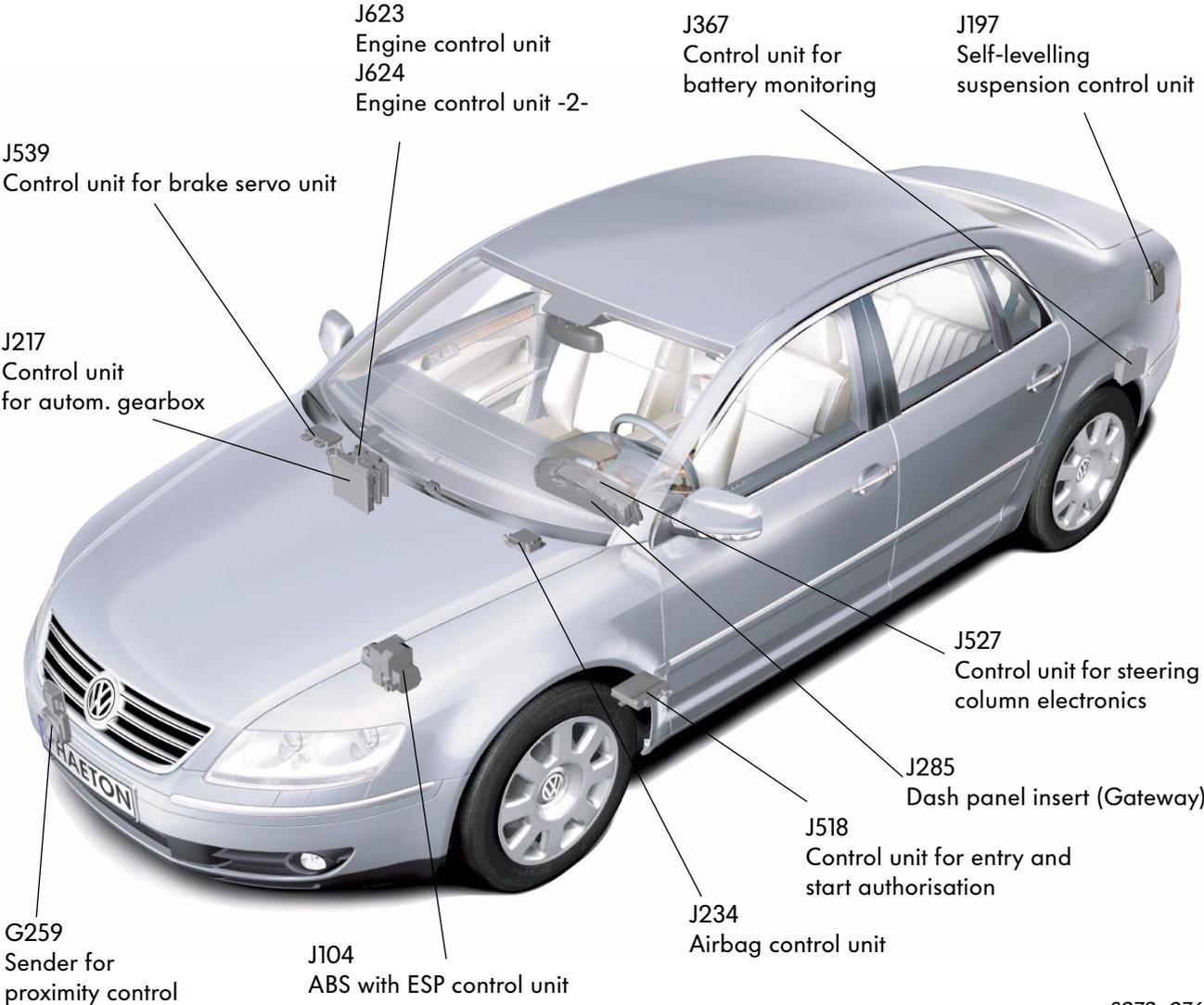


# Networking

## The control units in the Drive Train CAN bus

The Drive Train CAN bus operates at a data transfer rate of 500 kbit/s. The data is transmitted via the CAN High and CAN Low line.

