



Self-study Programme 545

The Passat 2015 Electrical System

Design and function

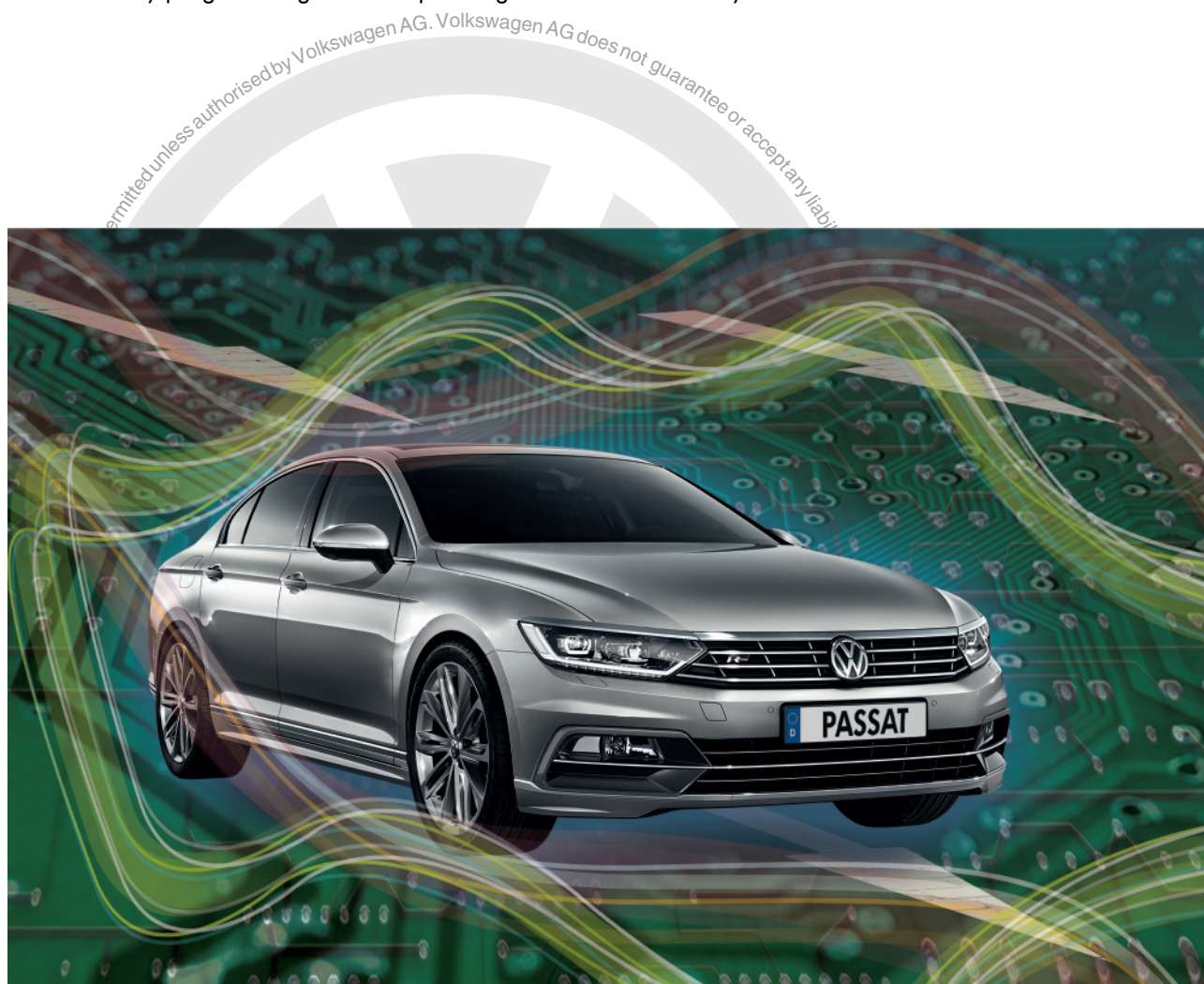


The eighth generation of the Passat is also now changing from the platform strategy to the modular transverse matrix MQB. MQB-B is the term referred to for the Passat (B-class) and allows for the differentiation of vehicle classes.

As a further development from the Golf class (MQB-A), the Passat plays host to state-of-the-art technical automotive innovations, such as:

- the Active Info Display (AID) dash panel insert
- LED headlight technology in conjunction with Dynamic Light Assist (DLA)

This self-study programme gives a deeper insight into the electrical system of the Passat 2015.



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**The self-study programme shows the design and function of new developments.
The contents will not be updated.**

For current testing, adjustment and repair instructions, refer to the relevant service literature.



**Important
note**

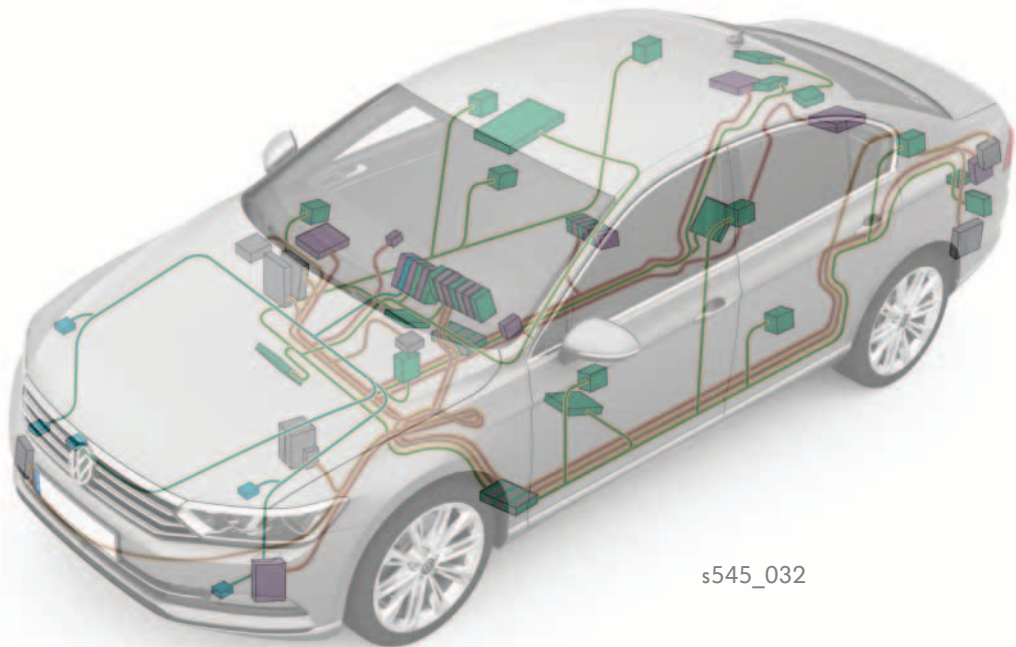
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Introduction

The electronics in the vehicle

While, even up to a few years ago, electronics were employed in places only where it was absolutely essential in physical terms, e.g. in ignition systems and engine management systems, the situation has progressively changed. Many purely mechanical systems have become technical innovations owing to their enhancement with electronics and electronics (such as the electromechanical parking brake). For example, the latest generation of Passat, equipped to the highest level, currently features 68 control units. To network this multitude of control units, the following data buses are used: CAN, LIN and MOST.



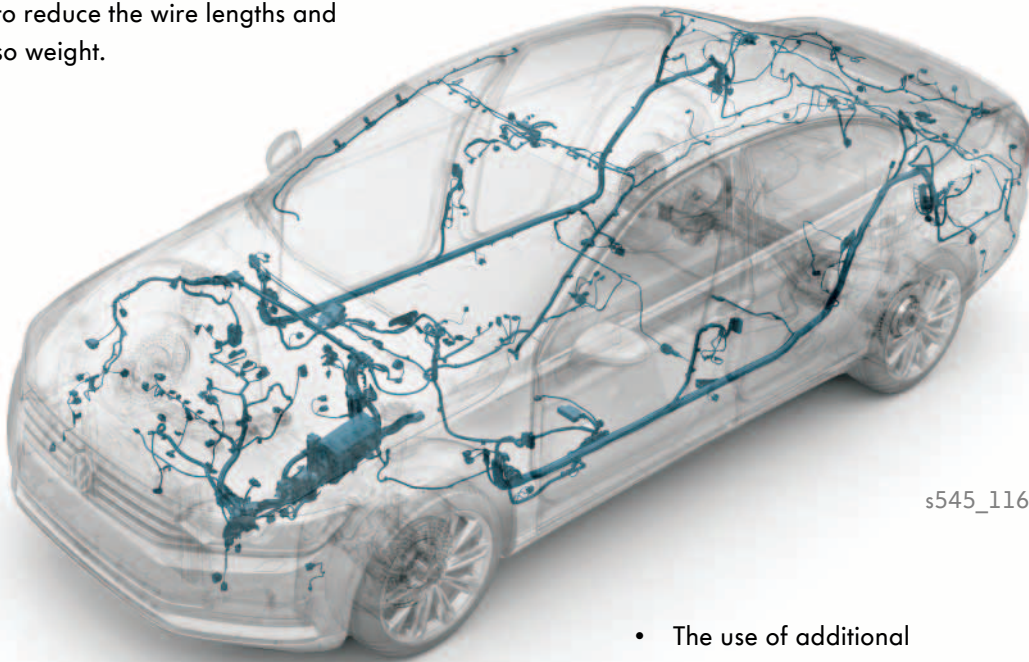
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The control units and other networked components are not connected to the same data buses in every model. In fact, the data buses are designed for each specific model to cater for bus capacity utilisation and the exchange of messages.

Lightweight features of the electrical system

To develop the new Passat specifically with CO₂ savings in mind, various measures were implemented in the electrical system to reduce weight. A saving of up to 3kg was achieved by the measures described in the overview:

- Control unit installation positions have been optimised to reduce the wire lengths and thereby also weight.
- Lighter materials are used (e.g. aluminium wiring).



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- Wiring made from a copper-magnesium alloy with a smaller cross section (0.13mm^2) is used for certain sections.
- The use of additional LIN buses means less wiring.

Overview of the electrical system

Depending on the equipment level, an alternator with an output of either 140A or 180A and the following battery types are used in the Passat 2015:

- Lead-acid battery
- EFB (Enhanced Flooded Battery)
- AGM (Absorbent Glass Matt)

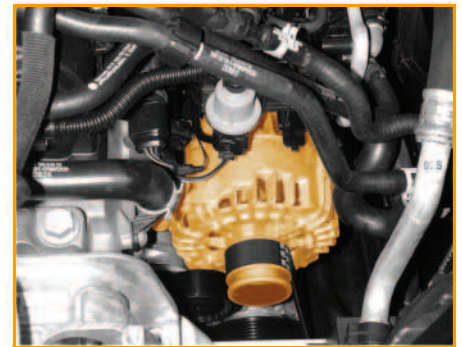
Also, depending on the equipment and power unit, the 12V battery is installed in the engine compartment or the luggage compartment.

The „front battery” supply concept

Three fuse holders distribute the current in the vehicle:

- a non-divided multifuse pre-fuse holder SA in the engine compartment electronics box
- a relay and fuse holder SB in the engine compartment electronics box
- a relay and fuse holder SC at the bottom left of the passenger compartment, behind the storage compartment

Alternator



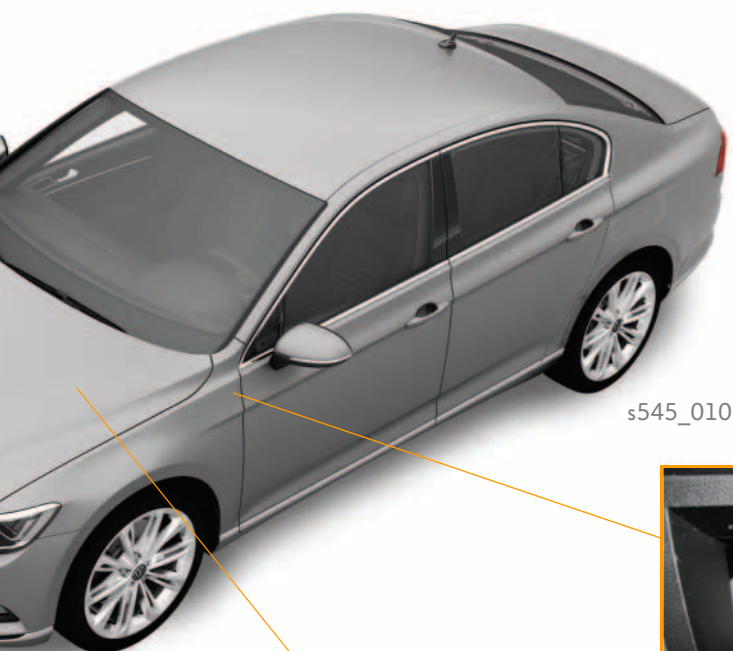
Electronics box with relay and fuse holder SB and multifuse pre-fuse holder SA



Non-divided multifuse pre-fuse holder SA



To find out the precise location of various fuses and relays, please refer to the relevant current flow diagram in ElsaPro (electronic service information system, professional).



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12V battery in engine compartment



Relay and fuse holder SC at the bottom left of the passenger compartment, behind the storage compartment

Overview of the electrical system

The „rear battery” supply concept

Due to limited space, the 12V battery is installed in the luggage compartment in vehicles with 7-speed dual clutch gearbox DQ500, special vehicles and vehicles with an auxiliary heater.

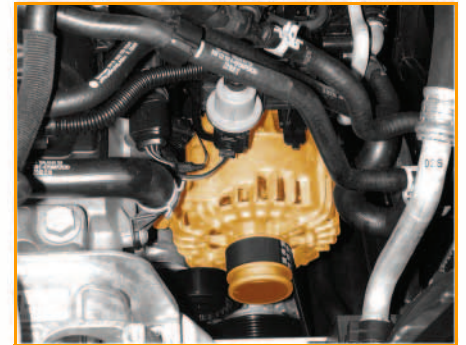
The battery is fitted in the luggage compartment on the left behind a trim panel.

Four fuse holders distribute the current in the vehicle:

- a divided multifuse pre-fuse holder SA in the engine compartment electronics box
- a relay and fuse holder SB in the engine compartment electronics box
- a relay and fuse holder SC at the bottom left of the passenger compartment, behind the storage compartment
- fuse holder SD in the main fuse box on the battery

The battery isolator switch J990 is also installed in the main fuse box. The electrical supply to the high-current consumers in the engine compartment is permanently disconnected by the battery isolator switch J990 when an airbag is deployed. Only the ABS control unit J104, the power steering control unit J500 and the consumers in the passenger compartment (fuse carrier SC) are still supplied with current. This means that the vehicle can still be steered, the brake functions remain intact and the vehicle can be exited.

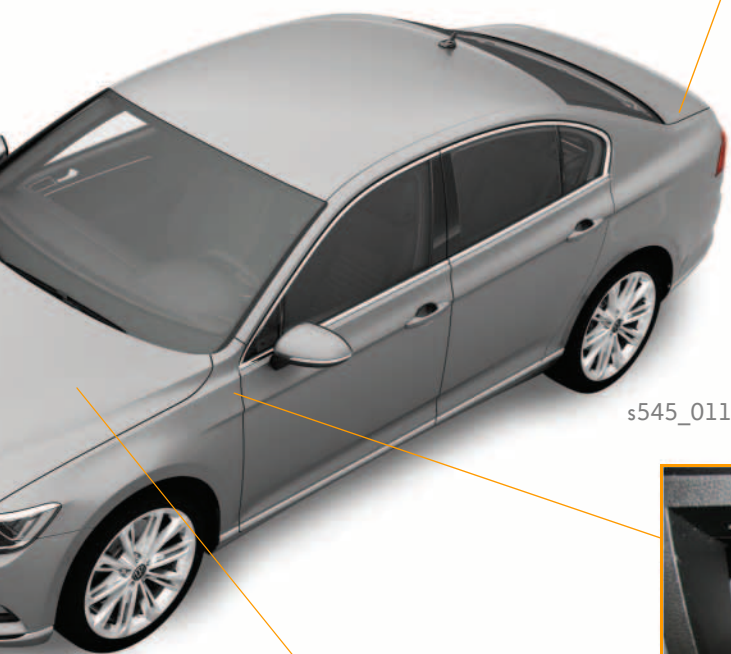
Alternator



Electronics box with relay and fuse holder SB and multifuse pre-fuse holder SA



Divided multifuse pre-fuse holder SA



12V battery in luggage compartment with main fuse box



Main fuse box with fuse holder SD, positive battery terminal clamp and battery isolator switch J990

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Relay and fuse holder SC at the bottom left of the passenger compartment, behind the storage compartment



Jump starting point

ability with respect to the correctness of information in this

Networking concept

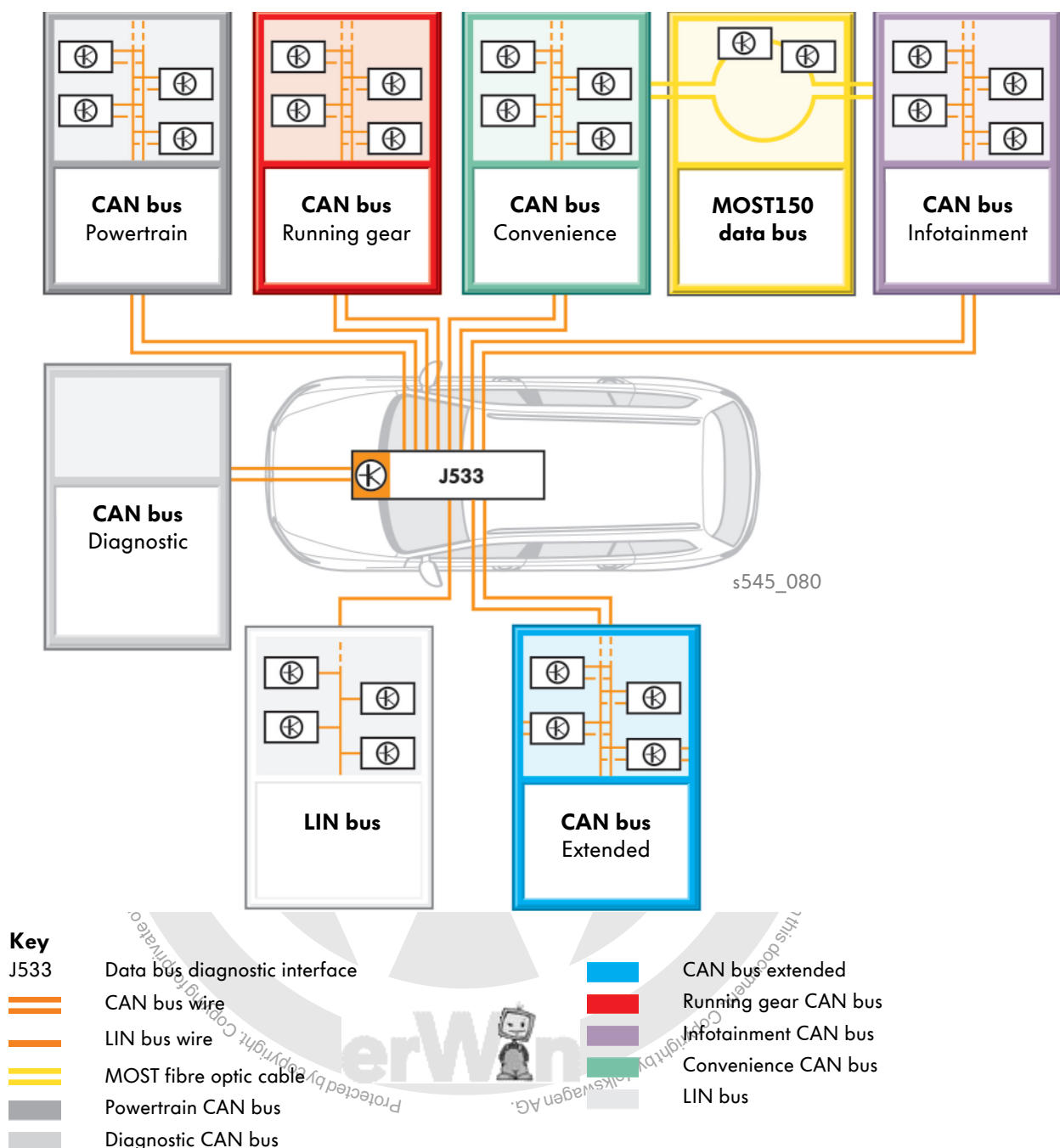
Overview of the data bus systems used

The networking concept is based on the MQB and has been enhanced for the Passat 2015 (MQB-B).

All CAN buses in the Passat 2015 have a transmission rate of 500 kbit/s.

The LIN bus rate is 19.2 kbit/s. The MOST150 data bus with fibre-optic technology and a transfer rate of 150 Mbit/s is new to the Passat. The data bus diagnostic interface J533 contains the control system for several LIN buses and forms the link between the individual CAN bus systems as usual.

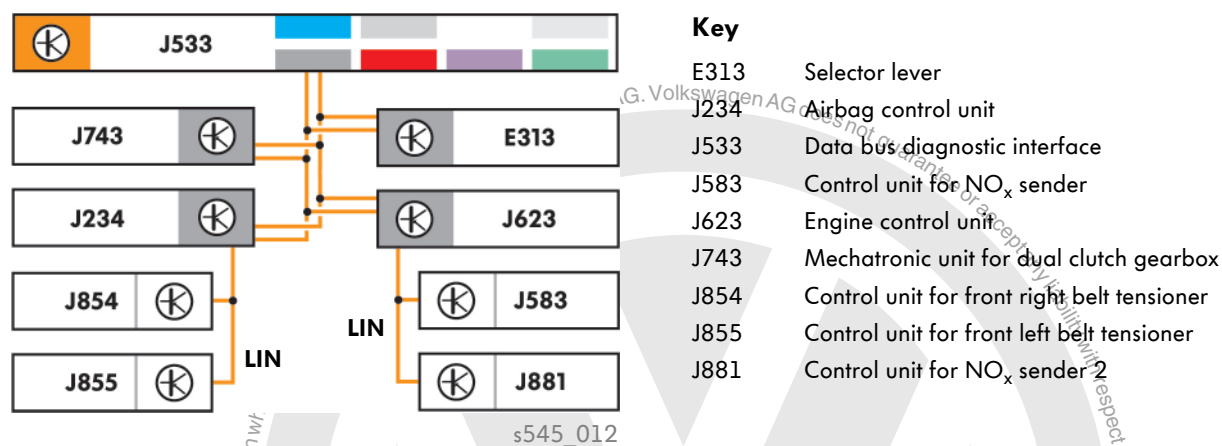
Further LIN buses are connected to various control units.



The CAN buses

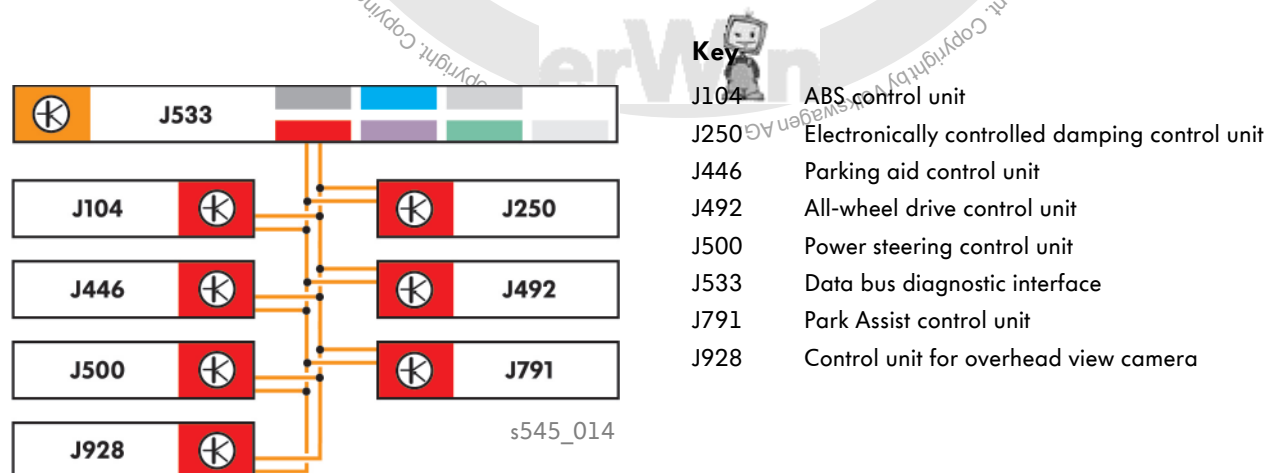
Powertrain CAN bus

To allow for the rising number of control units, several of the control units in the Passat that were previously networked in the powertrain CAN bus have been moved to different CAN buses, e.g. J104 and J500.



Running gear CAN bus

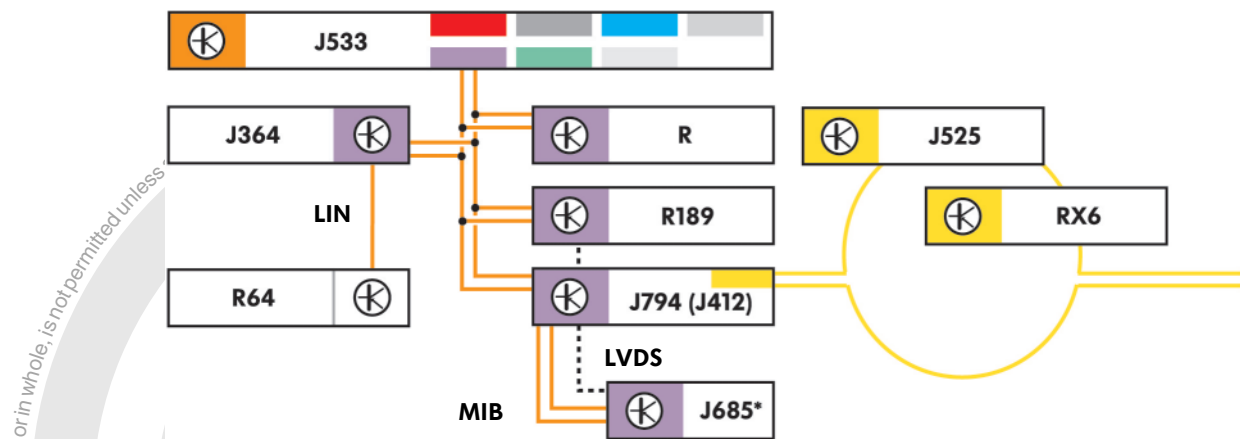
As with the Golf 2013, the Passat 2015 has a separate running gear CAN bus, which connects all control units relevant to the running gear both with each other and with the rest of the vehicle networks.



Networking concept

Infotainment CAN bus

The reversing camera is connected directly to the infotainment CAN bus. The image processing control unit in the Passat is part of the reversing camera R189.



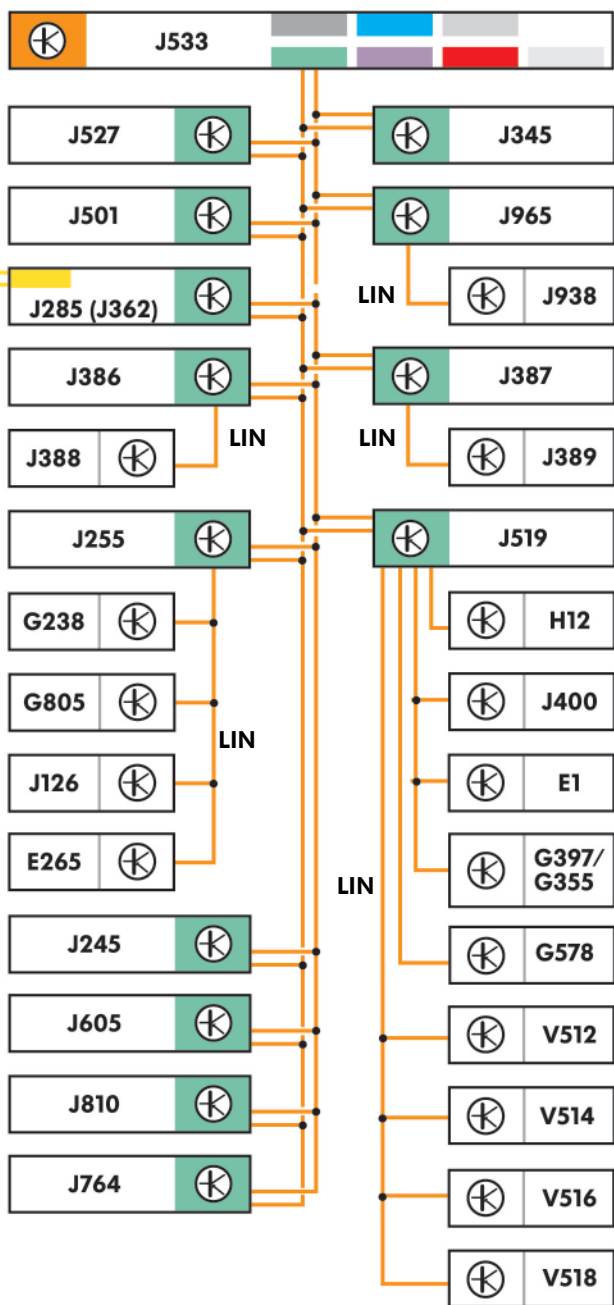
MOST150 data bus

The MOST connection is used for rapid multimedia data transfer, predominantly image, video and audio data, via a fibre optic cable. Transferring data with the aid of fibre optic cables enables a data transfer rate of 150 Mbit/s. On the optical MOST bus, data is exchanged between the following participating components: control unit in dash panel insert J285 (only with the Active Info Display dash panel insert), digital sound package control unit J525, digital TV tuner R171 and control unit for information electronics J794. The control unit 1 for information electronics J794 is the master of the MOST bus ring.

Key	
J364	Auxiliary heater control unit
J412	Mobile telephone operating electronics control unit
J525	Digital sound package control unit
J533	Data bus diagnostic interface
J685	Display unit for front information display and operating unit control unit (except R and J685 on MIB CAN)
J794	Control unit for information electronics
R	Radio
R64	Remote control receiver for auxiliary heating
RX6	TV tuner
R189	Reversing camera
MIB	CAN bus for the modular infotainment matrix
LVDS	Low-voltage differential signalling
*	on MIB CAN

Convenience CAN bus

Since the number of control units has increased, particularly on the convenience CAN bus, numerous systems have been combined into separate LIN buses. Among these is the rotary light switch E1 as a new LIN bus addition.



Key

E1	Light switch
E265	Operating and display unit for rear air conditioning system
G238	Air quality sensor
G355	Humidity sender
G397	Rain and light sensor
G578	Anti-theft alarm sensor
G805	Pressure sender for refrigerant circuit
H12	Alarm horn
J126	Fresh air blower control unit
J245	Sliding sunroof adjustment control unit
J255	Climatronic control unit
J285	Control unit in dash panel insert
J345	Trailer detector control unit
J362	Immobiliser control unit
J386	Driver door control unit
J387	Front passenger door control unit
J388	Rear left door control unit
J389	Rear right door control unit
J400	Wiper motor control unit
J501	Multifunction unit control unit
J519	Onboard supply control unit
J527	Steering column electronics control unit
J533	Data bus diagnostic interface
J605	Rear lid control unit
J764	Control unit for electronic steering column lock
J810	Driver seat adjustment control unit
J938	Rear lid power opening control unit
J965	Interface for access and start system
V512	Front left seat backrest fan 1
V514	Front left seat cushion fan 1
V516	Front right seat backrest fan 1
V518	Front right seat cushion fan 1

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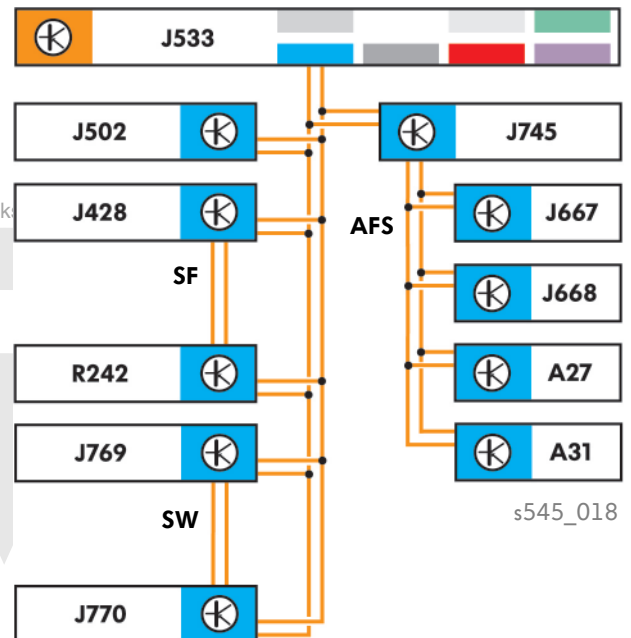
Networking concept

CAN bus extended

The majority of the control units allocated to the driver assist systems are combined on the CAN bus extended.

Key

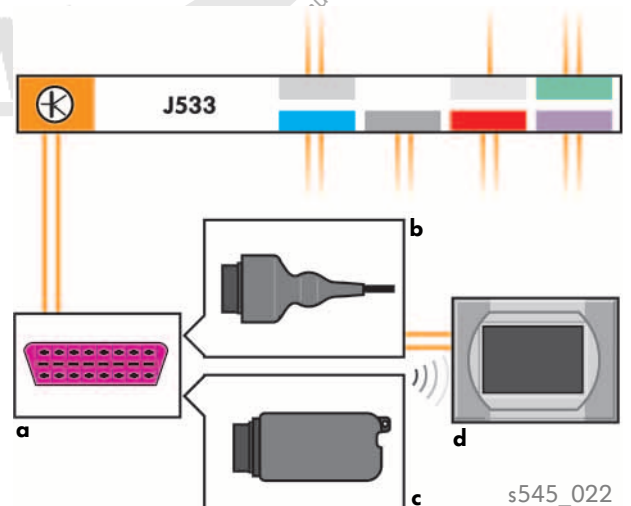
A27	Output module 1 for right LED headlight
A31	Output module 1 for left LED headlight
J428	Adaptive cruise control unit
J502	Tyre Pressure Monitoring System control unit
J533	Data bus diagnostic interface
J667	Output module for left headlight
J668	Output module for right headlight
J745	Control unit for cornering light and headlight range control
J769	Lane change assist control unit
J770	Lane change assist control unit 2
R242	Front camera for driver assist systems
AFS	Cornering light CAN bus
SF	Sensor fusion CAN bus
SW	Lane change CAN bus



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Diagnostic CAN bus

The diagnostic CAN bus ensures unique and fast communication between the external vehicle diagnostic tester and the electronic vehicle systems using the data bus diagnostic interface J533. Depending on the vehicle diagnostic tester, the data bus diagnostic interface can be connected either the usual way using a cable to the vehicle diagnostic connector or wirelessly. The diagnostic connection in the vehicle is found in the left footwell, below the relay and fuse carrier.



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Key

J533	Data bus diagnostic interface
a	Vehicle diagnostic connection
b	Diagnostic cable

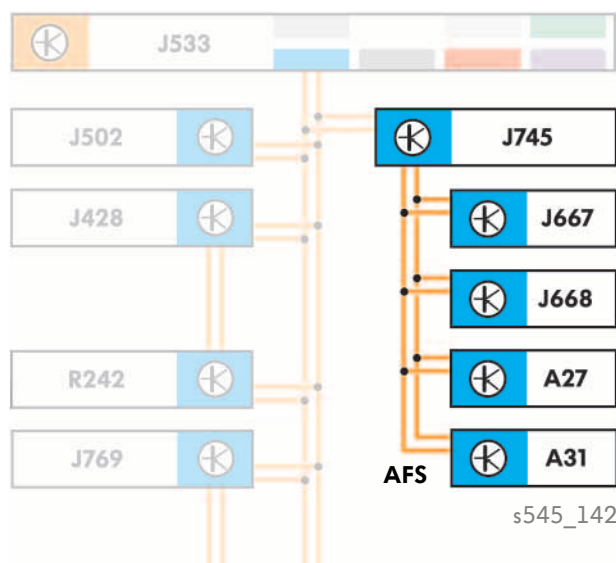
c	Connection adapter for wireless connection
d	Suitable diagnostic unit

CAN bus sub-networks

Given the rising number of control units, it is now necessary to apply individual network areas of a CAN bus as independent sub-networks that are subordinate to the respective data bus.

This reduces the flow of data on the higher-level data bus and makes fast data transmission, involving only the relevant control units, easier.

Cornering light CAN bus



The cornering light CAN bus is a separate network that is subordinate to the CAN bus extended and is only employed with the installation of LED headlights „High”.

The cornering light CAN bus combines the control unit for cornering light and headlight range control J745 with the output modules J667/J668 and A27/A31.

From this connection, data transfer ensues in connection with:

- actuation of the LED multichips for the surround lighting, dipped beam and main beam (A27/A31)
- regulation of the control motors for headlight range control
- the dynamic cornering light (J667/668)

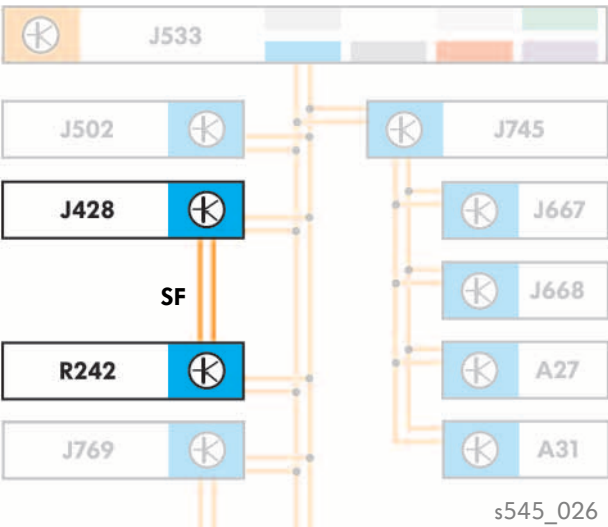
Key

A27	Output module 1 for right LED headlight
A31	Output module 1 for left LED headlight
J667	Output module for left headlight
J668	Output module for right headlight
J745	Control unit for cornering light and headlight range control
AFS	Cornering light CAN bus

Networking concept

Sensor fusion CAN bus

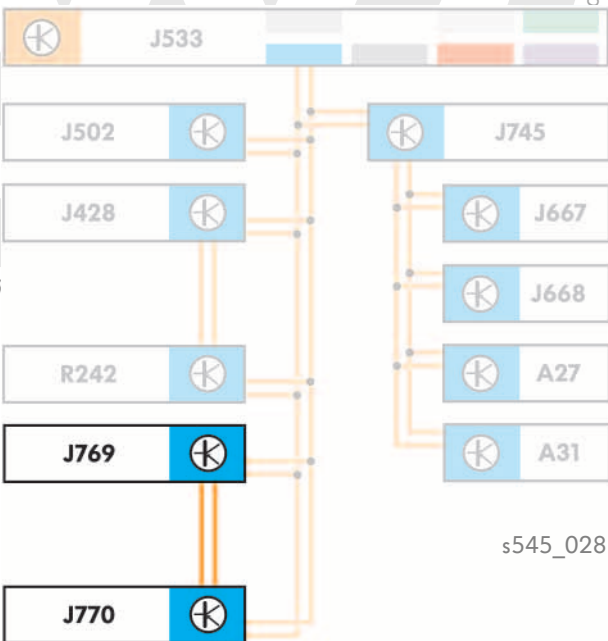
The sensor fusion CAN bus is a subordinate sub-network within the CAN bus extended. The front camera for driver assist systems R242 communicates directly with the adaptive cruise control unit J428 using the CAN bus to ensure fast and fault-free data transmission. J428 and the camera R242 are also connected directly to the CAN bus extended.



- Key**
- J428 Adaptive cruise control unit
 - R242 Front camera for driver assist systems
 - SF Sensor fusion CAN bus

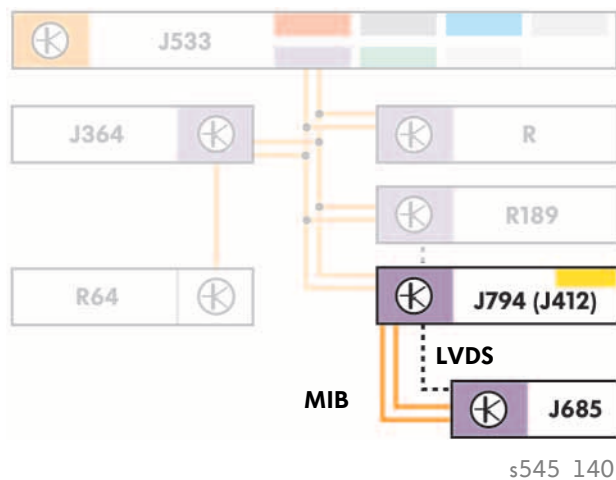
Lane change CAN bus

The lane change CAN bus is a subordinate sub-network within the CAN bus extended. The lane change assist control unit J769 uses the lane change CAN bus to communicate directly with lane change assist control unit 2 J770 to ensure fast and fault-free data transmission. In addition, both control units are also connected directly to the CAN bus extended.



- Key**
- J769 Lane change assist control unit
 - J770 Lane change assist control unit 2

MIB CAN bus



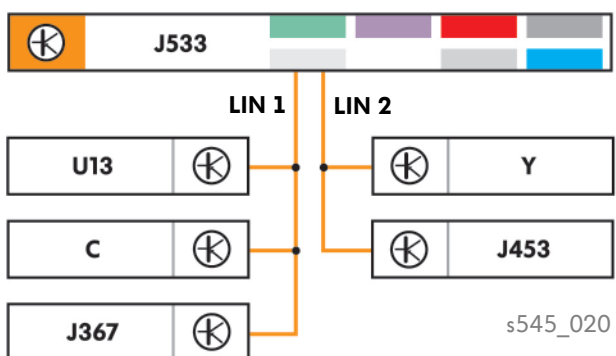
The control signals and operating commands are exchanged between the control unit 1 for information electronics J794 and the display unit for front information display and operating unit control unit J685 using the CAN bus MIB (modular infotainment matrix). Image, audio and information data are communicated between these two control units via the LVDS wire.