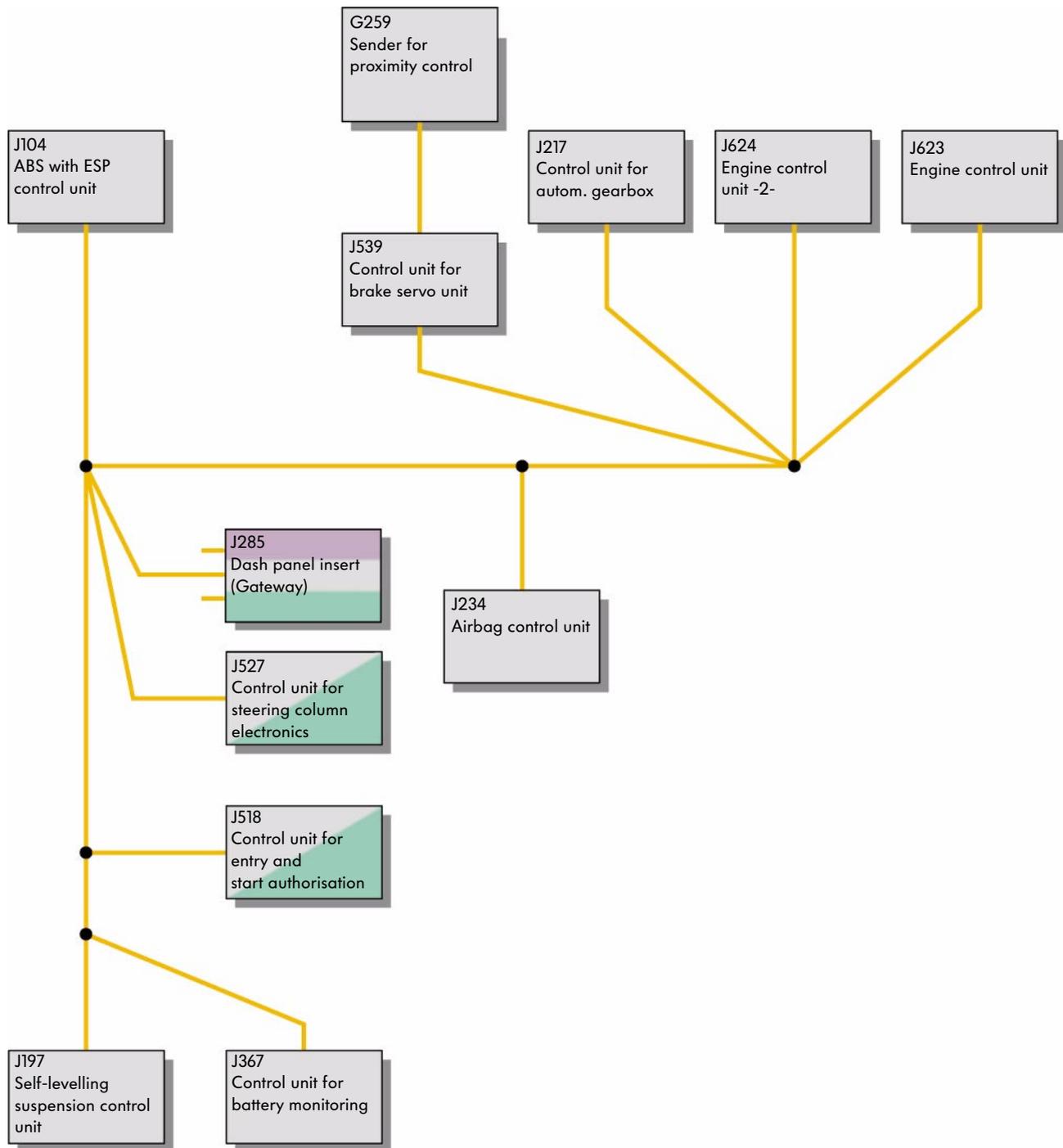
If one of these lines is defective, has a short circuit or an interruption, data transfer is no longer possible or only to a limited extent.



S272\_076

## Linking the Drive Train CAN bus

The control units are networked using a combination of linear and star-shaped links.



S272\_058



# Networking

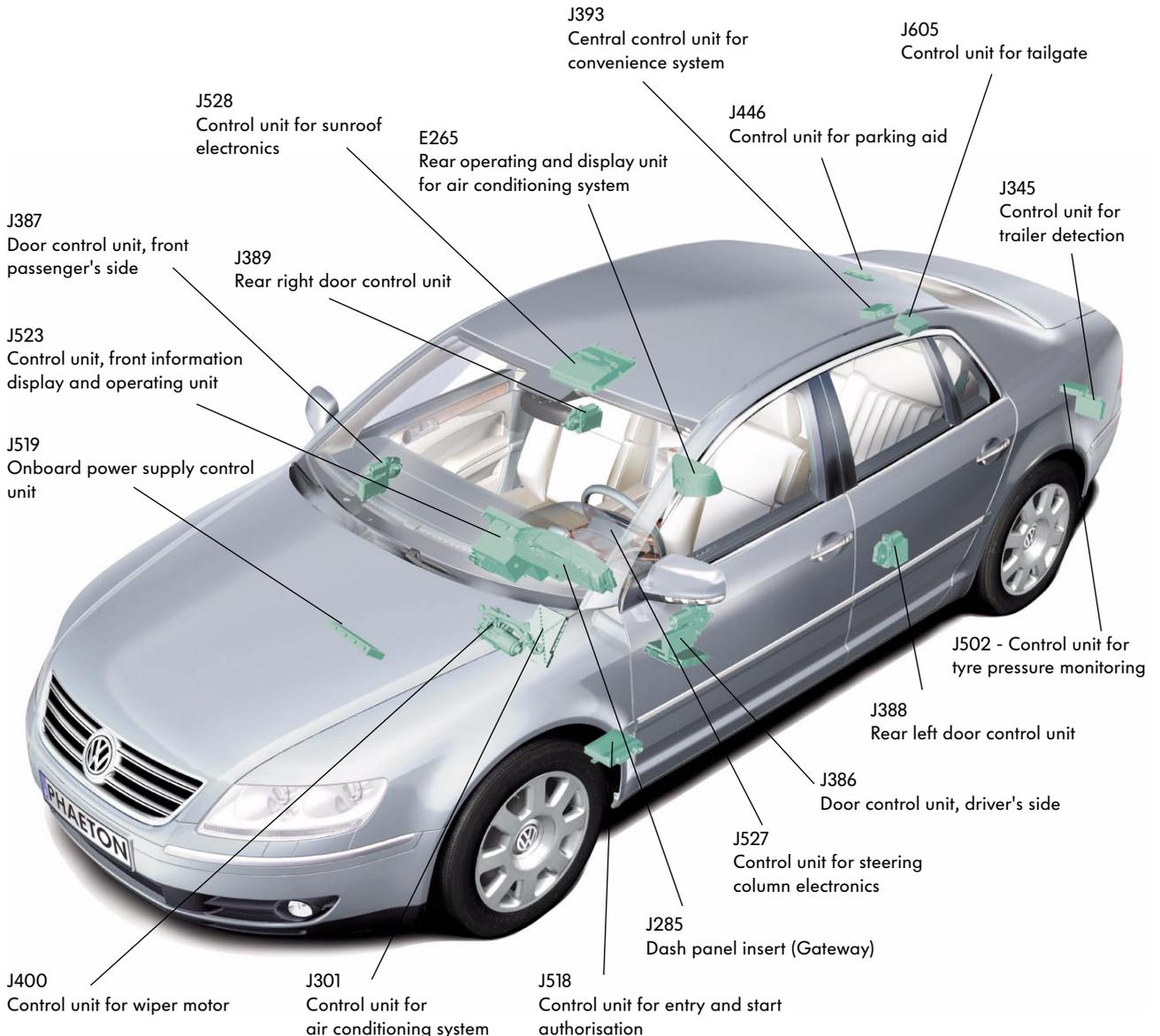
## Control units in the Convenience CAN bus