Key

J412	Mobile telephone operating electronics control unit
J685	Display unit for front information display and operating unit control unit
J794	Control unit for information electronics

MIB	CAN bus for the modular infotainment matrix
LVDS	Low-voltage differential signalling

LIN bus on the data bus diagnostic interface J533



Two separate LIN buses are connected to the data bus diagnostic interface. The diagnostics interface is the master for the two LIN buses.

Key

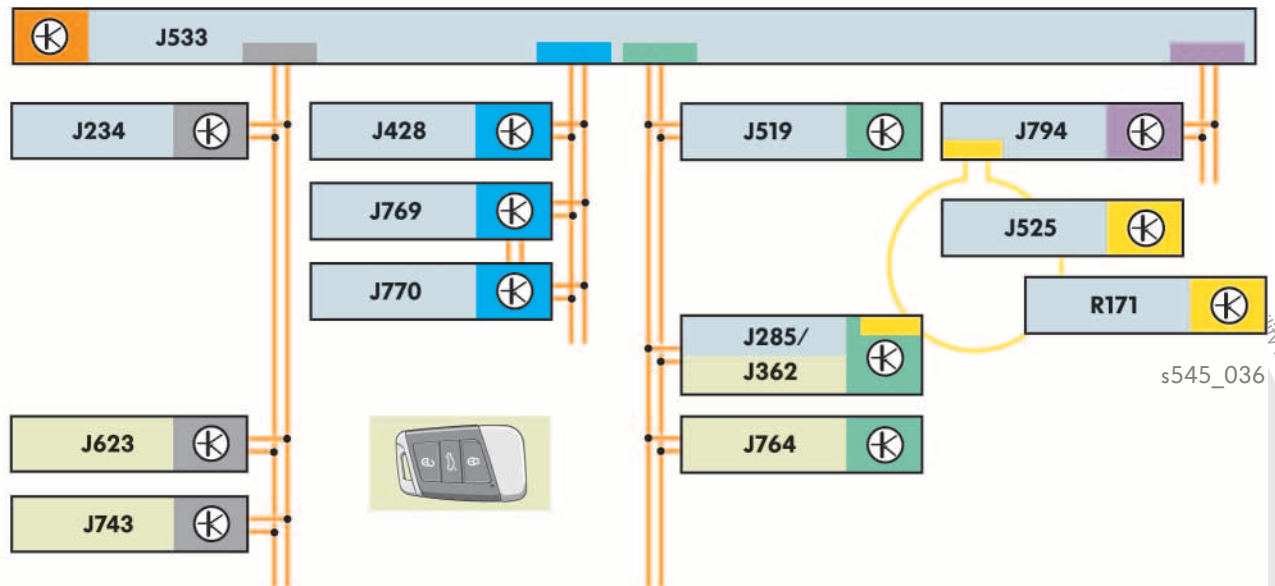
C	Alternator
J367	Battery monitor control unit
J453	Multifunction steering wheel control unit
J533	Data bus diagnostic interface
U13	DC/AC converter with socket, 12 V - 230 V
Y	Analogue clock

The optional steering wheel heating is the responsibility of J527.



Networking concept

Component protection and the immobiliser



Key

J234	Airbag control unit
J285	Control unit in dash panel insert
J362	Immobiliser control unit
J428	Adaptive cruise control unit
J519	Onboard supply control unit
J525	Digital sound package control unit
J533	Data bus diagnostic interface
J623	Engine control unit
J743	Mechatronic unit for dual clutch gearbox
J764	Control unit for electronic steering column lock
J769	Lane change assist control unit
J770	Lane change assist control unit 2

J794	Control unit 1 for information electronics
R171	Digital TV tuner
	Immobiliser subscriber
	Component protection subscriber
	Powertrain CAN bus
	CAN bus extended
	Convenience CAN bus
	Infotainment CAN bus
	MOST bus
	CAN bus wire
	MOST fibre optic cable

Component protection

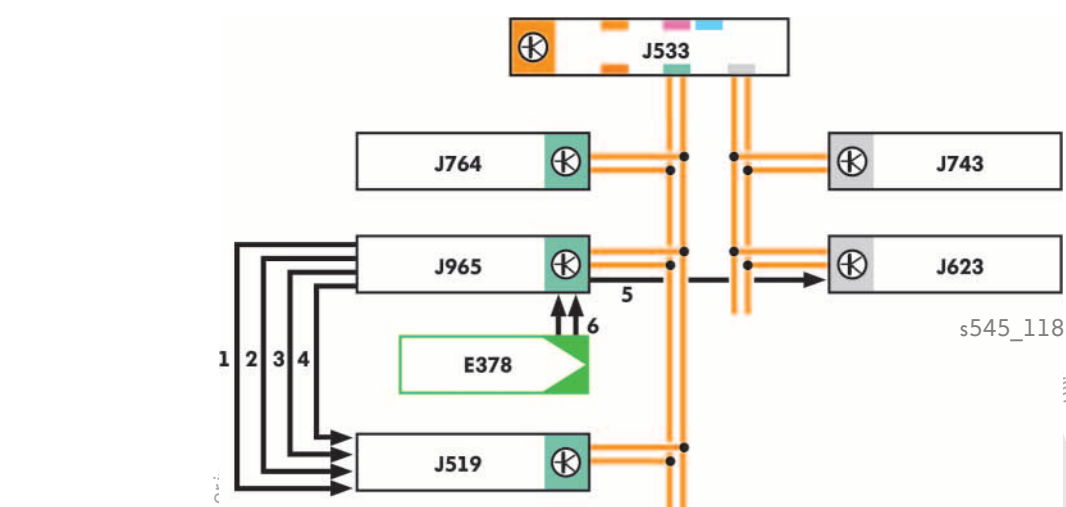
The diagnostic interface for data bus J533 is the master for the component protection. A comparison of the component protection subscribers occurs when terminal 15 is switched on. If the comparison result is negative, the respective component disables its function partially or completely and records this in the event memory. The component protection function must then first be enabled online using the vehicle diagnostic tester.

Generation V immobiliser

The latest immobiliser (WFS) generation V is installed in the Passat 2015. The way that it is used differs considerably from the previous version as the user no longer has to make numerous decisions when adapting the immobiliser in Guided Fault Finding with regard to the installation situation and the actual situation. The user simply has the option of either adapting the immobiliser (yes/no) or repairing it. Further data collection and decision-making is carried out by FAZIT. A new feature in the Passat 2015 is that the control unit for electronic steering column lock J764 is now a convenience CAN bus subscriber. If the optional J743 (mechatronic unit for dual clutch gearbox) is fitted, it is likewise an immobiliser subscriber.

The terminal control

In contrast to the Passat 2011, the control unit for electronic steering column lock J764 in the Passat 2015 is no longer responsible for terminal control in the vehicle but the interface for entry and start system J965 instead. Verification is via discrete wires and via CAN messages.



Key

E378	Starter button	1	Terminal 15 signal 1
J519	Onboard supply control unit	2	Terminal 15 signal 2
J533	Data bus diagnostic interface	3	S contact
J623	Engine control unit	4	Wake-up
J743	Mechatronic unit for dual clutch gearbox	5	Terminal 50 - prompt
J764	Control unit for electronic steering column lock	6	Start button signal
J965	Interface for access and start system		
—	Discrete wire		

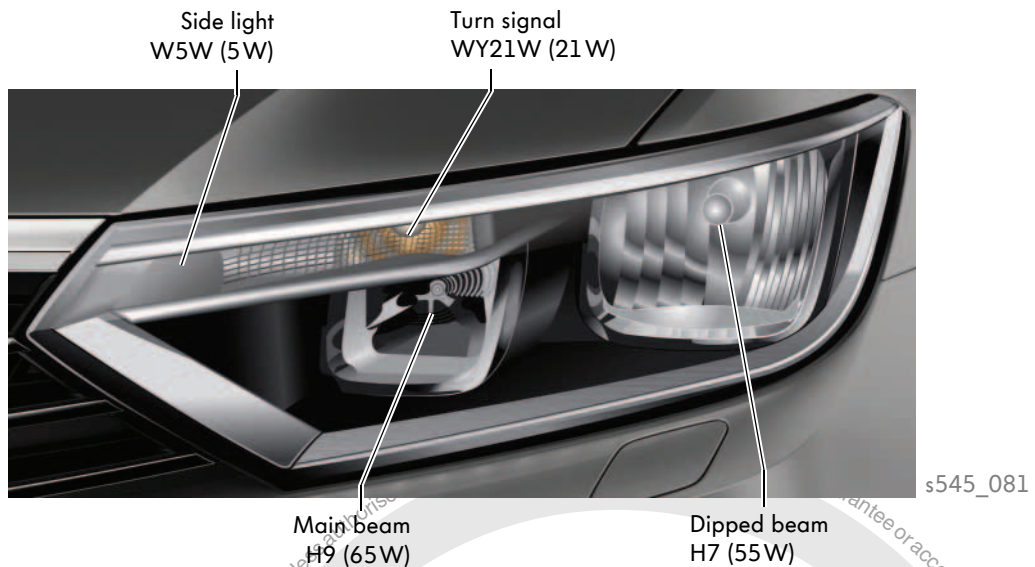
The headlights

Three types of headlight are available for the Passat 2015:

- Halogen headlights with conventional long-life bulbs
- „Basic“ LED headlights using reflector technology
- „High“ LED highlights using lens technology with Dynamic Light Assist (DLA) and dynamic cornering lights (AFS)

Halogen headlights

The halogen headlights feature the four light functions dipped beam, main beam, side light and turn signal.



Technical features

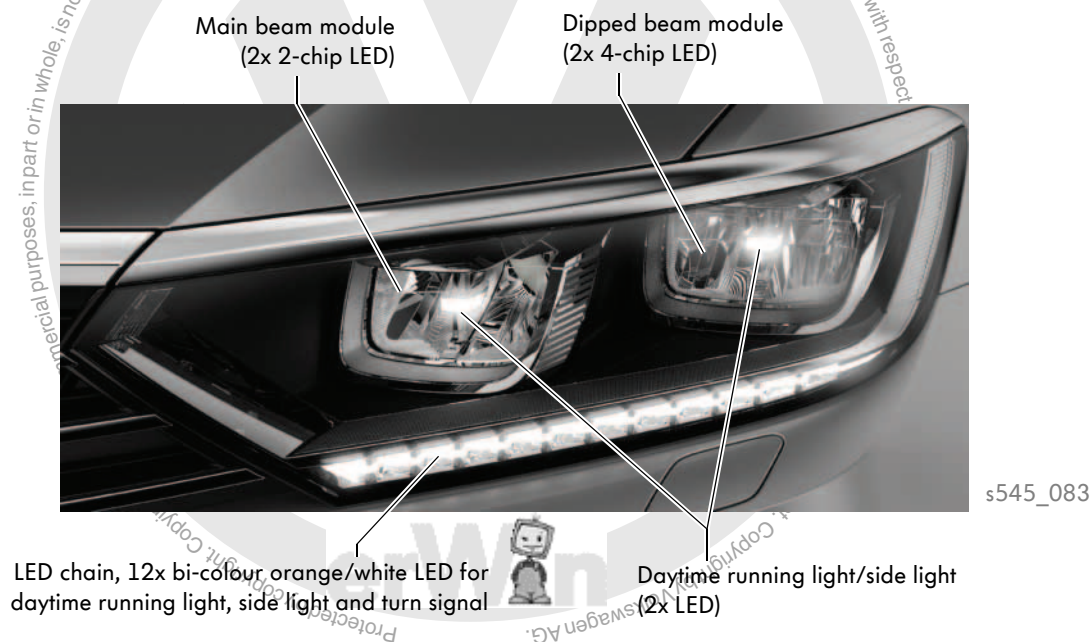
The Passat features a warning lamp monitoring function for all conventional versions of the headlights. It uses the dash panel insert as well as the „vehicle menu“ in the display of the infotainment system to indicate any defective lamps to the driver.

The halogen headlight is equipped with manual headlight range control, which can be re-adjusted using a potentiometer on the rotary light switch.

A dynamic headlight range control system is installed on the LED headlight versions.

„Basic” LED headlights

The Passat sees the start of large-scale production of LED technology for headlights at Volkswagen.



Technical features

The LED lamps are distinguished by light intensity, light spectrum and low power consumption.

As with the halogen headlight, the „Basic” LED headlight is based on reflector technology. The LED lamps emit their light against a reflector, which distributes it over the road in accordance with the legislative requirements.

The identifying feature of the headlight is a horizontal chain of daytime running light LED/side light LED.

The LED chain made of bi-colour LED is used for the daytime running light/side light and turn signal. The LED chain is illuminated white for the daytime running light and side light. It is illuminated orange for the turn signal.

The light from the LED chain and the two additional LED in the reflector are dimmed for the side light function.

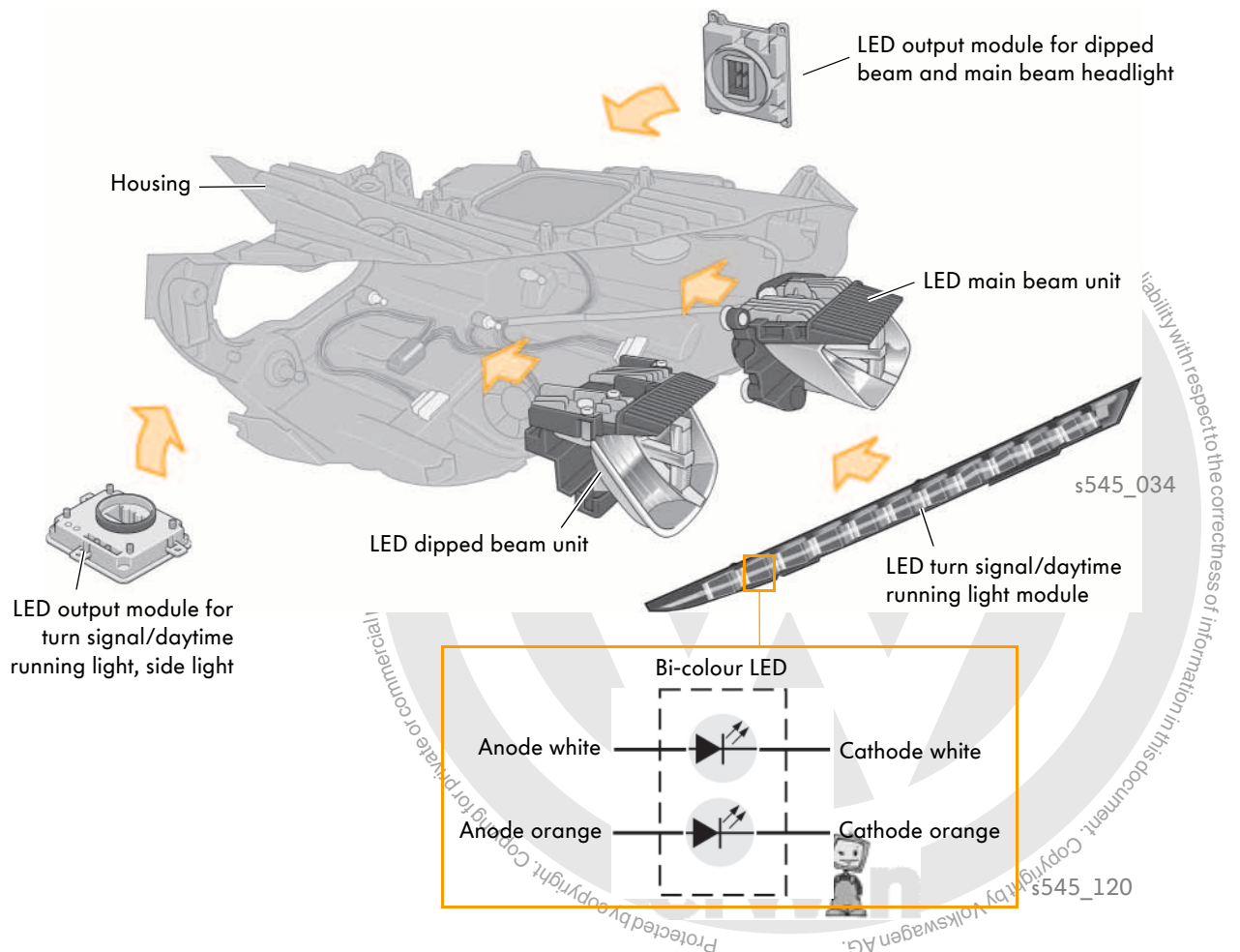
Since the luminous output of the lighting is below 2000 lumen, this version does not require a headlight washer system.

The LED headlight versions are equipped with dynamic headlight range control. The dynamic headlight range control works with an inclination sensor (G384 vehicle inclination sender) on the rear axle. If the vehicle features running gear with adaptive chassis control (dynamic cruise control, DCC), the electronically controlled damping control unit J250 makes the information from its sensors available to the headlight range control via the CAN bus. The inclination sensor on the rear axle is not installed in this case.

Lighting

Design

The following components are installed in the LED headlight housing:



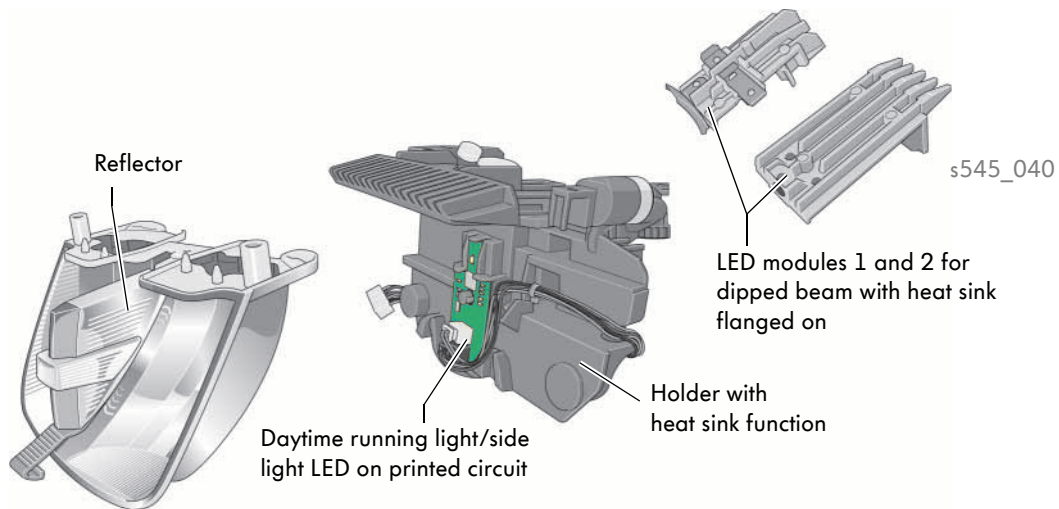
Bi-colour LED

The bi-colour LED in the „Basic“ LED headlight is responsible for the daytime running light, side light and turn signal functions. With the „daytime running light“ function, the white part of the LED is actuated at 13.5V with a 100% PWM-signal. If the turn signal is actuated at the same time, the daytime running light is switched off.

With the „side light“ function, the PWM-signal is reduced to 10% and the LED dimmed in the process. If the turn signal is actuated at the same time, the side light alternates with the turn signal.

LED dipped beam unit

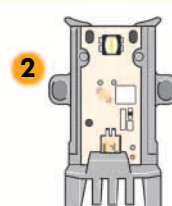
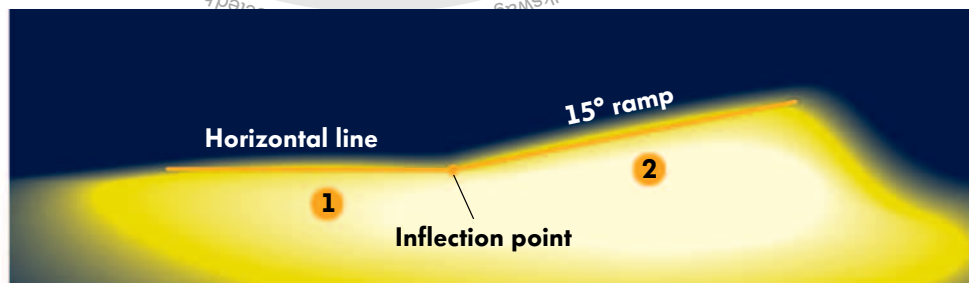
The LED dipped beam unit consists of the following main components:



The LED modules attached to the top of the holder form a large heat sink with the holder for passive cooling of the LED. The light of the LED is emitted from above into the reflector and distributed over the road in accordance with the legislative requirements. Also attached to the holder is a printed circuit with the daytime running light/side light LED.