The Convenience CAN bus operates at a data transfer rate of 100 kbit/s.

Data is transmitted via the CAN High and CAN Low line.

If one of these lines is defective, has a short circuit or an interruption, data transfer is possible only via one line. The databus goes to single-wire mode.

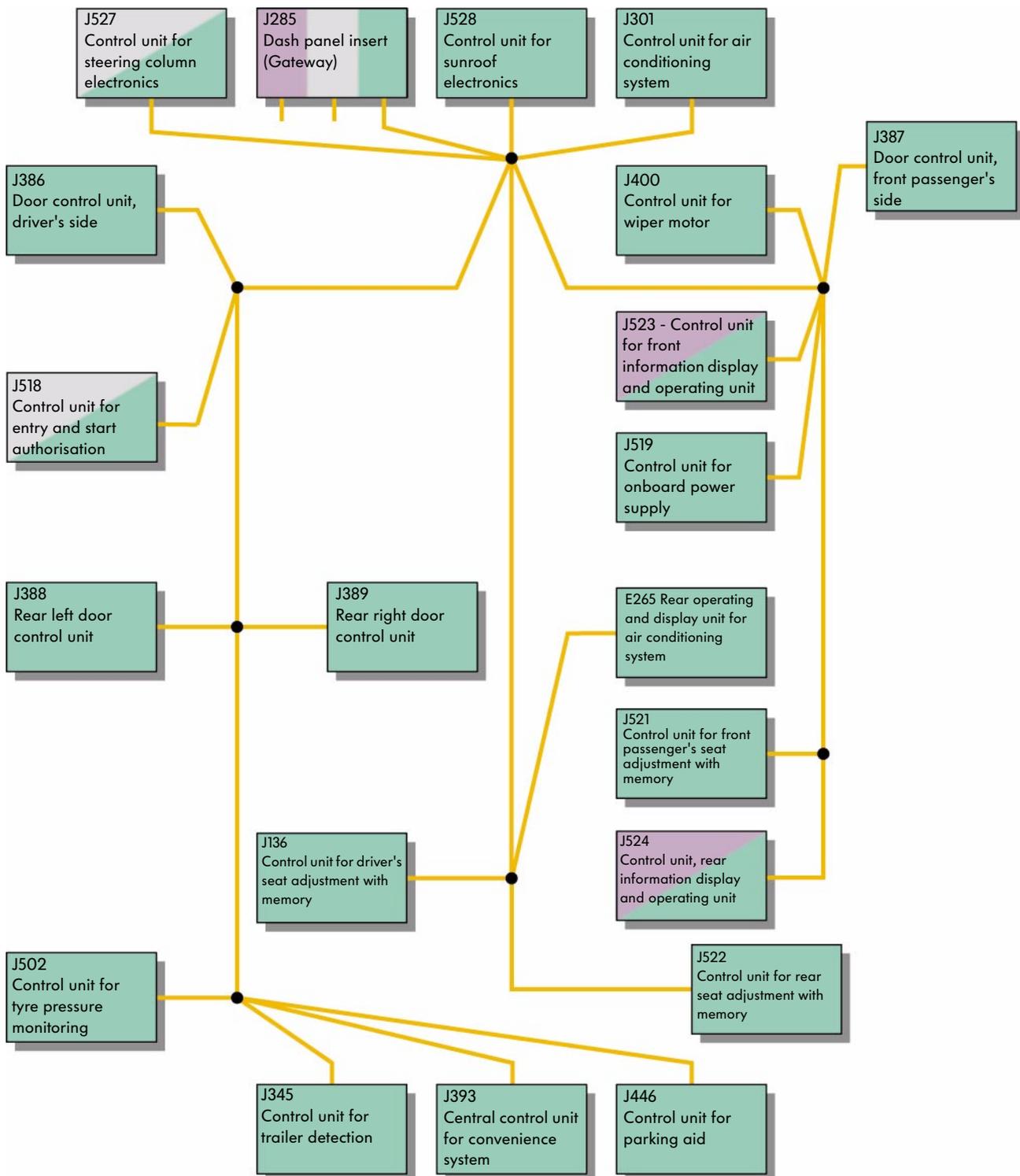
Various control units are designed as masters and communicate with their slaves via an internal data line to which only they have access. Slaves are executing control units that run the instructions from their master, e.g. switching on the wiper motor.



S272\_074

## Linking the Convenience CAN bus

The control units are networked using a combination of linear and star-shaped links.



# Networking

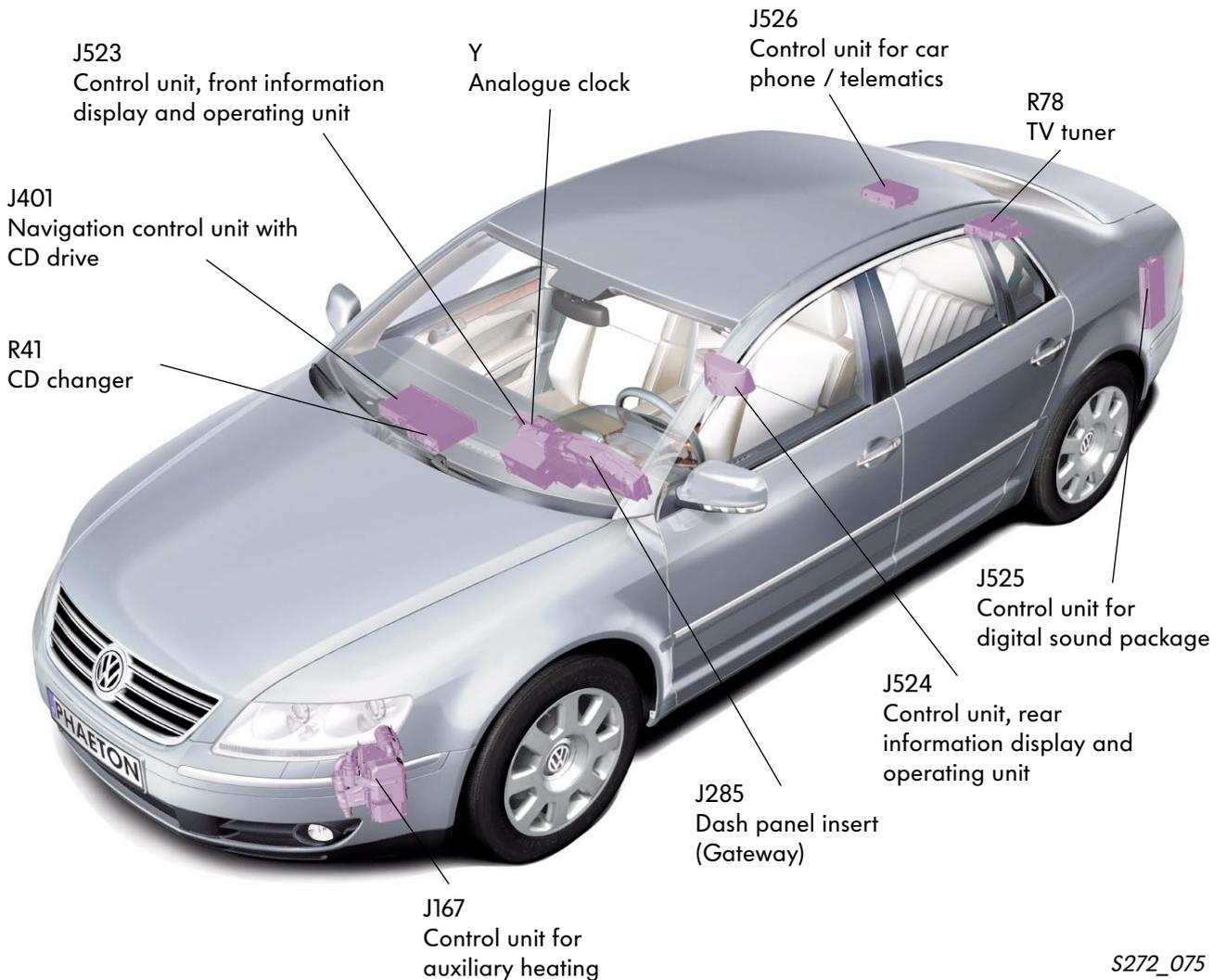
## Control units in the Infotainment CAN bus

The Infotainment CAN bus operates at a data transfer rate of 100 kbit/s.

The data is transmitted via the CAN High and CAN Low line.