Dipped beam light pattern

The LED dipped beam module has to generate a beam of light that meets the legislative requirements. LED modules 1 and 2 serve this purpose. In left-hand drive vehicles, LED module 1 generates the horizontal line while LED module 2 generates the 15° ramp angle (main beam light distribution). This is done by varying the arrangement of the LED chips, reflectors and panels on the LED dipped beam module.

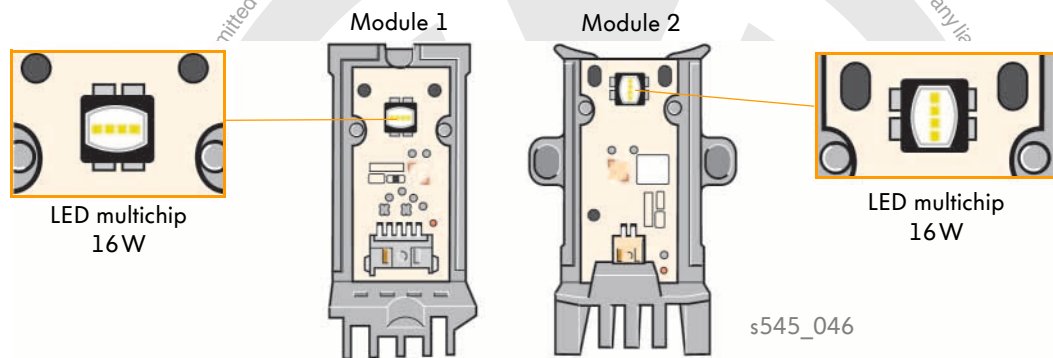


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Lighting

LED modules 1 and 2 for dipped beam

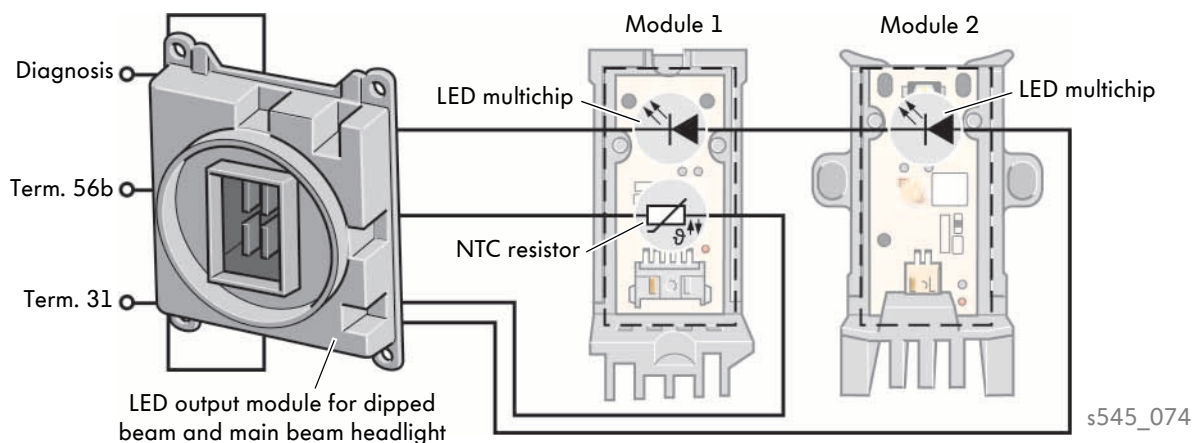
The LED modules 1 and 2 each feature an LED multichip that consists of four LED's placed very closely to each other.



The two multichip LED's are connected in series and are supplied from the LED output module for dipped beam and main beam headlight. This LED output module receives the activation and deactivation commands (term. 56b) as well as supply for the lighting directly from the onboard supply control unit J519. Lamp monitoring is also executed by the LED output module for dipped beam and main beam headlight and transfers the information via a diagnostic cable to the onboard supply control unit J519.

Furthermore, an NTC resistor is mounted on LED module 1. The resistor works as a temperature sender to monitor the temperature of the LED and, if necessary, to reduce the power supply.

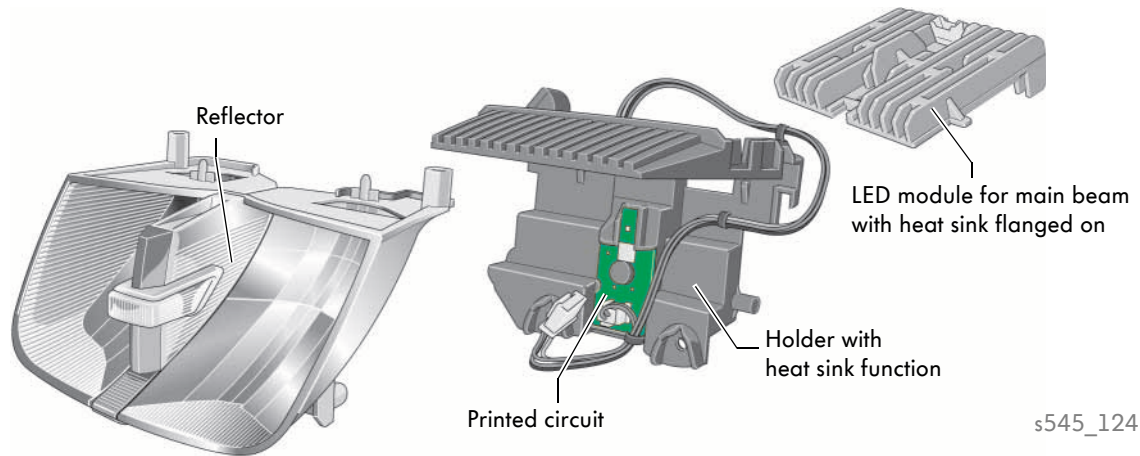
Circuit



In the event of repair, the LED modules are always replaced in pairs. Please observe the latest workshop manual concerning this.

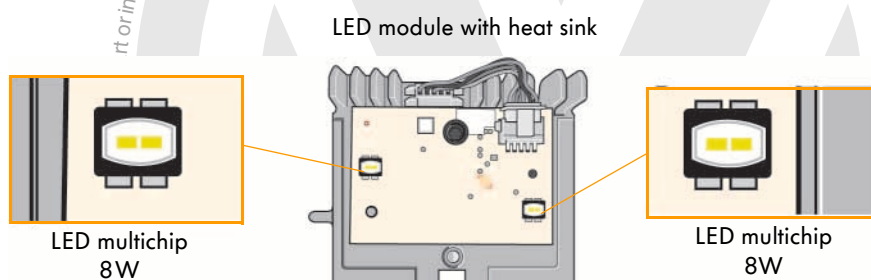
LED main beam unit

The LED main beam unit consists of the following main components:

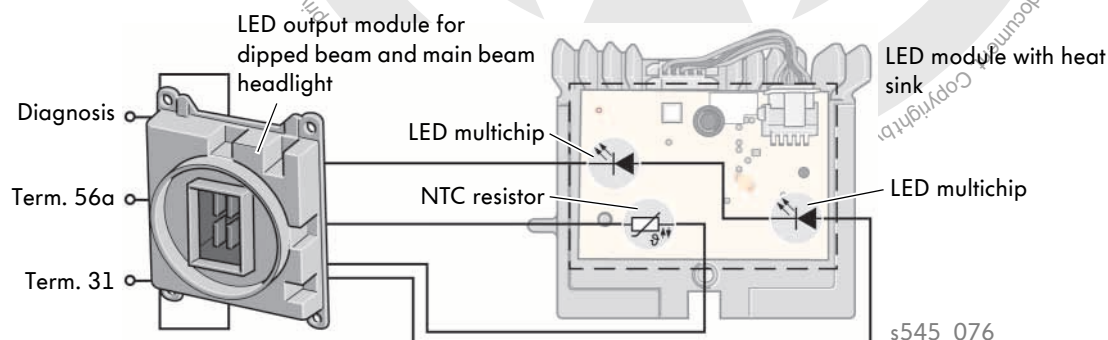


The LED main beam unit differs from the LED dipped beam unit in that only one LED module with heat sink is fitted. This LED module features two LED multichips that comprise two LED's. These are activated in addition to the dipped beam when the main beam is switched on. The LED multichips on the LED module are connected in series and are supplied from the LED output module for dipped beam and main beam headlight. This LED output module receives the activation and deactivation commands (term. 56a) as well as supply for the lighting directly from the onboard supply control unit J519.

Mounted on the LED module, as with LED dipped beam module 1, is an NTC resistor, which works as a temperature sender to monitor the temperature of the LED and, if necessary, to reduce the power supply.



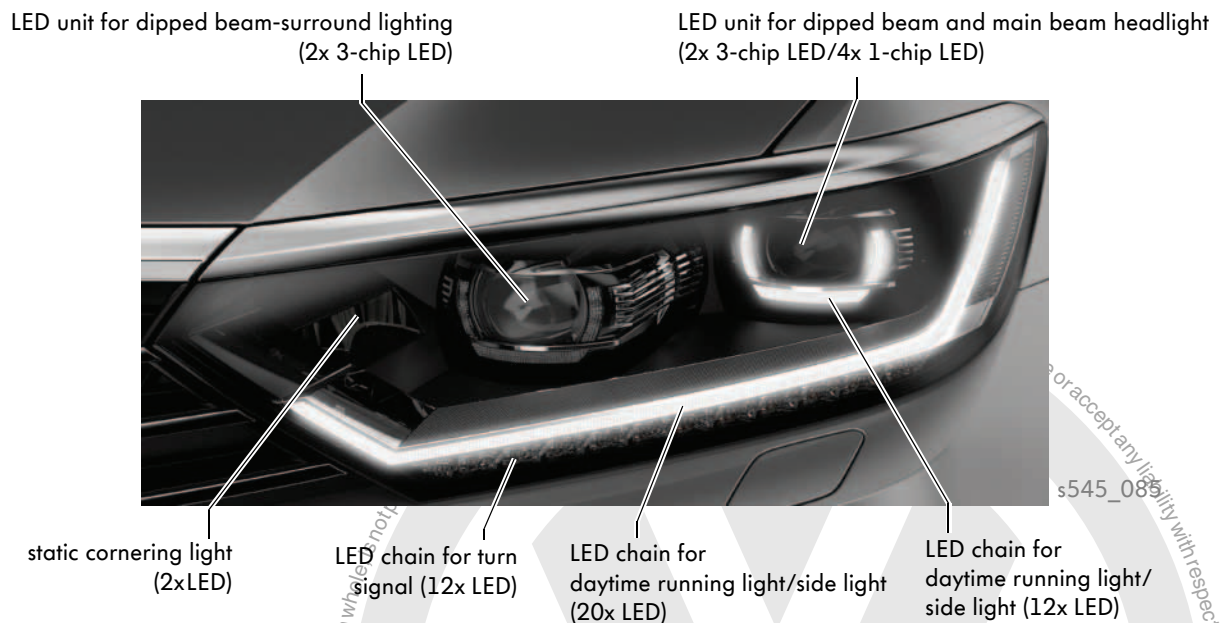
Circuit



„High” LED headlight

In addition to the standard light functions, the High LED headlight always features the following:

- Dynamic cornering light (AFS)
- Static cornering light with LED technology
- Dynamic main beam control (MDF) in conjunction with Dynamic Light Assist (DLA)



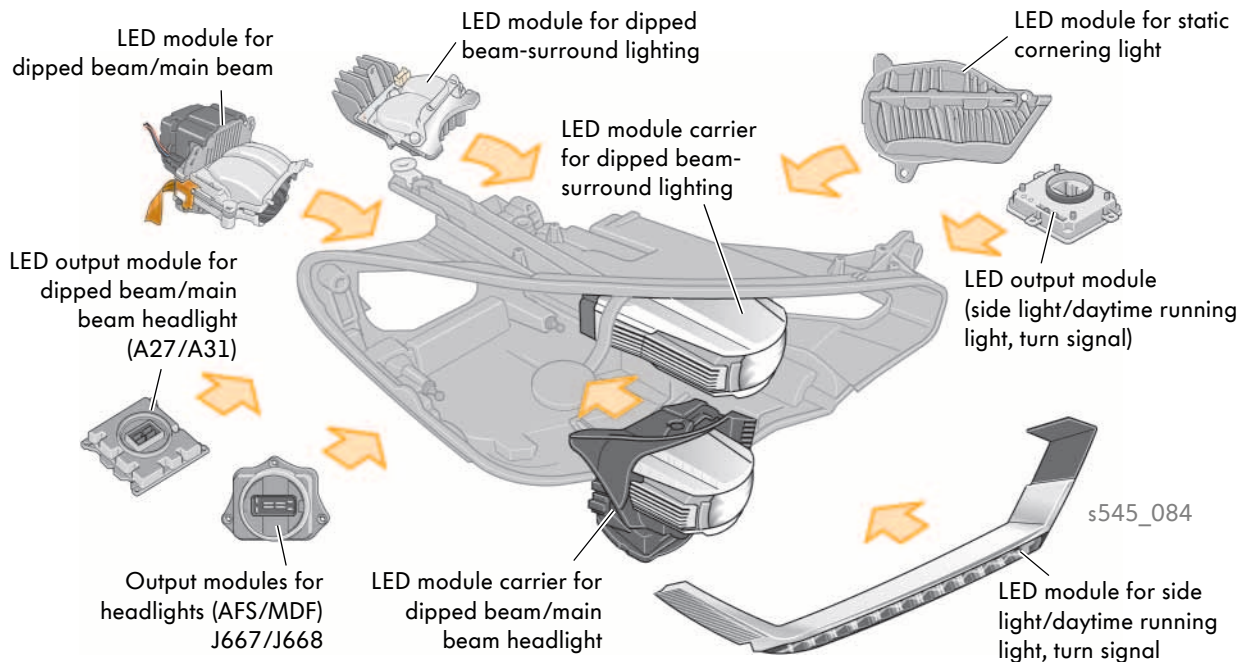
Technical features

The „High” LED headlight uses lens technology, which is also the distinguishing feature of this headlight. The light generated by the LED is passed through a lens and scattered. The beam of light created in this way illuminates the road surface in accordance with the legislative requirements.

The headlight features two dipped beam LED units. The LED unit for dipped beam-surround lighting illuminates a ten metre area immediately in front of the vehicle. The LED unit for dipped beam and main beam lights up the usual area beyond the ten metres. For main beam operation, the cylindrical mask in front of the light is changed. For the „dynamic cornering light” function, the LED unit for dipped beam and main beam swivels horizontally with the corner. For the „dynamic main beam control” function, the cylindrical mask in the main beam area adopts further positions to mask off the dazzling part of the main beam.

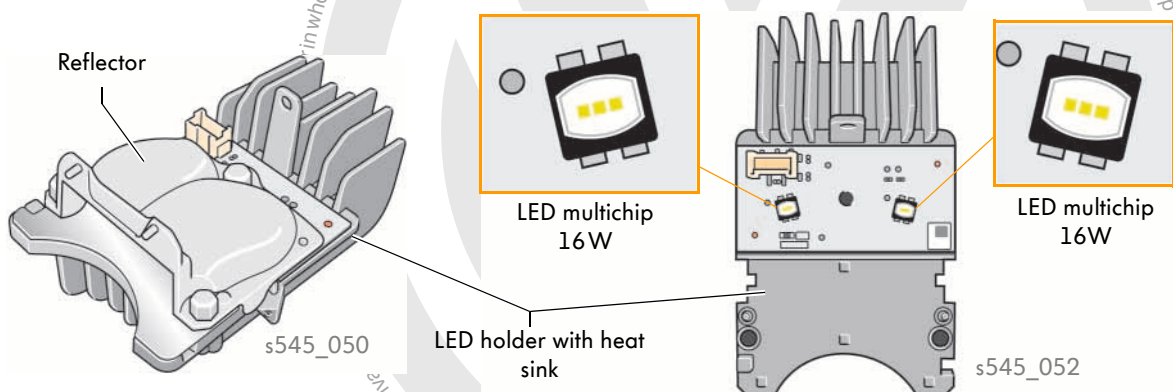
Design

The following components are installed in the LED headlight housing:



LED module for dipped beam-surround lighting

The dipped beam-surround lighting lights up an area of approx. 10 metres immediately in front of the vehicle. The lighting is activated with the dipped beam and with no control from the AFS/MDF functions. The two multichip LED are also connected in series here and are temperature-monitored by an NTC resistor.



The LED module for the dipped beam-surround lighting can be replaced individually. Please refer to the current workshop manual for information on this.

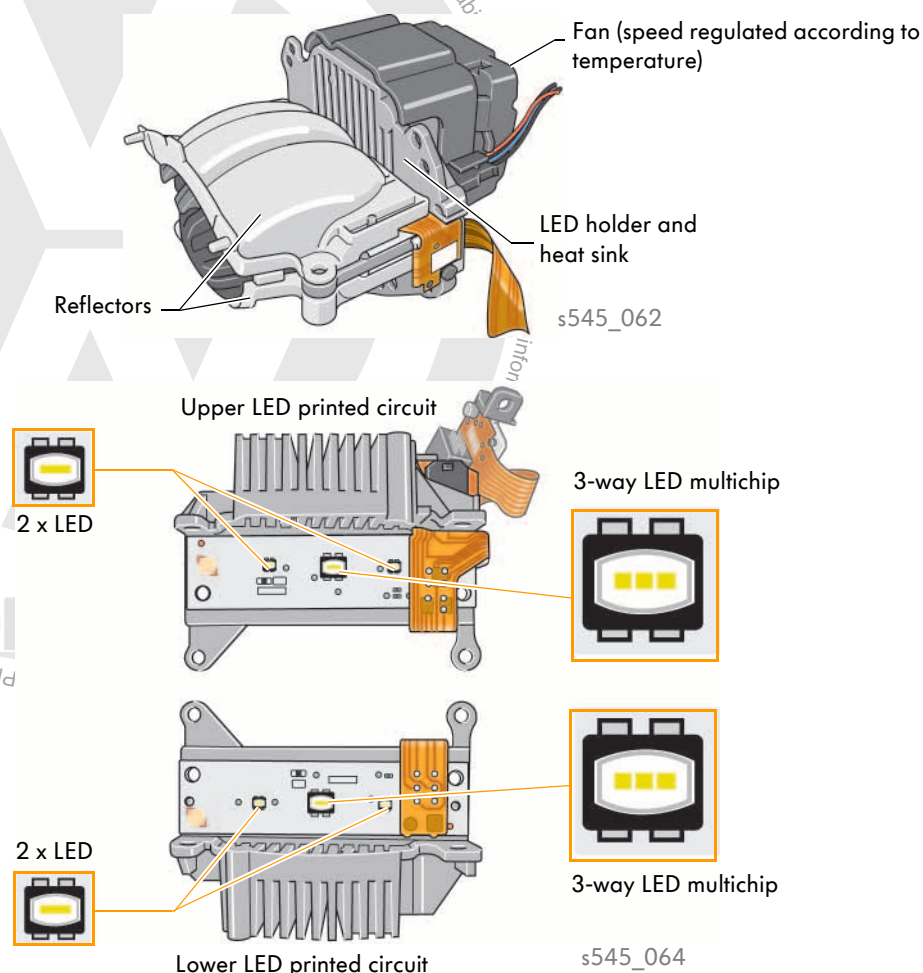


LED module for dipped beam/main beam headlight

The LED module for dipped beam/main beam is responsible for lighting up the area beyond the 10 metres lit up by the dipped beam-surround lighting. To actively cool the LED there is a fan, the speed of which is regulated according to the temperature.

The base carrier for the LED module for dipped beam/main beam is a heat sink on which the LED printed circuits are permanently mounted. Installed on the upper and lower printed circuits of the holder are 2 LED's each and a 3-way LED multichip, which are actuated depending on the light function.

Installed in the middle is one LED multichip respectively and two simple LED's are fitted to the outside in each case. The control function here is done by the LED output module for dipped beam and main beam headlight (A27/A31). The 2 LED's on the upper and lower printed circuits of the holder are dimmed to 50% if dipped beam is activated. The 3-way LED multichip on the lower printed circuit is deactivated when the static cornering light is switched on.

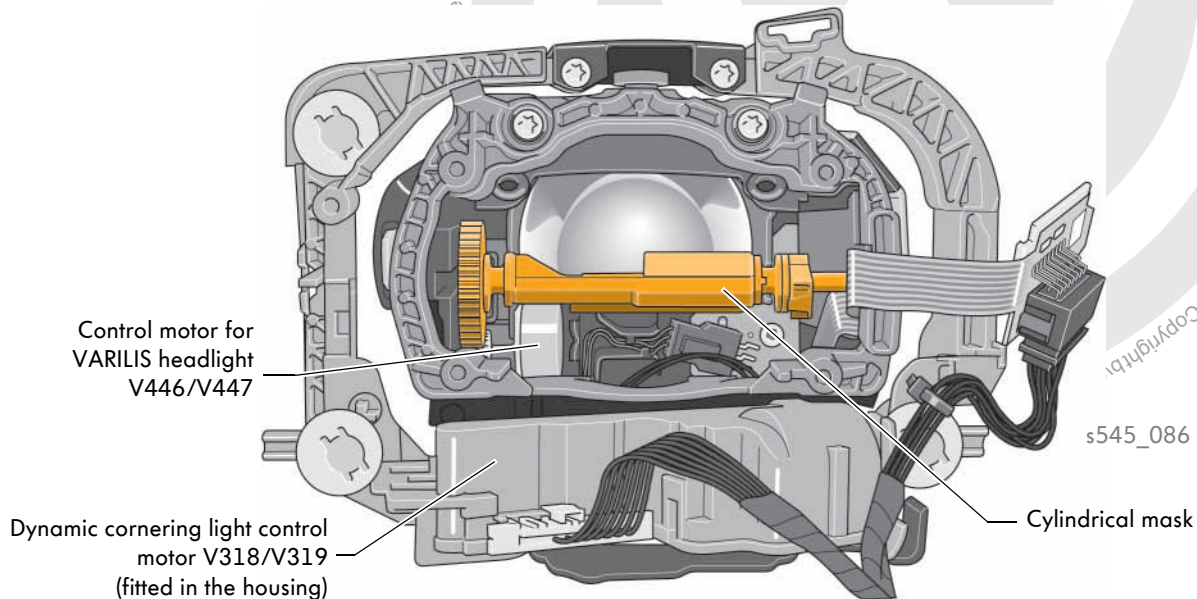


In the event of repair, the LED module can be replaced individually. Please refer to the latest workshop manual to do this as the module has to be restored to its basic setting.

Dynamic light assist/dynamic main beam control

The High LED headlight always features the Dynamic Light Assist (DLA) function, which is installed in combination with the dynamic main beam control (MDF).

LED module carrier for dipped beam/main beam headlight



The DLA and MDF ensure that the road and its edges are as well lit as possible without dazzling the drivers of vehicles travelling in front or vehicles approaching from the opposite direction. With the aid of the front camera for driver assist systems R242, the system detects other road users as well as their distance to this vehicle and masks part of the light beam in a targeted manner. The light beam is deflected by the cylindrical mask. The cylindrical mask is installed between the LED module for dipped beam/main beam and the lens.

For the dynamic cornering light (AFS) function, the whole LED module carrier is swivelled by the dynamic cornering light control motor V318/319.

Even with the DLA switched off, the mask ensures that the main beam and dipped beam light functions are available. Furthermore, it regulates the urban light, country road light and motorway light functions in the speed-dependent dipped beam position.



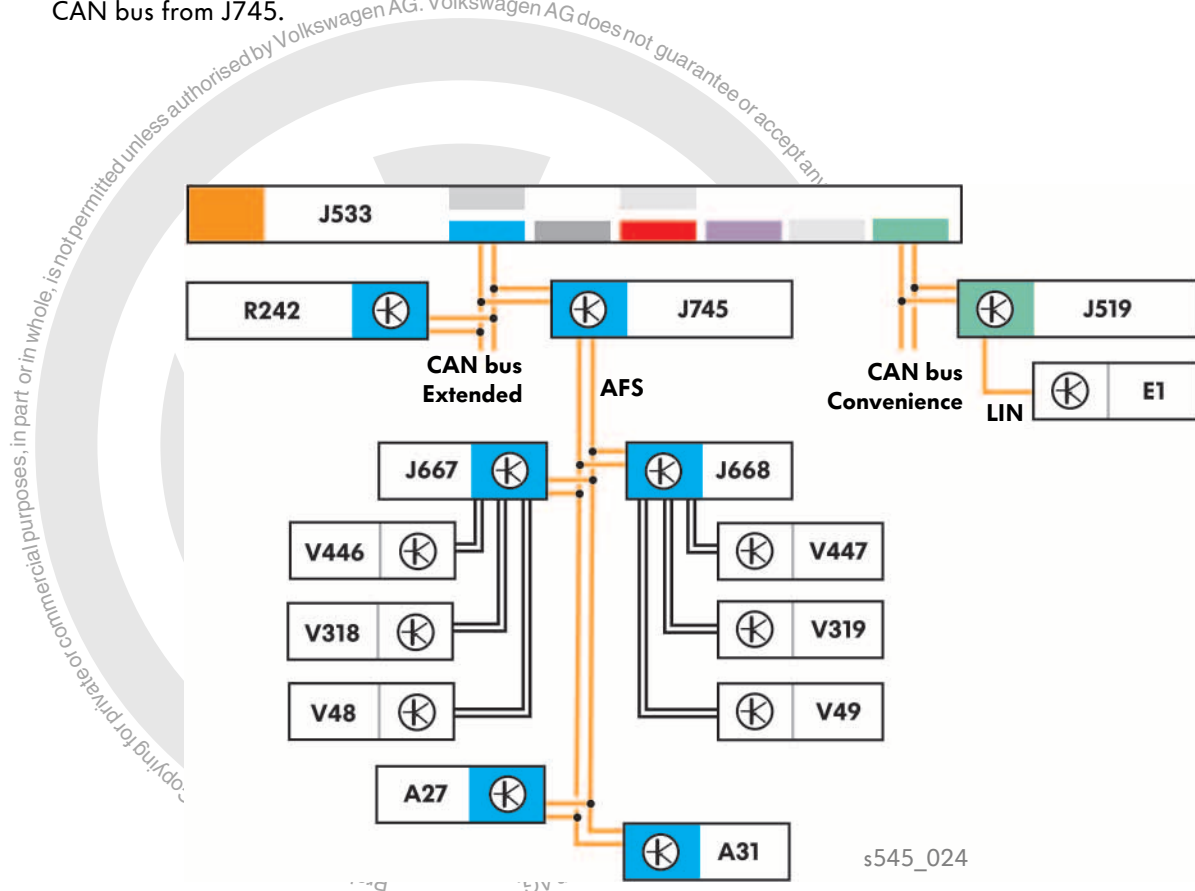
Further information about MDF in connection with DLA can be found in the Self-study Programme no. 470 „The Touareg 2011 – Electrical/Electronic System”.

Lighting

Networking

The cornering light (AFS) CAN bus has been supplemented with two control units due to the new „High” LED headlight. The control units A27 and A31 control activation, deactivation and dimming of the light functions of the LED modules (dipped beam/main beam, dipped beam-surround lighting as well as static cornering light) and communicate the diagnostic data for the lamps to the control unit J745. The onboard supply control unit J519 is partly involved in light actuation of the dipped beam light module.

Activation or deactivation of the turn signal and daytime running light/side light is executed directly by the onboard supply control unit. The control units J667/J668 are responsible for mechanical movement of the unit for dipped beam/main beam with AFS/MDF and the cylindrical mask. All other light functions are controlled by the CAN bus from J745.



Key

A27	Output module 1 for right LED headlight	V48	Left headlight range control motor
A31	Output module 1 for left LED headlight	V49	Right headlight range control motor
E1	Light switch	V318	Left dynamic cornering light control motor
J519	Onboard supply control unit	V319	Right dynamic cornering light control motor
J533	Data bus diagnostic interface	V446	Control motor for left VARILIS headlight
J667	Output module for left headlight	V447	Control motor for right VARILIS headlight
J668	Output module for right headlight	AFS	Cornering light CAN bus
J745	Control unit for cornering light and headlight range control		
R242	Front camera for driver assist systems		

The auxiliary light module



Front fog light/
static cornering light

Daytime running
light

If the vehicle is equipped with halogen headlights, the daytime running light is located in the auxiliary light module lower down in the bumper. The front fog light with static cornering light function is also optional in this auxiliary light module.



Front fog light/
static cornering light

If the „Basic“ LED headlight is fitted, the auxiliary light module of the front fog light features the static cornering light function.



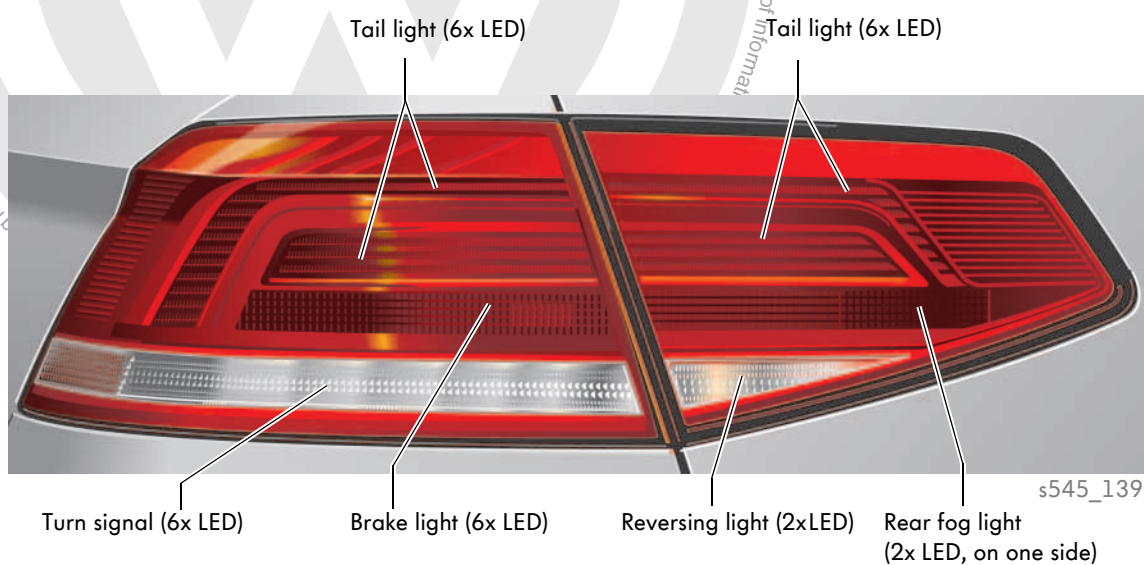
Front fog lights

If the „High“ LED headlight is fitted, the front fog light is installed in the auxiliary light module.

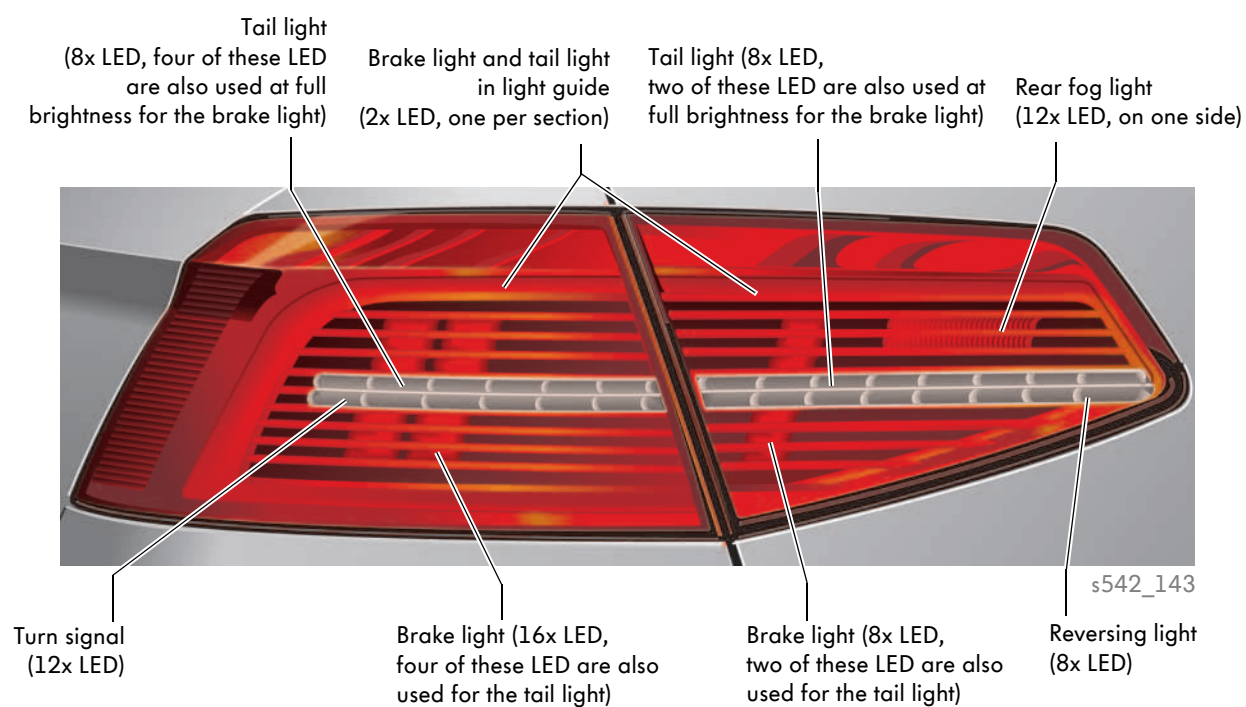
The tail lights

The tail lights of the Passat are equipped exclusively with LED technology. Two types are available: Basic and High. On both types, the tail lights are divided into a fixed section and a rear lid section.

„Basic” tail lights



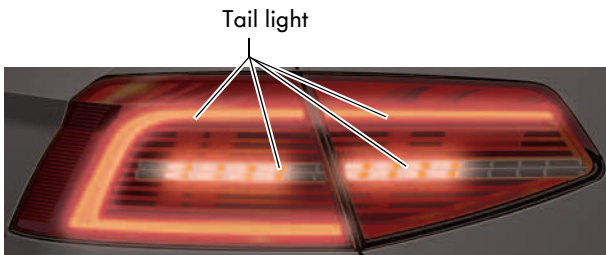
„High” tail lights



„High” version light functions

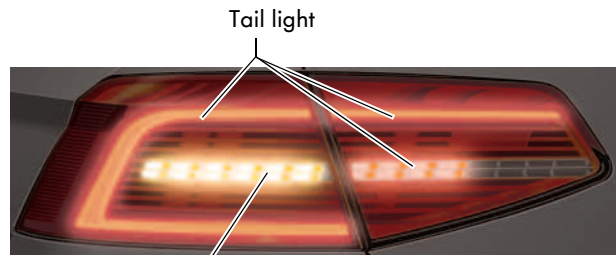
Some LED and LED segments on this version are used more than once for light functions.

Light pattern: tail light



s545_145

Light pattern: tail light with turn signal



s545_147

The following segments are illuminated for the tail light:

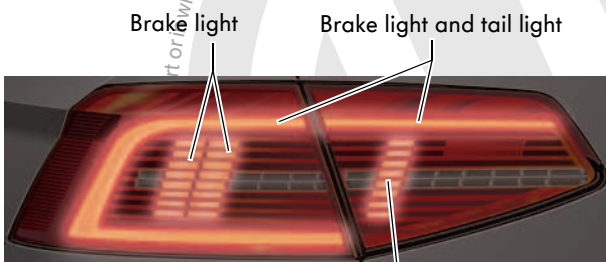
- Light guide in fixed section and rear lid section (2x LED, one per section)
- Row in fixed section (8x LED)
- Row in rear lid section (8x LED)

If the turn signal is activated while the tail lights are on, the following segments of the tail light will remain illuminated:

- Light guide in fixed section and rear lid section (2x LED, one per section)
- Row in rear lid section (8x LED)

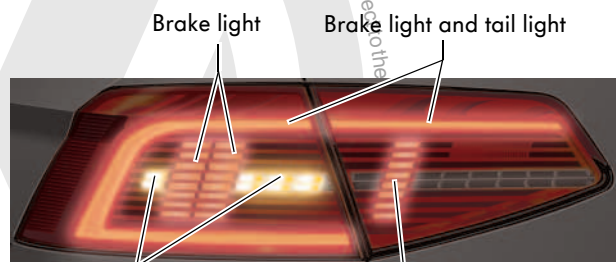
The row in the fixed section with the 12 turn signal LED is now illuminated for the turn signal.

Light pattern: brake light with or without tail light



s545_149

Light pattern: brake light with or without tail light and turn signal



Turn signal 2x LED and 6x LED
s545_151

For the brake light with or without tail light, the light guide in the fixed section and rear lid section (2x LED, one per section) is lit.

The following segments are also lit:

- two vertical rows in the fixed section (16x LED, 4 of these are also used dimmed for the tail light)
- one vertical row in the rear lid section (8x LED, 2 of these are also used dimmed for the tail light)

The segments are illuminated the same as for „Light pattern: brake light with or without tail light”.

Only 8 LED's are available for the turn signal.

The 4 common LED's in the two vertical rows are required for the brake light.

Lighting

The interior lighting

Three packages are available for the interior lighting:

- Standard package
- Light & Sight package
- Ambience package

Standard package

The standard package comprises the following lighting:

- Front/rear interior light (with reading lights)
- Glove compartment light
- Luggage compartment light
- Illuminated vanity mirror

Light & Sight package

In the Light & Sight package, the front/rear reading lights and the vanity mirror feature LED technology. In addition to the standard package, the Light & Sight package has the following lighting:

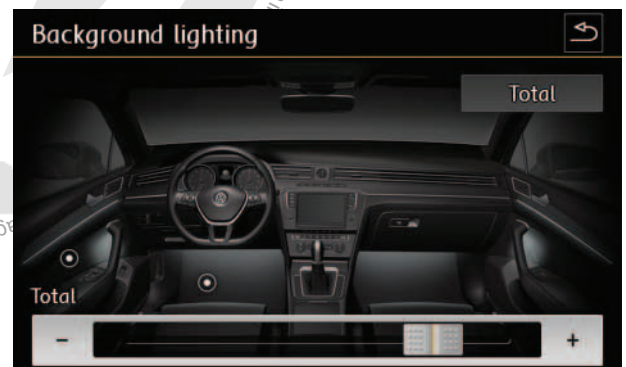
- Front LED footwell lights
- Front door warning light

Ambience package

In addition to the Light & Sight package, the ambience package has the following lighting:

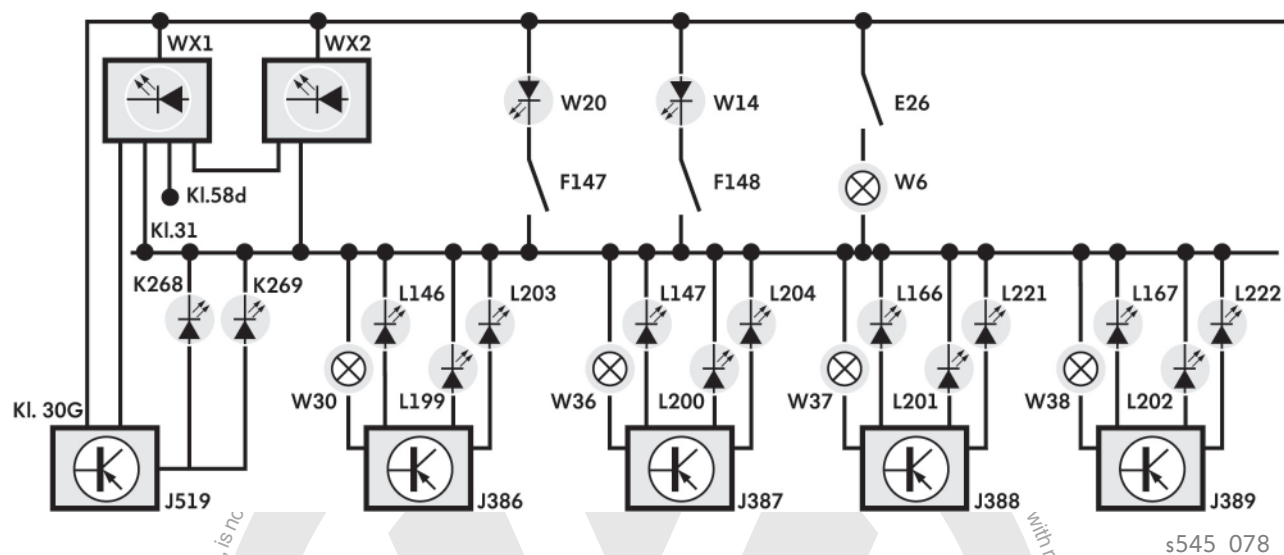
- Front/rear interior door handle illumination (light 1/lamp for background lighting)
- Lamp for front/rear interior door handle illumination
- Lamp for front/rear door (light 2 for background lighting)
- Rear door warning light

Settings for the interior lighting can be carried out via the infotainment display. The adjacent figure shows the menu option „Background lighting“.



s545_122

Ambience package circuit



Key

E26	Glove compartment light switch	L221	Light for rear driver side interior door handle illumination
F147	Driver vanity mirror contact switch	L222	Light for rear passenger side interior door handle illumination
F148	Front passenger vanity mirror contact switch	W6	Glove compartment light
J386	Driver door control unit	W14	Front passenger side illuminated vanity mirror
J387	Front passenger door control unit	W20	Driver side illuminated vanity mirror
J388	Rear left door control unit	W30	Driver side door warning lamp
J389	Rear right door control unit	W36	Front passenger side door warning lamp
J519	Onboard supply control unit	W37	Rear left door warning lamp
K268	Front left footwell light	W38	Rear right door warning lamp
K269	Front right footwell light	WX1	Front interior light
L146	Driver side door interior handle illumination bulb	WX2	Rear interior light
L147	Front passenger side door interior handle illumination bulb	Term. 30G	Switched positive cable
L166	Rear left door ambient lighting bulb	Term. 31	Earth
L167	Rear right door ambient lighting bulb	Term. 58d	Controllable instrument lighting
L199	Light 1 for front left door background lighting		
L200	Light 1 for front right door background lighting		
L201	Light 1 for rear left door background lighting		
L202	Light 1 for rear right door background lighting		
L203	Light 2 for front left door background lighting		
L204	Light 2 for front right door background lighting		

Dash panel insert

Three dash panel inserts are available for the Passat:

The Medium dash panel insert



Functions and characteristics

- Black and white TFT centre display with a resolution of 320 × 240 pixels
- Analogue gauges for rev counter, speed, coolant temperature and fuel
- Multifunction display showing the following information:
 - Time, total mileage, trip mileage
 - Vehicle warning messages in form of symbols and text in 24 languages
 - Selected range, gear change display
 - Onboard computer with efficiency display
 - Outside temperature, ice warning
 - Cruise control system display
 - Speed limiter display
 - Speed warning
 - Date
 - Loudspeaker for acoustic warnings
 - Service interval
 - Engine code
 - Additional driver assist systems
 - Navigation guidance
 - Telephone lists
 - Radio station list
 - Oil temperature display

The Colour dash panel insert



Functions and characteristics

The same functions as the Medium plus:

- Colour TFT centre display
- Screen transitions with animations

The Active Info Display (AID) dash panel insert



With the Active Info Display (AID), the analogue dial gauges are shown virtually for the first time.