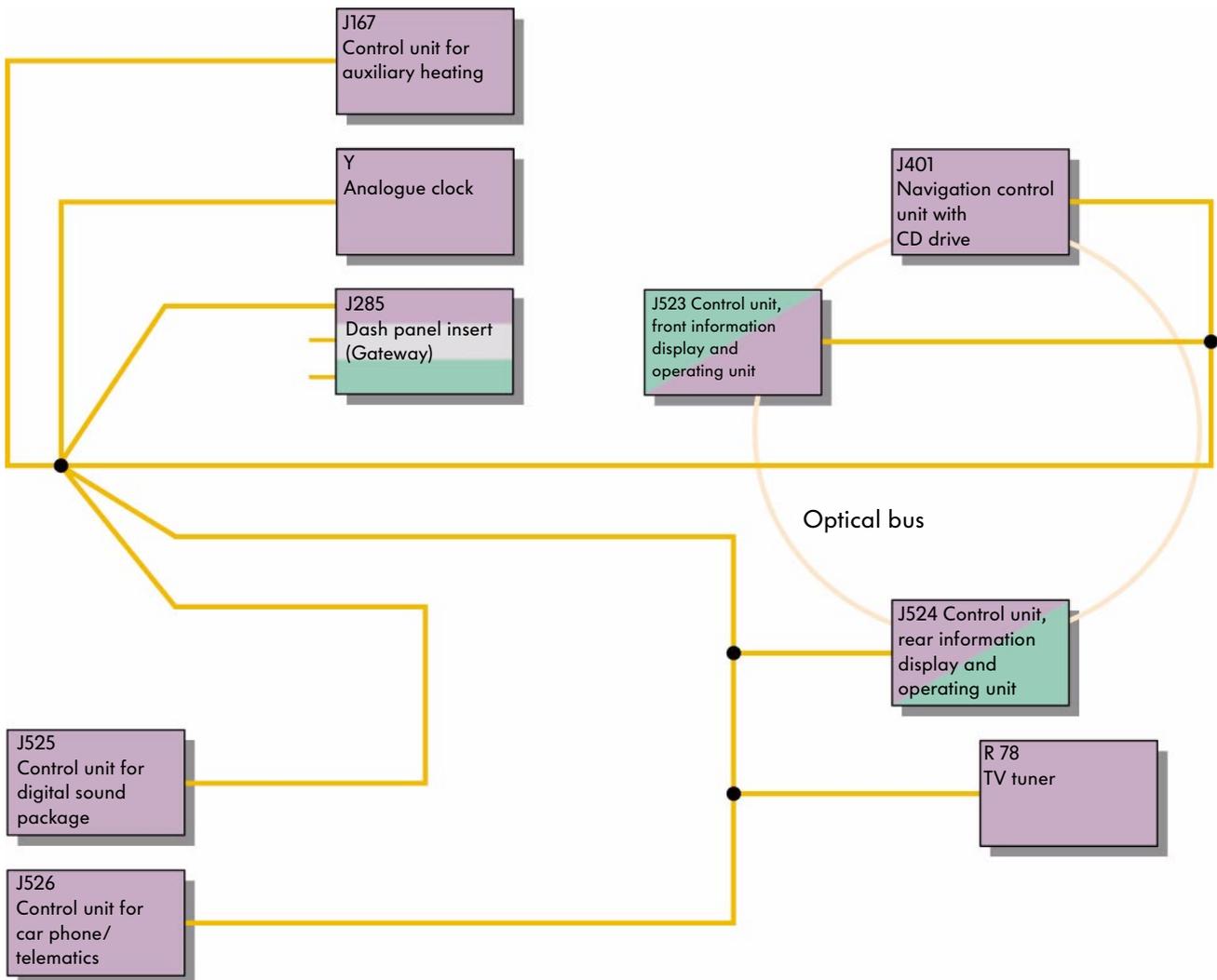
If one of these lines is defective, has a short circuit or an interruption, data transfer is possible only via one line. The databus goes to single-wire mode.

The front and rear control units, information display and operating units as well as the navigation control unit communicate with one another via an optical bus to which only they have access.



## Linking the Infotainment CAN bus

The control units are networked using a combination of linear and star-shaped links.



S272\_060



# Networking

## Optical databus

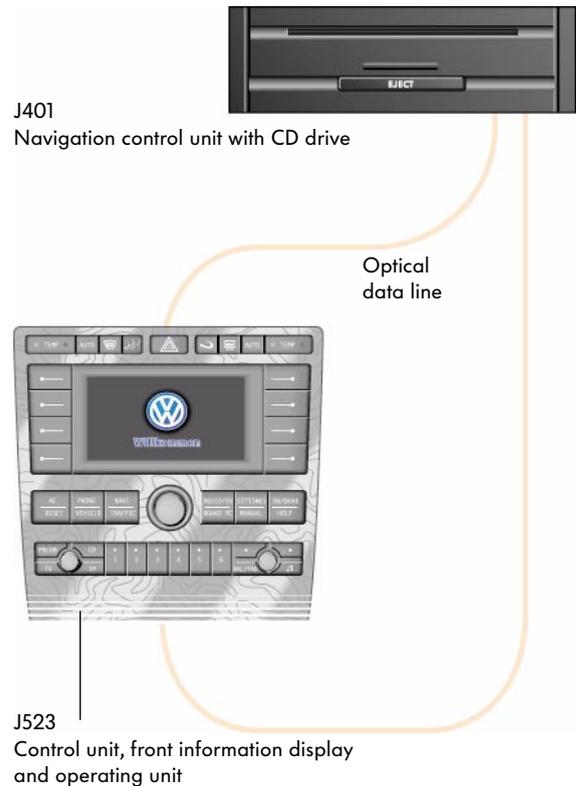
The front control unit, information display and operating unit as well as the navigation computer communicate with one another via an optical bus to which only they have access.

The optical databus operates at a data transfer rate of 11.2 Mbit/s. The available bandwidth is suitable for transmitting data from the navigation CD-ROM.