The following safety-related warning lamps are still in the form of fixed indicators located above the display:

- Turn signal
- Warning lamp for exhaust-related faults
- Glow period warning lamp for diesel engine
- ABS warning lamp
- Central warning lamp (observe displayed message)
- Warning lamp for faults in the electromechanical power steering
- Warning lamp for faults in the brake system
- Warning lamp for electromechanical parking brake

The driver information display can be customised to show additional data for the driving, navigation and driver assist functions in the middle areas of the speedometer and the rev counter.

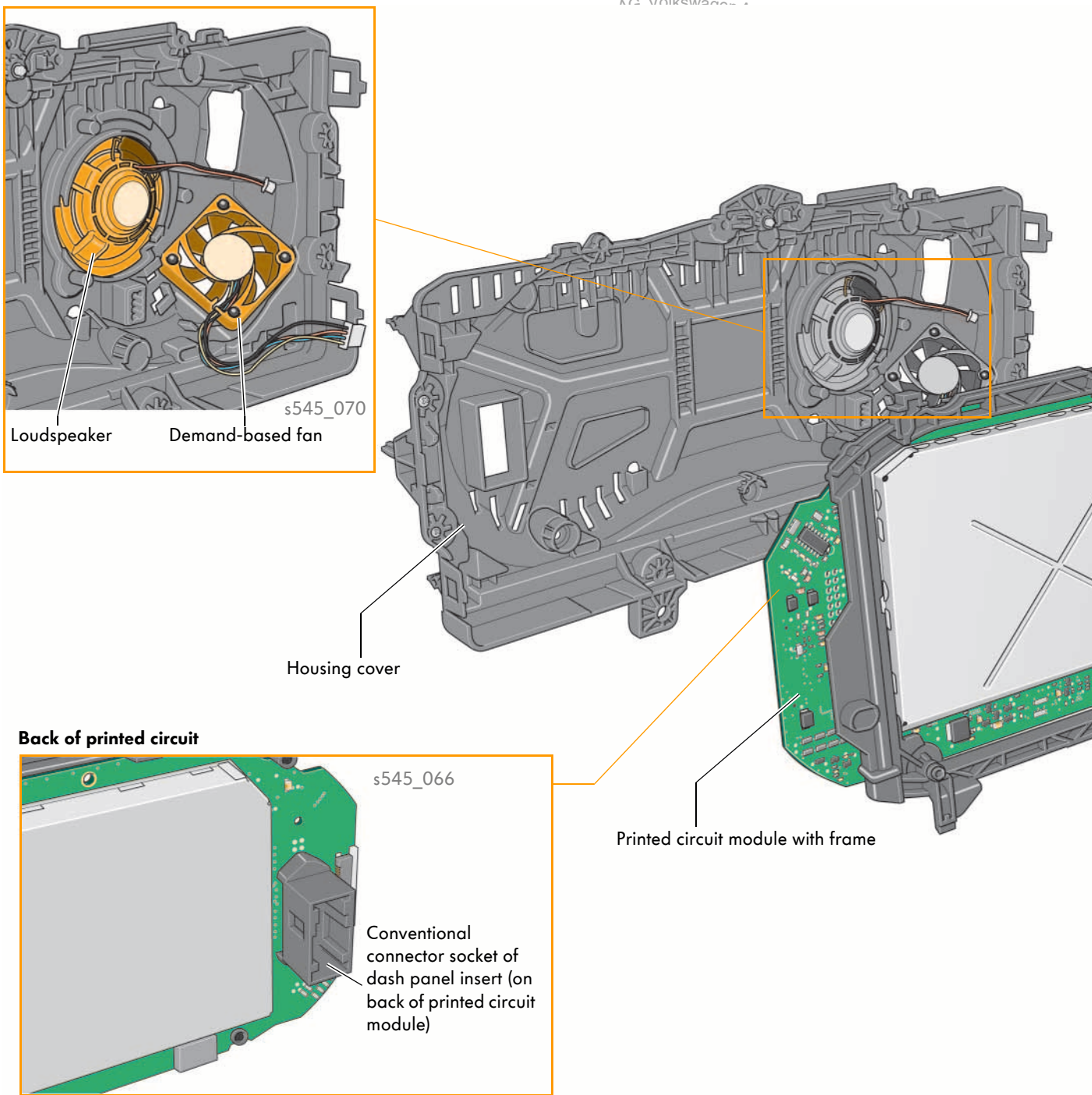
Functions and characteristics

- 12.3" TFT display with a resolution of 1440 x 540 pixels
- Features all basic functions
- Different displays can be selected
- Automatically changing displays depending on the active function
- Display of 2D and 3D graphics
- Navigation and media display

Dash panel insert

Active Info Display (AID) design

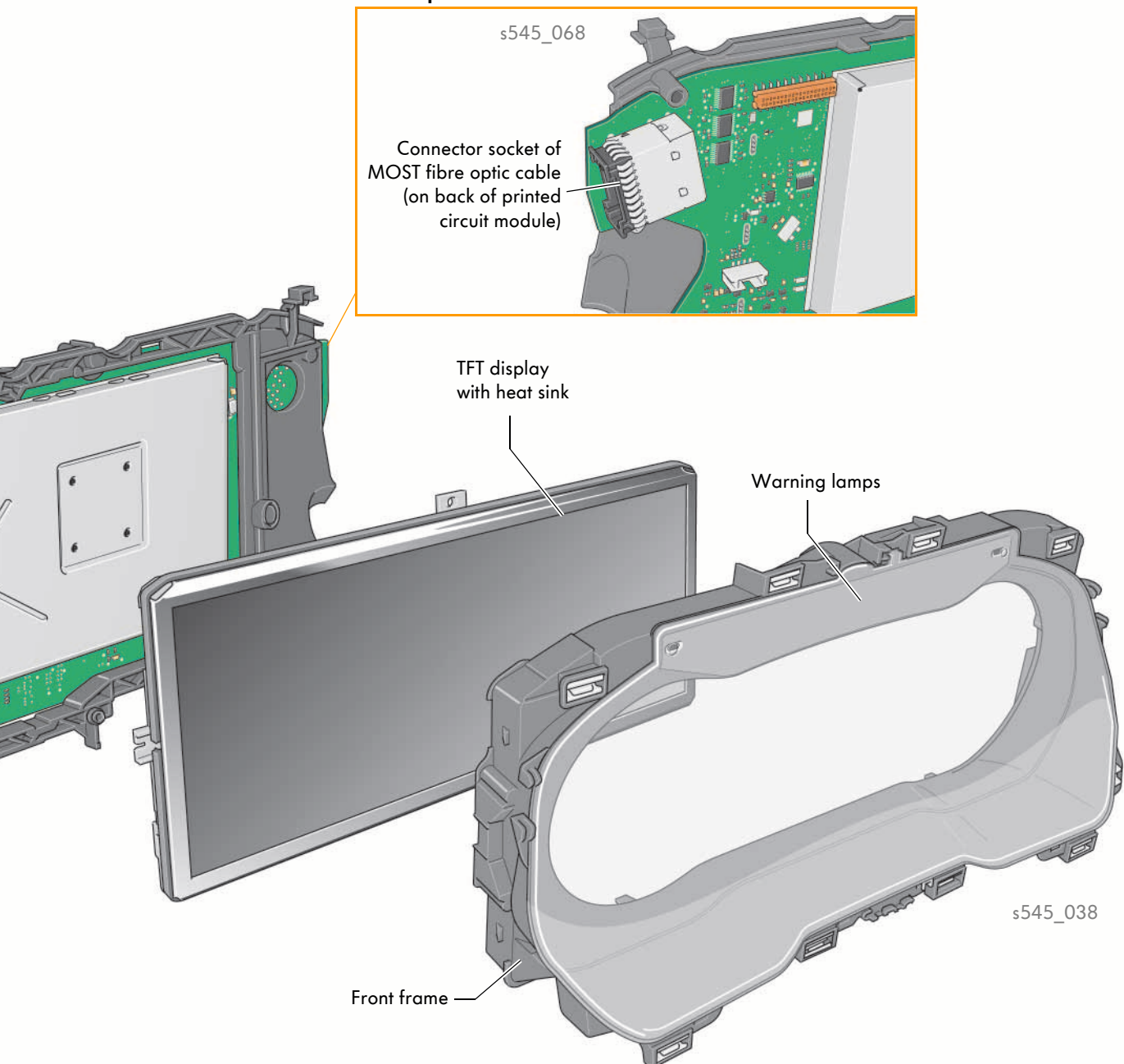
As with the other MQB dash panel inserts, the Active Info Display has a modular structure. It is connected to the fast MOST bus in order to show images and animations, such as the navigation map, audio covers or telephone contact images in the infotainment system with no loss or delay.



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Back of printed circuit



Convenience electrical system

The Keyless Entry and Start System

Two KESSY systems are available for the Passat: Press and Drive and Keyless Access.

The standard system is KESSY Press and Drive. Therefore, the Passat does not have a conventional ignition lock.

KESSY Press and Drive

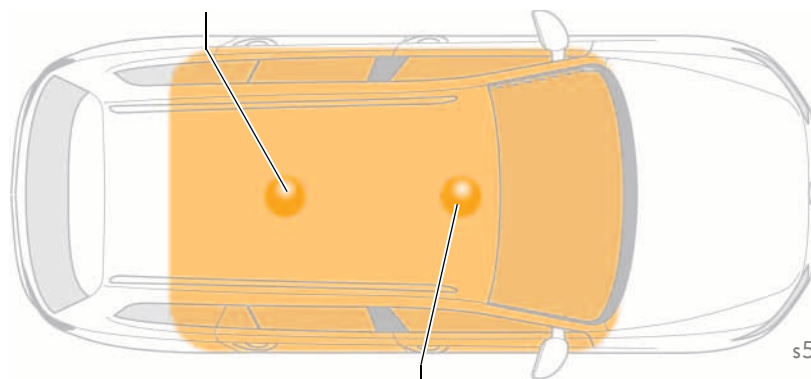
The convenience system in the Passat 2015 has two interior aerials. With the aid of these aerials, the system determines whether an authorised vehicle key is located in the vehicle. The ignition is switched on and the engine is started using the starter button E378. The vehicle must first be unlocked via the remote control (HF signal of 433 MHz).



Starter button E378

s545_017

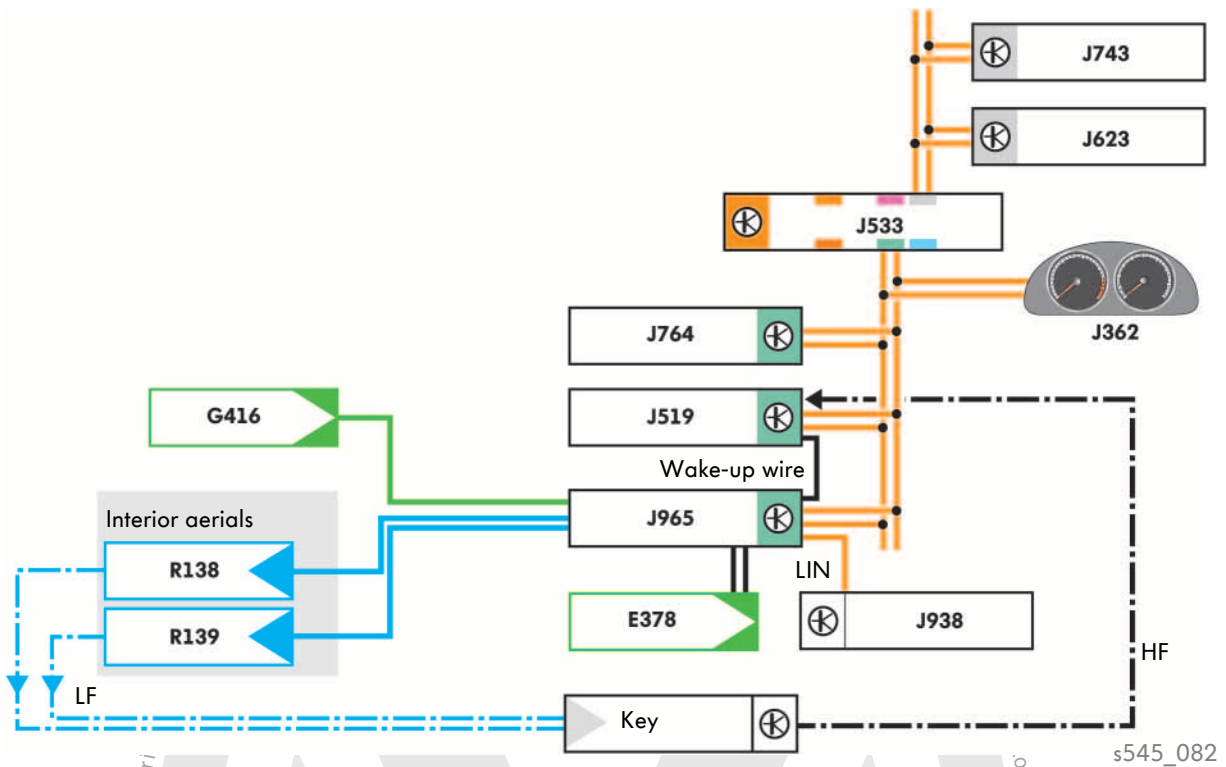
Interior aerial 2 for entry and start system R139



Interior aerial 1 for entry and start system R138

s545_058

Networking



Key

E378	Starter button	J965	Interface for access and start system
G416	Front passenger door exterior handle contact sensor	R138	Interior aerial 1 for entry and start system
J362	Immobiliser control unit	R139	Interior aerial 2 for entry and start system
J519	Onboard supply control unit	— (green)	Sensor wire
J533	Data bus diagnostic interface	— (blue)	Actuator
J623	Engine control unit	— (dashed blue)	Low frequency (LF)
J743	Mechatronic unit for dual clutch gearbox	— (dashed black)	High frequency (HF)
J764	Control unit for electronic steering column lock	— (orange)	CAN bus wire
J938	Rear lid power opening control unit		

Convenience electrical system

Authorisation procedure

Switching on terminal 15

The starter button E378 is pressed. The entry and start authorisation control unit J965 processes the signal, wakes the convenience CAN bus and asks the immobiliser control unit J362 whether terminal 15 is allowed to be switched on. To determine whether there are authorised keys inside the vehicle, J965 transmits the search pattern (LF signal of 125 kHz) via the interior aerials for the keys already matched. The authorised key recognises its signal pattern and sends its transponder data at a frequency of 433 MHz to J519. J519 forwards this transponder data to J362. J362 verifies the transponder data. If the key is authorised, J362 sends the command via the convenience CAN bus for release of the electric steering column to the control unit for electronic steering column lock J764. J965 transmits the CAN message to J519 and, at the same time, also via a discrete wire so that terminal 15 is switched on. The remaining CAN buses are woken by the data bus diagnostic interface J533.

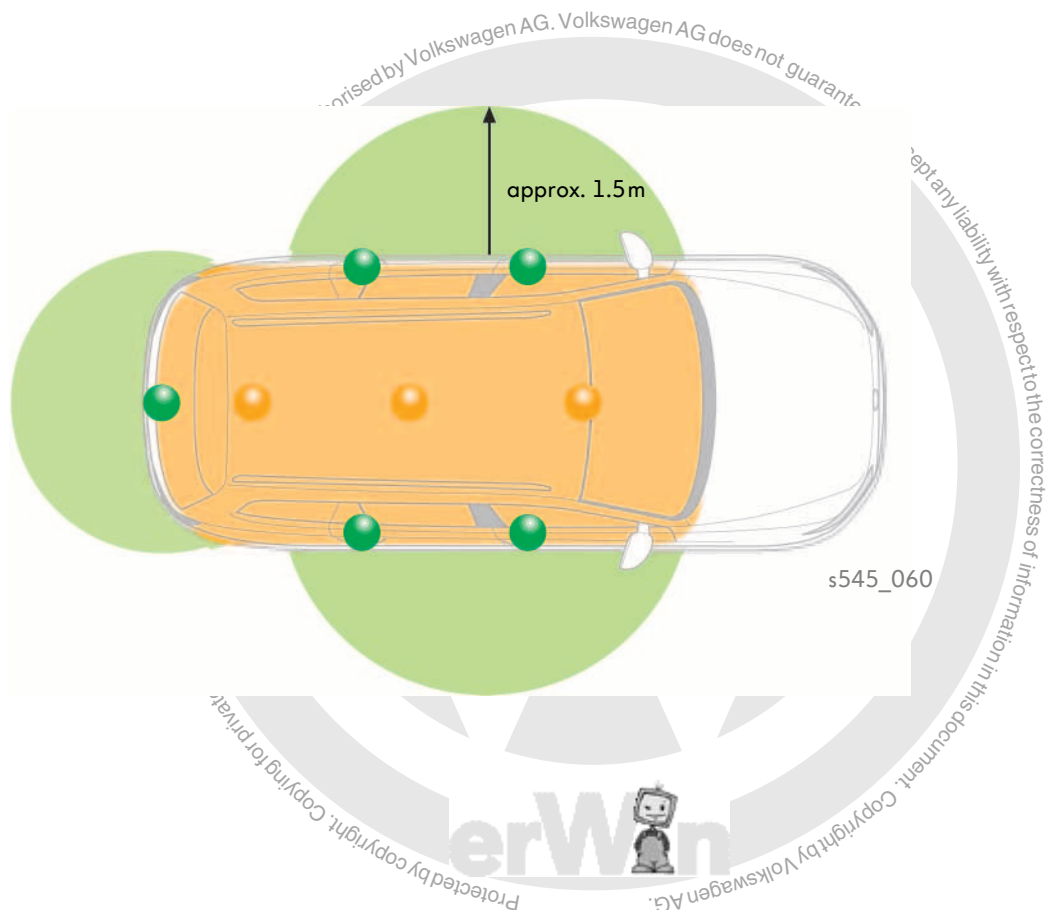
Starting the engine

As soon as all of the data buses are awake, immobiliser communication across all buses can take place. The immobiliser control unit J362 authorises the engine control unit to start the engine if the data match is successful. If a mechatronic unit for dual clutch gearbox J743 is fitted, it subsequently sends its query and authorisation request to the immobiliser control unit J362.

KESY Keyless Access

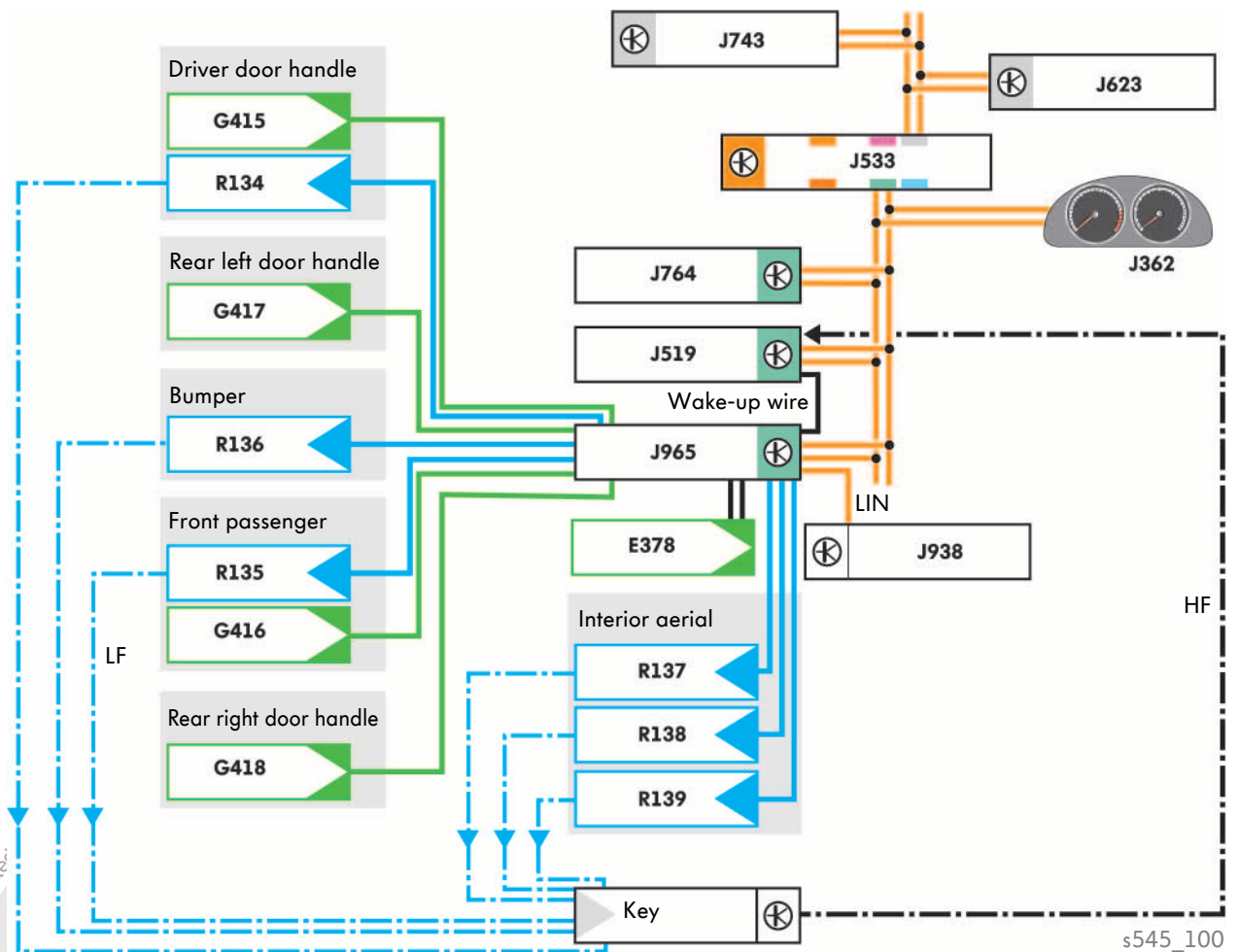
As an option, the standard „Press & Drive” function can be supplemented with the Keyless Access locking and starting system. The Keyless Access KESY system also makes it possible to lock and unlock the vehicle without a key. The Passat has one additional interior aerial and five external aerials for this system. The rear aerial is also used for the Easy Open system.

On the Passat, exterior handle contact sensors are fitted in all four door handles. Fitted in the front door handles for transmission are also aerials for the entry and start system. Furthermore, there is an exterior aerial in the bumper for the rear area and an interior aerial to cover the luggage compartment area. The exterior handle contact sensors are deactivated after 30 hours of inactivity, except for the driver's door, to reduce the no-load current. The sensor in the driver's door is deactivated after 90 hours.



Convenience electrical system

Networking



Key

E378	Starter button	R134	Driver side aerial for entry and start system
G415	Exterior handle contact sensor, driver door	R135	Passenger side aerial for entry and start system
G416	Exterior handle contact sensor, front passenger door	R136	Rear bumper aerial for entry and start system
G417	Contact sensor for rear exterior door handle, left	R137	Luggage compartment aerial for entry and start system
G418	Contact sensor for rear exterior door handle, right	R138	Interior aerial 1 for entry and start system
J362	Immobiliser control unit	R139	Interior aerial 2 for entry and start system
J519	Onboard supply control unit		— Sensor wire
J533	Data bus diagnostic interface		— Actuator
J623	Engine control unit		--- Low frequency (LF)
J743	Mechatronic unit for dual clutch gearbox		--- High frequency (HF)
J764	Control unit for electronic steering column lock		— CAN bus wire
J938	Rear lid power opening control unit		
J965	Interface for access and start system		

Authorisation procedure

Unlocking/locking the vehicle

A vehicle key is located in the vicinity of the vehicle. Reaching in to the door handle results in the corresponding exterior handle contact sensor (G415 ... G418) reporting this to the interface for entry and start system J965. Control unit J965 wakes up control unit J519 via a discrete wire. Subsequently, the aerial on the same side as the touched exterior door handle sensor transmits a specific search pattern (LF signal of 125 kHz) to the matched keys. Actuating the rear lid handle also has the same effect. The authorised and matched key detects its signal and transmits the rolling code for the central locking and key identification to J519 via an HF signal at a frequency of 433 MHz. Control unit J519 performs a preliminary check of the data for plausibility. If the basic key data is plausible, J519 wakes up the convenience CAN bus. The key data is sent from J519 to J965. J965 checks the data and sends an „OK“ to J519. J519 sends a door opening command to the door control units via the convenience CAN bus to unlock the doors.

Releasing the electronic steering column lock (ESL)

Once the driver has entered the vehicle (with a key) and the vehicle door is closed, the onboard supply control unit J519 queries the interface for entry and start system J965 to determine whether the number of authorised keys in the vehicle has increased. To do this, J965 uses its interior aerials to transmit the search pattern (LF signal of 125kHz) for the matched keys. The keys respond to J519 via an HF signal at a frequency of 433MHz and transmit their transponder data. J519 forwards these transponder data to the immobiliser control unit J362. J362 verifies the data and sends the unlock command to the control unit for electronic steering column lock J764.

Starting the engine

Press and Drive works in the same way.

Convenience electrical system

Easy Open

The „Easy Open” function makes it possible to open the rear lid without touching it by having the system detect a certain motion. To perform the function, a capacitive sensor is installed underneath the rear bumper, which recognises certain movements in the rear area of the vehicle.

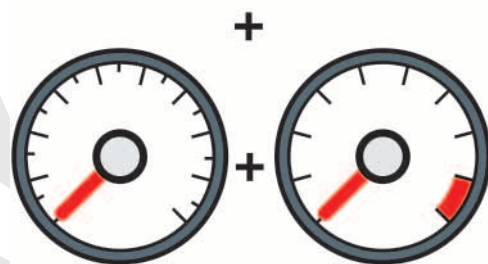
The capacitive sensor is connected to the rear lid power opening control unit J938. The sensor comprises two electrodes that work on the capacitor principle. If an object is brought into the vicinity of the two electrodes, the capacity of the sensor changes and so too does its current flow.

Prerequisite

The „Easy Open” function is only active if:

- there is a remote control key for authorisation within an area not exceeding 1.5 m to the rear of the vehicle.
- the speed of the vehicle equals 0 km/h
- ignition (term. 15) is „off”
- the engine is „off”.

The „Easy Open” function is active even from term. S.



Terminal 15 off

Easy Open

s545_138

Function

The user stands centrally behind the vehicle and sweeps a leg quickly to the bumper and back. In doing so, the shin bone enters the area in which the capacitive sensor can detect movement.

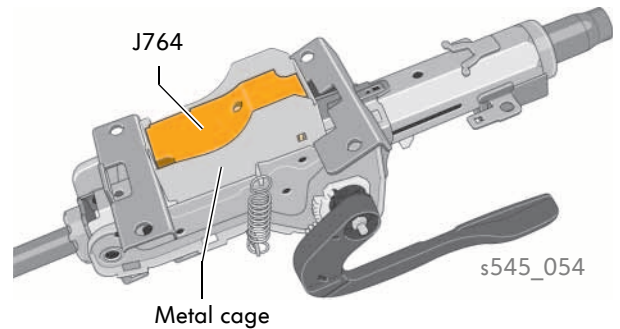
The sensor and with it the rear lid power opening control unit J938 recognise this movement as a „kick” and signal this using its own LIN bus to the interface for entry and start system J965. Using the rear bumper aerial for entry and start system R136 (LF signal with 125 kHz), the control unit J965 checks whether there is at least one remote control key in the rear area. If the key authorisation is successful, the 3rd brake light lights up (in the upper area of the rear window) and the rear lid opens. The authorisation is granted regardless of whether the vehicle is locked.



s545_021

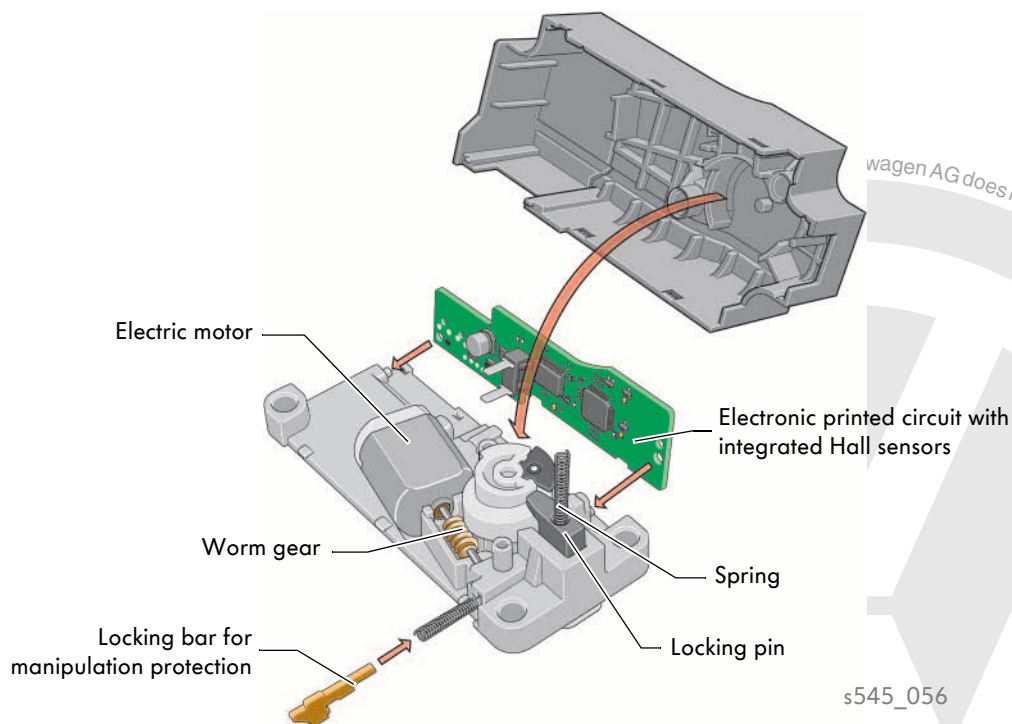
The control unit for electronic steering column lock J764

The control unit for electronic steering column lock J764 is secured to the upper part of the steering column by bolts. It is responsible for locking and unlocking the steering column. It is a subscriber of the immobiliser system and has to be adapted using the diagnostic tester upon renewal.



Design

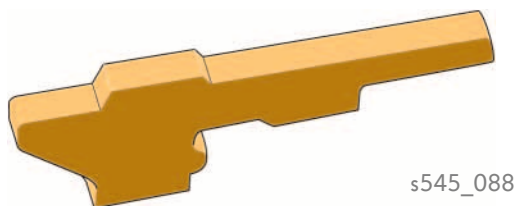
Installed in the control unit housing are the following components:



Function

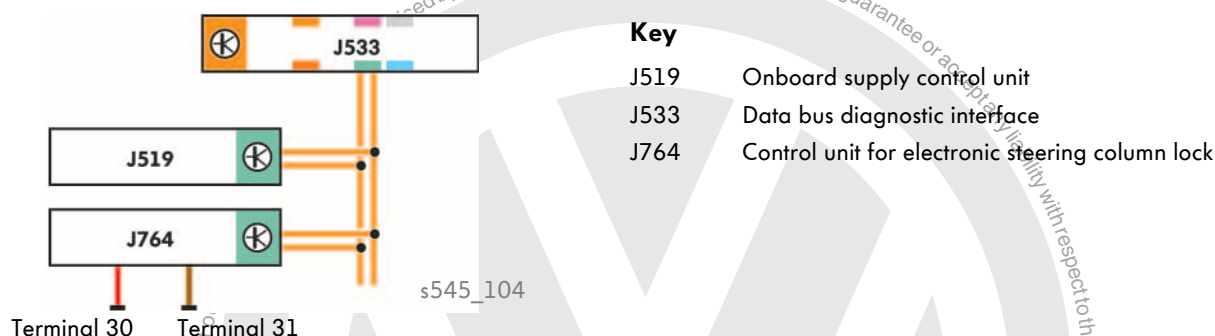
The electric motor actuates the locking pin via the worm gear and, in doing so, locks the steering column. If the electric motor is supplied with reverse polarity from the control unit, the locking pin moves back and the steering column is released. The integrated Hall sensors provide information about the end positions of the locking pin (steering column locked or unlocked).

Manipulation protection



In order to renew the control unit for the electronic steering column lock, the steering column has to be released. Only when the steering column is released can the locking bar for manipulation protection be pressed and thereby allow the control unit to be removed from the surrounding metal cage. When the steering column is locked, this locking bar cannot be pushed back which, in turn, prevents the control unit from being removed.

Networking



The exiting concept

Since the Passat is equipped as standard with a keyless start function as well as the start-stop system, there may be incidences when the vehicle is parked unlocked and exited with terminal 15 switched on. The exiting concept has the task of ensuring that the vehicle is left in the correct manner. It makes sure that terminal 15 (term. 15) is switched off and that the vehicle cannot set itself in motion.

To retain the battery charge and thereby safeguard restarting of the engine, terminal 15 is switched off at the right moment.

To prevent the vehicle from setting itself in motion, the electromechanical parking brake is activated automatically. The exiting concept has the following sub-functions that can occur in different situations:

- Convenience deactivation of term. 15
- Deactivation of term. 15
- Exit warning
- Deactivation of term. 15 with external locking request
- Automatic deactivation of term. 15 by energy management
- Electromechanical parking brake (EPB) roll-stop

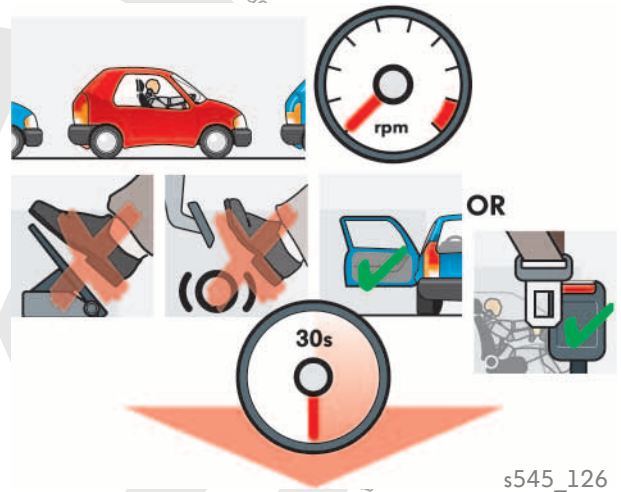
Convenience electrical system

Convenience deactivation of term. 15

For convenience deactivation of term. 15, the following conditions must be met:

- Vehicle in active stop mode (engine not running and vehicle stationary)
- No pedal actuation and door open or seatbelt off

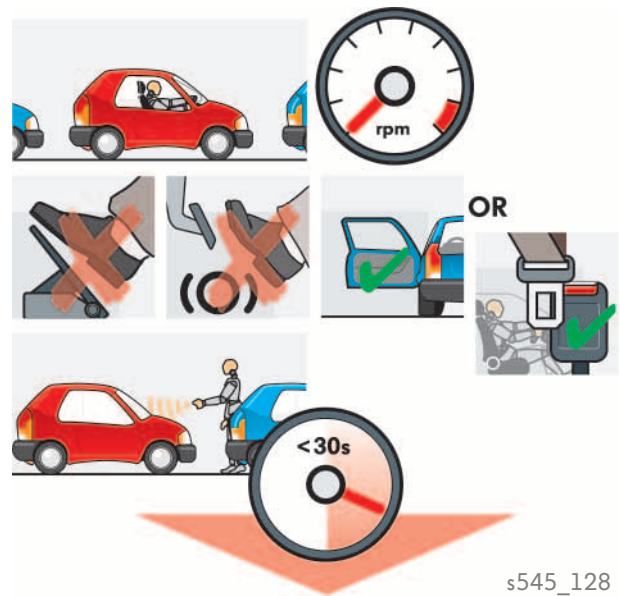
The ignition is switched off after 30 seconds.



s545_126

Deactivation of term. 15

If an external lock request occurs within 30 seconds of convenience deactivation, term. 15 is switched off immediately.



s545_128

Deactivation of term. 15 with external locking request



Terminal 15 on

Deactivation of term. 15 with external locking request takes place if the following conditions are met:

- Vehicle stationary
- Term. 15 switched on without engine start



s545_136

Terminal 15 off

Automatic deactivation of term. 15 by energy management



s545_134

Terminal 15 off

Automatic deactivation of term. 15 takes place if the following conditions remain unchanged for two minutes.

- Driver absence detected due to:
 - driver door open and closed
 - driver seatbelt not worn
 - no pedal operated
- Engine not running
- Low charge status of battery

This calculated value is dependent on the environmental conditions.

It takes into account the requisite battery charge to restart the vehicle.

Convenience electrical system

Exit warning (only with dual clutch gearbox)

A visual and acoustic warning is given in the dash panel insert if the following conditions occur:

- Vehicle stationary
- Selector lever not in P
- Door open

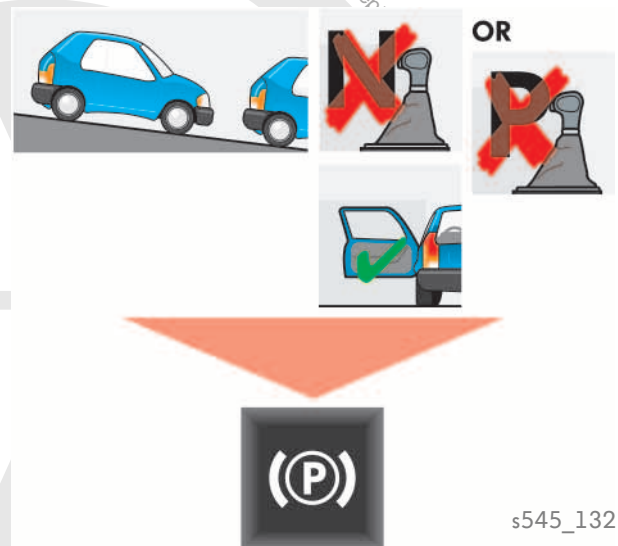


s545_130

Roll-stop (only with dual clutch gearbox)

The roll-stop via the electromechanical parking brake engages if the following conditions are met:

- Vehicle stationary
- Selector lever not in P or N
- Door open



s545_132

The start-stop system 2.0

The Passat uses the second generation start-stop system.

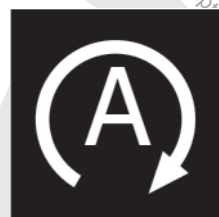
The start-stop system 2.0 has the following main features:

- Extended display possibilities (e.g. reason for stop refusal)
- Intermittent mode: multiple stop and restart operations on request when the vehicle is stationary (including position P)
- The engine can enter stop mode in the following situations:
 - Adaptive cruise control (ACC) is activated
 - Auto Hold (AVH) is activated
 - Electromechanical parking brake (EPB) is activated
 - Trailer attached (slope of terrain < 3%)
 - During stopping (even before the vehicle comes to a halt)

Extended display possibilities

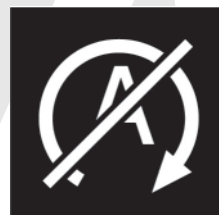
Start-stop active or notice

How it is possible to stop the engine (e.g. disengage gear).



Prohibited stop/restart

The driver has no influence over the system (e.g. operating temperature too low or system error).



Prohibited stop/restart through driver action

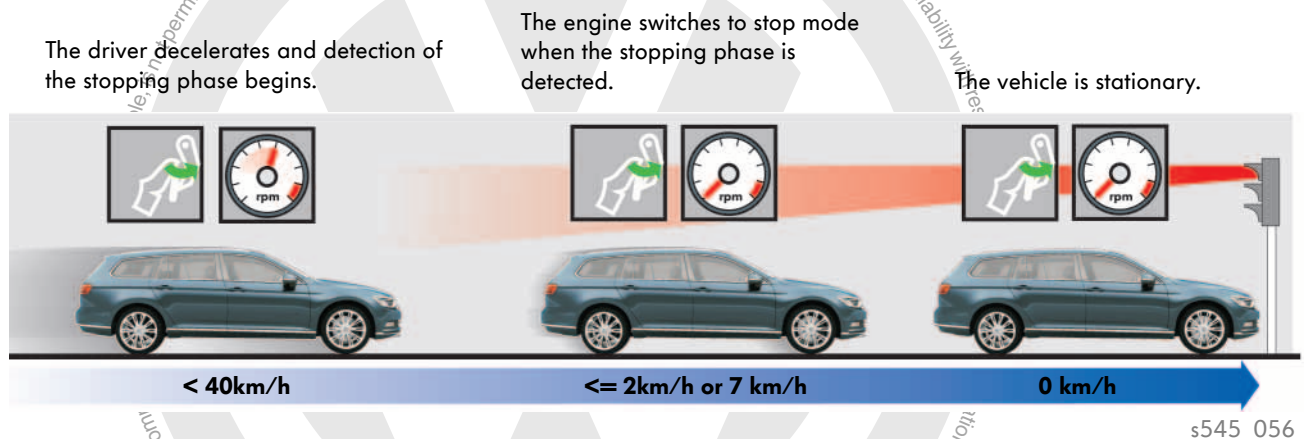
The prohibited stop can be influenced by the driver (e.g. switch off defrost or close driver door).