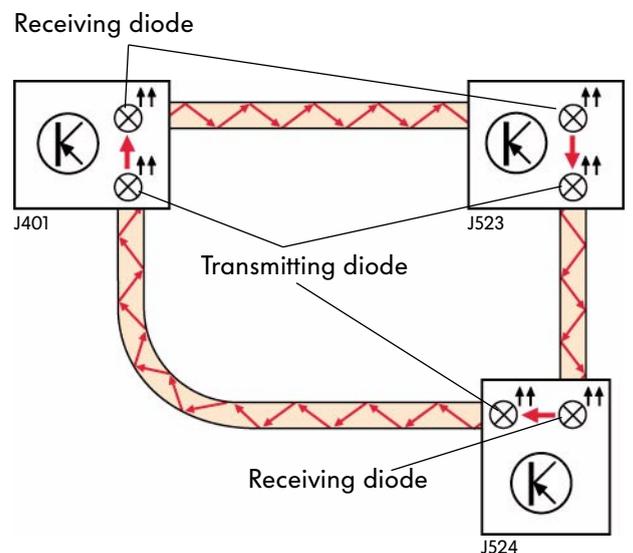
On the connection level, this optical bus system is based on a single polymer fibre-optic cable that connects all the devices in a ring topology.

The information is received via an optical receiving diode and is forwarded via a transmitting diode.

Due to the ring-shaped design, overall failure of the databus is unavoidable if one node is unable to pass on the information.



S272\_091



S272\_090

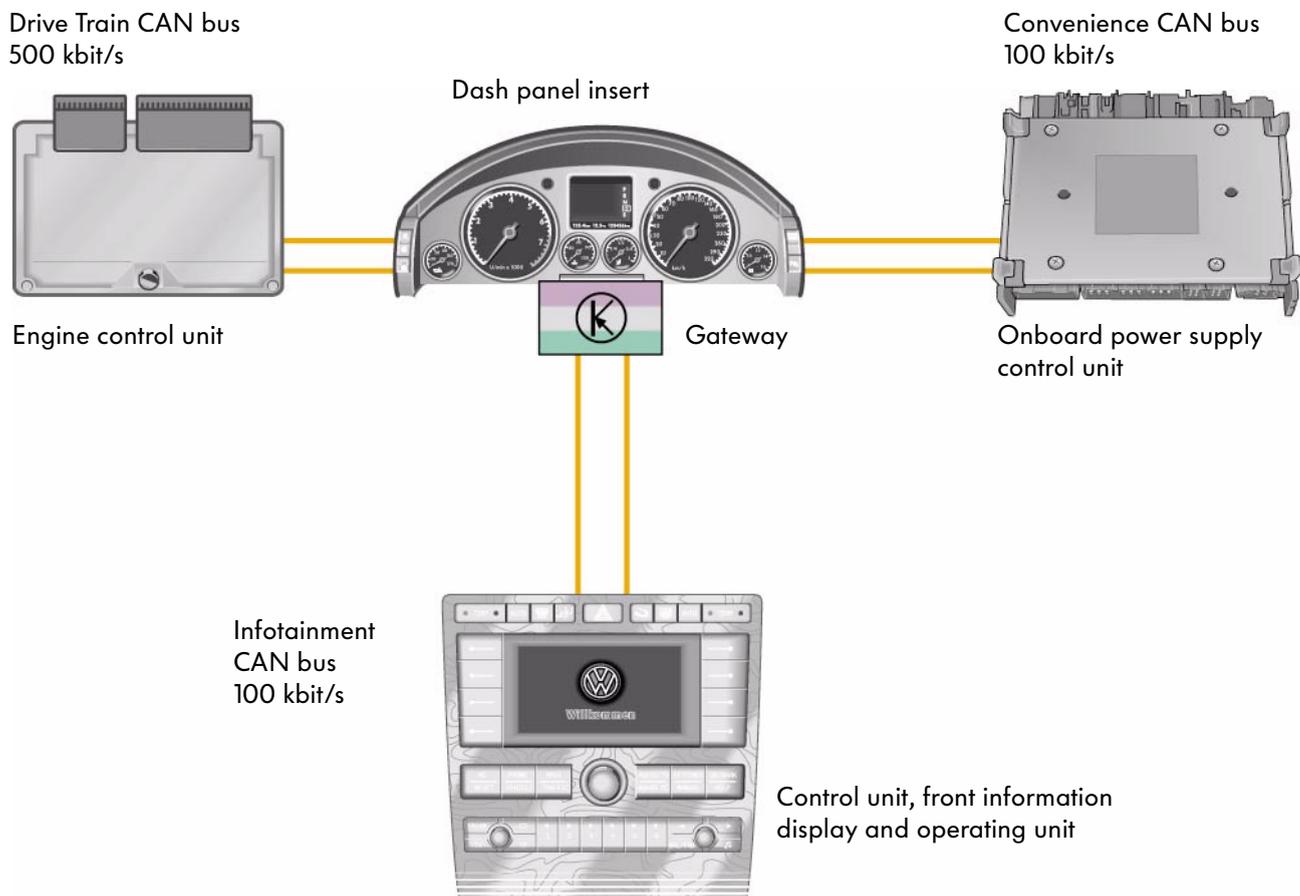


When laying fibre-optic cables, special care is necessary, as it is only possible to bend them up a maximum radius of 25 mm.