Convenience electrical system

Stop mode in stopping phase

The new function of the start-stop system 2.0, i.e. the stop mode when the vehicle is coming to a halt, is a further development. If the system detects that the vehicle is coming to a halt (provided the framework conditions are in place), the engine is stopped at a speed below 7 km/h or 2 km/h (depending on the gearbox). This results in an increase in the start/stop availability and thus a further CO₂ saving.



Criteria for detecting that the vehicle is stopping

The start-stop mode when the vehicle is coming to a halt only switches off the engine if the stopping phase is detected. To recognise that the vehicle is coming to a halt, the following criteria must be met:

The vehicle with **dual clutch gearbox** must:

- be driven faster than 12 km/h in the driving cycle
- be driven on a surface with a gradient of less than 3% (towing mode)
- observe the deceleration parameters that characterise a stopping phase
- have a steering angle under 45° and not detect any steering activity.
- be travelling at less than 2 km/h with DQ 500/250
- be travelling at less than 7 km/h with DQ 200

The vehicle with **manual gearbox** must:

- be driven faster than 2 km/h in the driving cycle
- be driven on a surface with a gradient of less than 3% (towing mode)
- be in neutral gear
- not have the clutch actuated
- have a steering angle under 45° and not indicate any steering activity.
- be travelling at less than 7 km/h

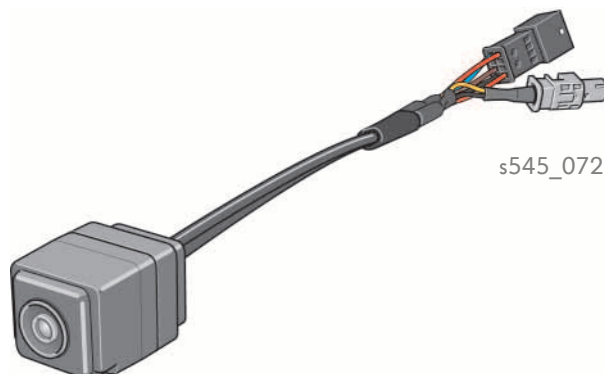
If the criteria for a stopping phase is not met, the previous operating mode intervenes, i.e. the engine stops if necessary only after the vehicle has come to a halt.

The reversing camera R189

In order to have a better overview of the area behind the vehicle when parking and manoeuvring, the Passat features a reversing camera. It provides a video image of the situation behind the vehicle. The reversing camera is installed behind the folding swivel emblem in the rear lid.

When reverse gear is engaged, the swivel emblem opens and the video signal from the camera is shown in the infotainment display.

Integrated in the camera housing itself is also the image processing control unit. The control unit electronic system of the reversing camera is a subscriber of the infotainment CAN bus. It has the task of correcting the distorted video image and displaying static and dynamic guide lines.



If the vehicle has the Trailer Assist function there is another reversing camera version. More comprehensive software and different part number are the differences.

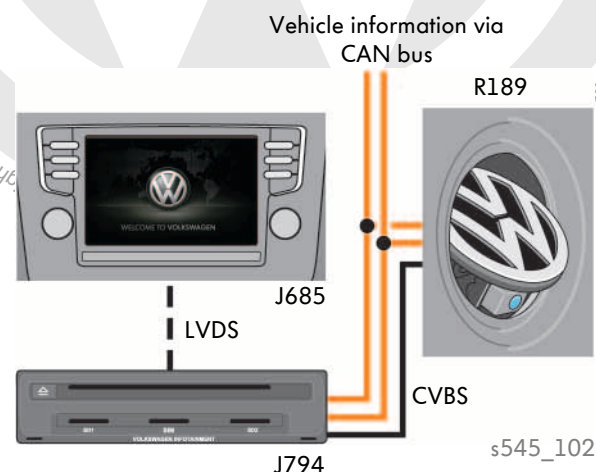


Further information about Trailer Assist can be obtained from Self-study Programme no. 543 „The Passat 2015 – Driver Assist Systems”.

Networking

Key

- J685 Display unit for front information display and operating unit control unit
- J794 Control unit 1 for information electronics
- R189 Reversing camera
- LVDS Low-voltage differential signalling
- CVBS Colour video blanking signal
-  CAN bus wire



If the reversing camera is renewed or repaired, it will need to be calibrated. Please refer to the current workshop manual for information on this.

Convenience electrical system

Views of the reversing camera

The camera itself has an overall opening angle of 180°. However, depending on the viewing mode, the control unit electronics system only shows the corresponding section in the relevant perspective.

If the guide lines are displayed, the viewing mode is adapted.

Mode 1: Park box

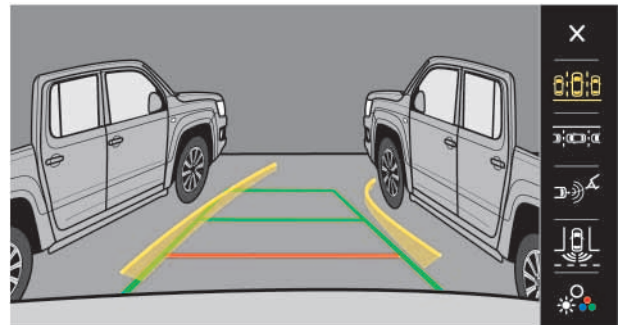
This mode is suitable for perpendicular parking. Different lines are shown that are helpful during the parking process.

Red line: This marks the safe distance.

The red line is located about 40 cm behind the vehicle on the road surface. This line aids orientation and does not change when the steering is turned.

Green lines: These indicate the extension of the vehicle to the rear. The green area that can be seen ends about two metres behind the vehicle on the road surface. These lines aid orientation and do not change when the steering is turned.

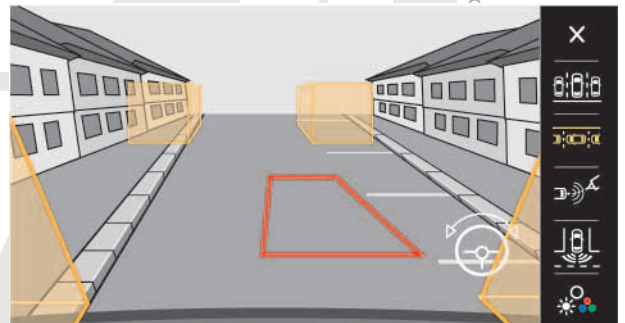
Yellow lines: These mark the expected path that the vehicle will take with the current steering angle.



s545_092

Mode 2: Parallel parking

The red rectangle represents the length of the vehicle. The yellow guide boxes highlight the boundaries of the parking space along the row of parked cars. The boundaries of the parking space must not protrude outside the guide boxes. The space between the yellow guide boxes represents the area in which the vehicle has to be maneuvered and the target parking space.

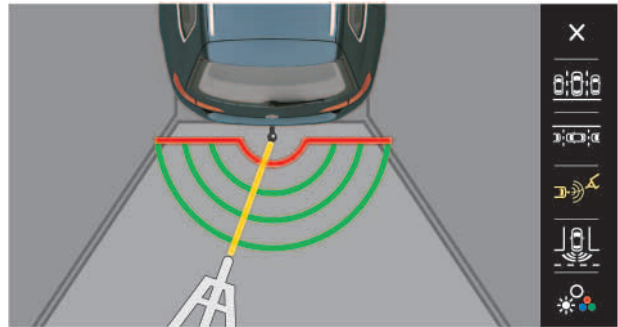


s545_094

Mode 3: Trailer maneuvering system

Vehicles fitted in the factory with a towing bracket can be driven up to the trailer hitch with the aid of the trailer maneuvering system.

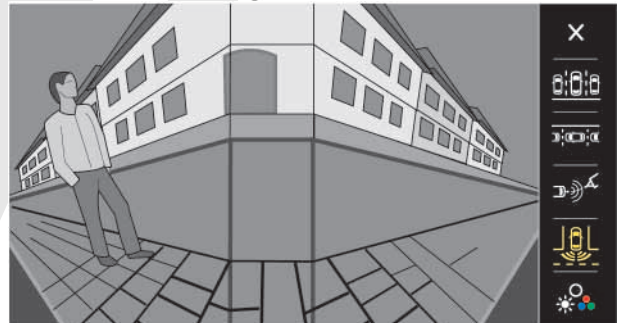
The horizontal part of the red guide lines for the trailer hitch that can be seen are at the same height as the towing bracket. Green and red semi-circular guide lines indicate the distance to the towing bracket. The distances of the green guide lines and the red guide line to each other are about 10 cm respectively. The yellow guide line highlights the pre-calculated direction of travel to the towing bracket depending on the steering angle.



s545_096

Mode 4: Cross traffic

With a wide angle view of 180°, the whole area behind the vehicle is shown along with the side areas. This mode is particularly suitable for driving out of garages or narrow passages.

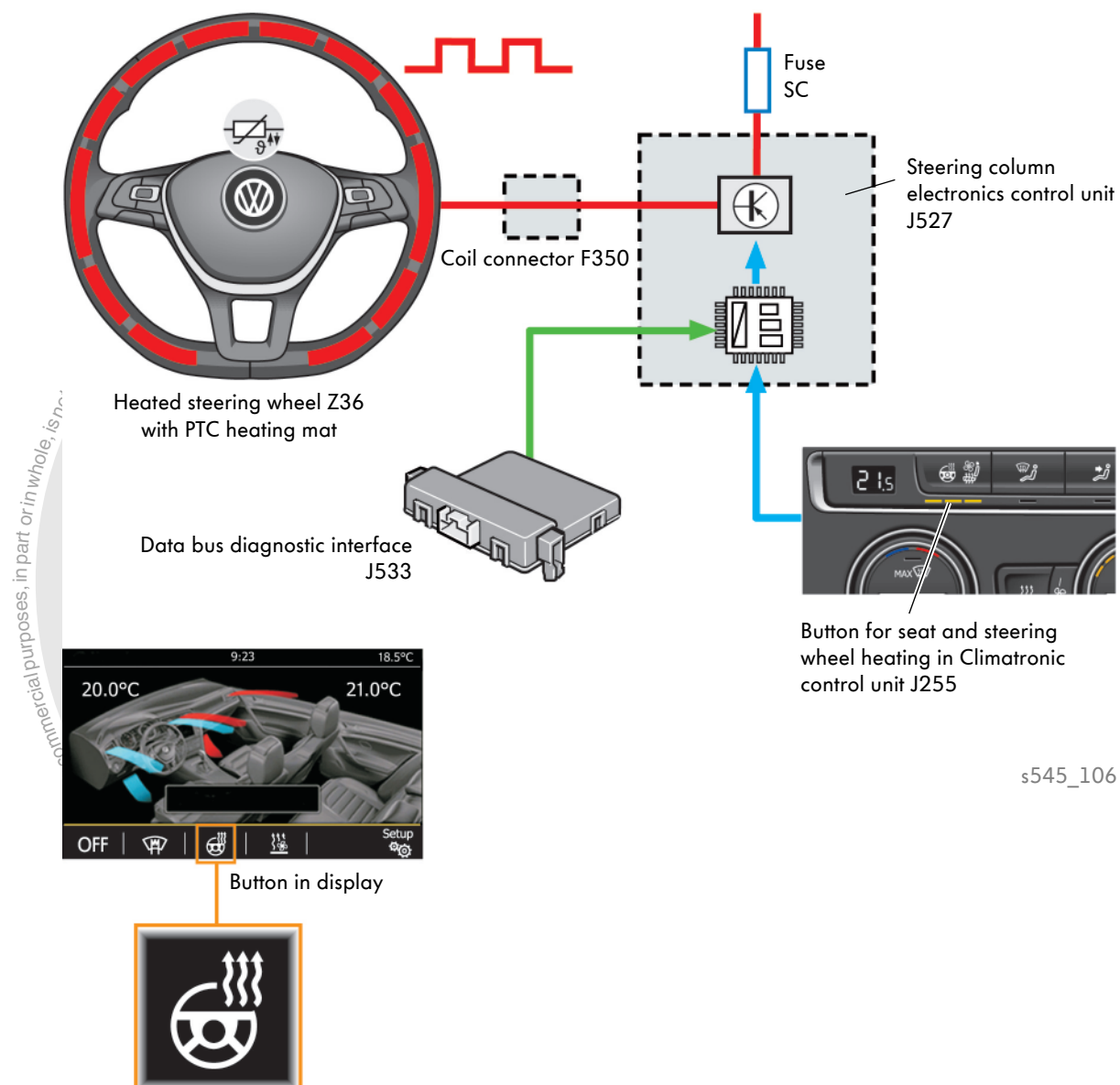


s545_098

Convenience electrical system

The heated steering wheel

The Passat is equipped with the option of a heated multifunction steering wheel.



Function

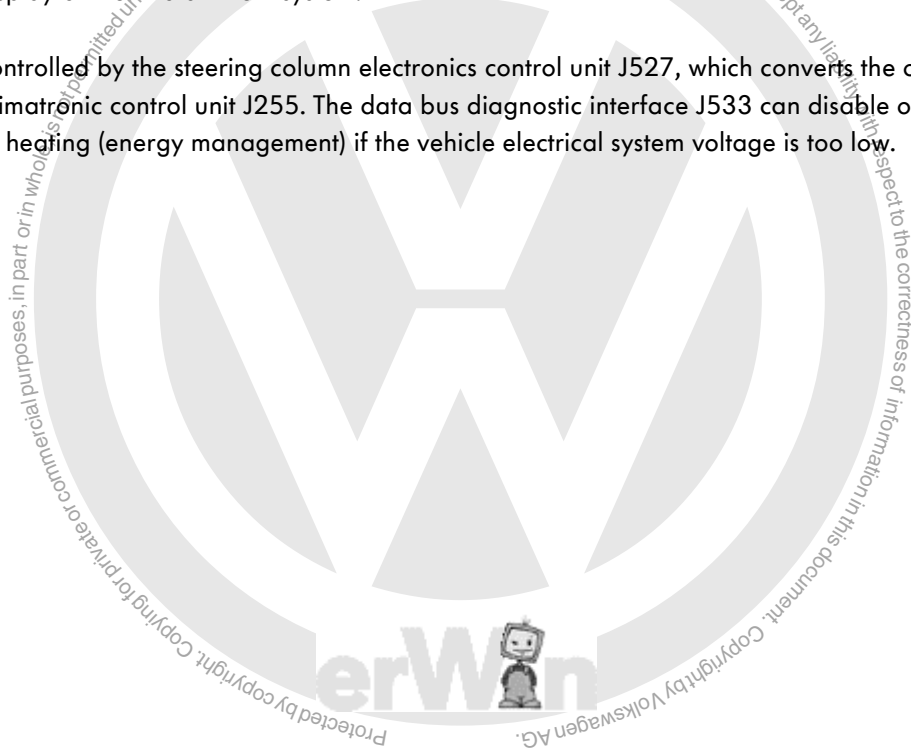
The steering wheel is equipped with a PTC heating pad, which is integrated into the foam. The heating output of the PTC pad is increased at the usual hand positions (3 o'clock and 9 o'clock).

The heated steering wheel can be switched on together with the seat heating for the driver seat or independently. There are two ways to activate or deactivate the heated steering wheel.

- via the button in the display of the infotainment system.
- via the button for seat and steering wheel heating.

Using the button in the display of the infotainment system, the heated steering wheel can be switched on and off separately or together with the seat heating. In addition, the temperature can be preset in three stages. Using the button for seat and steering wheel heating in the Climatronic control unit J255, the heated steering wheel can also be switched on and off together with the seat heating. The pre-requisite is that the respective function is active in the display of the infotainment system.

It is controlled by the steering column electronics control unit J527, which converts the on and off commands from the Climatronic control unit J255. The data bus diagnostic interface J533 can disable operation of the steering wheel heating (energy management) if the vehicle electrical system voltage is too low.



Glossary

ABS

(Anti-lock braking system)

Traction control system that stops the wheels locking during braking.

ACC

(Adaptive Cruise Control)

Abbreviation for adaptive cruise control.

AFS

(Advanced Frontlighting System)

Abbreviation for dynamic cornering light.

AGM

(Absorbent Glass Mat)

Abbreviation for a type of battery in which the electrolyte is held in micro-glass fibre mats.

CAN

(Controller Area Network)

Standardised digital two-wire data network used in vehicle electronics.

DLA

(Dynamic Light Assist)

Abbreviation for an assistance system for controlling the light beam from the headlights, e.g. to prevent dazzling approaching traffic when the main beam headlights are being used.

EFB

(Enhanced Flooded Battery)

Abbreviation for an improved type of wet battery.

FAZIT

(Vehicle information and central identification tool)

Stored in this central database at Volkswagen are all theft-relevant control unit data integrated in the „immobiliser“ function.

CVBS

(Colour video blanking signal)

A signal standard for transmitting colour video images.

LED

(Light Emitting Diode)

Energy-saving light system in which one or more light-emitting diodes are combined to form a single source of light.

LIN

(Local Interconnect Network)

Serial, single-wire data network that is used to connect electronic components to higher-level control units.

LVDS

(Low Voltage Differential Signalling)

Interface standard for high speed data transfer.

MIB

(Modular infotainment matrix)

Name for a modular system of infotainment components used by Volkswagen Group brands for their models.

MQB

(Modular transverse matrix)

Designation for a modular system used by Volkswagen Group brands in vehicle development and production.

NO_x

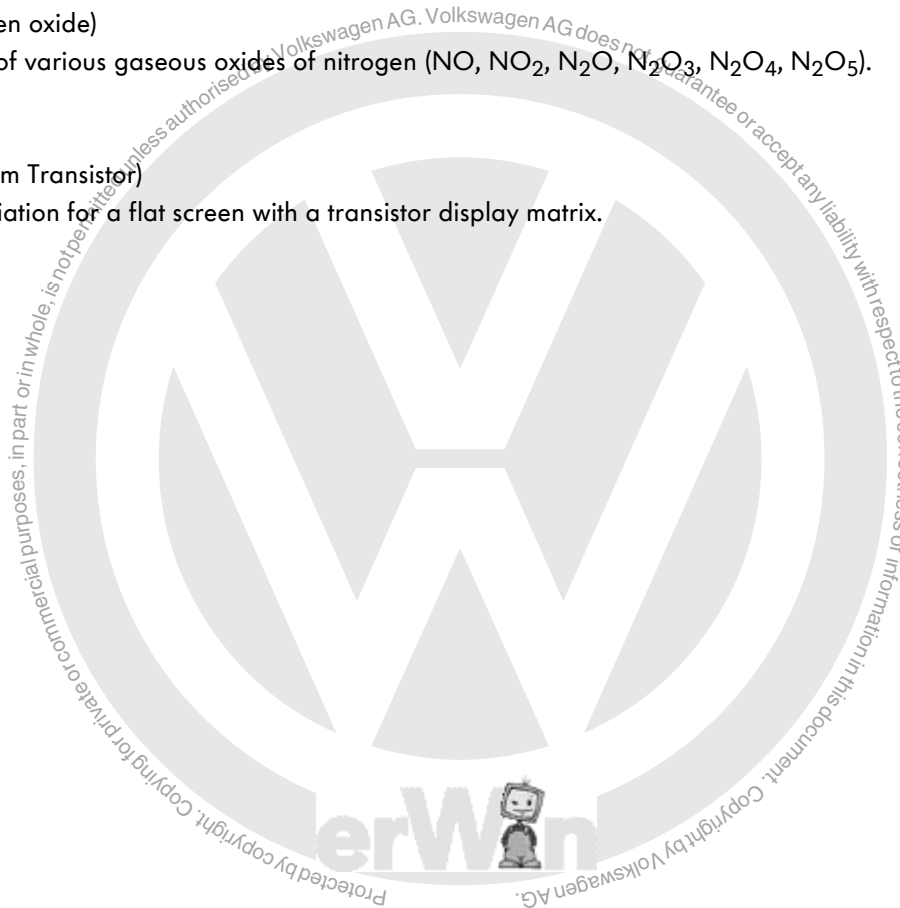
(Nitrogen oxide)

Group of various gaseous oxides of nitrogen (NO, NO₂, N₂O, N₂O₃, N₂O₄, N₂O₅).

TFT

(Thin Film Transistor)

Abbreviation for a flat screen with a transistor display matrix.









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