## Gateway

The gateway control unit is integrated in the dash panel insert as software; it controls communication traffic over the bus systems

- Drive Train,
- Convenience and
- Infotainment



S272\_066

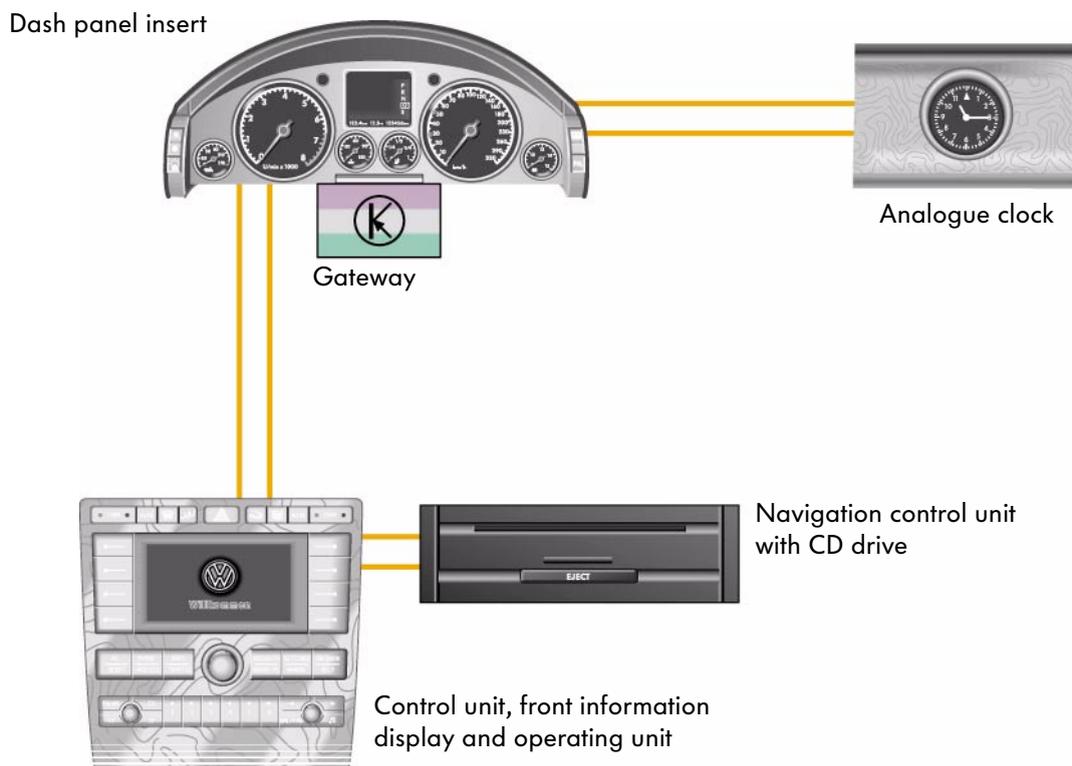


# Analogue clock

The high-quality analogue clock is integrated in the wood trim strip of the dash panel in the vehicle centre.

The time is set using the control unit for the front information display and operating unit. The signals are transmitted via the CAN bus.

In the case of vehicles with navigation system, the time is synchronised by the Global Positioning System (GPS) via the navigation computer.



S272\_067

## **CAN bus**

A large number of control units are required in today's motor vehicles. In order to implement their functions, data interchange among them is absolutely necessary. The conventional method of interchanging information via individual cable connections has reached its limits. The CAN bus connects the control units with two bi-directional data lines. Data transfer is digital.

## **Dot-matrix screen**

Numbers, letter and characters are shown on the screen as interrelated dots.

## **Electrical equipment required for starting**

Electrical equipment absolutely necessary for starting:

- Engine control unit
- Fuel pump
- Electronic ignition lock
- Dash panel insert
- Control unit for entry and start authorisation
- Airbag control unit

## **Global Positioning System**

This navigation system developed by the US Ministry of Defense makes world-wide navigation possible. With currently 24 to 27 satellites, the accuracy of position determination is ideally under 10 m.

## **Polymer fibre-optic cable**

This lead comprises fibre-optic cable, comparable with flexible Plexiglas, through which digital light signals can be transmitted for data transfer without loss. Fibre-optic cables are a modern transfer medium, operating on an optical basis. The data is transported by means of high-frequency light pulses.

## **TFT screen**

Thin Film Transistor screen, technology used for flat monitors; provides good contrast and a clear picture.



# Test your knowledge

---

## 1. What are the power management components?

- a) The starter battery, the onboard power supply control unit, the relay for parallel switching of batteries, the switch-over relay for starter battery, the switch-over relay for onboard power supply and the onboard power supply battery
- b) The starter battery, the control unit for battery monitoring, the relay for parallel switching of batteries, the switch-over relay for starter battery, the switch-over relay for onboard power supply battery and the onboard power supply battery
- c) The starter battery, the control unit for battery monitoring, the relay for parallel switching, the switch-over relay for starter battery, the main relay and the onboard power supply battery

## 2. Which statement is correct?

- a) In the case of vehicles with petrol engine and two-battery onboard power supply, both batteries are connected in series at temperatures below  $-20^{\circ}$ .
- b) In the case of vehicles with petrol engine and two-battery onboard power supply, both batteries are switched in parallel at temperatures below  $+5^{\circ}$ .
- c) In the case of vehicles with petrol engine and two-battery onboard power supply, both batteries are switched in parallel at temperatures below  $-10^{\circ}$ .

## 3. What functions are switched through the onboard power supply control unit?

- a) Parking lights, main beam headlights, central locking, dipped beam headlights
- b) Fog lights, side lights, indicator lights, footwell lights
- c) Horn, indicator lamp for hazard warning lights, relay for headlight washer system



**4. Which statement is correct with regard to switching off convenience electrical equipment in the case of a very critical onboard power supply?**

- a) Convenience electrical equipment is switched off by priority.
- b) Convenience electrical equipment is switched off depending on the amount of power consumption.
- c) Convenience electrical equipment is switched off in the order they were switched on.

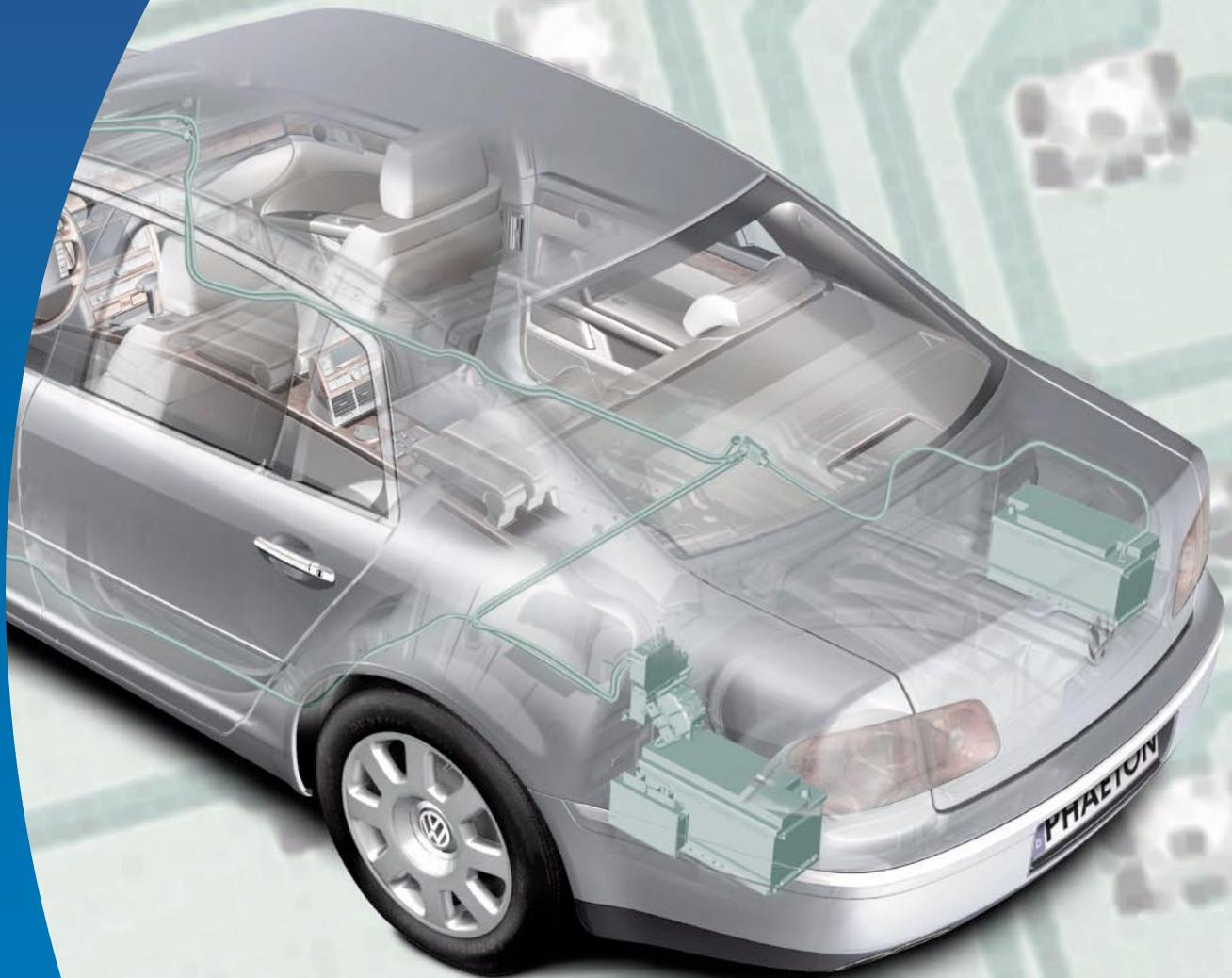
**5. Which control units are involved in turn indicator activation?**

- a) The steering column switching module, the control unit for entry and start authorisation, the onboard power supply control unit, the door control unit on the driver's and front passenger's side
- a) The steering column switching module, the control unit for entry and start authorisation, the indicator relay, the door control unit on the driver's and front passenger's side
- a) The control unit for entry and start authorisation, the onboard power supply control unit, the door control unit on the driver's and front passenger's side, the control unit for trailer detection

**6. Which control units belong to the Convenience CAN bus?**

- a) The gas discharge headlights, the control unit for entry and start authorisation, the control unit for sunroof electronics, the control unit for the air conditioning system
- b) The onboard power supply control unit, the control unit for battery monitoring, the control unit for the additional heating
- c) The control unit for trailer detection, the door control unit, the control unit for air conditioning system, the seat memory control units





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